Mainstreaming Climate Resilience in Urban Areas
A case of Gorakhpur City

SYNTHESIS REPORT
AUGUST 2012

teri
The Energy and Resources Institute

ACCCRN
Asian Cities Climate Change Resilience Network

THE ROCKEFELLER FOUNDATION

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Disclaimer:

This publication was prepared with support from the Rockefeller Foundation as part of the Asian Cities Climate Change Resilience Network (ACCCRN). ACCCRN aims to catalyse attention, funding, and action on building climate change resilience for poor and vulnerable people in cities by creating robust models and methodologies for assessing and addressing risk through active engagement and analysis of 10 cities in Asia. The ACCCRN programme engages local level and national organizations in India, Indonesia, Thailand, and Vietnam, and was conceived and launched by The Rockefeller Foundation in 2008.

TERI was appointed as the National Policy Adviser to ACCCRN in India in the year 2009. In late 2010, TERI started working on Gorakhpur city to help the city mainstream its resilience strategy. This synthesis report is an abridged version of the final report submitted to the Rockefeller Foundation. The report draws from TERI's in-depth study and review of various Acts, Bylaws, Policies, and planning documents applicable to city of Gorakhpur and Uttar Pradesh State where the city is located. Various city stakeholder consultations have contributed towards city specific understanding and have helped shape the recommendations. Any comments and questions on this publication can be directed to divyas@teri.res.in

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LIST OF ABBREVIATIONS

ACCCRN	Asian Cities Climate Change Resilience Network
BSUP	Basic Services to Urban Poor
CETP	Common Effluent Treatment Plant
CAA	Constitutional Amendment Act
CMO	Chief Medical Officer
CPHEEO	Central Public Health and Environmental Engineering Organization
DDMA	District Disaster Management Authority
DEWATS	Decentralized Wastewater Treatment System
DUDA	District Urban Development Authority
EWS	Early Warning System
GEAG	Gorakhpur Environment Action Group
GWD	(State) Ground Water Board
GDA	Gorakhpur Development Authority
GIDA	Gorakhpur Industrial Development Authority
GMC/ MCG	Municipal Corporation of Gorakhpur
GoI	Government of India
GRS	Gorakhpur Resilience Strategy
ICT	Information Communication Technology
IDH	Infectious Diseases Hospital
IHSDP	Integrated Housing and Slum Development Programe
ILCS	Integrated Low Cost Sanitation Scheme
ISET	Institute for Social and Environmental Transition
ISWM	Integrated Solid Waste Management
JE	Japanese Encephalitis
JnNURM	Jawaharlal Nehru National Urban Renewal Mission
LIG	Lower Income Group
MLD	Million Litres per day
MIG	Middle Income Group
MoEF	Ministry of Environment and Forests
MoHUPA	Ministry of Housing and Urban Poverty Alleviation
MoUD	Ministry of Urban Development
MSW	Municipal Solid Waste
NDMA	National Disaster Management Authority
NMSH	National Mission on Sustainable Habitat
O&M	Operation and Maintenance
OHT	Overhead tank
PPP	Public Private Partnership
PWD	Public Works Department
RAY	Rajiv Awas Yojana
SHG	Self help group
SJSRY	Swarna Jayanti Shahari Rojgar Yojana
SWM	Solid Waste Management
SDMA	State Disaster Management Authority
SOP	Standard Operating Procedure
SPCB	State Pollution Control Board
SPV	Solar Photovoltaic
STP	Sewage Treatment Plant
SSLB	Standardized Service Level Benchmarks
SUDA	State Urban Development Authority
SUDS	Sustainable Urban Drainage System
UDPFI	Urban Development and Plan Formulation and Implementation Guidelines
UIDSSMT	Urban Infrastructure Development Scheme for Small and Medium Towns
ULB	Urban Local Body
UNDP	United Nations Development Programme
URR	Urban Risk Reduction
UP	Uttar Pradesh
USEP	Urban Self Employment Programme

PREFACE

The Asian Cities Climate Change Resilience Network (ACCCRN) has helped 10 cities in Asia to assess their risks from climate change impacts and build their resilience strategy to respond to these impacts.

Gorakhpur has been one of the three ACCCRN cities in India. The Gorakhpur Risk Assessment and Vulnerability Analysis was conducted as part of Phase I of the ACCCRN initiative in India. The outcome was a resilience strategy prepared by The Gorakhpur Environment Action Group (GEAG).

While the resilience strategy proposed sector-specific actions to be carried out to build resilience and reduce vulnerability of the population of the city, it was felt by TERI that the strategy could not practically be adopted in a comprehensive manner in the city. Some climate change adaptation projects were identified during the course of the study, but only a couple of them could be taken forward for implementation with funding provided 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. It was felt that for long-term planning for climate resilience, the strategies developed under ACCCRN should be brought into the regular urban planning framework of cities. Thus, the project on "Risk Assessment and Review of Prevailing Laws, Standards, Policies, and Programmes to Climate Proof Cities", was commissioned to TERI under the ACCCRN and has been developed with the basic aim of providing inputs to mainstream resilience options into the urban development process.

The study suggests potential entry points for climate adaptation in the existing policy and regulatory framework and identifies specific action points that may be taken up at the city and state level to mainstream climate resilience (both mid-term and long-term). TERI used the resilience strategy document of Gorakhpur as a baseline to develop this resilience mainstreaming strategy for the city. A review of policies and programmes was conducted for each sector in order to recommend actions for the identified sector, so that authorities could be identified and held accountable for those actions.

TERI realises that such a change in the governance system is a complex and time consuming process. It may also not be possible to bring about all the changes in one go and to this end an incremental approach is required. The primary objective of this study is to showcase the potential of bringing about the necessary changes in our policies and at least initiate this paradigm shift. The study has helped us to identify the possible window of opportunity to bring in climate resilience measures in the urban development process.

The process involved a detailed assessment of the vulnerability report—the geo-hydrological report of Gorakhpur—among others. In addition, GEAG shared the climate scenario report prepared by Institute for Social and Environmental Transition (ISET), USA. A review of the same was carried out by the climate modelling team at TERI to understand the future implications of climate change on the city. Various questions on the same were taken up with GEAG and ISET and further clarifications were sought. The team made a presentation to the Divisional Commissioner of Gorakhpur at his office on 11 January 2012 and sought his support for the study. An advisory was then released to all the important stakeholders at the city level to support TERI's study and a nodal person was appointed to assist various engagements in the city during the course of the study.

The process took close to eight months to complete, which included several rounds of discussion with key stakeholders in the city to make it a reiterative process wherein it was made sure that the concerns, experience, and learning of the city stakeholders were well documented. This was substantiated with an in-depth analysis of the regulatory-institutional set up at the level of Gorakhpur city as well as, at the level of the State of Uttar Pradesh. Final recommendations were presented at a consultation chaired by the Divisional Commissioner of Gorakhpur, in presence of the Municipal Commissioner and all city officials and detailed discussions were held on TERI's recommendations. Later, TERI submitted 'Action Points' to the city, which is being pursued for adoption by the city. A State Government engagement is also being planned and preliminary communication with the Urban Development Department, Uttar Pradesh has been conducted.

ACKNOWLEDGEMENTS

We are grateful to The Rockefeller Foundation for granting this study to TERI. We are thankful to Dr Cristina Rumbiatis Del Rio for her constant involvement and support to TERI during the course of this study. A special mention to Mr Shiraz Wajih, and his colleagues at the Gorakhpur Environmental Action Group, who extended all the help and understanding to TERI to take up the task of mainstreaming of the resilience strategy. We are thankful to Mr K Ravindra Naik, Divisional Commissioner, Gorakhpur for supporting the study and steering interest and participation from the city officials during the course of the study. We are also thankful to various policy-makers and city officials who were consulted for the study for their valuable inputs and insights. TERI extends its gratitude to all the members of the Consultation Committee formed within the project for their time, inputs, and expert advice to make this study practical and implementable for the city and the State Government.

Our sincere thanks to Dr Vinod Tewari, Professor, TERI University and Advisor , Centre for Research for Sustainable Urban Development and Transport systems, Sustainable Habitat Division, TERI for his inputs, advice, and guidance as a reviewer to the project. This project has benefitted immensely by inputs from Ms Mili Majumdar, Director, Sustainable Habitat Division, and Ms Suruchi Bhadwal, Associate Director, Earth Sciences and Climate Change Division at TERI. Finally, many thanks to all the team members associated with this project.

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EXECUTIVE SUMMARY AND KEY MESSAGES

The study involved a detailed review of regulations and policies applicable to the city of Gorakhpur and the State of Uttar Pradesh where the city is located. The objective was to foresee the entry points for mainstreaming the Gorakhpur Resilience Strategy. TERI identified 'water logging' as the most prominent risk to city systems due to future and predicted climate change and identified five prime sectors for addressing this risk: Basic Services (drinking water, drainage and sewerage, solid waste), Housing, Urban Planning, Health and Ecosystem Conservation, and Flood Management. The Institutional Analysis section presents the functions of the institutions responsible for the specific sectors at the national, state, city, and district level.

The Sectorial Analysis section provides the current status and strategy action points for building resilience of each sector of the city for anticipated climate change impacts, supported by an enabling mechanism, i.e., relevant institutions and regulatory framework (policies, Acts). The Discussion and Way Forward section highlights the importance of concepts like 'political economy of cities' and 'decentralization'.

In the end, the sector specific recommendations and immediate action points for Gorakhpur city have been summarized. One of the key recommendations has been enforcement of the 74th Constitutional Amendment Act (CAA) to give a legal backing to ward level plans. TERI also recommends including a chapter on climate change resilience in the Master Plan of the city. TERI identifies: Capacity, Accountability, Coordination, and Efficiency of Institutions, as areas requiring foremost attention to ensure sustainable and resilient urban systems. Capacity building and awareness generation of the state agencies, urban local bodies (ULBs) and local community can play a major role in building resilience. For instance, capacity building of the government health set-ups in the city by assessment of required infrastructure and manpower can help in building an effective public health surveillance system.

Another recommendation is to 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 as and when they are sanctioned. Exploring the option of decentralized solid waste management systems has also been proposed. The application of ICT for building resilience through strengthening municipal database management systems has been highlighted. On these lines, in the drinking water section, establishing multiple channels for data collection and reporting on drinking water quality has been suggested. With regard to the issue of urban planning and land-use change, mapping and demarcation of green areas and water bodies in the city to regulate encroachment and reclamation has been suggested.

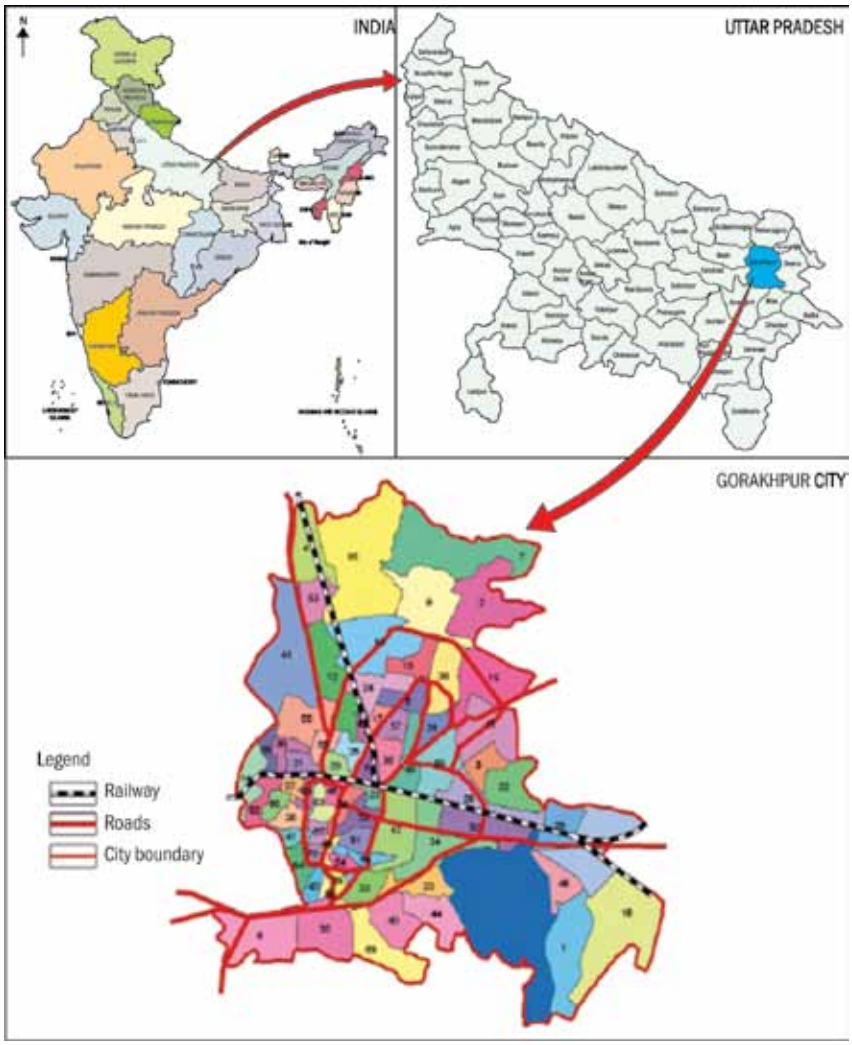
TERI feels that preparation and enforcement of the Flood Management Plan, which includes measures for Preparedness, Response, Relief, and Recovery, can go a long way in addressing the enhanced risk of water logging due to climate change. Implementation of Sustainable Urban Drainage Systems (SUDS) in residential areas could further help in this aspect.

This report, thus, predicts the possibility of Gorakhpur city becoming a pioneer city in terms of building a robust plan to climate proof its systems. It can be used as a model for building resilience in other cities as well.

INTRODUCTION

1. Introduction

Gorakhpur is one of the fastest growing urban centres in Uttar Pradesh (UP), located in the Terai belt of eastern UP. The city is 147 sq. km in area and divided into 70 administrative wards. The topography of the city is largely plain with a marginal slope from North to South. There are many water bodies in the city, the Ramgarh Tal is the biggest, situated in the south east part of the city.



MAP 1 Gorakhpur City

The city is grappling with insufficient infrastructure facilities and basic service provision due to tremendous pressure from influx of rural population in the city. This has led to proliferation of slums and there are about 110 slums in the city accommodating 33 per cent of the total population (Gorakhpur resilience strategy document). The city is already facing problems of flooding, water logging, temperature extremes, power shortage, poor quality of water, and increased incidence of water- and vector-borne diseases. All these pressures are likely to be aggravated by potential climate change impacts, which were analysed while preparing the resilience strategy for Gorakhpur.

