

# **Adaptation to climate change and urbanization: Coping with the dual environmental challenge**

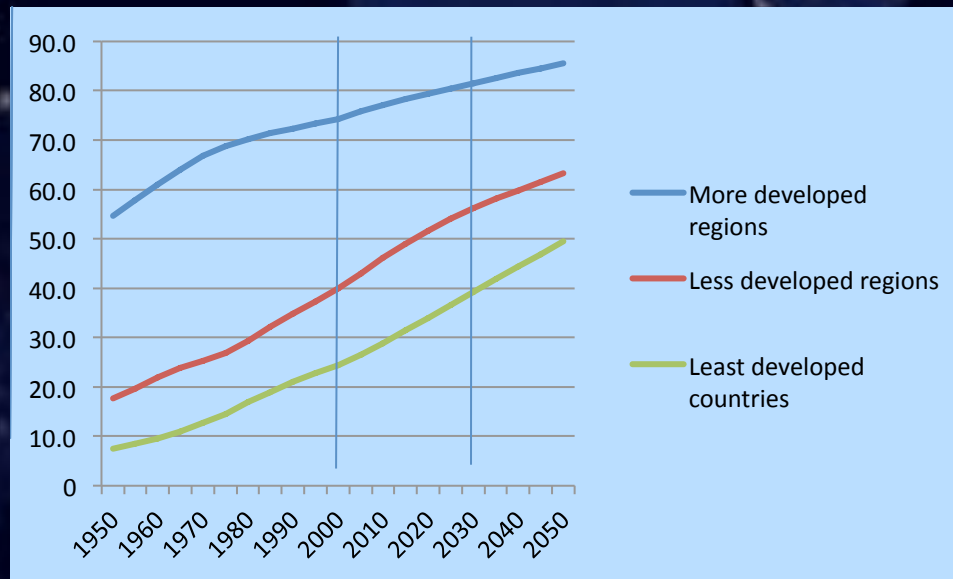


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# The world is experiencing a massive urban transition

NASA-NOAA Suomi National Polar-orbiting Partnership satellite composite:  
courtesy NASA Earth Observatory

Most urban areas of the future will originate from a “new urban”:  
from the expansion of small cities  
and the creation of new cities

