



# Blue-Green Infrastructure

**Dr. Mahua Mukherjee**  
**Indian Institute of Technology Roorkee, Roorkee**  
**INDIA**

UNSPIDER International Conference on Space-based Technologies for DRR :  
**A POLICY PERSPECTIVES**  
Beijing, China, 11 – 12 September, 2019



# Blue-Green Infrastructure

Blue-Green Infrastructure is **strategic technique of introducing/ utilizing existing/ enhancing natural resources and natural processes** in the form of water bodies or vegetated elements to benefit habitats.



Multiple sources of research have indisputably proven that **networking of blue and green spaces** can provide exponential benefits over time.

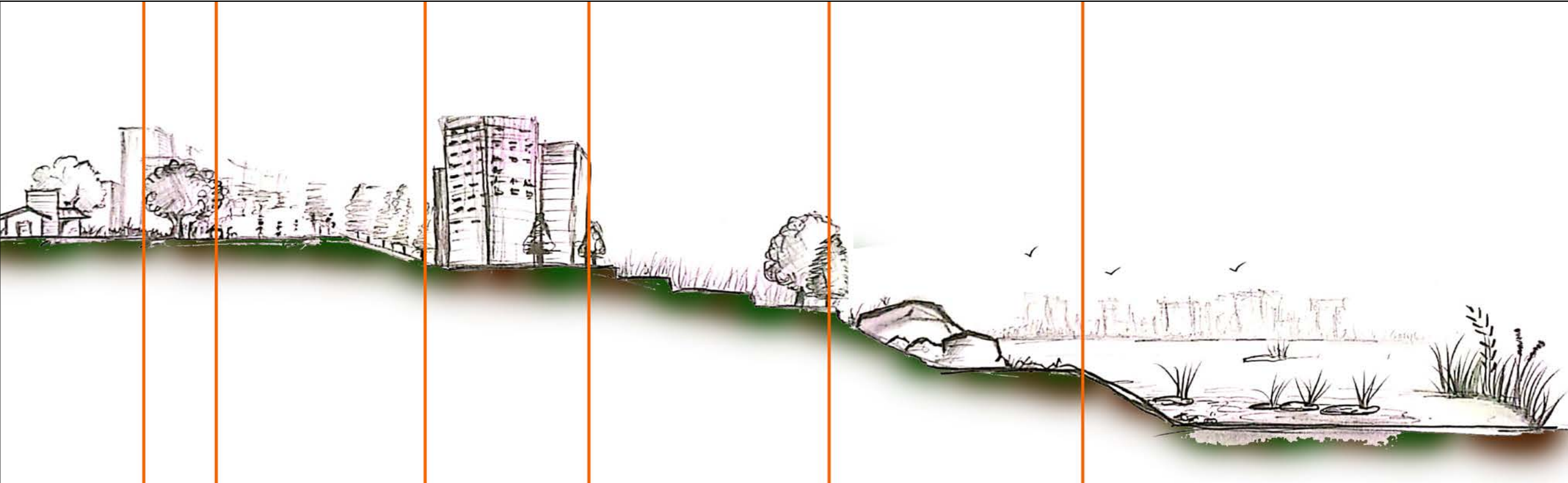
**... can be a measure towards Sustainable and Resilience Development**



# NETWORKING: BGI Elements and Urban Scale

## Urban Scale

Micro                      Local                      Meso                      Macro



Bits of nature                      Patch                      Corridor                      Matrix



BGI Elements' Scale

# BGI- Environmental Benefits in Urban Areas

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## ▶ **Environment:** energy and health security

- ▶ Thermal quality- **Heat wave, UHI** (shading, evapotranspiration)
- ▶ Air **Pollution** (removal), carbon sequestration (storage)
- ▶ Avoidance of **emissions** (reduced energy use)
- ▶ **Wind** regime- strong wind, pedestrian level discomfort (landscape)

## ▶ **Water Ecology:** water security

- ▶ **Water quality** - Natural treatment
- ▶ Water cycle- **ground water recharge** (Soil infiltration and storage )
- ▶ Storm-water drainage- **Urban Flood, Drought** (Flow control and flood reduction, Canopy interception)

## ▶ **Urban Agriculture:** food security

- ▶ **Soil** protection - Soil stabilization, Increased permeability
- ▶ **Nutrient** cycle - Waste decomposition and nutrient cycling
- ▶ **Food** Production

## ▶ **Bio-diversity:** habitat protection

- ▶ **Species diversity, Habitat and corridors.**





# The 10 Essentials for making Cities Sustainable and Resilient

## THE TEN ESSENTIALS FOR MAKING CITIES RESILIENT



### Essential Four: Pursue Resilient Urban Development and Design

Invest in and maintain critical infrastructure that reduces risk, such as flood drainage, adjusted where needed to cope with climate change.

Essential 4: "The built environment needs to be assessed and made resilient as applicable, informed by risk identified in essential 2."



### Essential Five: Safeguard Natural Buffers to Enhance Ecosystems' Protective Functions

Assess the safety of all schools and health facilities and upgrade these as necessary.

Essential 5: "Safeguard natural buffers to enhance the protective functions offered by natural ecosystems. Identify, protect and monitor critical ecosystems services that confer a disaster resilience benefit."

# Strategic Inclusion of BGI network in City Resilience Mission: Interventions Proposed (IPs) and deliverables



## IP 1. BGI Potential Investigation

Application of advanced tools and techniques

- High stress/ Hot spot Region
- BGI Potential Region
- Intervention Region



## IP2. Protocol for Implementation

Participatory Decision on Implementation

- Co-designed **Process Framework** with stakeholders (community / funding agencies).
- **Best Case Solution Basket**
- Priority based solution implementation and scheduling to achieve **networked BGI**.



## IP3. Systematic BGI Integration by Urban Authority

- Policy integration
- Risk resilient **Blue-Green Infrastructure integrated planning**
- Monitoring its benefit and performance as **LIVING Laboratory**



