Urban resilience planning approaches:
Gorakhpur and Guwahati cities

Pune

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Raina Singh

Associate Fellow,

Sustainable Habitat Division, TERI

Urban resilience planning - Why and How?

Urbanization and climate risk – Why does it matter?

Urban areas are concentration of large population, economies, infrastructure: central to growth of the nation or the region

Urban areas are growing at an unprecedented rate - often unplanned and unregulated on vulnerable land, prone
to hazards

Over 50% of India's GDP is derived from cities - Climate change impacts can wipe out development gains and significantly reduce quality of life

Climate related Disasters cost an estimated $370 billon USD globally in 2011 (80 per cent of this was in Asia alone)

Associated social costs - Vulnerable groups are the most affected

Development challenges for cities

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In-migration, unplanned growth and urban sprawl

Inadequate infrastructure and limited access to:

- Housing
- Basic services
- Employment opportunities

Marginalization of vulnerable groups

Environmental Degradation

Poor quality of life

Limited resources and capacities of city governments

Source:Francesco Terzini Flickr Creative Commons

Climate risks & The Urban System

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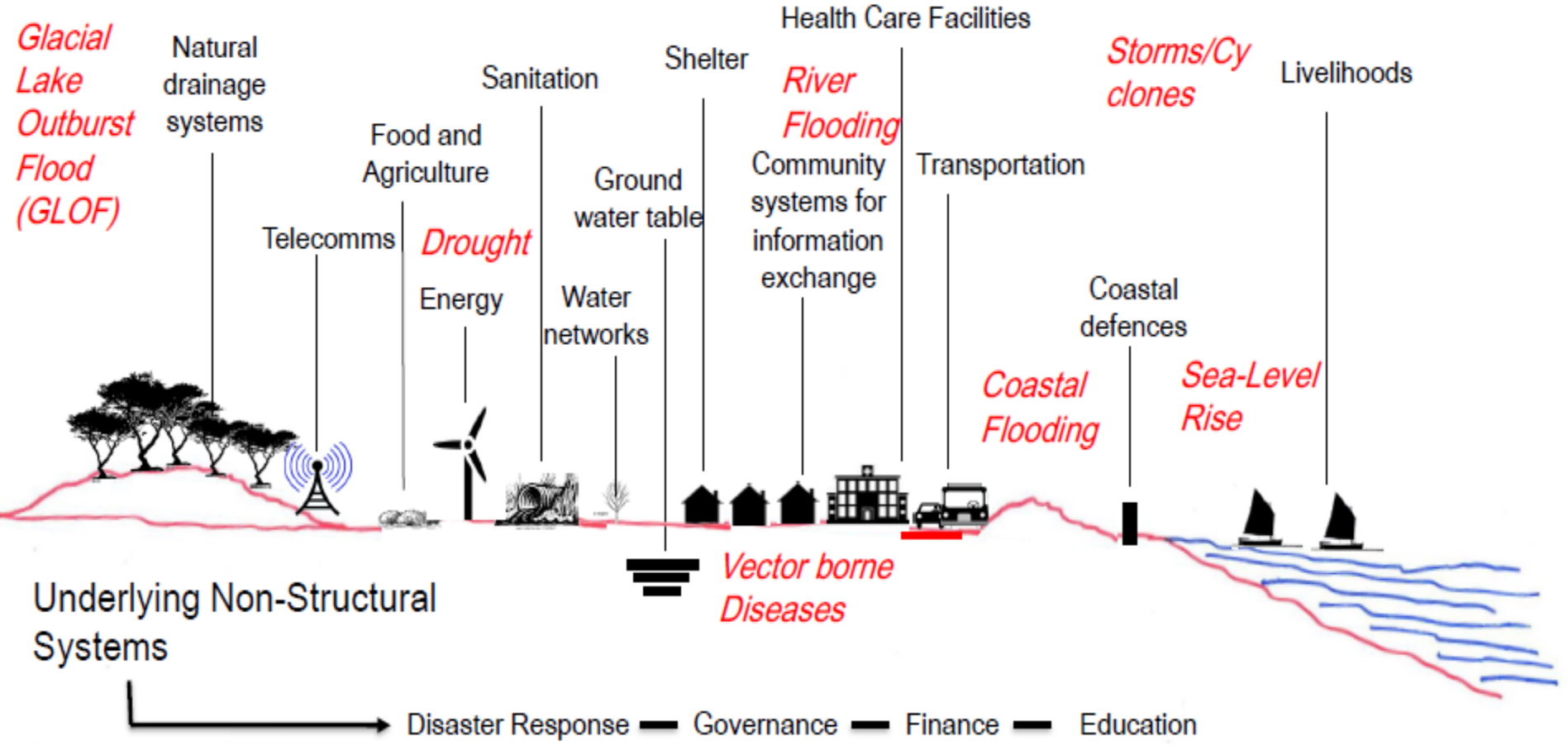

How to climate proof cities

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- Strengthening the adaptive capacity
- Reducing the vulnerability of the urban system against climate change
- Developing strategies and policy instruments for building resilience of our cities
  - **Sensitized planning and management practices – climate resilience on agenda**
  - **Long term resilience building – integrated approach to sector wise climate change adaptation**
  - **Ensuring flow of planned investments for climate resilience**

- Key steps:
  - **Urban profiling**
  - **Identification of current and future climate stressors**
  - **Understanding risks and vulnerabilities**
  - **Identification of strategies to reduce vulnerability and manage risks- develop resilience**
  - **Steering governance processes, regulations and institutions for long term benefits**
  - **Locating finance**
  - **Involving community throughout**

How to plan for climate resilient cities? Are there general rules to follow?

Contextualization is an important element of urban resilience process. It allows for identification of most appropriate process and means for resilience planning considering the geo-topographical, governance, socio-economic as well as climate elements unique to an urban space.

Case Studies

Case study

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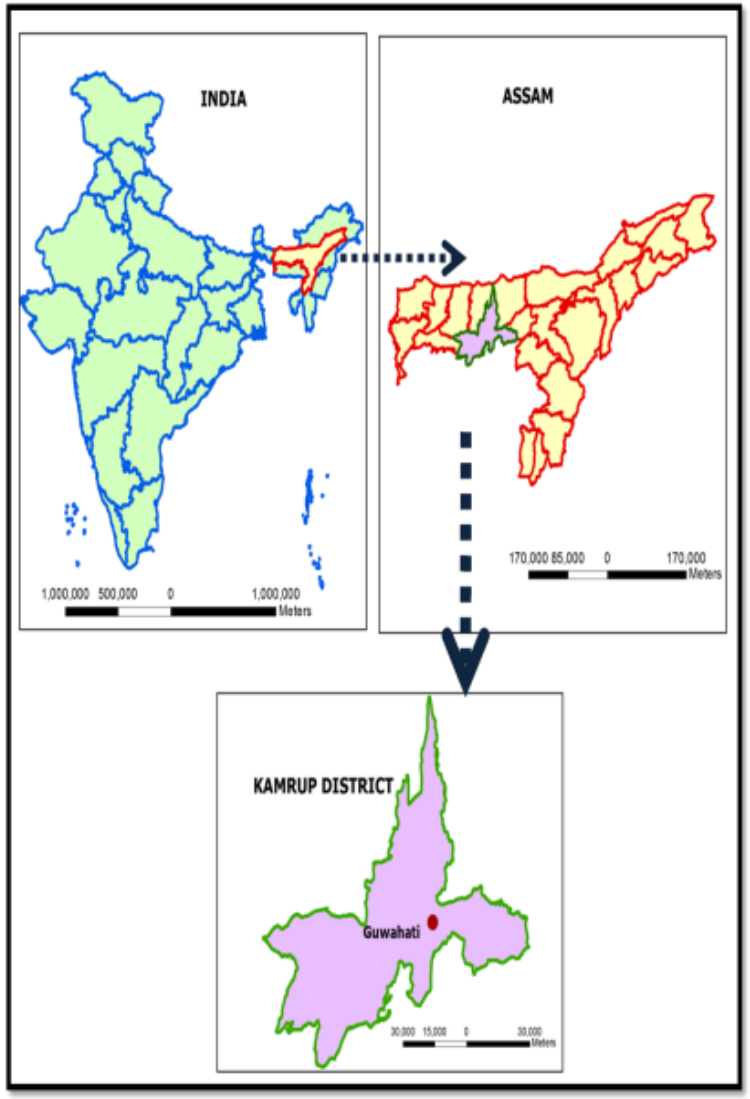
- Project on “Risk Assessment and Review of Prevailing Laws, Standards, Policies and Programs to Climate Proof Cities”
- Part of the Rockefeller Foundation’s Asian Cities Climate Change Resilience Network
- Goals:
  - **Assess risk** of the city to climate change impacts
  - Review the **regulatory environment** and
  - Suggest **resilience measures** and ways to **integrate them into city planning** in order to climate proof Guwahati
- Study cities- Gorakhpur (UP) and Guwahati(Assam)

Guwahati



Guwahati:

Capital city of the State of Assam

Population – 11.9 lacs (UA area, 2011)

Location- $26^0 10'$ N and $92^0 49'$ E

Undulating topography

Located on the banks of the Brahmaputra River, in Kamrup Metropolitan District

JnNURM city

Guwahati – Risks and Challenges

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PUBLIC HEALTH AND SANITATION ISSUES

