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# Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 02 Cities of Tamil Nadu

09 July 2024

Centre of Urbanization, Buildings and Environment [CUBE]

A Centre of Excellence of Government of Tamil Nadu, Joint Initiative of IIT Madras & GoTN



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# AGENDA

- ✓ **UNDERSTANDING URBAN RESILIENCE**
- ✓ **NATURE-BASED SOLUTIONS (NBS)**
- ✓ **URBAN CHALLENGES IN TAMIL NADU'S TIER 02 CITIES**
- ✓ **FRAMEWORK FOR NATURE-BASED SOLUTIONS**
- ✓ **TIER 02 CITIES OF TAMIL NADU**
- ✓ **DATA-DRIVEN FRAMEWORK DEVELOPMENT**
- ✓ **PROPOSED NBS MATRIX**

Communities of Practice on 'Nature-Based Solutions for building Urban Resilience with Gender Lens

Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu



Communities of Practice on 'Nature-Based Solutions  
for building Urban Resilience with Gender Lens

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# Understanding Urban Resilience

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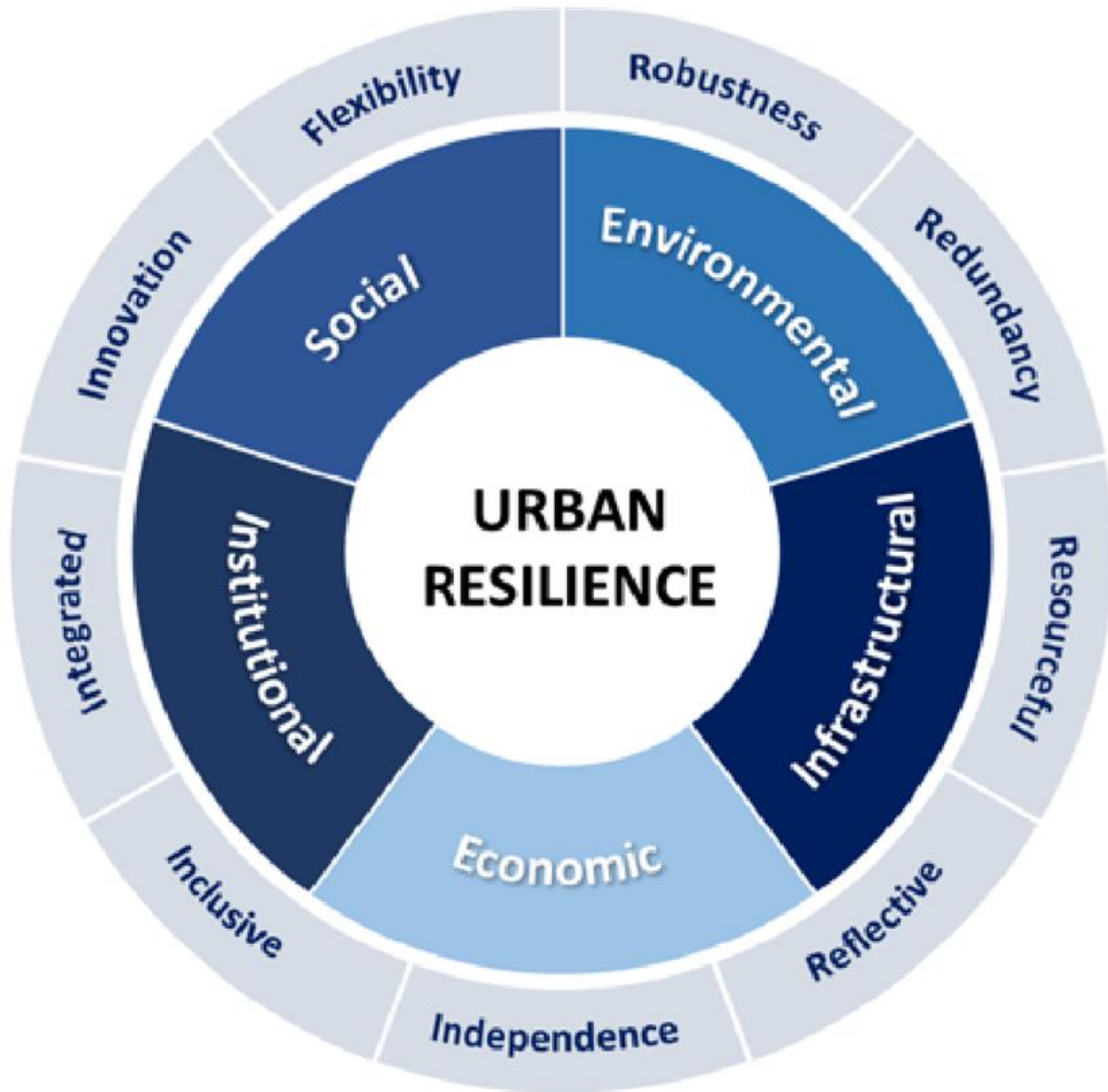


# UNDERSTANDING URBAN RESILIENCE

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- Urban Resilience refers to the ability of cities to withstand, adapt to, and recover from various challenges such as natural disasters, economic shocks, and social disruptions.
- Enhancing Urban Resilience ensures the long-term sustainability, safety, and well-being of urban populations, protecting infrastructure and minimizing economic losses.

Source: <https://resilientcitiesnetwork.org/what-is-urban-resilience/>



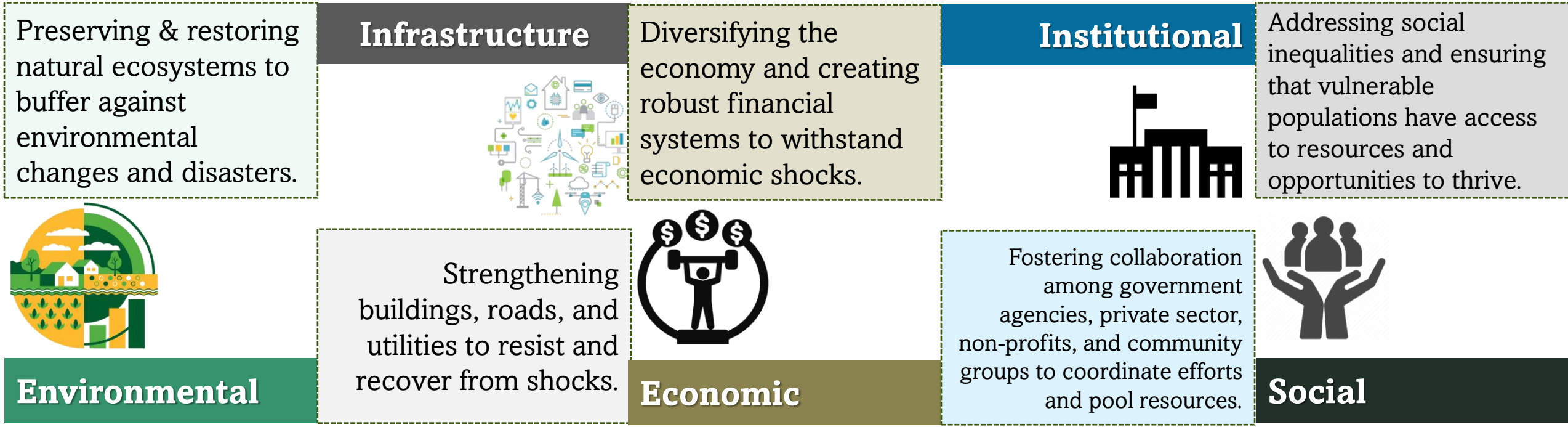
# UNDERSTANDING URBAN RESILIENCE

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## KEY COMPONENTS OF URBAN RESILIENCE





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# Nature-based Solutions (NbS)

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# NATURE-BASED SOLUTIONS (NBS)

Nature-based Solutions (NbS) are actions to address societal challenges through the **Protection, Sustainable Management and Restoration** of ecosystems, benefiting both **biodiversity and human well-being\***.

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## TYPES

### Strategies

#### Protection & Conservation

Eco Sensitive / Conservation / Protected Zones.  
Ecological Networks  
Habitat Continuity

#### Urban & Regional Planning

Urban & Regional Planning  
Urban Regeneration  
Urban Expansion / Sprawl

#### Environment

Air  
Water  
Soil

### Management

#### Management Plans

Integrated Ecological Management  
Biodiversity Connectors.  
Aquifer Protection & Management  
Catchment Protection & Management  
Urban Flood Plain Protection & Management  
Solid Waste Management  
Wastewater Management  
Integrated Water Resources Management  
Urban Forests & Greens  
Fallow Land Management  
Land Degradation  
Control of Soil Erosion  
Agroforestry  
Urban Farming & Horticulture  
Environmental Impact Management  
Shoreline Protection & Management

#### Policy, Guidelines & Regulations

### Engineering with Nature

#### Urban Biodiversity

Trees, Forests, Hedges / Shrubs, Plantations  
Fauna, Habitats and Ecosystems

#### Land & Soil

Erosion Prevention, Windbreaks  
Permaculture & Horticulture  
Soil Conservation & Enrichment

#### Blue Green Networks

Water-Sensitive Urban Design, SUDS, Riparian Zones, Biodiversity Connectors  
Mangroves, Saltmarsh/Sea Grass  
Inter tidal Habitats  
Sand Trapping, Dunes, Reefs & Levees  
Green Infrastructure

#### Built Environment

Parks, Gardens, Open Spaces, Green Belts, Buffer Zones, Green Streets, Permeable Pavements  
Green roofs, Green wall/façade  
Biophilic Architecture, Urban Farming, Solid Waste Management, Carbon Sinks

#### Surface & Ground Water

Wetlands, Riverine Ecosystems, Floodplains, Waterbodies  
Waterways, Infiltration, Rain Gardens, Wet/dry Vegetated swale, Bioretention, GWR, Managed Aquifer Recharge, Constructed Wetlands, Waste Water Management

