

11:51:37











Geo Informatics & Remote sensing technology for early

Warning System for Risk Reduction

#### Dr. T.V. Ramachandra

Convenor, IISc EIACP, Environmental Information System

Co-ordinator, Energy & Wetlands Research Group, Centre for Ecological Sciences [CES]
Associate Faculty, Centre for Sustainable Technologies [CST],

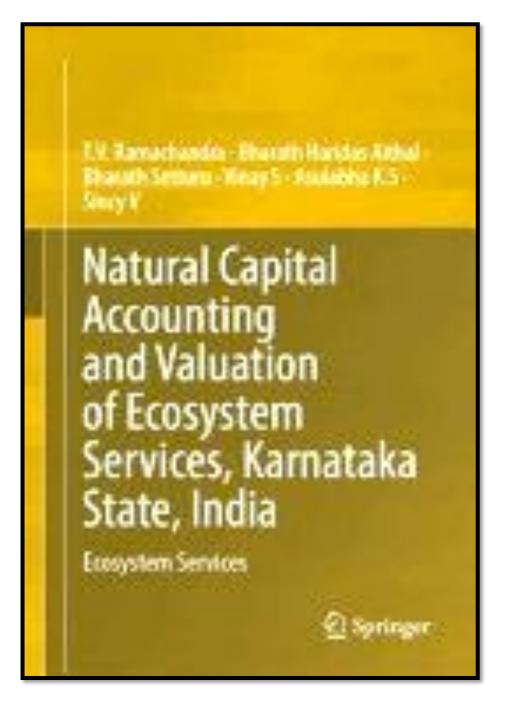
Centre for Infrastructure, Sustainable Transport & Urban Planning [CiSTUP],

Indian Institute of Science, Bangalore 560 012, INDIA

Bharat Ka Amrut Mohotsav 20 June 2025 tälk @ CBDM India

Web: http://wgbis.ces.iisc.ac.in/energy, http://wgbis.ces.iisc.ac.in/biodiversity, E Mail: tvr@iisc.ac.in;

Tel: 91-08022933099 / 080-22933503/080 23608661, envis.ces@iisc.ac.in



#### 20<sup>th</sup> June 2025

- Drivers of Disasters: Climate Change, Pollution, ...
- Western Ghats and water security
- Bangalore lakes
- Success Stories -Nature-based solutions
   Wastewater treatment
- Society relevant science

# https://wgbis.ces.iisc.ac.in

#### IISC\_EIACP [PC]: Environmental Information Awareness Capacity Building and Livelihood Programme

CES TE 15, 3rd Floor, New Bioscience Building (near D gate) | Map - Latitude 13°1'24.76"N, Longitude 77°33'50.72"E





CENTRE FOR ECOLOGICAL SCIENCES.

INDIAN INSTITUTE OF SCIENCE, BANGALORE, INDIA - 560012

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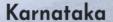


- ENVironment Information System (ENVIS)
- Energy & Wetlands Research Group [EWRG]
- GeoVisualization
- Free & Open Source Software (FOSS)
- GRASS GIS Mirror Site GRASS Master Site GRASS GIS @ IISc (Copy)
- Biodiversity, Energy, Ecology and Environmental Portal
- EM 2024 : Environmental Management NEW
- EM 2024: Login(Registered participants) NEW



#### Western Ghats

- Western Ghats Spatial Decision Support System NEW
- · Western Ghats SDSS Mobile App (Android) NEW
- Uttara Kannada Spatial Decision Support System NEW



- Natural Capital Accounting in Karnataka NEW
- Natural Resource Rich Regions Karnataka NEW



#### Bangalore

- Bangalore Urban information System [BUiS] NEW
- Bangalore Urban information System Mobile App NEW
- Bangalore Lakes Information System [BLIS] NEW



Lake Symposium 2024 XIV Biennial Symposium (17th - 20th Oct 2024) NEW

#### SAHYADRI E-news NEW

- Centre for Ecological Sciences
- ENVIS [RP] Contact
- · Social media & Resources:









#### ENVIS DIVISION @MoEFCC; Government of India:

ENVIS (@MoEFCC)
About ENVIS (@MoEFCC)
ENVIS - Subjects
Experts







ENVIS [MoEFCC] - Contact ISBEID GSDP

ENVIS [RP] @IISc

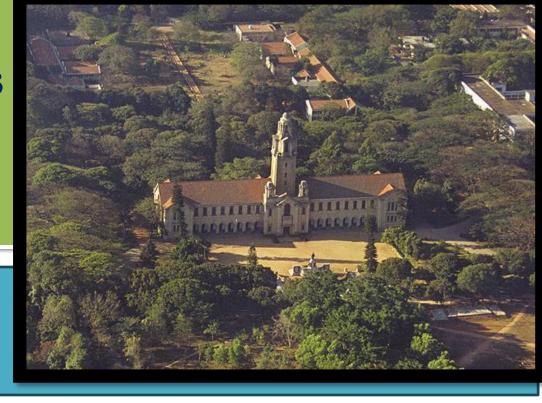
#### **Goal: Sustainable Future**

Ensuring Clean Air, Water and Environment to our Next

Generation

- Sustenance of Natural Resources
- Minimal Disasters
- Security, Survival and Peace

Sustainable Future – Maintain Ecosystem Integrity

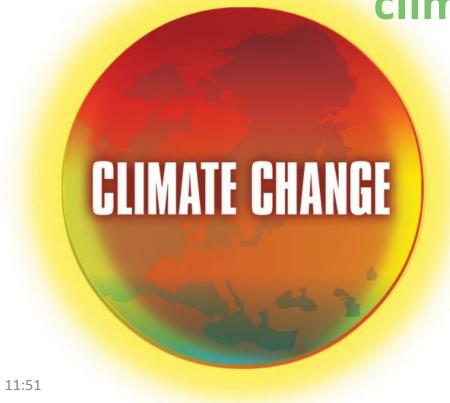


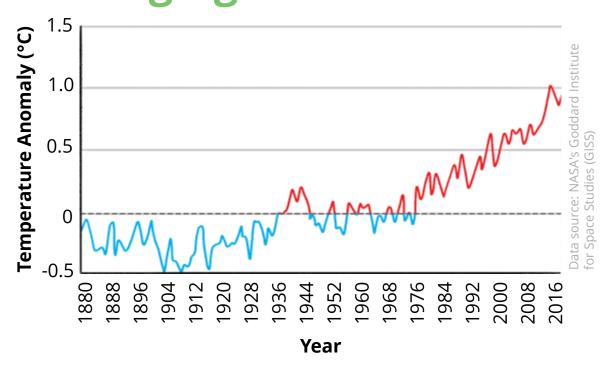
Responsible decision making – Decentralised Governance For Prudent Management of Natural Resources

#### **Disasters- Drivers: Changes in the Climate**

Climate change is a change in the average temperature and cycles of weather over a long period of time.

The planet is becoming warmer; the climate is changing.

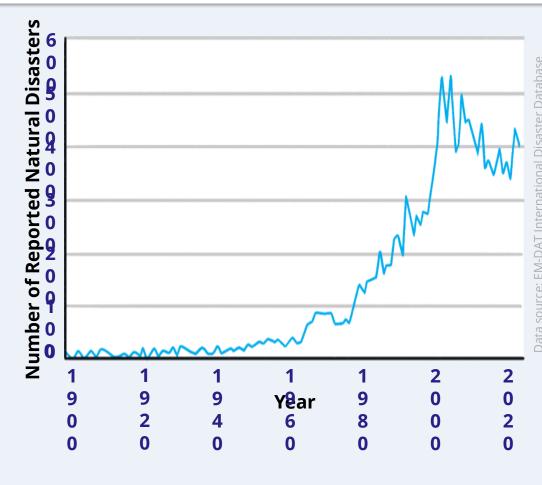




# Why Is Climate Change a Problem?

Climate change disrupts weather patterns and causes extreme weather events to become more common. These include hurricane activity, droughts and floods.

As the global temperature has increased, so has the number of reported natural disasters.





increase.

The rising water can cover coastal areas, destroying habitats and displacing whole populations from lowlying areas. **BEYOND** 

#### Developing Countries are the Most Vulnerable

#### Impacts are worse:

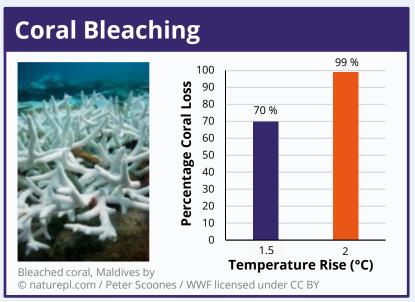
- Large share of economy in climate sensitive sectors (e.g. agriculture, tourism)
- Prone to natural disasters (e.g. floods and droughts)
- Adds to existing water resource stresses

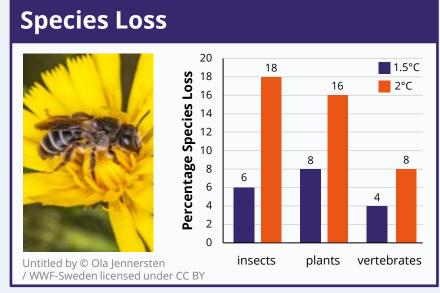


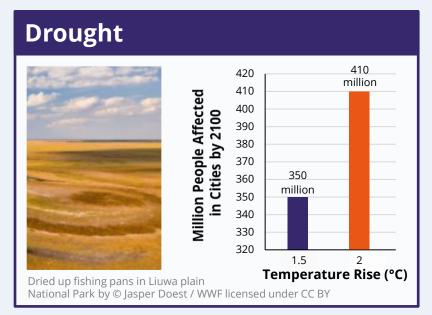
- Limited financial, institutional, technological capacity
- Limited access to knowledge
- Impacts disproportionately on poorest countries and poorest people:
  - Exacerbated human health, food security, malnutrition, clean water and other resource access concerns
     Slide adapted from Dr. RK Pachauri presentation, State of the World Symposium, Washington, 15th January 2009.

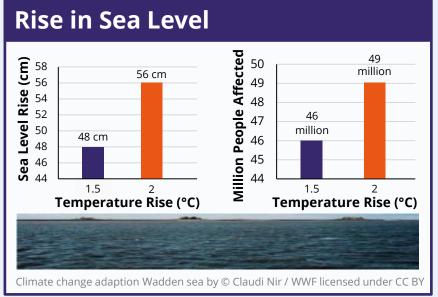


# **Problem of Climate Change- Loss of Immunity**











# **Expected Impacts on Poor Regions**

#### People exposed to increased water stress by 2025:



- 120 million to 1.2 billion in Asia
- 12 to 81 million in Latin America
- 75 to 250 million in Africa

#### Possible **yield reduction** in agriculture:



- 30% by 2050 in Central and South Asia
- 30% by 2080 in Latin America
- 50% by 2020 in some African countries

