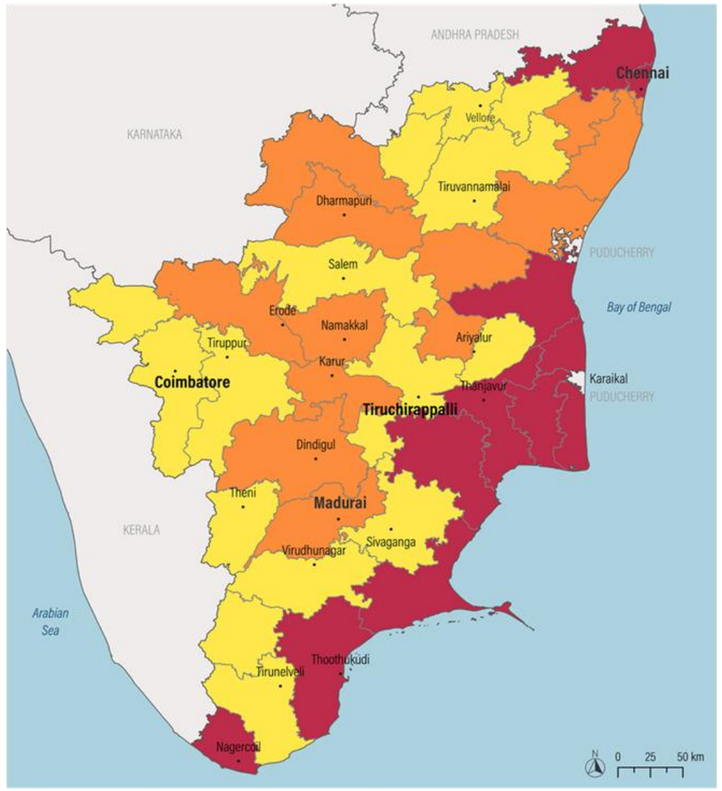
# Tamil Nadu's Action on Heat Mitigation and Cooling

*Sudha Ramen*

*Government of Tamil Nadu*

# Why Heat is a concern to Tamil Nadu




- Tropical peninsular state - **long coastline** of 1100kms
- Heat + **Humidity** → Heat Stress + Thermal Discomfort
- **59%** of Tamil Nadu's Population affected by temperatures **over 35°C**, disrupting daily life, health, and productivity.
- **Economic, Health & Agricultural** Consequences – Higher temperatures lead to increased energy demand, water shortages, affecting public health, and infrastructure resilience, also declining crop yields, putting stress on the state's economy and food security.

# Need for Heat Mitigation

- 41.7 million population of Tamil Nadu exposed to high intensity of **Urban Heat Island.**
- Change in **maximum temperature to increase** by 1.1°C, 2.0°C and 3.1°C in the years 2040, 2070 and 2100, respectively.
- **Agriculture** in the state **projected to reduce** 30-35% by 2050, 80% by 2080 due to rising temperature and change in rainfall.
- **Heat related illnesses** are highly under reported – TN reported 12 deaths due to heat in 2023.

**Feeling heatwave? Here are top 10 hottest cities in India right now**

1 min read • 03 May 2024, 07:13 AM IST

Livemint


**Heatwave claims life of labourer in Chennai, another hospitalised**

A construction worker died of a suspected heat stroke in Chennai on Sunday.

A labourer aged 35 and another aged 25, suffered heat strokes and were brought to the Rajiv Gandhi Government General Hospital (RGGGH) in Chennai on Sunday. The 25-year-old

**Heatwave hits many in Tamil Nadu, no deaths reported**

*A 35-year-old man was admitted to Chennai's Rajiv Gandhi Government General Hospital with heat-related illness on Saturday.*

**Reporting cases vital for precautions: DPH**

Government hospital doctors see such cases daily but, despite a March 7 advisory from the Directorate of Public Health, the institutions do not report them to the DPH.

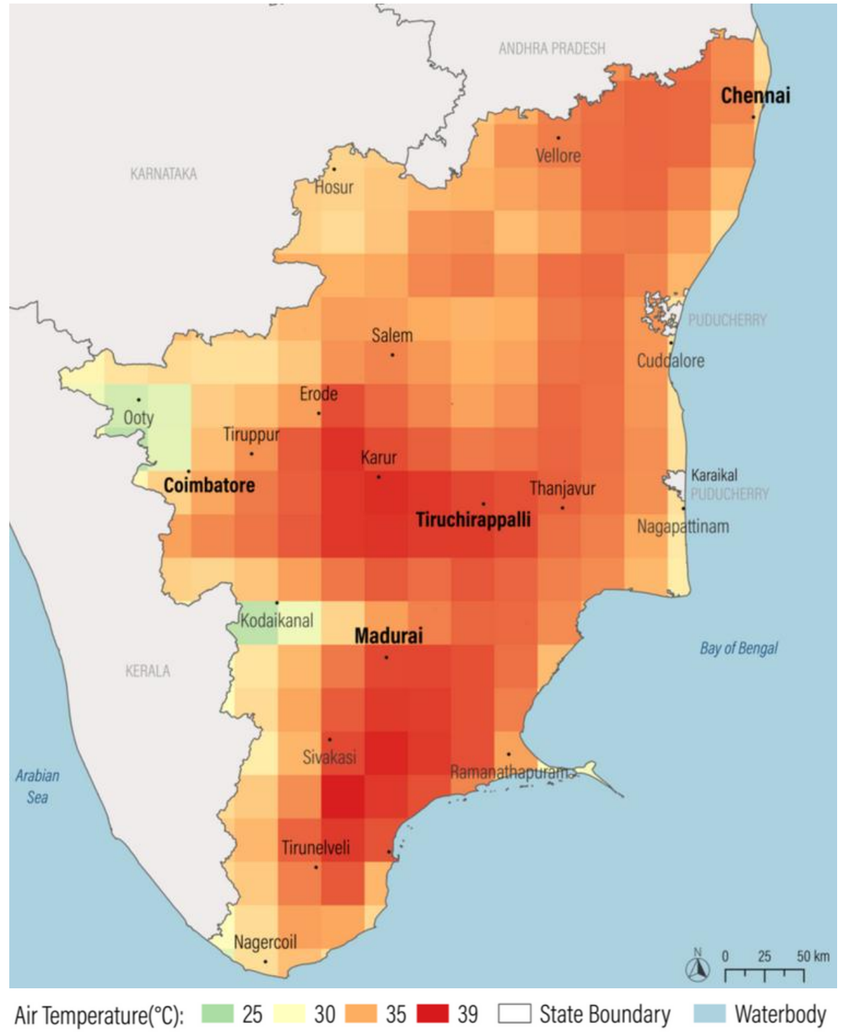
The doctors told TNIE that their hesitancy in officially recording such cases stems from the difficulty in making a diagnosis. "A case can only be diagnosed as caused by heat-related illnesses if other causes of illness have been ruled out," a doctor said.

# Need for Heat Mitigation

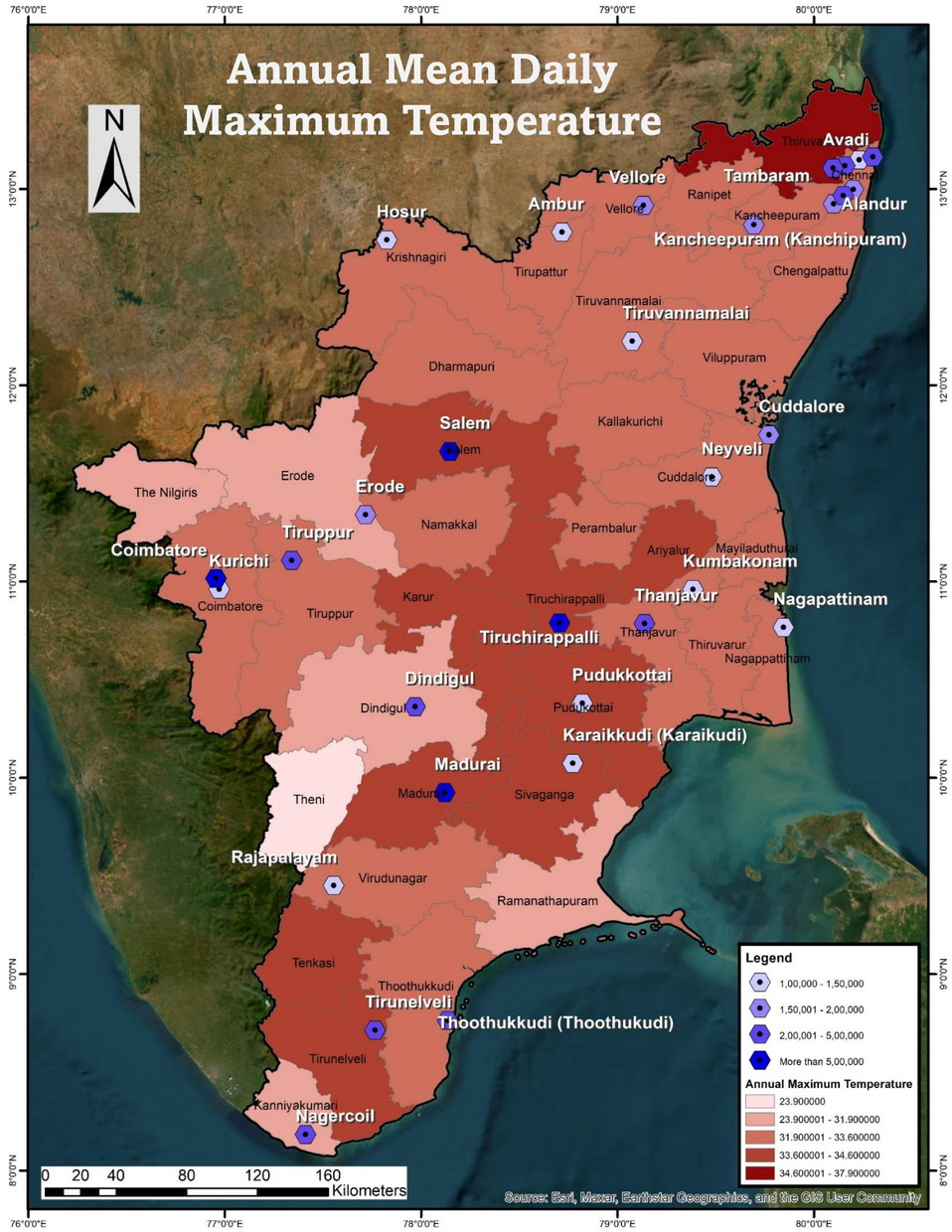
- **Rapid Urbanisation**
  Tamil Nadu is among India's fastest urbanising states and highly vulnerable to heat-related disasters.

- **Rising Temperatures**
  Over 100 taluks recorded more than 2°C warming between 2010 and 2020; urban land surface temperature increased by about 2.6°C.

- **Urban Heat Islands**
  Chennai's **night-time temperatures are 1.5°C higher** than rural peripheries; 23.8% of state land is built-up, reducing natural cooling.