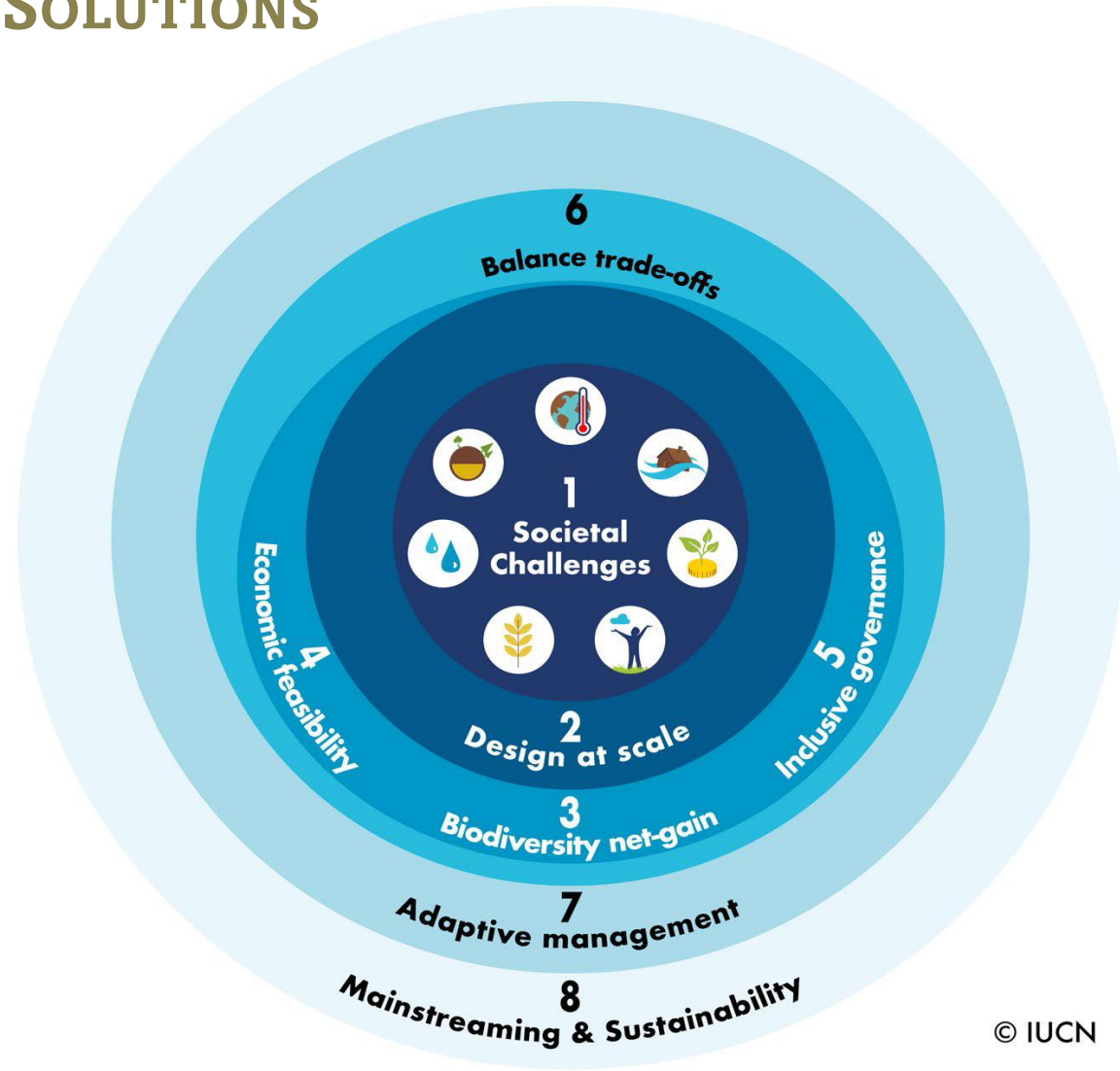
# IUCN GLOBAL STANDARD FOR NATURE-BASED SOLUTIONS

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## EIGHT CRITERIA OF IUCN GLOBAL STANDARD FOR NBS



© IUCN

1. NbS effectively address societal challenges.
2. Design of NbS is informed by scale.
3. NbS result in a net gain to biodiversity and ecosystem integrity.
4. NbS are economically viable.
5. NbS are based on inclusive, transparent and empowering governance processes.
6. NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits.
7. NbS are managed adaptively, based on evidence.
8. NbS are sustainable and mainstreamed within an appropriate jurisdictional context





## ROLE OF NBS

### Urban Resilience

- ✓ Building urban resilience requires long-term, integrated approaches to urban planning and development, as well as a diverse range of disciplines, perspectives, and mechanisms.
- ✓ Urban resilience is increased through the inclusion of nature-based solutions and their associated delivery of ecosystem services in urban areas.
- ✓ Nature-based solutions and urban green spaces provide the location for recreation, social interaction, building community cohesion and contributing to physical and mental health and well-being.
- ✓ These services contribute to enhanced resilience to the chronic stresses and gradual changes to which cities are exposed.

### Sustainable Development

- ✓ Nature-based solutions offer a multifaceted approach to addressing the interconnected challenges of sustainable development outlined in the SDGs.
- ✓ integrating NbS into policies, strategies, and actions at all levels will be paramount in building a more resilient, inclusive, and prosperous future for current and future generations.

## Climate Risk Mitigation and Adaptation

- ✓ Decrease greenhouse gas emissions related to deforestation and land use.
- ✓ Capture and store carbon dioxide from the atmosphere.
- ✓ Develop and implement ecosystem-based adaptation (EbA) strategies to improve natural habitat resilience against climate hazards.
- ✓ Utilize green infrastructure, such as wetlands restoration and urban green spaces, to mitigate the impacts of flooding and sea-level rise.
- ✓ Advance water management systems to address more frequent and intense droughts, including the development of drought-resistant crop varieties and efficient irrigation techniques.

## ROLE OF NBS

### Disaster Risk Reduction

- ✓ It contributes to effective water management, reducing the risk of water-related disasters such as floods and droughts.
- ✓ Restoring watersheds, conserving forests, and implementing green infrastructure help regulate water flow, improve water quality, and enhance resilience to extreme weather events.
- ✓ It offers sustainable and cost-effective approaches to disaster risk reduction by leveraging the inherent resilience of natural ecosystems.

# NATURE-BASED SOLUTIONS

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## BARRIERS TO ADOPTION



### LIMITED AWARENESS & TECHNICAL CAPACITY

- ✓ Lack of widespread awareness about the benefits and potential of NbS contribution.
- ✓ Insufficient understanding among decision-makers and communities



### POLICY AND REGULATORY GAPS

- ✓ Absence of supportive policies and regulatory frameworks at the national and international levels.
- ✓ Limited integration of NbS into existing legal and policy structures.



### TECHNOLOGICAL BIAS

- ✓ Solutions often gravitate towards technology, overshadowing the potential of nature-based approaches.
- ✓ This emphasis may result in the neglect of simpler, yet effective, NbS strategies.
- ✓ A prevailing mindset that views nature as a separate entity from urban development limits the adoption of NbS.

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## BARRIERS TO ADOPTION



### FINANCIAL BARRIERS

- ✓ Perception of high initial costs and investment.
- ✓ Difficulty in quantifying and monetizing the long-term benefits of NbS can create challenges in securing funding and garnering attention.



### LACK OF EVIDENCE OF EFFICACY

- ✓ Challenges in Measuring and Quantifying Benefits.
- ✓ Difficulty for policymakers, practitioners, and investors to justify implementation.



### COMPLEXITY AND INTERDISCIPLINARITY

- ✓ NbS often involves interdisciplinary solutions that may be challenging to implement and monitor.
- ✓ Decision-makers may favor simpler, more straightforward engineering solutions that align with specific sectors.





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# Urban Challenges in Tamil Nadu's Tier 02 Cities

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# CHALLENGES IN TAMIL NADU'S TIER 02 CITIES

## Rapid Urbanization

1

The rapid pace of urbanization leads to increased pressure on resources, infrastructure, and ecosystems in Tier 02 cities.

2

## Water Scarcity

Chronic water scarcity challenges urban residents and necessitates sustainable water management practices.

3

## Pollution and Waste Management

Inadequate waste management systems contribute to pollution, impacting public health and environmental quality.

4

## Vulnerability to Climate Change & Disasters

Tier 02 cities face heightened vulnerability to climate change impacts, including extreme Disasters events.



Source: <https://www.tn.gov.in/dear/Urban%20development.pdf>

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# Framework for Nature-based Solutions

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# FRAMEWORK FOR NATURE-BASED SOLUTIONS

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## OBJECTIVES





# PROPOSED FOCUS AREAS

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Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu

## 1. Nature for Nature & Nature for Cities

- ✓ It involves protecting habitats, species and Ecosystems ensuring they thrive independently of human needs or urban development.
- ✓ It also acknowledges the critical role of integrating natural elements to enhance the quality of life.

## 2. Driving Urban Resilience: Disaster Risk Reduction, Climate Change, Sustainable Development

- ✓ Focuses on minimizing vulnerabilities and disaster risks through Proactive measures.
- ✓ Involves resilient infrastructure for sustainable development.

## 3. What gets Measured gets Managed: Monitoring, Evaluation and Adaptation

- ✓ The critical role of systematic monitoring and evaluation processes in achieving NbS.
- ✓ Identifying what works well and what needs improvement.



# PROPOSED FOCUS AREAS

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## 4. Unfolding Finance: Strategies for NbS Implementation

- ✓ Integrating NbS into national and local policies, strategies, and development plans.
- ✓ Ensuring NbS projects are financially viable and attractive to investors.

## 5. Forging Connections: Urban Resilience with NbS Information Networks

- ✓ Provides access to up-to-date information, data, and research on NbS effectiveness and benefits.
- ✓ Encourages the mainstreaming of NbS across sectors such as infrastructure, water management, and land use planning.

## 6. Enablers: Streamlining the Integration of NbS

- ✓ The enablers help overcome barriers and promote the adoption of NbS as integral components of urban planning and resilience strategies.
- ✓ Establishing Policy and Regulatory frameworks for incorporating NbS into Urban planning



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# INTEGRATING GESI FRAMEWORK WITH NBS

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- The Gender Equality and Social Inclusion (GESI) framework is a comprehensive approach that ensures equal rights, opportunities, and participation for all individuals, particularly those marginalized and vulnerable.
- Gender equality within GESI focuses on dismantling stereotypes and norms that perpetuate inequalities between genders, striving for equitable access to resources, services, and decision-making processes.



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## FOUNDATIONAL ELEMENTS OF GESI IN NBS

### Gender and Social Equity in NbS Implementation

- ✓ Recognizing Gender and Social Differences in Needs and Capacities to Implement NbS for Adaptation.
- ✓ Differences in needs and capacities are best understood through an intersectional gender analysis.

### Inclusive Decision-Making in NbS for Adaptation

- ✓ Facilitating Equitable Participation and Influence in NbS for Adaptation Decision-Making Processes.
- ✓ This also requires reducing and eliminating the barriers within socio-ecological systems that prevent equity-deserving groups from participating in decision-making processes.

### Equitable NbS Benefits Distribution for Adaptation

- ✓ Promoting an Equitable Distribution of Benefits From NbS for Adaptation.
- ✓ Measures may include dedicated budgets for actions targeting equity-deserving groups, prioritization of NbS actions through participatory processes.

### Key Considerations for Integrating GESI into NbS Initiatives

- ✓ Prioritize GESI in NbS design and implementation
- ✓ Establish a gender-responsive MEL (Monitor and evaluate) system
- ✓ Apply GESI lens to climate risk and vulnerability assessment



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# Data-Driven Framework Development

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# DATA-DRIVEN FRAMEWORK DEVELOPMENT



Relying on empirical evidence and quantitative analysis instead of relying on intuition, opinion, or personal experience.