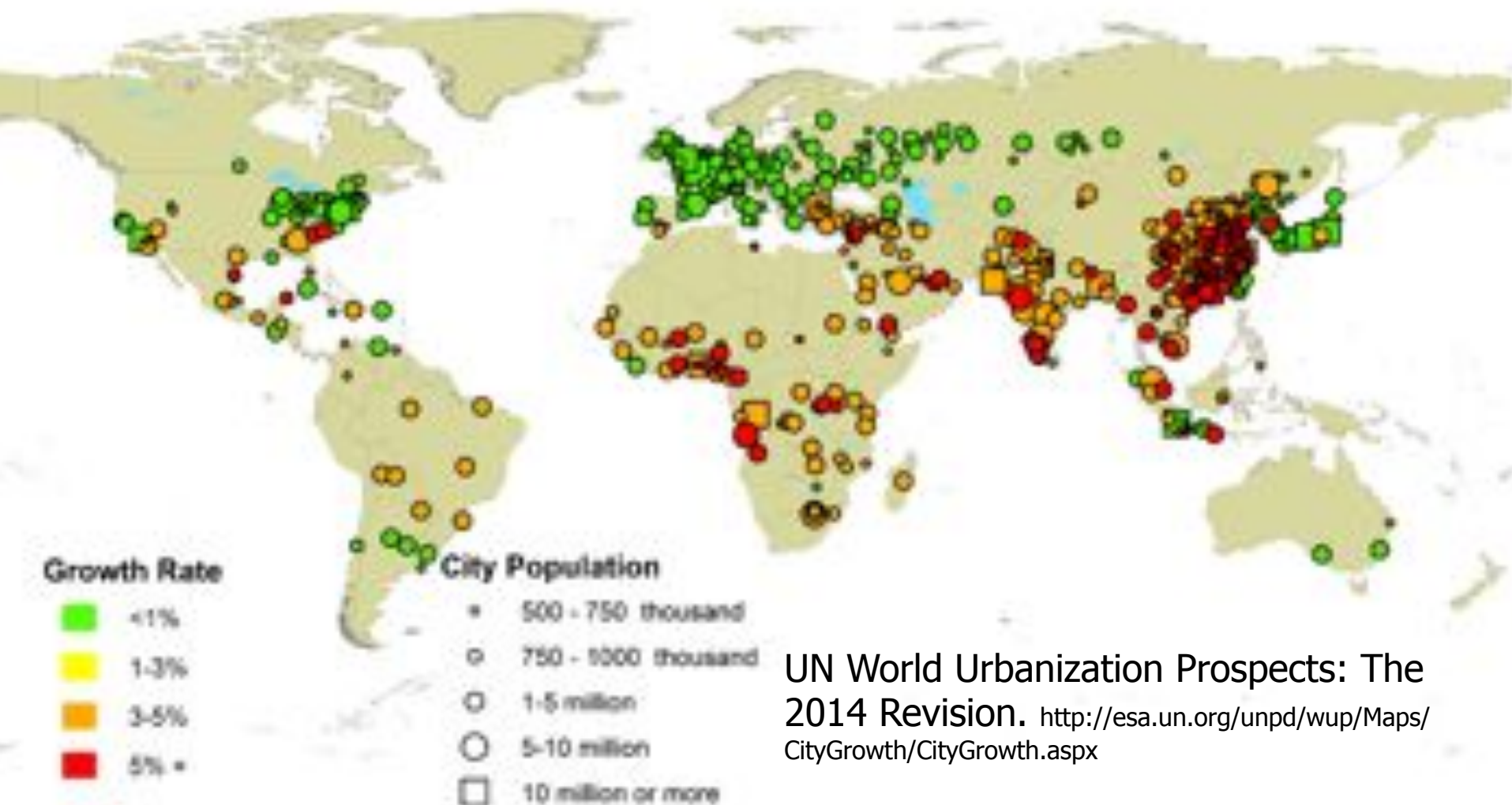


From: UN World Urbanization Prospects: The 2014 Revision