Despite all the challenges, Gorakhpur still provides various opportunities and has the potential to become a pioneer city in terms of building a robust plan to climate proof the city and its systems. Mainstreaming some of the interventions proposed in the resilience strategy (prepared as part of the ACCCRN programme) that are based on detailed risk and vulnerability analysis would allow regularizing adaptation interventions in city planning and investment designs, thus, building resilience of urban systems for a longer period of time. This will also facilitate putting in place the institutional regulatory system needed to support climate resilience in cities.

1.1 Objectives

The objective was to foresee the entry points for mainstreaming the Gorakhpur Resilience Strategy that was prepared by Gorakhpur Environment Action Group (GEAG) in Phase I and II of the ACCCRN programme (with support from Rockefeller Foundation, ISET, and national partners to ACCCRN in India—TARU and TERI).

1.2 Study Approach

TERI identified 'water logging' as the most prominent risk to city systems due to future and predicted climate change. It then prepared an implementation strategy and a supporting regulatory framework (taking into account adaptation measures suggested by GEAG) that reinforced these sectors to withstand present development pressures and to become resilient towards any future climate impacts. The recommendations draw from various stakeholder consultations conducted during the process of the study with city officials.

The key sectors requiring actions to build resilience were identified as: Solid Waste Management; Drainage and Sewerage System; Drinking Water; Ecosystem Conservation and Flood Management; Public Health; Urban Planning; and Energy.

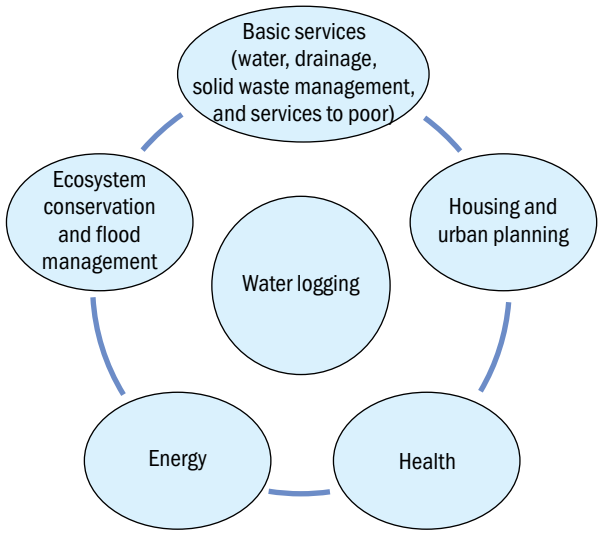


FIGURE 1 Options to address risk of water logging

INSTITUTIONAL ANALYSIS

2. Institutional Analysis

This section presents the overall institutional set-up that drives urban development in the cities in India. The sectors are divided into urban planning, environment and disaster management, and housing and infrastructure for ease of understanding. The section also presents the corresponding institutions for Uttar Pradesh state and for Gorakhpur city.

2.1 Urban Planning

National level framework

The function of development planning falls in the State List of the Constitution of India. The Ministry of Urban Development (MoUD) is responsible for formulating national level policies and coordinates the activities of various nodal authorities related to urban development in the country. The Town and Country Planning Organization (TCPO) functions as the technical wing of MoUD for urban planning and related activities.

The Urban Development and Plan Formulation and Implementation (UDPFI) Guidelines can be used by the ULB or Development Authority for planning at city/zonal/ neighbourhood level. The Jawaharlal Nehru National Urban Renewal Mission (JnNURM) provides financial assistance to the cities under two basic components: (a) Basic services to urban poor (b) Urban infrastructure provision and governance. Under this, City Development Plans have been prepared for 65 selected cities.[1]

The National Mission on Sustainable Habitat (NMSH) of the National Action Plan on Climate Change (NAPCC) focusses on planning for sustainable urban development in the country, given the future risks and impacts associated with climate change.

State level framework

The state line department for urban planning in UP is the Town and Country Planning Department (TCPD), which comes under the Housing and Urban Planning Department (HUPD) of Government of UP. The other line departments under HUPD are Housing and Urban Planning Department and the UP Housing Board, which are responsible for development of housing in the urban areas of the state. The development authorities are responsible for Master/Development plan formulation (with assistance from TCPD) and its implementation. There are Special Area Development Authorities (SADAs) in case of delineated 'Special Areas' constituted under the UP Special Area Development Authorities Act, 1986. The powers and functions are same as that of the development authorities and they also report to the state HUPD.

Gorakhpur city

There are primarily two agencies in Gorakhpur looking after the function of urban planning and development—Gorakhpur Development Authority (GDA) and Gorakhpur Industrial Development Authority (GIDA). The GDA is responsible for preparation of the Master Plan[2], zonal and layout

[1] Required to comply with certain urban sector reforms targeting efficiency enhancement and sustainable infrastructure development.

[2] Prepared for a period of 20 years, the Gorakhpur Master Plan 2021 outlines the land use and development policies for the Gorakhpur development area. As per the 74th CAA, the master plan and ward level plans need to be prepared by the ULB with a participatory approach (not yet implemented)

plans for the city, with assistance from the TCPD. GDA provides housing and infrastructure in its colonies within municipal limits and also in peri-urban areas (areas that do not fall under the Municipal Corporation's jurisdiction). The colonies developed by the GDA, that fall within municipal limits, have to be handed over to the Gorakhpur Municipal Corporation (GMC) for maintenance after a stipulated period of time. GIDA has similar powers and functions as GDA in its jurisdiction.

2.2 Housing

National level framework

As per the federal structure of governance in India, matters pertaining to housing have been assigned to the State Governments. The Ministry of Housing and Urban Poverty Alleviation (MoHUPA) is the apex authority to formulate national level policies. The Ministry has formulated the National Urban Housing and Habitat Policy 2007, which aims at providing equitable and affordable access to land and shelter to the residents of the city, with cooperative action between diverse stakeholders. MoHUPA is also the nodal Ministry for implementation of the component on Basic Services to Urban Poor (BSUP) under JnNURM and the Rajiv Awas Yojana (RAY), a scheme that targets provision of low-cost housing to the urban poor.

State level framework

Housing and Urban Planning Department is responsible for planning, whereas implementation of housing schemes is done by the UP Housing Board, also known as the Avas Vikas Parishad constituted under UP Avas Evam Vikas Parishad Adhiniyam, 1965. Apart from this, development authorities, SADAs, and industrial development authorities carry out the function of housing in their respective jurisdictions.

Gorakhpur city

The Avas Vikas Parishad has its housing projects in the city. GDA and GIDA are carrying out the function of development of housing in their respective areas of jurisdiction.

2.3 Water Supply and Sanitation

National level framework

At the national level, MoUD and MoHUPA are the key ministries implementing various programmes and schemes for water supply and sanitation. The National Urban Sanitation Policy (NUSP), which aims at transforming towns and cities of India into 100 per cent sanitized, healthy spaces, ensuring public health, and clean environment was launched by MoUD in 2008. The MoUD has Standardized Service Level Benchmarks (SSLBs) for benchmarking certain indicators for key urban services, such as water supply, sewerage, storm-water drainage, and solid waste management.

State level framework

At the state level, UP Jal Nigam is the nodal agency for water supply and sanitation under the Uttar Pradesh Water Supply and Sewerage Act, 1975.

Gorakhpur city

At the city level, UP Jal Nigam is responsible for design and construction of the water supply, sewerage, and drainage systems, including networks as well as treatment plants. The GMC looks after the operation and maintenance of the systems within municipal limits. The Jal Kal Vibhag of the GMC does the treatment and distribution of water supply in the city, as well as general maintenance and tariff collection. The Health Department of the GMC is involved in periodic cleaning of the sewers/drains. Apart from this, the GMC is responsible for construction and O&M of community toilets in the city, especially in the slum areas.

GDA and GIDA are supposed to provide water supply and sanitation systems within their jurisdiction and then handover the colonies to the GMC for O&M (for colonies within GMC limits). However, this has not happened in most cases and there are ad-hoc provisions for water supply/sewerage/drainage at present. Apart from the above mentioned institutions, the State Urban Development Authority (SUDA) is the nodal agency for steering several schemes (See Table 1). The District Urban Development Authorities (DUDA) has been constituted to implement these schemes.

TABLE 1 Institutional setup

Institution/ department	Functions	Supporting /enabling regulatory framework	Level
Urban Planning and Management			
Ministry of Urban Development (MoUD), GoI	Entrusted with activities related to urban development, it is responsible for formulating national level policies, supporting and monitoring programmes, and coordinating the activities of various Central ministries, State governments, and other nodal authorities relating to urban development issues in the country.	Model Town and Country Planning Act 1960 Jawaharlal Nehru National Urban renewal Mission (JnNURM) Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) National Mission on Sustainable Habitat (NMSH) Urban Development and Plan Formulation and Implementation (UDPFI) Guidelines	National
Town and Country Planning Organization	Technical advisory and consultant wing of the MoUD on matters concerning urban and regional planning strategies, research, appraisal, and monitoring of central government schemes and development policies.		National
Town and Country Planning Department under Housing and Urban Planning Department of GoUP	Preparation of Master Plans for rural as well as urban areas.		State
Gorakhpur Development Authority	Master Planning, Service (water supply, sewerage/ drainage facilities) and infrastructure provision (roads, street lighting) and housing for GDA colonies and peri-urban areas (areas that do not fall under Municipal Corporation's jurisdiction)	UP Urban Planning and Development Act 1973 Gorakhpur Master Plan Building Construction and Development Regulation 2008	City
Municipal Corporation of Gorakhpur	A 'NOC' (no-objection certificate) is a requisite for obtaining building permission in the Corporation area, Property Tax collection.	UP Municipal Corporation Act 1959	City
Gorakhpur Industrial Development Authority	Housing, infrastructure, and basic service provision for GIDA area.		District
Housing and Infrastructure			
Ministry of Housing and Urban Poverty Alleviation (MoHUPA)	Apex authority of GoI to formulate policies, sponsor and support programme, coordinate the activities of various Central ministries, State governments, and other nodal authorities and monitor the programmes concerning all the issues of urban employment, poverty and housing, and basic services in the country.	National Urban Housing and Habitat Policy 2007 Basic Services to Urban Poor (BSUP) scheme under JnNURM Rajiv Awas Yojana (RAY) Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) Standardized Service Level Benchmarks (SSLBs)	National
UP Awas Vikas Nigam under Housing and Urban Planning Department of GoUP	Nodal agency for housing. The agency is also involved with planning, construction, and development of urban development projects in the state. Autonomous body.	UP Avas Evam Vikas Parishad Adhiniyam, 1965 UP Special Area Development Authorities Act, 1986	State
UP Jal Nigam	Water supply and sewerage, including design and construction of water supply, sewerage networks, and treatment plants.	Uttar Pradesh Water Supply and Sewerage Act, 1975	State

TABLE 1 Institutional setup

Institution/ department	Functions	Supporting /enabling regulatory framework	Level
State Urban Development Authority (SUDA)	To improve the quality of life of urban poor by helping them avail the benefit of various government schemes targeted towards them, in the area of livelihood, services, shelter, sanitation, etc.	Steers the following schemes: Integrated Low Cost Sanitation Scheme (ILCS), Swarna Jayanti Shahari Rojgar Yojana (SJSRY), Integrated Housing and Slum Development Programme (IHSDP), The Urban Self Employment Programme (USEP). Important points regarding formulation and execution of BSUP and IHSDP Projects.	State
District Urban Development Authority (DUDA)	This is the implementation agency for plans prepared by SUDA. Functions include community development works in slums, construction of community toilets, assisting households in construction of individual toilets, awareness generation, etc.		
Public Works Department (PWD)	Construction of roads, main roads, and transport infrastructure. Construction and maintenance of Government houses and institutions.		State
Gorakhpur Development Authority	Development of housing and provision of services for GDA colonies and peri-urban areas (areas that do not fall under Municipal Corporation's jurisdiction)	UP Urban Planning and Development Act, 1973 Municipal Solid Waste Management and Handling Rules, 2000	City
Municipal Corporation of Gorakhpur	Provision of basic services to Corporation area, operation and maintenance of services and infrastructure within corporation area like water supply lines, solid waste management, O&M of internal sewers/ drains and community toilets, etc. Collection of property tax, management of ghats (river banks), construction and O&M of community toilets.	UP Municipal Corporation Act, 1959 Municipal Solid Waste Management and Handling Rules, 2000 UP State Water Policy	City
Gorakhpur Jal Kal Department (Part of Municipal Corporation of Gorakhpur)	Nodal agency for water supply in the city. O&M of water supply and sewerage assets. Propose tariffs (and receive approval from UP Jal Nigam and the State government) and collect revenues.	UP Municipal Corporation Act, 1959	City
Gorakhpur Industrial Development Authority	Housing, infrastructure, and basic service provision for GIDA area.		City
Environment and Disaster Management			
Ministry of Environment and Forests (MoEF)	Formulating policies, supporting and monitoring programmes, and coordinating the activities of various Central Ministries, State governments, and other nodal authorities relating to environmental and forestry issues in the country. The primary concerns of the Ministry are implementation of policies and programmes relating to conservation of the country's natural resources and the prevention and abatement of pollution for sustainable development and enhancement of human well-being.	Environment (Protection) Act, 1986 Water (Prevention and Control of Pollution Act), 1974 Water (Prevention and Control of Pollution) Rules, 1975 Hazardous Waste (Management and Handling) Amendment Rules, 2003 Air (Prevention and Control Act), 1971 Municipal Solid Waste Management and Handling Rules, 2000	National
National Disaster Management Authority	To spearhead and implement a holistic and integrated approach to Disaster Management in India. NDMA is mandated to lay down the policies, plans, and guidelines for disaster management to ensure timely and effective response to disasters.	Disaster Management Act, 2005	National

TABLE 1 Institutional setup

Institution/ department	Functions	Supporting /enabling regulatory framework	Level
UP Pollution Control Board under Department of Environment, GoUP	Pollution control, river water quality conservation, industries.	River Board Act, 1966 UP Draft Environmental Policy, 2010 Environment (Protection) Act, 1986 Water (Prevention and Control of Pollution Act), 1974 Water (Prevention and Control of Pollution) Rules, 1975 Hazardous Waste (Management and Handling) Amendment Rules, 2003 Air (Prevention and Control Act), 1971 Municipal Solid Waste (Management and Handling) Rules, 2000	State
UP State Disaster Management Authority	Disaster management, preparedness, and response	Disaster Management Act, 2005	State
Disaster Management Cell, Gorakhpur	Disaster response mechanism, Gorakhpur flood risk reduction	Disaster Management Act, 2005	District/ city
CMO office	Health		District/ city
Municipal Corporation	Sanitation and hygiene	UP Municipal Corporation Act, 1959	City

2.4 Solid Waste

National level framework

The Central Public Health and Environmental Engineering Organization (CPHEEO), attached to the MoUD is the nodal agency, which provides guidelines on solid waste management. Apart from this, the Hazardous Substances Management (HSM) Division of the Ministry of Environment and Forests (MoEF) is the nodal agency for safe management and use of hazardous substances, including e-waste, as per the Hazardous Waste (Management and Handling) Rules, 1989. The CPHEEO Manual on Solid Waste Management, 2000; the Municipal Solid Waste (Management and Handling) Rules, 2000 has been formulated at the national level for providing standards and guidelines for management of solid waste in the country.