DRAINAGE ISSUES

DEGRADATION AND ENCROACHMENT OF WETLANDS AND WATERBODIES

LACK OF WASTE DISPOSAL SYSTEM

PRONE TO LANDSLIDES

Source: english.samaylive.com

GUWAHATI CITY

Source:http://rahconteur.wordpress.com/2010/12/20/dispur-is-thatpur/

UNAUTHORISED AND INFORMAL SETTLEMENTS

PRONE TO URBAN FLOODING

Source: ibnlive.in

LACK OF SEWERAGE SYSTEM

UNPLANNED AND UNREGULATED GROWTH OF THE CITY

Approach to Resilience Strategy

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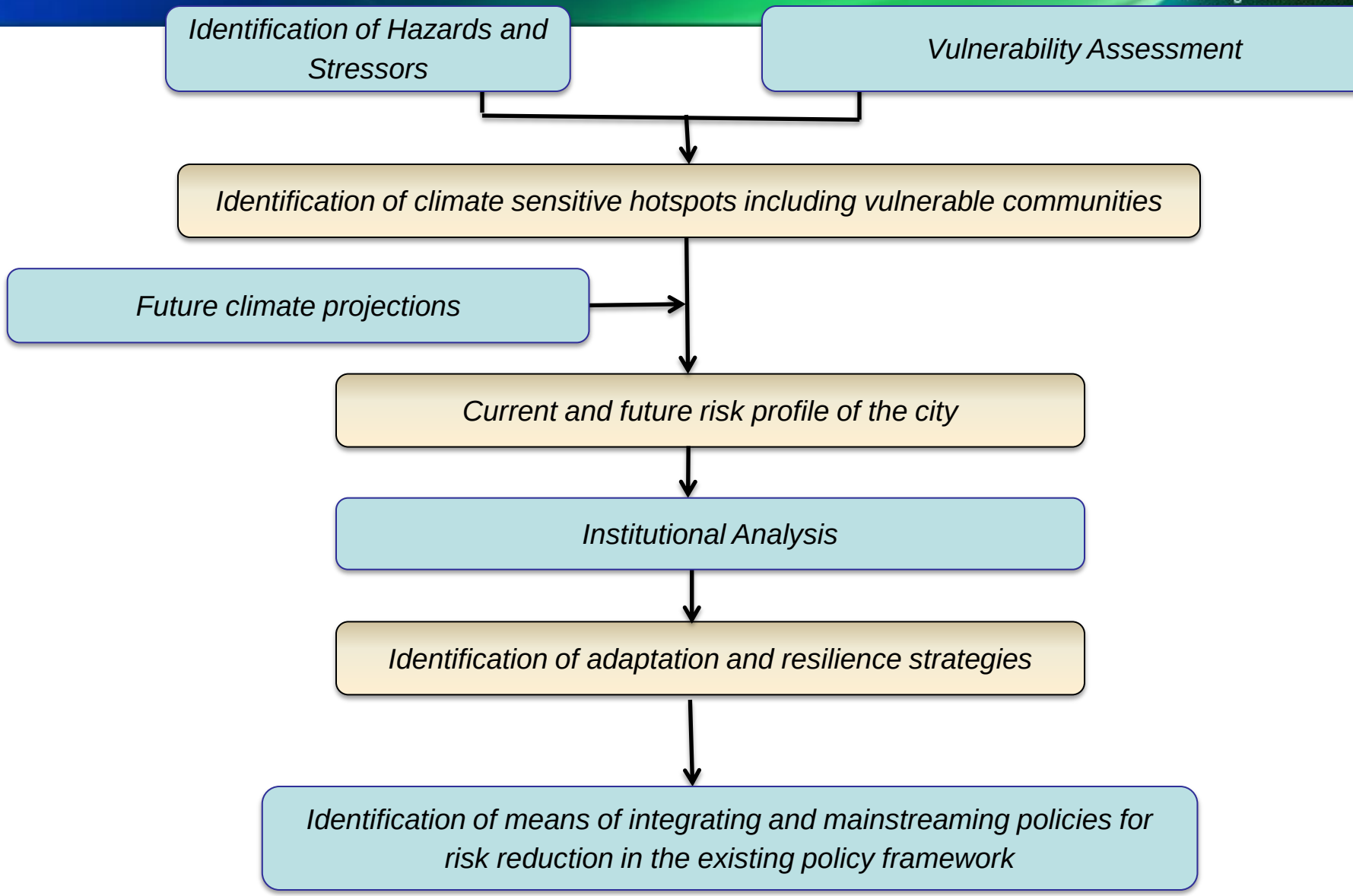
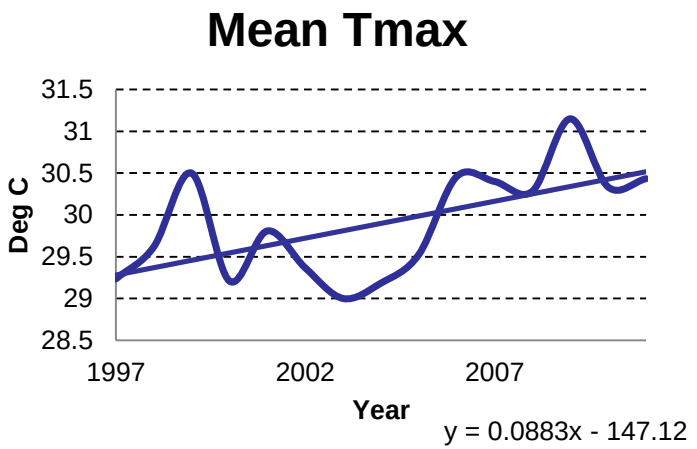
- What are the critical assets in the city which might be at risk due to flooding or any other disasters?
- What are the sectors impacted by the ‘future and current risks’?
- Which are the vulnerable class subjected critically to risks?
- What are the governance parameters that can help build resilience?

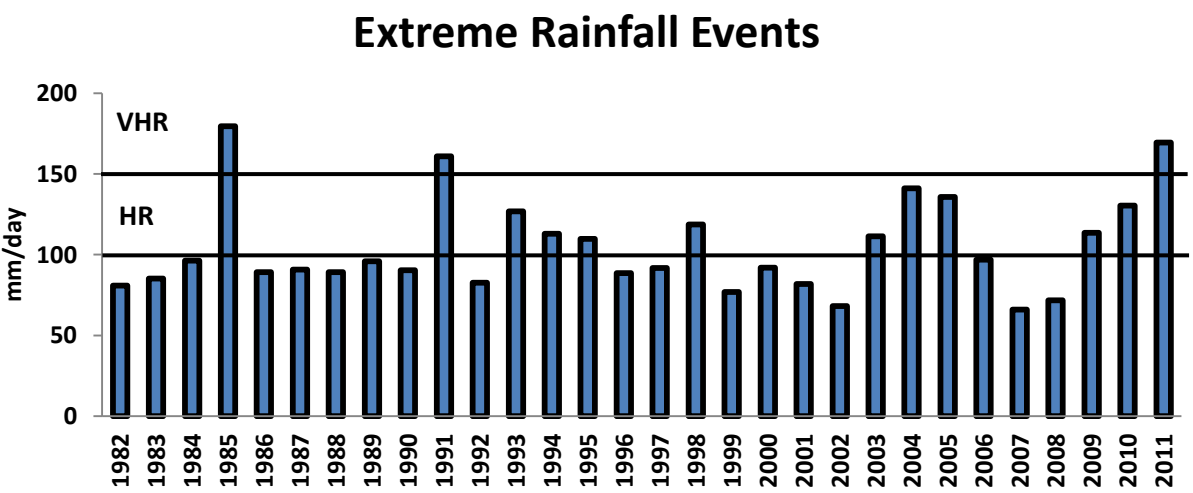
Framework for Risk Assessment

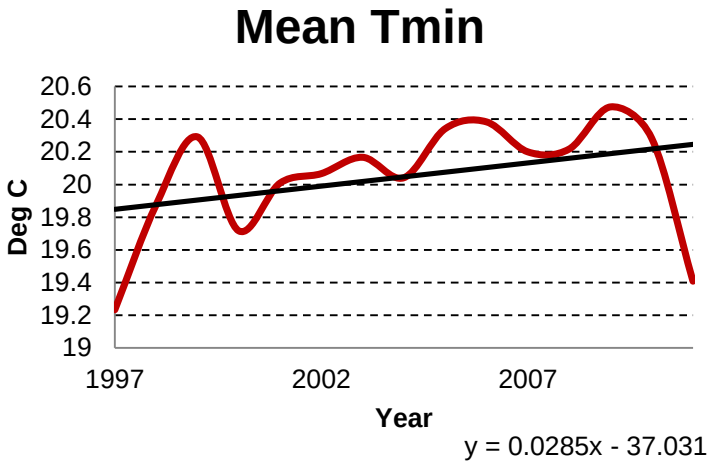


Climatic stressors – Past trends

- Increasing trend for both maximum and minimum temperature for Guwahati city
- Decreasing trend seen in seasonal mean rainfall for monsoon months over Guwahati
- Increase in extreme rainfall events especially in the last decade







Source: Regional Meteorological Centre, Guwahati

Climatic stressors - Future Projections A1B scenario for 2030s

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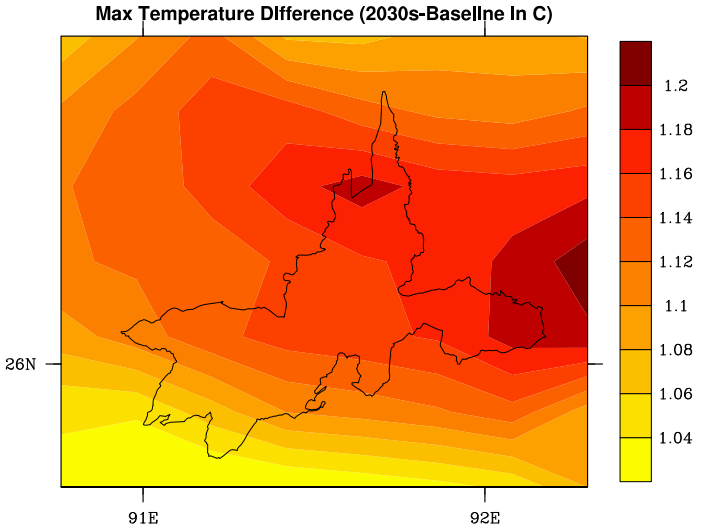
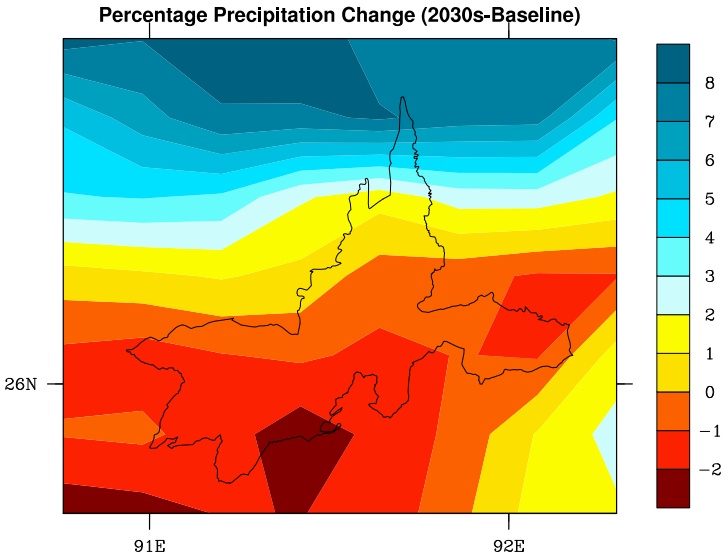
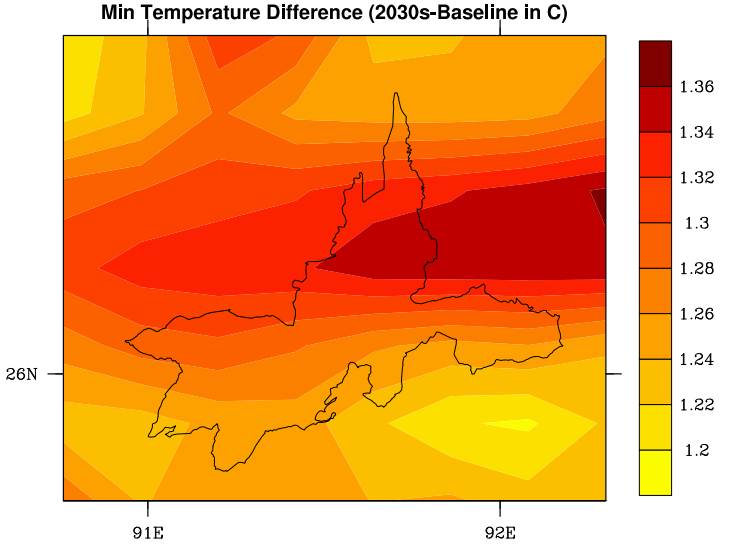
- Projections of temperatures for the whole district shows an increasing trend for the future in 2030s as compared to the baseline period of 1970-2000.
- The city of Guwahati shows an increase of about 1.2° in maximum and about 1.3° in minimum temperature.
- Slight insignificant decreasing trend seen in percentage precipitation change