# BGI Potential Investigation

IP1



Application of RS Imagery, GIS, overlaying

## Initiation

Background Study

ROI Identification

**Methodology for Investigation involved in Risk Resilient BGI-integrated Planning:**

- a) High stress Region
- b) BGI Potential Region
- c) Intervention Region

**Land cover Distribution map  
(Spatio-temporal resolution)**

NDVI

NDBI

NDWI

**Concentration trend analysis**

Urban  
Heat  
Island

Urban  
Water

PM 2.5

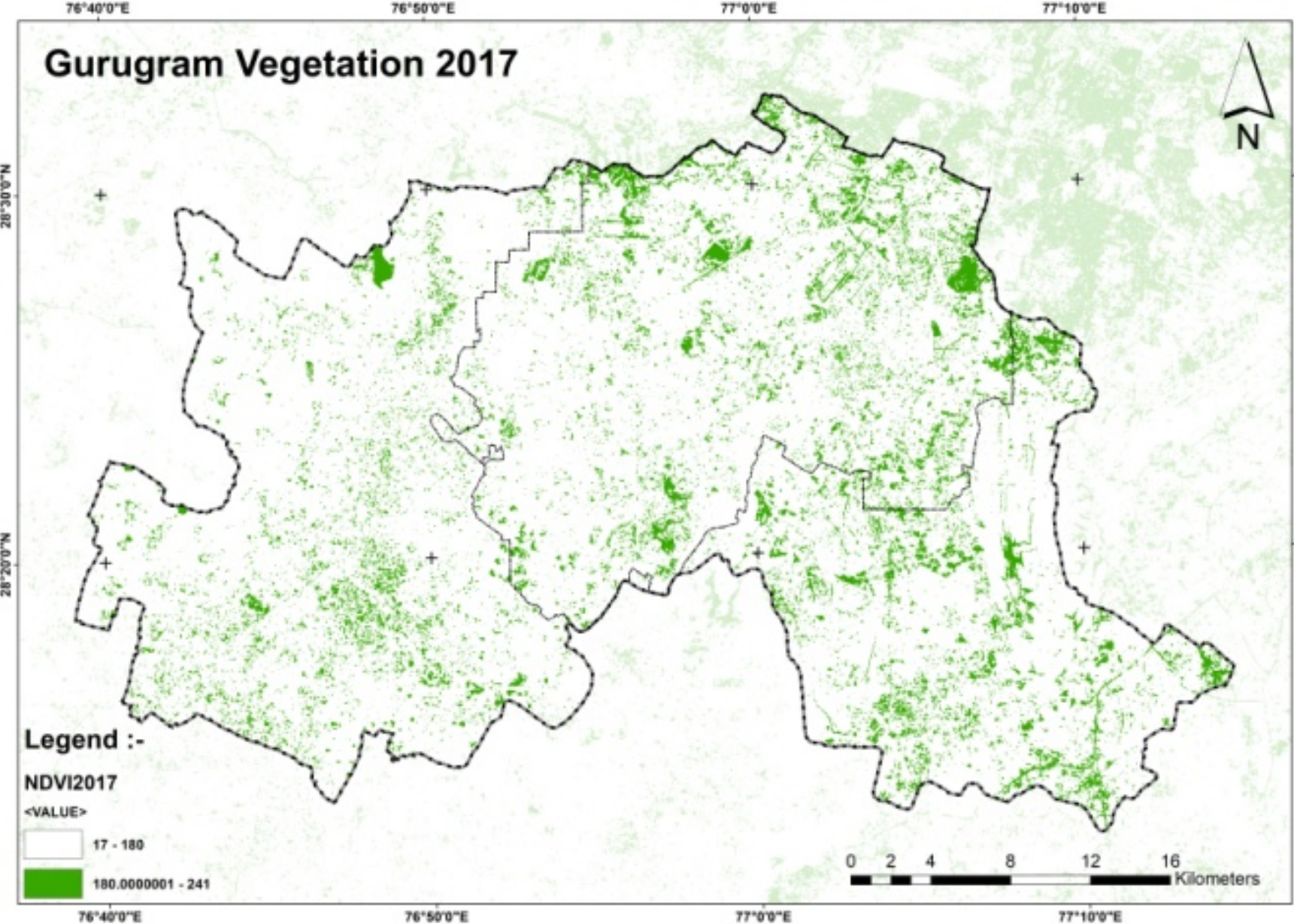
**Hot spot Identification**

Stress Concentration  
Point

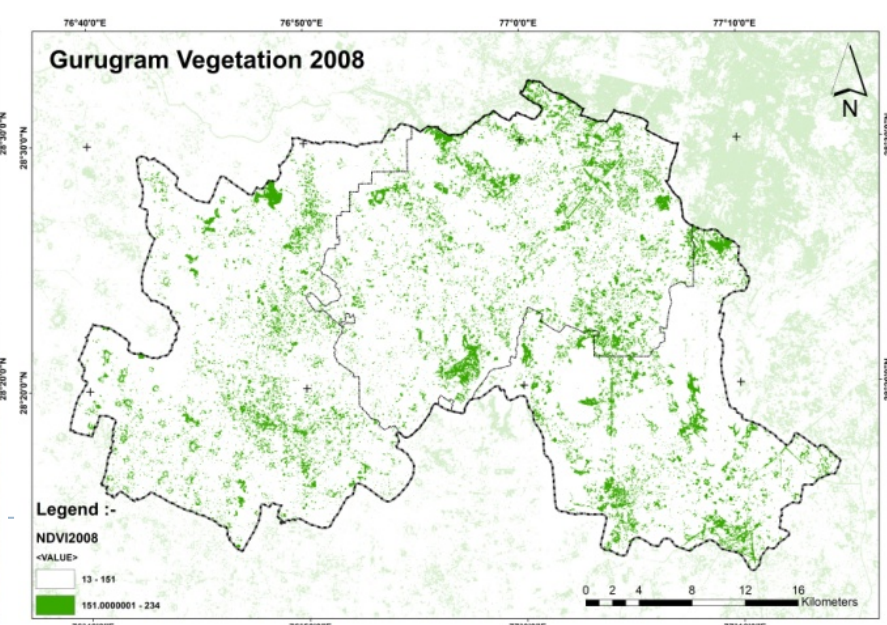
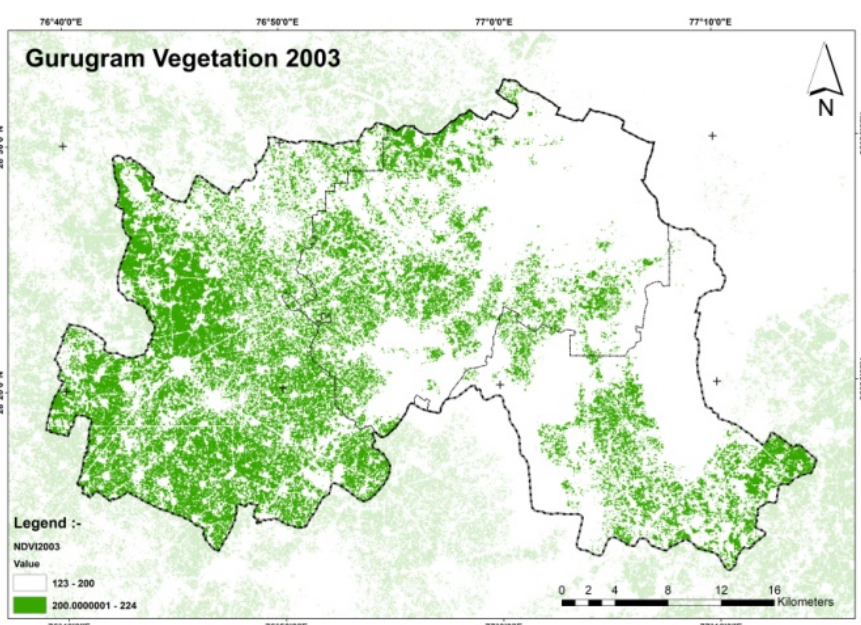
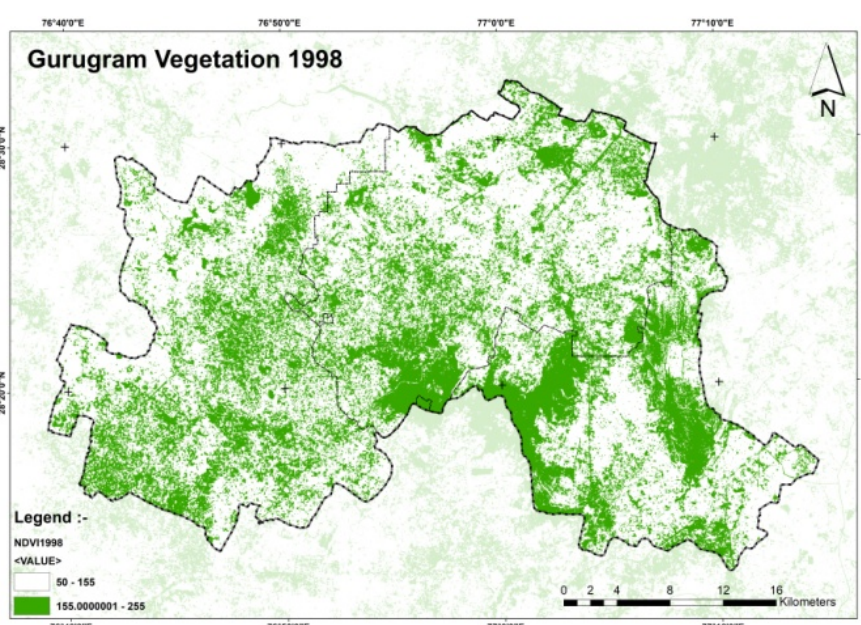
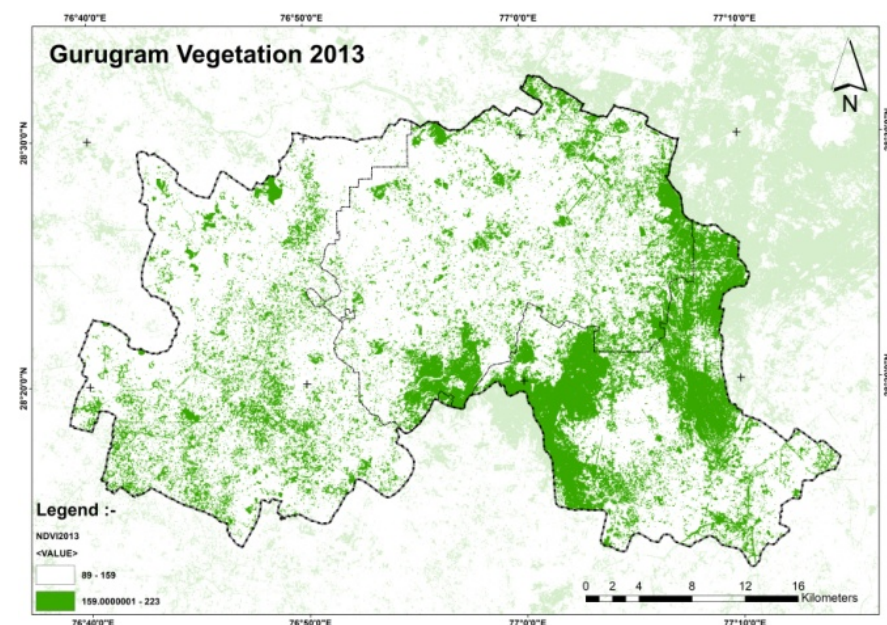
Potential BGI  
Intervention Area