State level framework

At the state level, UP State Pollution Control Board, under the Department of Environment, Government of UP monitors the compliance of standards regarding ground water, ambient air, leachate quality, and compost quality, including the incineration standards as laid out under the MSW Rules, 2000.

Gorakhpur city

The GMC is responsible for the development of infrastructure for collection, storage, segregation, transportation, processing, and disposal of municipal solid wastes. As per the Rules, the development authority also needs to identify the landfill sites and hand them over to the municipal body for development, operation, and maintenance.

2.5 Environment and disaster management

Environment

National level framework

At the national level, the Ministry of Environment and Forests (MoEF) has been entrusted with all activities related to environment and forests.

State level framework

The UP Pollution Control Board is the nodal agency for pollution control and other environment related aspects in the state. Its powers and functions are

guided by various regulations (mentioned in Table 1). At the state level, the UP Draft Environmental Policy 2010 provides guidelines on conservation of natural resources and carrying out Environmental Impact Assessment of industrial/development projects among other things. It also outlines significance of addressing climate change related impacts while drawing policy recommendations on various environmental issues.

Gorakhpur city

The norms and guidelines of the UP Pollution Control Board have to be incorporated by various agencies during implementation of projects. These are applicable to activities like solid waste management (by GMC), industrial effluent discharge (by GIDA), waste water management (by GMC), etc.

Disaster management

National level framework

The National Disaster Management Authority (NDMA), headed by the Prime Minister, was formulated in 2005 under the Disaster Management Act, 2005, to spearhead and implement a holistic and integrated approach to Disaster Management in India.

State level framework

The UP State Disaster Management Authority is the nodal agency at the state level, responsible for disaster preparedness, management, response, and recovery.

Gorakhpur city

The District Disaster Management Authority (DDMA) in Gorakhpur is responsible for preparation and implementation of the Disaster Management Plan for the district. The DDMA has a Disaster Management Cell, which comprises representatives of all important state line departments for coordination and implementation of Disaster Management Plans. The Irrigation Department is responsible for maintenance of embankments and flood warning systems. Under the State Water Policy, it is also doing water resources planning and management at the catchment level and resettlement and rehabilitation in case of floods and droughts. The State Department of Medical Health and Family Welfare, through the District Hospital (in coordination with GMC and DDMA), is responsible for public health management in case of outbreak of diseases in the aftermath of floods.

SECTORIAL ANALYSIS

3. Basic services

Drinking water contamination, inadequate drainage, and solid waste management system in the city are three problems that need to be addressed. All three problems increase the vulnerability of the city to the risk of water logging.

3.1 Solid waste management

3.1.1 Status

The present solid waste generation for the city is 3,462.57 tonnes/day (Population: 692,514)[1]. The projected population of the city in 2021 is 1.3 million, for which the estimated solid waste generation (keeping the same rate of generation) would be 6,500 tonnes/day.

Currently, the waste is either used as land fill material or is dumped in some of the demarcated locations in the city (*Geohydrology report, vulnerability report, GEAG*) (Map 2). Low lying areas in the outskirts of the city are also being used as dumping sites. The uncollected waste becomes a cause for stagnation of water at various locations of the city. At present, the Municipal Corporation has started door-to-door collection of waste in eight wards in the city as a pilot project, which might be scaled up in future.

The development plan proposes to establish four SWM dumping stations at the following locations:
(a) In south, at the Devaria–Gorakhpur bypass road
(b) In north, near the Gorakhpur–Pipraich road
(c) Near the Chiruatal
(d) To the west of Maluni–Bandha Road

MAP 2 Solid Waste Dumping Locations

A detailed SWM scheme is proposed to be prepared by the Gorakhpur Development Authority (*Development Plan, Gorakhpur*). An SWM plant has been proposed on 32 acres of land in *Jangal Bahadur Ali* area (*Source: City consultations, March 2012*). This will involve segregation, treatment, and composting of solid waste. The project is estimated to cost

[1] The per capita waste generation of cities in India is 0.5 kg/day (CPHEEO).

₹290 million and is proposed to be developed under Public Private Partnership (PPP) with EPR Hyderabad and Construction and Design sub-cell of the Municipal Corporation.

Action Points

The present waste dumping sites are located in the low-lying areas prone to water logging, which are hazardous and may contaminate the soil as well the ground water. These sites should be assessed and closed down in a phased manner. The location of the proposed central SWM plant should be demarcated and buffered within the land-use plan of the city. The municipal body should also consider potential climate impacts while making decisions for siting.

Since, 72 per cent of the developed area in Gorakhpur is residential in nature (See Section 3.8, Table 8), it offers an opportunity for adopting decentralized community waste management models. These could be managed at the level of eight zones for which the zonal plans are proposed to be prepared under the provisions provided in the development plan of the city.

Refer to MSW Rules 2000 for detailed stepwise methodology to manage solid waste under the following categories:

1 **Door to door collection and segregation**: Schedule II, Point 2 of the MSW Rules 2000, stipulates the municipal body to organize awareness generation programmes and undertake phased programmes ensuring community participation in waste segregation, hence, alternatively, such an arrangement could be made in the city.
2 **Primary collection centers**: Primary collection could

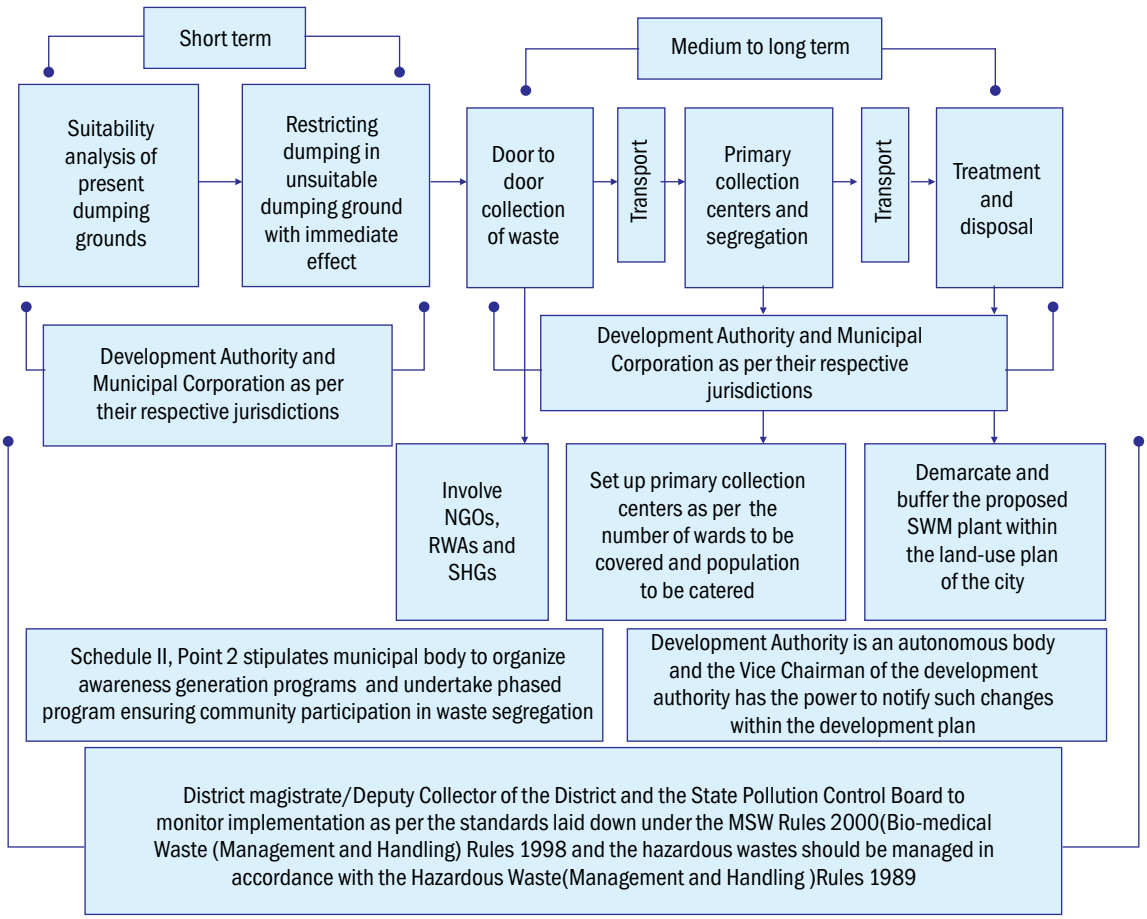


FIGURE 2 TERI's proposal on Solid Waste Management

be set up at zonal levels depending upon the wards covered under each zone. Each zone could have more than one primary collection center depending upon the population to be catered. The upkeep and operation of the primary collection center, including waste segregation would essentially be the responsibility of the municipal corporation.

3 **Treatment and disposal**: The non-biodegradable, inert waste, and waste not suitable for recycling or biological processing should be sent to the landfill site.

The CPHEEO[2] Manual on 'Solid Waste Management'[3] should be referred while designing a detailed solid waste management plan for Gorakhpur city.

Enabling Mechanism

TABLE 2 Regulation structure for solid waste management

Institute and regulations	Description
CPHEEO's manual on 'Solid Waste Management' (2000)	Elaborate manual providing guidance to urban local bodies to set up an integrated solid waste management system (ISWM) in their cities
MSW Rules 2000	Effective from 2003, these rules are applicable to every municipal authority responsible for collection, segregation, storage, transportation, processing, and disposal of municipal solids. The Rules contain four schedules.
	City level Every municipal authority would make an application for grant of authorization for setting up waste processing and disposal facility, including landfills from the State Pollution Control Board (Section 4, MSW Rules, 2000) and shall follow the implementation schedule as laid out in 'Schedule I'[4] .
	State level The District Magistrate or the Deputy Commissioner of the district shall have the overall responsibility of enforcement of the provisions of the MSW rules within the territorial limits of their jurisdiction[5] (Section 5, MSW Rules, 2000). The State Pollution Control Board shall monitor the compliance of the standards as laid out under schedule II, III, and IV[6] of the MSW Rules 2000.

3.2 Drainage and sewerage system

Status

Only 22% of the city is served by sewer lines (55 km). The rest of the city is covered by 229 open drains, which not only carries the storm water, but also carries sewage from homes. The topography of the city constraints building an effective drainage system (*Source: City consultations*).

The city consultations revealed that a project worth ₹8 crore (INR 80 million) has been sanctioned by the State Government for extending the drainage facility of the city. It involves widening and upgrading of five (trunk) *kutcha* drains.

Untreated waste water to the tune of 90 MLD is discharged into the river Rapti and Ramgarh Tal (lake) through five pumping stations. The UP Jal Nigam had submitted a proposal to the state government for extension of the sewerage system in the city (*Source: City consultations*). As per the development plan, a sewerage farm is proposed at the Malauni–Bandha road for disposal of sewage in the city.

Besides this, the Lake Conservation Department of GoI is implementing a project for cleaning and beautification of the Ramgarh Tal. It is being partially funded through both central and state governments

[2] Central Public Health and Environmental Engineering Organization, Ministry of Urban Development, Government of India

[3] Introduced in the year 2000, by the Ministry of Urban Development Available at: http://www.indiawaterportal.org/sites/indiawaterportal.org/files/Manual%20on%20municipal%20solid%20waste%20management_%20MoUD_GOI_2000.pdf

[4] Schedule I(MSW Rules,2000) is the Implementation schedule for the MSW rules including setting up waste processing and disposal facilities, monitoring the performance of the facility, improvement in existing and selection of future land fill sites.

[5] In case of metropolitan cities the official in charge of enforcement shall be the Secretary-in-charge of the Department of Urban Development of the State or the Union Territory.

[6] Schedule II (MSW Rules 2000)-management of solid waste in terms of collection, segregation, storage, transportation, and processing of municipal solid waste;
Schedule III (MSW Rules 2000)- specifications for landfill sites in terms of selection of landfill sites, facilities to be provided at the site, specifications for land filling, pollution prevention, water and ambient air quality monitoring, closure of landfill sites, and post care;
Schedule IV (MSW Rules 2000)-standards for composting, treated leachates, and incineration

at a cost of ₹124.32 crore (70:30). As part of the project, two Sewage treatment plants (STPs) (30+15 MLD) are going to be installed for treatment of waste water being discharged by six drains into Ramgarh Tal.