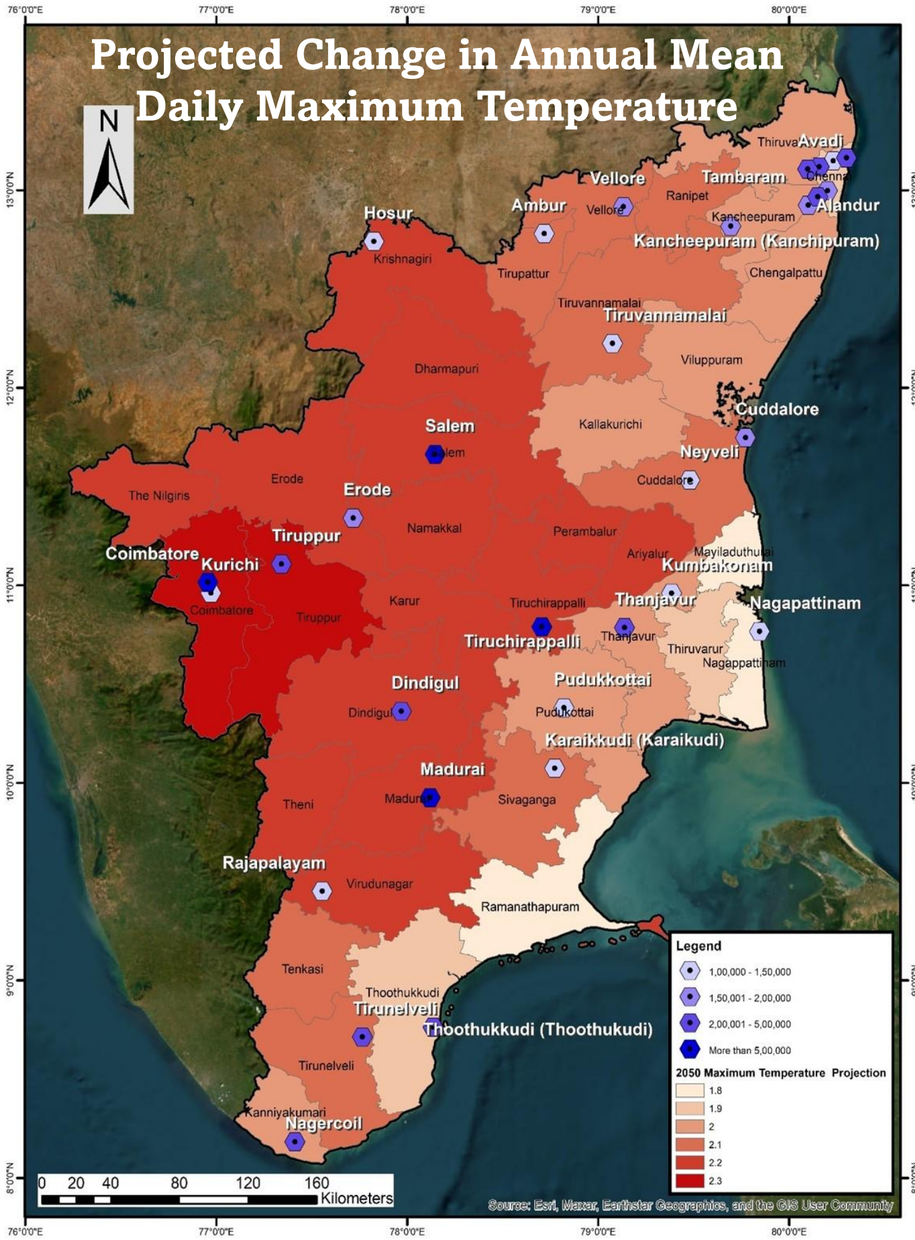

Source: ERA5 Maximum Air Temperature 2015-2019, Census 2011, WRI India 2024




## Year of Analysis: 2015

Cities with Maximum Temperature more than 34˚C

- Avadi
- Tirunelveli
- Salem
- Tiruchirappalli
- Madurai
- Pudukkottai




## Year of Analysis: 2050

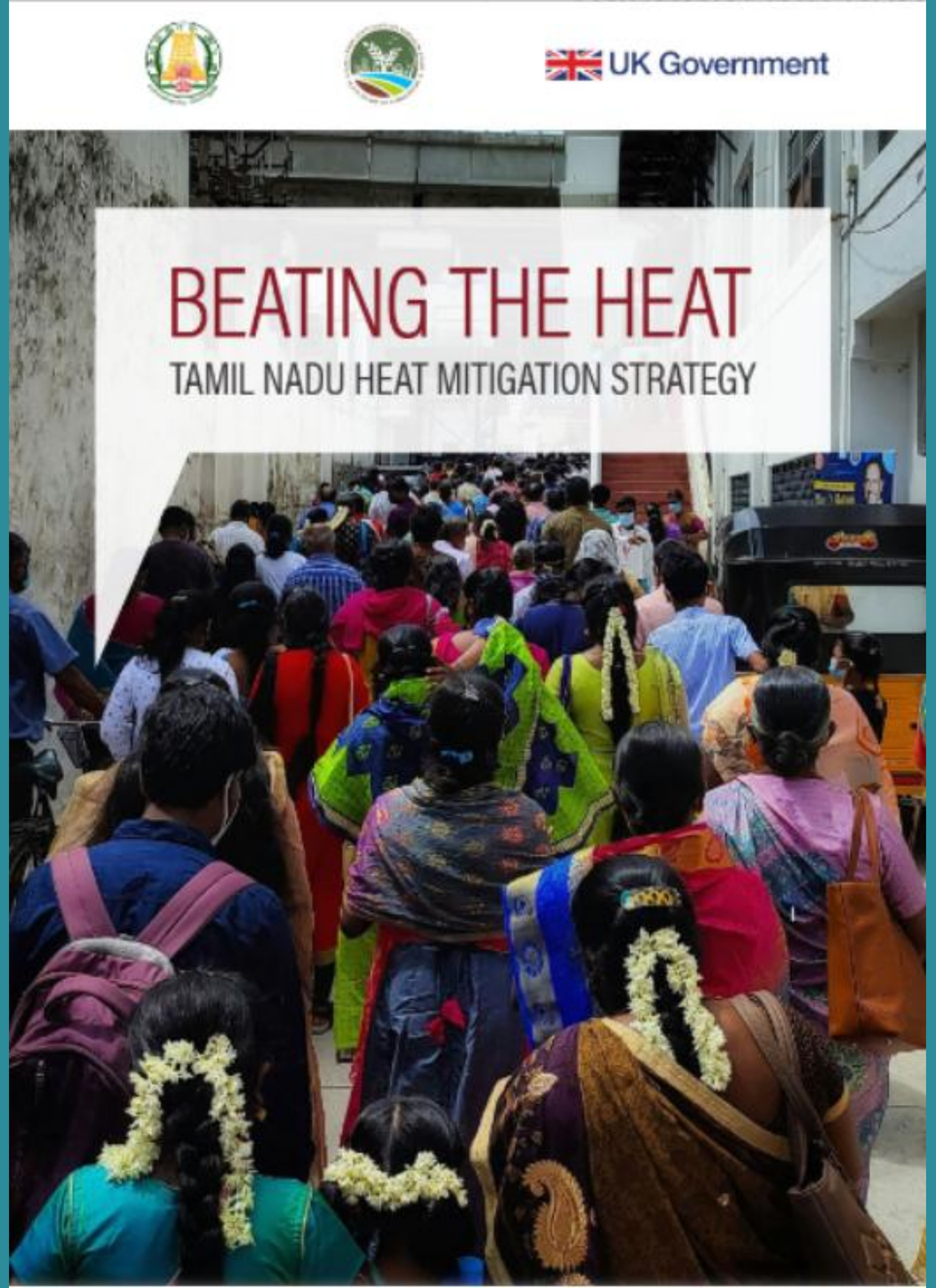
- Reference baseline 1970 – 2000.
- No. of Cities with more than +2˚C rise in temperature = 20

Source: IMD

# Why Increase in Temperature matters

Cities with temperature changes (both maximum and minimum) of more than +1.5˚C are expected to experience

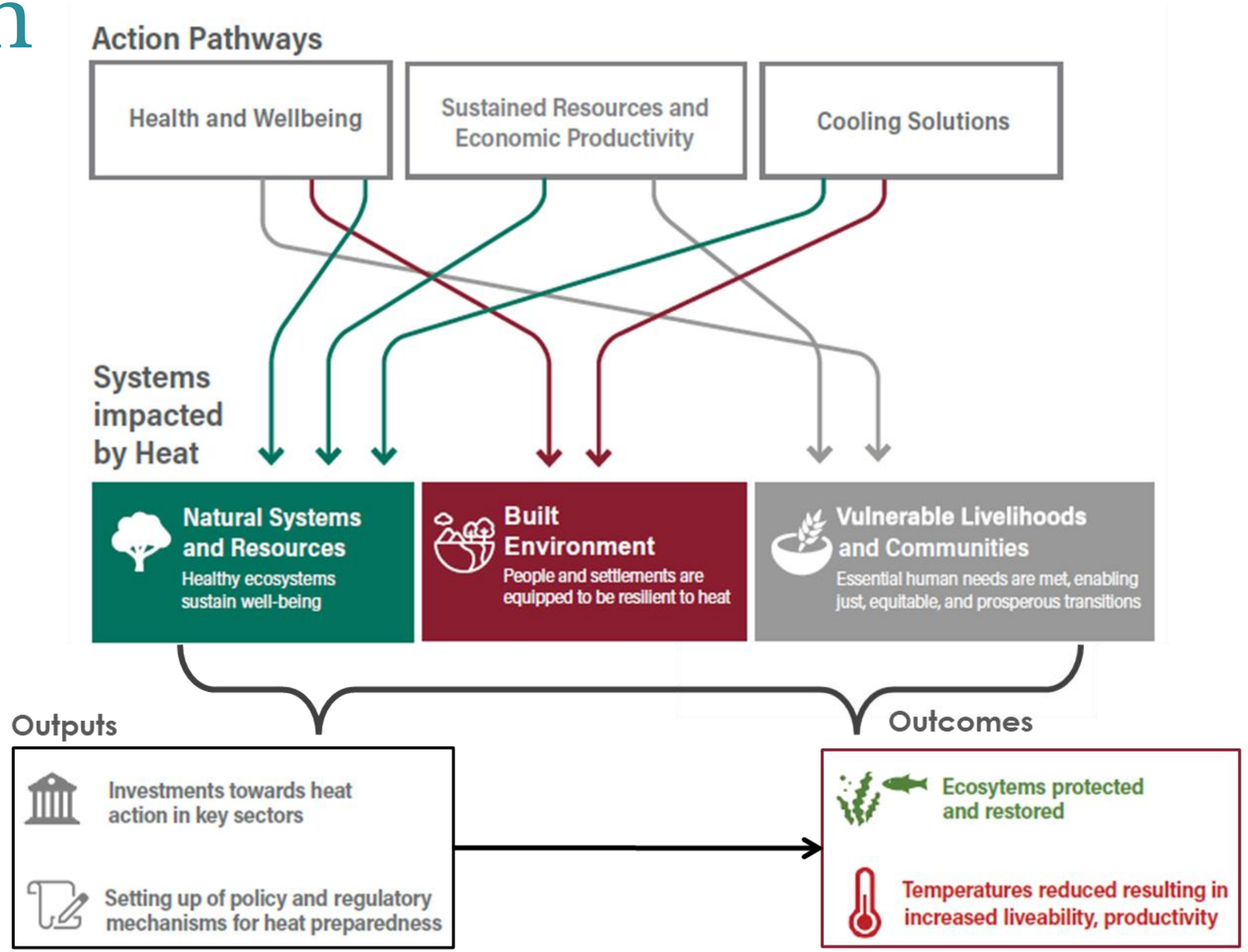
- Cities will experience an average of **16.3 heatwave days per year**.
- The average city may experience **4.9 Nos. of heatwaves per year**.
- These cities could face **double their historical cooling demand**.
- The incidence of arboviruses, such as dengue, Zika, West Nile, yellow fever, and chikungunya, will likely increase as days with optimal temperatures for disease-carrying mosquitoes become more common.
- At this level of warming, cities may experience **73.4 peak arbovirus days each year**.




*Tamil Nadu became the first Indian state in 2024 to declare heatwaves as a state-specific disaster, enabling coordinated disaster response and fund utilization for HEAT ACTION.*

# Heat Mitigation Pathways Identified for Tamil Nadu

*Heat Action Network with all key departments and stakeholders was established.*




Source: TN Heat Mitigation Strategy, 2024

# Heat declared as State -Specific Disater

### STATE DISASTER RELIEF FUND

available for heat mitigation works

### EXGRATIA TO DECEASED VICTIMS

INR 0.4 million to each

### HEAT ACTION PLAN FOR CITIES

Key elements of the plan focus on increasing greenery, protecting water bodies, promoting well-ventilated buildings, and enhancing medical infrastructure.

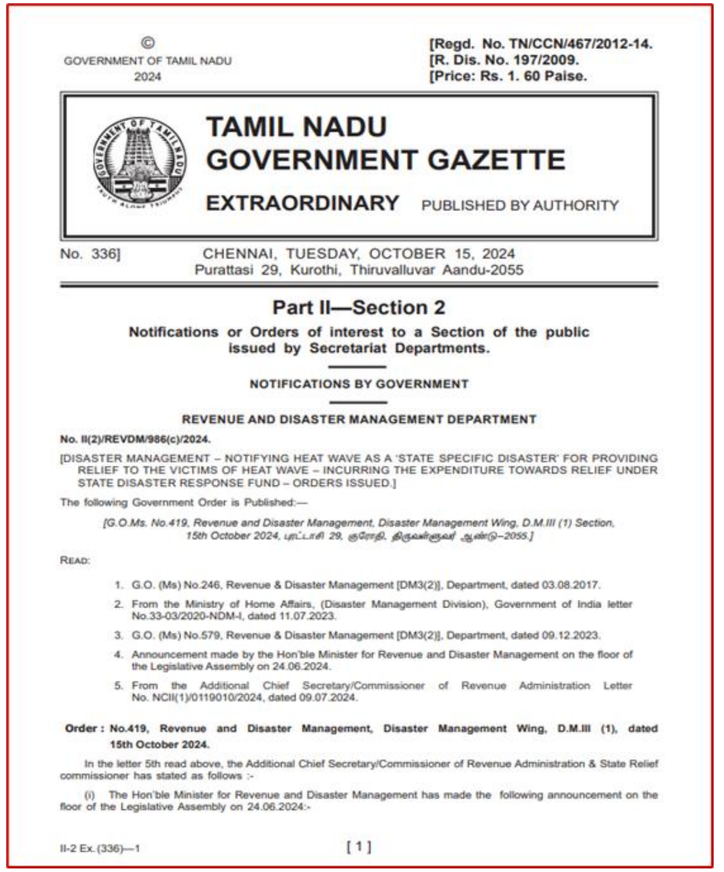
### INTEGRATED HEALTH INFORMATION SYSTEM FOR REPORTINGS

Advisories issued to Public and Private health institutions to identify and report heat related ailments

### ONE HEALTH AND CLIMATE CHANGE HUB

Aims to integrate strategies across health, agriculture, environment, and other relevant sectors to mitigate climate change challenges

# Tamil Nadu declares HEAT as State Specific Disaster



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[R. Dis. No. 197/2009.
[Price: Rs. 1. 60 Paise.

**TAMIL NADU GOVERNMENT GAZETTE**

**EXTRAORDINARY** PUBLISHED BY AUTHORITY

No. 336] CHENNAI, TUESDAY, OCTOBER 15, 2024
Purattasi 29, Kurothi, Thiruvalluvar Aandu-2055

**Part II—Section 2**

**Notifications or Orders of interest to a Section of the public issued by Secretariat Departments.**

**NOTIFICATIONS BY GOVERNMENT**

**REVENUE AND DISASTER MANAGEMENT DEPARTMENT**

**No. II(2)/REVDM/986(c)/2024.**

[DISASTER MANAGEMENT – NOTIFYING HEAT WAVE AS A 'STATE SPECIFIC DISASTER' FOR PROVIDING RELIEF TO THE VICTIMS OF HEAT WAVE – INCURRING THE EXPENDITURE TOWARDS RELIEF UNDER STATE DISASTER RESPONSE FUND – ORDERS ISSUED.]

The following Government Order is Published:—

*[G.O.Ms. No.419, Revenue and Disaster Management, Disaster Management Wing, D.M.III (1) Section, 15th October 2024, புரட்டாசி 29, குரோதி, திருவள்ளுவர் ஆண்டு–2055.]*

READ:

1. G.O. (Ms) No.246, Revenue & Disaster Management [DM3(2)], Department, dated 03.08.2017.
2. From the Ministry of Home Affairs, (Disaster Management Division), Government of India letter No.33-03/2020-NDM-I, dated 11.07.2023.
3. G.O. (Ms) No.579, Revenue & Disaster Management [DM3(2)], Department, dated 09.12.2023.
4. Announcement made by the Hon'ble Minister for Revenue and Disaster Management on the floor of the Legislative Assembly on 24.06.2024.
5. From the Additional Chief Secretary/Commissioner of Revenue Administration Letter No. NCII(1)/0119010/2024, dated 09.07.2024.