**Strategic Spot for Intervention  
- Blue-green Infrastructure**

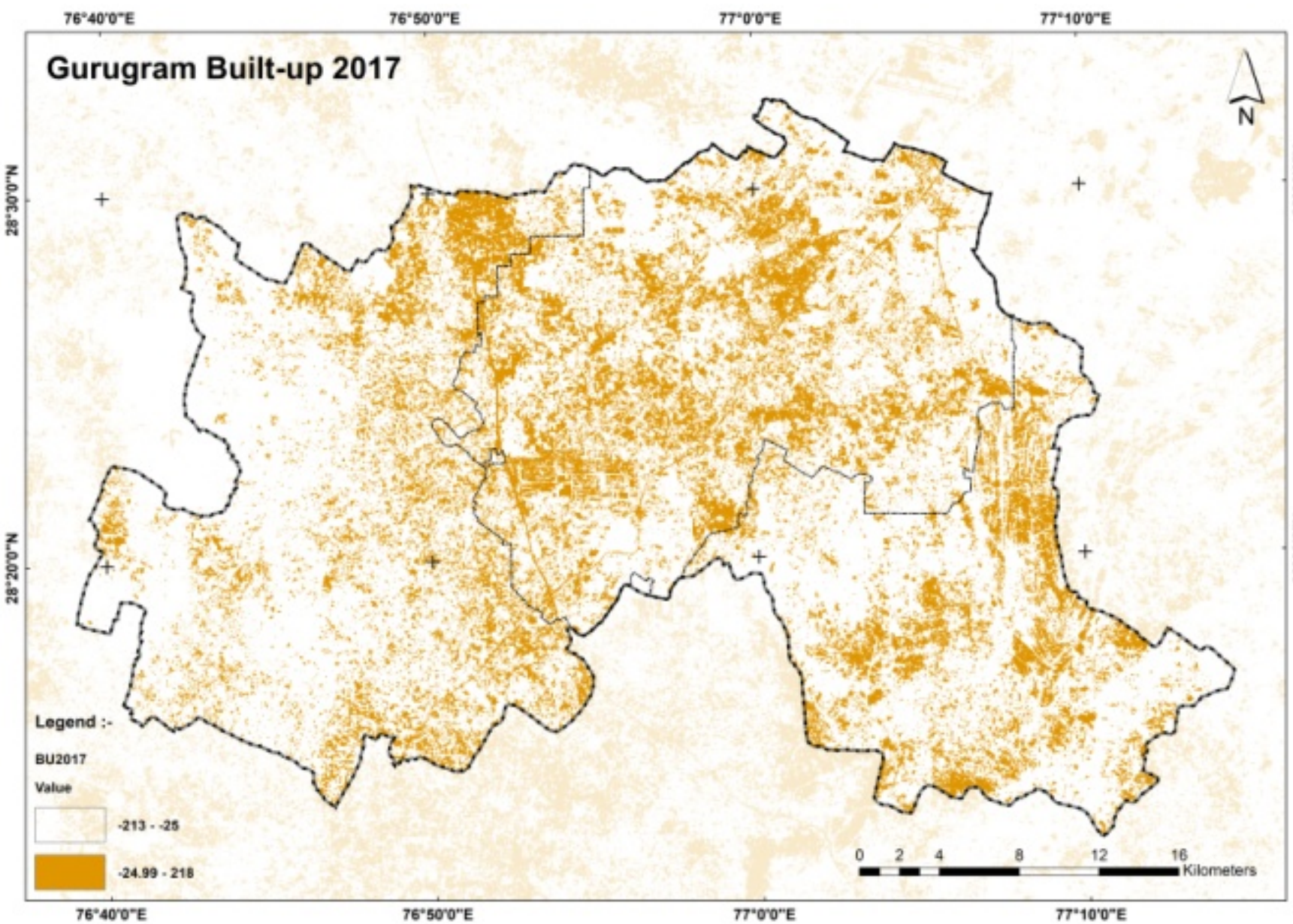




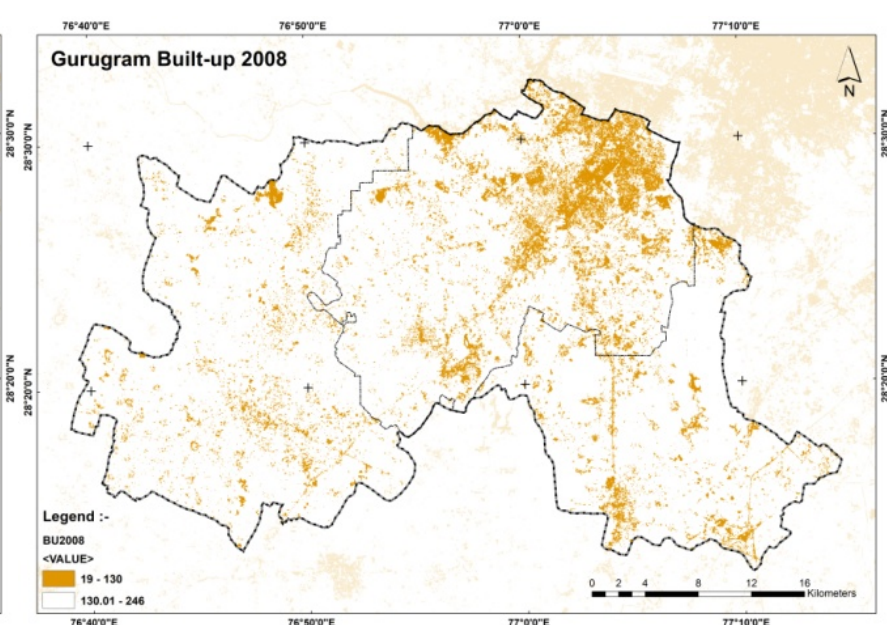
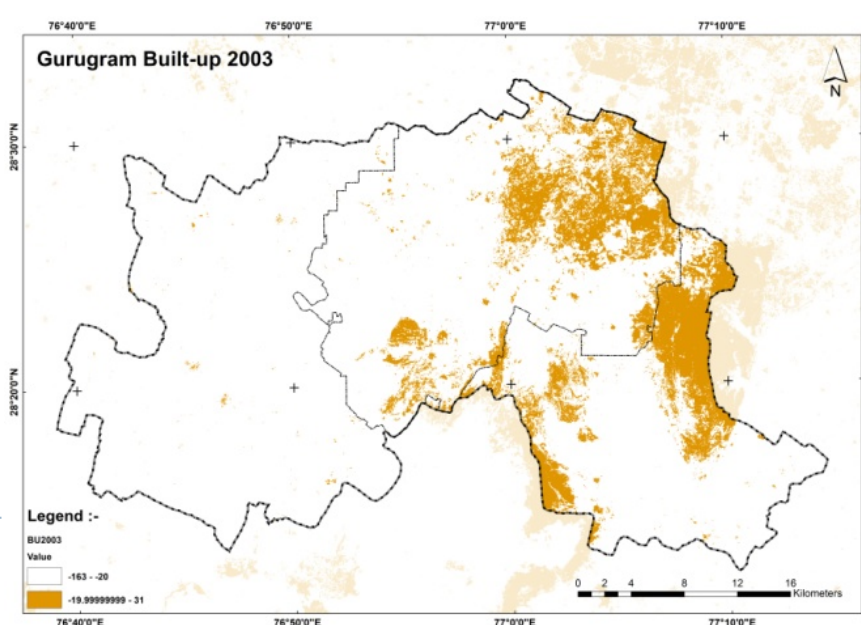
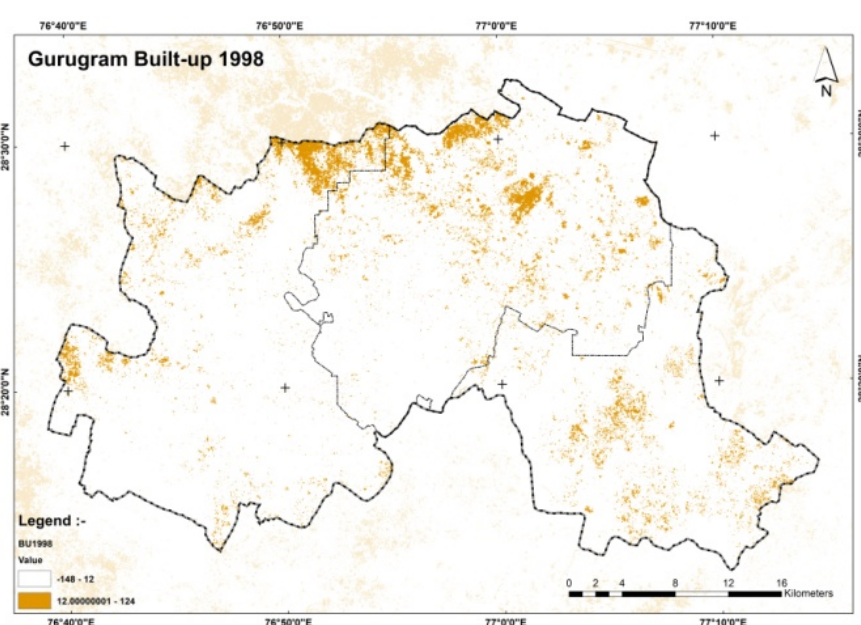
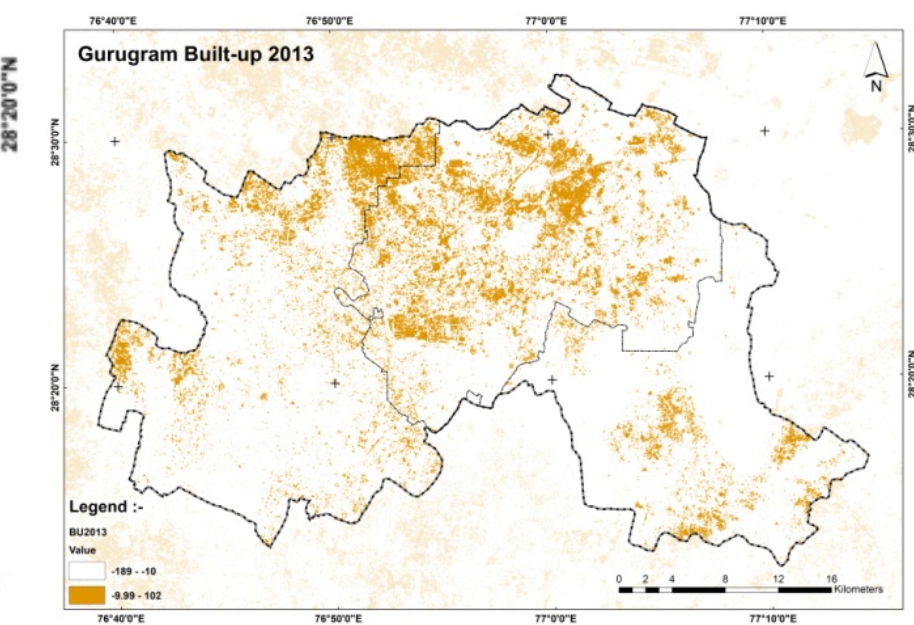
Normalized Difference Vegetation Index (NDVI) shows the trend of green cover over the last 25 years.