PROCESS



1. Data Collection



2. Data Processing



3. Data Analysis



4. Decision Making

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## DATA DRIVEN APPROACH

### Pros of Data Driven Approach

**Empirical Evidence** Based on decisions on solid, empirical data rather than subjective judgment.

**Quantitative Analysis** Utilizes quantitative methods to provide objective and measurable insights.

**Accuracy** Reduces the risk of errors by relying on factual data.

**Transparency** Ensures decisions can be traced back to data, promoting accountability.

**Predictability** Helps identify trends and forecast future events based on historical data.

**Efficiency** Reveals inefficiencies and areas for improvement, leading to optimized processes.



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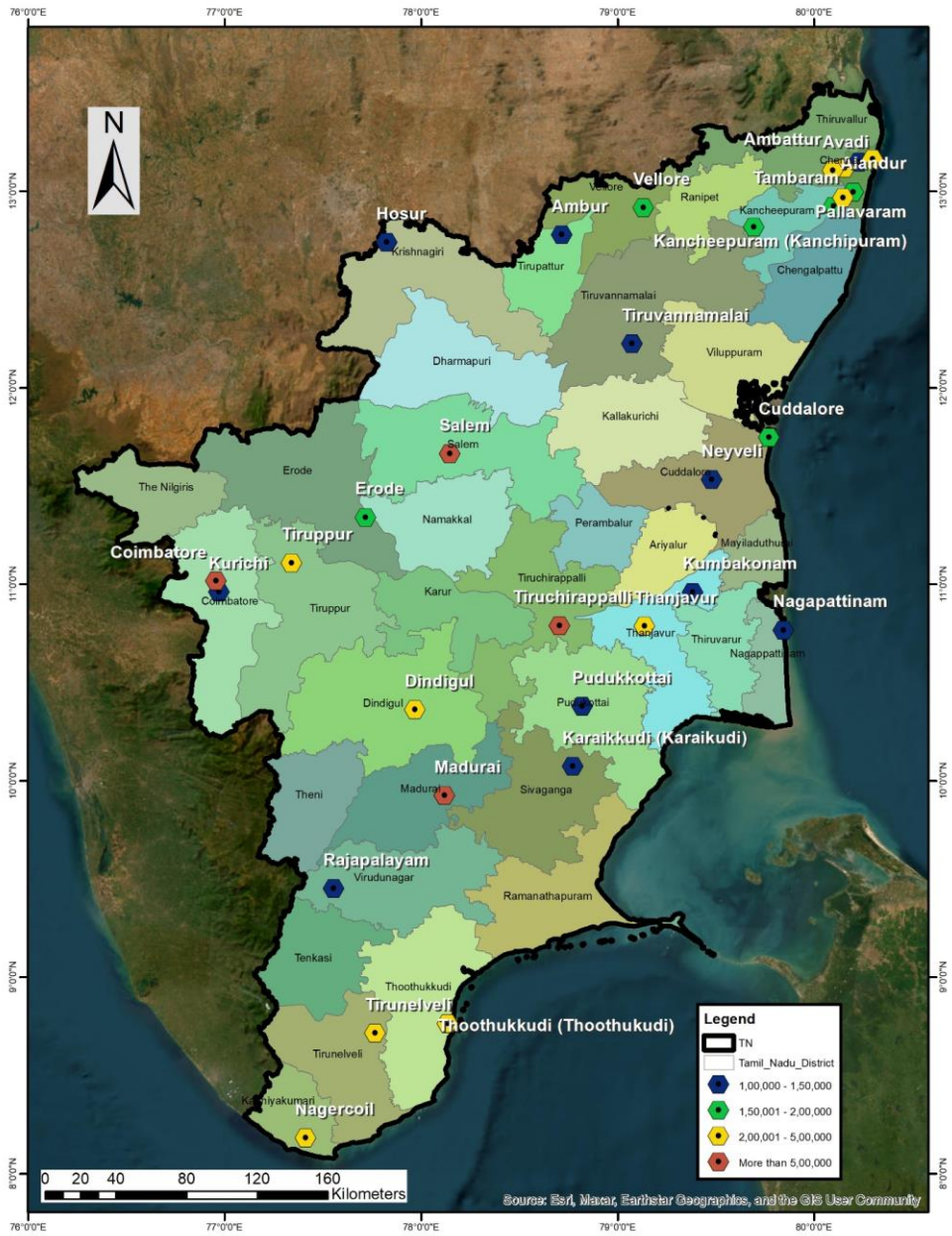
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## TIER II CITIES CLASSIFICATION



### Populations from 1 lakh to 1.5 lakhs

- Moderate urbanization
- Relatively smaller population size
- Mix of urban and semi-urban features
- Infrastructure development tailored to accommodate the needs of their populace

### Populations from 1.5 lakhs to 2 lakhs

- Slightly larger urban footprint
- Increased level of development

### Populations from 2 lakhs to 5 lakhs:

- Highly urbanized centers
- Major economic hubs

### Populations exceeding 5 lakhs

- Major economic hubs driving regional growth and development
- Extensive amenities including advanced healthcare facilities, educational institutions, and commercial establishments
- Attract residents from surrounding areas in search of opportunities



# DATA DRIVEN FRAMEWORK DEVELOPMENT

## TIER II CITIES

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### ANALYSIS

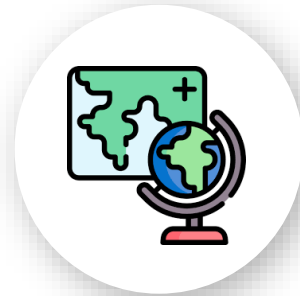
### INDICATORS



**Governance**



**Demography**



**Geophysical**



**Environment**



**Climate**



**Disaster**



# DATA DRIVEN FRAMEWORK DEVELOPMENT

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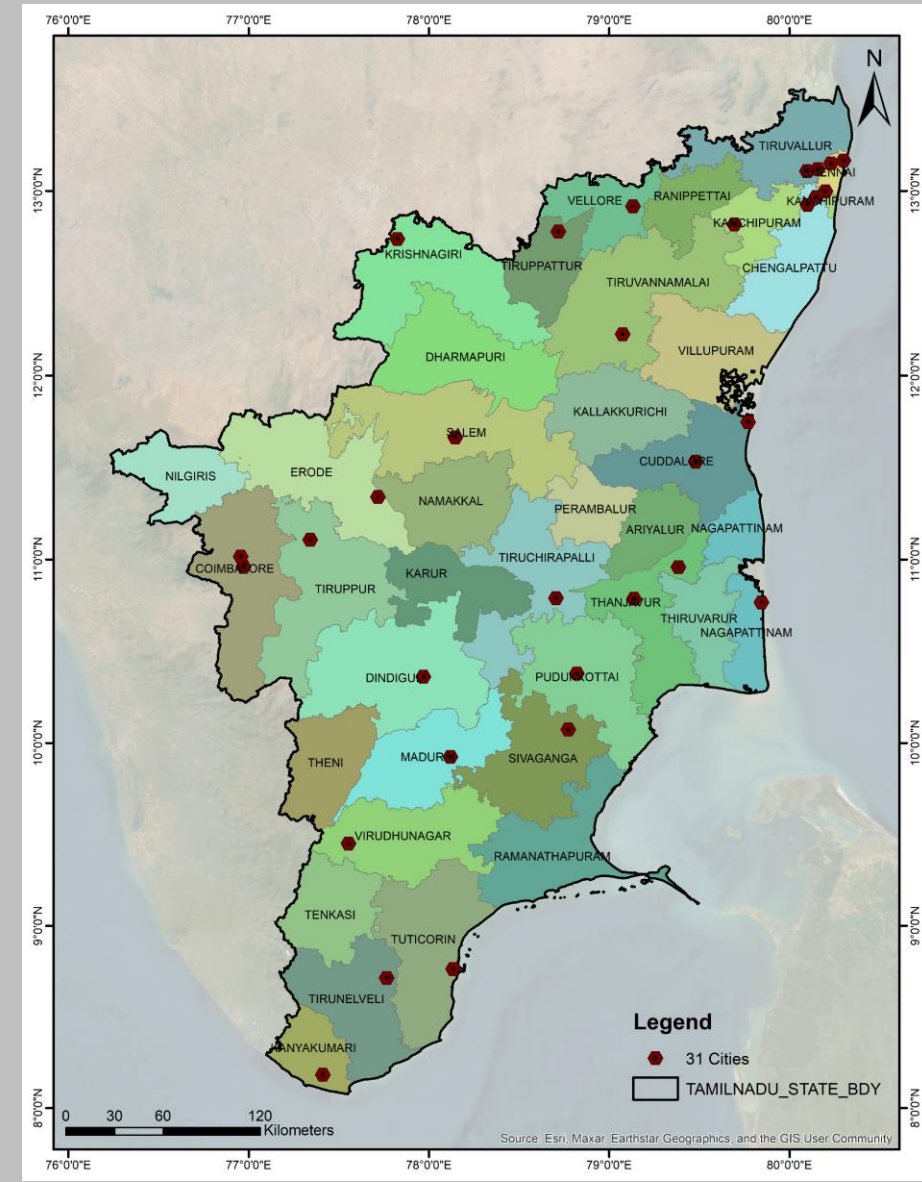
## GOVERNANCE



### Districts

Name	District
Nagapattinam	Nagapattinam
Neyveli	Cuddalore
Karaikkudi (Karaikudi)	Sivaganga
Ambur	Vellore
Hosur	Krishnagiri
Pudukkottai	Pudukkottai
Madavaram (Madhavaram)	Thiruvallur
Kurichi	Coimbatore
Rajapalayam	Virudhunagar
Kumbakonam	Thanjavur
Tiruvannamalai	Tiruvannamalai
Erode	Erode
Kancheepuram	Kanchipuram
Alandur	Kanchipuram
Cuddalore	Cuddalore
Tambaram	Kanchipuram
Vellore	Vellore
Dindigul	Dindigul
Thanjavur	Thanjavur
Nagercoil	Kanniyakumari
Pallavaram	Kanchipuram
Toothukkudi (Toothukudi)	Toothukkudi
Tiruvottiyur	Thiruvallur
Avadi	Thiruvallur
Tiruppur	Tiruppur
Ambattur	Thiruvallur
Tirunelveli	Tirunelveli
Salem	Salem
Tiruchirappalli	Tiruchirappalli
Madurai	Madurai
Coimbatore	Coimbatore