**Order : No.419, Revenue and Disaster Management, Disaster Management Wing, D.M.III (1), dated 15th October 2024.**

In the letter 5th read above, the Additional Chief Secretary/Commissioner of Revenue Administration & State Relief commissioner has stated as follows :-

(i) The Hon'ble Minister for Revenue and Disaster Management has made the following announcement on the floor of the Legislative Assembly on 24.06.2024:-

II-2 Ex.(336)—1 [ 1 ]


ABSTRACT

HEALTH AND FAMILY WELFARE (P1) DEPARTMENT

ORDER:

# Establishing One Health and Climate Hub under Health and Family Welfare Department

# Govt. releases Climate Action Plan for Chennai


## Climate action plan is ready, let's back it up with science

GARBAGE DAMAGE : In Chennai, the waste sector contributes 13% of emissions, with solid waste constituting 94.1% and wastewater 5.9%

Shankar Prakash

*Chennai gets proactive against climate change, aiming for carbon neutrality by 2050. However, rethinking baseline emissions is crucial for implementation*

Cities occupy only two per cent of the world's land area, yet consume more than two-thirds of the world's energy and are responsible for more than 70% of global greenhouse gas (GHG) emissions, according to a 2021 World Bank report.

Coastal cities are at the forefront of the global climate crisis. The Chennai Climate Action Plan (CCAP) was recently unveiled by chief minister M K Stalin. The plan was prepared by the Greater Chennai corporation and the TN department of environment and climate change with support from C40 Cities and the Urban Management Centre. It aims to align with the Paris Agreement and focuses on six sectors: electrical grid and renewable energy; building energy; sustainable transport, solid waste management, urban flooding and water scarcity, and vulnerable populations and health. The plan serves as a roadmap by adhering to the intergovernmental panel on climate change target of net zero by 2050 against India's national goal of net zero by 2070.

Any climate action plan is fundamentally based on data. Scientific processes need to be followed rigorously for CCAP to be seen as a strategic document. According to the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) — the 2018 emissions data from here have been used as the baseline for CCAP — Chennai's total annual emissions were generated in buildings, but the plan lacks a blueprint on how to achieve the goals.

Despite wastewater, including sewage, being discharged into the Adyar, Cooum and Kosasthalayar, the action plan claims all wastewater is treated using aerobic technology-based sewage treatment plants (STPs) that do not produce methane as a by-product. Biological treatment methods are considered economical and effective for treating wastewater, but the CCAP neither talks about measures to stop wastewater discharge into the rivers nor about biological treatment methods. The plan does not consider circularity in managing wastewater discharge in rivers. This approach, which aims to recover and reuse elements of wastewater for beneficial purposes based on circular economy principles, can help to protect waterways from pollution.

According to the Climate Vulnerability Index, Chennai is highly susceptible to floods and cyclones. The CCAP also includes heatwaves, water scarcity, and sea level rise as potential climate risks. A review of existing research on climate action plans highlighted that most plans do not account for heatwaves and the urban heat island effect. Although increasing tree cover and biodiversity can help mitigate heatwaves and the urban heat island effect, the CCAP does not suggest specific actions such as green roofs or cool pavements, other than adding green cover and creating biodiversity parks. The city's green cover is often diminished by development works such as metro rail construction and stormwater drainage and the CCAP provides no solution to this ongoing problem.

The CCAP prescribes mitigation measures such as investing in solar rooftop systems and maintaining storm water drains with the goal of achieving carbon neutrality by 2050. The plan includes perspectives from consultations with a few civil society organisations, but not from city vehicles as private and commercial for the baseline does not offer enough data for future actions to mitigate vehicular emissions.

The CCAP also fails to draw inferences from the non-motorised transport policy developed for the GCC in 2014, which could have provided actionable insights for reducing emissions. The waste sector contributes 13% of emissions, with solid waste constituting 94.1% and





DISASTER ZONE: According to the Climate Vulnerability Index, Chennai is highly susceptible to floods and cyclones

**PRIVATE VEHICLES HAVE BEEN IDENTIFIED AS RESPONSIBLE FOR 84% OF GHG EMISSIONS, BUT NO CLEAR MEASURES HAVE BEEN IDENTIFIED TO DISCOURAGE THIS**

nario, emissions are projected to increase almost fourfold by 2050 to 55.08 MtCO2e. Managing these anticipated increases and recording outcomes is likely to need better data handling. For example, the GPC includes the following emission categories: stationary emissions, transportation, waste, industrial processes, and agri-

identify specific emission sources which the CCAP does not use in its data. These differences between baseline data and how future GHG emissions are projected or outcomes are calculated can hinder concerted efforts to address actions under sectors identified in the CCAP.

Within stationary energy use, residential and commercial buildings constitute 8.27 MtCO2e. Although it is acknowledged in

per capita emission.

In transportation, private vehicles have been identified as responsible for 84% of GHG emissions, but no clear measures have been identified to discourage this. Merely classifying vehicles as private and commercial for the baseline does not offer enough data for future actions to mitigate vehicular emissions.

## Administration takes precautionary measures to beat the summer heat

May 02, 2024 10:47 pm | Updated 10:47 pm IST – MADURAI

Collector Sangeetha holds a meeting with officials at the Madurai Collectorate on Thursday. | Photo Credit: Special Arrangement

Advisories issued by District Administration

## TVMCH creates air-conditioned ward to treat heat stroke patients

Published - May 08, 2024 06:22 pm IST – TIRUNELVELI

The heat stroke special ward set up at Tirunelveli Medical College Hospital. | Photo Credit: A. SHAIKMOHIDEEN

Separate Wards for heat stroke patients

Shade nets at most traffic junctions


Restrictions on working hours for construction workers during extreme heat days

# Subnational Action on Cooling and Extreme Heat

## Awareness and Preparedness


**Heat wave readiness**

- Integrated Heat Action/Cooling Plans
- Vulnerability mapping
- Governance structures
- Social programs
- Climate & industrial strategy
- Skilling and innovation

## Redesign the built environment

**01** Reduce heat at the urban scale

- UHIE mapping
- Heat-resilient urban design
- Cool surfaces
- Nature-based solutions
- District cooling
- Traffic reduction

**02** Reduce cooling needs in buildings

- Shading
- Cool/green roof
- Insulation
- Orientation
- Window area and glazing
- Rooftop shading

**03** Serve cooling needs in buildings efficiently

- Efficient ACs, fans and coolers
- District cooling
- Chiller replacement
- Thermal storage
- Cooling as a Service

## Redesign health and food logistics

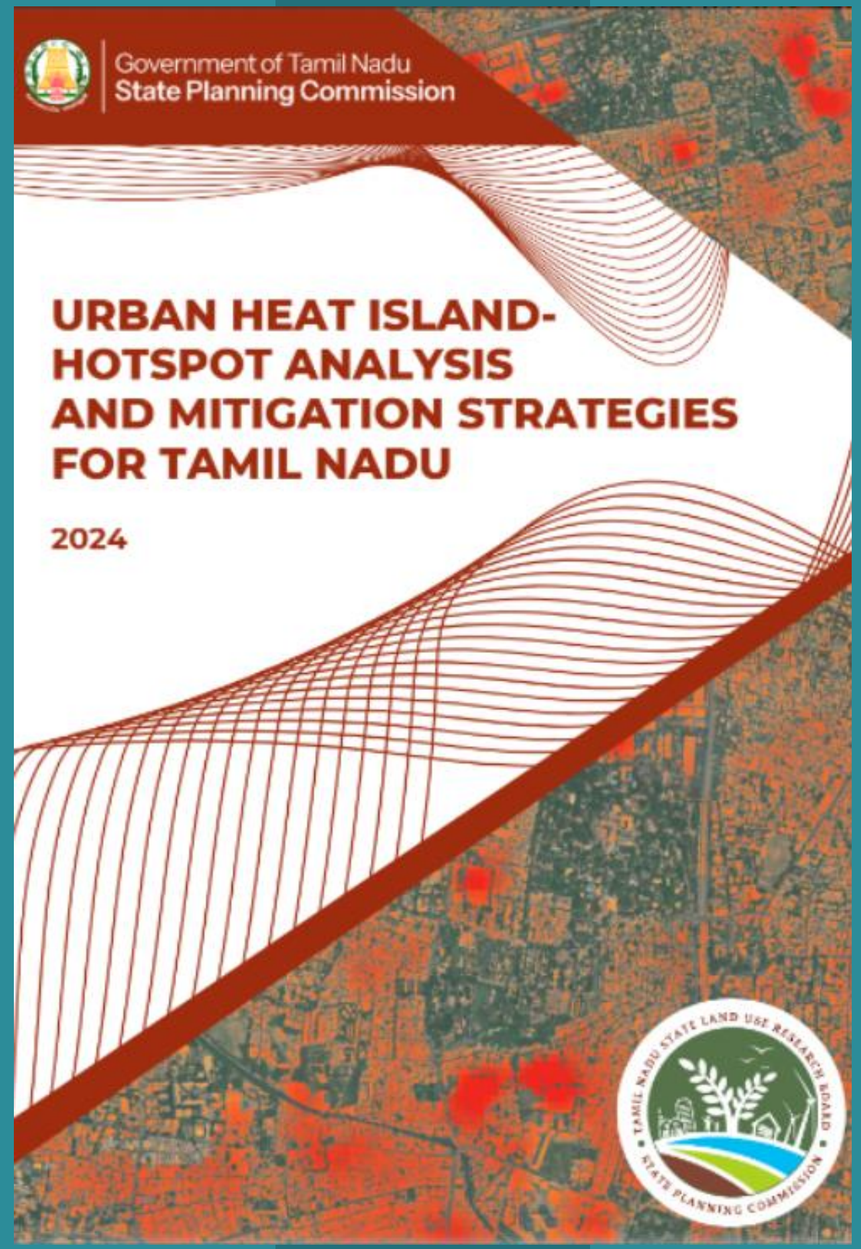

**Expand clean cold chains**

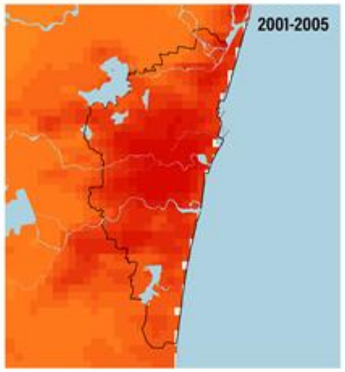
- Farm-to-fork integrated cold chain
- Packhouses, reefer transport, large-scale cold storage
- Reduce vaccine wastage – factory-to-arm integrated cold chain

# *Studies, Assessments, Frameworks & Strategies*

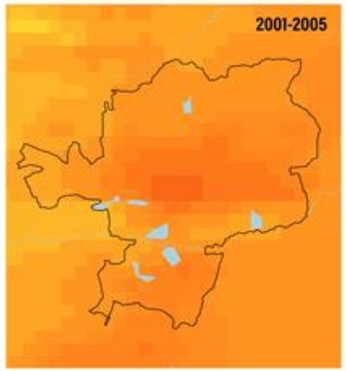
# 1. UHIE Assessments

- The Urban Heat Island Effect (UHIE) is significantly intensifying heat in the state's urban areas, particularly in Tier 1 cities like Chennai
- With nighttime temperatures nearly 2°C higher than their rural counterparts
- Increase in night-time temperatures in urban areas, with summer night-time temperatures in Chennai increasing by 0.63°C between 2013 and 2023