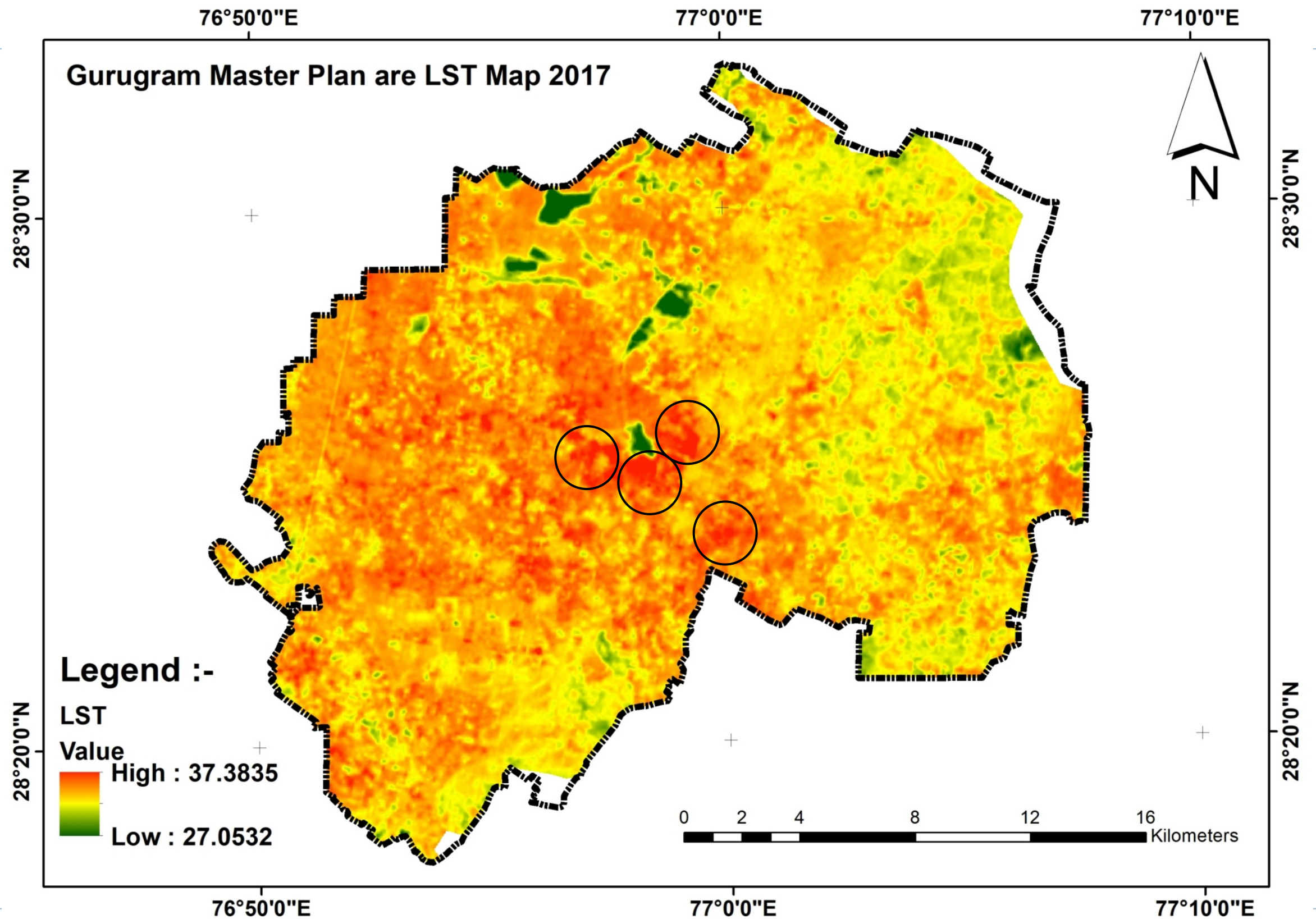


**Normalized Difference Built-up Index (NDBI) shows the trend in the expansion of the built-up cover of the region.**



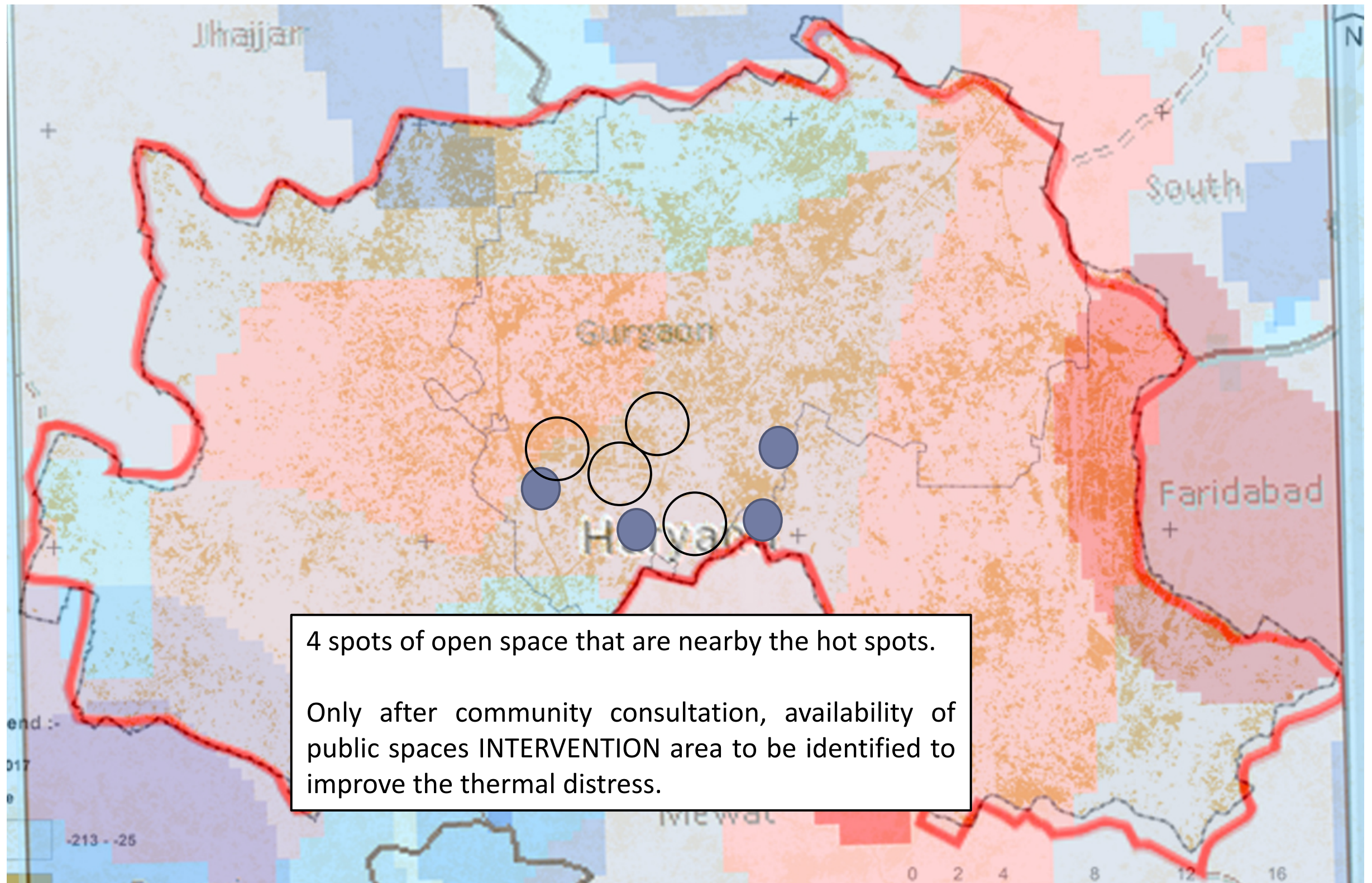


# Land Surface Temperature of Gurugram region 2017 April (Summer)





## Immediate intervention area



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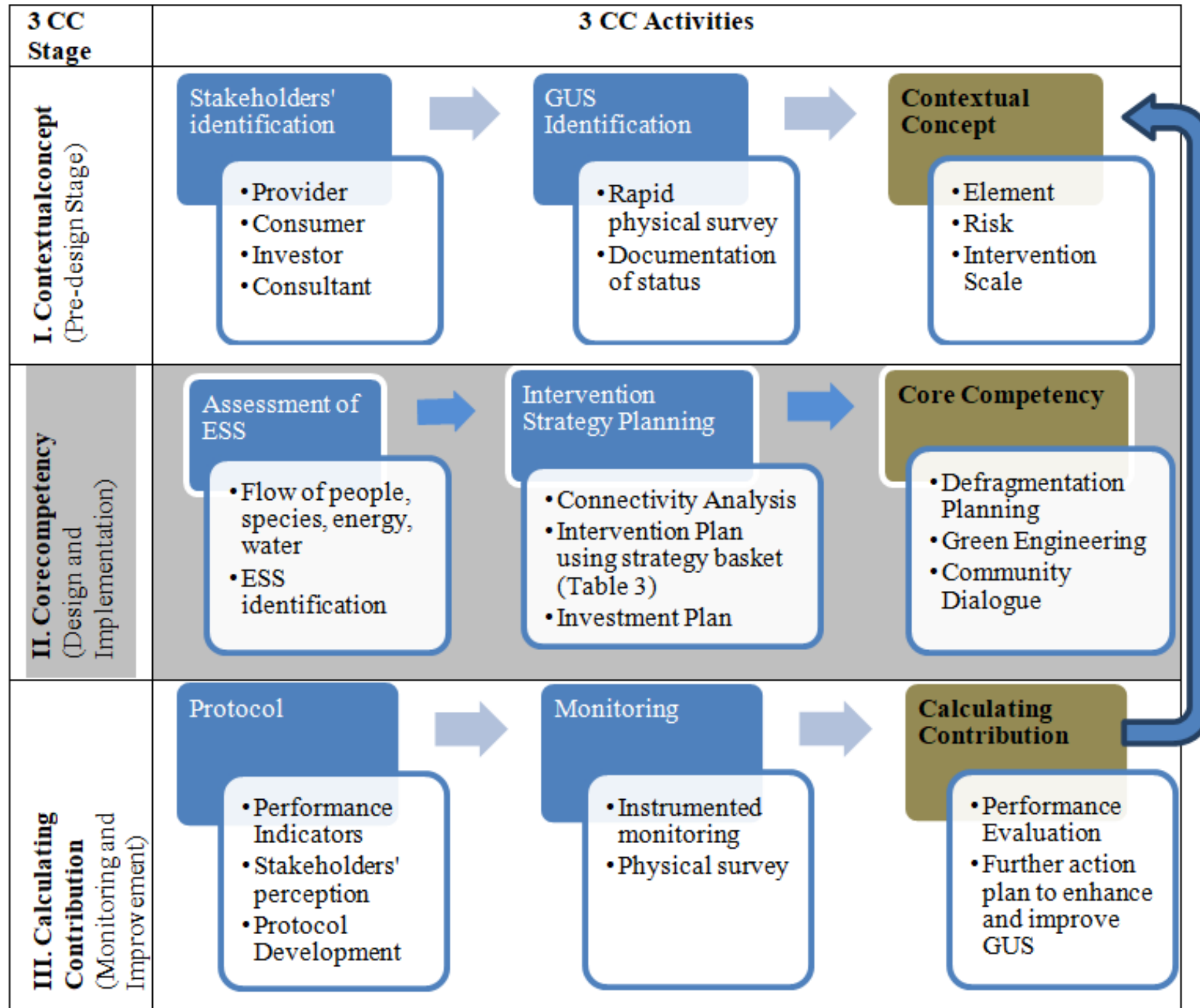
## **IP2. Protocol for Implementation**