Crop revenues could fall by 60% by 2100 in India

#### Escalation in Vector borne diseases

• Increase range or abundance of animal reservoirs

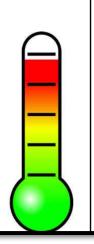
#### &/or arthropod vectors

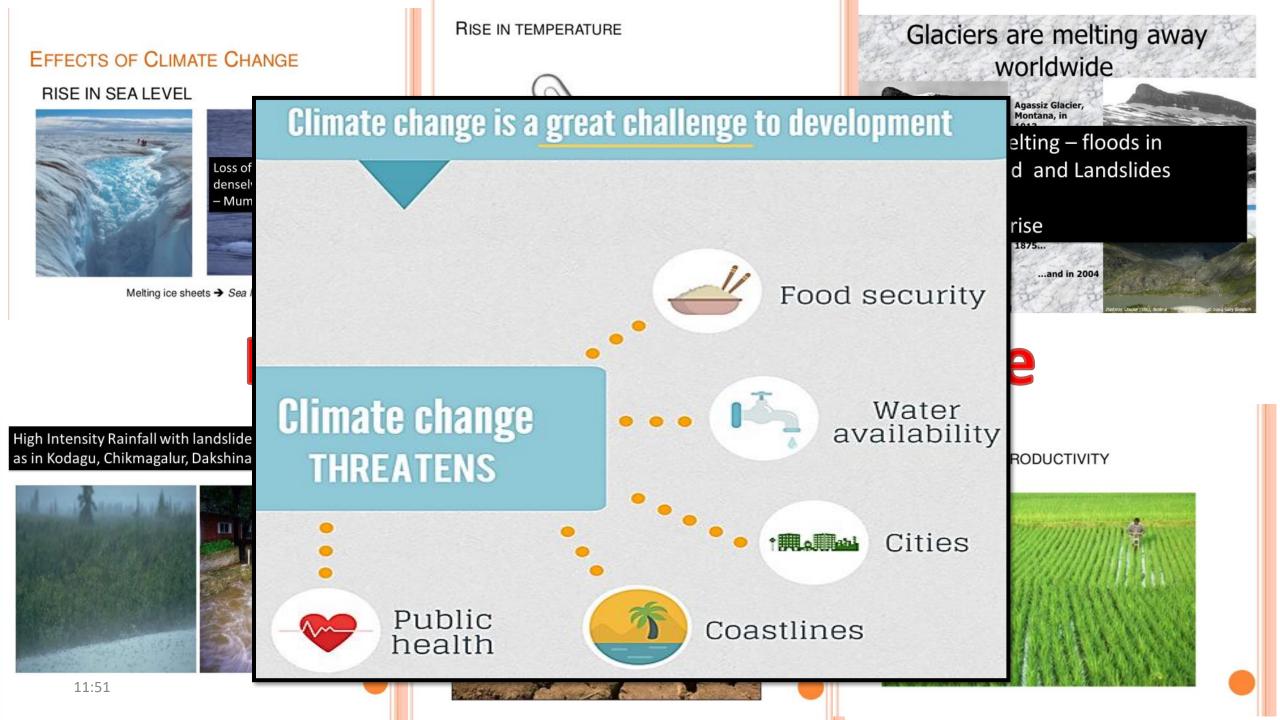
- e.g. Malaria, dengue, etc.
- Enhance transmission
- e.g. virus & other arboviruses
- Increase importation of vectors or pathogens
- e.g. Dengue, Chikungunya, etc.
- Increase animal disease risk & potential human risk

# Temperature effects on vectors & pathogens

#### Vector

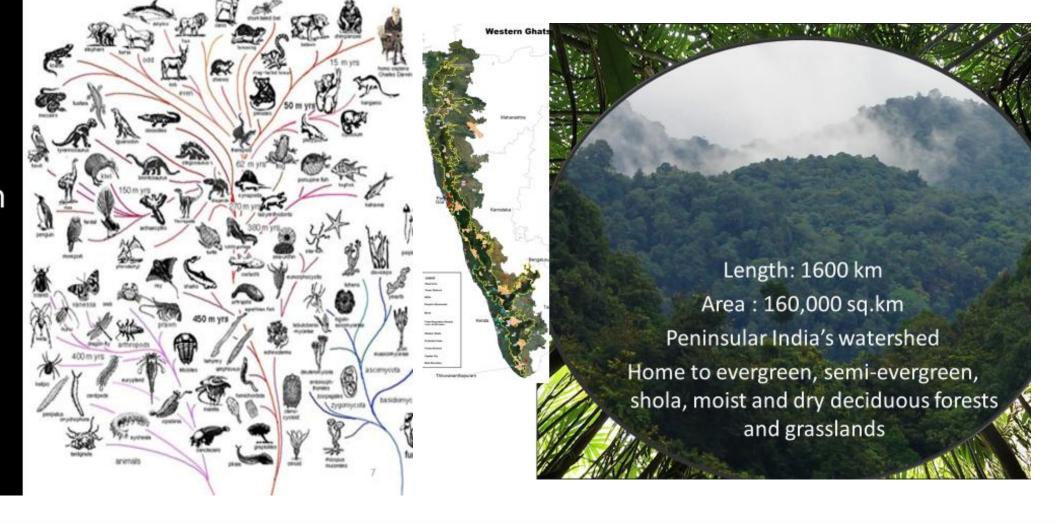
- Survival decrease/increase depending on the species
- Changes in the susceptibility of vectors to some pathogens
- Changes in rate of vector population growth
- Changes in feeding rate & host contact



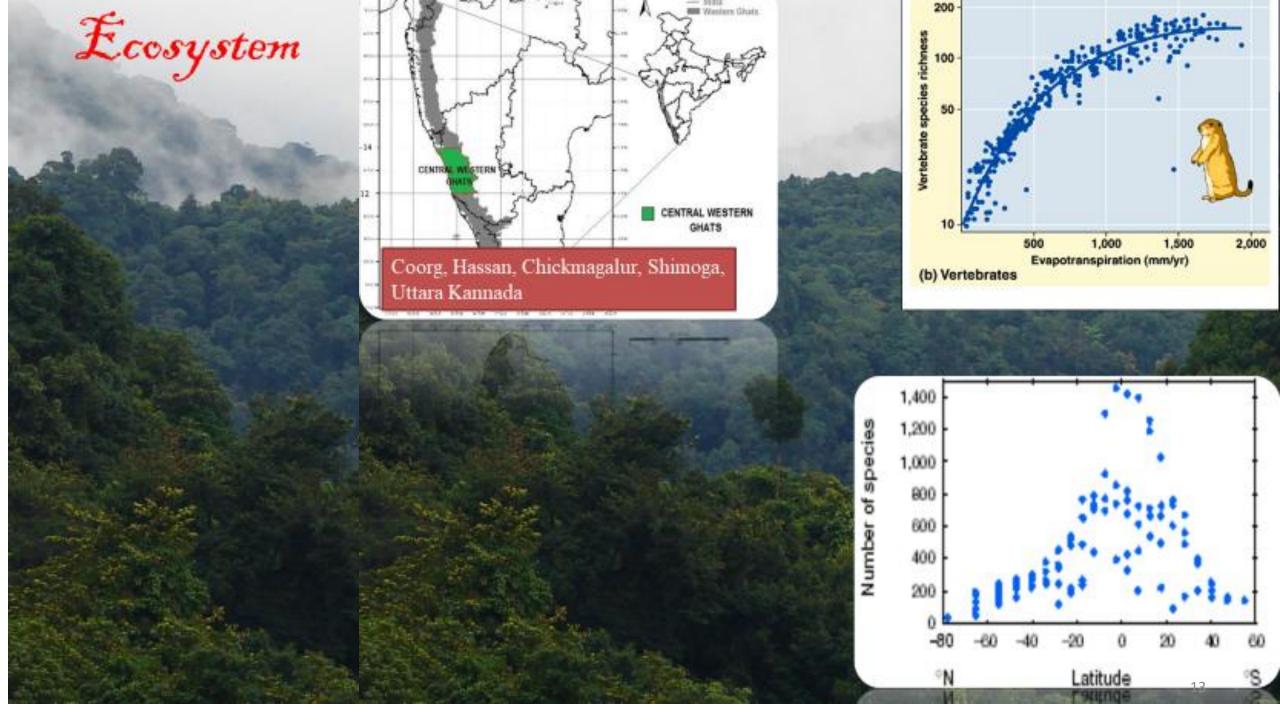


8-12 Million species

1-1.3 Million as per science



# BIODIVERSITY FOR PEOPLE Diverse Food, Medicine and Immunity





## Big Data:

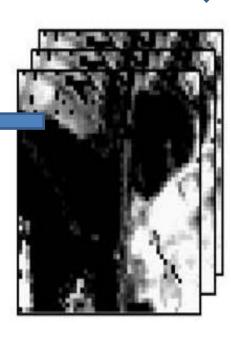
#### Spatial data -Remote sensing



112	112	109	101	103	109	109	109
109	106	105	108	113	105	108	108
105	112	108	110	116	113	110	102
102	102	113	113	119	124	109	103
98	98	108	112	112	102	96	98
98	98	108	112	112	102	96	98
99	109	110	108	103	103	92	89

7-bit image (0 - 127)

Digital Data – Raster data

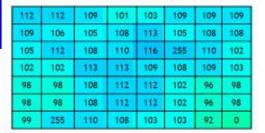


#### Big Data - RS data for Natural Capital Accounting Satellite / Source Time Sensor Spectral bands Spatial resolution Temporal resolution scale in metres (m) 1972 Landsat -1, 5, and MSS, TM PAN, 15 m - 120 m 16-18 days ETM+ VIS, NIR, MIR, 1999 (moderate spatial (free) TIR resolution) 1988 IRS-1C/1D, P6 PAN, LISS-5.8 m - 23.5 24 days PAN, VIS-2. NIR-1 2010 (high to moderate (medium cost (low spectral spatial resolution) moderate resolution) temporal resolution) 1999 **IKONOS** OSA PAN. 1 m (PAN) 1-3 days VIS-3, NIR-1 4 m (Others) (costly) Till date (high spatial) 250 m - 1 km 1999 MODIS VIS, NIR 36 1-2 days (Terra, Aqua) MIR, TIR (high spectral (low spatial (free & high Till date resolution) resolution) temporal resolution) 2002 SRTM (Shuttle Radar Topography DEM-1 90 m 1 time Mission) (free) Radar- Hydro 1K Precipitation. 2002 1 time 1 Km Asia Slope, Aspect-1 (free)

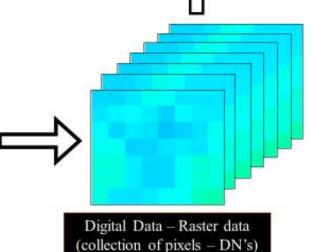
Science of obtaining information about an object or phenomena without being in contact with it

11:51:39

#### **Spatial Data**



8-bit image (0 - 255)



Images of Earth's Surface



#### Data

- Survey of India (SOI)
   Topographical Sheets to generate base layers.
- RS data of various resolutions.
- Pre-calibrated handheld GPS.
- Google Earth image along with the field data for validation.









MODIS

IKONOS









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Up to several MHz

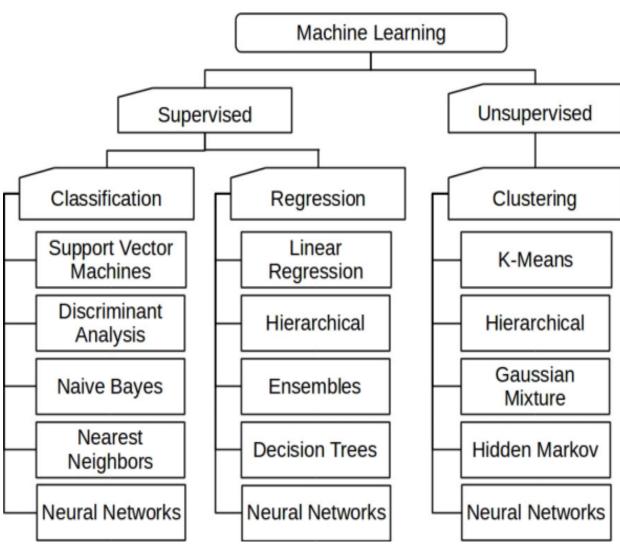
Image, Laser, Radar, Multispectral Ground, aerial, and space

Huge information to be analyzed!