Regional model simulations at 25kmX25km resolution carried over the Kamrup district using PRECIS

Non-climatic stressors - Urbanization trend, 1999-2010

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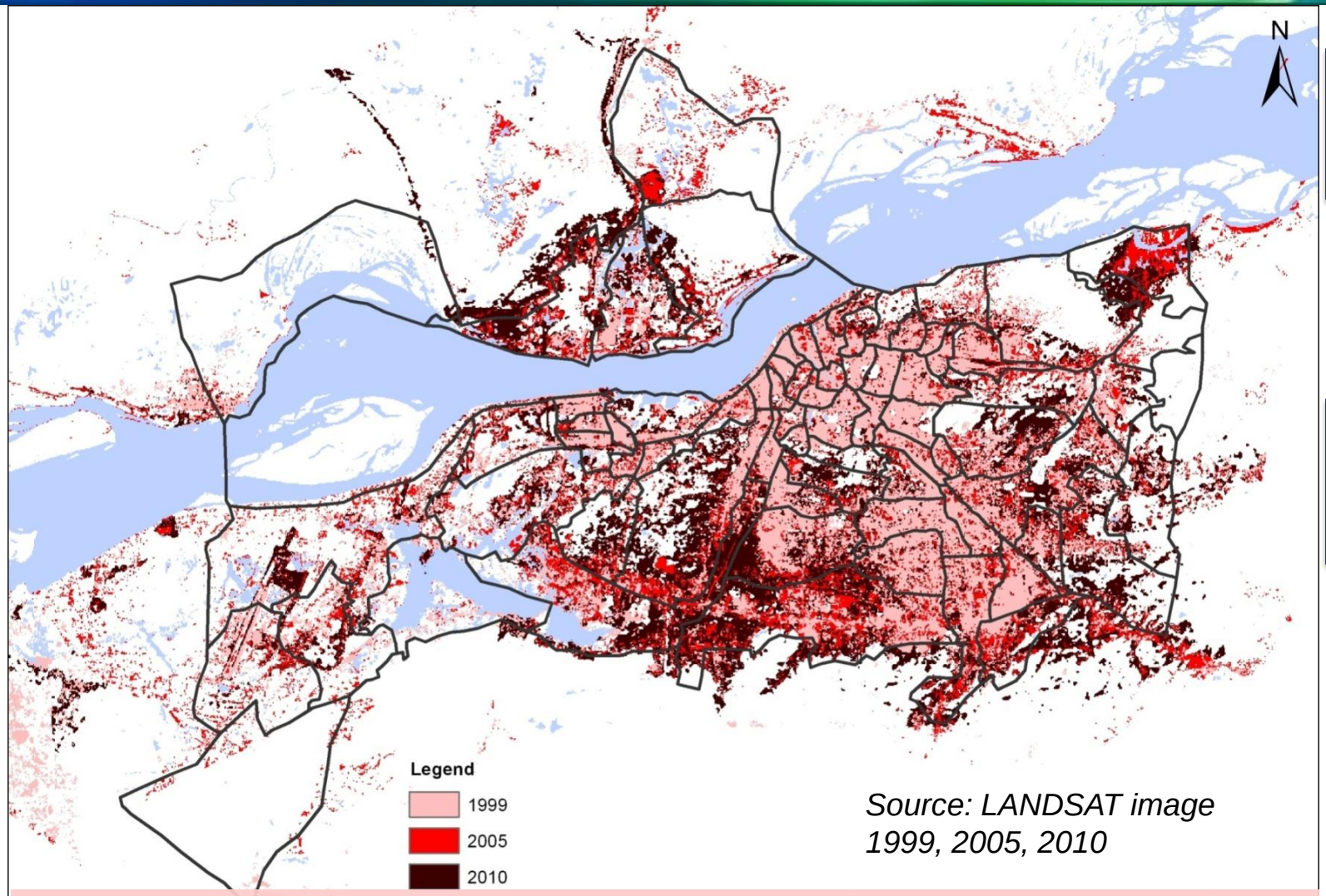