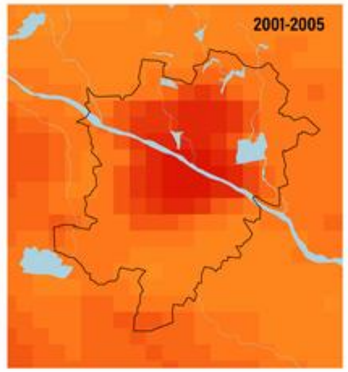




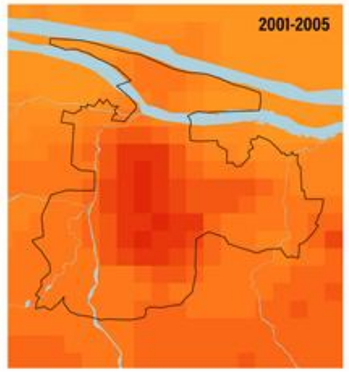

Chennai




Coimbatore

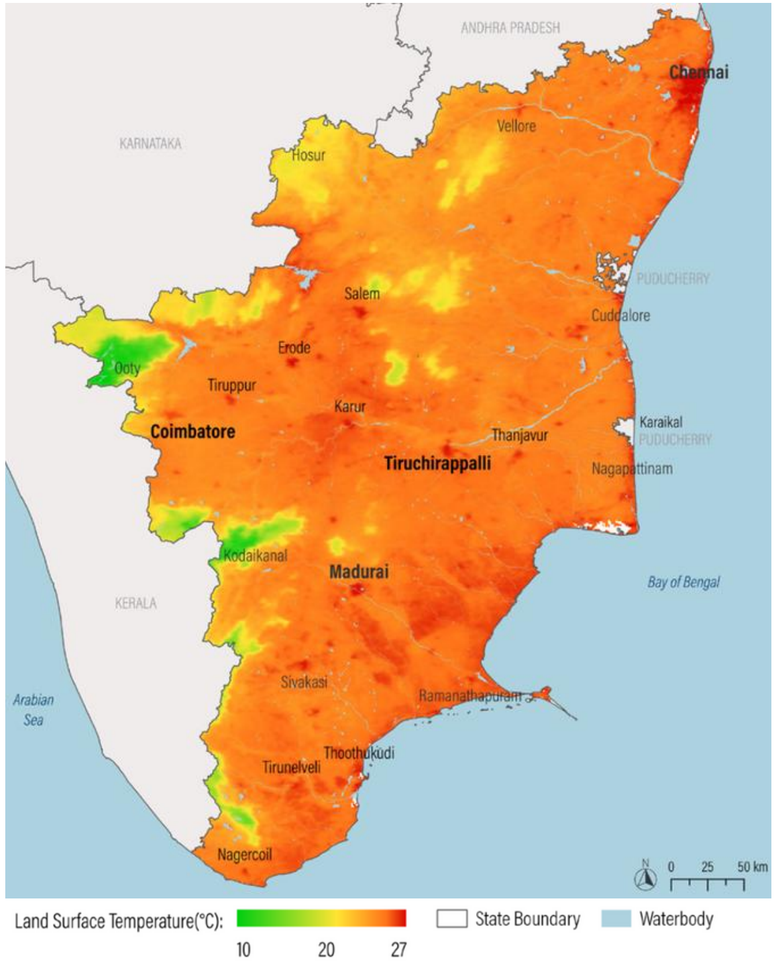



Madurai



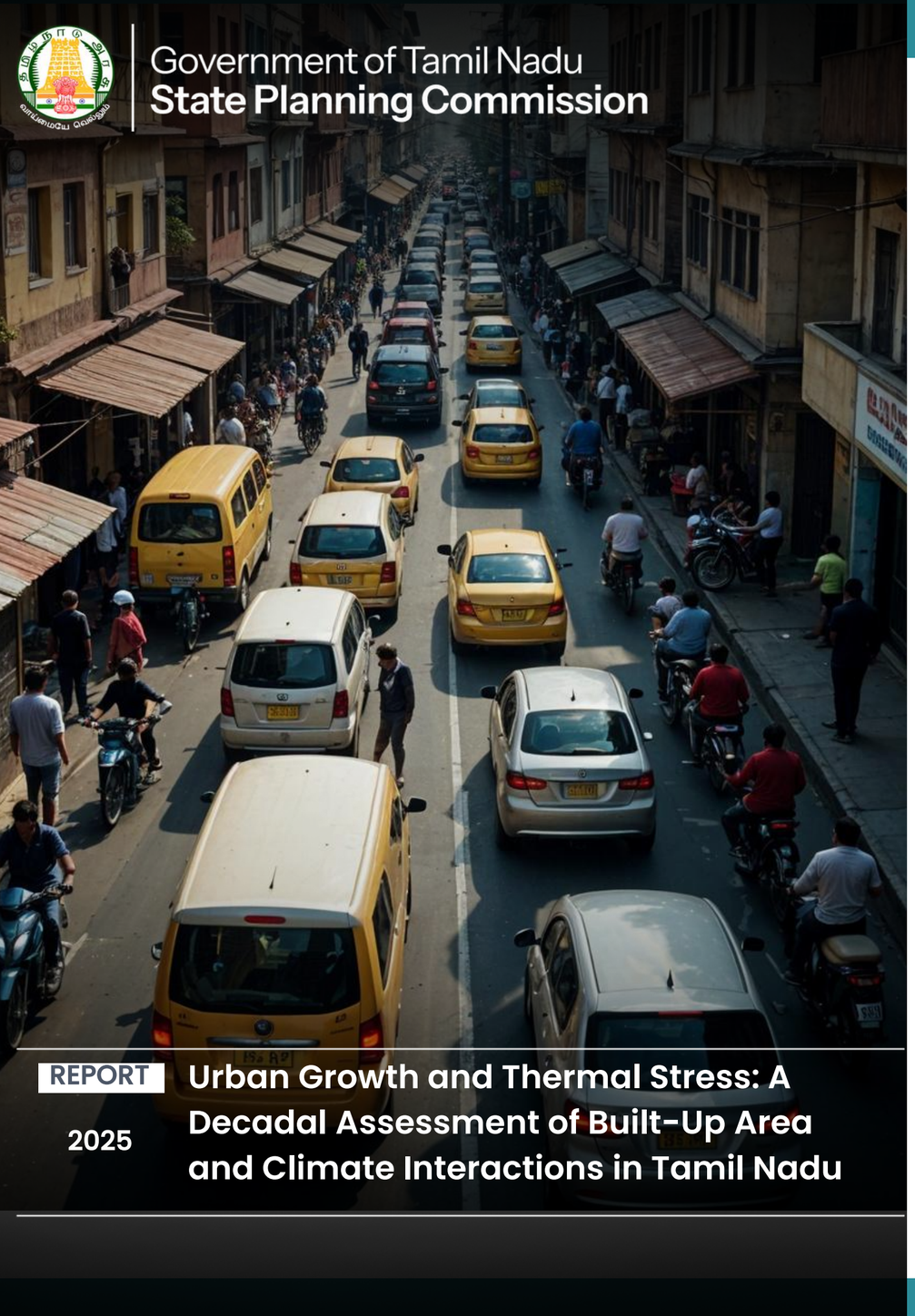

Tiruchirappalli

- About 27% of the State's population faces Urban Heat Island effects.
- At least 35% of the total state population is exposed to relatively higher intensity of "UHI".
- UHI intensity in Chennai and Thiruvallur rising by nearly 3°C



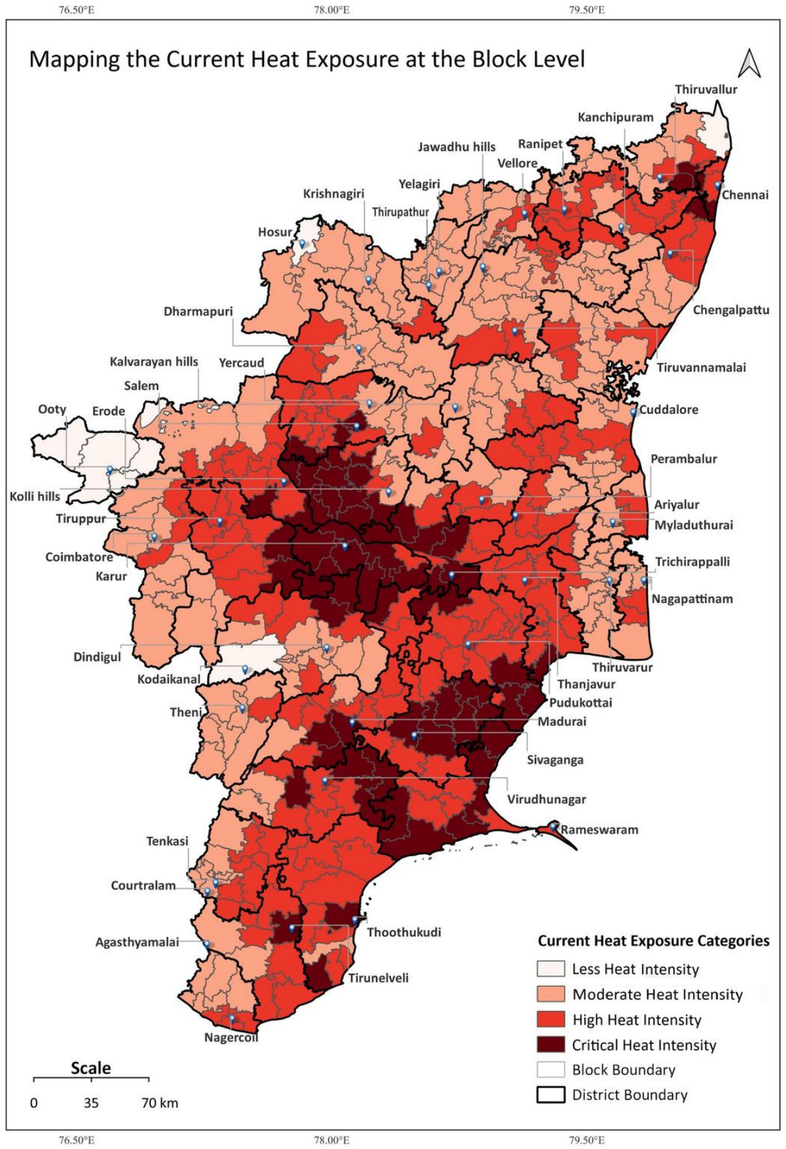

Night-time land surface temperature changes from 2001-05 average to 2019-23

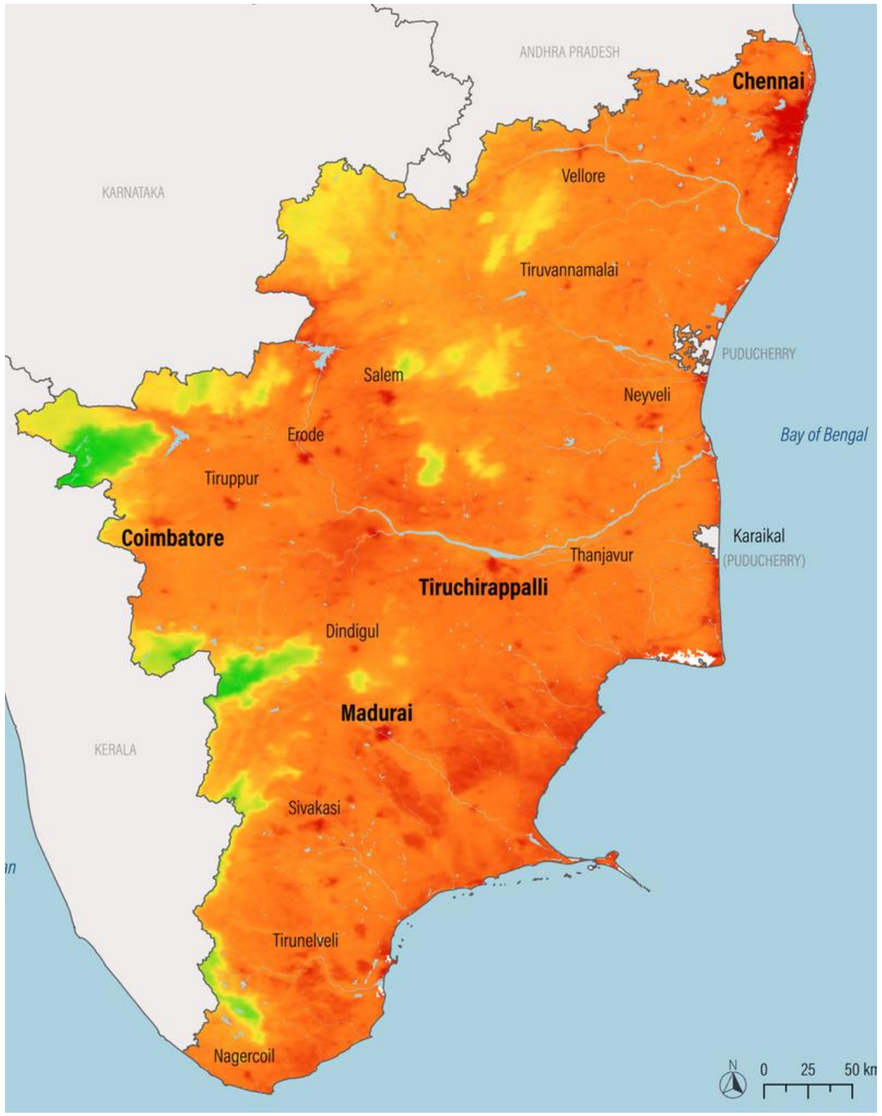
Data/ method: LST average for summer months of 2019-2023. MODIS Terra Land Surface Temperature and Emissivity Daily Global 1km, Census 2011, WRI India 2024

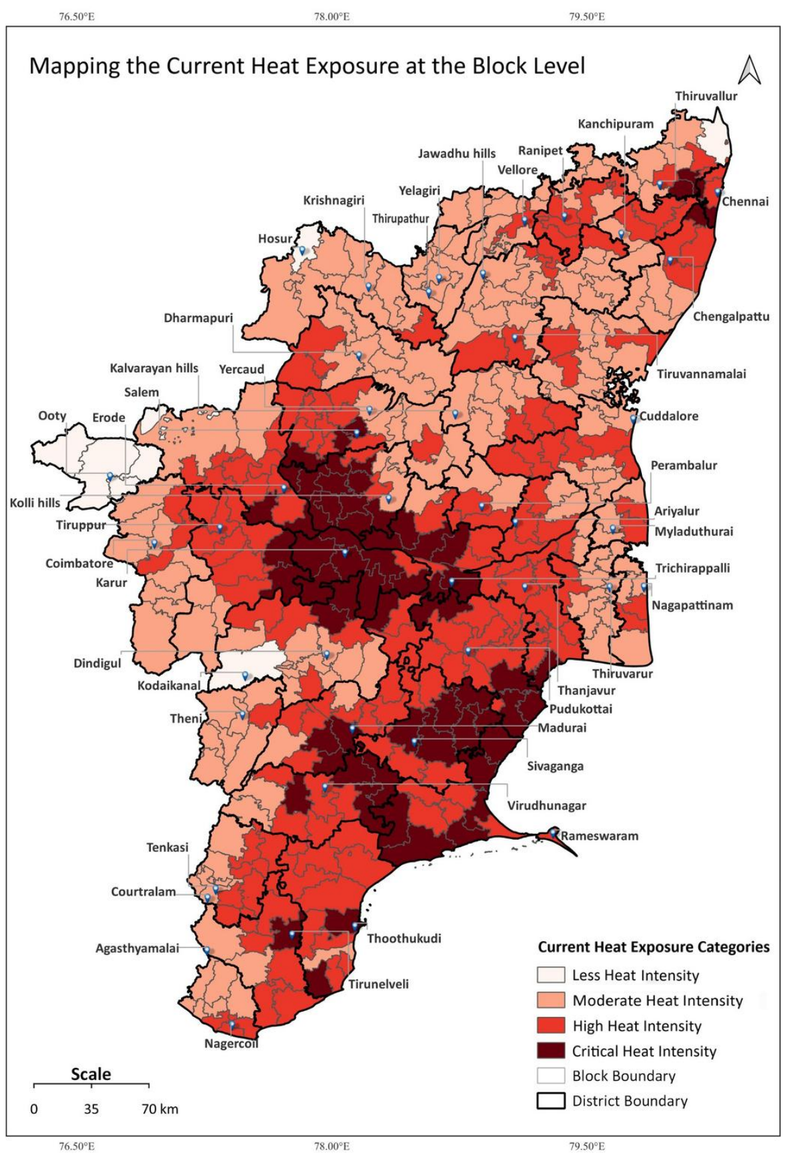



# 2. Decadal Assessment of Urban Growth & Thermal Stress

- 90% increase in built-up area over 15 years
- 3,025 sq. km forest loss contributing to heat rise
- 94 blocks with long-term temperature rise
- 64 blocks with current high heat exposure
- 25 dual-vulnerable blocks needing urgent action




MODIS LST, ERA5 air temperature, Copernicus GHSL, SRTM DEM datasets

Adyar Eco Park,
Chennai

# 3. Mapping and Framework for Management of Blue - Green Infrastructure

- Existing blue and green networks across the state mapped
- Opportunities for enhancement and expansion of these networks has been identified
- Areas for conservation based on ecosystem services and connectivity has been recommended.