#### AI (ARTIFICIAL INTELLIGENCE)

#### **Geospatial Machine Learning Operators**

**Geospatial Machine Learning Operators** 



Clustering

Hot Spot Analysis

Spatial
DensityClustering

Recognition of
Address Elements

Forest- Based
Classification

Geographically
Weighted Regression

Generalized Linear
Regression

Forest- Based
Regression

Geospatial Deep Learning Operators

Extracting Building
Footprint from Oblique
Photography DSM Data

Image Analysis

Object Detection

Scene
Classification

Binary
Classification

Land Use/Cover
Classification

16

11:51:39

# **Geo-Visualisation of Land Cover Dynamics**

Current

Fuzzy,

Markov models

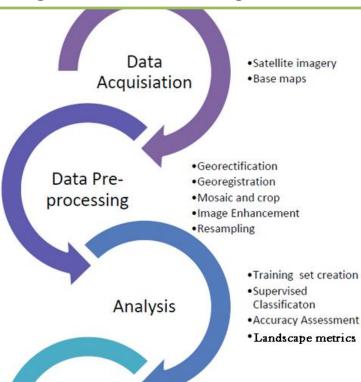
AHP

- Spatio-temporal pattern analyses
- Visualisation— Agent based modelling

Interpretation

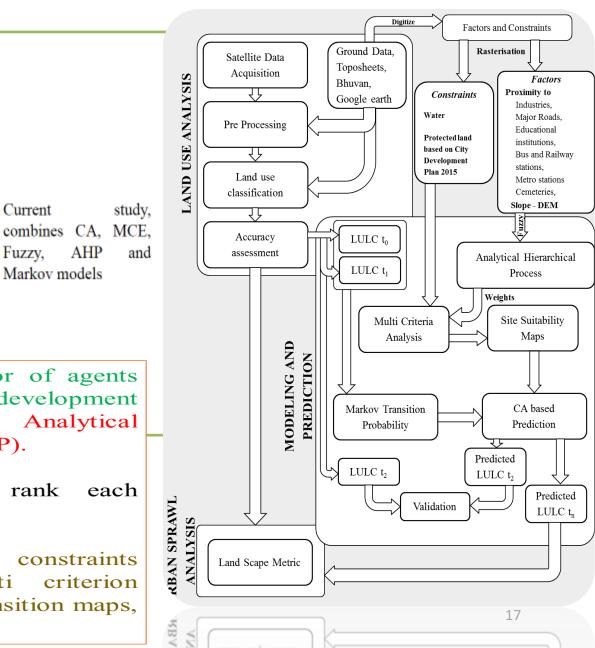
of results

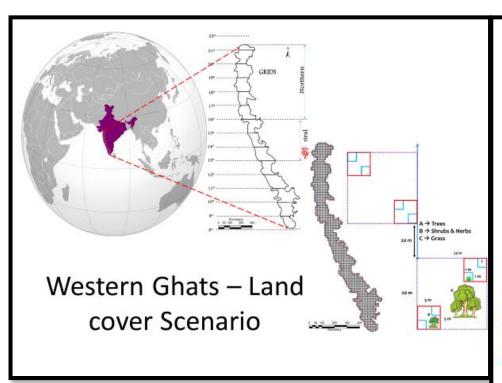
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#### Models

- Cellular Automata
- CA-Markov
- Geomod
- AHP-CA-Markov [
- Land change modeler
- Multi Criteria Evaluation
- Regression
- Bayesian
- understand the behavior of agents and its contribution in development through Fuzzy and Analytical Hierarchal Process (AHP).
- AHP was used rank each to agent/parameter
- Output of AHP with constraints Multi criterion used were in evaluation to derive transition maps, inputs to CA markov

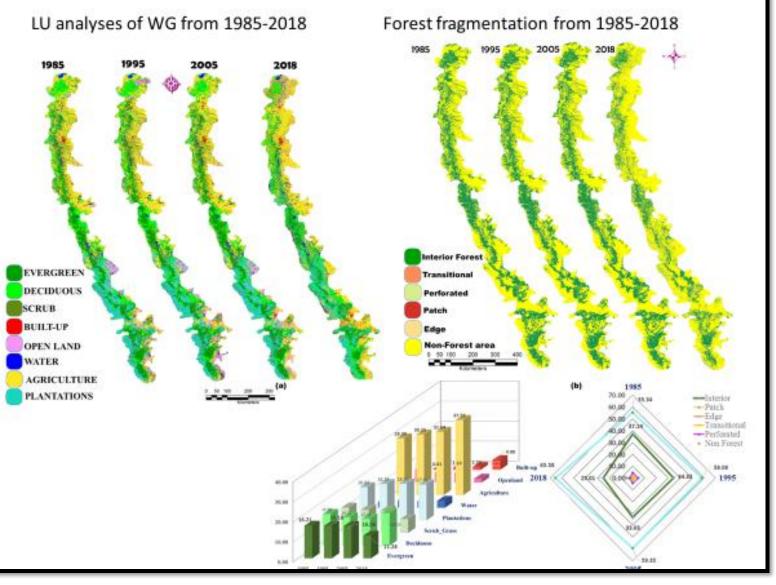


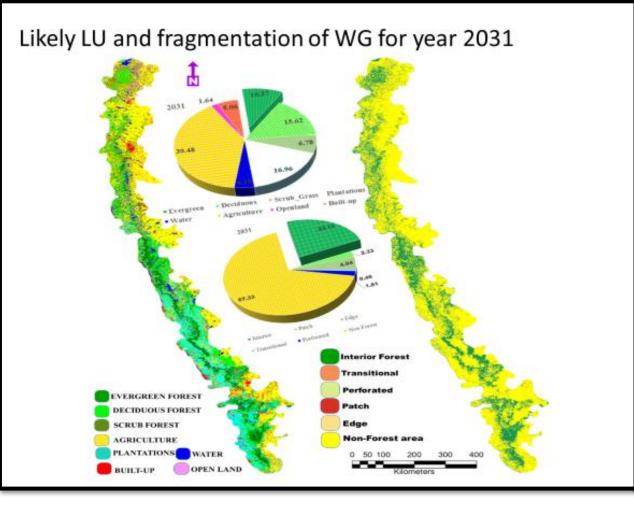


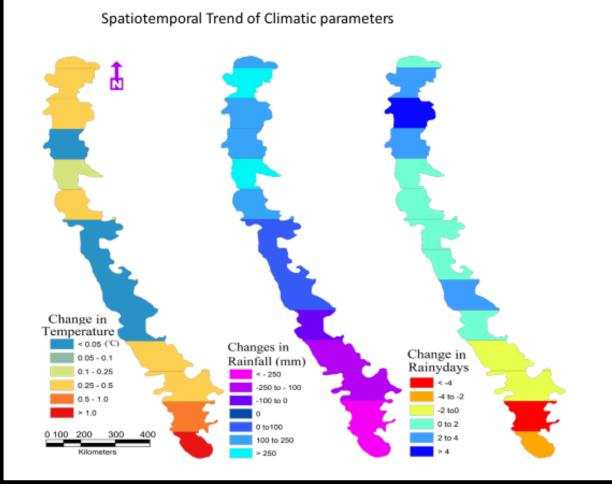
Remote Sensing and GIS
Big Data

8

AI, ML



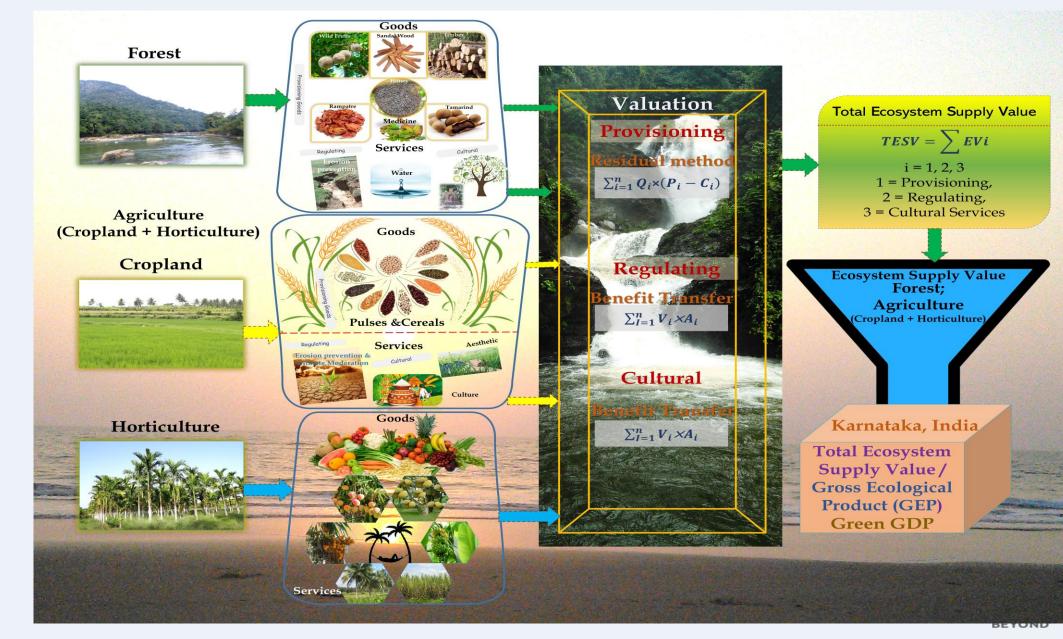




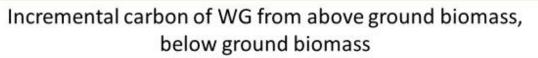
An increase of mean temperature by 0.5 °C and decline of rainy days with the decline of forests.

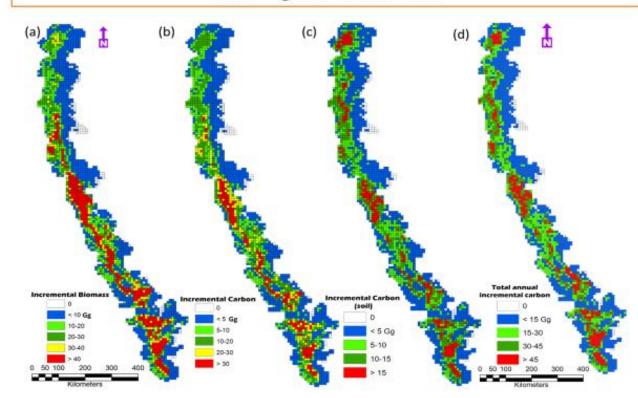
#### Carbon sequestration

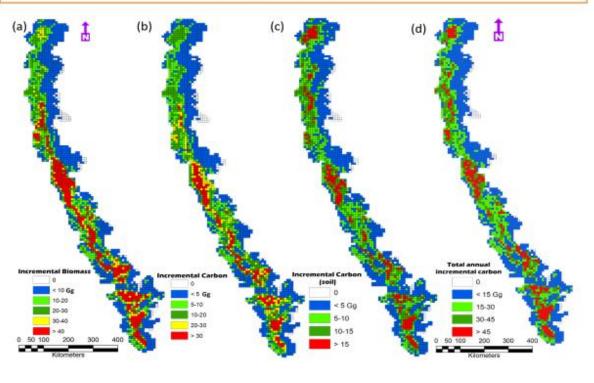
Water



Incremental carbon of WG from above ground biomass, below ground biomass







Forest ecosystem in the Western Ghats holds 1.23 MGg in vegetation and soils

The annual incremental carbon is about 37507.3 Gg, and the highest in the forests of Karnataka part of WG.