Action Points

TERI suggests two alternatives:

- Revisiting the drainage proposal sanctioned under UIDSSMT:
  - To plan phase II of the project where a separate sewerage system is designed for the city along with sewage treatment plants to dispose the treated water into the water bodies at specific identified and safe locations.
  - Revisit the construction plan to allow for disintegration points and channels within the blueprint of the scheme, so that when at a later stage a sewerage system is sanctioned, the storm water system is easily disintegrated from it.
- The city can establish decentralized systems (DEWATS). This could be planned at the level of residential pockets or ward level. This option is cost effective and does not require high-end technology to implement. Refer to: CPHEEO manual on sewerage and sewage treatment; 'Norms and standards for environment clearance of large construction projects, MoEF, GoI.
- Frequency of cleaning of the open drains should be increased immediately before and during the monsoon period to allow for easy flow of storm water.
- Ban on polythene has to be enforced strictly by imposing penalties on defaulters. It has to be supplemented with innovative campaigns to promote alternatives like cloth and jute bags.
- An interdepartmental committee could be set up for issues related to drainage and sewerage, which

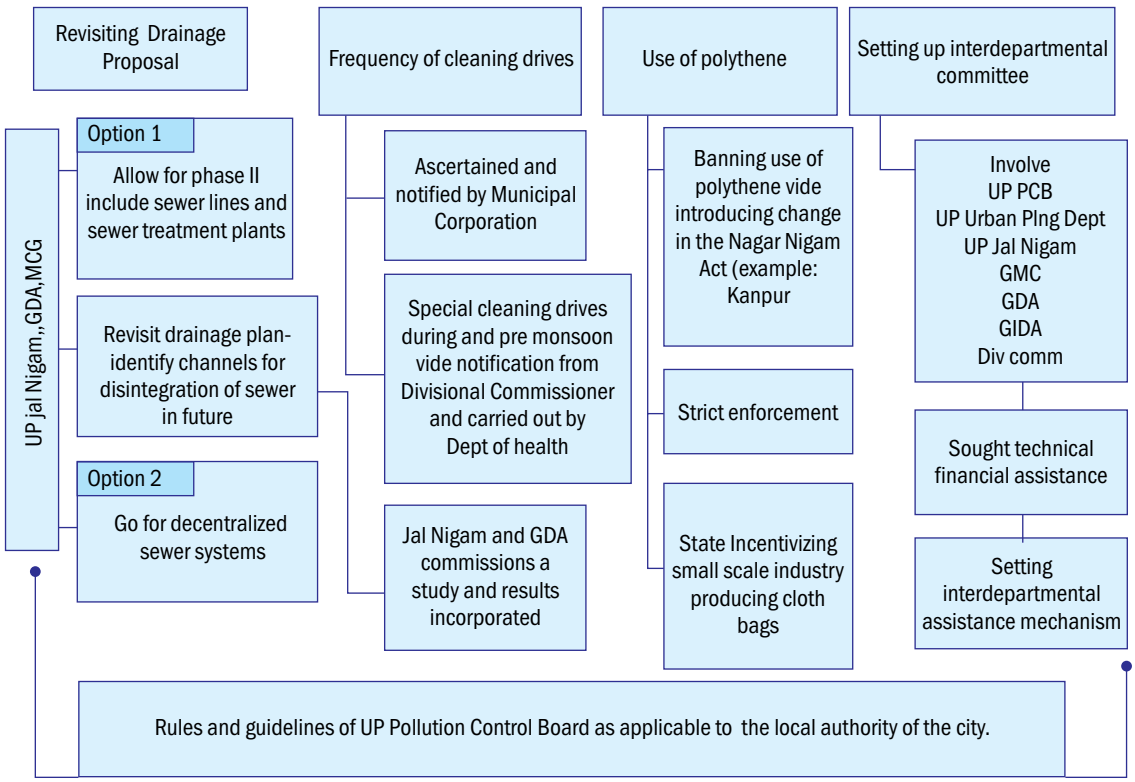


FIGURE 3 TERI's proposal on drainage and sewerage

brings together the Pollution Control Board of the state, the UP Jal Nigam, the Municipal Corporation of Gorakhpur, the Gorakhpur Development Authority, and GIDA to understand the challenges and find solutions. Some of the previous studies conducted as part of the ACCCRN project could become a baseline to be shared with all the concerned departments.

5 Suggestions from community and NGOs working in this area, should also be incorporated in planning a robust drainage and sewerage system in the city.

Enabling Mechanism

TABLE 3 Institute and regulations for drainage and sewerage system

Institute and regulations	Description
UP Jal Nigam	Responsible for design and construction of the sewerage and drainage systems, including networks as well as treatment plants in the city
GMC (As per UP Municipal Corporation Act, 1959)	Key agency for the O&M of the existing sewerage and drainage systems in the city
Health Department, GMC	Periodic cleaning of the sewers/drains
GDA	Responsible for provision of sanitation systems in its colonies and then handover to GMC for O&M. *Has not happened in most cases, only ad-hoc provisions for water supply/sewerage/ drainage available.*
GIDA	Responsible for provision, operation, and maintenance of water supply, sewerage, industrial effluent treatment, and drainage systems in its jurisdiction. *No adequate system at present, only ad-hoc provisions are in place.*
UP Pollution Control Board	Norms and guidelines are applicable to local departments at city level for activities like solid waste management (by GMC), industrial effluent discharge (by GIDA areas), waste water management (by GMC), etc. *Present status of implementation of these norms (especially for O&M) not very promising in the city.*

3.3 Drinking Water

3.3.1 Status

Currently, 21 water supply zones covering 48 wards out of 70 are connected by pipelines. In the rest of the area, India Mark II hand pumps have been installed for public use. Residents have installed their own hand pumps within their plots. Four new water supply zones covering 13 wards are about to be included under the water supply extension scheme. A total funding of ₹19.8 crore ($3.80 million) has been acquired from UIDSSMT for this (*Source: City consultations*). The scheme involves installation of new 90 over head tanks, 22 tube wells, and 115 km of pipelines. According to the projections given in the Development Plan, the population of the city would reach 1.3 million by the year 2021 and the requirement of water would approximately reach 25,500 KL per day as against the current capacity of 12,000 KL per day. Due to acute problem of water logging and high ground water table, the first stratum of ground water is contaminated. Other sources of contamination are soak pits, un-cemented toilets in the city, and proximity of drains to the hand pumps.

Action Points

Quality of ground water

The State Ground Water Board (GWD) should assist the municipal corporation to do quality monitoring and assessments on specific locations of bulk withdrawal of water for the purpose of supply and also at certain destination locations. This would help locate flaws that can cause health hazards.

For individual boring cases, testing should be done at destination, for example, from various residential colonies, slums, LIG locations, etc. GWD has a dynamic repository of data[7] on ground water resources, level, quality, etc., which should be used by departments like UP Jal Nigam.

TERI proposes that a section be introduced in the existing Uttar Pradesh Ground Water Conservation Protection and Development (Management, Control, and Regulation) Bill 2010. The section should focus

[7] State Government order no 436/62-1-2004-863/98 dated 25 May 2004

on the periodicity of inspection not only for recharge facilities, but also for monitoring the quality of water withdrawn and the situation of the aquifer with regard to water availability for future withdrawal. The Act may establish or nominate Jal Nigam as the nodal agency at the city level.

Multiple channels for data collection and reporting

A database management system should be introduced at the Municipal Corporation, which can be housed at the Jal Kal Department or the State Ground Water Department office at Gorakhpur. The new data can

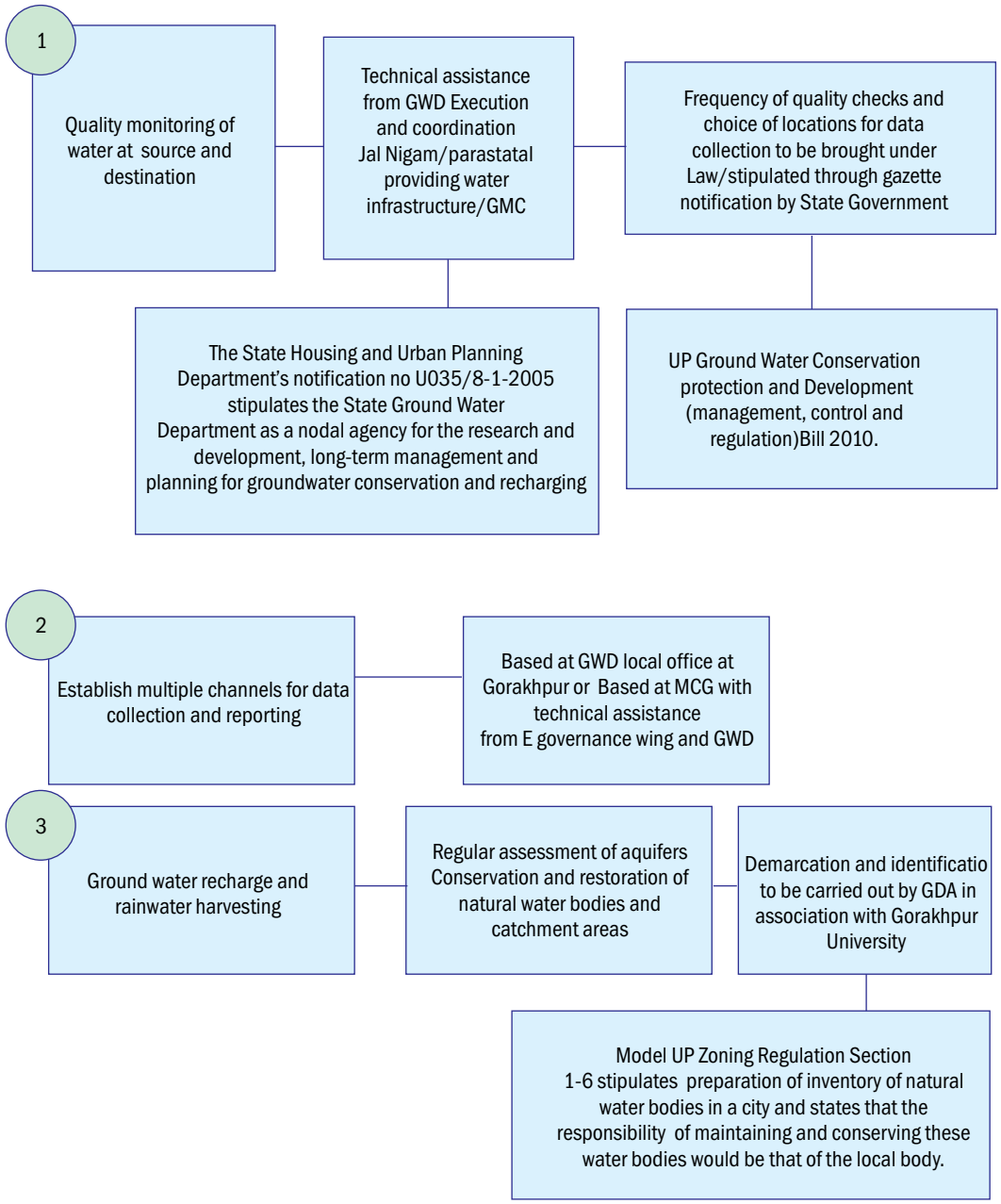


FIGURE 4 TERI's proposal for drinking water

be fed into the existing system of the GWD to reduce the cost. The data should be collected at regular frequency and at various locations of withdrawal and destination.

Ground water recharge and rainwater harvesting

Regular assessment of aquifers particularly the ones, which are subjected to bulk withdrawals should be conducted. There is a need to demarcate prime catchment areas within the city for conservation and restoration. GDA should collaborate with Gorakhpur University for this.[8]

3.3.3 Enabling Mechanism

TABLE 4 Institute and regulations for drinking water management

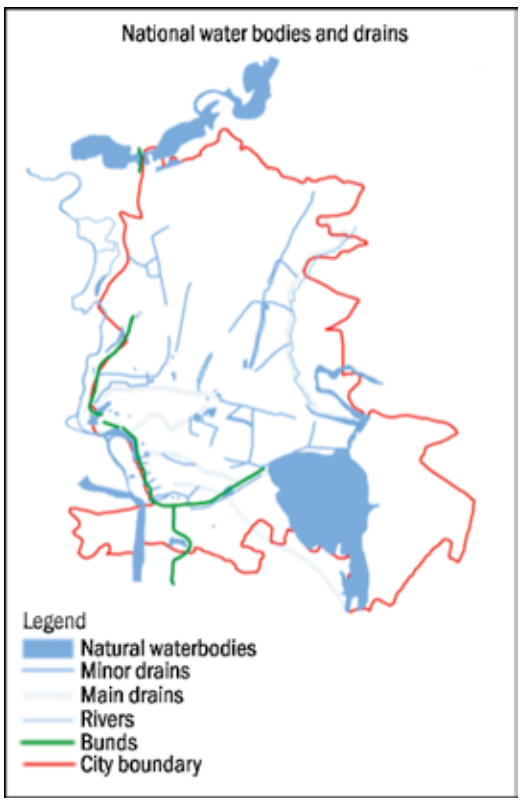
Institute and regulations	Description
UP Jal Nigam	Responsible for design and construction of the new water supply schemes. This involves construction of tube wells, pipelines, Over Head Tanks (OHT), installation of hand pumps, etc.
GMC	Involved with the treatment, distribution, and revenue collection of the water supply
Jal Kal Department, Municipal Corporation	Tests the quality of water at source as per the prescribed norms
State Ground Water Board (GWD)	Has a dynamic repository of data on ground water resources, level, quality, etc., which is available for use to other department, research institutes, planners, and managers. Also assists in identifying appropriate locations for tube wells for the purpose of withdrawal and necessary technical assistance on the design, distance, depth, etc. of the tube wells.
The State Housing and Urban Planning Department's notification no U035/8-1-2005	Provides information and advisory on the rainwater harvesting policy of the State;
	It establishes the State Ground Water Department as a nodal agency for research and development, long-term management, and planning for groundwater conservation and recharging.
Model UP Zoning Regulations	Sections 1–6 stipulate maintaining the natural water bodies, ponds, and lakes in a city, which are larger than 1 acre in area (4,046.85 sq. m). The Law states that the natural water bodies should not be disturbed; instead it stipulates that an inventory of such water bodies should be made and maintained and included in the development plan/zonal plans and lay out plans and all measures for the conservation of these water bodies should be made by the local authority.
The Uttar Pradesh Ground Water Conservation, Protection and Development (Management, Control, and Regulation) Bill, 2010	(*Chapter iii, section 32, point 2, 3, 11, 12)* gives the ground water authority the requisite powers to stipulate provision of roof top rainwater harvesting structures in the building plan in an area of 100 sq. m or more. The Law goes further to the extent saying that the water and electricity connections will be granted only after fulfilling this condition. The authority also has powers to issue directions to the Housing Department for providing combined rainwater harvesting system for existing urban colonies along with provisions of maintenance. It also stipulates involving government agencies, NGOs, volunteer organizations, etc., for awareness generation towards rainwater harvesting. *Section 16(1), 17(1), and 18* of the Act, deals with rules to be followed during extraction of ground water in urban areas as per the degree of criticality of that particular area.
The Government of Uttar Pradesh vide Notification no U035/8-1-2005 dated- 25 April 2006 (*refer Gorakhpur Development Plan, page 160, Annexure 4*)	Outlines several measures for introducing ground water recharging and rainwater harvesting within the city. For instance, it proposes that the area prone to water logging should not be subjected to any recharge; instead the area should be used for storage and reuse.

[8] The vulnerability report of Gorakhpur and the Hydro geology report prepared by University of Gorakhpur highlights the issue of depletion of about 100 water bodies within the city of Gorakhpur which were the major catchment area for rain water

3.4 Ecosystem Conservation & Flood Management

Status

The city of Gorakhpur faces extreme developmental pressure due to its strategic location—it is the District and Divisional Headquarters—causing in-migration for availing economic opportunities, educational, and health services. The residential units have more than doubled in the city during 1981–2001 (*Gorakhpur Master Plan, 2021*). As per the Gorakhpur Master Plan 2021, about 111 ha (3 per cent) of residential areas in the city have grown in an unauthorized manner especially in the peripheral areas, agricultural land, and land earmarked for open/green spaces.



MAP 3 Natural Water Bodies & Drains, Gorakhpur

Source Vulnerability Assessment Report, 2009; GEAG – ACCCRN

As compared to the Master Plan 2001, out of the provision of 943.94 ha, only 291.20 ha of parks/ playgrounds were developed in the city. As compared to 103 small and large water bodies/ lakes in the city during 1950s, there are only some 20–25 remaining at present (See Map 3). Even these are facing threats due to silting, disposal of solid waste, and waste water.