Source: LANDSAT image 1999, 2005, 2010

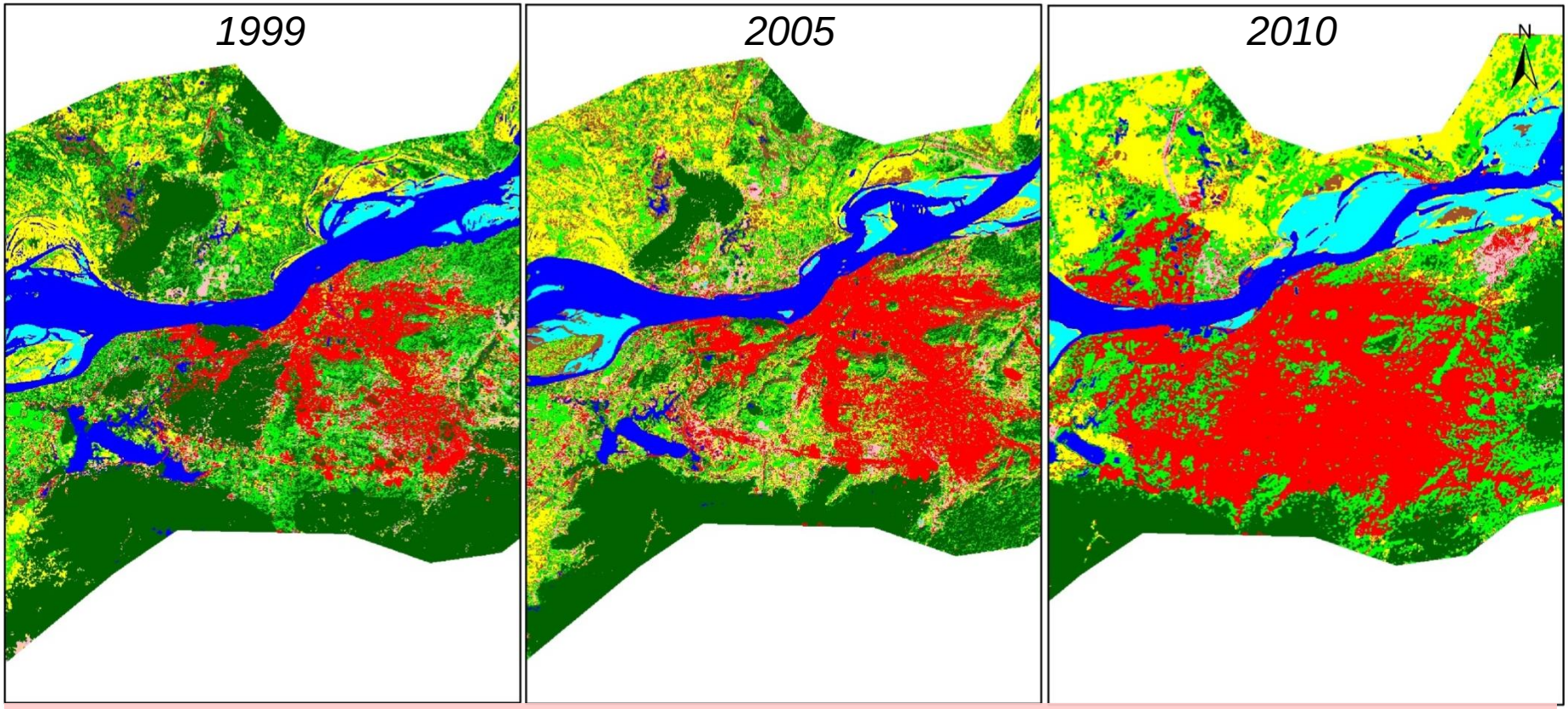
1991 Population: 646,169

2001 Population: 890,773

2011 Population: 1,193,429

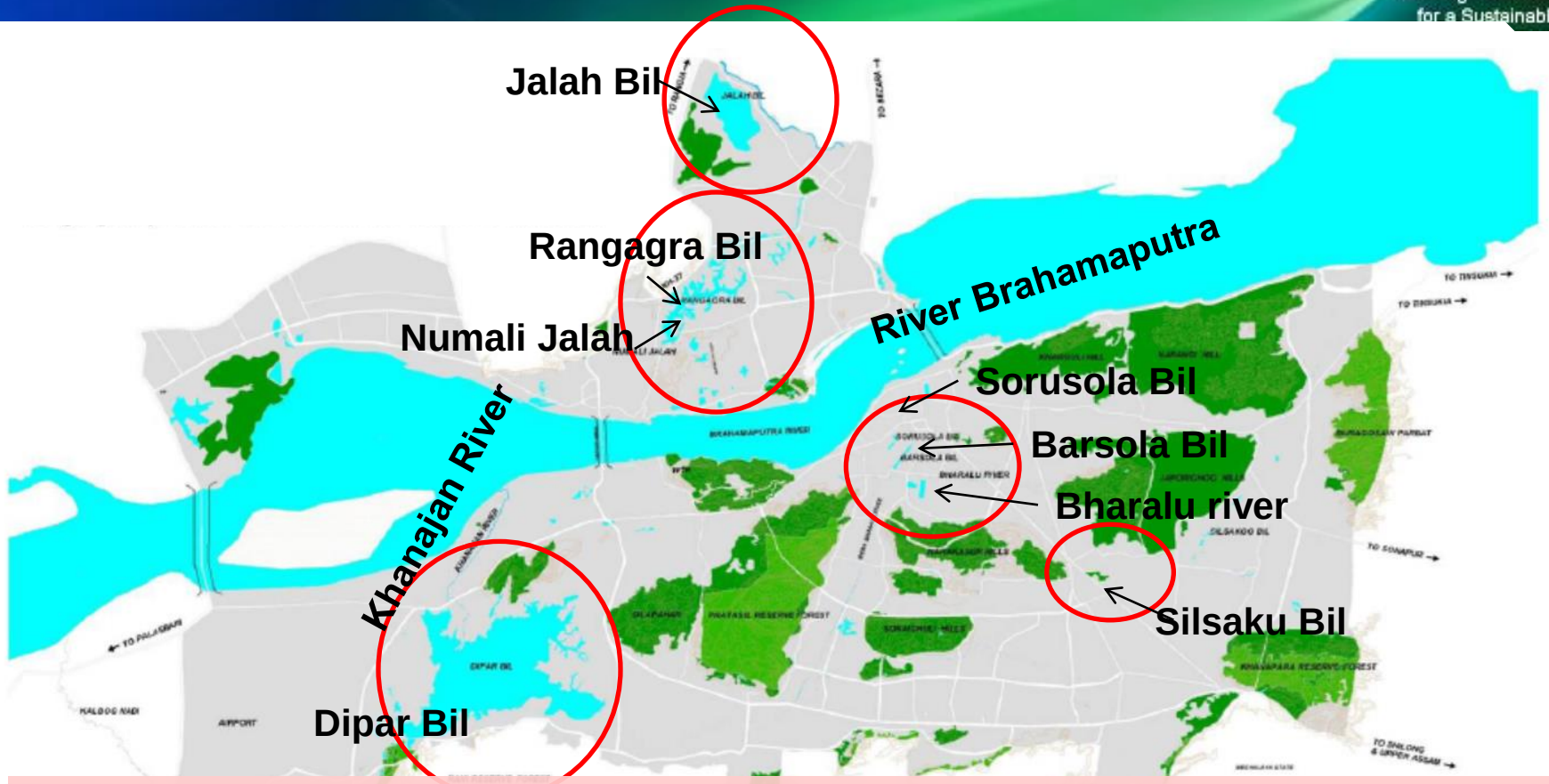
Rapid increase in population and spatial extent (built-up) of the city

Non-climatic stressors – Land Use Land Cover Changes, 1999-2010



- *Conversion of sparse built-up into dense built-up*
- *Emergence of pockets of sparse built-up*
- *Northern part of the river has emerged as a new built-up in year 2010.*
- *Decrease in extent of dense forest and conversion of dense to sparse forest*

Implications on the urban ecosystem



- *Encroachment of significant natural features like natural wetlands (Bils), watershed areas and hills.*
- *Hill cutting in fragile hilly areas which are not fit for development.*
- *Unplanned and unregulated expansion of the city, especially on hills has added to the vulnerability of the city. 90% of the landslides occur in these areas*

Non-climatic stressors – Inadequate and inefficient urban services

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- **Inadequate capacity of existing drainage and sewerage systems**
- **Siltation, solid waste**

- **Marginalization of informal settlements and slums while urban planning and service provision**

- **Inadequate pubic health management – lack of resources and infrastructure**
- **Low emergency response capacity**

POLLUTED FLOWS THE BHARALU

A view of the polluted Bharalu river in the Bharalumukh area in Guwahati on Sunday. The river has been reduced to a stagnant water body because of the solid waste and sewage that is dumped into it. The obnoxious stink from the polluted river has made life miserable for the residents of Bharalumukh. Despite repeated appeals from various quarters, no concrete steps have to taken so far to clean the river. Pollution Control Board (PCB) chairman Dr RM Dubey said that disposal of waste materials in the Bharalu river affected the flow of water and this was a major reason for flooding in the low-lying areas in Guwahati. (Sentinel)

Implication - Increased incidence of Urban Floods and Epidemics

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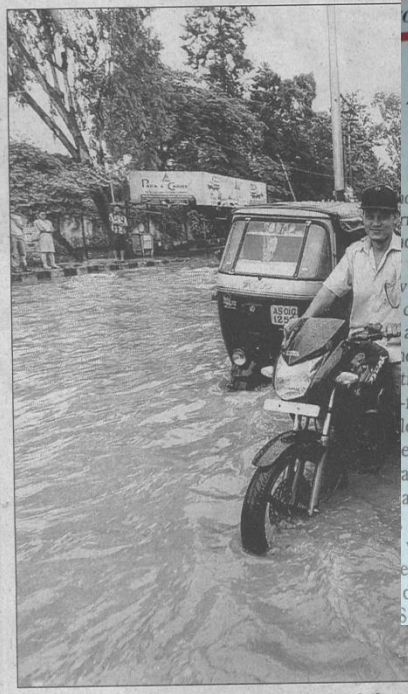
WATER WORLD

Plans in time of waterlogging

Govt to seek IIT help on floods

ARNALI HANDIQUE

4: The Kamrup (metro) ict administration will seek the help of IIT ahati to conduct a study he perennial problem of logging in the city.
he study will be under- to find a permanent and g solution to bail out the ents from recurring flash s.
he recent heavy rain had nerged several low-lying ities here under floodwa- or days at a stretch, cut- off these areas from the of the city. While Bharalu as the main drain, ugh which floodwater can et out from the city, the e gates at Bharalamukh Bonda could not be ed this time to let out the r as the level of Brahma- a was higher than that of



Vehicles plough through a waterlogged street. File picture

flood-related issues for the comprehensive proposal that main channel through which can be let out into the Brahma-

Commuters wade through a waterlogged street in Guwahati on Monday night. Heavy rain triggered traffic snarls after vehicles got stuck at several places.
Picture by UB Photos

ISHED SIMULTANEOUSLY
OL. 74, NO. 250, GUWAHATI, WEDNESDAY, SEPTEMBER 12, 2012, Pages 16

Flash floods throw city life out of gear

STAFF REPORTER

GUWAHATI, Sept 11 – A ort spell of rains in the af- noon hours inundated the ds of Guwahati city, expos- the face of the Guwahati velopment Department, civic bodies and the dis- administration.
e tall claims of the admin- tion to make Guwahati free, submerged under loodwaters that threw e's lives out of gear for al hours.
always, the RG Baruah GNB Road and MRD were completely sub- ed in water, with knee- density at places. Parts S Road also witnessed

A waterlogged street in Guwahati on Tuesday evening. – UB Photos

hours made the situation more be a folly to expect anything floods waters from the flood

well as remote areas in the Kamrup (metropolitan) district and educating people on how they can prevent the outbreak of water and vector-borne diseases by keeping their surroundings clean and

warned the public against consuming contaminated water and uncovered street food during this time.

"Though street-side vendors selling different edibles

Guwahati: Vulnerability to floods & landslides

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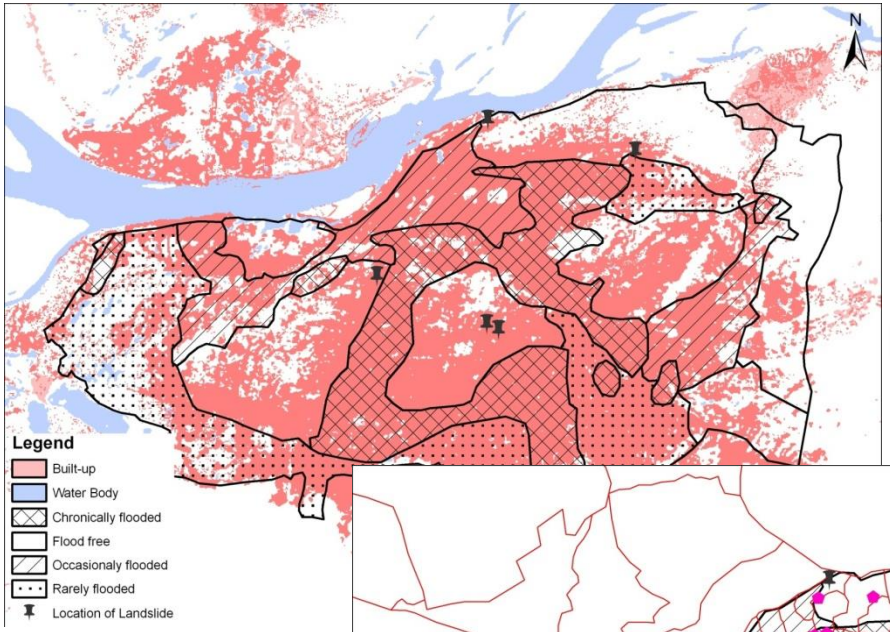
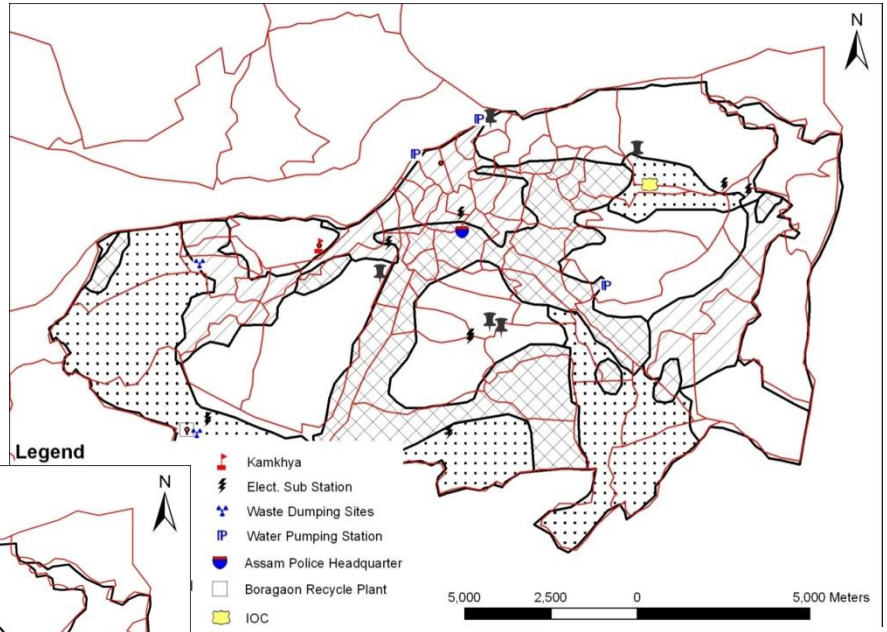
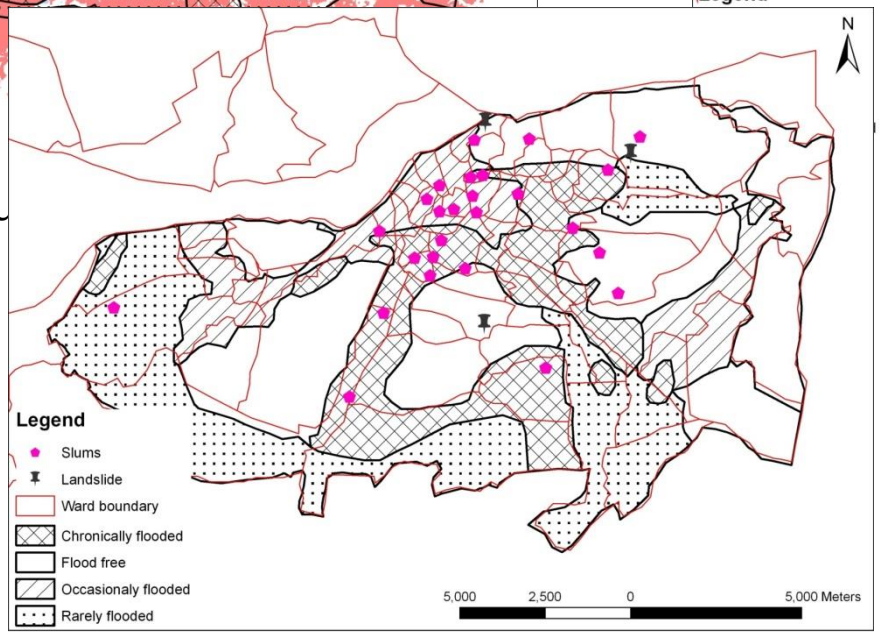