Sequestered carbon in WG is about INR 100 billion (\$1.4 billion) at \$30 per tonne of carbon

# Water









1991

**Today** 

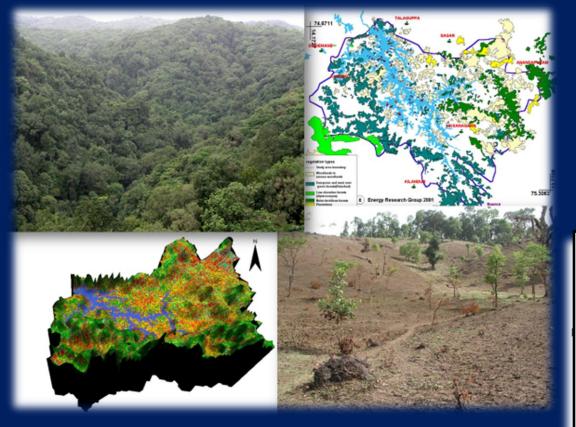
· Material flow

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· Energy flow

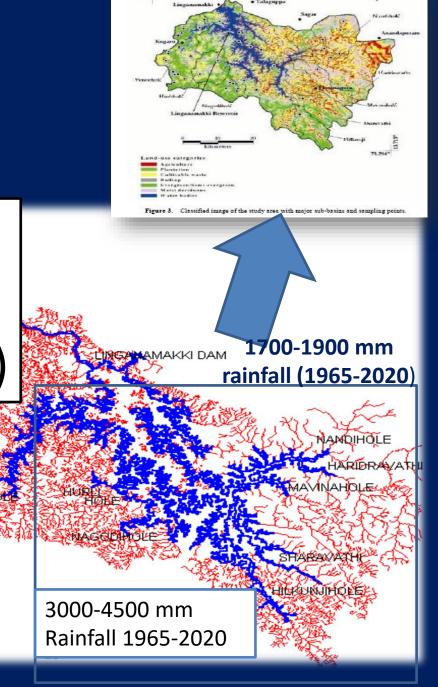
Alteration in structure and

\*Hydrological \*Ecological \*Nutrient \*Nutrient

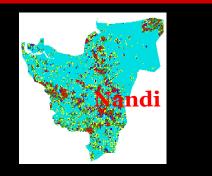


3000-4500 mm rainfall (1901-1964)

Land Cover Changes and Rainfall



#### **Forests and Rainfall**

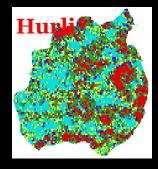




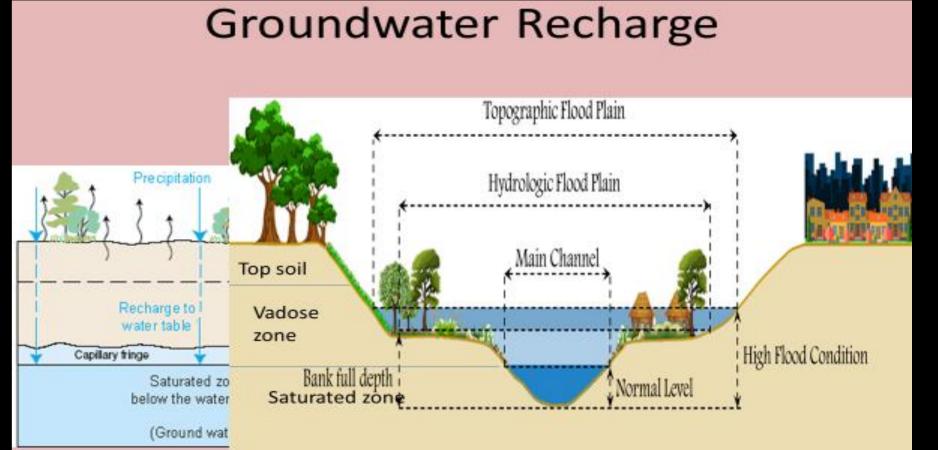


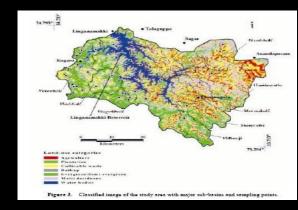


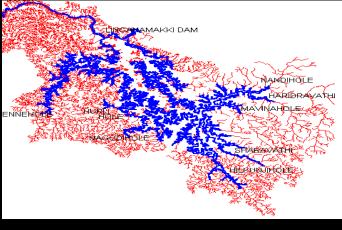




Rainfall (mm)	Forest (%)	Agri-		Forest (%)		Rainfall (mm)	Forest (%)	Agri-	Rainfall (mm)	Forest (%)	Rainfall (mm)	Forest (%)	Agri-open(%)	Rainfall (mm)	Forest (%)	Agri-open(%)
1715.20	41.4		1776.49	30.5	64	2157.88	46	4	3382.40	42.1	4801.25	65.8	22.7	4410.05	60.7	27.7

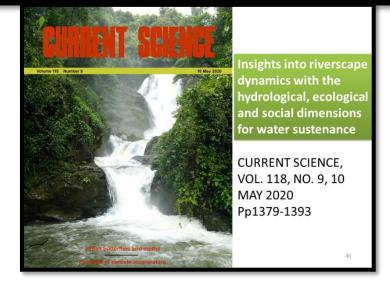




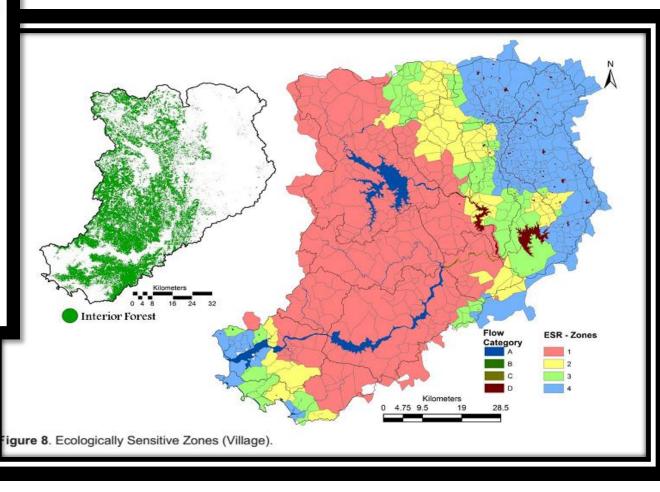


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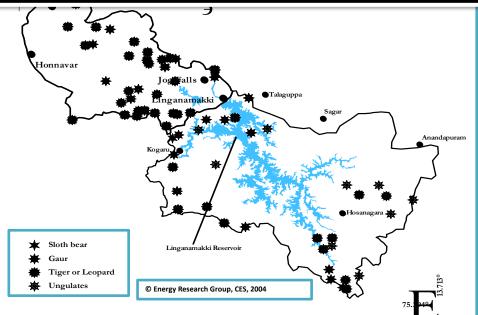
Figure 6. Eco-Hydrological Status in the Kali river basin.



#### Water Sustenance and Vegetation Cover in a Landscape



#### **Catchment Integrity - Fauna diversity, Vegetation and water linkages**

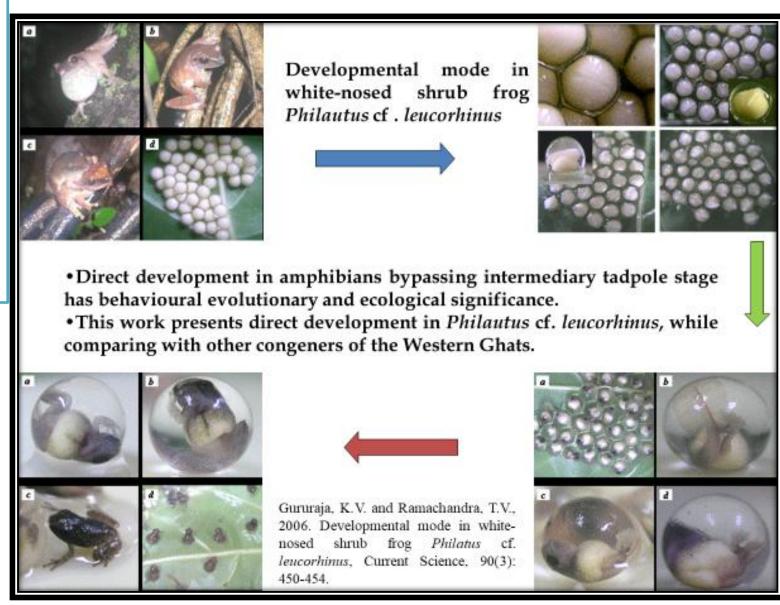


*Schistura nagodiensis* and *S. sharavathiensis* are the new fish species described from Sharavathi river, central Western Ghats.



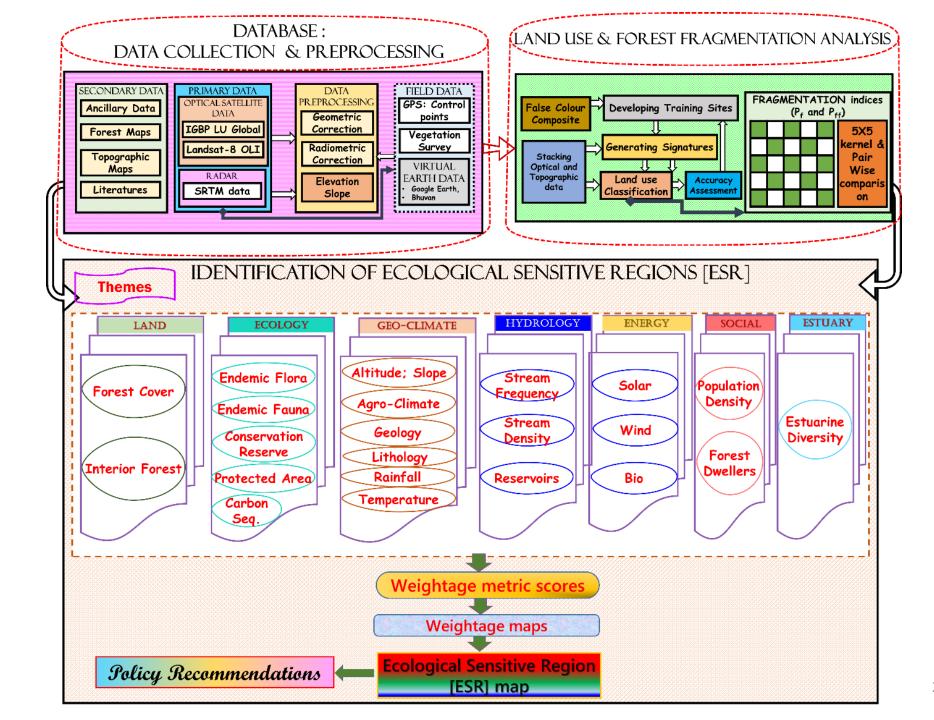


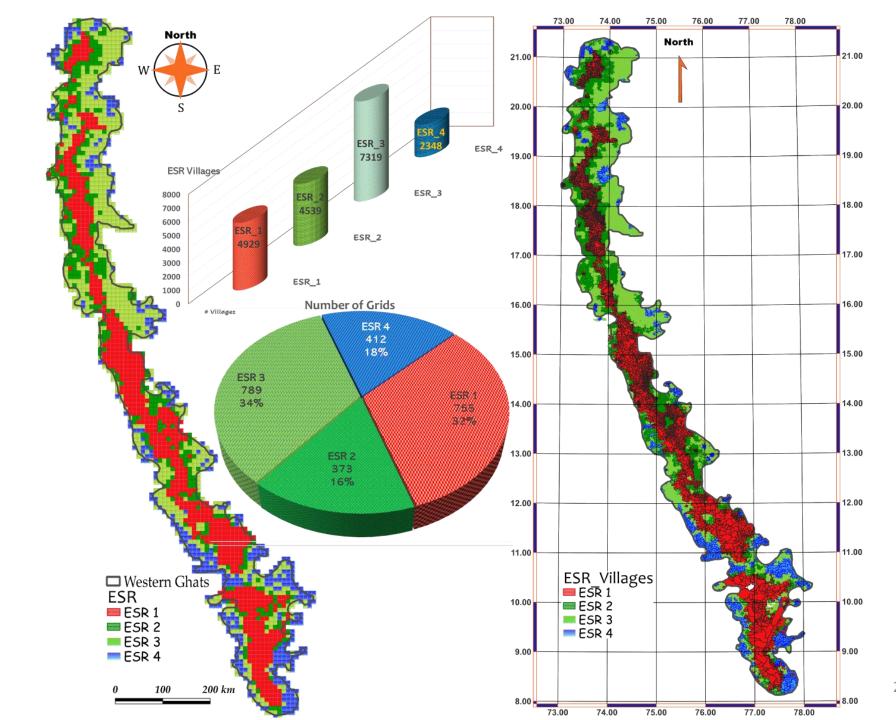
Sreekantha, K.V. Gururaja, K. Remadevi, T.J. Indra and T.V. Ramachandra, 2006. Two new fish species of the genus *Schistura* Mcclelland (Cypriniformes: Balitoridae) from Western Ghats, India. Zoos' PRINT JOURNAL 21(4):2211-2216