Present vulnerabilities identified by the Gorakhpur Resilience Strategy (GRS) in this sector correspond to the impacts on the ecosystem in the city:

- Caused due to frequent flooding
- Encroachment and reclamation of drains and water bodies in the city
- Lack of open/ green areas in the city due to development pressures
- Decline in ground water table

Action Points

The following steps are proposed for implementing the strategies for ecosystem conservation in the city.

Mapping and demarcation

Mapping and demarcation of water bodies and open areas in the city is important to regulate reclamation and unauthorized change of land use. Existing studies like the one prepared by Gorakhpur University should be taken into account while making decisions and drawing up strategies for ecosystem conservation and flood management.

Protection from encroachments and reclamation

To protect key areas from encroachments and unauthorized land-use conversions, GDA should mark these as low built/ no development zones with green/ recreational uses for conservation of natural ecosystems.

Revisiting the impact fee

The impact fee is charged by the GDA for any change in land-use considering the added burden of traffic and construction activities that might result from the new land-use patterns. The fee is supposed to

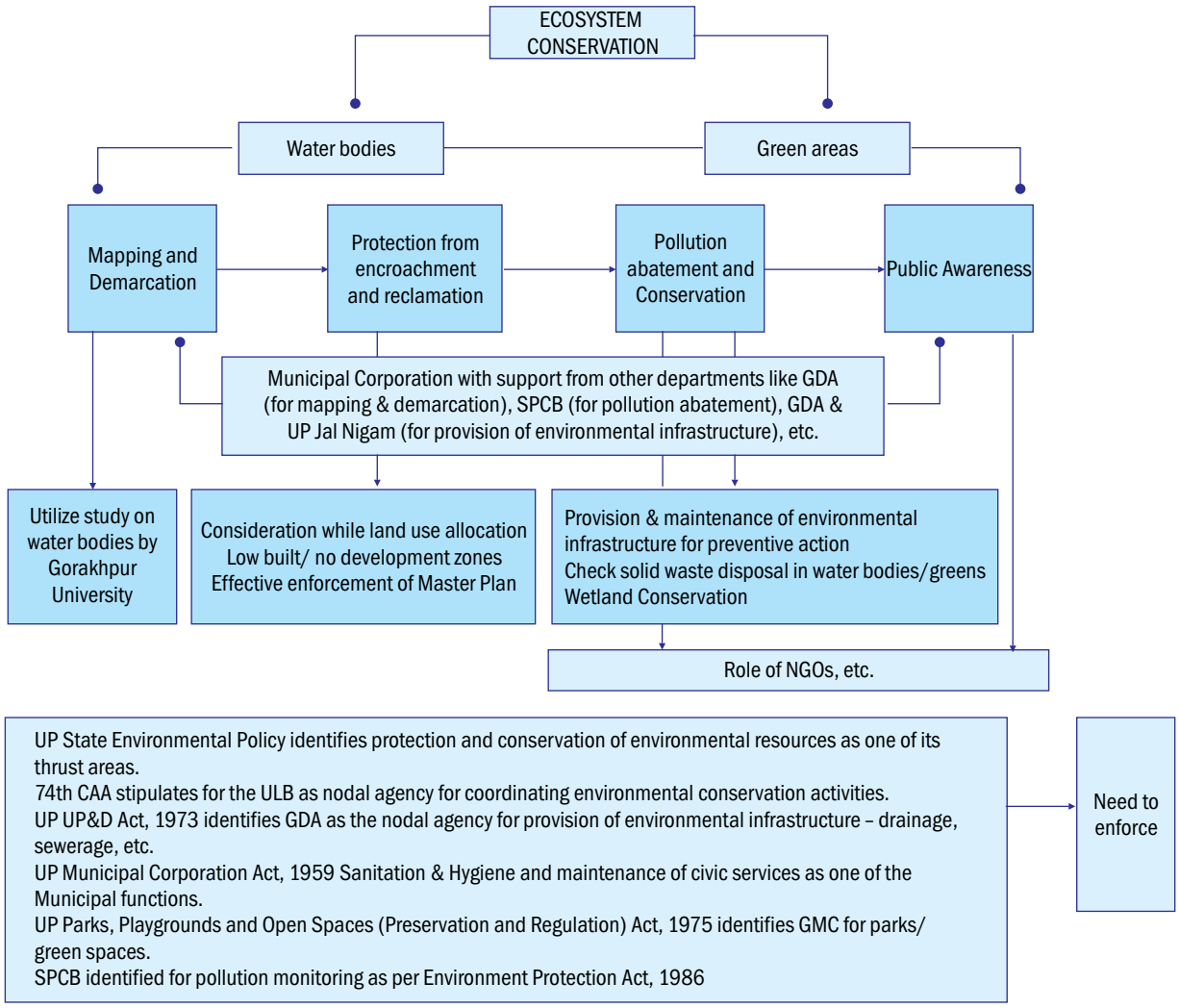


FIGURE 5 TERI's proposal for ecosystem conservation

provide the infrastructure/ services lacking in the area to accommodate the new land use. However, it was found during the consultations that this has not really happened in the past and only ad-hoc provisions have been made. This not only adds to the pressure on the existing services of such an area, but has also been used as a loophole where new and environmentally conflicting land uses are introduced in the city. It is proposed to revisit the efficacy of this rule and introduce an EIA study before allowing for any land use in lieu of the impacts fee.

Pollution abatement and conservation

Adequate systems for waste water and solid waste management in the city can check pollution. Regular monitoring of water pollution is another step.

As mentioned in Section 3.1, the Central Wetlands Regulatory Authority of GoI is implementing a project for cleaning and beautification of the Ramgarh Tal. Similar to this scheme, other water bodies of importance should be identified by the District Administration to the State Government, which in turn can submit a proposal for conservation to the Central

Wetlands Regulatory Authority of the Government of India as per the Wetlands (Conservation and Management) Rules, 2010.

Public awareness

The local population should be sensitized about the socio-economic and health related benefits of conserving water bodies and green areas through campaigns similar to the one used for Japanese Encephalitis in the district. The Municipal Corporation, with the help of local NGOs, volunteers, etc., should take up such measures.

Coordination

The Model UP Zoning Regulations has not assigned an authority for preparation of inventory of natural water bodies. It is, therefore, proposed that the GMC can carry out these functions with support from other departments like GDA (for mapping and demarcation under Model UP Zoning Regulations), SPCB (for pollution abatement under Environment Protection Act, 1986), GDA, and UP Jal Nigam (for provision of environmental infrastructure like sewerage, drainage, etc., under UP UP&D Act, 1973), etc.

Enabling Mechanism

TABLE 5 Institute and regulations for ecosystem conservation and flood management

Institute and regulations	Description
GMC under provisions of UP Parks, Playgrounds, and Open Spaces (Preservation and Regulation) Act, 1975	Nodal agency for mapping and demarcation, protection, conservation, pollution abatement, and maintenance of open/ green spaces
Model UP Zoning Regulations	Sections 1–6 stipulate preparation of inventory of natural water bodies in a city and state that the responsibility of maintaining and conserving these water bodies would be that of the local body. *However, it has not been specified as to which local body this would be.*
The UP State Environmental Policy and Wetlands (Conservation and Management) Rules, 2010	Identifies protection and conservation of environmental resources as one of its thrust areas; including forests, biodiversity, and water bodies. It also recommends formulation of water conservation standards and preparing an inventory of wetlands in the state.

3.5 Flood Management

Status

At present, a large part of the city, especially in the southern, western, and central areas, faces acute water logging. In order to minimize water inflow to the city, more than 12 km of earth bunds have been constructed along the river lengths and about 6.8 km of length along the banks of Ramgarh Tal. In addition to this, four pumping stations have also been established in the city to pump out the water.

Present vulnerabilities identified by the Gorakhpur Resilience Strategy (GRS) in this sector are:

- Water logging, caused due to (as found in consultations and GRS):
  - Bowl shaped topography of the city
  - The city falls in the Rapti catchment area. The water from river Rohin and Kuano falls in River Rapti endangering the city. Constant silting of river has also reduced the capacity of river to hold water.
  - Inadequate drainage system in the city
  - Encroachment and reclamation of drains and water bodies in the city
- Highly irregular and increasing rainfall pattern predicted for future with high probability of extreme flooding event.

Action Points

Long-term measures

- The vulnerable low lying zones should be marked as low built/no development zones with restricted green land use to maximize drainage of storm water and also for ground water recharge.
- It is important that a detailed assessment of the design parameters (e.g. peak flow of storm water

drainage) is conducted based on past trends and likely future scenarios of rainfall. Removal of encroachments and regular maintenance of existing drains by GMC is also required.

- There is a need for strengthening and capacity building of the GMC as it currently faces acute lack of manpower (*Source: City consultations*).
- Environmental/disaster risk reduction concerns should be integrated in the Development Act/Rules of the State to make it part of the Master Plan provisions.
- There is a need to integrate the provisions of State Water Policy and provisions of Disaster Management Act, 2005 for flood management. The State water policy constitutes a State Water Board, which shall be the apex body at the state level overseeing the preparation of Flood Management Plans for various watershed/river basins. It stipulates that the ULB will be the nodal agency for all activities related to flood management plan preparation and enforcement in the urban area. On the other hand, the DM Act, 2005 has constituted the State Disaster Management Authority (SDMA) for the same and stipulates for the DDMA to do the same function for urban as well as rural areas in a district. Such issues need to be sorted out at the state level.

Short-term measure

- Flood Management Plan
  - There is a need to translate the URR Plan at the lower level, to the community for effective enforcement. Ward/area level resilience

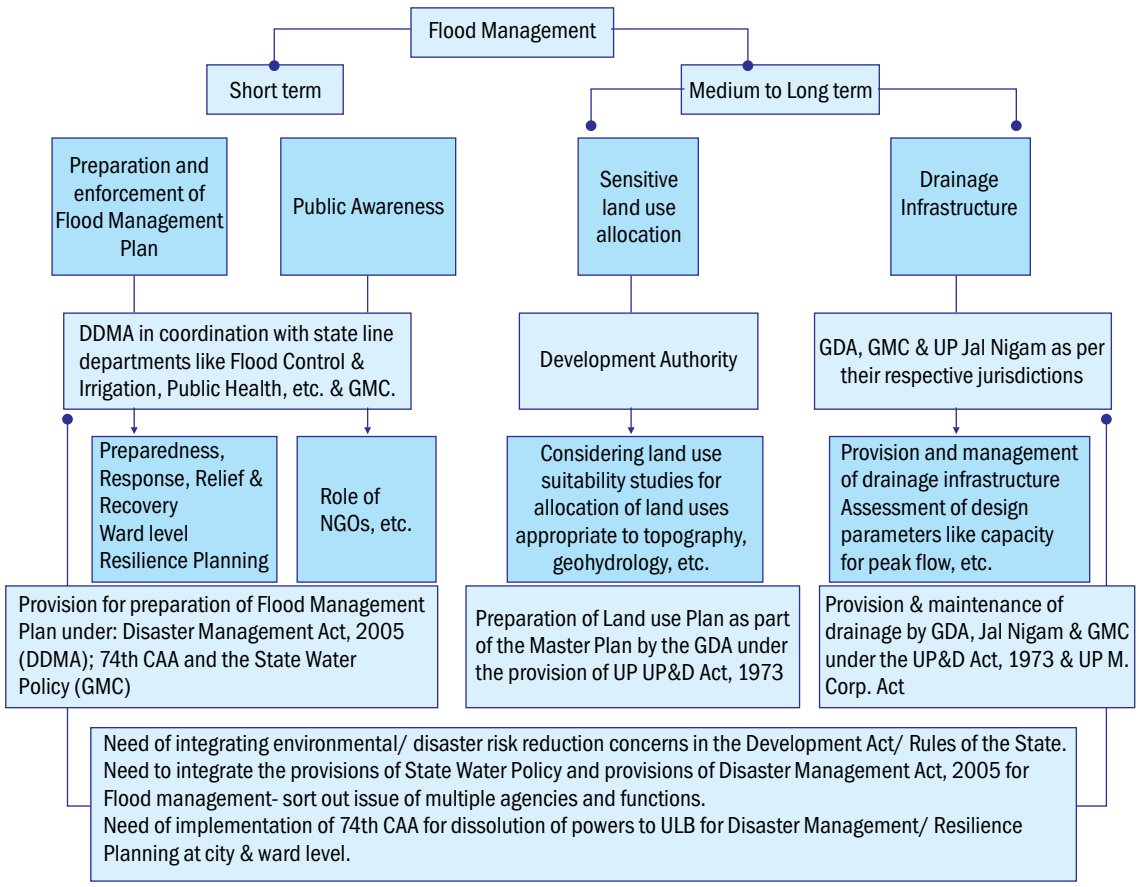


FIGURE 6 TERI's proposal for flood management

planning can go a long way to achieve this objective. [9]

- It is proposed that an Environment & Disaster Management Cell may be set up under the chairmanship of the Municipal Commissioner/Mayor with representatives of various concerned departments for effective enforcement of various plans/provisions for ecosystem conservation and flood management.

■ Public awareness and Participation

This can be done through various print, electronic, ICT-based media and also innovative activities like street plays, mock drills, school campaigns, etc. Local NGOs can play an important part in this.

Enabling Mechanism

District Disaster Management Authority (DDMA), Gorakhpur has prepared the Gorakhpur District Disaster Management and Risk Reduction Plan 2011, with support from UNDP, under the provisions of the Disaster Management Act, 2005. As part of this Plan, the Urban Risk Reduction Plan for Gorakhpur Municipal Corporation Area has also been prepared.

It has been prepared on the basis of the experience of flood events of 1998, 2001, and 2007. The Plan has identified 59 hotspots of water logging

TABLE 6 Institute and regulations for flood management

Institute and regulations	Description
Gorakhpur University	Has conducted a study on the geo-hydrology and water bodies in the city, which should be utilized by GMC and other nodal agencies while planning.
DDMA's District Disaster Management and Risk Reduction Plan	**Pre-flood scenario** • Establishment of a 24-hour Control Room for real time monitoring, analysis of meteorological observations, issuance of early warnings, and rapid responses • Maintenance and upgrade of drains and pumping stations • Regular cleaning of drains • Regular maintenance and protection of bunds through buffers, etc. in various areas of the district, including Gorakhpur city **At the time of a flood** • The District Plan gives a Standard Operating Procedure (SOP) to be followed in case of flooding events. This gives detailed directions on deployment of resources and is also supplemented by various maps including the road map, which may be referred for evacuation and relief. • Has identified 15 flood posts for monitoring and relief measures (report to control room), 17 relief centers for distribution of food packets and other necessities, and 15 relief camps (higher locations identified for refuge during extreme floods) in Gorakhpur urban area. • Gives a list of all the hospitals, clinics, etc. in the city to facilitate easy access and minimizing impacts on Public Health during a flood. **Post-flood scenario** • Gives a list of the pumping stations established in the city, which start working to minimize resulting water logging.
GDA	Nodal agency for preparation of the Master Plan, which allocates land uses under the UP UP&D Act, 1973
	For drainage infrastructure, GDA is responsible for construction, operation, and maintenance in its jurisdiction
UP Jal Nigam	In GMC area, UP Jal Nigam is the responsible authority for construction of the system, whereas, removal of encroachments and proper maintenance and cleaning of existing drains is to be done by GMC as per the municipal functions defined under UP Municipal Corporation Act, 1959
GMC	Nodal agency for preparation and enforcement of Flood Management Plan/Resilience Plans under 74th CAA (yet to be implemented in State) and the State Water Policy.
State Disaster Management Authority (SDMA)	DM Act, 2005 has constituted SDMA for disaster management/resilience planning.