AurovilleConsulting

**Blue and green elements**

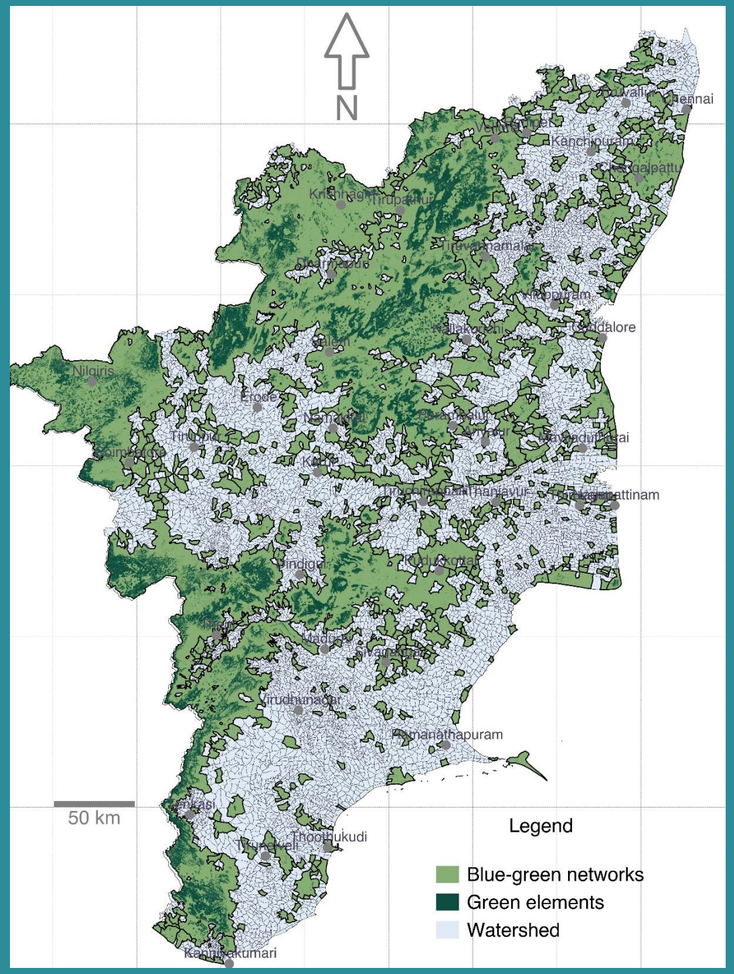
- Blue elements are largely concentrated in the south-eastern districts.
- Reserve forests are the most dominant green elements across districts, covering large areas.

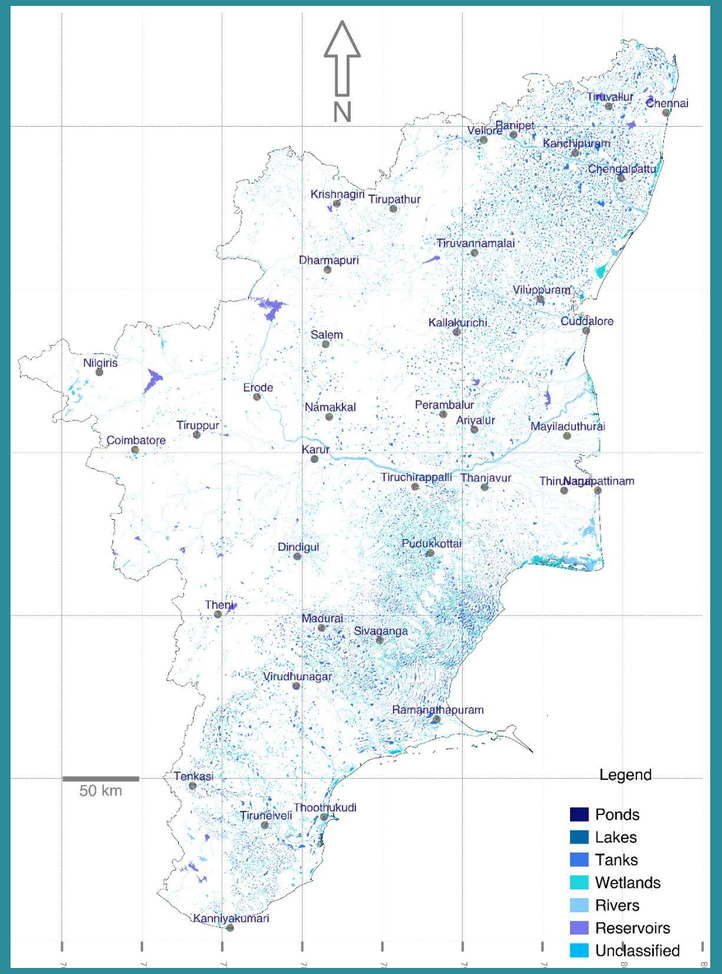
**Blue-Green Networks (BGNs)**

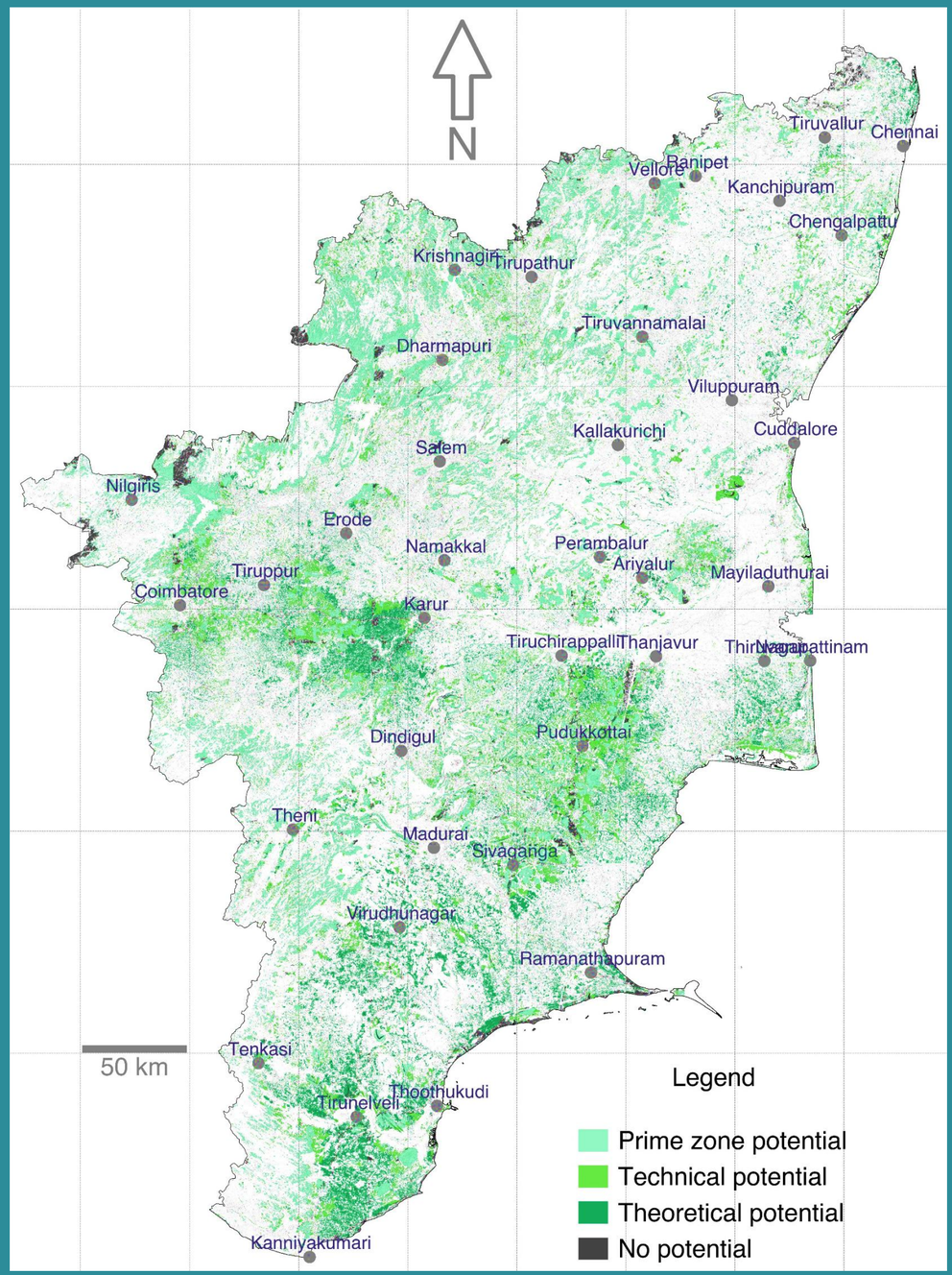
- A total of 667 BGNs identified across the state.
- 98% of BGNs are categorized as nano; only two BGNs (in the Western Ghats) fall under macro and mega categories.
- 37 BGNs have potential for expansion; Most BGNs are situated in rural landscapes, with limited presence in urban and peri-urban areas.
- Maximum BGN ecosystem services rating is 13. Lower-rated BGNs indicate greater need for intervention via nature-based solutions.

**District-Level Insights**

- Highest number of BGNs: Dharmapuri (56)
- High green element share: Dindigul, Salem, Dharmapuri.
- High blue element share: Sivagangai, Thiruvannamalai, Pudukotai.
- High BGN opportunity (enhancement + expansion): Sivagangai, Pudukotai, Tiruppur.




# Distribution of BGN and Potential zones for BGN development

# Green Tamil Nadu Mission

# Tamil Nadu Wetlands Mission


- 265 Crore seedlings are to be planted in 10 years
- 12076 sq.km increase in forest and tree cover in 10 years


- 20 Ramsar Wetlands – Highest in India
- 28904 Wetlands under monitoring
- aims to increase mangrove cover by

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

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

| Strategies | | Management | | Engineering with Nature | |
|---|---|---|---|---|---|
| Protection & Conservation | Eco Sensitive / Conservation / Protected Zones.<br>Ecological Networks<br>Habitat Continuity | Management Plans | Integrated Ecological Management<br>Biodiversity Connectors.<br>Aquifer Protection & Management<br>Catchment Protection & Management<br>Urban Flood Plain Protection & Management<br>Solid Waste Management<br>Wastewater Management<br>Integrated Water Resources Management<br>Urban Forests & Greens<br>Fallow Land Management<br>Land Degradation<br>Control of Soil Erosion<br>Agroforestry<br>Urban Farming & Horticulture<br>Environmental Impact Management<br>Shoreline Protection & Management | Urban Biodiversity | Trees, Forests, Hedges / Shrubs, Plantations<br>Fauna, Habitats and Ecosystems |
| Urban & Regional Planning | Urban & Regional Planning<br>Urban Regeneration<br>Urban Expansion / Sprawl | Policy, Guidelines & Regulations | | Land & Soil | Erosion Prevention, Windbreaks<br>Permaculture & Horticulture<br>Soil Conservation & Enrichment |
| Environment | Air<br>Water<br>Soil | | | Blue Green Networks | Water-Sensitive Urban Design, SUDS, Riparian Zones, Biodiversity Connectors<br>Mangroves, Saltmarsh/Sea Grass<br>Inter tidal Habitats<br>Sand Trapping, Dunes, Reefs & Levees<br>Green Infrastructure |
| | | | | Built Environment | Parks, Gardens, Open Spaces, Green Belts, Buffer Zones, Green Streets, Permeable Pavements<br>Green roofs, Green wall/façade<br>Biophilic Architecture, Urban Farming, Solid Waste Management, Carbon Sinks |
| | | | | Surface & Ground Water | Wetlands, Riverine Ecosystems, Floodplains, Waterbodies<br>Waterways, Infiltration, Rain Gardens, Wet/dry Vegetated swale, Bioretention, GWR, Managed Aquifer Recharge, Constructed Wetlands, Waste Water Management |

# Recommended NbS for Urban Heat mitigation

## Strategies

### Urban Green Spaces & Canopy Expansion

- Planting parks, green belts, and gardens helps lower urban temperatures by providing shade and promoting evapotranspiration.
- Increasing the number of trees along streets, in public spaces, and in neighborhoods provides shade, cools the air, and absorbs $CO_2$.

### Green Corridors & Community Gardens

- Establishing green corridors with connected parks and natural pathways cools urban areas and facilitates biodiversity.
- Promoting urban agriculture and community gardens in neighborhoods cools localized areas while engaging residents in environmental stewardship.

## Management

### Restoring Natural Ecosystems

✓ Protecting and restoring nearby forests, wetlands, and grasslands helps regulate local climate and creates buffer zones against urban heat islands.

### Water Bodies and Urban Wetlands

✓ Integrating lakes, ponds, and wetlands into urban planning cools surrounding areas through evaporative cooling and helps manage stormwater.

## Engineering with Nature

### Green Roofs and Walls

✓ Vegetation-covered roofs and walls reduce surface temperatures, provide insulation, and decrease energy consumption for cooling.

### Rain Gardens and Bioswales

✓ These landscape elements capture stormwater and increase green coverage, which aids in cooling and improving urban hydrology.