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SDSS Identify Ecosensitive Regions





# https://wgbis.ces.iisc.ac.in/sdss/wgsdss/index.php





#### Western Ghats Spatial Decision Support System [WGSDSS]

**Ecologically Sensitive Regions in the Western Ghats** 

T V Ramachandra, Bharath Setturu, Vinay S, MD Subash Chandran, Bharath H. Aithal

Energy and Wetlands Research Group (EWRG), Environment Information System (ENVIS), Center for Ecological Sciences (CES), Indian Institute of Science (IISc), Tel: 080-22933099 / 22933503 / 23608661 Email: tvr@iisc.ac.in, envis.ces@iisc.ac.in







**HOME** About Publications

ESR in Western Ghats

Uttara Kannada





ESR in Western Ghats:

Grids Villages

Visualize ESR at Disaggregated Levels Taluk State District Village OR ESR in Western Ghats: Villages

> **Bio Geo Climatic Ecological and** Social Variables Used For Computing ESR Select an Attribute Y Attribute Relative Weight

Referral Data:

Select a Dataset \*

Inited Arab Bangladesh: MADHYA PRADESH India JHARKHAND TRIPURA O Bhuvan GUJARAT . WEST BENGAL MIZORAM Ahmedabad Satellite (Google) CHHATTISGARH Kolkata અમદાવાદ Myanmar কলকাতা Open Street Map (Burma) ODISHA: HARASHTRA Mum. TELANGANA Hyderabad హైదరాబాద్ ANDHRA INATAKA PRADESH **Bengaluru** Bay of Bengal ಚಿಂಗಳೂರು சென்னை Arabian Sea TAMIL NADU Andaman Sea തിരുവനന്തപുരം Sri Lanka ESR 2 ESR 3 Laccadive Sea Colombo Banda Aceh

GRASS

Energy

CES

CISTUP

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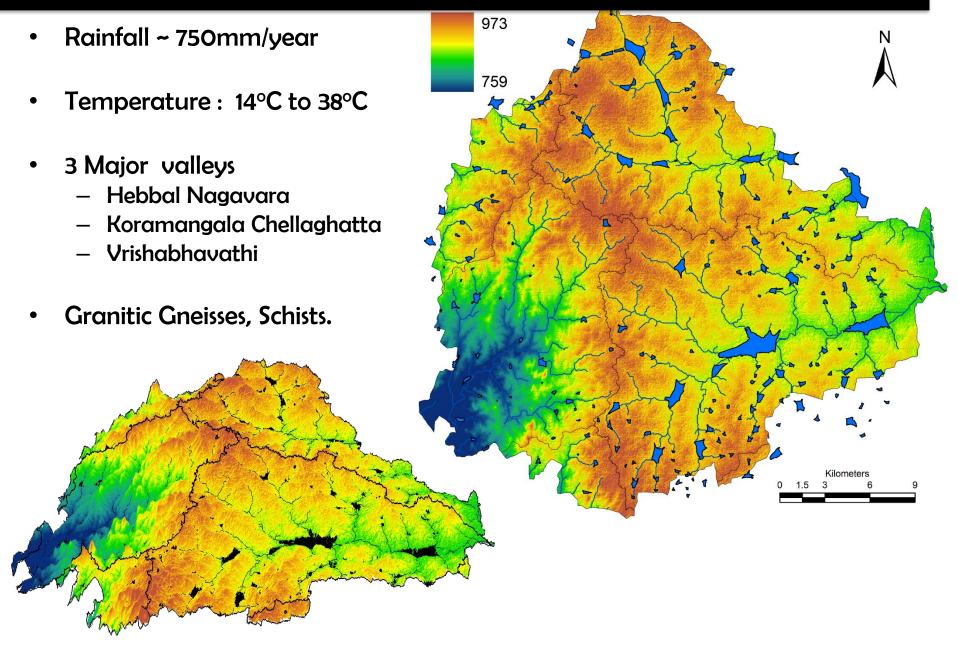








### Bangalore - Interconnected wetlands



# Ecosystem Services- Groundwater Recharge

Removal of lakes – GW table has fallen to 600' from 80 – 100'

- Some localities with Intense urbanisation GWT is about 800 1000'
- Rejuvenated lakes groundwater table increase (Example: Sarakki Lake)

# Wetlands – goods and services

#### UNPOLLUTED

- Rachenahalli Lake
   — Rs 10500/day/hectare
  - (fish, fodder, agriculture in command area, flood mitigation, GW recharge, recreation,...)

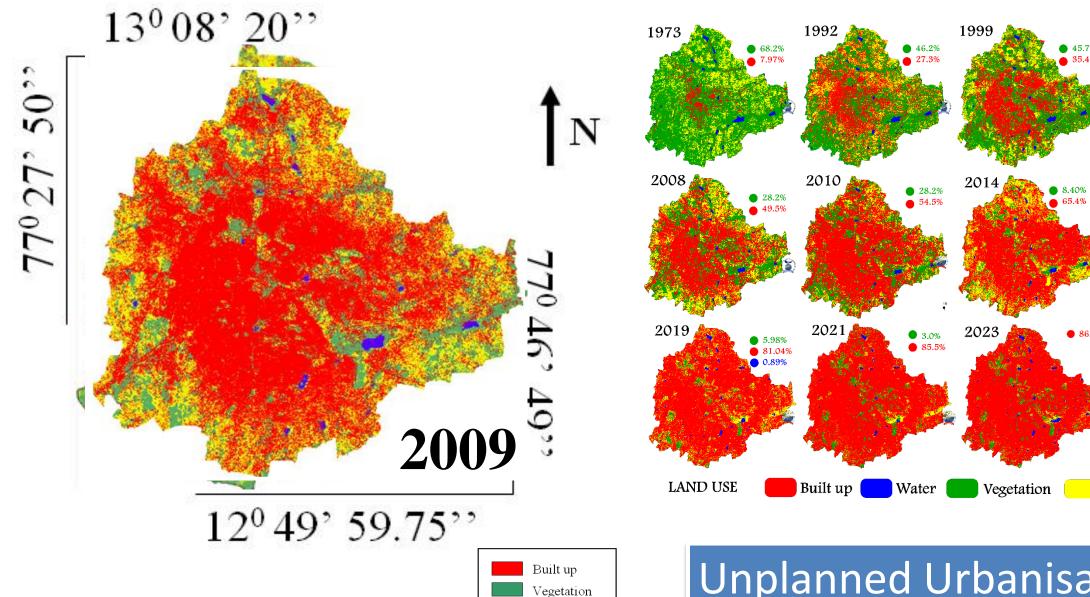
#### **POLLUTED**

 Amruthhalli Lake: Rs 20/day/hectare (Most waterbodies are Sewage fed)

11:51:39

#### Wetlands – Threats

- (i) Unplanned Urbanisation: loss of flood sinks wetlands and trees
- (ii) Loss of Floodplains
- (iii) loss of interconnectivity among wetlands
- (iv) narrowing drains with concretisation
- (v) loss of Riparian Vegetation (Water infiltration), reduces shocks and aid in infiltration



# Unplanned Urbanisation

2002

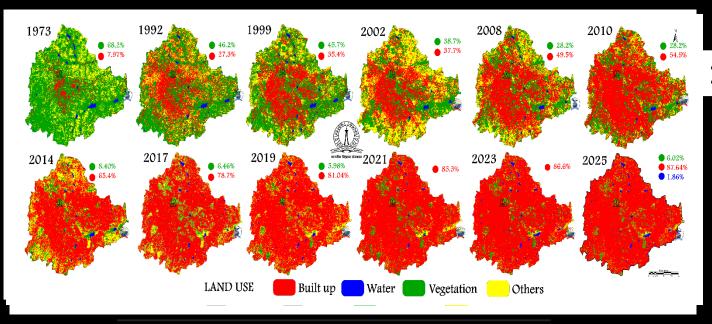
2017

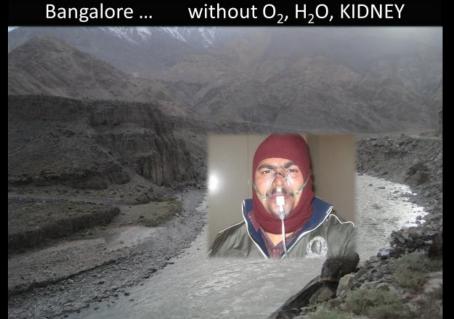
Others

36 11:51:39

Water Bodies

Others





1078% ncrease in built up area from 1973 to 2019

leading to a decline of 88% vegetation, 79% area in water bodies in Greater Bangalore mostly attributing to intense urbanisation process

98.5% would be concretised by 2025

**NOT ACCEPTABLE** 

### **ENOUGH IS ENOUGH**

STOP UNREALISTIC CONCRETISATION – ALLOW **GRONDWATER RECHARGE DECONGEST Bangalore** 

#### TREES IN BENGALURU





ದಶಕೂಪಸಮಾ ವಾರ್ಷಿ ದಶವಾರ್ವಿಸರ್ವೋ ಹದ: ದಶಪ್ರದಸಮ: ಪುತ್ರೋ ದಶಮತ್ರಸಮೋ ದ್ರಮ: ಕ

ಹತ್ತು ಬಾವಿಗಳು ಒಂದು ಕೆರೆಗೆ ಸಮ, ಹತ್ತು ಕೆರೆಗಳಿಂದ ಒಂದು ಸರೋವರ. ಹತ್ತು ಸರೋವರಗಳು ಒಂದು ಮಗುವಿಗೆ ಸಮ, ಹಾಗೆಯೇ ಒಂದು ವೃಕ್ತ ಹತ್ತು ಮಕ್ಕಳಿಗೆ ಸಮ.