[9] In this context, an exercise on Ward Resilience Plans has been initiated for seven wards in the city as a pilot project under ACCCRN phase I. The project is being expanded in the current phase i.e. phase III of the ACCCRN programme.

and outlines the various measures for management of flooding and inundation in the city (See Table 4). TERI recommends including recovery measures in the plan for a post-flood scenario. For example, there is always a high probability of outbreak of epidemic or high occurrence of water- and vector-borne diseases after a flood event. Therefore, it becomes important to have disease surveillance, an adequate and functioning Health Management System, and a well defined operating procedure in place.

3.6 Public Health

Status

As a result of water logging, the city faces high risks from diseases. Apart from the common water- and vector-borne diseases, Japanese Encephalitis (JE) is another major disease prevalent in Gorakhpur. The period from April to October is very sensitive (*Vulnerability Assessment Report, 2009; GEAG – ACCCRN*).

A large part of the existing health care set-up primarily belongs to the private sector. As a result, it becomes difficult for middle- and low-income groups to bear the treatment costs incurred. The situation is aggravated by the fact that Gorakhpur city is a major urban centre in the district and division level, which results in the influx of a heavy load of patients from adjoining areas to the city for availing health facilities.

Present vulnerabilities in this sector are:

- Susceptibility to increase in water- and vector-borne diseases
- Pressure on health delivery system

3.6.2 Action Points

Health surveillance system

An effective public health surveillance involves:

- Data Collection and Reporting: The Office of the Chief Medical Officer (CMO) has seven control

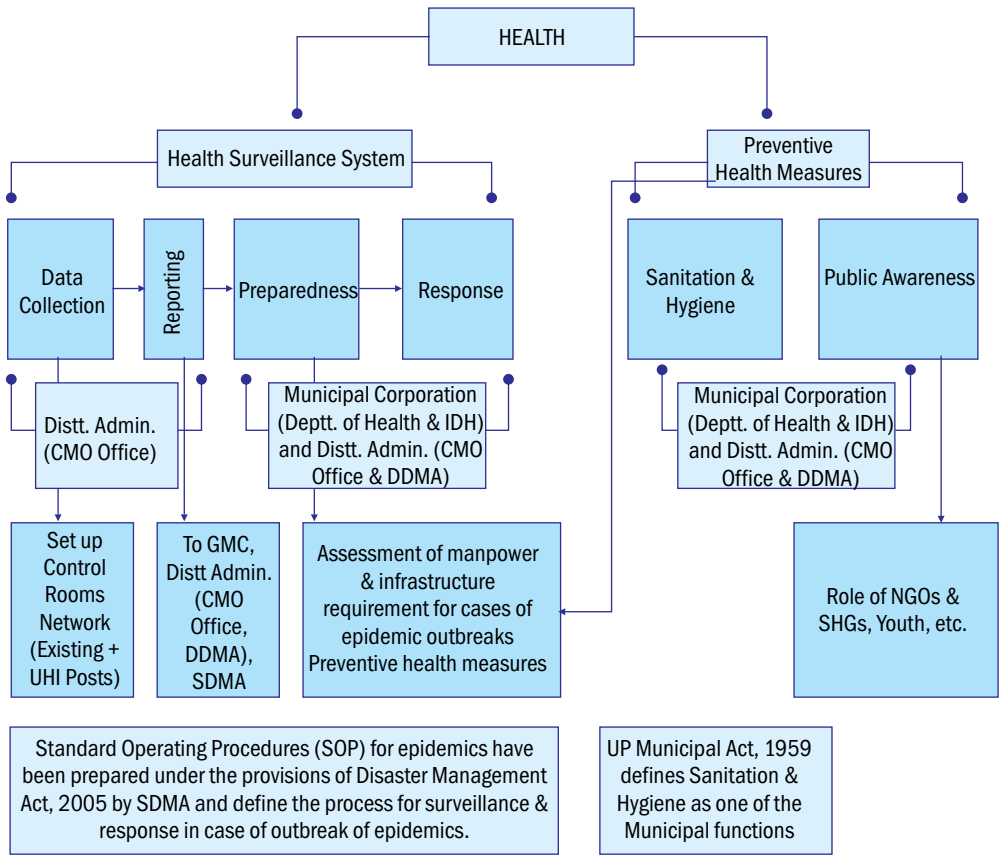


FIGURE 7 TERI's proposal on health

rooms in the city. These should be integrated with the 15 health posts in Gorakhpur urban area to help build a large-scale network for monitoring and reporting of infectious disease cases. Provided with adequate infrastructure and manpower they will also act as control rooms for emergency situations. This data should feed into an Early Warning System (EWS).

- Preparedness: The District Administration (DDMA or CMO Office) through consultants should conduct an assessment on the past trends of outbreaks under normal water logging conditions and at the time of flood events. Accordingly, the requirement of manpower (doctors and paramedics) and infrastructure, like hospitals, number of beds, mobile vans, etc. should be assessed.
- Effective Response System: Mobile vans, health camps, etc. can be effective measures for outreach to the population to ensure accessibility of health services, particularly the poor. The e-governance cell of the Municipal Corporation should include public helplines, information and communication technology (ICT)-based mediums like SMS, public portals, etc. in reporting occurrence of cases as well as for disseminating information in case of emergencies.

Preventive health measures and practices

Preventive health measures should be deployed at the level of the administration as well as at the community level.

- Sanitation and Hygiene: Presently, the number of permanent and casual sanitary workers in the GMC is only 70 per cent of the requirement (*Vulnerability Assessment Report, 2009; ACCCRN-GEAG*). Therefore, large-scale intake of sanitary workers, to carry out regular sanitation activities, at least in the vulnerable monsoon and post-monsoon months, is required on the part of the GMC.
- Public awareness: Generation of public awareness to adopt preventive health measures and practices may prove quite beneficial especially in case of slums, urban poor/squatter settlements, etc. In this context, the District Administration has already taken few initiatives like generating awareness to discourage use of plastic bags, for control of Japanese encephalitis, etc. wherein the local NGOs, school teachers, SHGs, etc. were involved. More of such initiatives/drives should be undertaken.
- Understanding potential shifts in seasonality of diseases due to climate change would help design measures for prevention and treatment of diseases.

Enabling Mechanism

TABLE 7 Institute and regulations for public health management

Institute and regulations	Description
Health Department, GMC	Nodal agency for public health and sanitation at the city level under the UP Municipal Act, 1959; Responsible for running of the Infectious Diseases Hospital (IDH) in the city; The Chief Health Officer (JD-level officer), on deputation from the office of the CMO, is responsible for carrying out sanitation and hygiene works in the city. This involves regular cleaning, fogging, chlorination, spraying in drains, management of solid waste, etc.
CMO	District-level nodal officer for public health is responsible for all related activities in urban as well as rural areas of the District. The CMO Office also has 15 health posts in Gorakhpur urban area, with paramedics, computer operators (statistical assistant), and doctors.
DDMA	It is the nodal agency for preparing and enforcing the District Disaster Management and Risk Reduction Plan in the district and also the Urban risk Reduction Programme (of UNDP), under the UP State Disaster Management Act, 2005. The Plan looks after various affected sectors, including health, in case of a disaster.
The Department of Medical Health and Family Welfare	It is the nodal agency for public health in the state; only looking at family welfare and few other programmes like control of AIDS, TB, leprosy, etc.
SDMA	It is the nodal agency for preparing and enforcing the Disaster Management Plans and all other related activities as per the provisions of the UP State Disaster Management Act, 2005; Prepared the Standard Operating Procedures (SOP) for epidemics to define the process for surveillance, preparedness, and response in case of outbreak of epidemics

3.7 Urban Planning

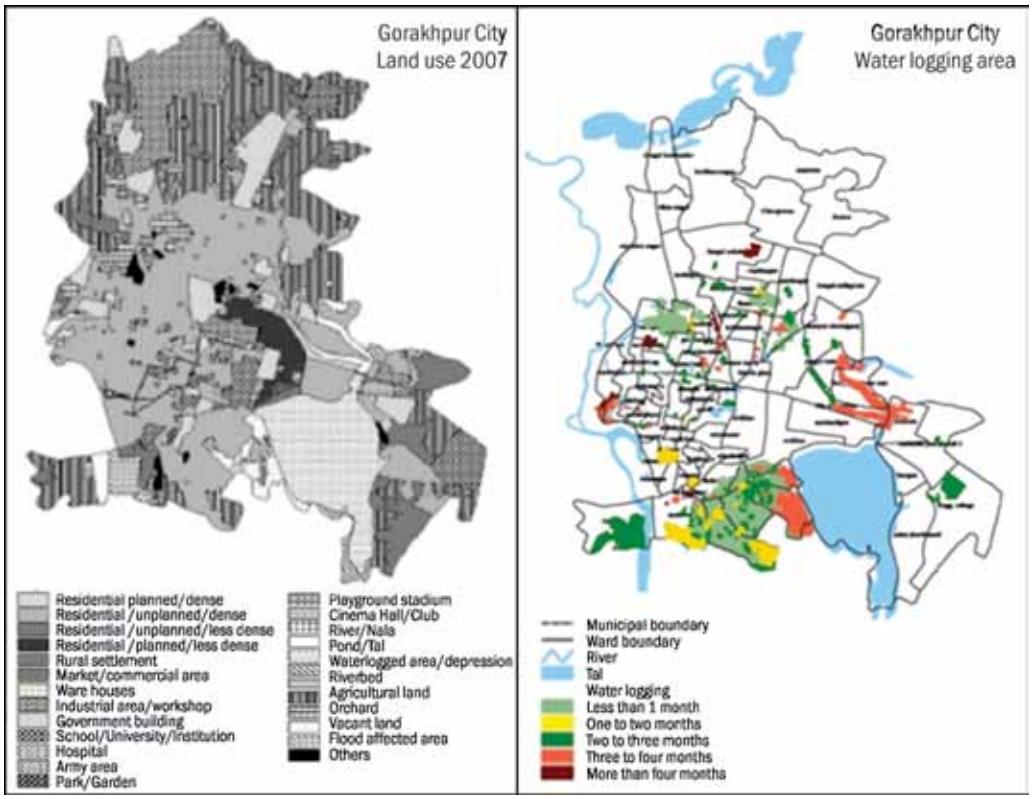
Status

For the urban planning framework in the state, the Model Town and Country Planning Act has been adopted in the form of the Urban Planning and Development Act, 1973. As per this Act, a development plan has to be prepared to guide the growth of the city. However, this plan is primarily a land use plan and environmental considerations are not given a priority while defining land uses. (*Source: City consultations*)

At present, the provision for change in land use, other than stipulated in the development plan, is carried out by paying an *impact fee* to the Development Authority. On the other hand, if a complete change in land use is proposed then a land-use change fee is deposited to the GDA.

Action Points

- A chapter on climate change resilience, which includes present vulnerabilities like water logging and frequent floods must be incorporated in the Master plan of the city and should be duly factored in land-use planning.
- The Gorakhpur resilience strategy has prepared a water logging plan. A simple overlaying of this plan on the land-use plan of the city would give useful insights on land-use planning for future (See Map 4). Proper land-use planning integrated with a scientifically designed sewerage /drainage system and solid waste management system would reduce the city's vulnerability immensely.
- The impact fee (Zoning Regulation, Gorakhpur Development Plan, section 1.7, 1.8) system as a concept may look at the cost escalation due to the changed land-use/activity, however, particularly the environmental damages due to such changes



MAP 4 Maps showing residential land uses falling under the water logged area

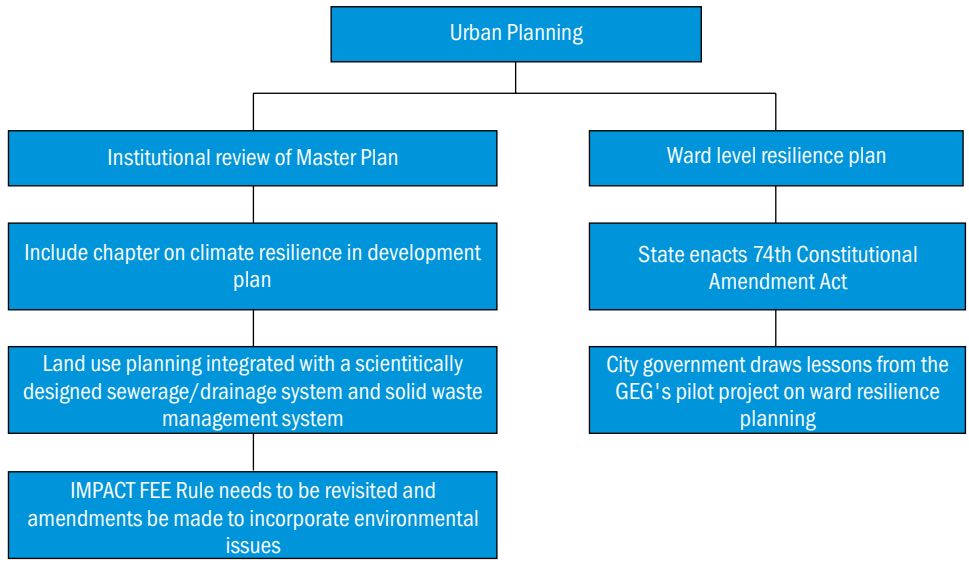


FIGURE 8 TERI's proposal on urban planning

cannot be factored on monetary terms. There is no way to link the fees so collected to be spent on decreasing the environmental influence of such a land-use change. This rule needs to be revisited and amendments be made to incorporate environmental issues.

- Ward level resilience plan: As gathered from the city consultations, the zonal plans cannot be integrated with ward-level resilience plans. The city government could draw lessons from GEAG, which is attempting to prepare a pilot ward-level resilience plan with a view that such a plan would factor specific vulnerabilities at the grassroot level.

Enabling Mechanism

The State Government must enact the 74th CAA, which allows for preparation of ward-level plans and devolves many functions to local bodies, thus, empowering them to make decisions and plan for their development.