Source: https://irade.org/NBS_28.08.2021_REV%20v2.pdf

# DRIVERS

1

**Baseline Assessment**

Assess, Understand, Strategize, Sustain

**Spatial Characterization & Mapping**

Map, Analyze, Inform, Transform

2

3

**Stakeholder Engagement and Communication**

Engage, Communicate, Empower, Sustain

4

**Selection of Nature Based Solutions**

Assess, Adapt, Integrate, Thrive

5

**Mobilizing Finance**

Mobilize, Integrate, Invest, Sustain

**NbS Integration**

Integrate, Implement, Restore, Resilience

6

# POLICY GUIDELINES

**01. Nature in Cities**

Maintain and Enhance Nature's Contributions in Urban Areas

**02. Urban Resilience through NbS**

The Active Role of NbS in Enhancing Urban Resilience

**03. NbS for Environmental Preservation**

Conservation and Protection through NbS

**04. Technology for Nature:**

Utilizing Technology for Mapping and Geodatabase Creation

**05. Knowledge Co-Creation, Dissemination, and Sharing**

**06. Valuing NbS:**

Creating Evidence of Effectiveness and Valuing Ecosystem Services and NbS Benefits

**07. Leave No One Behind**

**08. Monitoring & Evaluation**

Impact Assessment through Key Performance Indicators (KPIs)

**09. Capacity Building & Skill Development**

**10. Ensure Long-Term Sustainability:**

Operation and Maintenance Framework

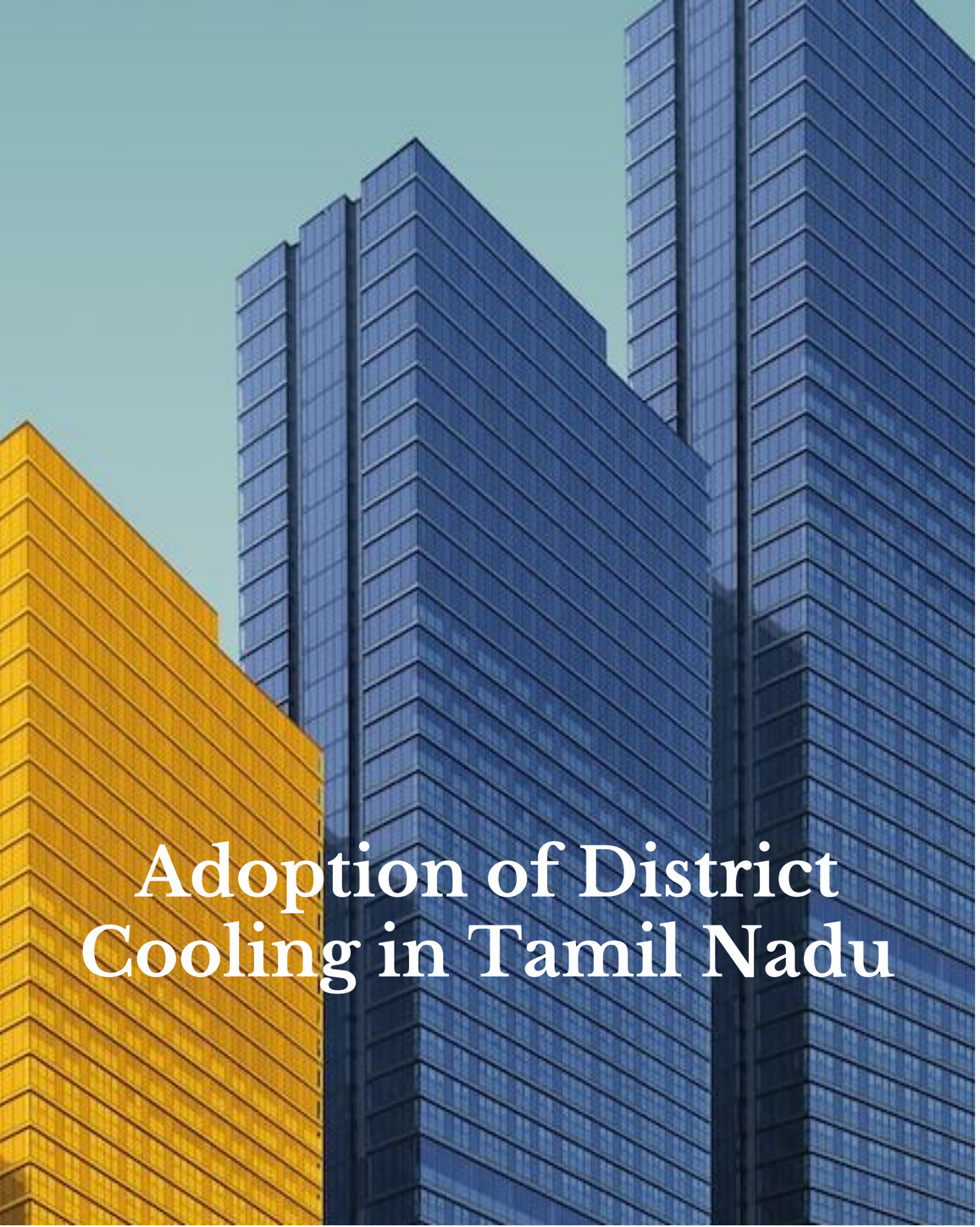
**11. Financial Mechanism**

**12. Economic Revitalization through NbS**

**13. Enabling Frameworks**

Governance, Regulatory, and Legal

**14. Align NbS with Broader SDG:**

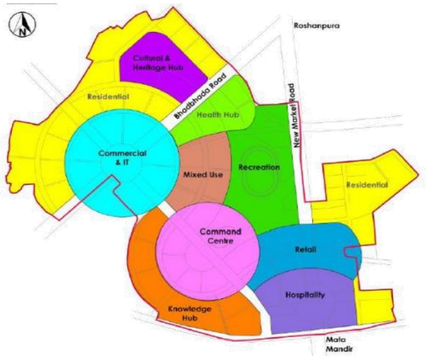


# Adoption of District Cooling in Tamil Nadu

## 5. Potential for District Cooling System (DCS)

- India is commissioning **3 million sqft.** of commercial space per day.
- Tamil Nadu will be the most urbanized state with 67 % of its population living in urban areas by 2030.

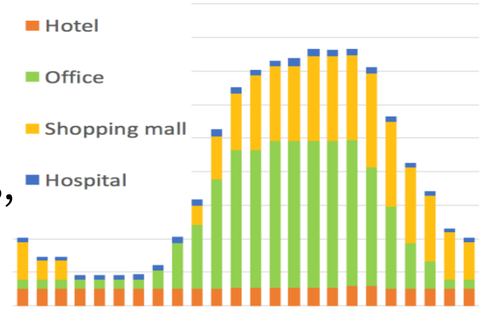
### Target developments




- Smart City areas & CBDs
- Integrated townships, campus
- Industrial areas, SEZs
- Dense brownfield sites
- Gas connections

### Target Consumers

- Data centres, IT Offices
- Hospitals, hotels, malls, offices, conference centres
- Universities, public offices etc.
- HIG residential



# Pilot project for DCS in Tamil Nadu

## Fintech City, Chennai

Provides an opportunity to:

1. **Demonstrate technical feasibility** of DCS in real-world conditions.
2. Establish appropriate **policy framework** ensuring that District Cooling projects can be scaled up effectively.
3. Build **stakeholder confidence** in the technology
4. **Build capacities** of local engineers, technicians, operators, etc.
5. **Raise awareness** and support market development.

Greenfield

Mix use

High cooling density

# State level Implementation Strategy for DCS

## Enabling Policy and Regulatory Framework

- Establish supportive policies and regulatory frameworks
- Utilize zoning, mandatory connection requirements, subsidies, certification programs, updates to building codes, and mandates for renewables and waste heat.

## Integration with Development Regulations

- Integrate policies with existing development regulations mandating district cooling readiness.
- Encouraging buildings to be district cooling ready in the long term.

## Innovative Business Models and Financing Instruments

- Engage with companies and explore innovative financing instruments.
- Collaborate with ESCOs, utilize revolving funds, land use capture, low-rate loans, grants, and green bonds.

## Building Technical Capacities and Experience

- Conduct awareness-raising campaigns and workshops with key decision-making stakeholders.

## Combining Infrastructure Development

- Reduce costs by combining district energy development with road/metro infrastructure projects.
- Coordinate the development of district cooling networks with other infrastructure projects such as new transport links, metro lines, and sewage pipes.

## Partnerships

- Identified potential partners for district cooling projects through stakeholder consultations and in-depth assessments

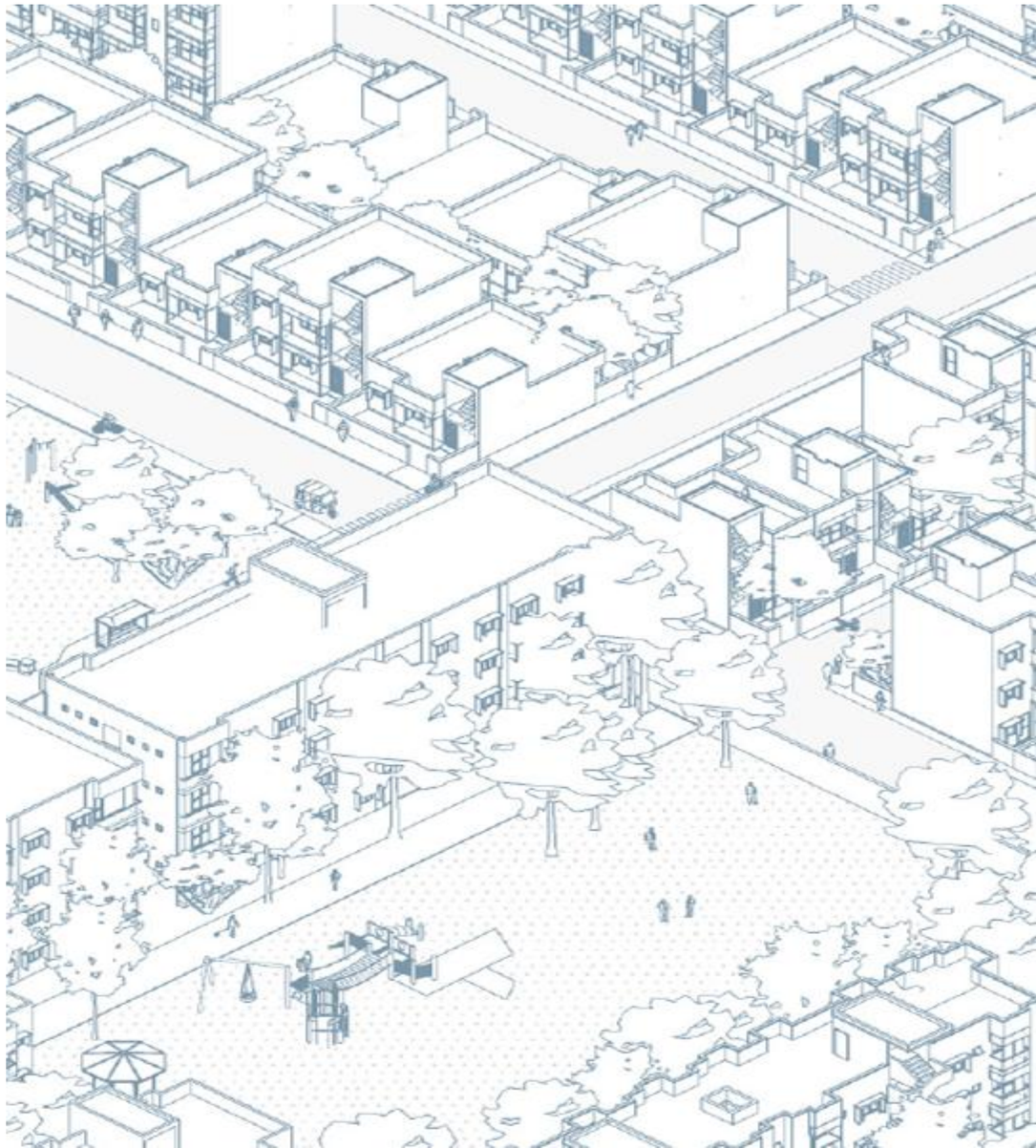
# 6. Passive Cooling Strategies for Tamil Nadu

*Case Studies of*
*Global, State and City -level Initiatives*
*for implementing Passive Cooling Strategies*
*at city and institution level*

**Passive Cooling Strategies - CITY LEVEL** + **Passive Cooling Strategies - BUILDING LEVEL**

## PLANNED URBAN EXTENSION

Integrated approach for cooling cities – Town planning, site planning/urban design, building design, on-site renewable energy



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Agency for Development and Cooperation SDC

# 7. Cool Roof Project

*Case Study from Perumbakkam Light House habitation*

- Light House habitation was selected to test cool roof solutions for low-income housing to reduce indoor heat stress and improve thermal comfort.
- The intervention reduced surface temperatures by 9°C–12°C and indoor temperatures by 1.5°C–3°C, increasing thermal comfort hours from 65% to 85%.
- The project demonstrated up to 12% energy savings and highlighted cool roofs as a cost-effective strategy to mitigate urban heat island effects and enhance citywide climate resilience.

# 8. Heat Action Plans

*Smart Cities of Tamil Nadu*

**HEAT ACTION PLAN**

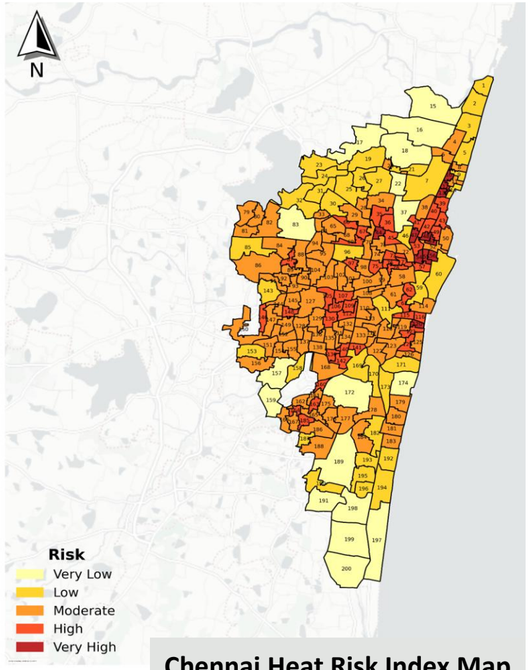
**Identification and Recommendation of suitable sustainable cooling solutions**

**Continuous Monitoring and Evaluation of the cooling solutions**

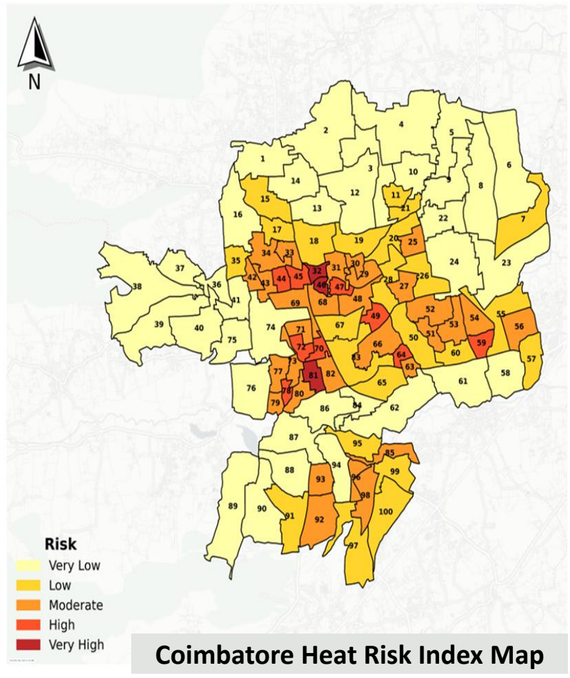
**When to take action**
Localised heat thresholds for early warning systems