- Districts
- Governance



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Guwahati  
09 July 2024

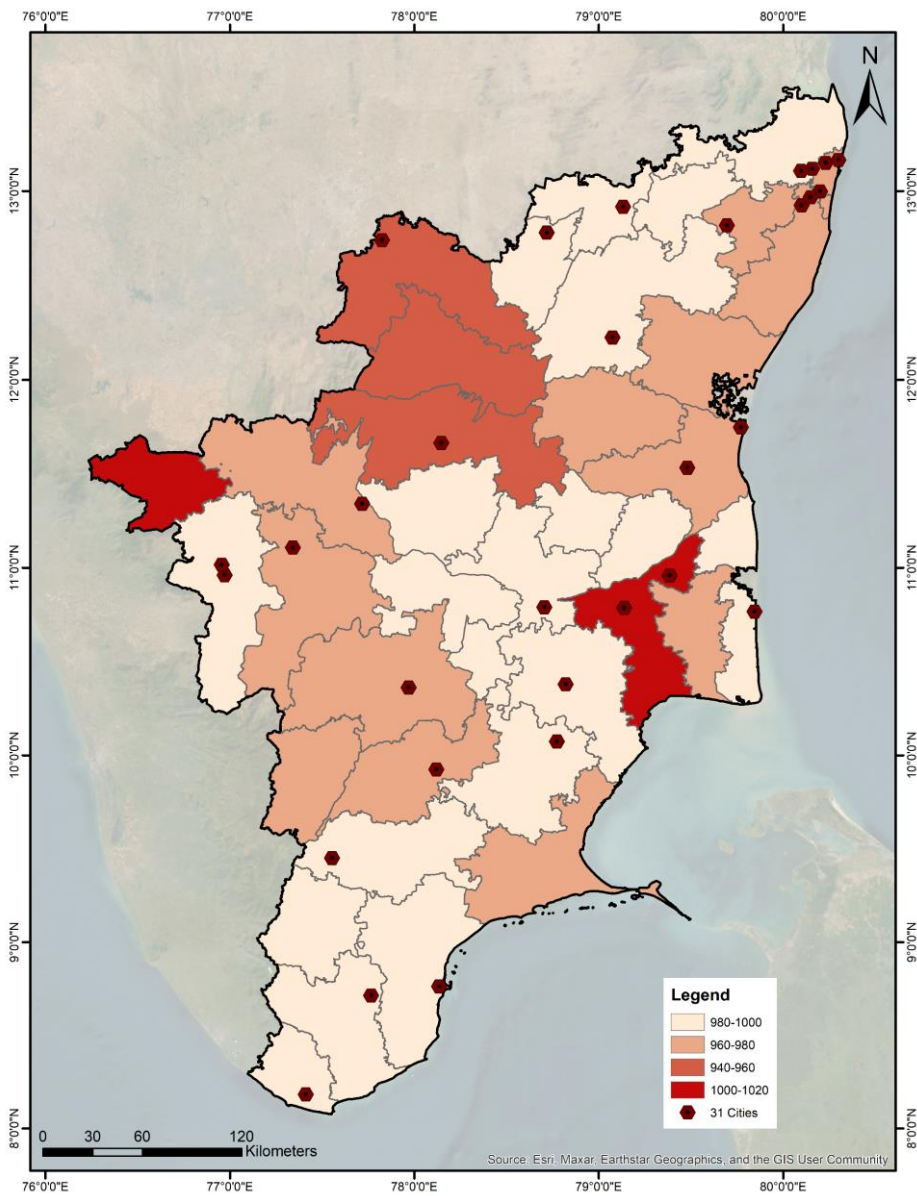
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## DEMOGRAPHY



### Sex Ratio Map

No of Females per 1000 Males

Hosur	940-960
Salem	940-960
Alandhur	960-980
Ambattur	960-980
Cuddalore	960-980
Dindugal	960-980
Tiruppur	960-980
Madavaram	960-980
Tiruvottiyur	960-980
Pallavaram	960-980
Tambaram	960-980
Kancheepuram	960-980
Erode	960-980
Madurai	960-980
Neyveli	960-980
Avadi	980-1000
Ambur	980-1000
Tiruchirappalli	980-1000
Coimbatore	980-1000
Vellore	980-1000
Tiruvannamalai	980-1000
Nagercoil	980-1000
Tirunelveli	980-1000
Thoothukudi	980-1000
Rajapalayam	980-1000
Karaikudi	980-1000
Pudukkottai	980-1000
Nagapattinam	980-1000
Kurichi	980-1000
Thanjavur	1000-1020
Kumbakonam	1000-1020

Source: Census India (2011)

- Population Category
- Socio Economic Status
- Sex Ratio
- Growth Rate
- Primary Economic Base



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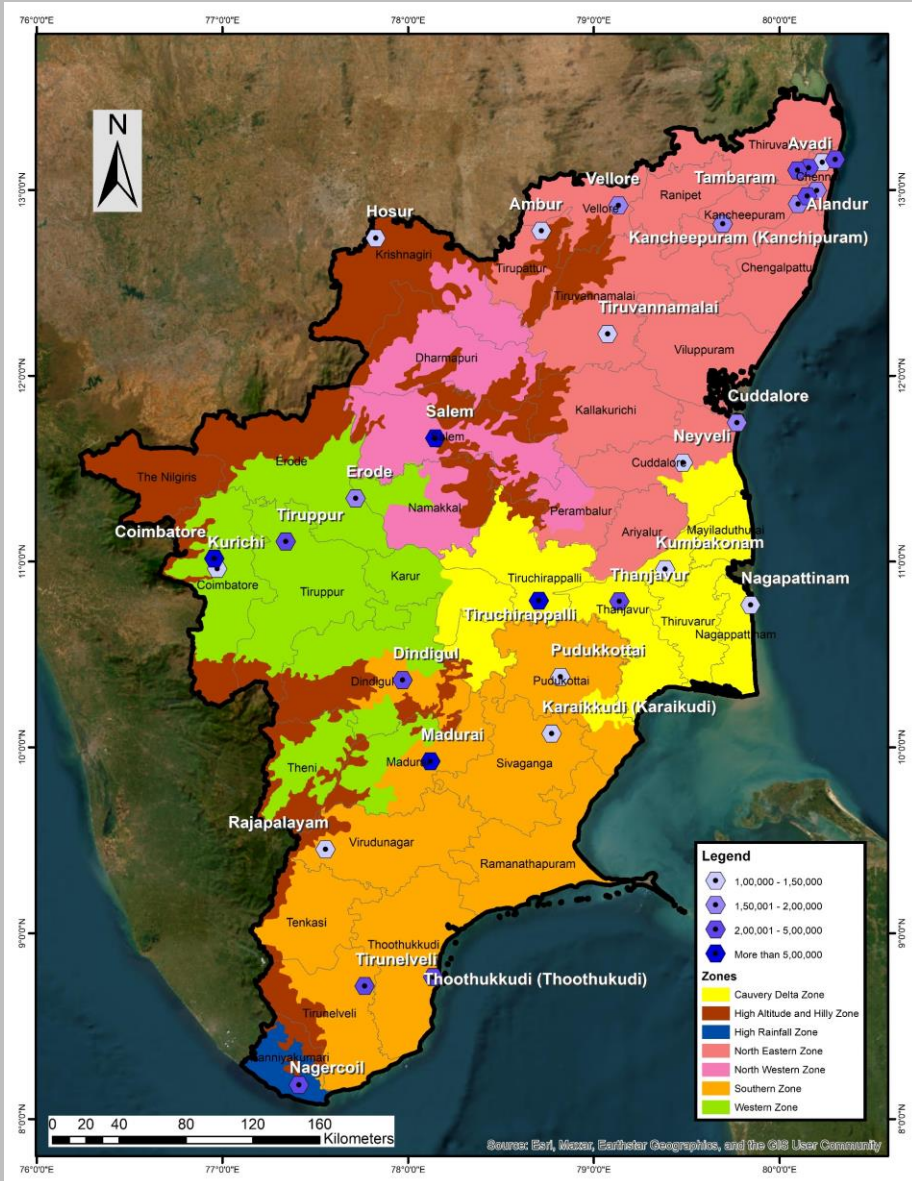
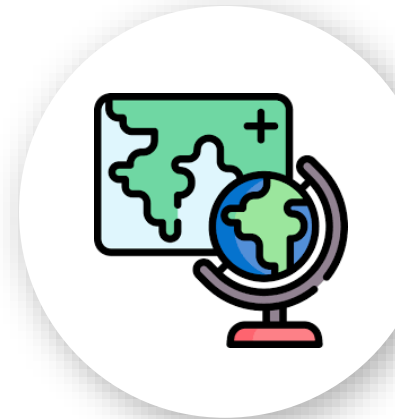


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## GEOPHYSICAL



- Physical Attributes
- Coastal Districts
- River Basin
- Geomorphology
- Geology
- Land Form Analysis
- DEM
- Agro Climatic Zone