# Growth of urban agglomerations 1990-2014

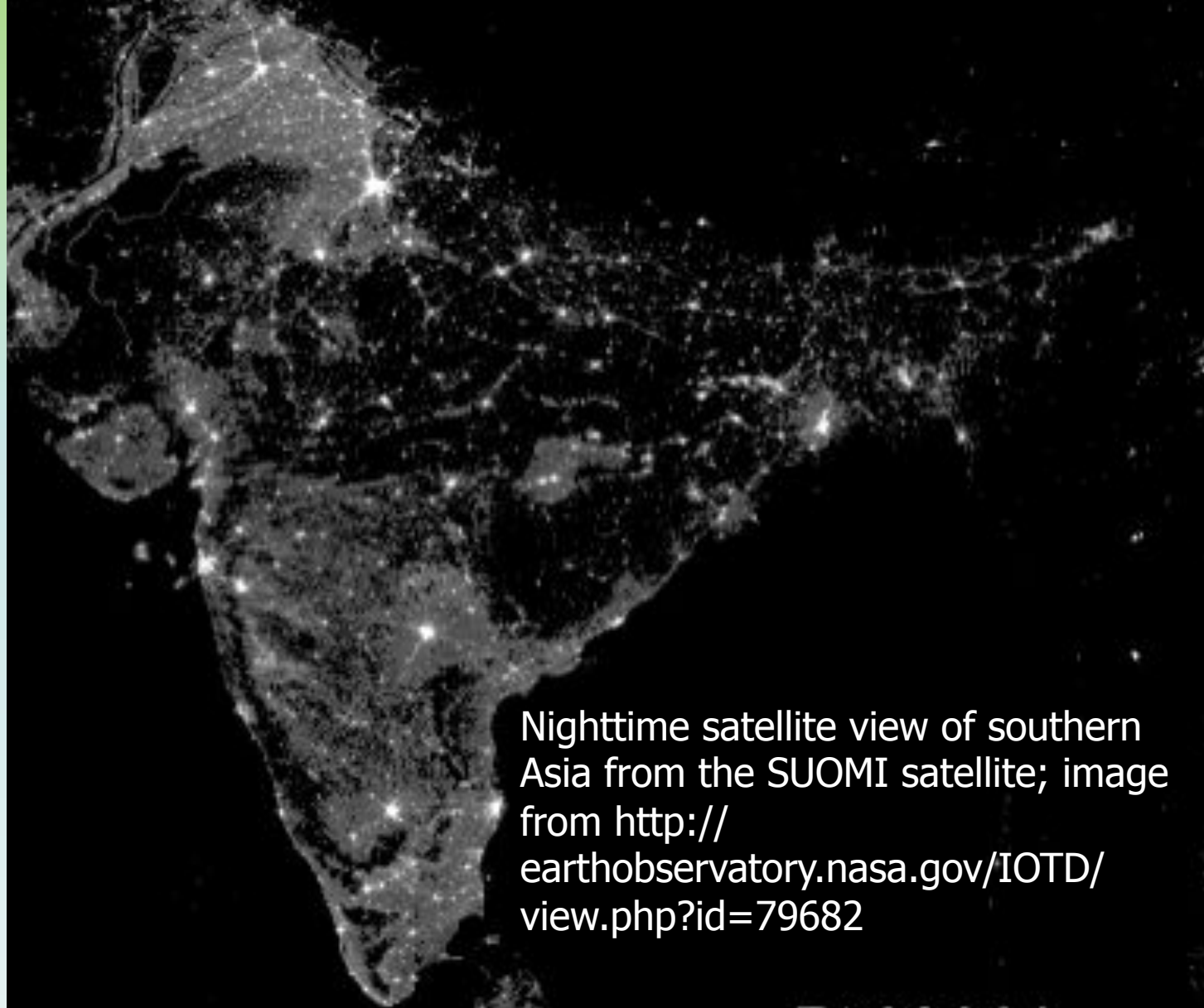
## Growth is largely in the global South