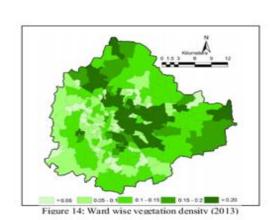
mades in a, gow our care, and are, our ster. No seeks, not arread, name

ಎಲ್ಲಿ ನೋಡಿದರಲ್ಲಿ ಹಸಿರು ವನರಾಶಿ, ಪಕ್ಷಿಗಳ ಚಲಿಪಿಲಿ, ಕಣ್ಣಿಗೆ ಮುದನೀಡುವ ವನ್ಯಮ್ಮಗಗಳ ಜಿಲ್ಲಾಟ, ಬಿರುಬೇಗಿಗೆಯಲ್ಲೂ ಹಿತವಾದ ತಂಗಾಳಿ, ಮುಸಂಜೆಯ ಅವೇಶರಹಿತ ಸೂರ್ಯಾಸ, ಮಂಜಿನ ಹನಿಗಳ ನಡುವೆ ಹೊಂಬಣ್ಣದ ಸೂರ್ಯೋದಯ, ಒಂದು ನಗರ ಅದ್ಭುತ ಗಿರಿಪ್ರದೇಶವಾಗಲು ಇತ್ತೇನು ಬೇಕು.! ಮನೆ–ಮನೆಯಲ್ಲೂ ಹಣ್ಣಿನ ಮರಗಳು, ಮನೆ ಮುಂದಿನ ತುಳಸಿ ಕಟ್ಟೆಗಳು, ಕೇವಲ 20 ಅರ್ಜಿಳಗೇ ನೀರಿರುವ ಬಾವಿಗಳು, ಕೇರಿಗೊಂದು ಉದ್ಯಾನವನ್ನ ಹತ್ತಾರು ಕೆರೆಗಳು, ಆಟದ ಬಯಲು, ದೀಪಾವಳಿಯ ದೀಮೋತ್ರವ, ಚಳಿಗಾಲದ ಕರಗ, ಬಸವನಗುಡಿಯ ಕಡಲೆಕಾಯೆ ಪರಿಷೆ. ಹೌದು, ಇದು ಕರ್ನಾಟಕದ ರಾಜಧಾನಿ, ಕೆಂಪೇಗೌಡರ ಕನಸಿನ ನಗರ, ಬೆಂಗಳೂರಿನದೇ ವರ್ಣನೆ. ಬಹುಶ: ಈ ರೀತಿಯ ವರ್ಣನೆಯನ್ನು ಹಿರಿಯರಿಂದ ಅಥವಾ ಪತ್ರಿಕೆಗಳಲ್ಲಿ ಲೆಕ್ಷವಿಲ್ಲದಷ್ಟು ಸಲ ಕೇಳಿದ್ದೇವೆ, ಒದಿದ್ದೇವೆ. ಪ್ರಸ್ತುಕ ಬೆಂಗಳೂರು ನಗರವನ್ನು ಆ ರೀತಿಯಾಗಿ ಕಲ್ಪಸಿಕೊಳ್ಳಲು ಒದ್ದಾಡಿದ್ದೇವೆ, ಅಂತಹುದೇ ನಗರದಲ್ಲಿರಬೇಕೆಂದು ಬಯಸಿದ್ದೇವೆ. ಎಲ್ಲವೂ ಕ್ಷಣಕಾಲ. ಮನಸ್ಸು ಕಲ್ಪನೆಯ, ಭಾವಪರವಶತೆಯ ಲೋಕದಿಂದ ಮರಳುತ್ತಿದ್ದಂತೆ ಸುತ್ತಲಿನ ಹೊಗೆನಹಿತ ಗಾಳಿಯೇ ಪ್ರಾಣವಾಯು, ವಾಹನಗಳ ಘರ್ಜನೆಯೇ ಇಂಪಾದ ಹಕ್ಷಗಳ ಕೂಗು, ಯಾಂತಿಕ ಜಗಕ್ಕೇ ಸರ್ವಸ್ಥ

#### 21ನೇ ಶತಮಾನದ ಬೆಂಗಳೂರು: ಆರಾಗರೀಕ ನಗರೀಕರಣದ ಉಡುಗೊರೆ.!

හත්පාක්ස් බණ්ණත් බ්රාකා, බස පත්ර හත්පාක්ස්ෆ් සරහ රෝගේ බංගාක්ෂ ಅಷ್ಟೇ ಮುಖ್ಯ. ಇದಕ್ಕೆ ಪ್ರಕೃತಿಯೇ ಕಾರಣವಾವಾಗಿದ್ದರೆ, ಅದು ಸಹಜ ಹಾಗೂ ಪ್ರಶ್ನಾತೀತ. ಆದರೆ ಬೆಂಗಳೂರಿನ ಬದಲಾವಣೆ ಇದಕ್ಕೆ ಮೀರಿದ್ದು, ಇದರ ಹಿಂದೆ ಪಾಶವೀ ಮಾನವೀಯ ಚಟುವಟಿಕೆಗಳು ಅವಿಶ್ವಂತವಾಗಿ ನಡೆದಿವೆ. ನಡೆಯುತ್ತಿವೆ. ಕೇವಲ ಮೂರೇ ದಶಕಗಳಲ್ಲಿ ಗಾರ್ಡನ್ ಸಿಟಿಯನ್ನು ಗಾರ್ಬೇಜ್ ಸಿಟಿಯನ್ನಾಗಿಸಿದವು. ವನ್ಯ ಸಂಕುಲಗಳು ನಾಶಗೊಂಡು ವಸತಿ ಸಮುಚ್ರಯಗಳು ಕಲೆಎತ್ತಿದವು, ವಾಣೆಜ್ಯ ಸಂಕೀರ್ಣಗಳು ಆಟದ ಬಯಲಸ್ವಾಕಮಿಸಿದವು. ಕರೆಗಳು ನಗರದ ಕನದ ತೊಟ್ಟಗಳಾದವು ಸೂರ್ಯಾಸ್ತ ಸೂರ್ಯೋದಯಗಳು ಬಹುಮಹಡಿ ಕಟ್ಟಡಗಳ ಹಿಂದೆ ಕಾಣದಾದವು. ಮಾಹಿತಿ ತಂತ್ರಣ್ಣವ, ಕೈಗಾರಿಕೆಗಳು ಹಾಗೂ ಸ್ವಿರಾಸ್ತಿ ವ್ಯವಹಾರ ಬೆಂಗಳೂರನ್ನೇ ಆಳಿದವು. ನಗರೀಕರಣದ ಬಿಸಿಲುಗುದುರೆಯನ್ನೇರಿದ ಮಾನವ ಸ್ವಯಂಕೃತ ಪ್ರಮಾದದ ಮೂಕಪ್ರೇಕ್ಷಕರಾದನು, ಭ್ರಮಾಲೋಕದ ಅಲೆಮಾರಿಯಾದನು, ಯಾಂತ್ರಿಕ ಜಗತ್ತಿನ ಬಂದಿಯಾದನು ಹಾಗೂ ಏಕಾಂಗಿಯಾದನು.

#### # of TREES STILL SUVIVING FROM BUREUCRATS **IRRESPONSIBLE AXE**



through pattern classifiers Figure 17: Tree Distribution in Indian Institute of Science campus

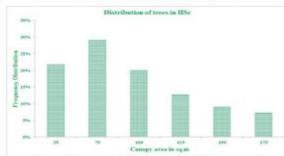


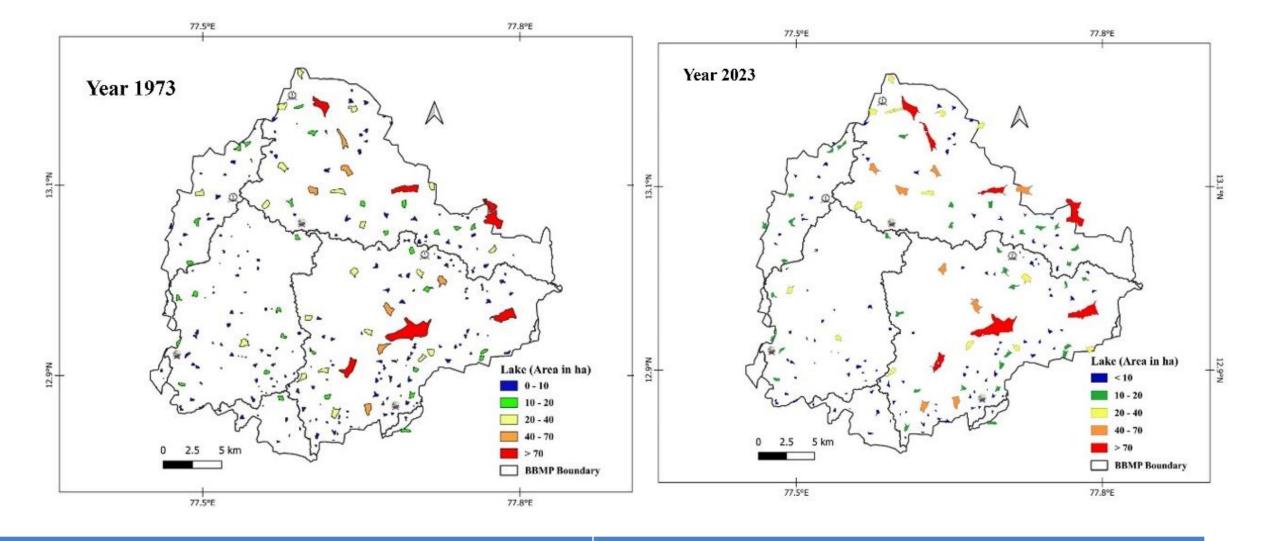


Figure 16: Tree distribution

Gradient Wise

# of TREES: 14,78,412 Population: 95,82,999, TREES per person: 0.155 + 0.25 0.25 - 0.5 0.5 - 1 1 1 - 1.25 - > 1.25 Figure 20: Ward wise tree per person

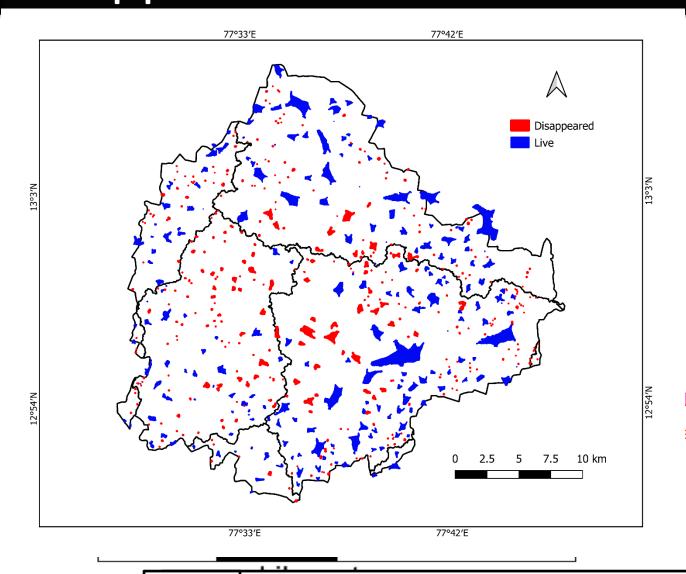
88% Decline in vegetation cover during 5 decades



(a)Spatial distribution of lakes in 1973 (as (a)Spatial distribution of lakes (2023) based per the Survey of India topographic maps)

on the field survey

## Disappeared Wetlands – ABUSED





LAKE ENCROACHMENTS: 98%

RAJAKALUVE (STORMWATER DRAINS) ENCROACHMENTS: 82%

L078% increase in built up area from 1973 to 2019 leading to La sharp decline of 88% vegetation. 79% area in water bodies in Greater Bai

a sharp decline of 88% vegetation, 79% area in water bodies in Greater Bangalore mostly



### https://wgbis.ces.iisc.ac.in/sdss/BUiS/















T V Ramachandra, Bharath H Aithal, Vinay S, Bharath Setturu, Tulika Mondal, Abhishek Baghel, Bhuwan C Arya

Energy and Wetlands Research Group (EWRG), Environment Information System (ENVIS), Center for Ecological Sciences (CES), Indian Institute of Science (IISc),

Tel: 080-22933099 / 22933503 / 23608661 Email: tvr@iisc.ac.in, envis.ces@iisc.ac.in



WGSDSS





VISITOR : 3030

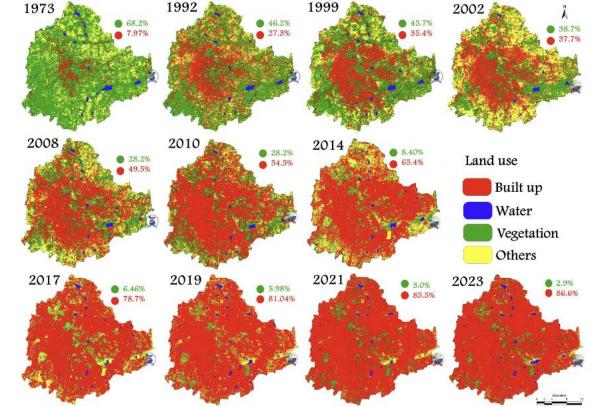


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**NCAVES** 1992



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Energy







CST





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CES







CISTUP





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#### **Escalating GHG FOOTPRINT**

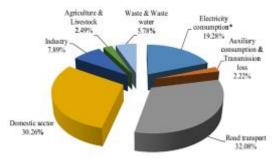


Fig. 12. GHG footprint (carbon dioxide equivalent emissions, Gg) of Delhi.