3.8 Housing

Status

Gorakhpur is a major centre of socio-economic, commercial, cultural, and administrative activities of north eastern UP with a high population density of 4,559 person/km^2 (2001). Close to 72.1 per cent of the total area (4,103.3 ha) falls under the residential area (Table 6).

Master Plan 2021 clearly mentions that most of the land-use conversion contrary to the one proposed in Master Plan 2001, happened for residential use. Land use converted by the administration alone for residential purpose is 190.36 ha. Rest of the residential development on an area of 753.44 ha is unauthorized. There are several consequences of this unplanned development as stated in sections 4, 5, and 8.

TABLE 8 Land use of Gorakhpur City

S. No.	Land use	Area (ha.)	% of developed area
1	Residential	4103.30	72.10
2.	Commercial	173.20	3.05
3.	Industrial	445.00	7.82
4.	Govt. organization	161.00	2.83
5.	Public and semi-public services	398.32	7.01
6.	Park and open space	291.2	5.12
7.	Transport	117.10	2.07
	Total	5689.12	100.00

Source GDA, Gorakhpur Master Plan 2021

Action Points

Approaches to flood risk/water logging management:

- Avoidance: Includes measures that can be taken to prevent floodwater from reaching a property. Example: Low defence mounds/barriers surrounding a development or individual property; landscaping the ground surrounding a building to divert floodwaters away or into temporary storage.
- Resistance: Includes measures taken at the building level to prevent floodwater entering the building and damaging its fabric. Example: Use of low walls/ mounds around development sites, pumping the water, etc.
- Resilience: Includes sustainable measures that can be incorporated into the building fabric, fixtures and fittings to reduce the impact of floodwater on the property.

In light of the above, TERI recommends strategies for two categories—existing and new construction.

New construction

Guidelines for all new development/buildings/ colonies coming up in the Municipal Corporation area/development area/industrial area:

- Basements should not be allowed in any low-lying/ water-logging prone areas.
- Natural Sustainable Urban Drainage Systems (SUDS) should be encouraged while implementing the zonal plans. SUDS manage surface water runoff in a more sustainable manner compared to traditional pipes (open/closed) systems. However, these natural SUDS should not become sites for dumping of waste.
- For all new buildings/building complexes whose connected load is more than 100 kW, it

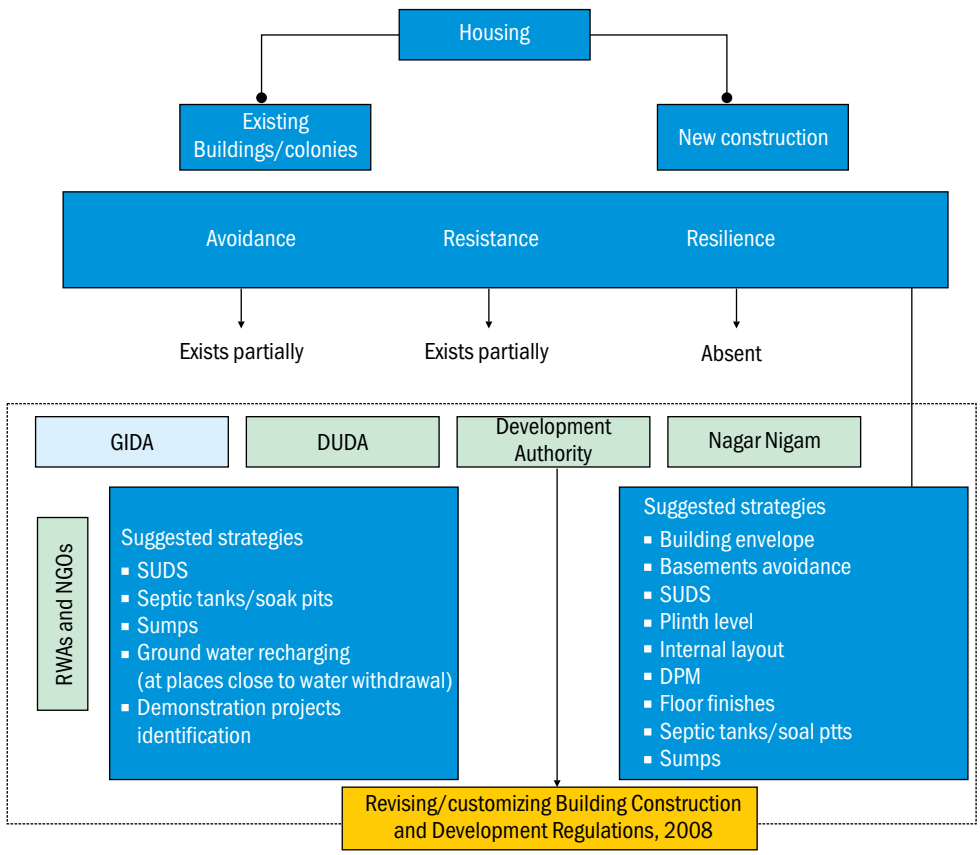


FIGURE 9 TERI's proposal on housing

is recommended to also consider the various provisions under the Energy Conservation Buildings Code by the Bureau of Energy Efficiency.

- Water and electricity meters should be located above predicted floor level and electrical sockets should be installed above flood level. Similarly, wiring for telephone, TV, internet, etc. should be protected by suitable insulation in the distribution ducts to prevent damage.
- As a resilience strategy, it is suggested to propose 'improvised septic tanks' for all new construction and/or DEWATS/other suitable decentralized grey water/black water treatment systems, which are not capital intensive. Soak pits should not be allowed as the city has high ground water table and possibility of contamination due to seepage of untreated sewage through these soak pits is high.
- Use of wetlands is strongly recommended as a design strategy in all new housing colonies and wherever possible in existing settlements.

Existing buildings/ colonies

- It is proposed to intercept the storm water drains (wherever available) and build recharging wells of appropriate depths along with filtering media.
- Decentralized sewage treatment systems could be proposed depending on the applicability on scale/ building typology, starting with few demonstration projects. Wherever feasible, the existing septic tanks could be converted to improvised septic tanks. Such structures should maintain appropriate distance from the tubewells/borewells/recharging structures/rainwater harvesting for storage, etc.

Enabling Mechanism

Currently, building bylaws do not specifically cover flood risk management or water logging issues. Indirectly, Urban Heat Island and rainwater recharging issues have been addressed to a certain extent in the Building Construction and Development Regulations, 2008—a state-level regulation. For instance, pages 8–9 contain provisions for keeping 5 per cent of the area for recharging structures in all developments with an area greater than 20 acre. Prior to planning, strong recommendations for hydro-geological study and feasibility have been given. These provisions need to be further customized for Gorakhpur city.

3.9 Energy

3.9.1 Status

Jal Nigam has established three pumping stations to dispose of the city's water in the rivers. These are:

- Domingarh pumping station: 6 pumps (with 5 cusecs and 10 cusecs capacities)
- Elahibagh pumping station: 6 pumps
- Mirzapur pumping station: 2 pumps

Apart from these, Municipal Corporation has established three pumps at Laldiggi Park, with a total capacity of 1,450 lps.[10]

Most of the above pumps are diesel based and few are electricity based. New pump houses are also proposed at four key sites of water logging, viz., Bhediaghat, Vishnupuram, Dharamshala Bridge, and Gaderia Tola, where currently temporary arrangement of pumps has been made. Pump efficiencies of both electric and diesel sets are not known. However, studies[11] suggest that against the maximum achievable 'system efficiency' of 54 per cent for electric pump sets and 20 per cent for diesel pump sets, observed efficiencies are sometimes as low as 13 per cent and 5 per cent, respectively. Although these figures are mentioned for agricultural pump sets and the efficiency mapping needs to be done in consultation with the Municipal Corporation and Jal Nigam.

Further, Gorakhpur suffers electricity supply shortages, which makes the performance of electricity pump sets for water pumping even worse.

[10] Gorakhpur District Disaster Management and Risk Reduction Plan-2011

[11] IWMI-Tata Water Policy Program, 2002, "Bringing pumps to people" in Water Policy Briefing in Issue 2.

3.9.2 Action Points

- Solar Photovoltaic (SPV) feasibility for converting the current fleet of pumps to solar PV and improvement of efficiencies of motors (both diesel and electric).
- Priority for locating the recharging structures along with filters should be given to water logging prone areas as listed out in the Report on "Gorakhpur District Disaster Management and Risk Reduction Plan-2011".

3.9.3 Enabling Mechanism

The District Disaster Management Cell is the agency responsible for preparation of the Gorakhpur District Disaster Management and Risk Reduction Plan. The document also looks at getting the desired coordination among the various departments/ agencies of the place. Therefore, the cell is the best agency to implement the proposed coordinated action on improvization of efficiency of motors/conversion to SPV-based pumps and development/operation and maintenance of the proposed recharging structures through appropriate agencies.

CONCLUSION

The current vulnerability of the city is so pronounced that there is hardly a benchmark available to base climate preparedness/climate proofing measures at this stage. TERI's sectorial recommendations, which are based on the resilience strategy, have therefore tried to address the current vulnerability. Besides this, few action points were outlined that the city and the state can take up immediately to have adaptation mainstreamed into their processes.

4.1. Sector specific recommendations for building resilience for future

The table given below summarizes the actions at three levels, namely institutions, regulations, and community under the broad sectors taken up in this study:

TABLE 9 Sector specific recommendations

Sector	Institutions	Regulations	Community
Housing	• Need for stringent compliance mechanism if the suggested changes in the building bylaws happen	• Revision/customization of Building Construction and Development Regulations 2008	• For implementation of SUDS, improvised septic tanks, and rainwater recharging/storing schemes, community buy-in few demonstration projects will be essential • Awareness programme on case studies for community
Urban Planning	• Ensure Implementation of Master Plans • Develop mechanisms that evaluate and monitor the implementation (This is partially carried out now at the time of revision) • Resilience measures to be included in the master planning process • Strengthening technical capacity of the institutions to do so	• Bringing in sustainability, environmental, and climate change related issues within a purview of a single Act (an Urban Development Act that talks of urban development in totality) • Master Plan to be guided by the new proposed Act • Implementing 74th CAA to ensure planning at grassroot level	• Ensure participation within the Master Planning process by developing a transparent and easy mechanism to include people in the decision making system/planning
Basic services	• Ensuring inter-institutional coordination and integration • Developing monitoring and evaluation mechanisms • Database management and data sharing • Developing capacity of institutions to deliver quality services	• Enforcement of 74th CAA (service provision and user charges) • Bringing in law that sets standards of service delivery and prescribes measurement of service level • Regulations setting capacity requirements particularly targeting urban local bodies	• Public awareness programmes through involvement of NGOs, schools, volunteers, etc. on behavioural issues

Ecological Conservation and Flood Management	• Strengthening of the ULB by adoption of 74th CAA (Schedule XII devolves powers to ULB for environment, climate change and disaster risk reduction issues) • Technical and financial capacity building	• Need to enforce the provisions of various regulations and guidelines—UP Draft Environmental Policy, Parks, Playgrounds, and Open Spaces (Preservation and Regulation) Act, 1975, Model UP Zoning Regulations, etc. • Enforcement of 74th CAA to give a legal backing to ward level plans (currently under preparation) • Ward resilience plans should take climate change related future vulnerability into account	• Public awareness programmes through involvement of NGOs, schools, volunteers, etc. on climate change, conservation of natural resources, pollution abatement, etc. • Participation of local community in formulation and implementation of various plans for better enforcement
Public Health	• Setting-up of a surveillance system for public health management • Capacity building of the government health set-ups in the city by assessment of required infrastructure and manpower	• Draw up a city health and sanitation policy guided by the provisions of the National Sanitation Policy, the Air Pollution Act, the Environment Act, and the Water Pollution Act	• Public awareness programmes on preventive sanitation and health measures— role of NGOs, schools, youth, etc.

4.2. Summary of Immediate Action Points

The following table gives a summary of immediate action points that Gorakhpur city and the State of Uttar Pradesh can initiate:

TABLE 10 Solid waste management

City	Actions	Institutions	Supporting regulation/policy
Medium term	Phasing out current dumping grounds, particularly those in the low lying areas of the city	Municipal Corporation of Gorakhpur	
	Facilitating door to door collection of waste in the city	Municipal Corporation of Gorakhpur with help from NGOs, CBOs, SHGs , RWAs, and community	MSW Rules 2000
	Setting up primary collection systems with segregation facility	Municipal Corporation of Gorakhpur and Development Authority	MSW Rules 2000
	Consider decentralized solid waste management system for peri-urban areas.	Municipal Corporation of Gorakhpur and Development Authority	MSW Rules 2000 CPHEEO guidelines on solid waste management
	Campaign to create public awareness to keep the city clean	Municipal Corporation of Gorakhpur and Development Authority	
	For cleaning open drains: Special drives for cleaning the drains pre-monsoon and during the monsoon	Regular cleaning drives to be ascertained and notified by Municipal Corporation of Gorakhpur	Rules and guidelines of UP Pollution Control Board
	Banning use of polythene: Prepare a project for plastic recycling and implement [12]	Municipal Corporation of Gorakhpur	
	Strict enforcement	Overseen by Divisional Commissioner, Gorakhpur	
Long term	Prepare detailed SWM scheme	Municipal Corporation of Gorakhpur, Development Authority	MSW Rules 2000, CPHEEO guidelines on solid waste management

[12] As suggested by Divisional Commissioner during the second consultation in Gorakhpur on 2 June 2012

	Make an application for grant of authorization for setting up waste processing and disposal facility, including landfills from the State Pollution Control Board	Municipal Corporation	Section 4 MSW rules 2000
	Development, Operation, and maintenance of SWM	Municipal Corporation	
	Manage bio-medical waste (waste from hospitals)	Development authority, Municipal Corporation, and Health Department	Bio-medical Waste (Management and Handling) Rules 1998
	Manage hazardous waste	Development authority, Municipal Corporation, and GIDA	Hazardous Waste (Management and Handling) Rules 1989
Note: The District Magistrate or the Deputy Commissioner of the district shall have the responsibility of enforcement of the provisions of the MSW rules. The State Pollution Control Board shall monitor the compliance of the standards regarding ground water, ambient air, leachate quality, and the compost quality as laid out under the schedule II, III, and IV of the MSW rules 2000.			