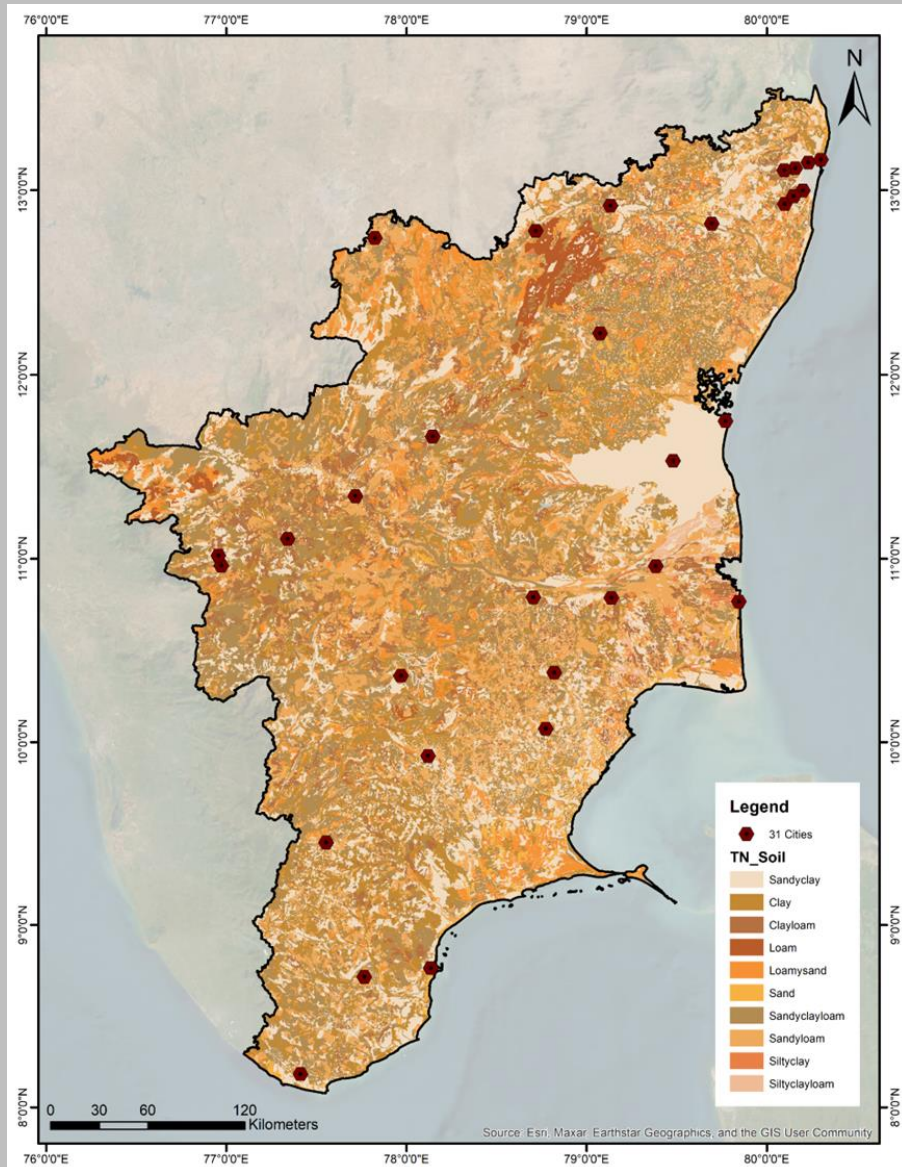


## Agro Climatic Zone

City Name	Agro-Climatic Zones
Alandhur	North Eastern Zone
Ambattur	North Eastern Zone
Avadi	North Eastern Zone
Ambur	North Eastern Zone
Cuddalore	North Eastern Zone
Tiruchirappalli	Cauvery Delta Zone
Dindigul	Southern Zone
Tiruppur	Western Zone
Coimbatore	Western Zone
Madavaram	North Eastern Zone
Tiruvottiyur	North Eastern Zone
Pallavaram	North Eastern Zone
Tambaram	North Eastern Zone
Kancheepuram	North Eastern Zone
Vellore	North Eastern Zone
Hosur	High Altitude and Hilly Zone
Tiruvannamalai	North Eastern Zone
Salem	North Western zone
Erode	Western Zone
Nagercoil	High rainfall
Tirunelveli	Southern Zone
Toothukudi	Southern Zone
Rajapalayam	Southern Zone
Madurai	Southern Zone
Karaikudi	Southern Zone
Pudukkottai	Southern Zone
Thanjavur	Cauvery Delta Zone
Nagapattinam	Cauvery Delta Zone
Kumbakonam	Cauvery Delta Zone
Neyveli	North Eastern Zone
Kurichi	Western Zone

Source: TNAU

## ENVIRONMENT



## Soil Types

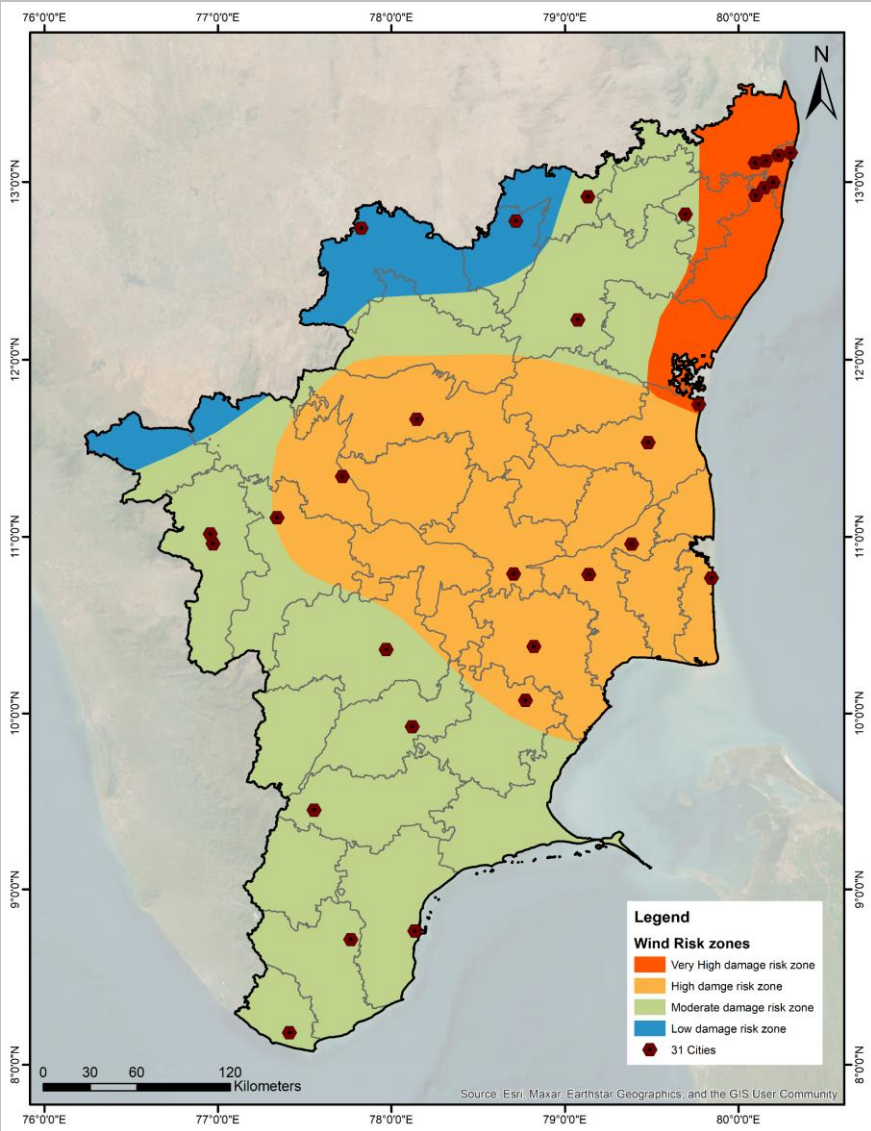


Source: CGWB

- Ground Water
  - Quality
  - Status
- Air Quality
- Vegetation Cover
- Soil Types
- Forest Cover





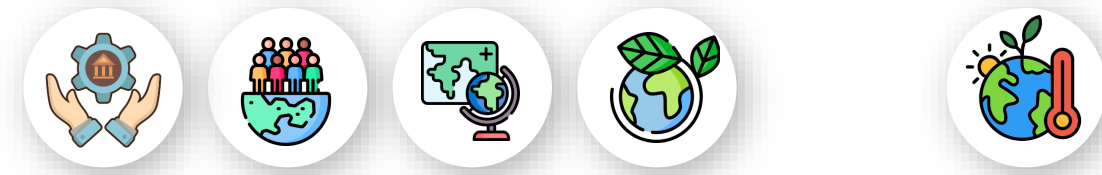


## Wind Hazard

City Name	Wind
Alandhur	Very High damage risk zone
Ambattur	Very High damage risk zone
Ambur	Low damage risk zone
Avadi	Very High damage risk zone
Coimbatore	Moderate damage risk zone
Cuddalore	High damage risk zone
Dindigul	Very High damage risk zone
Erode	High damage risk zone
Hosur	Low damage risk zone
Kancheepuram	Very High damage risk zone, Moderate damage risk zone
Karaikudi	High damage risk zone, Very High damage risk zone
Kumbakonam	High damage risk zone
Kurichi	Moderate damage risk zone
Madavaram	Very High damage risk zone
Madurai	Very High damage risk zone
Nagapattinam	High damage risk zone
Nagercoil	Very High damage risk zone
Neyveli	High damage risk zone
Pallavaram	High damage risk zone
Pudukkottai	High damage risk zone
Rajapalayam	Very High damage risk zone
Salem	High damage risk zone
Tambaram	High damage risk zone
Thanjavur	High damage risk zone
Thoothukudi	Very High damage risk zone
Tiruchirappalli	High damage risk zone
Tirunelveli	Very High damage risk zone
Tiruppur	Moderate damage risk zone, High damage risk zone
Tiruvannamalai	Moderate damage risk zone
Tiruvottiyur	Very High damage risk zone
Vellore	Moderate damage risk zone

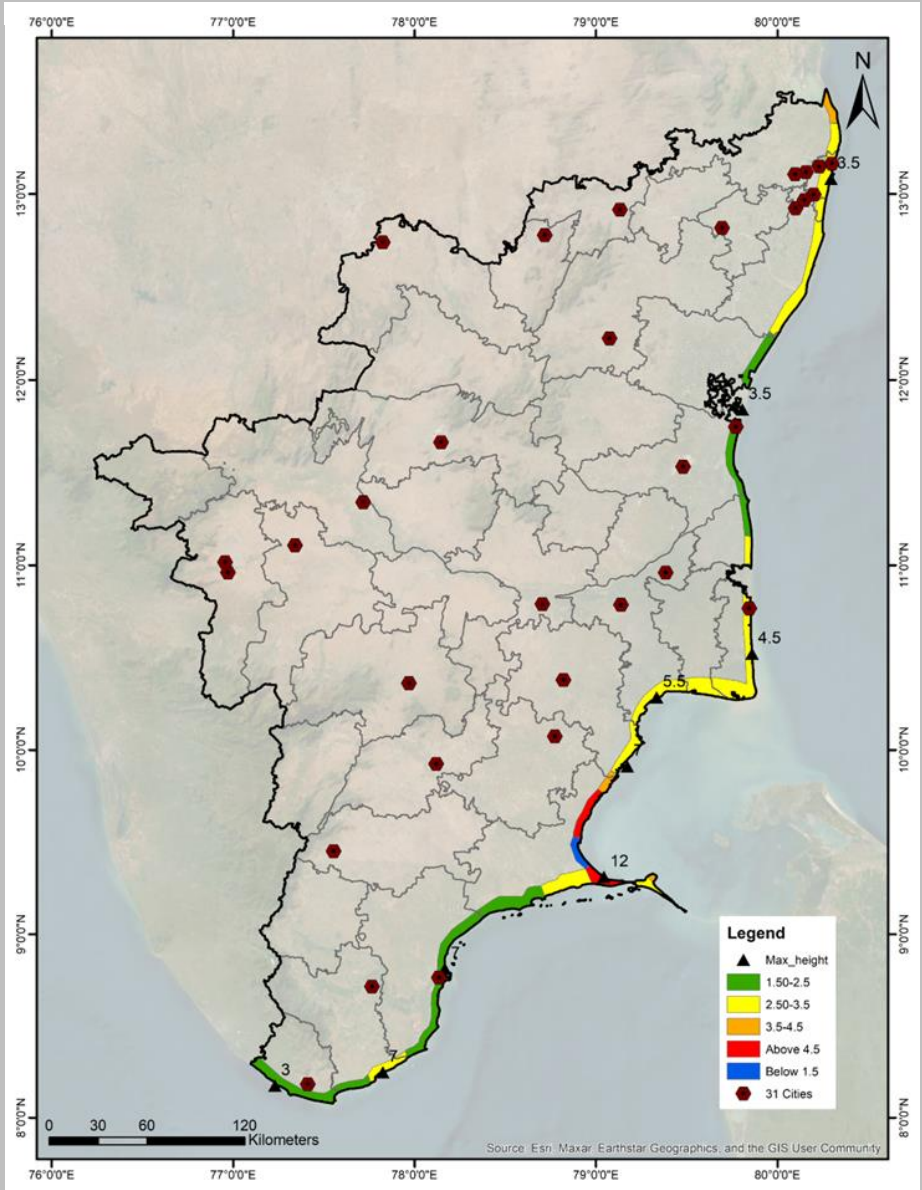
Source: MoHUA

## CLIMATE



- Rainfall Analysis
- Temperature Analysis
- Sea Level Rise
- Wind
- Land Surface Temp.
- Water Vulnerability
- Climate Change