Identification of vu



Identification of vulnerable infrastructure and services



Identification of vulnerable communities

Guwahati City Resilience Strategy

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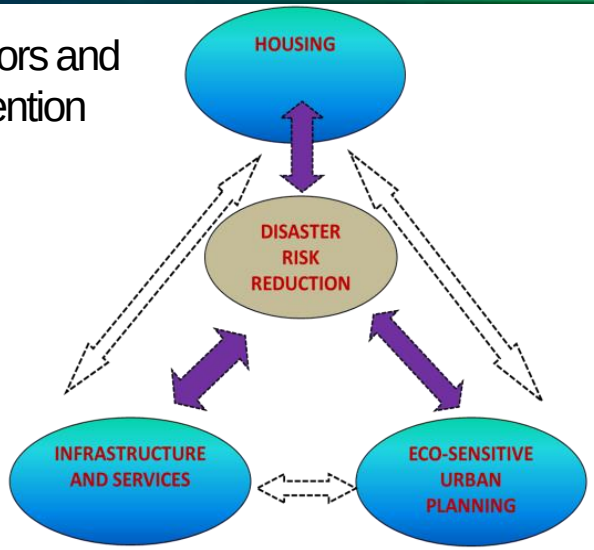
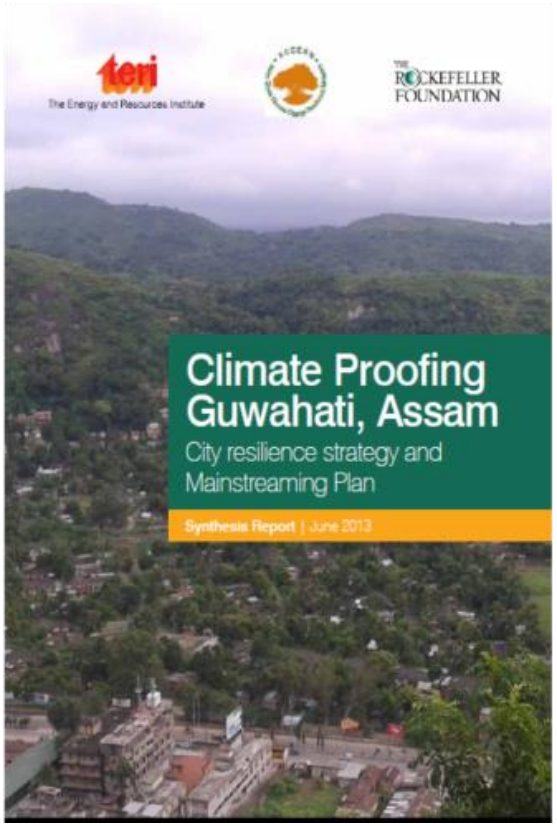
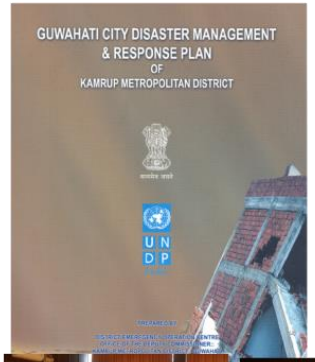
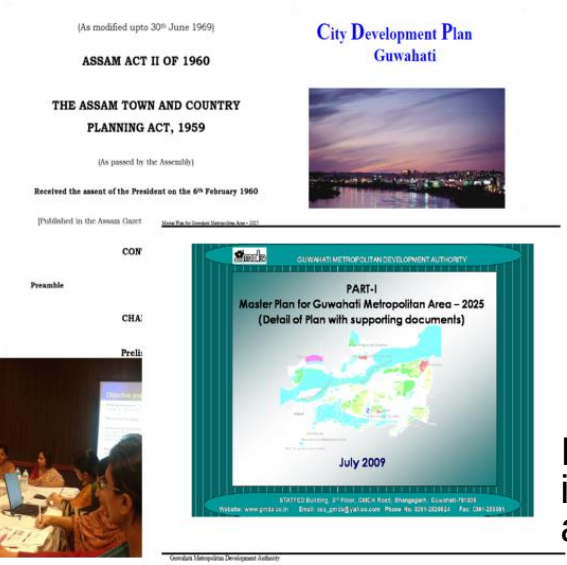
Identification of sectors and strategies for intervention



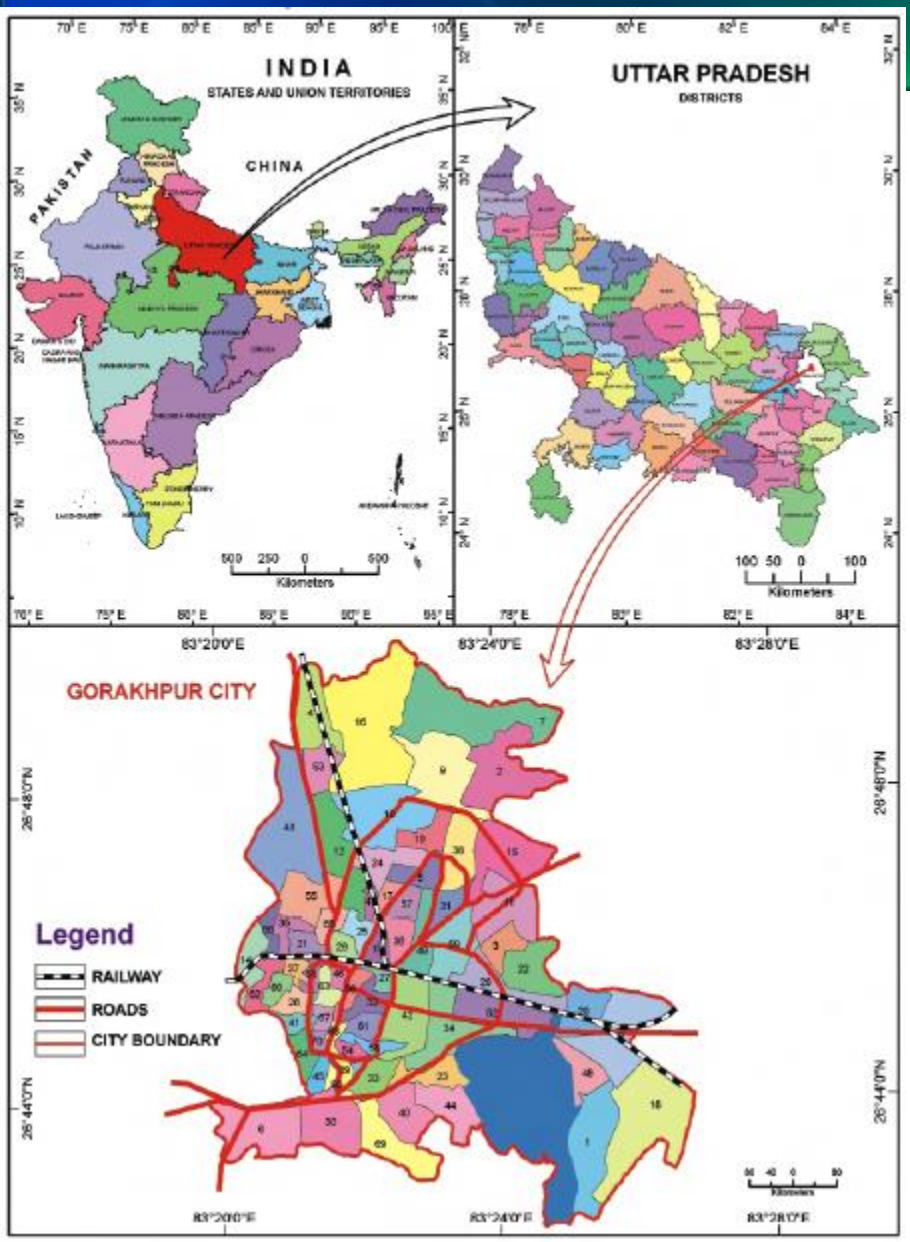






Identification of entry-points for implementation through Institutional and Policy Analysis

Gorakhpur



Gorakhpur:

Medium sized city in the State of Uttar Pradesh

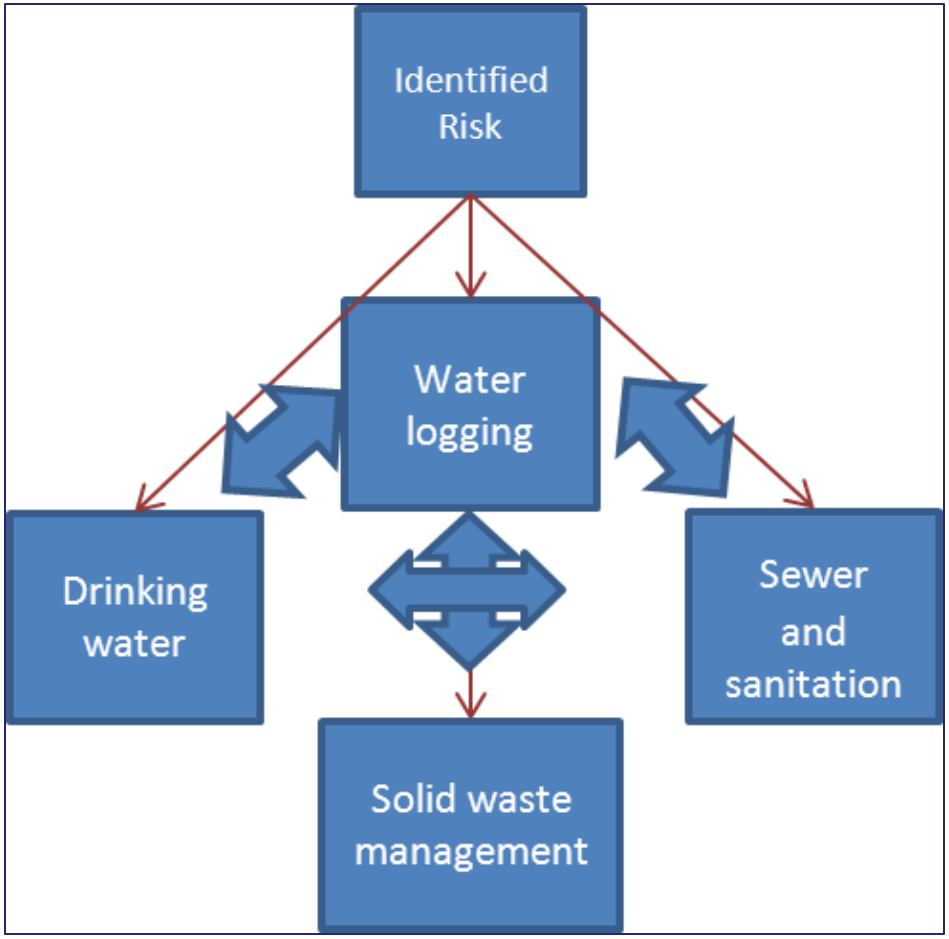
Population -692,519 (UA area, 2011)

Location- 26° 45’ N and 83° 24’ E

Height- 80m above sea level

Set in the foothills of the Himalayas, at the convergence of two rivers ‘Rapti’ and ‘Rohin’.

Gorakhpur - Identified Risk



- Water logging is the prime risk for the city and would accentuated in the climate change scenario.
- The other 3 risks either have causal relationship with the occurrence of water logging or are impacted severely by the water logging problem.
- They become an essential components while addressing the overall problem of water logging in the city with climate change scenario or without climate change scenario.

Gorakhpur City Resilience Strategy (CRS)

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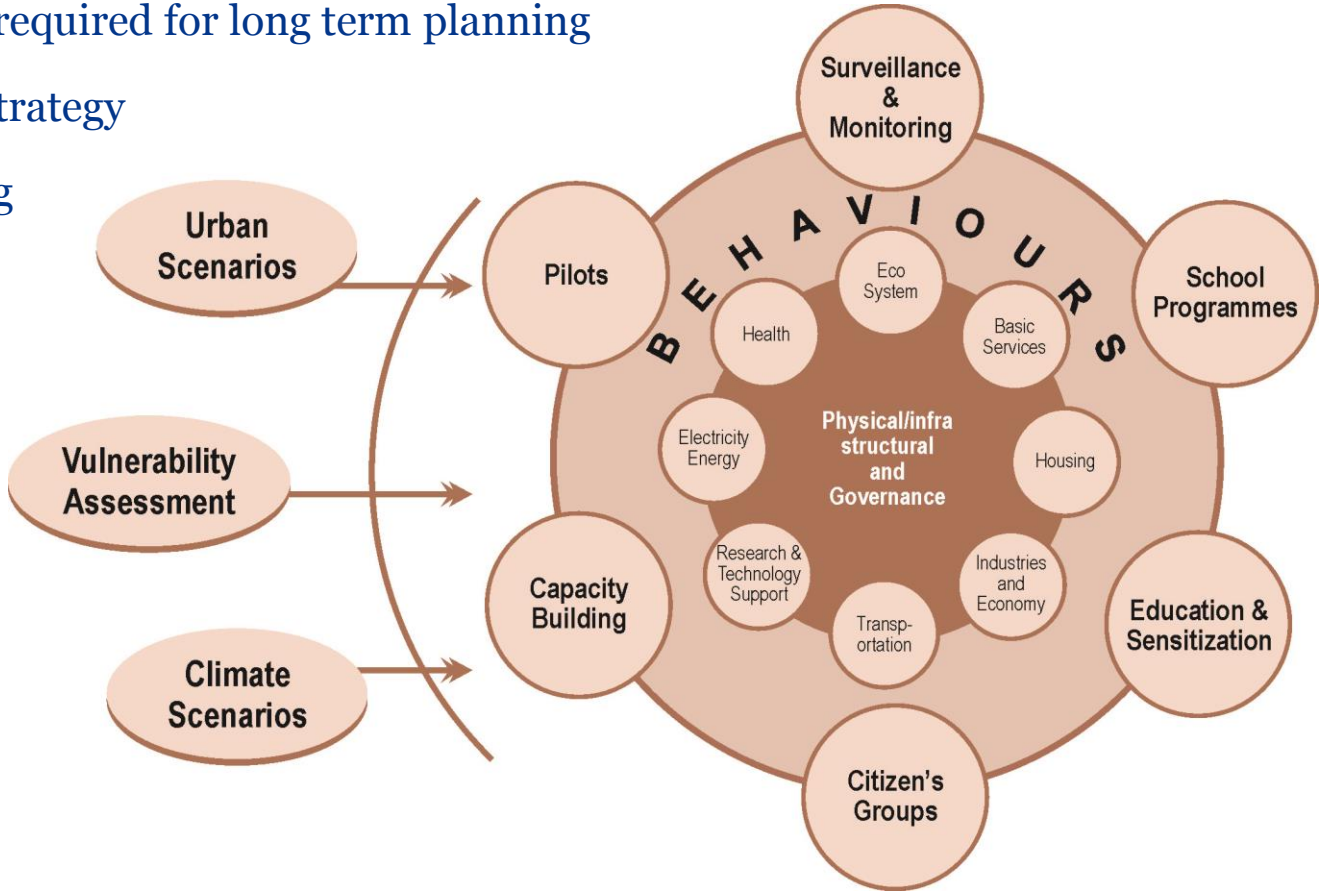
- Targeted physical and institutional actions to improve drainage, housing, health and communications systems
- Calls for information, data and knowledge focused activities to establish the evidence base required for long term planning
- An evolutionary resilience strategy
- Focuses on capacity building



Challenges in CRS implementation

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- The CRS identified climate resilience projects. Selected projects funded by the Rockefeller foundation
- Most part of the strategy remained shelved in the absence of any regulatory or policy backing and as a result could not be integrated in the formal urban planning and development framework nor could all the projects/strategies be channelized to any funding
- Current vulnerability too pronounced – difficult for city managers to take precautionary approach to future vulnerabilities
- Lack of awareness and capacity at city level to address its vulnerabilities
- Lack of funds at city and state level to address basic infrastructure related issues

TERI's Action Plan for CRS implementation

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1

Analytical Review of Secondary literature

- Resilience strategy
- Vulnerability Report
- Geohydrology study
- Includes:
  - Climate analysis
  - Risk
  - Vulnerability
  - Resilience options

2

Review of institutions and regulatory environment

- Review of state and city level regulations
- Institutional assessment
- Stakeholder consultation at Gorakhpur
- Consultation with GEAG team

3

TERI's Action plan to help implement resilience strategy

- Scoping exercise
- Identifying sectors for implementation
- Assessing current sectoral status
- Sectoral Recommendations
  - **Structural/ physical**
  - **Regulatory and institutional**
- Overall recommendations

Scoping

Institutional and regulatory analysis

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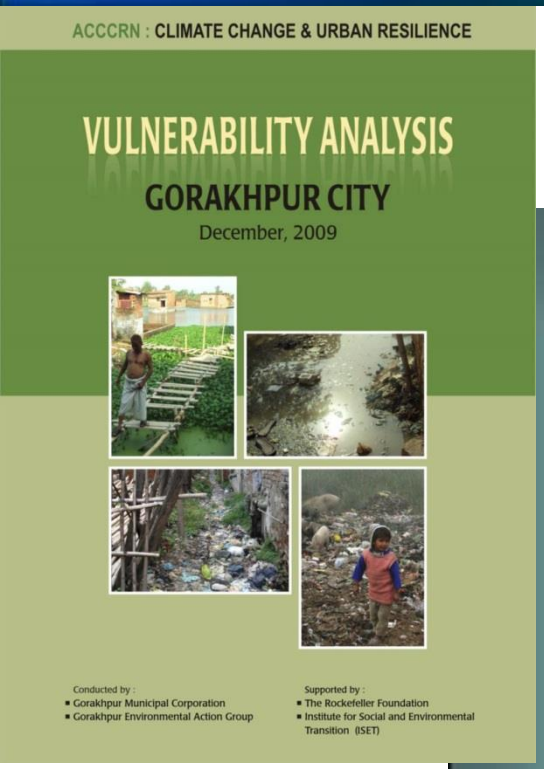
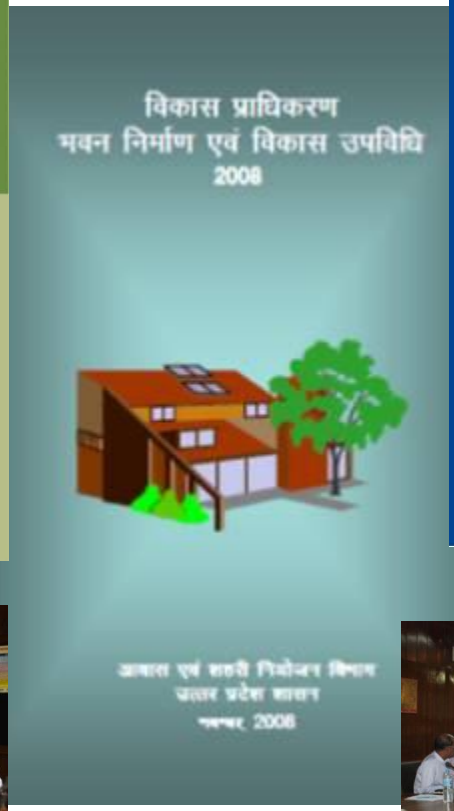
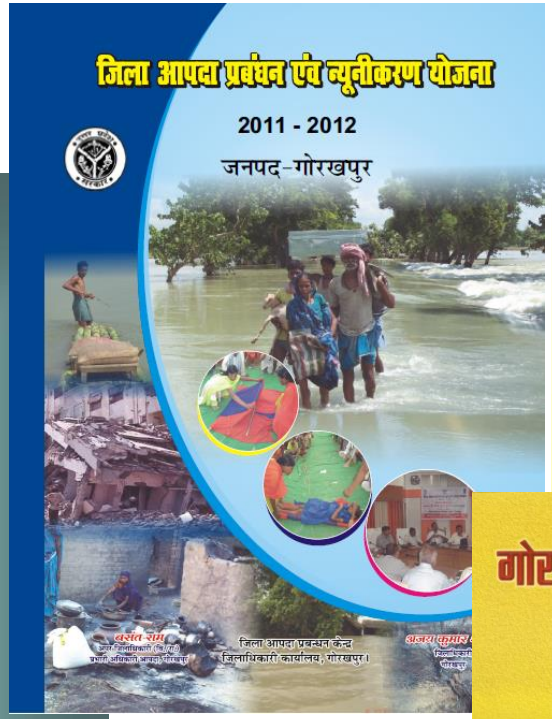
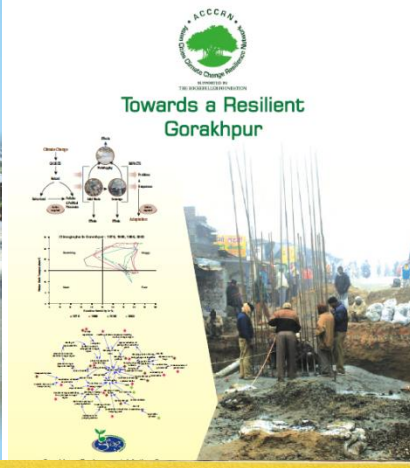
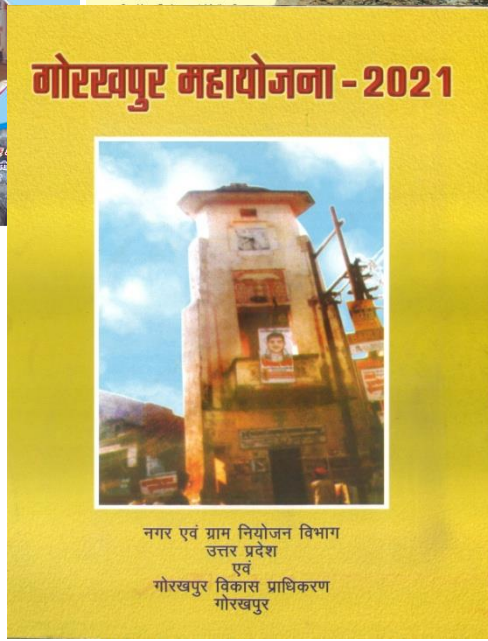
Creating Innovative Solutions for a Sustainable Future