**Where to take action**
Ward-level heat risk and vulnerability assessment

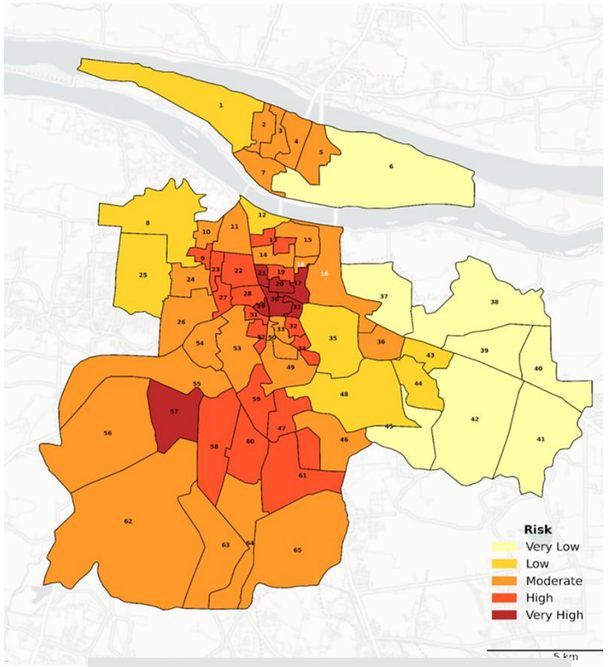

**What action to take**
Stakeholder-wise responsibility matrix of solutions



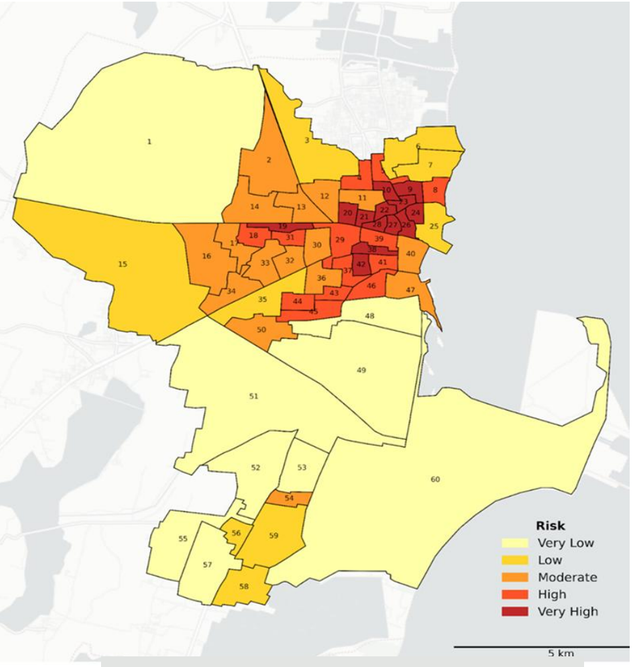

Chennai Heat Risk Index Map



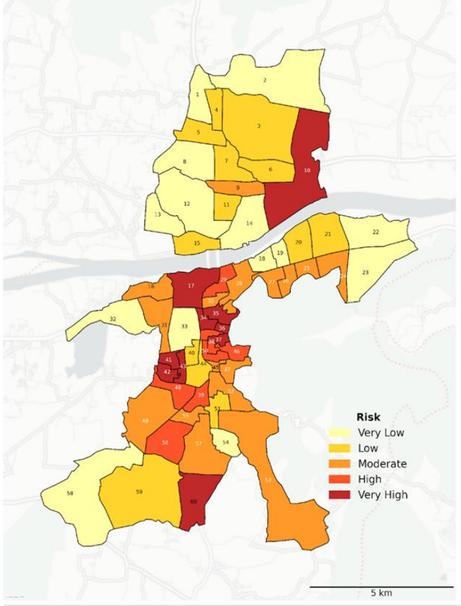

Coimbatore Heat Risk Index Map



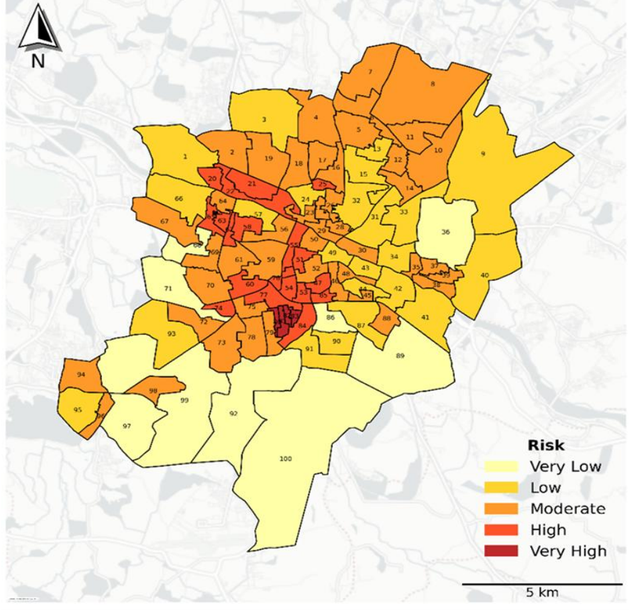

Tiruchirapalli Heat Risk Index Map



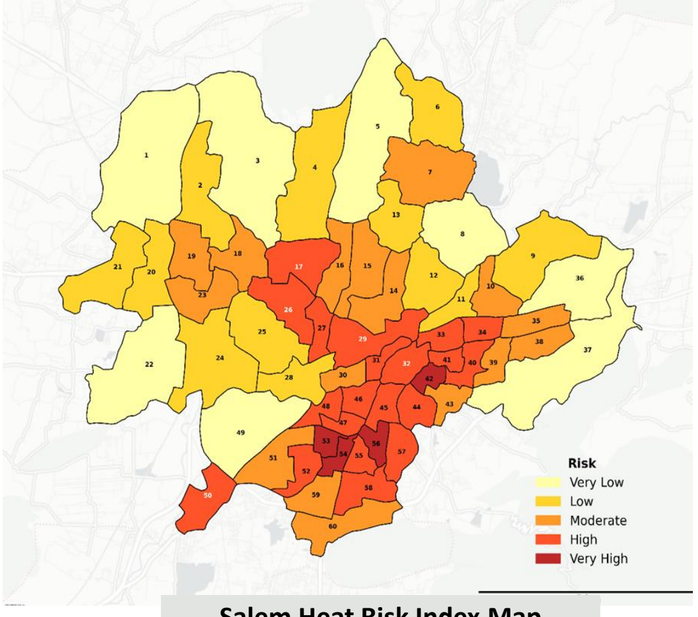

Thoothukudi Heat Risk Index Map



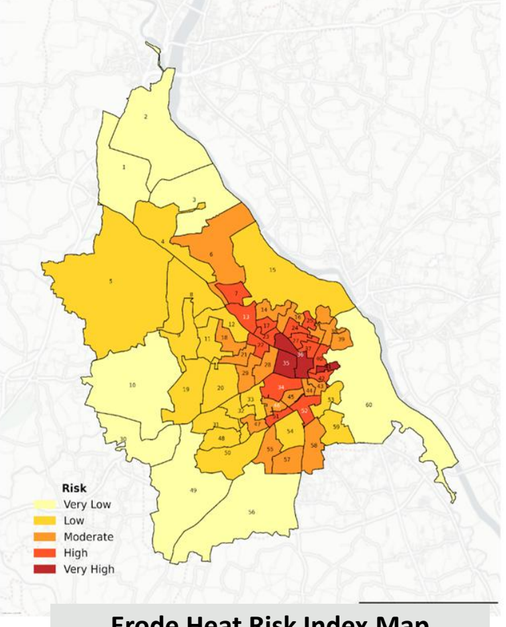

Vellore Heat Risk Index Map




Madurai Heat Risk Index Map

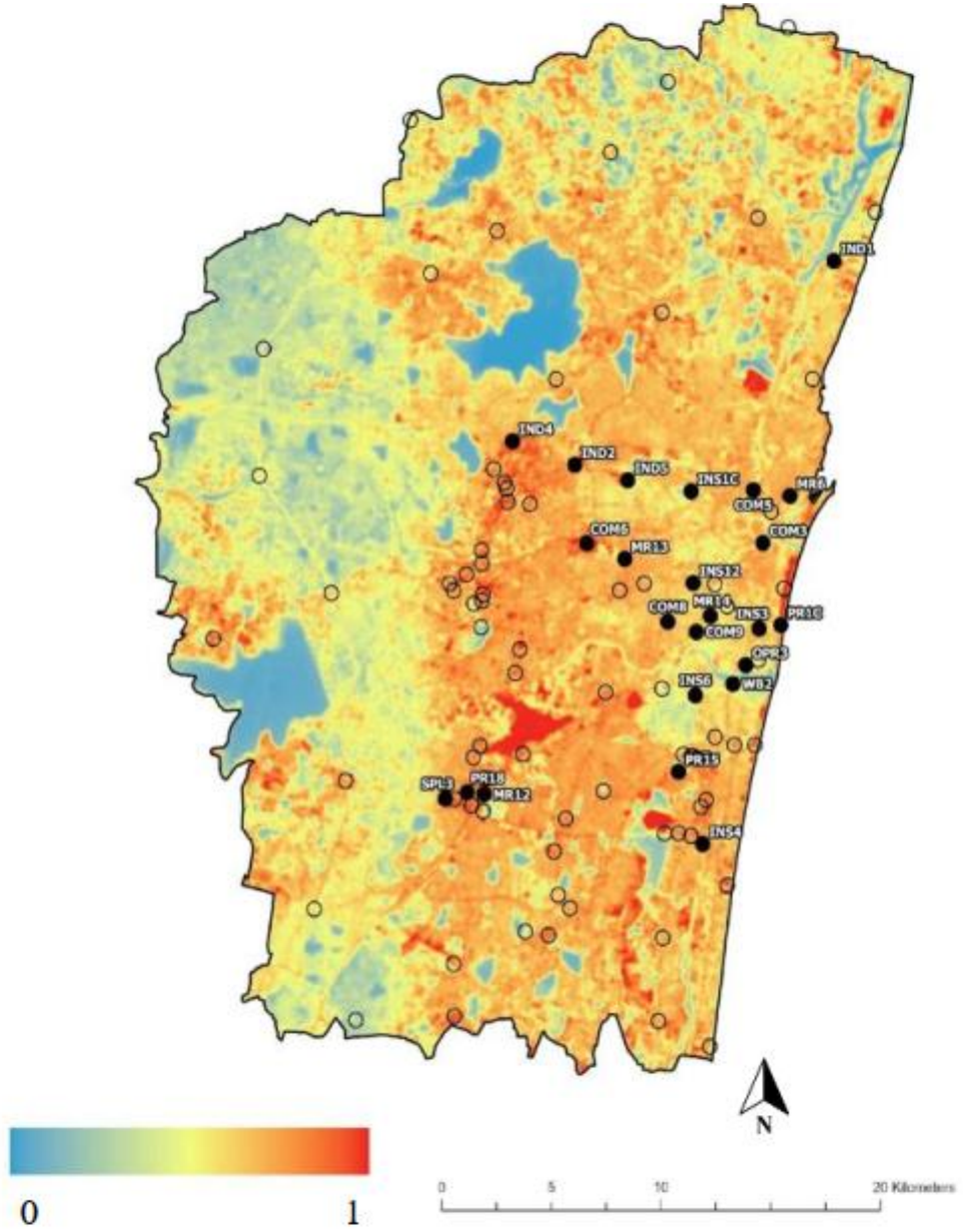



Salem Heat Risk Index Map




Erode Heat Risk Index Map

# Chennai Urban Heat and Passive Cooling




- 1 year of monitoring in 100 hotspots and detailed recommendations for 20 areas
- Recommendations being integrated into Chennai's master plan as dedicated chapter on extreme heat and passive cooling – focused on:
  - reducing urban temperatures with cool/green roofs, nature, street design, cool surfaces, moving AC exhaust to roofs
  - passive cooling measures mandated and incentivised: cool roof, shading, roof insulation etc.
- Will reduce urban heat by up to 4°C and cut heat-caused illnesses by 15-30 per cent.
- Urban planning measures expected to reduce AC energy us by up to 20%

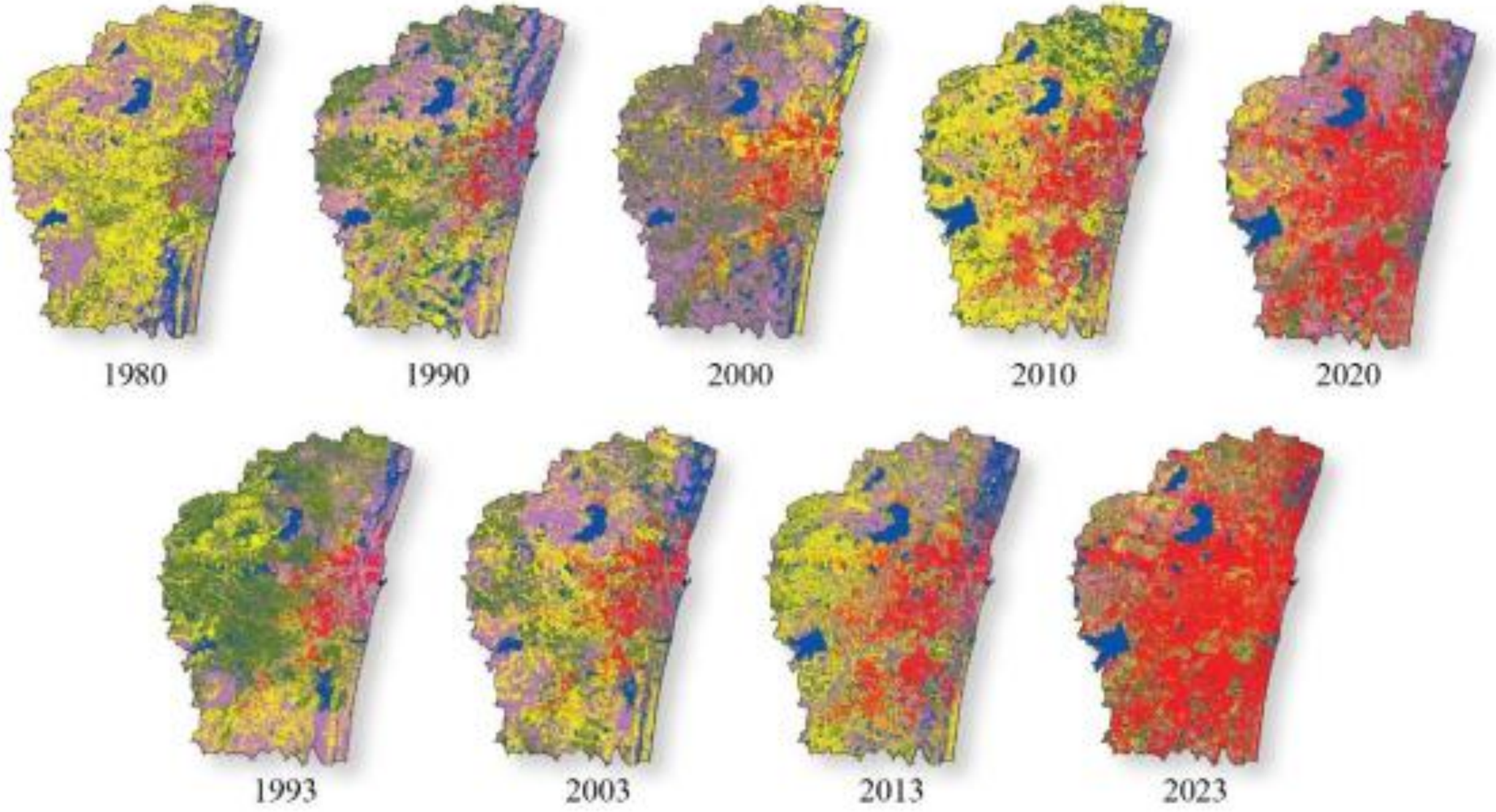



*Figure 17. Land use land cover trends from 1980 to 2023*

## IND1


| | |
|---|---|
| Location | Manali, Tiruvottiyur, Chennai |
| Co-ordinates | 13.18 N, 80.30 E |