## Storm Surge

City Name	Storm Surge (Strom height)
Cuddalore	1.5 to 2.5 m
Madavaram	2.5 to 3.5 m
Tiruvottiyur	2.5 to 3.5 m
Thoothukudi	1.5 to 2.5 m
Nagapattinam	2.5 to 3.5 m

Source: IMD

## DISASTER



- Flood Vulnerability
- Drought Prone
- Earth Quake
- Landslide
- Lightning Risk Map
- Cyclone
- Storm Surge



## CHARACTERISTICS & VULNERABILITY

31 Cities		Demographic		Geo - Physical					
City Name	Population	sex Ratio No. of females per 1000 males	Coastal Districts	River Basins	Geomorphology	Lithology	Digital Elevation Model	Landform Classification	Agro-Climatic Zones
<b>Alandhur</b>	164430	960-980	Kancheepuram	Chennai Basin	Pediment Pediplain Complex	Alluvium	39	Inland plains	North Eastern Zone
<b>Ambattur</b>	466205	960-980	Chennai	Chennai Basin	Older Deltaic Plain	Laterite / Alluvium	44	Riverine Landform / Laterite land form	North Eastern Zone
<b>Avadi</b>	345996	980-1000	Thiruvallur	Chennai Basin	Deltaic Plain	Granite Gneiss(Peninsular Gnesis)	55	Laterite Land form	North Eastern Zone
<b>Ambur</b>	114608	980-1000	NA	Palar Basin	Moderately dissected hills and valleys / Pediment Pediplain Complex / Flood Plain	Granite Gneiss(Peninsular Gnesis)	346	Eastern Ghats South	North Eastern Zone
<b>Cuddalore</b>	173636	960-980	Cuddalore	Pennaiyar Basin	Costal Plain / Deltaic Plain / Flood Plain	Alluvium	6	Marine Land form	North Eastern Zone
<b>Tiruchirappalli</b>	847387	980-1000	NA	Cauvery Basin	Pediment Pediplain Complex	Granite Gneiss(Peninsular Gnesis) / Alluvium	81	Laterite land Form / Riveraine land Form	Cauvery Delta Zone
<b>Dindigul</b>	207327	960-980	NA	Cauvery Basin	Pediment Pediplain Complex	Granite Gneiss(Peninsular Gnesis)	265	Tamil Nadu Uplands	Southern Zone
<b>Tiruppur</b>	4,44,352	960-980	NA	Cauvery Basin	Pediment Pediplain Complex	Granite Gneiss(Peninsular Gnesis)	330	Tamil Nadu Uplands	Western Zone
<b>Coimbatore</b>	1050721	980-1000	NA	Cauvery Basin	Pediment Pediplain Complex	Granite Gneiss(Peninsular Gnesis)	427	Tamil Nadu Uplands	Western Zone
<b>Madavaram</b>	119105	960-980	Chennai	Chennai Basin	Deltaic Plain	Laterite	34	Riverine Land form	North Eastern Zone

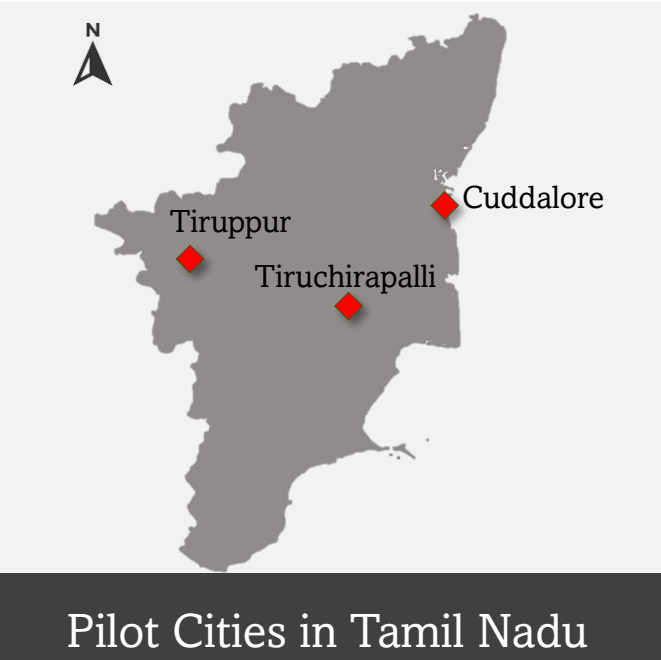


## CHARACTERISTICS & VULNERABILITY

31 Cities		Environment		Climate					Disaster				
City Name	Groundwater Status	Annual Rainfall	Annual Maximum Daily Temperatures	Annual Minimum Daily Temperatures	Sea Level Rise	Wind	Flood risk No. of floods average (1969-2019)	Drought Prone Zones	Earthquake	Normalized Vulnerability Index of Lightning days (1969-2019)	Cyclone return period in years (1961-2020)	Storm Surge (Strom height)	
<b>Alandhur</b>	Over exploited	1346.2	33	24.5	1.5-2.0 m	Very High damage risk zone	11 to 30	Low	Moderate damage risk zone	11 to 40	4 to 6	0	
<b>Ambattur</b>	Over exploited	1346.2	33	24.5	1.5-2.0 m	Very High damage risk zone	31 to 50	High	Moderate damage risk zone	1 to 10	4 to 6	0	
<b>Avadi</b>	Over exploited / Safe	1182.1	37.9	18.5	2.0-3.5 m	Very High damage risk zone	11 to 30	Moderate	Moderate damage risk zone	1 to 10	4 to 6	0	
<b>Ambur</b>	Over exploited / Safe	817.6	33.5	23	0 m	Low damage risk zone	11 to 30	Moderate	Moderate damage risk zone	11 to 40	0	0	
<b>Cuddalore</b>	Over exploited / Semi critical	1178.6	32.8	23.4	0-1.5 m	High damage risk zone	11 to 30	Moderate	Low damage risk zone	1 to 10	6 to 10	1.5 to 2.5 m	
<b>Tiruchirappalli</b>	Over exploited / Semi critical / Critical / Safe	774.9	34	22.6	0 m	High damage risk zone	11 to 30	Moderate	Low damage risk zone	1 to 10	0	0	
<b>Dindigul</b>	Over exploited / Semi critical / Safe	956.5	31.5	20.8	0 m	Very High damage risk zone	11 to 30	Moderate	Low damage risk zone	1 to 10	0	0	
<b>Tiruppur</b>	Over exploited / critical / Safe	599.5	33.2	20.8	0 m	Moderate damage risk zone, High damage risk zone	<=10	Moderate	Moderate damage risk zone	1 to 10	0	0	
<b>Coimbatore</b>	Over exploited / Critical / Semi critical	1205.8	32.5	21.3	0 m	Moderate damage risk zone	31 to 50	Moderate	Moderate damage risk zone	1 to 10	0	0	
<b>Madavaram</b>	Over exploited	1346.2	33	24.5	1.5-2.0 m	Very High damage risk zone	31 to 50	High	Moderate damage risk zone	1 to 10	4 to 6	2.5 to 3.5 m	



## PILOT CITY SELECTION



### TIRUCHIRAPALLI



- Situated on a plain, generally flat with few hills.
- Lies on the banks of the Kaveri River.
- Fertile region with major agricultural activities.
- Major transportation hub.

Flood Vulnerability  
Water Quality Concerns  
Water Vulnerability  
Ground Water Depletion  
Climate Risks

### TIRUPPUR



- Situated on flat terrain with some featuring undulating landscape
- Lies on the banks of the Noyyal River
- Major center for textile manufacturing

Flood Vulnerability  
Drought Prone  
Water Pollution  
Climate Change Impact

### CUDDALORE



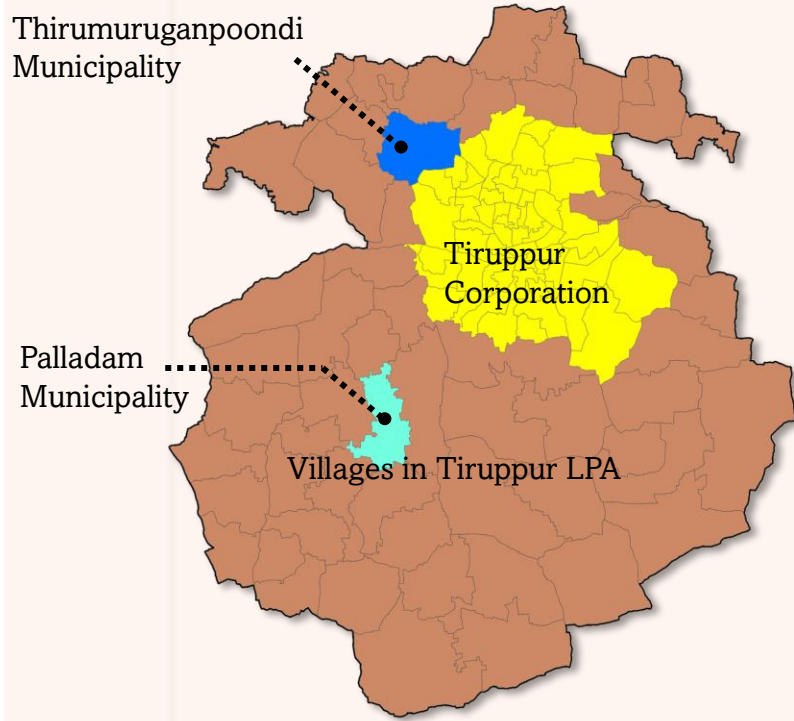
- Situated along the Coromandel Coast of Bay of Bengal
- Low lying coastal plain
- Fertile and supports various agriculture activities
- Presence of Chemical and Pharmaceutical industries

Flood Vulnerability  
Water Pollution  
Water Susceptibility  
Climate Change Impact  
Environmental & Disaster Challenges