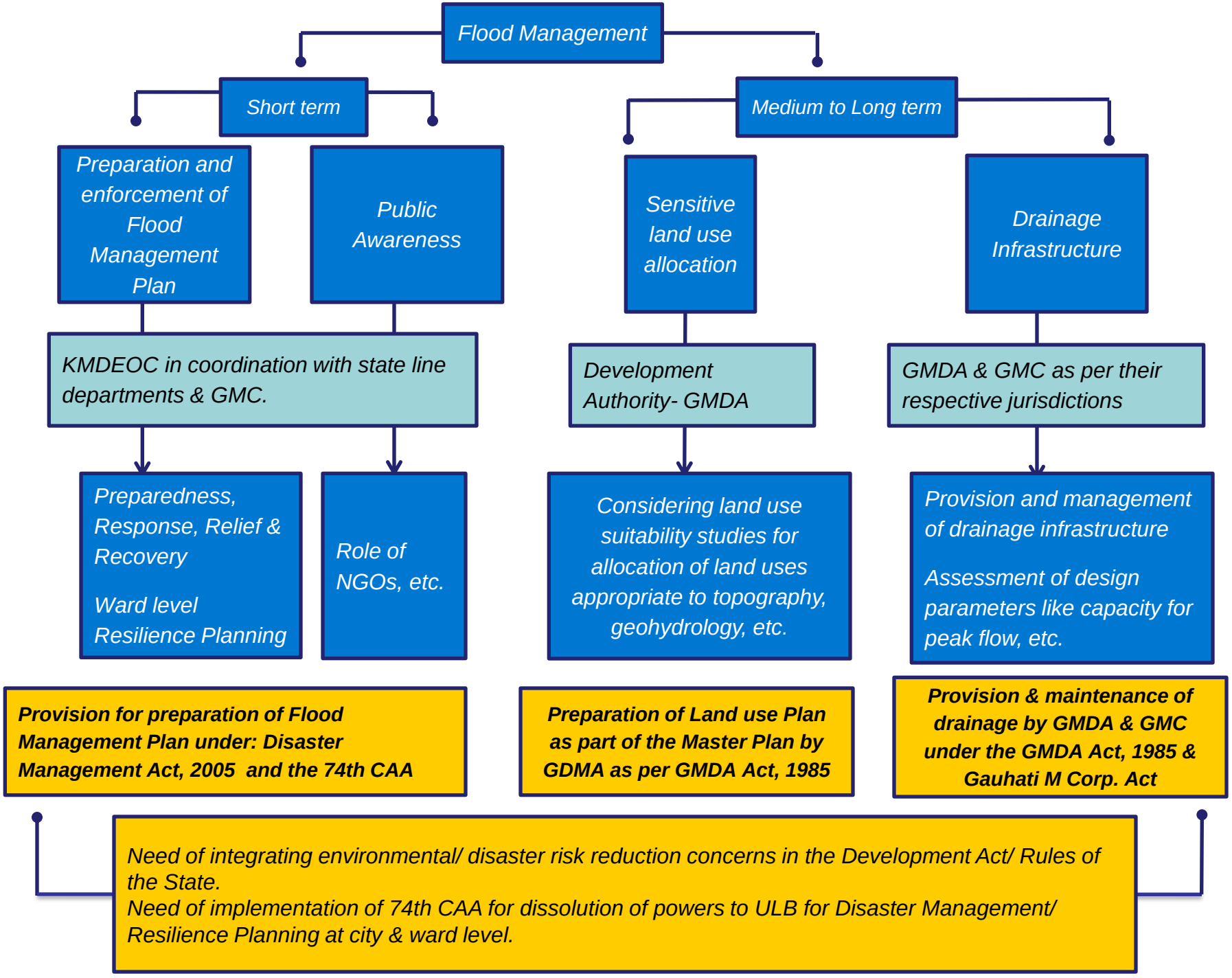











Flood Management
Short term
Medium to Long term
Preparation and enforcement of Flood Management Plan
Public Awareness
Sensitive land use allocation
Drainage Infrastructure
KMDEOC in coordination with state line departments & GMC.
Development Authority- GMDA
GMDA & GMC as per their respective jurisdictions
Preparedness, Response, Relief & Recovery
Ward level Resilience Planning
Role of NGOs, etc.
Considering land use suitability studies for allocation of land uses appropriate to topography, geohydrology, etc.
Provision and management of drainage infrastructure
Assessment of design parameters like capacity for peak flow, etc.
Provision for preparation of Flood Management Plan under: Disaster Management Act, 2005 and the 74th CAA
Preparation of Land use Plan as part of the Master Plan by GDMA as per GMDA Act, 1985
Provision & maintenance of drainage by GMDA & GMC under the GMDA Act, 1985 & Gauhati M Corp. Act
Need of integrating environmental/ disaster risk reduction concerns in the Development Act/ Rules of the State.
Need of implementation of 74th CAA for dissolution of powers to ULB for Disaster Management/ Resilience Planning at city & ward level.

Phased action points for CRS

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Risk Assessment and Review of Pr
Programs to Cl
Summary of Sug

Submitted to the Divisional C

The following table gives a summary of imm
State of Uttar Pradesh can take up. The list w
Commissioner, Mr K Ravindra Naik asked T
consultation meeting at Gorakhpur that was
of these recommendations for implementatio

Drainage and Sewerage:

City:	Actions	In
Medium term	**Drainage and Sewerage in the city:** **Option 1:** Revisit the drainage (storm water drainage) project sanctioned under UIDSSMT to allow for disintegration points and channels to ensure disintegration of storm water drains appropriately with the new sewer drains when they are sanctioned for.	M Gi te
	Conduct a feasibility analysis for a centralized dual system	M Gi te
	Option 2: City goes for decentralized systems- DEWATS at level of residential units/wards	M Gi Au (T al pe Gi
	Strict action on encroachment of drains	M Gi
Long term	Constitute an interdepartmental committee to foresee technical and financial details of various projects and also to resolve the jurisdictional overlaps and other coordination issues.	M th PC De Ui Co

Risk Assessment and Review of Prevailing Laws, Standards, Policies and Programs to Climate Proof Cities -
Summary of Suggested Action Points to State

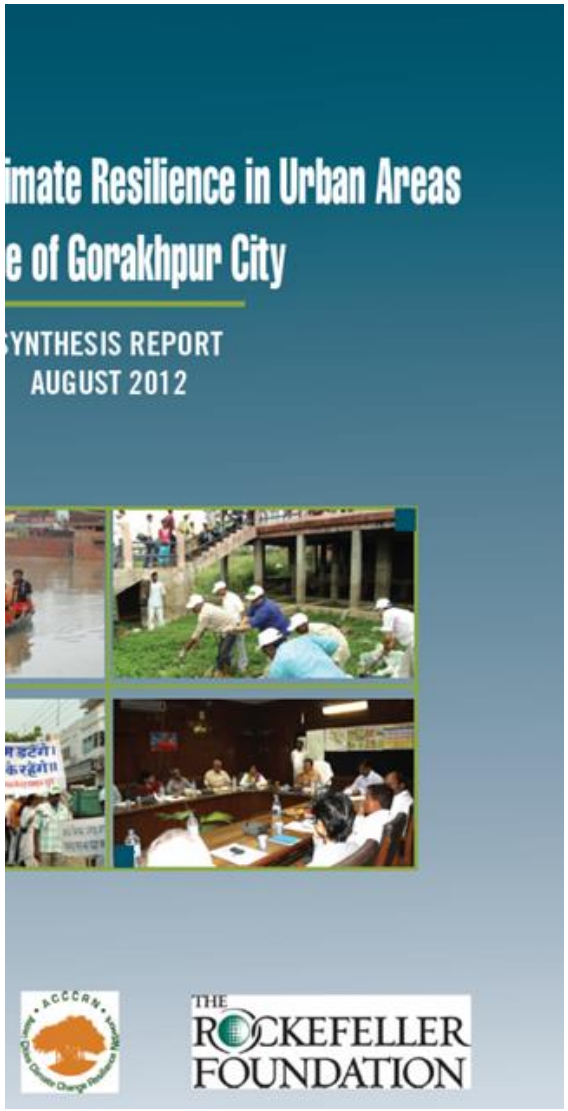
Submitted to the PS (UD), Govt. of Uttar Pradesh

The following table gives a summary of action points that the State of Uttar Pradesh can take up for mainstreaming climate resilience based on TERI's study.