UN World Urbanization Prospects: The 2014 Revision. <http://esa.un.org/unpd/wup/Maps/CityGrowth/CityGrowth.aspx>

Note: Designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

# India - major land transformation in recent decades



Nighttime satellite view of southern Asia from the SUOMI satellite; image from <http://earthobservatory.nasa.gov/IOTD/view.php?id=79682>

- Indian cities contain 11% of world's urban population
- Population growth is mostly going to come from cities







The urban transition is dominated by new and growing cities, largely in countries like India

These cities are highly vulnerable to the double pressures of global climate change and local environmental change







- This presentation:
- How does nature shape the vulnerability and resilience to climate and environmental change in Indian cities
- What are the implications for the research and practice of sustainable urbanization in the 21<sup>st</sup> century?



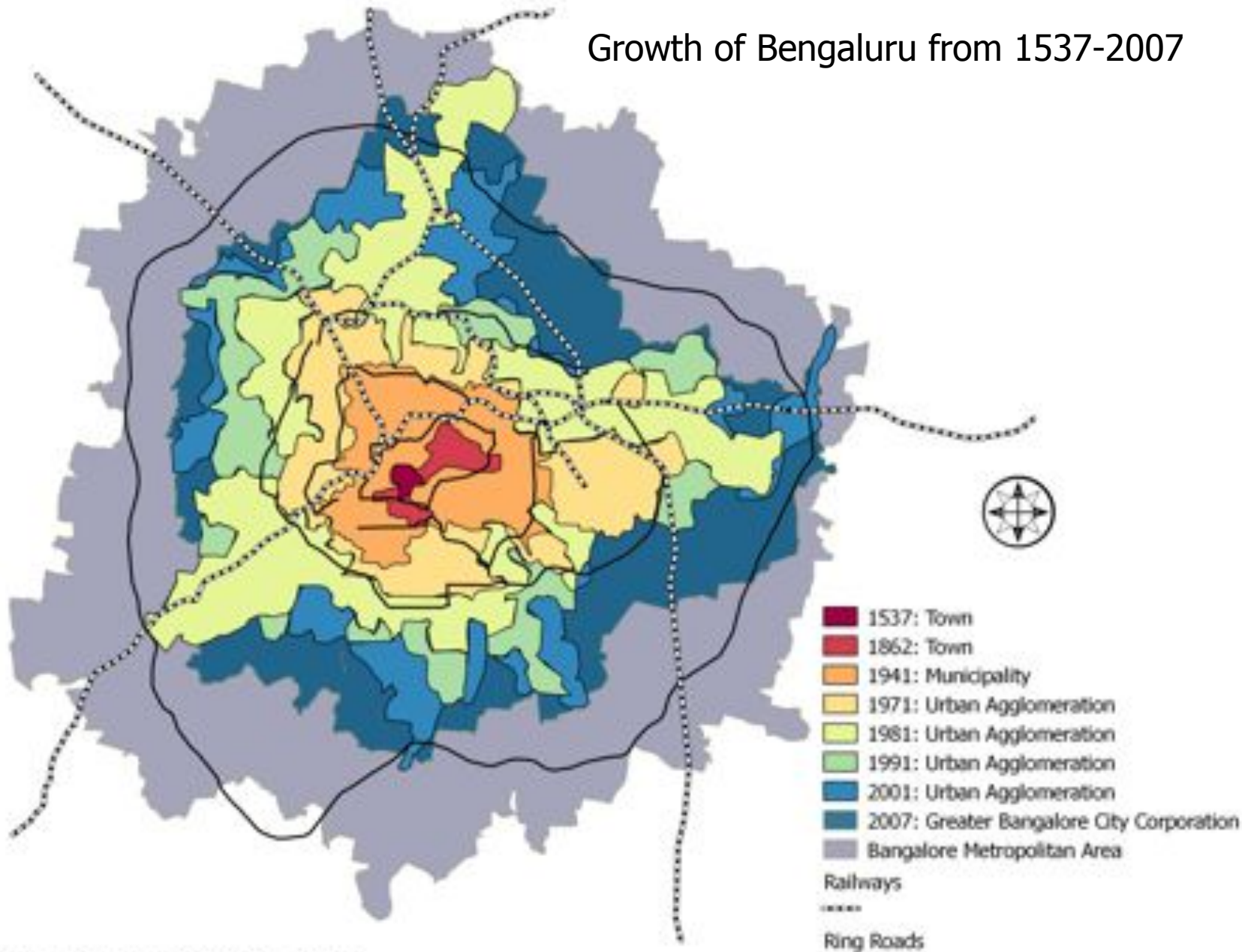


# Examples from Bangalore, India: a city with a large ongoing, long term study of change





## Growth of Bengaluru from 1537-2007



Map re-composed from Shashidhar, 2001. Paper 2 of 2001. Census of India.

Reference: Sudhira and Nagendra (2013); map by H.S. Sudhira

# Climate change and environmental change – in Bangalore

- Nights are getting warmer
- Minimum temperatures are rising
- No major changes in rainfall
- But, the ground water table is being depleted
- Discomfort due to pollution, heat, distant food footprints, and water stress