## TIRUPPUR – KNITWEAR CAPITAL OF INDIA



### Tiruppur LPA



### City Profile

**Area**

- LPA : 1034 Sq.Km
- Tiruppur Corp. : 159 Sq Km

**Co ordinates**

- Lat: 11.1085° N
- Long: 77.3411° E


**Climate**

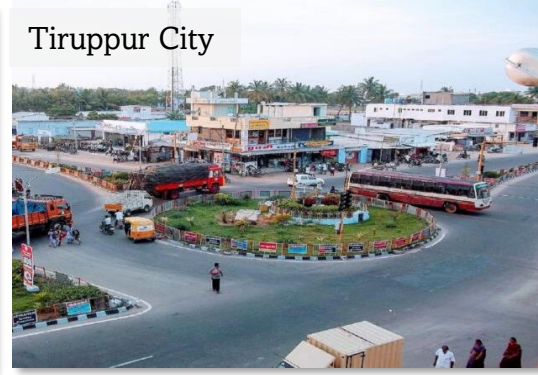
- Tropical wet and dry climate

### Characteristics

**Predominantly Tamil-speaking population with a diverse mix of communities involved in the textile industry.**

### Demography

- 
1. **Population** : 4,44,352 (2011)
  2. **Population Growth Rate**: 61.4%
  3. **Socio Economic Status** :
    - a) Labour Force Participation (district): 62.15%
    - b) GDP (district): Rs. 1,61,462
  4. **Sex Ratio**: 955 Female per 1000 Male



## TIRUPPUR – VULNERABILITY

### Temperature



- Average Annual Temperature is 26.4 °C

### Wind Hazard



- Moderate Risk
- and High Risk Zone

### Drought



- Moderate Prone to Droughts
- Periodic Challenges with Water Scarcity and Agriculture Productivity

### Flood Risk



- Average Flood Risk Zone
- Fewer than 10 Floods Annually

### Environmental

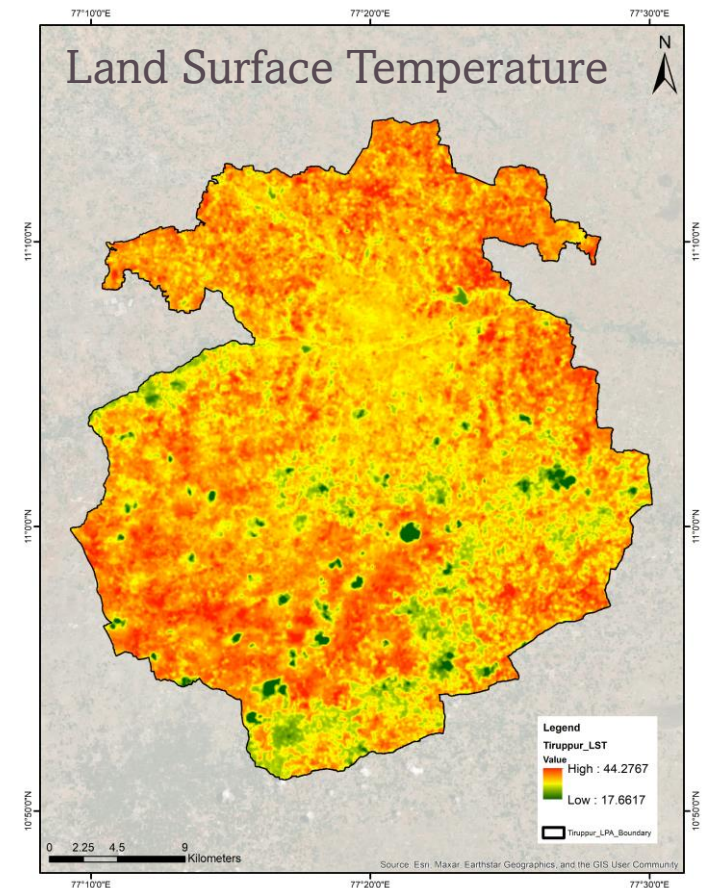


- The city's dyeing and bleaching units add color and flair to its apparel.
- These units have turned the once-beautiful Noyyal river into a toxic sewer.
- Vast areas of agricultural land that the Noyyal river once sustained have been destroyed.

### Earthquake



- Moderate Damage Risk Zone







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# Proposed NbS Matrix

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# PROPOSED NBS MATRIX

Communities of Practice on 'Nature-Based Solutions for building Urban Resilience with Gender Lens



Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu

## STRATEGIES

Category	Nature-based Solutions (NbS)	Rainfall Intensity	Water Security	Flood Vulnerability	River Water Quality	Groundwater Status	Ground Water Quality	Drought Prone Zones	Cyclone	Lightning Risk	Storm Surge	Sea Level Rise	Landslide	Land Surface Temperature	Variation in Temperatures	Air Quality	Wind Hazard	Earthquake	Forest Fires	Climate Change	Socio Economic Status
		Protection & Conservation	Eco Sensitive / Conservation / Protected Zones	Green	Green	Green	Green	Green	Green	White	White	White	Green	Green	Green	White	White	White	White	White	White
Ecological Networks	White		White	White	White	White	White	White	White	White	White	White	White	Green	White	Green	Green	White	White	Green	White
Habitat Continuity	White		White	White	White	White	White	White	White	White	Green	Green	Green	White	White	White	White	White	White	White	Green
Urban & Regional Planning	Urban & Regional Planning	Green	Green	White	White	White	White	Green	White	White	Green	Green	Green	White	Green	White	White	White	White	Green	White
	Urban Regeneration	Green	Green	White	White	White	White	Green	White	White	Green	Green	Green	White	Green	White	White	White	White	Green	White
	Urban Expansion / Sprawl	Green	White	White	White	White	White	Green	White	White	Green	Green	Green	White	Green	White	White	White	White	Green	White
Environment	Air Quality Management	Green	White	White	White	White	Green	White	White	White	White	White	White	Green	White	White	White	White	White	White	Green
	Water Resources Management	Green	Green	Green	White	White	White	White	White	White	White	White	White	Green	Green	Green	White	White	White	Green	White
	Soil Conservation	Green	Green	White	Green	White	White	Green	Green	White	White	Green	Green	White	White	White	White	White	White	Green	White



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Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu

## MANAGEMENT

Category	Nature-based Solutions (NbS)	Rainfall Intensity	Water Security	Flood Vulnerability	River Water Quality	Groundwater Status	Ground Water Quality	Drought Prone Zones	Cyclone	Lightning Risk	Storm Surge	Sea Level Rise	Landslide	Land Surface Temperature Variation in Temperatures	Air Quality	Wind Hazard	Earthquake	Forest Fires	Climate Change	Socio Economic Status
		Management Plans	Integrated Ecological Management																	
Solid Waste Management																				
Wastewater Management																				
Urban Forests & Greens																				
Fallow Land Management																				
Agroforestry																				
Urban Farming & Horticulture																				
Policy, Guidelines & Regulations	Integrated Water Resources Management																			
	Aquifer Protection & Management																			
	Catchment Protection & Management																			
	Urban Flood Plain Protection & Management																			
	Land Degradation																			
	Control of Soil Erosion																			
	Environmental Impact Management																			
Shoreline Protection & Management																				



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# PROPOSED NBS MATRIX

Communities of Practice on 'Nature-Based Solutions for building Urban Resilience with Gender Lens

## ENGINEERING WITH NATURE

Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu



Category	Nature-based Solutions (NbS)	Rainfall Intensity	Water Security	Flood Vulnerability	River Water Quality	Groundwater Status	Ground Water Quality	Drought Prone Zones	Cyclone	Lightning Risk	Storm Surge	Sea Level Rise	Landslide	Land Surface Temperature	Variation in Temperatures	Air Quality	Wind Hazard	Earthquake	Forest Fires	Climate Change	Socio Economic Status
		Urban Biodiversity	Trees, Forests, Hedges / Shrubs, Plantations		█								█			█	█	█	█		
	Fauna, Habitats and Ecosystems	█					█							█							█
Land & Soil	Erosion Prevention	█						█					█	█				█			
	Windbreaks										█					█	█	█			
	Permaculture & Horticulture	█	█				█		█		█	█		█	█	█					█
	Soil Conservation & Enrichment	█									█	█		█	█	█					█
Blue Green Networks	Water-Sensitive Urban Design	█		█			█							█							█
	Sustainable Urban Drainage System [SUDS]	█			█		█				█	█									█
	Riparian Zones	█		█			█				█	█			█						█
	Biodiversity Connectors.						█						█				█	█			█
	Mangroves, Saltmarsh/Sea Grass			█					█		█	█				█					█
	Inter Tidal Habitats	█	█	█			█				█	█			█						█
	Sand Trapping, Dunes, Reefs & Levees			█					█		█	█									
Green Infrastructure	█	█	█												█					█	



# PROPOSED NBS MATRIX

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## ENGINEERING WITH NATURE

Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu



Category	Nature-based Solutions (NbS)	Rainfall Intensity	Water Security	Flood Vulnerability	River Water Quality	Groundwater Status	Ground Water Quality	Drought Prone Zones	Cyclone	Lightning Risk	Storm Surge	Sea Level Rise	Landslide	Land Surface Temperature	Variation in Temperatures	Air Quality	Wind Hazard	Earthquake	Forest Fires	Climate Change	Socio Economic Status	
Built Environment	Parks, Gardens, Open Spaces & Green Belts			■																		
	Buffer Zones & Green Streets			■					■		■	■										
	Permeable Pavements	■	■																			
	Green Roofs, Green Wall/façade																				■	■
	Biophilic Architecture								■		■										■	■
	Urban Farming	■	■				■		■		■	■		■	■		■				■	
	Carbon Sinks																					
Surface & Ground Water	Wetlands			■					■		■	■									■	
	Riverine Ecosystems	■	■	■			■				■	■									■	
	Flood Plains	■	■	■			■				■	■									■	
	Waterbodies Rejuvenation	■	■	■			■				■	■						■			■	
	Infiltration & Rain Gardens	■	■					■	■				■	■							■	
	Wet/dry Vegetated swale	■	■										■	■							■	
	Bioretention Ponds	■	■	■											■	■					■	
	Managed Aquifer Recharge	■	■		■	■	■		■												■	■
	Constructed Wetlands	■			■	■	■				■				■	■					■	



# DIGITAL TOOL

## Intent

TNSLURB intends to develop a web based interactive tool as digital platform to enable decision makers of ULBs to prioritise Nature based solutions.