Participatory Decision on Implementation





# Green Urban Space as a Risk Resilience Measure



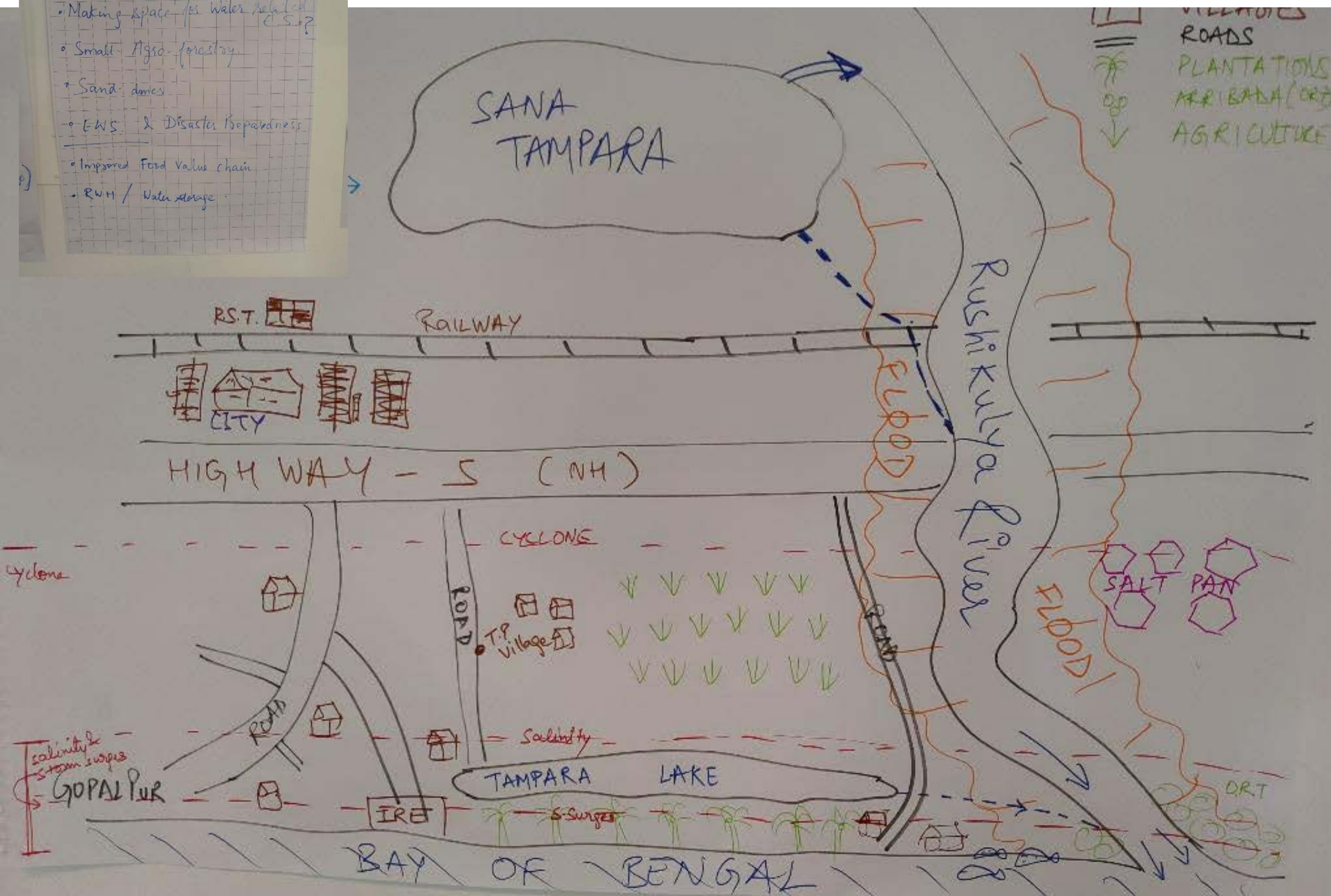
The GUS-3CC Framework

- Biodiversity & Tourism values
- Alternate Livelihoods (mushroom)
- Dialogue with Pvt. Sector
- Making space for water related E.S.s?
- Small Agro-forestry
- Sand dunes
- EWS & Disaster Preparedness
- Improved Food Value chain
- RWH / Water storage

# PRA

IP2

## Participatory Risk Assessment



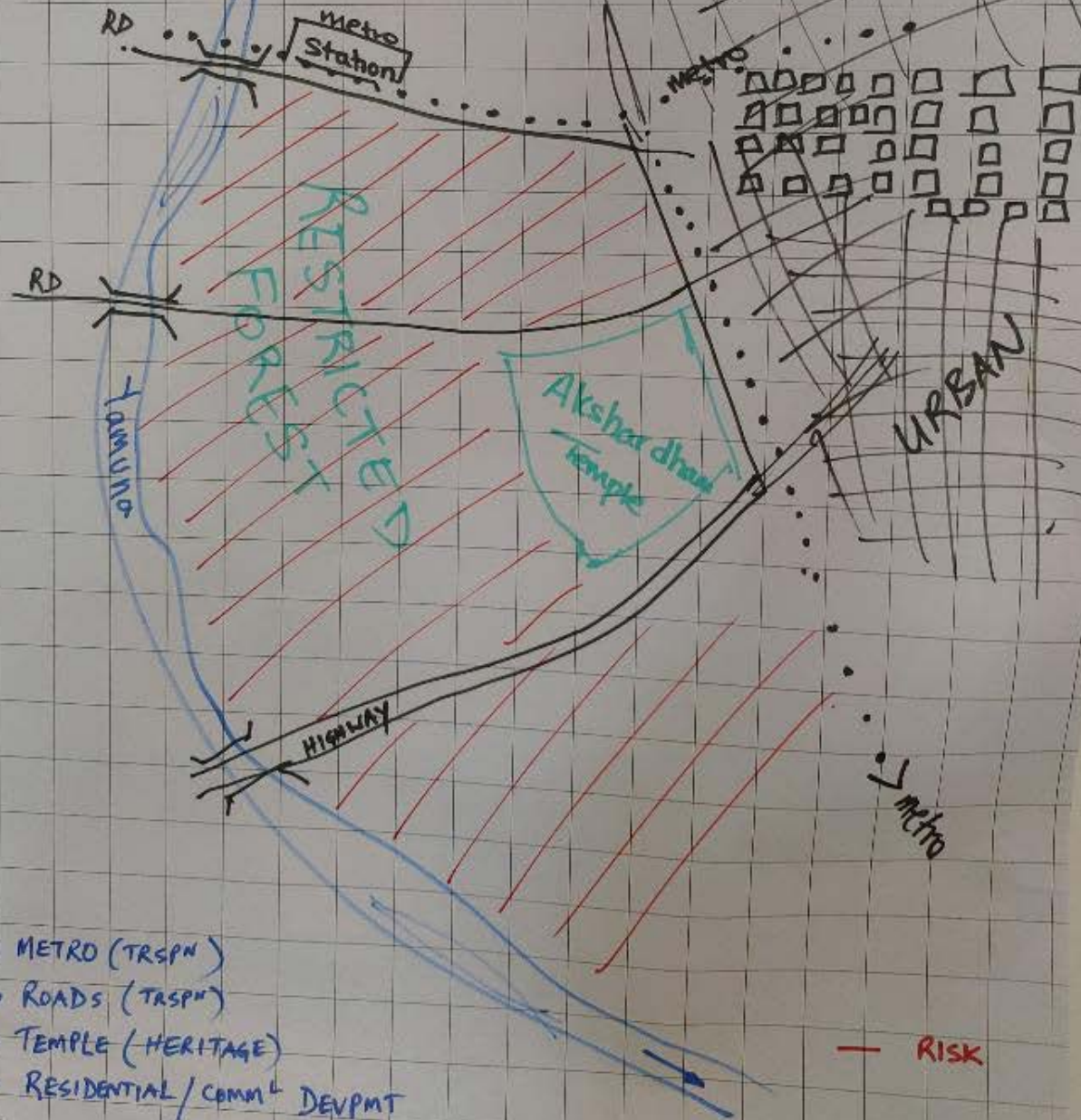


## Hazards:

- flooding ✓
- earthquake.
- drought
- flash flood

## Solutions-flood

- building ~~on~~ wall
- natural embankment
- regrading landscape
- wetland development
- rejuvenate natural ecology
- EWS - river level, rainfall monitoring warning system



## CHALLENGES

- Zoning Clarity Missing
- People acceptance
- Enforcement of Zoning
- Engineering challenges to building wall
- No Community relation
- Weak governance
- Master Plan does not take this (100yr Flooding) flood plain into Account (Hazard frequency)
- Inter Community Relationship
- Faulty Land Distribution Policy
- Conflict between 2 govt policies
- Absence of designated maps
- Govt Inaction of proposed solutions
- Communities lost coping capacity



► Upcoming Publication

# GEOS-NAT for URR



UNITED NATIONS

Office for Outer Space Affairs IIT Roorkee



## GEOS-NAT for Urban Risk Resilience

### Remote Sense Image Analysis for Blue-Green Infrastructure Planning



#### **Mahua Mukherjee**

Centre of Excellence in  
Disaster Mitigation and Management  
Department of Architecture and Planning  
Indian Institute of Technology Roorkee,  
Roorkee, INDIA

#### **Shirish Ravan**

Head, UN-SPIDER Beijing Office  
United Nations Office for  
Outer Space Affairs (UNOOSA)  
Vienna, Austria

#### Research Support:

Arjun Satheesh, Vickyson Naorem and Atul Kumar



# India - International Training Course on Space based information system for Ecosystem based Disaster Risk Reduction (Eco-DRR)