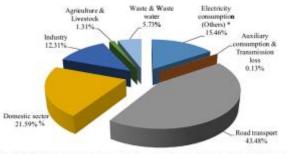


Fig. 16. GHG footprint (carbon dioxide equivalent emissions, Gg) of Greater

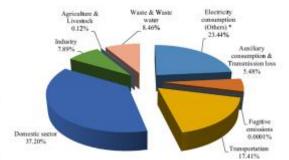


Fig. 13. GHG footprint (carbon dioxide equivalent emissions, Gg) of Greater

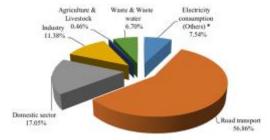
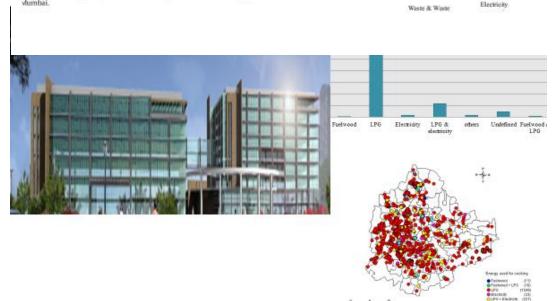
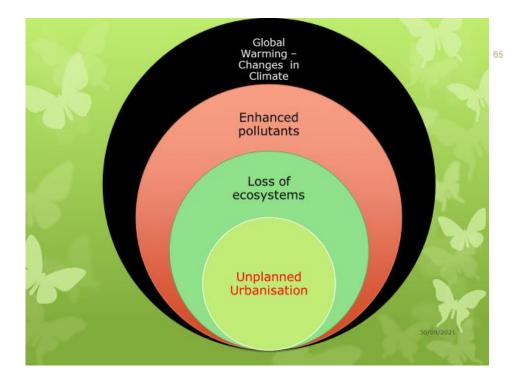


Fig. 17. GHG footprint (carbon dioxide equivalent emissions, Gg) of Hyderabad.



#### Per capita electricity consumption in Zones

Zones	Minimum	Maximum	
North	0	1796.00	
South	0	1902.50	
East	0	2337.25	
West	0	13796.50	
North East	0	750.00	
NorthWest	0	3252.40	
SouthWest	0	5718.75	
SouthEast	0	0 14849.10	

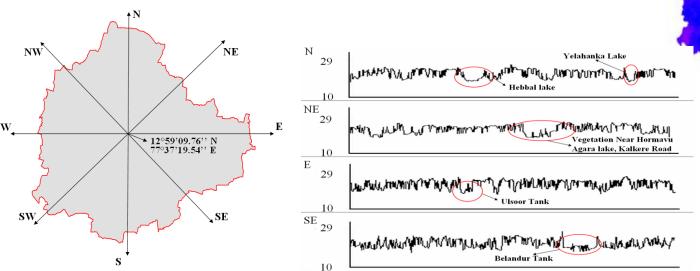


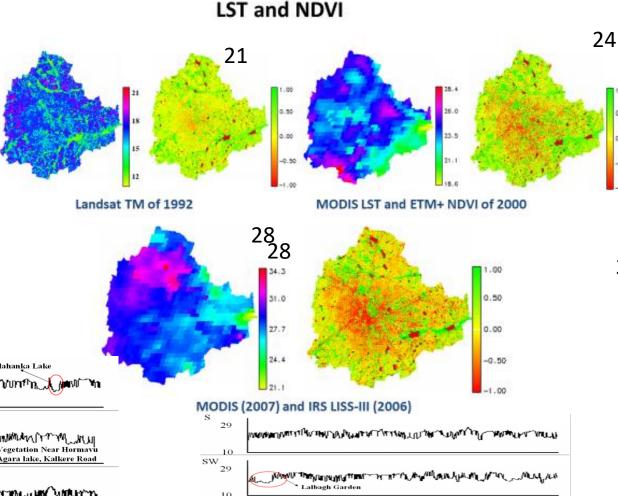
# Loss of Wetlands with the Unplanned Urbanisation - Increased Temperature

• Lakes have become Seasonal

Ground water table decline

• Changes in Local Temperatures



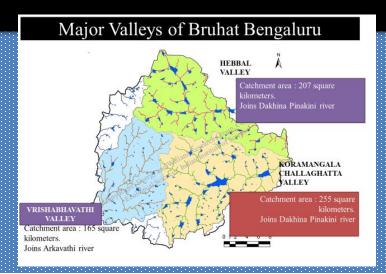


29

NW

38

### Abuse of wetlands: FLOODS & WATER SCARCITY







Water scarcity, Droughts and also floods





April, July-August, Oct News - Every Year since 2001



GARVIBAVI PALYA NEAR HOSUR ROAD



HOSUR ROAD FLOODED IN BANGALORE





TRAFFIC JAM DUE TO HEAVY RAINS



SUBWAY BETWEEN MAJESTIC AND RAILWAY STATION



RISING WATER LEVEL AND VEHICLES



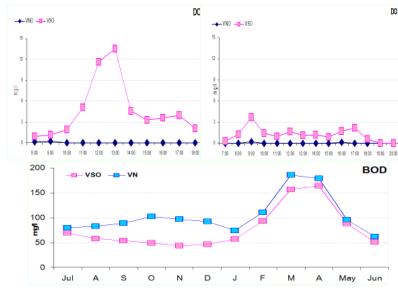
PLATES: 4.2: SHOWING THE HAVOC OF RAINFALL IN CERTAIN AREAS OF BANGALORE:

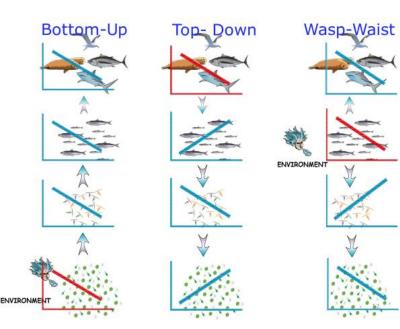
#### **WATER: CURRENT STATUS**

POOR WATER AND WASTEWATER MANAGEMENT by BWSSB

- (i) Lakes polluted, abused ..
- (ii) Rainwater Harvesting
   suboptimal
- (ii)No Reduce, reuse, recycle of wastewater Sewage Diversion, River diversions – Fools' Idea & not of sensible Citizens

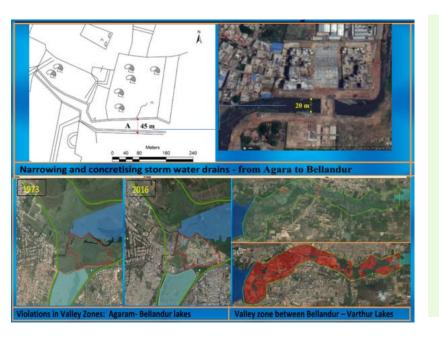


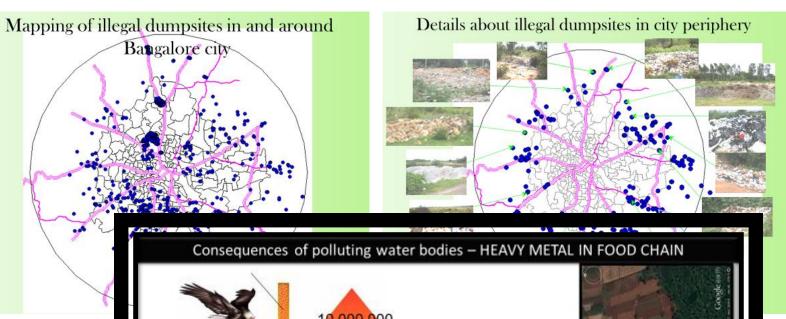






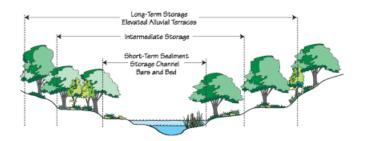


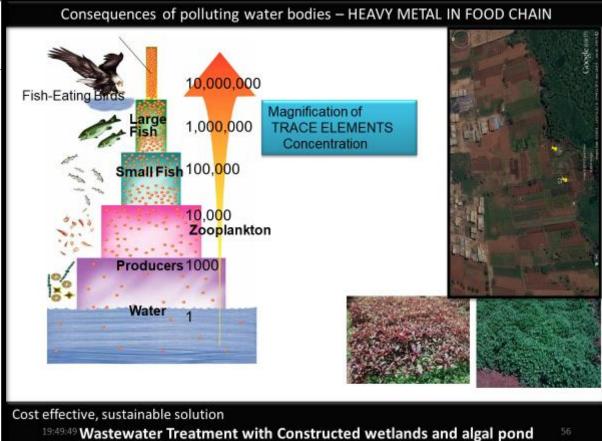




### Riparian - Vegetation

- Allows water to percolate vadose zone and saturated / groundwater zone
- · Controls timing and amount of water yield
- Controls amount of soil for downstream transport
- Habitat for Biota





#### **WATER: CURRENT STATUS**

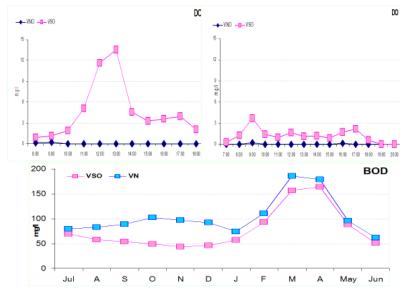
POOR WATER AND WASTEWATER MANAGEMENT by BWSSB

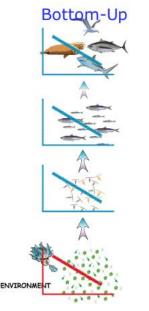
- (i) Lakes polluted, abused ..
- (ii) Rainwater Harvesting

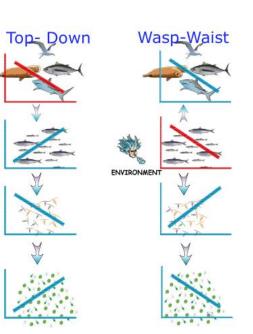
suboptimal

(ii)No Reduce, reuse, recycle of wastewater Sewage Diversion, River diversions – Fools' Idea & not of sensible Citizens







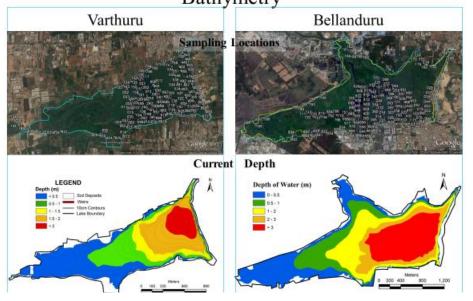




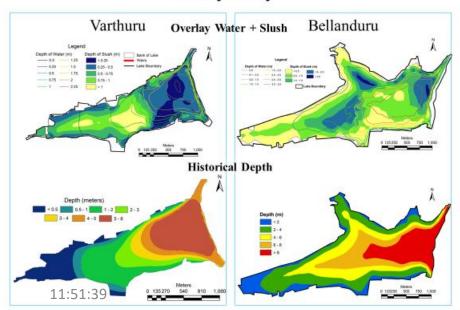


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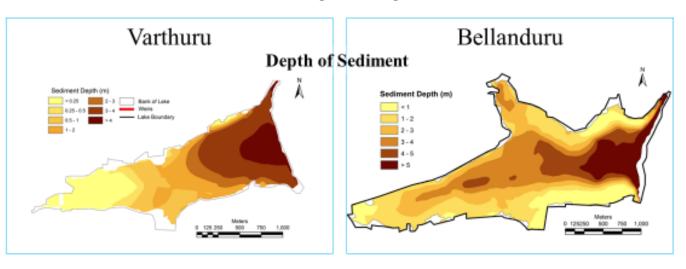
Quantify accumulated silt – Scientifically Bathymetry