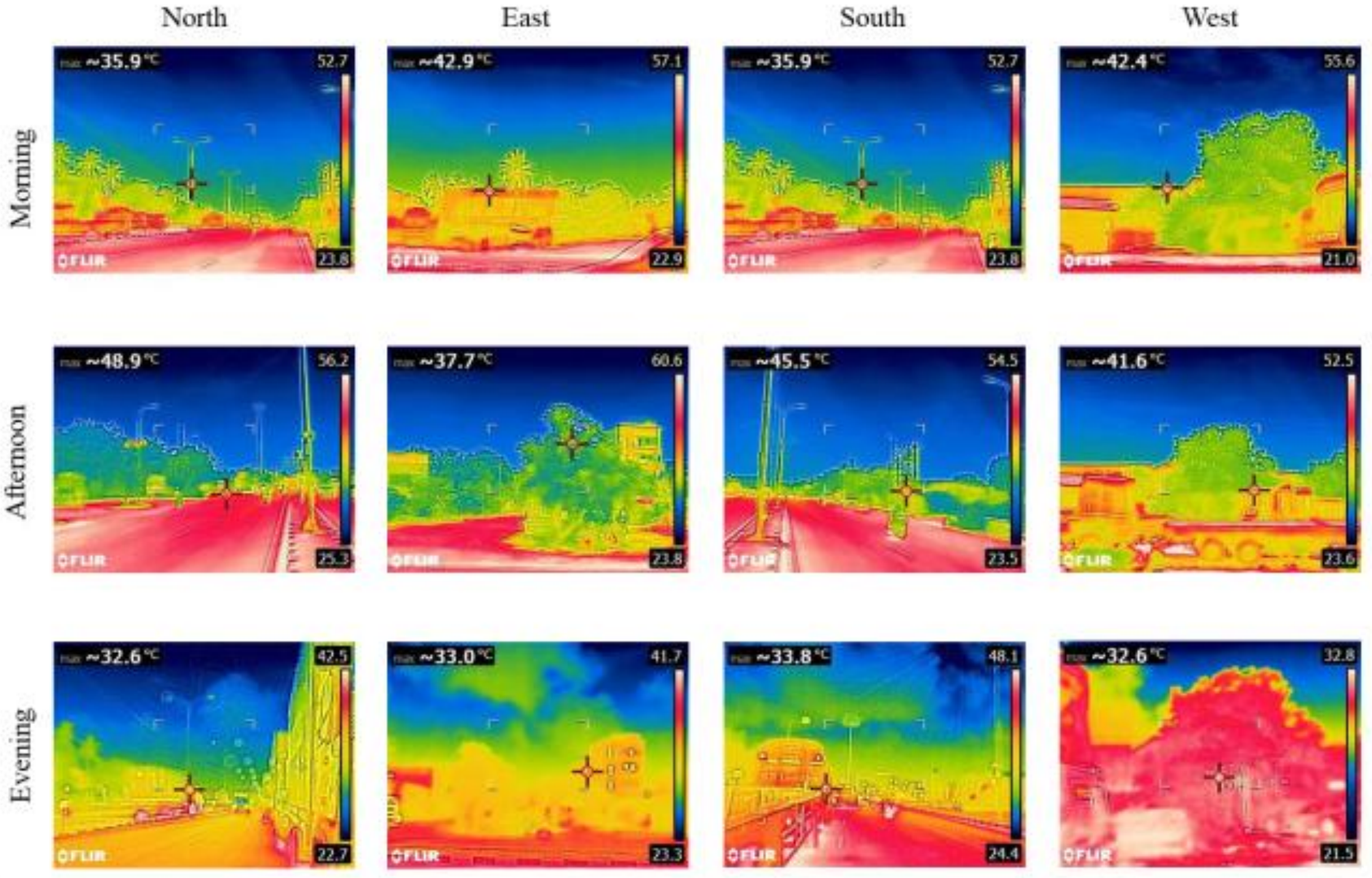
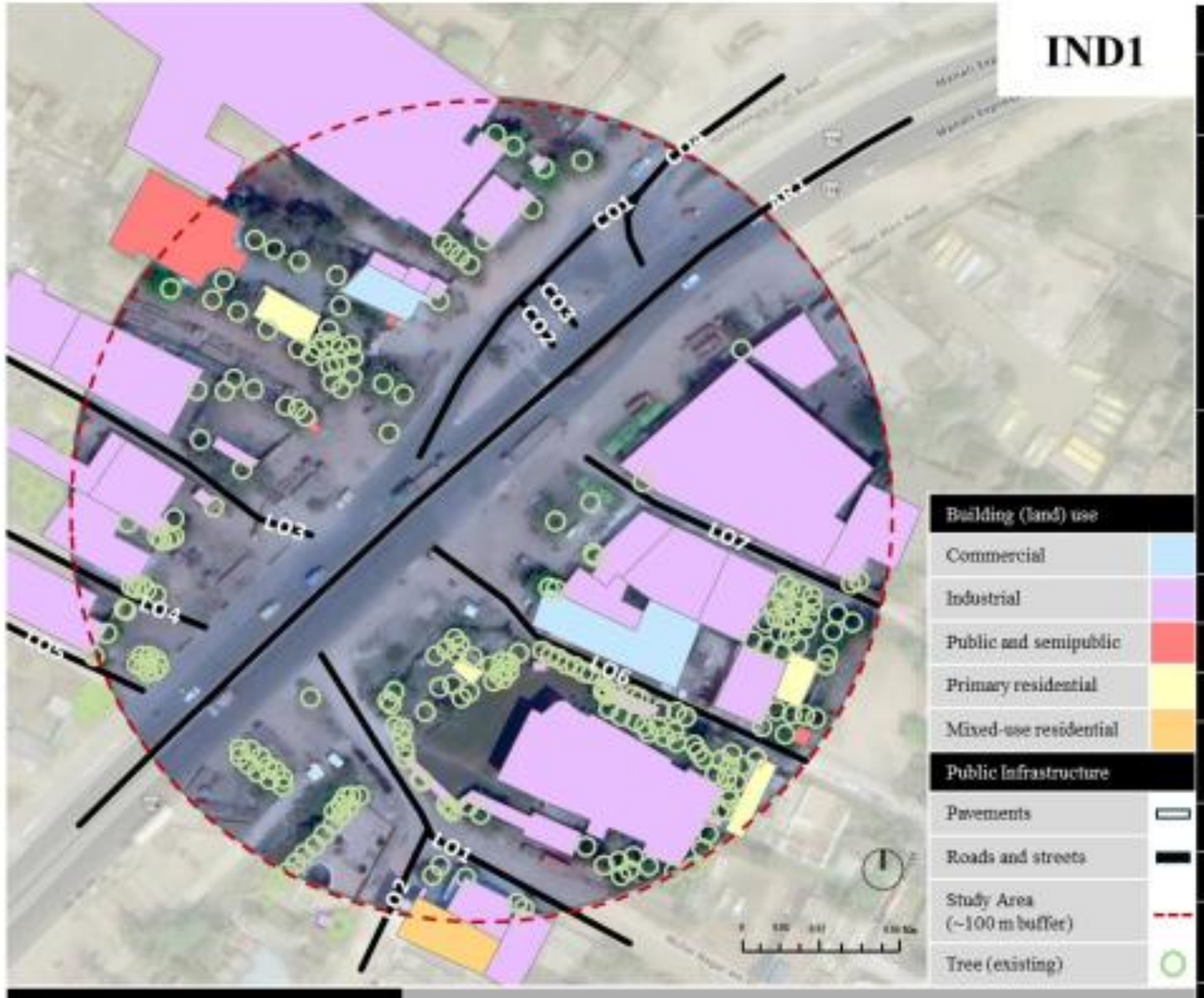


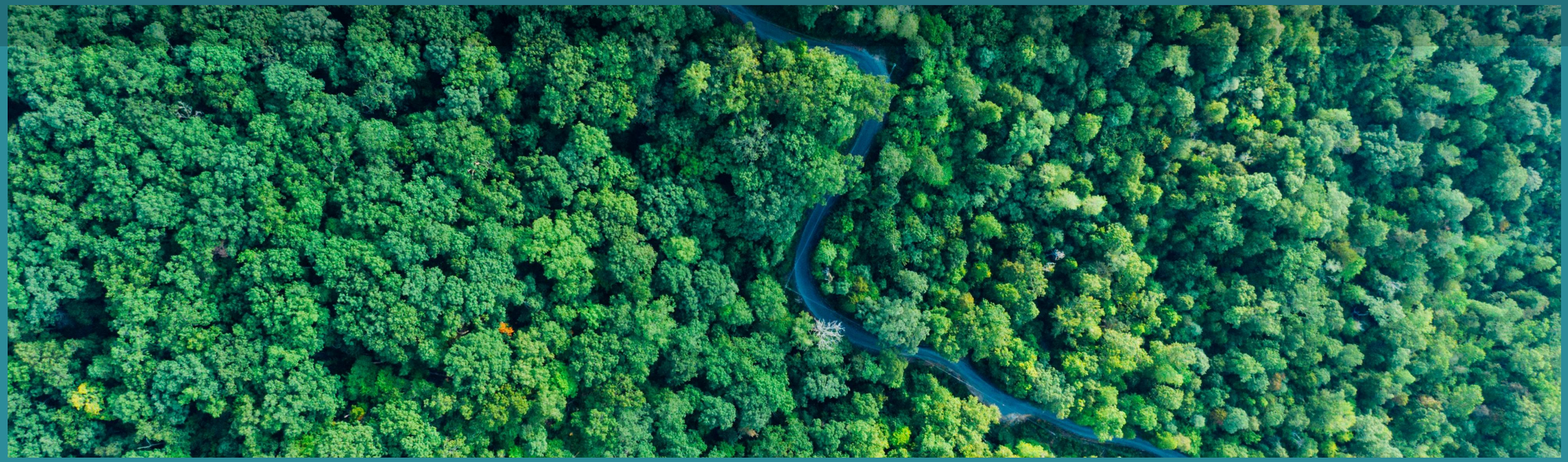

*Figure 68 Thermal images at IND1*

*Table 27. Overview of Urban Morphology- IND1- BAU scenario*




| | |
|---|---|
| Location | Manali, Tiruvottiyur, Chennai |
| Co-ordinates | 13.18 N, 80.30 E |
| Building use | Commercial: 8%, Industrial: 90%, Primary residential: 2% |

| | |
|---|---|
| % Building footprint (area in ha) | 26.7% (0.84 ha) |
| Building height (m) | Commercial: 2.4 to 12m, Industrial: 2.4 to 10m, Primary residential: 3 to 6m |
| No. of floors | Commercial: 1 to 3 floors, Industrial: 1 to 2 floors, Primary residential: 1 to 2 floors |
| U value (w/m$^2$k)- Building envelope | Wall: 7.14 (metal sheet), 2.10 (granite clad over brick wall), 2.05 (burnt brick with cement plaster), 1.9 (wooden masonry) |
| | Roof: 7.14 (metal sheet), 3.86 (brick with cement plaster), 3.86 (burnt brick tile) 3.19 (concrete slab with cement plaster), 2.35 (asbestos), 1.94 (clay/ terracotta tile) |
| Surface emissivity (frac.)- Building envelope | Wall: 0.9 (painted wall), 0.89 (hardwood-composite), 0.88 (granite), 0.76 (coated GI/ PVC sheet) |
| | Roof: 0.9 (asbestos); 0.89 (cement plaster); 0.88 (terracotta tile); 0.76 (coated GI/ PVC sheet), 0.25 (shiny metal sheet) |
| Surface emissivity (frac.)- Streets | 0.92 (dirt road), 0.91 (paver block), 0.88 (asphalt) |
| % Paved and unpaved cover (area) | 36.62% (1.15 ha) and 17.49% (0.55 ha) |
| Sky view factor | 0.25 to 0.65 |
| Road/street width (m) | Arterial (AR): 24m, Sub-arterial (SA): 28m, Collector (CO): 5 to 7m, Local streets (LO): 3 to 7m |
| Canyon aspect ratio | 1.75 (LO3), 2.25 (LO4), 3.5 (LO6), 2.35 (LO7) |
| % Canopy (tree) cover (area in ha) | 19.19% (0.6 ha) |
| Tree phenology (nos.) | Evergreen (124 trees, 12 shrubs)- Deciduous (106 trees, 15 shrubs)- Palm (30) |
| Leaf Area Index | Evergreen: 3 (Neem- Peepal- Jamun- Tulip- Jamaican cherry), 4 (Mango), 4.5 (shrubs); Palm: 2.5 (Coconut) |
| | Deciduous: 2 (Shirish), 2.5 (Dasaunda- Vilayati Babul), 3 (Pride of India- Copperpod- Indian almond) |
| Tree height (m) | Evergreen (5 to 15 m); Deciduous (5 to 15 m); Palm (5 to 10 m) |



# Thank You!

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