Urban Planning

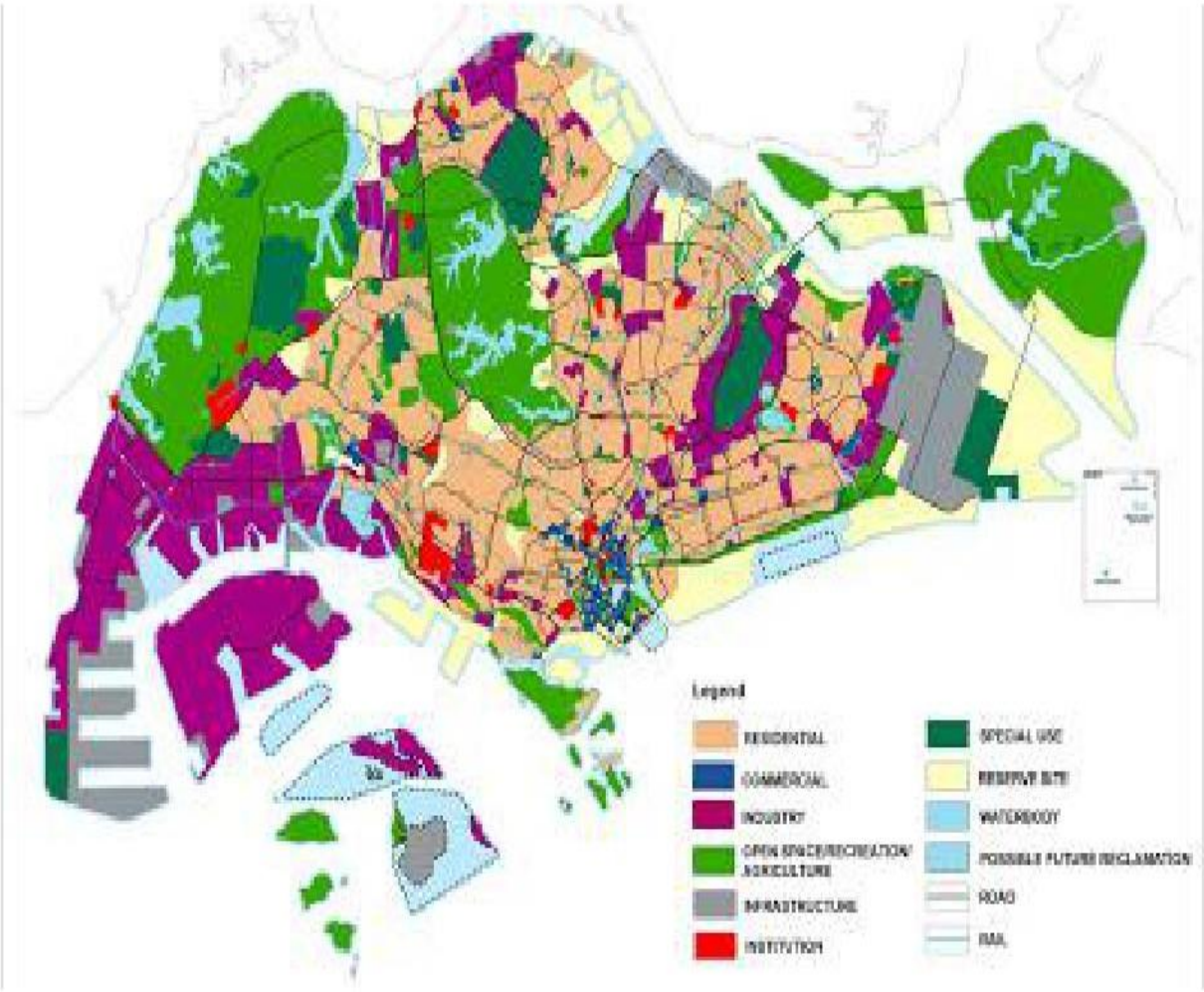
Time frame	Actions	Institutions	Supporting Regulation/policy
Medium term	**Include a chapter on climate change resilience in the Master Plan of cities in the state**	Housing and Urban Planning Department, Government of UP	Amendment in the UP Urban Planning and Development Act 1973
	Revisit and evaluate land-use planning in existing urban areas to reduce city's vulnerability	Housing and Urban Planning Department, Government of UP	
	Revisit 'Impact Fee 'rule[1]. Bring in environmental impact assessment of any land-use change that is proposed deviating from the Master Plan and restrictions on the same if the environmental criteria are not met with.(*Right now, the rule does say that impact fee is levied in return to the anticipated impacts of change in land-use on traffic, infrastructure and environment*[2]. *It also says that the 90% of the fee collected will be send to the infrastructure fund. However, it does not specify that the funds so collected will be used for mitigation of the impacts that will happen.)*	Housing and Urban Planning Department, Government of UP	UP Urban Planning and Development Act 1973[3],
Long term	**State adopts and implements 74th Constitution Amendment Act**		

[1] Section 1.7, 1.8 Gorakhpur Master Plan 2021, UP Model Zoning Regulations,Section1.7 to 1.10
[2] Section 1.7 Gorakhpur Master Plan 2012
[3] UP Model Zoning Regulations, section 1-10(1.10.2)



Planning tools for building climate resilience

Regulatory Tools – Land use plans



- Legal spatial policy which designates use of land, typically by:
  - Residential
  - Commercial
  - Industrial
  - Governmental
  - Infrastructure
  - Green/Open Space
  - Mixed Use
- The function of land can be limited due to characteristics related to risk or other geographic features
- Can be limited in dynamic settings

Source: Government of Singapore, online database

Regulatory Tools – Building codes

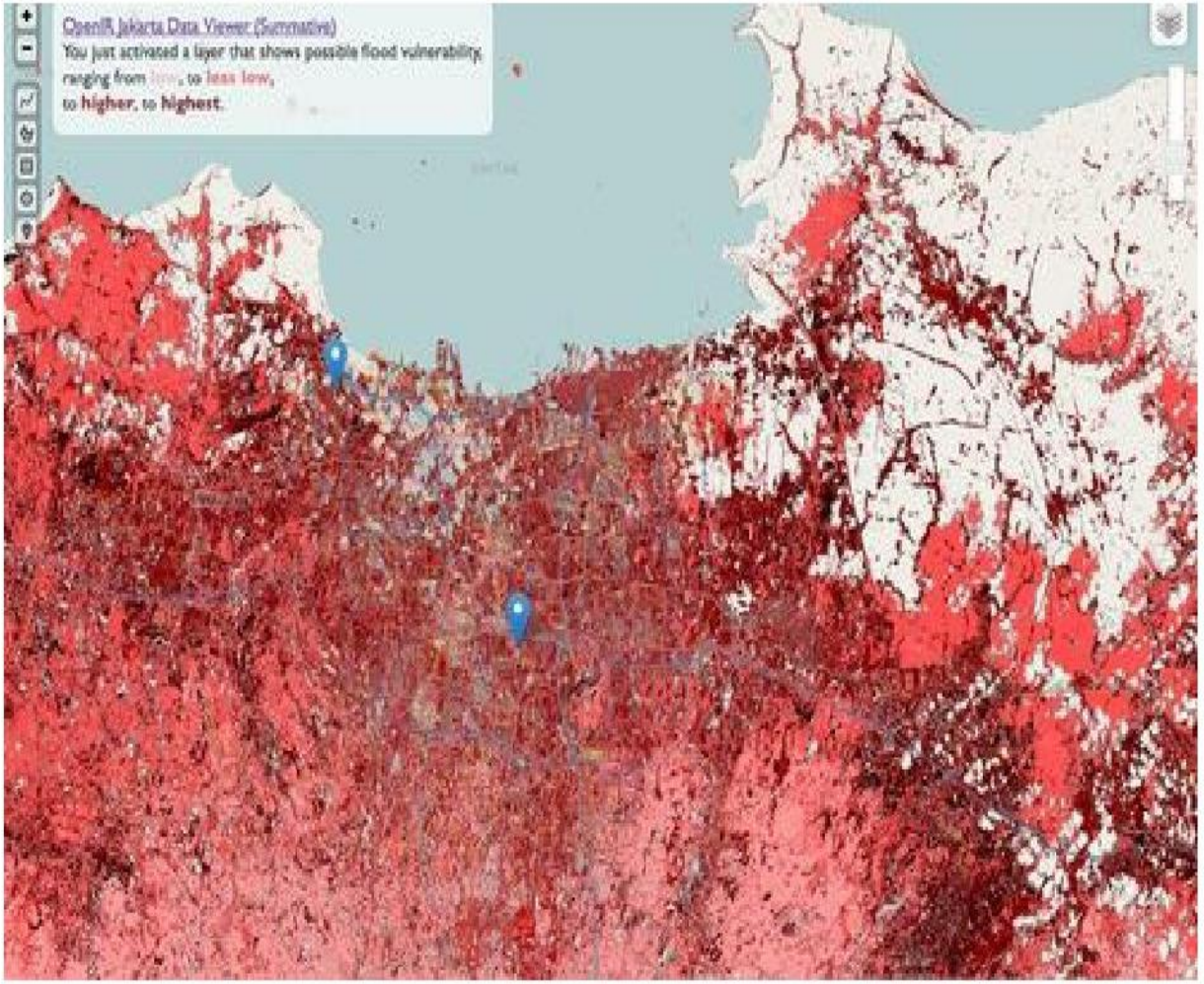
Source ADPC database

- Ensure that new development does not occur unless structures are designed and built to withstand the impact of hazards.
- Can be implemented at various levels.
  - Ward
  - City-wide
  - Provincial/State
  - National
- Many are hazard specific but some regulations can provide support from various hazard

Restriction Tools – Transfer of Development Rights

Creating Innovative Solutions for a Sustainable Future

- The transfer of a property's development potential under current zoning provisions from one site or property to another.
- The development potential can be relocated to another area of land or parcel not at risk.
- Usually requires a cost-benefit analysis from the local government and developer



Source Jakarta city, Online database

Natural Protection Tools - Mangroves and Wetland Creation/Restoration

Creating Innovative Solutions for a Sustainable Future

- The natural functions of wetlands and mangroves create a buffer to reduce wave energy, which can greatly reduce the impact of cyclones, storm surge, and flooding
- Planting trees or other vegetation that can withstand high-speed wind from cyclones and other storms.
- Less of a negative impact on environment when compared to “hard” engineering solutions
- Also fosters biodiversity and can contribute to livelihood development

Source: IFRC, Vietnam

Natural Protection Tools – Dune building and rehabilitation

Creating Innovative Solutions for a Sustainable Future

- Enriching natural sand dunes provide an effective defense against coastal erosion and flooding by dissipating floodwaters from coastal or riverrine sources.

- Less of a negative impact on environment when compared to “hard” engineering solutions

- Can be difficult to implement in areas that thrive on beach front development, notably for tourism

Source: Landscape Urbanism

Thank you!

Raina.singh@teri.res.in