## The Trainers:

Dr. Shirish Ravana, UN-SPIDER

Professor Talbot Brooks, Delta State University

Dr. Senthil Kumar, CSSTEAP, Dehradun

Anshuman Saikia, IUCN

Faculty from CoEDMM, IIT Roorkee

## Date:

25-29 November, 2019

### **IP3. Systematic BGI Integration by Urban Authority**







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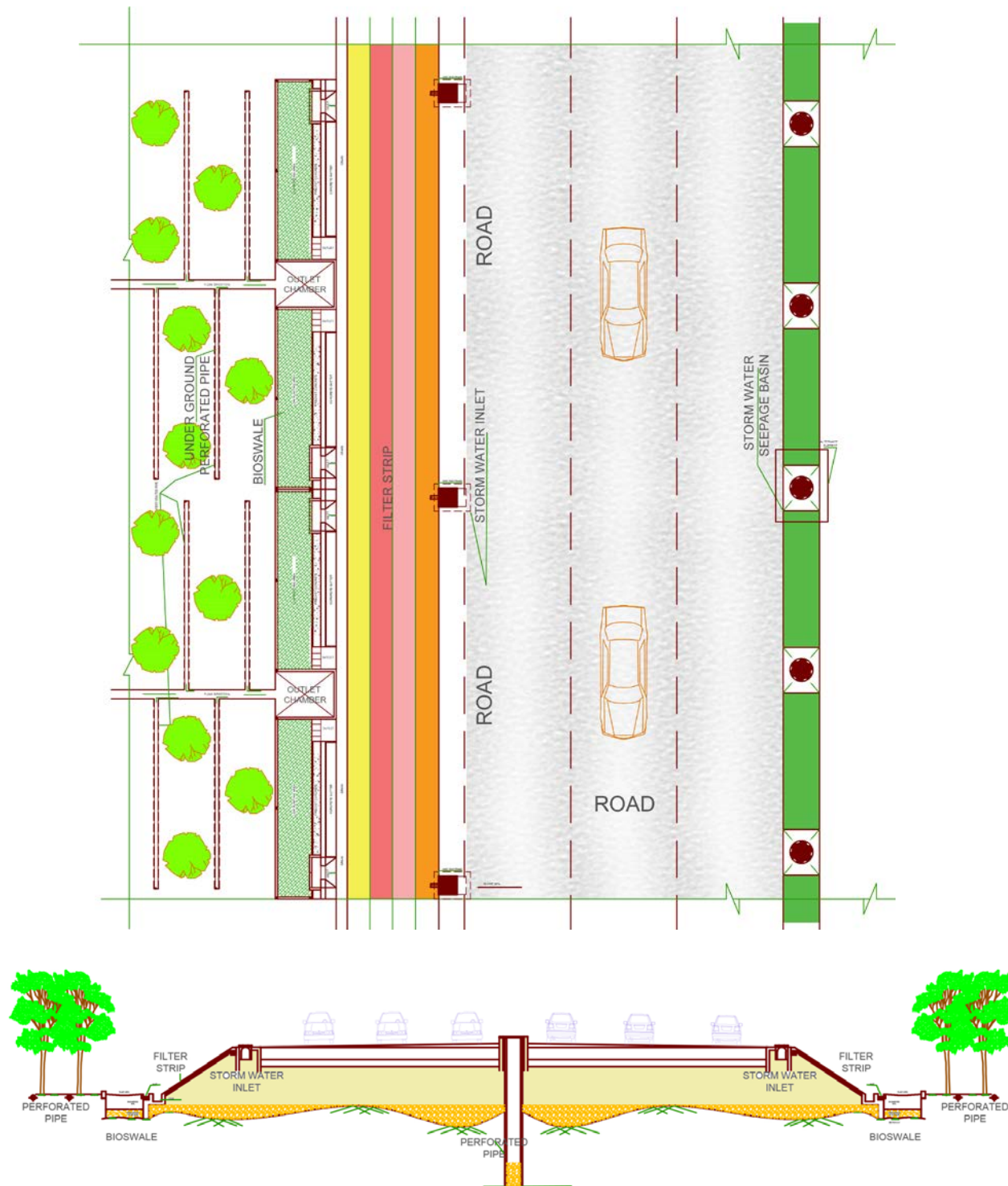
Mission Programmes- 1000 Sponge Cities in China  
Green Highways in India