## Approach

### 1. Geodatabase Creation

- Data collection and mapping
- Geodatabase creation
- Framework customization

### 2. Dashboard Creation

- Building of GIS dashboard/ web application
- Integration with LUIS

### 3. Training workshops

- Development of User Manuals
- Onsite training for administrators and city level officials

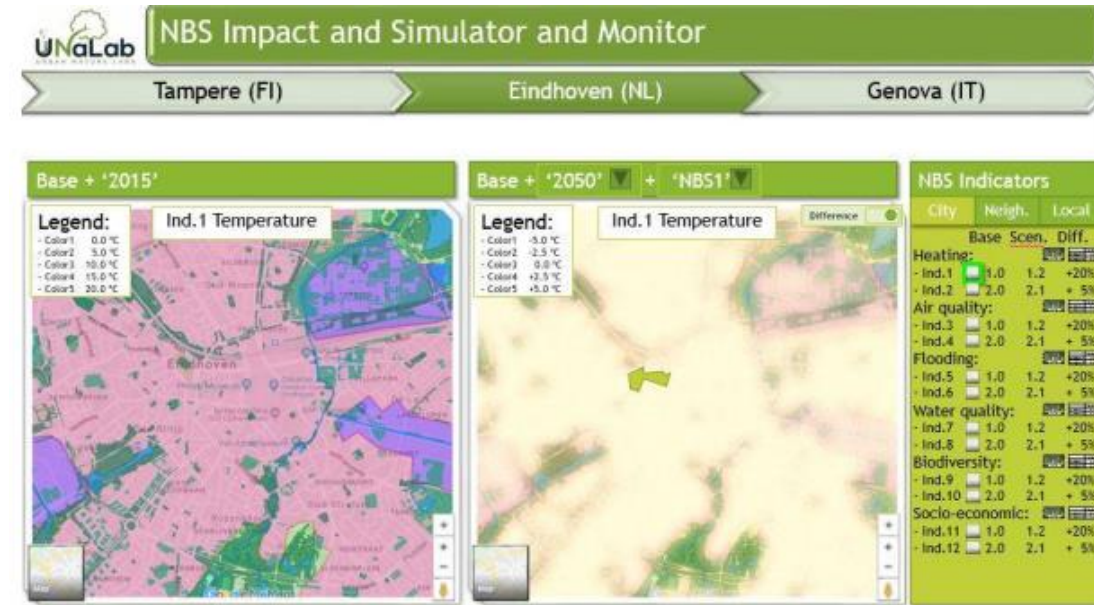
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## TOOL KIT DEVELOPMENT

## Similar Digital Application



## UNaLab's NbS Simulation Tool- Netherlands



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# Case Studies

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# FLOOD INUNDATION MAPPING FOR AN AREA LOCATED NEAR ADYAR RIVER FOR CMDA

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Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu

## OBJECTIVES

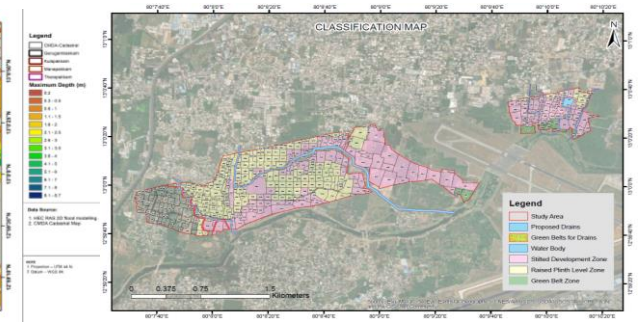
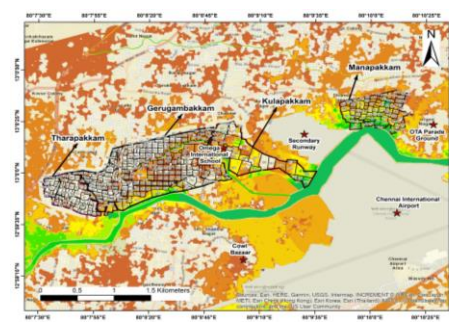
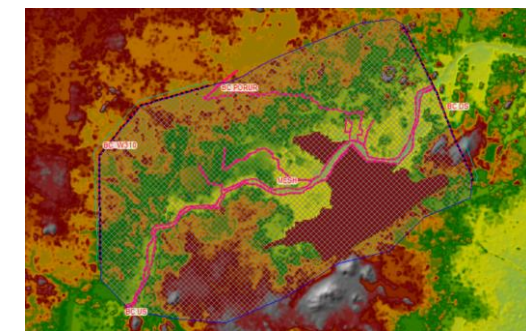
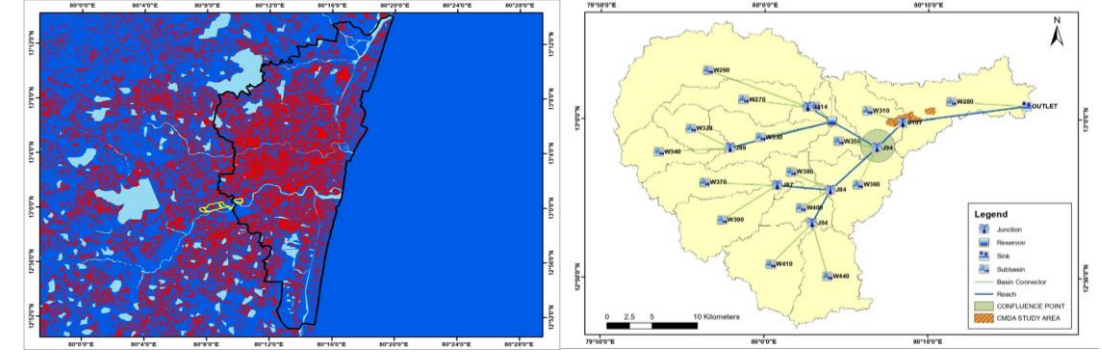
- ✓ Preparation of **Flood Inundation Maps** for major flood disaster years **2005, 2015, 2017** and **2020** for the study area.
- ✓ Identification of **Flood Vulnerable Areas** and to **categorize them on the basis of inundation levels** (high, medium, low).
- ✓ Recommend suitable interventions for River Adyar and on-site measures to alleviate flooding in the study area.

## SOFTWARE'S USED

HEC-HMS, HEC-RAS, SWMM, ArcGIS, NEST & SNAP

## OUTCOMES

- ✓ The simulation has been carried out for the extreme rainfall events of **2005, 2015, 2017, 2020**, Return Periods of **5 Year, 10Year, 25 Years** and Inundations are verified with Satellite Imagery classification.
- ✓ **Flood Vulnerable Areas** are classified based on **inundation levels** (high, medium, low).
- ✓ Recommend with interventions in River Adyar is suggested based on Engineering Approach, **Urban Planning Approach & Risk Mitigation Approach.**





# STUDY ON IMPACT OF URBAN DEVELOPMENT ON COASTAL AQUIFER AND MEASURES FOR PROTECTION IN THE VILLAGES FROM KOTTIVAKKAM TO MAHABALIPURAM BETWEEN BAY OF BENGAL AND BUCKINGHAM CANAL

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Framework for Nature-based Solutions for Enhancing Urban Resilience in Tier 2 Cities of Tamil Nadu

## OBJECTIVES

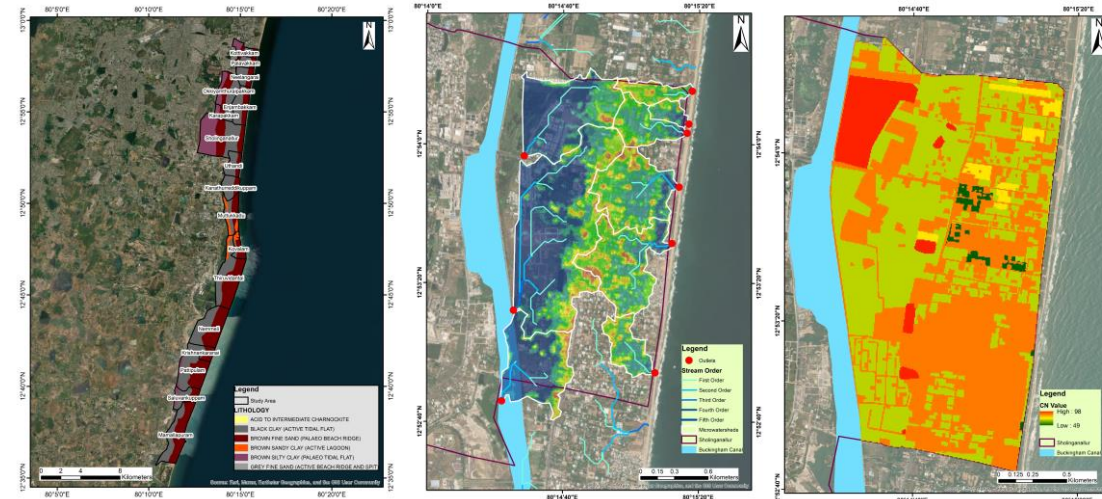
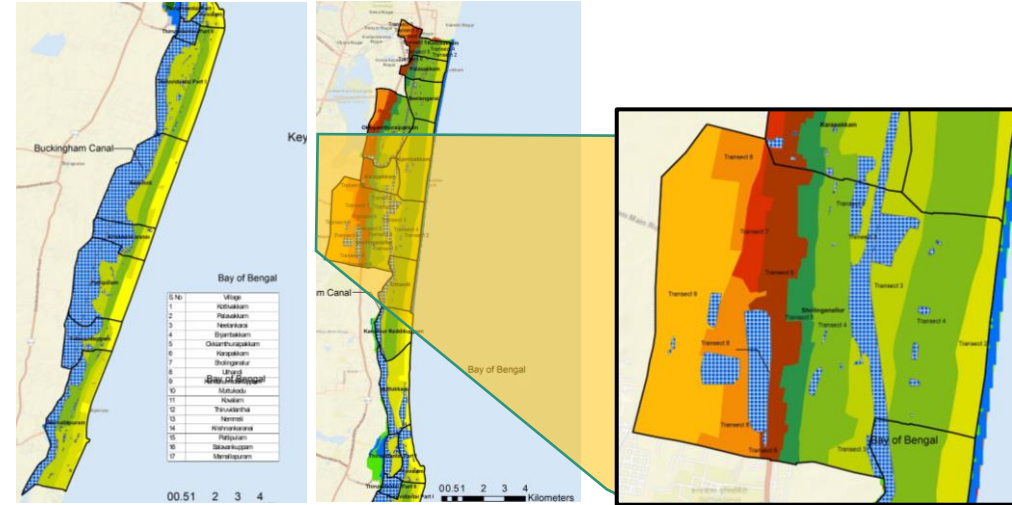
- ✓ Provide an overview of the past and current status of the aquifers in the study area.
- ✓ Provide the pattern of population growth and density, type of developments and the ground coverage of the developments in the study area.
- ✓ Quantum of extraction of groundwater and the impact of developments on the aquifers.
- ✓ Introduce best practices at the international and national level in protecting the aquifers.

## SOFTWARE'S USED

ArcGIS, Finite Element FLOW (FEFLOW 7.0)

## EXPECTED OUTCOMES

- ✓ 'Development regulations' for the study area in each of the optimized scenarios
- ✓ Protection measures for the aquifers in the study area.
- ✓ Recommendations on utilizing the open wells, bore wells, extraction of ground water and rain water harvesting in developments.



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# Thank You..!!



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