#### Bathymetry



### Bathymetry



Slno	Description	Unit of measurement	Varthuru	Bellanduru
1	Surface area of Lake	Hectare	190.78	367.34
2	Storage Volume	Million cubic meters	6.10	18.67
3	Current Storage Volume of Water	Million cubic meters	1.61	5.50
4	Volume of Slush deposit	Million cubic meters	0.62	6.56
5	Volume of Sediment deposits	Million cubic meters	3.87	6.60



Revenue for farmer – Rs 1,50,000 per acre (additional benefit then regular profit) – data from Mr. Yatish, Mr Khan



### https://wgbis.ces.iisc.ac.in/sdss/BLIS/



















#### **BANGALORE LAKES INFORMATION SYSTEM [BLIS]**

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Email: tvr@iisc.ac.in, envis.ces@iisc.ac.in

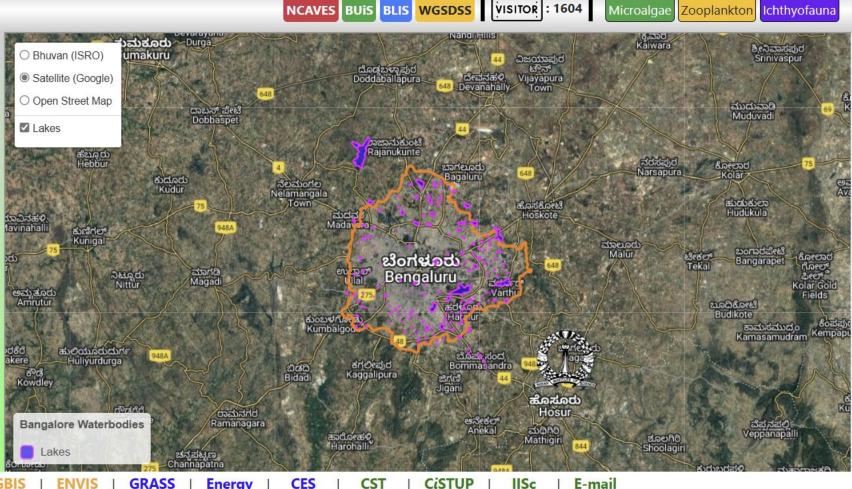


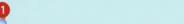






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**Efficacy of Restoration:** 

PDF





Collateral Data:

Links >





































OPTION 1 - Cost effective, sustainable solution

**SOLUTION / ACTION PLANS** 

**Wastewater Treatment with Constructed** wetlands and algal pond

> REUSE, RECYCLE **WASTEWATER**

OPTION 2 - Sensible, sustainable solution

RAINWATER HARVESTING THROUGH REJUVENATED LAKES (WITH CONSTRUCTED WETLANDS)

SOLUTION / ACTION PLANS

3

#### Option 3

 Create water bodies and mini forest in each ward /village for adequate water and oxygen Option 4 – Mini forest in each ward

Improvements in ground water table

Local ecology

Carbon sequestration

Reduction in the temperature at least by 2 °C

**ENVIRONMENT EDUCATION to** Enhance Environment Literacy

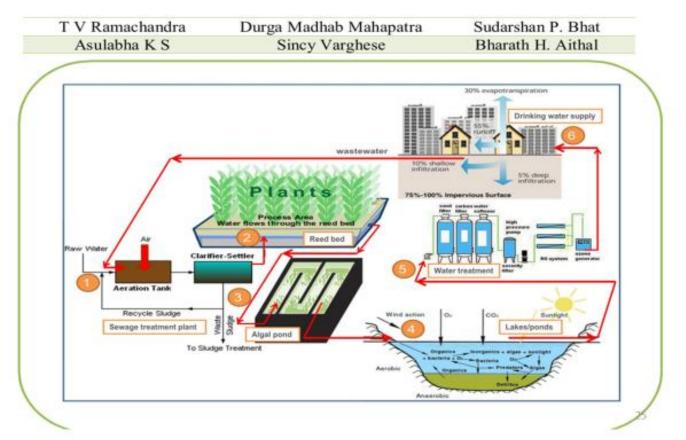
Sensitise Youth

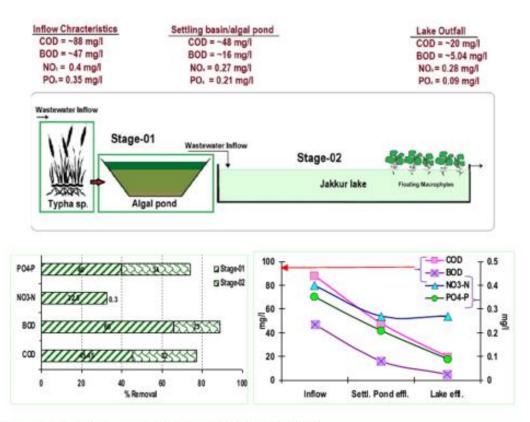
Sensible Youth -> Responsible -> Optimal Decisions towards

SUSTAINABLE DEVELOPMENT

### Tertiary Treatment of Wastewater – Model working since 14 years

#### INTEGRATED WETLANDS ECOSYSTEM: SUSTAINABLE MODEL TO MITIGATE WATER CRISIS IN BANGALORE



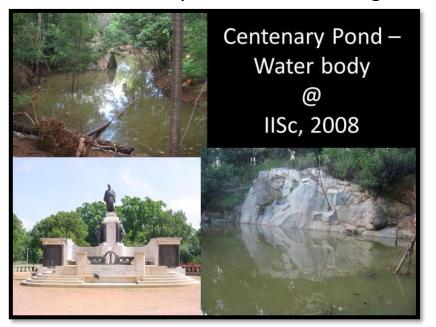


gure 4: Integrated wastewater management system

tive, sustainable solution – OPTION 2 ATER HARVESTING THROUGH REJUVENATED LAKES (WITH CONSTRUCTED WETLANDS)

### Sustainability – Water Harvesting

#### [Give back to the Nature 10 times of consumption]





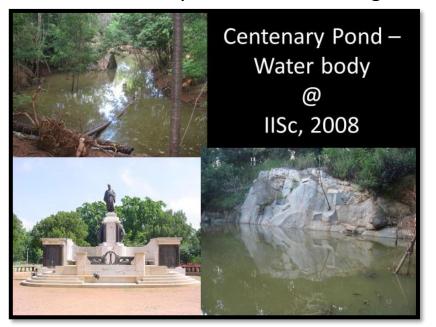






### Sustainability – Water Harvesting

#### [Give back to the Nature 10 times of consumption]











#### Option 4 – Mini forest in each ward

- Improvements in ground water table
- Local ecology

150' earlier

- Carbon sequestration
- Reduction in the temperature at least by 2 °C

#### Mini Forest with Native plant species

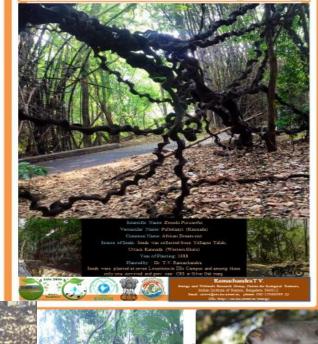




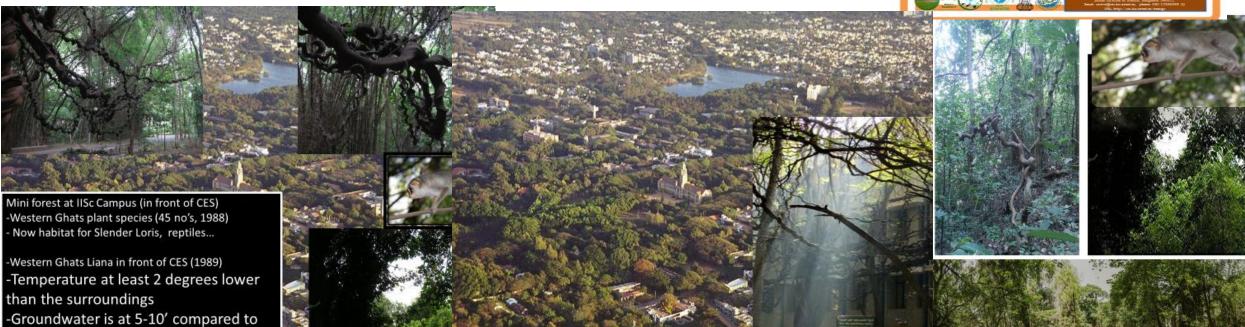








🚇 BOTANICAL WONDER @ IISc 잎



## SUCCESS STORIES –Environment Education

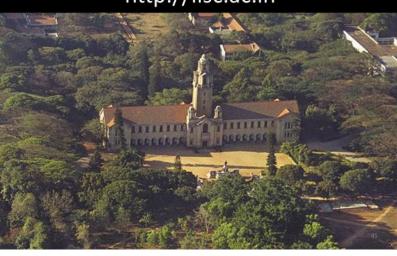
- Environment Education (school and colleges)
- Capacity Building (Training Programmes, workshops and Symposiums –
- Lake series: XII Event Lake 2020, Lake 2018 .... Lake 2012 ...... Lake 2000, 1998)
- Know Your Ecosystem Orientation Programmes,
   Webinars
- Working Professionals Capacity Building through ODL: Environment Management (19 sessions)
- Advocacy and Sensitize Decision makers/planners

# Know Your Ecosystem 555 sessions since 1998





# Indian Institute of Science http://iisc.ac.in





### Course – Environment Management 22 sessions

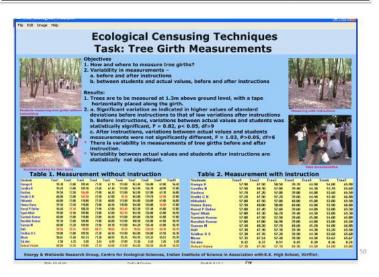


### **Lake 2024 - 14th Biennial Lake Conference**

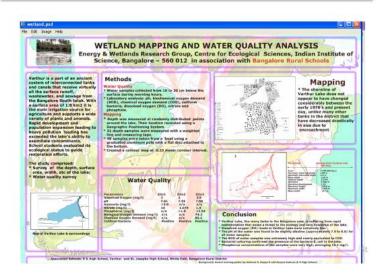
Wetlands for Human Well-being, 17-20 October 2024,



#### Environment Education — learn by doing



#### Environment Education — learn by doing







Diatom Collection at Varthur & Siddapura Lake with School Children













#### My Village Biodiversity – Schools and Colleges



# Empowering Rural schools – Water testing laboratories

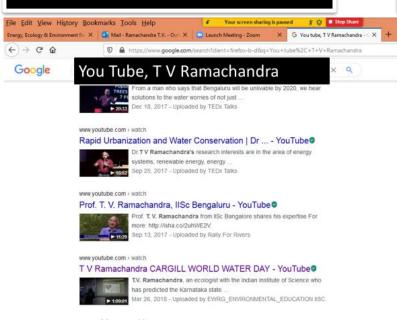


#### http://ces.iisc.ernet.in/energy



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#### 2000+ lectures





#### Knowledge Dissemination

#### Explore Further .....

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http://ces.iisc.ernet.in/biodiversity
 http://ces.iisc.ernet.in/foss
 http://ces.iisc.ernet.in/energy
 RESEARCH GATE:
 https://www.researchgate.net/profile/T\_V\_Rama chandra/stats
 GOOGLE SCHOLAR
 https://scholar.google.co.in/citations?user=Woh1 fa8AAAAJ&hl=en



# Explore Further ... Energy & Wetlands Research Group, IISc, Bangalore emram.ces@iisc.ac.in

http://wgbis.ces.iisc.ac.in/energy

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- http://wgbis.ces.iisc.ac.in/foss
- https://www.researchgate.net/profile/T\_V\_Ramachandra/publications
- https://scholar.google.com/citations?user=Woh1fa8AAAAJ&hl=ru