# Pollution and heat



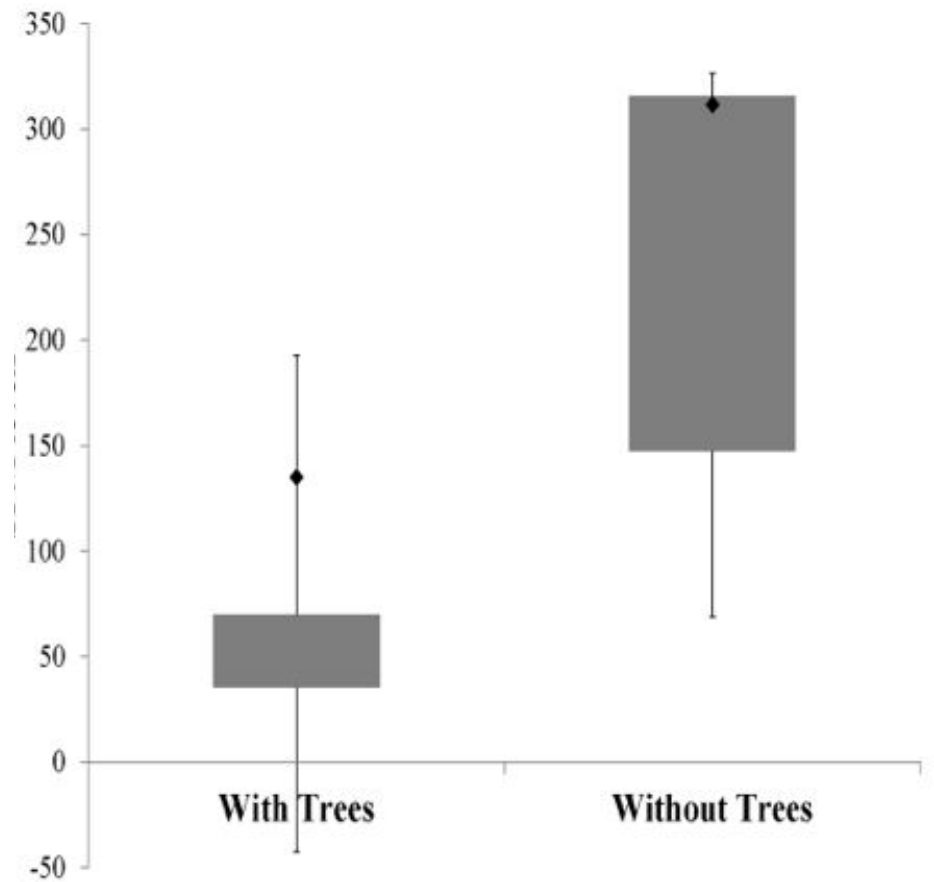


# Widespread tree felling



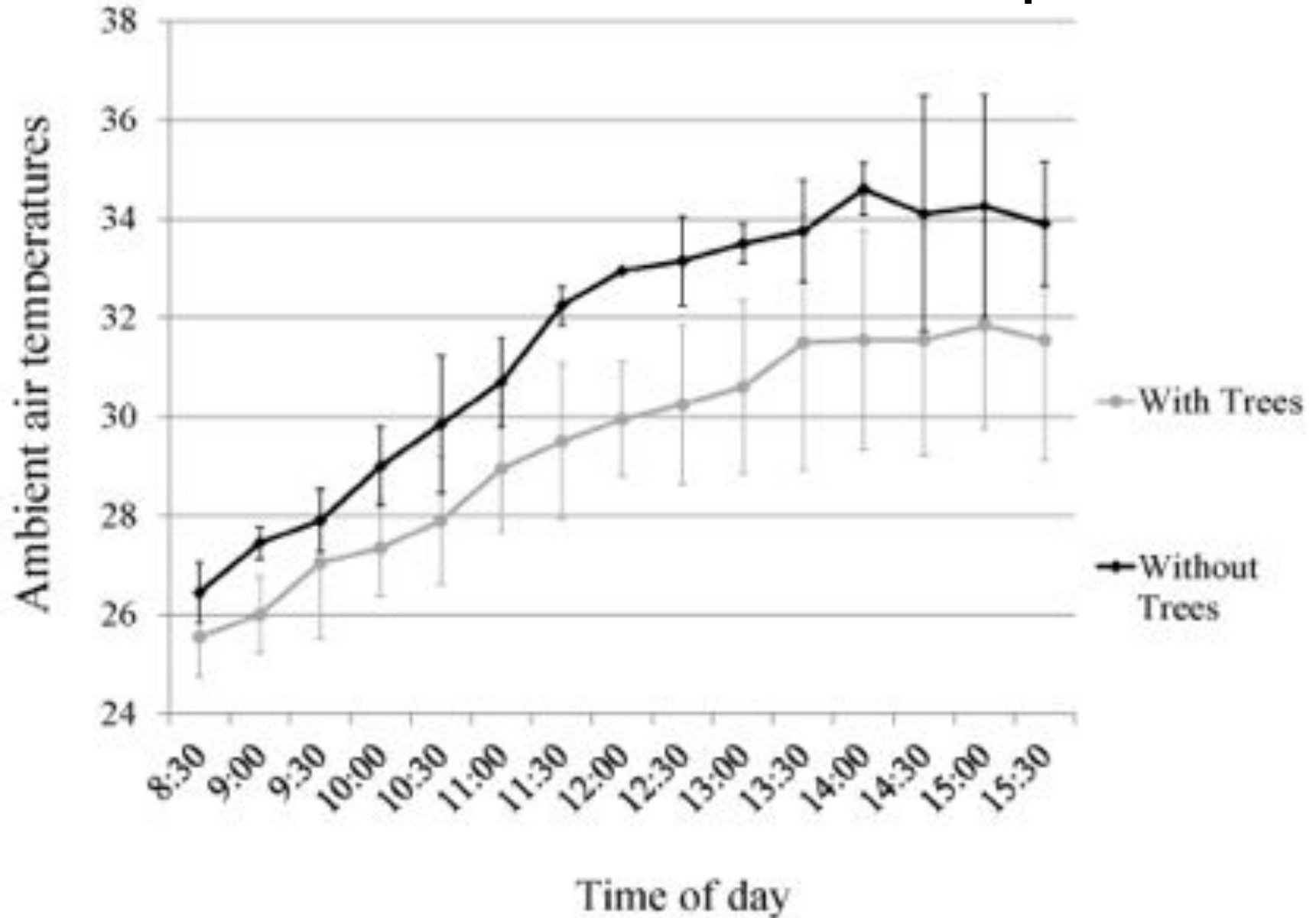


# Street trees reduce pollution



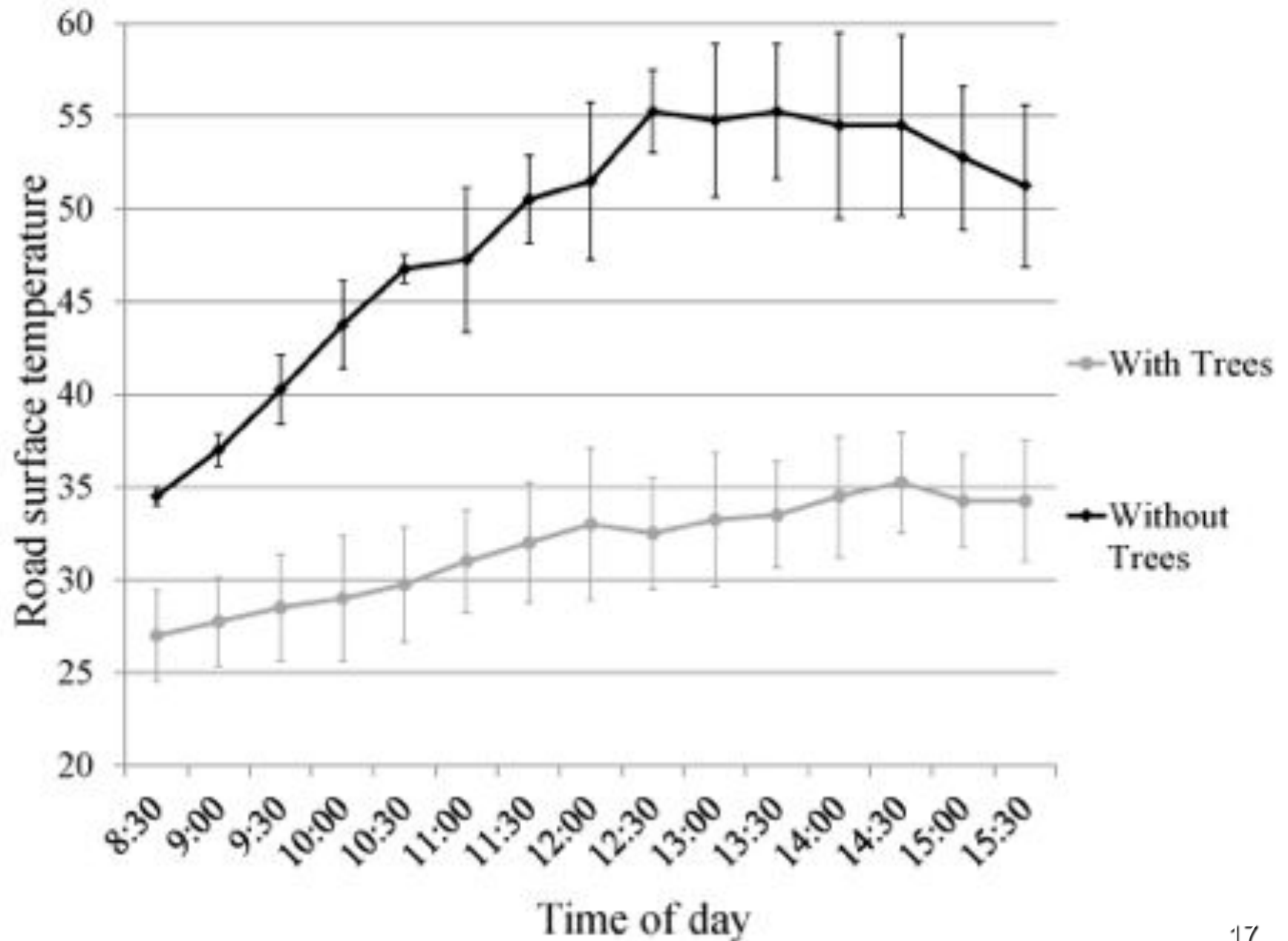
Suspended Particulate Matter

# Street trees decrease air temperature





# Street trees reduce road surface temperature



Yet the focus of planning has moved from the pedestrian, largely lower income...