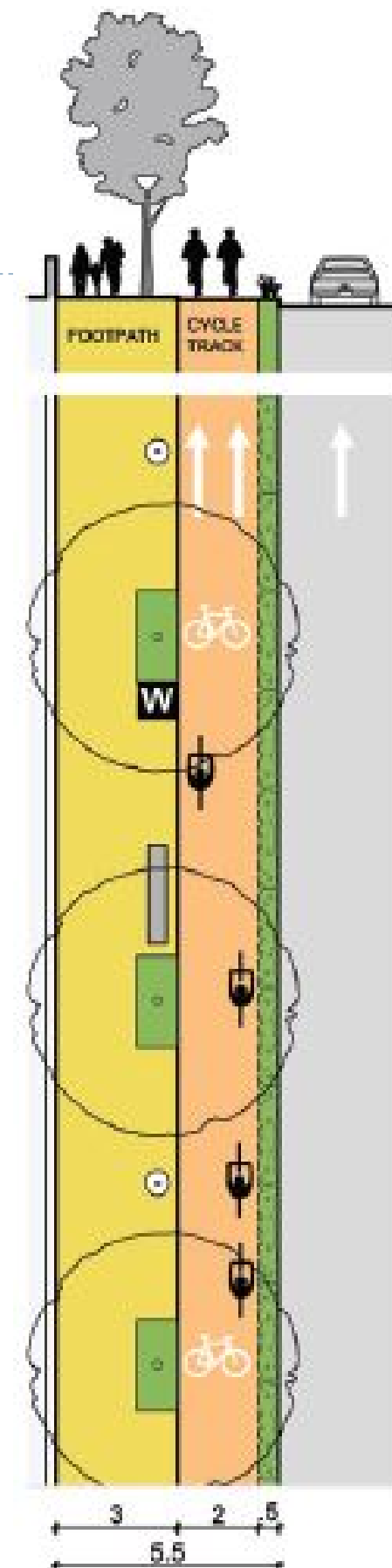


# Fast miles to Last miles :: Green Highway to Footpaths

## Urban Infrastructure:Transportation

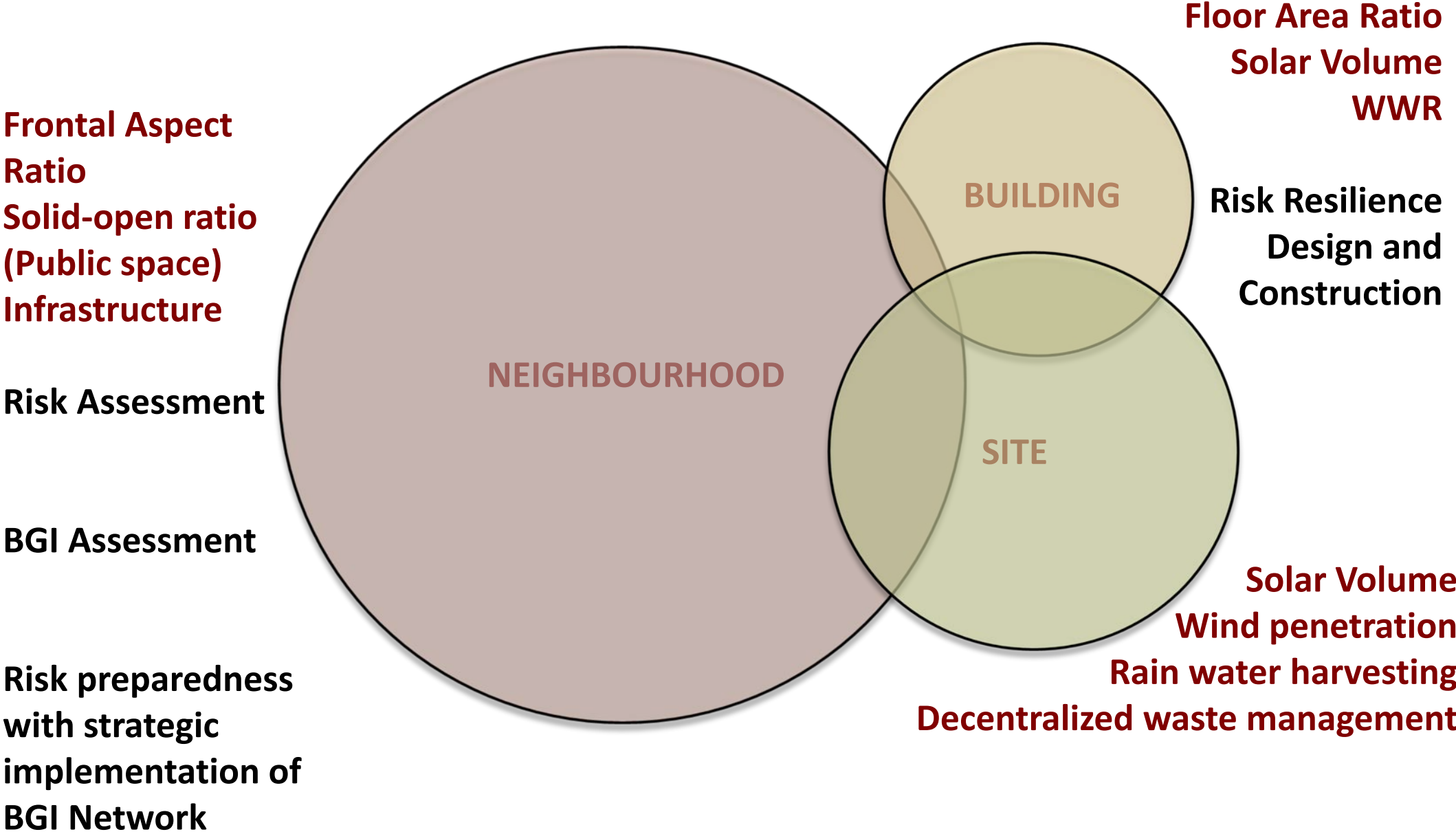


Green highway concepts



Cycle Lanes





# Proposed Assessment Criteria- IP3



Cr. #	Description	Assessment Criteria
AC1	Blue Space ratio	1 km <sup>2</sup> or 250 acres size and avg depth of 7 metres or more all-year round within 3 kms of urban built-up
AC2	Water consumption ratio	Access to large water bodies within their district from which the <b>100% of the urban population's current water requirements can be satisfied</b> (as defined by URDPFI guidelines)
AC3	Green cover ratio	within residential neighbourhoods <b>20% green cover in peak summer</b> months while commercial and industrial areas <b>30% green cover</b>
AC 4	Impervious surface area ratio	<b>50% open, unpaved pervious surface</b> which can soak up rainwater or <b>allow for direct percolation of 100%</b> of mean annual rainfall volume after natural runoff
AC5	Peri-urban to core-urban networking of Blue-Green infrastructure	√ Major BGI for stormwater <b>detention, retention, constructed wetland, artificial lake systems</b> urban forest, botanical and other gardens; and <b>networked through to the core-urban regions via strategic BGI</b>
		√ Right of Way for Blue-Green infrastructure may be proposed similar to right of way for engineered (gray) infrastructure so as to <b>facilitate networking of Blue-Green infrastructure</b>
AC6	Urban heat level index	<b>night time temperature reduction of 4 degrees Celsius</b> to be achieved through BGI interventions while a corresponding <b>daytime heat level reduction of at least 1.5 degrees Celsius</b> to be achieved.
AC7	Underground water Level Index	<b>Annual increase of underground water level of 2m to 4m</b>
AC8	Waste water Index	<b>75% or more of the waste water and sewage</b> being generated in the city is released in to purpose built wetlands or natural wetland systems



# LETS SEE THE CHANGE

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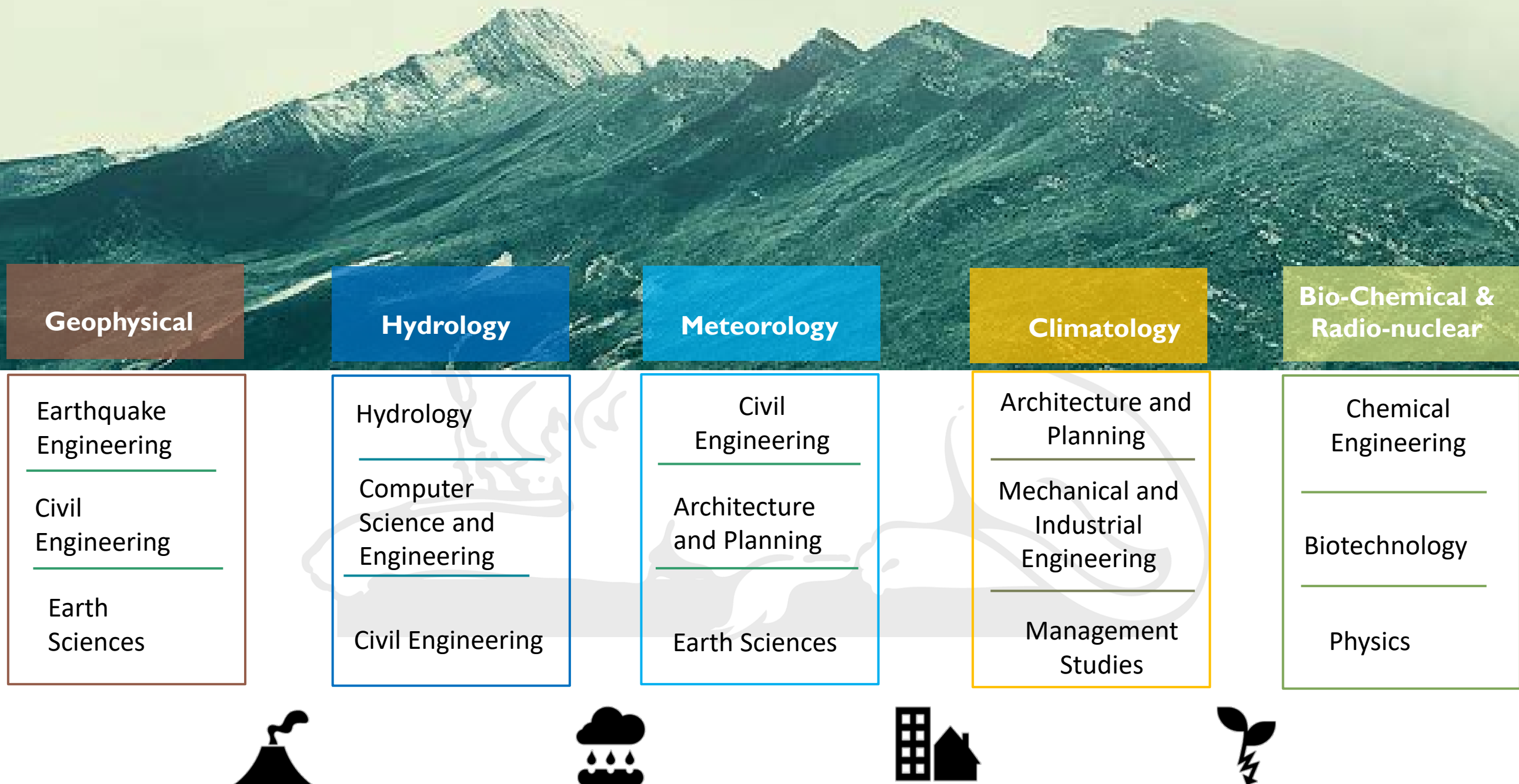
**Cheonggyecheon River urban design in Seoul**

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# The CoEDMM, IIT Roorkee

The CoEDMM has faculty associated from various departments and they together or individually contribute in diverse fields of research.





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**CALL FOR PAPERS and POSTER**