To high speed highways, occupied by the cars of the wealthy during peak traffic – otherwise empty



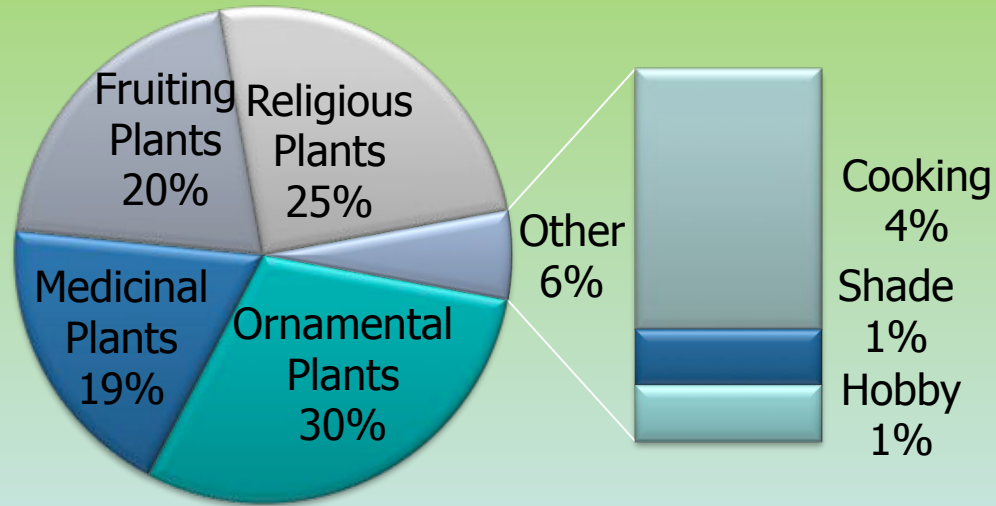


# Growing your food...the traditional Bangalore bungalow





## Emphasis on “useful” endemic plants







- Trees and plants play a central role in slums
- Dominated by endemic species
- Over 70% of species have “useful” attributes



- Greens and fruits for nutrition; herbs for medicine; cosmetics



- Wealthy residents in apartments: emphasis on manicured lawns, reduced fruiting/ food producing/herbal plants
- Increased food miles, reduced local resilience

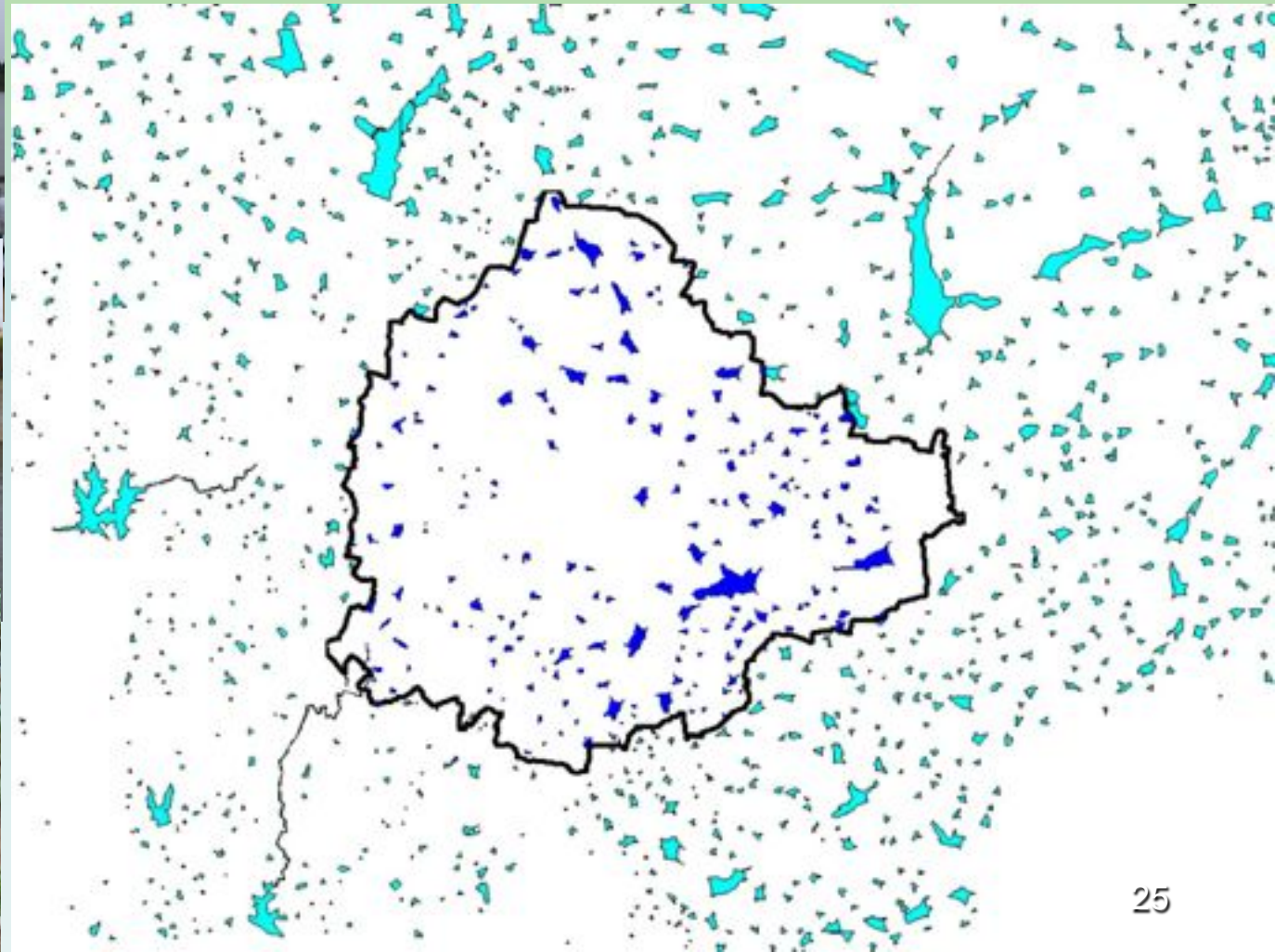




# Water - Lakes

870 AD –

*"In the victorious year of the Srirajya... Irugamayya's son Sirimayya, fixed sluices to the two tanks, had the Eastern tank built and obtained the 'bittuvatta' of the three tanks...."*





Widely used by fishers, grazers, migrant workers







Protection by local groups focused on recharging the ground water table






Leads to exclusion of poor;  
Ban on harvest and extraction of products  
Reduced resilience to climate/environment change






ಪರಿಸರವನ್ನು ಸ್ವಚ್ಛವಾಗಿಡುವಲ್ಲಿ ಸಹಕರಿಸಿ.



<b>Cultural Services</b> 	<b>Provisioning Services</b> 	<b>Regulatory and Supporting Services</b> 
Spiritual and sacred Recreational Aesthetic Inspirational Educational	Fishing Grazing Growing food Fresh water Fuelwood	Microclimate regulation Water recharge Water and air purification
Environmental change education	Environmental change adaptation Climate change adaptation	Climate change mitigation Environmental change mitigation

# Different Framings

<b>Cultural Services</b> 	<b>Provisioning Services</b> 	<b>Regulatory and Supporting Services</b> 
<p>Spiritual and sacred Recreational Aesthetic Inspirational Educational</p> <p>Increased adaptation: by urban elite</p>	<p>Fishing Grazing Growing food Fresh water Fuelwood</p> <p>Decreased adaptation: by urban poor</p>	<p>Climate regulation Water regulation Water and air purification</p> <p>Mitigation: by policy makers, planners, media</p>



# Summary

- Bangalore exemplifies coupled environmental & climatic stresses of a growing Southern city
- Pollution, heat and water stress: major environmental/climatic challenges
- The importance of urban nature is undervalued in urban planning and practice
- When ecosystem restoration is done, this further impacts traditional users and the poor, reducing their resilience and adaptation

# Challenges for a sustainable urban future

- A greater awareness of the importance of urban ecosystems for resilience to urban environmental and climate change
- A coupled focus on production services e.g. food and fodder; and regulatory services e.g. pollution control and temperature regulation
- Action via urban interventions around Nature must be planned BY (not just FOR) diverse audiences for greater environmental and climate resilience





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## Bangalore residents



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