You are invited to submit extended abstract of about 1000-1200 words on the given objectives through the websites (APHW, <http://rwes.dpri.kyoto-u.ac.jp/~tanaka/APHW/APHW.html>) till 10<sup>th</sup> August 2019. mention your affiliation, postal address, phone and fax numbers, and email address. Alternatively you can also email the abstract to the Organising Secretary ETUFM 2019 by above date at [ETUFM2019@gmail.com](mailto:ETUFM2019@gmail.com). Selected abstract will be published as peer-reviewed papers in "Progress in Disaster Science" by Elsevier Journal and "Hydrological Research Letters".

**KEY DATES**

Task	Completion Date
Last Date of Abstract submission	10 <sup>th</sup> August 2019
Notification of acceptance of abstract	30 <sup>th</sup> August 2019
Last date submission of modified abstract	15 <sup>th</sup> September 2019
Early bird registration	15 <sup>th</sup> October 2019
Conference	22-23 November 2019

**REGISTRATION DETAIL****REGISTRATION FEE\*\***

	For Early registration till 15 <sup>th</sup> October 2019	For late registration after 15 <sup>th</sup> October 2019
Delegates	USD 350	USD 450
Delegates from SAARC Countries	RS 6000	RS 8000
Research Scholars / Students	USD 200	USD 250
Research Scholars / Students from SAARC Countries	RS 2500	RS 3500

\*\*Registration fee waiver for selected young scientist including students

**PAYMENT MODE**

DEMAND DRAFT in favour of "DEAN SRIC IIT Roorkee" payable at Roorkee

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Bank IFSC – PUNB0404400

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**ACCOMODATION**

Rooms shall be available on the payment basis for delegates in a wide range of categories within IIT Campus, (NCNGH, KIH, CEC, Community Centre and student hostels on sharing basis. The hotel details shall be posted on website.

**CONTACT DETAILS****Sumit Sen**

Associate Professor

Centre of Excellence in Disaster Mitigation and Management

Dept. of Hydrology, IIT Roorkee

Email- [ssenhfhy@iitr.ac.in](mailto:ssenhfhy@iitr.ac.in)

Tel – +91-01332-284754

For more information please website =

<http://rwes.dpri.kyoto-u.ac.jp/~tanaka/APHW/APHW.htm>

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**APHW2019**

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on

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**22-23 November 2019**  
**IIT Roorkee**

Pre-Conference Event on 21st November 2019

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Thank You!

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Email: [mahuafap@iitr.ac.in](mailto:mahuafap@iitr.ac.in)