TABLE 11 Drainage and Sewerage

City	Actions	Institutions	Supporting Regulation/policy
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.	Municipal Corporation of Gorakhpur with technical team of the Jal Nigam	
	Conduct a feasibility analysis for a centralized dual system	Municipal Corporation of Gorakhpur with technical team of the Jal Nigam	
	Option 2: City goes for decentralized systems-DEWATS at level of residential units/wards	Municipal Corporation of Gorakhpur, Development Authority, Jal Nigam (Technical assistance could also be sought from ACCCRN partners ARUP through GEAG)	CPHEEO guidelines on sewerage and sewage system and, Manual on Norms and Standards for environmental clearance of large Construction project, Ministry of Environment and Forests, Government of India
	Strict action on encroachment of drains	Municipal Corporation of Gorakhpur	
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	Municipal Corporation takes the lead and involves UP PCB, UP Urban Planning and Development Department, UP Jal Nigam, Div. Commissioner, GDA, GIDA in the committee	
State	Actions	Institutions	Supporting regulation/policy
Medium term	Banning use of polythene by means of amendment made under the Municipal Act[13]	State Government	
	Incentivize small scale industries that produce cloth bags and popularize the use of cloth bags	State Government	
Long term	Allows for phase II of the project where separate sewer system along with the sewer treatment plant is sanctioned	Urban Development Department	

[13] As is done in Kanpur city in UP State

TABLE 12 Drinking water

City	Actions	Institutions	Supporting regulation/policy
Medium term	Quality monitoring of water at source and destination: Setting up of high quality lab equipped with modern testing instruments, trained personnel, and financial allocation for conducting sample surveys for water quality testing in a professional manner.	Technical assistance from GWD, execution and coordination Jal Nigam and GMC	The State Housing and Urban Planning Department's notification no U035/8-1-2005 stipulates the State Ground Water Department as a nodal agency for research and development, long-term management and planning for groundwater conservation and recharging
	Ground water recharge and rainwater harvesting: Use of roof top water for collection and storage. Start practice from public buildings and let them become a demonstration projects which people can replicate.	All Departments, especially Municipal Corporation and GDA	By order from the Divisional Commissioner
	Regular assessment of aquifers	Municipal Corporation of Gorakhpur and Ground Water Board	By order from the Divisional Commissioner
	Conservation and restoration of natural water bodies and catchment areas	Demarcation and identification to be carried out by GDA in consultation with Gorakhpur University (Prof. Verma's team that was involved in the geo-hydrological study of the city)	Model UP Zoning Regulations Section 1–6 stipulates preparation of inventory of natural water bodies in a city and states that the responsibility of maintaining and conserving these water bodies would be that of the local body
Long term	Establish multiple channels for data collection and reporting	Should be based at GWD local office at Gorakhpur Or Based at MCG with technical assistance from E-governance wing and GWD	
State	Actions	Institutions	Supporting regulation/policy
Medium term	Frequency of water quality checks, choice of locations for data collection to be brought under law, stipulated through gazette notification by State Government	State Government	UP Ground Water Conservation Protection and Development (Management, Control, and Regulation)Bill 2010

TABLE 13 Urban planning

City	Actions	Institutions	Supporting regulation/policy
Medium term	Include a chapter on climate change resilience in the Master Plan of the city: Gorakhpur resilience strategy, vulnerability report, geo-hydrology report, and TERI's report could guide such a chapter	GDA	GDA is an autonomous body, Vice Chairman can introduce this as an amendment in consultation with the Board of the GDA.
	Overlay water logging plan(prepared by GEAG and Gorakhpur University) with land-use plan of the Master Plan and identify areas where no build up should be further allowed	GDA	By order from the Divisional Commissioner
Long term	Revisit land-use planning and couple with scientifically designed sewerage/ drainage system and solid waste system to further reduce city's vulnerability	GDA and Jal Nigam	

State	Actions	Institutions	Supporting regulation/policy
Medium term	Revisit 'Impact Fee 'rule[14]. 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. (Right now, the rule does say that impact fee is levied as a return on the anticipated impacts of change in land use on traffic, infrastructure, and environment[15]. It also says that 90% of the fee collected will be sent to the infrastructure fund. However, it does not specify that the funds so collected will be used for mitigation of the impacts that will be felt.)	UP Housing and Urban Planning Department, Government of UP	UP Urban Planning and Development Act, 1973[16]
	State adopts and implements 74th Constitution Amendment Act		

TABLE 14 Housing/buildings

City	Actions	Institutions	Supporting regulation/policy
Medium term	New Construction: Changes in the building regulations, including flood resistant/ enabling design strategies[17]	Gorakhpur Development Authority/ Town and Country Planning Department, Uttar Pradesh	Building Construction and Development Regulations, 2008
	Provision to elevate proposed buildings in select areas above the flood level or to elevate it sufficiently to reduce the depth of floodwater likely to occur below 300 mm.	Gorakhpur Development Authority/ Town and Country Planning Department, Uttar Pradesh	
	Provision for improvised septic tanks and/or appropriate decentralized sewerage system (since conventional septic tanks do not function properly due to non-turbulent flow after a certain time); prohibition of standalone soak pits	Gorakhpur Development Authority/ Town and Country Planning Department, Uttar Pradesh	
	Prohibition of basements in identified low-lying areas (hotspots)	Gorakhpur Development Authority/ Town and Country Planning Department, Uttar Pradesh	
	Customization of rainwater recharging structures along with appropriate filtering mechanisms specific to Gorakhpur	Gorakhpur Development Authority, with support from organizations like GEAG, Centre for Science and Environment	
	Implementation/compliance of above changes	Municipal Corporation, GDA, GIDA	
	Provision of low-cost, decentralized basic services (storm water, sewage management) for all slum development schemes	DUDA	
Medium term	Existing development Selection of few demonstration projects/colonies showing implementation of rainwater recharging by intervening storm water drains (to prevent water logging); appropriate decentralized wastewater (sewage) management system; conversion of existing septic tanks to improvised septic tanks	GDA, GIDA in their colonies with support from design agencies capable to do SUDS and involving communities	
	Implementation of Sustainable Urban Drainage Systems (SUDS) at selected colony/mohalla scale for demonstration. SUDS employ various techniques to effectively manage drainage, which includes green roofs, dry ditches (swales), detention/attenuation ponds, permeable paving, underground storage tanks, and many other measures, all of which aim to detain run-off and release it slowly into watercourses or to ground		

[14] Section 1.7, 1.8 Gorakhpur Master Plan 2021, UP Model Zoning Regulations,Section1.7 to 1.10

[15] Section 1.7 Gorakhpur Master Plan 2012

[16] UP Model Zoning Regulations, section 1-10(1.10.2)

[17] If changes in building regulations are taken up, it is advised to also consider integration of Energy Conservation Building Code, 2007 (applicable for buildings with a connected load of 100kW) by the Bureau of Energy Efficiency (BEE)

Long term	Customizing Building construction and Development Regulations, 2008 for Gorakhpur. The regulations should be customized, such that the building bylaws proposed are simple to understand and implement and ensure compliance of the same.	Development Authority and Municipal Corporation	UP Building Construction and Development Regulations, 2008

TABLE 15 Energy

City	Actions	Institutions	Supporting regulation/policy
Short term	Improving the efficiency of diesel and electric pumps	District Disaster Management Centre to coordinate with Jal Nigam and Municipal Corporation	Gorakhpur District Disaster Management & Risk Reduction Plan-2011
	Feasibility of converting the existing pumps to solar PV based	District Disaster Management Centre to coordinate with Jal Nigam and Municipal Corporation	Gorakhpur District Disaster Management & Risk Reduction Plan-2011
	Implementing rainwater recharging structures in priority areas (low lying areas as given in the Gorakhpur District Disaster Management & Risk Reduction Plan-2011)		
	District Disaster Management Centre to coordinate with Jal Nigam, Municipal Corporation, and Development Authority	Gorakhpur District Disaster Management & Risk Reduction Plan-2011	
Medium term	Implementing SUDS strategies in all existing parks and open spaces in the city	GDA, GIDA, and Municipal Corporation with support from design agencies capable to do SUDS	Gorakhpur District Disaster Management & Risk Reduction Plan-2011

TABLE 16 Ecosystem conservation and flood management

City	Actions	Institutions	Supporting regulation/policy
Medium term	Mapping and demarcation of green areas and water bodies in the city to regulate encroachment and reclamation (study by Gorakhpur University on water bodies can be utilized for this)	GMC and GDA	UP Parks, Playgrounds and Open Spaces (Preservation and Regulation) Act, 1975 and UP Model Zoning Regulations vest the powers in GMC and GDA, respectively; UP State Environmental Policy
	Pollution abatement: Regular cleaning and maintenance of drains and parks/ playgrounds. Regulating solid waste disposal in water bodies/green areas	GMC	By order from the Divisional Commissioner/ Municipal Commissioner; UP State Environmental Policy
	Regulating encroachment: Effective enforcement of Master Plan	GDA and GMC	Master Plan and Model Zoning Regulations under the provision of UP UP&D Act, 1973
	Preparation and enforcement of Flood Management Plan: Should include measures for Preparedness, Response, Relief, and Recovery	DDMA and GMC in coordination with other relevant state departments	Provision for preparation of Flood Management Plan under Disaster Management Act, 2005 and 74th CAA
Long term	Protection from reclamation: Consideration of land suitability and demarcated green areas/ water bodies during land-use allocation; water bodies/ green/ sensitive areas to be demarcated as low- built/ no-development zones	GDA	Master Plan and Model Zoning Regulations under the provision of UP UP&D Act, 1973; UP State Environmental Policy
	Provision of environmental infrastructure: Sewerage, drainage, green/ open areas	GDA, UP Jal Nigam, and GMC in their respective jurisdictions	Master Plan and Model Zoning Regulations, UP Municipal Corporation Act, 1959, Uttar Pradesh Water Supply and Sewerage Act, 1975

	Capacity building and awareness generation of the state agencies/ ULB/ and local community	State Government/ District Administration with support from civil society, NGOs, etc.	By order from the Divisional Commissioner/ Municipal Commissioner; UP State Environmental Policy
State	Actions	Institutions	Supporting regulation/policy
Medium term	State adopts and implements 74th Constitution Amendment Act		

TABLE 17 Public health

City	Actions	Institutions	Supporting regulation/policy
Medium term	Data collection and reporting: Setting up of additional control rooms for wide round-the-clock reporting	GMC (Health Department) and District Administration (CMO Office)	Standard Operating Procedures (SOP) for epidemics prepared under the provisions of Disaster Management Act, 2005 by SDMA
	Preventive health measures: Sanitation and hygiene	GMC (Health Department) with support from civil society, NGOs, and local community	UP Municipal Act, 1959 defines sanitation and hygiene as one of the municipal functions
Long term	Health surveillance system (Reporting, preparedness, and response mechanism): Assessment of manpower and infrastructure requirement for cases of epidemic outbreaks	GMC (Health Department) and District Administration (CMO Office, DDMA) with support from consultants	Standard Operating Procedures (SOP) for epidemics prepared under the provisions of Disaster Management Act, 2005 by SDMA
	Public awareness	GMC (Health Department) and District Administration (CMO Office, DDMA) with support from civil society, NGOs, and local community	By order from the Divisional Commissioner/Municipal Commissioner

DISCUSSIONS AND WAY FORWARD

While detailed recommendations have been made on institutional and regulatory mechanisms for each sector under consideration in this study, there are broad issues that need equal attention and need to be addressed. One of the major issues is to understand the political economy of the city to develop urban governance mechanisms conducive to climate change adaptation.

Political economy can be defined as 'the role of capital in policy making'. Urban areas are estimated to generate about 80 per cent of global GDP. This makes land values a driver for most of the choices related to use of urban space. This attracts powerful interests and decisions that have public good implications are mediated through private considerations *(Brown, Dayal, Del Rio, 2012).* Given the centrality of land use for building urban climate change resilience, this political economy reality poses enormous challenges for implementing actions. For instance, in Gorakhpur through the impact fee payment, land-use change can be legalized by private builders. Cost-benefit analysis that favours long-term ecosystem conservation and public benefit over immediate private (commercial) and financial gains is a far-fetched dream. Moreover, such decisions are driven by underlying politics at the scale of both centre and state, which shapes governance systems.

The UN Habitat's 2011 global report on human settlements, titled '*Cities and Climate change: policy directions*' notes that urban areas with weak governance systems—as a result of political instability, exclusion of climate change from the political agenda, or lack of governmental resources—are especially vulnerable to climate change impacts. This holds true for urban India as well. In addition, it is also characterized by jurisdictional overlap; multiplicity of institutions, which makes it difficult to prioritize actions for adaptation. Setting priorities is usually driven by political agenda, which changes with the change in political power.

Though urban climate governance is at a very nascent stage in Indian cities, there are several political factors that shape the opportunities and constraints for urban climate governance. There are issues of leadership (individual and organizational), questions of opportunity (windows of opportunity), the framing of the costs and benefits of acting on climate change, and underlying structures and processes of political economy (UN Habitat, 2011). Since urban adaptation planning is intrinsically linked with local governance, in order to build resilience of cities, such governance systems must include features of: decentralization and autonomy, accountability and transparency, responsiveness and flexibility, participation and inclusion, and experience and support.

I. **Decentralization**: Under the 12th Schedule of the Constitution, 74th Amendment Act, the subject of urban planning, including town planning has been mandated for the third tier— municipal corporations and municipalities. It calls for delegation of function of basic service provision to the Municipal Corporations (ULBs). Unfortunately, the implementation has been fragmented and the provisions have not been adopted in their true spirit. There is hardly any ULB, which follows all the 18 functions defined in Schedule XII of the Act. It has been observed that ULBs do not have the capacity (neither financial nor technical) to implement these provisions. For instance, many cities have not yet adopted mandatory reforms under JNNURM.[18]

[18] As per the reforms progress section in the official website. (http://jnnurm.nic.in/reforms.html)

In cities where ward committees are established, it is reported that ward councillors do not have sufficient powers (especially financial) to develop urban infrastructure and strategies for adaptation. On the city-region scale, another key issue is the fragmentation of urban governance across multiple authorities. This can be seen as a challenge of horizontal coordination. Unfortunately, a fragmented approach prevails instead of an integrated approach, which is required especially for land-use/urban planning, basic service provision, etc. Multiplicity is further aggravated by PPPs. These modes are preferred by central and state governments and sometimes included as pre-requisites for projects (JNNURM). There is no doubt about their success, but currently these do not integrate resilience arrangements. In fact, no climate change related arrangements exist at city level.

The National Mission on Sustainable Habitat, one of the eight missions under the Prime Minister's National Action Plan on Climate Change (NAPCC) has recently received final approval from the Prime Minister's office. The Ministry of Urban Development (MoUD), Government of India was the nodal agency for formulation of the National Mission on Sustainable Habitat, and is now inclined to implement the mission. The Mission seeks to bring in sustainability of habitats through improvements in the following broad areas:

Energy efficiency in buildings
Urban planning
Improved management of solid and liquid waste
Public transport
Climate change and disaster mitigation and adaptation

The Ministry of Environment and Forests (MoEF) has asked all Indian states to develop action plans to define how they intend to undertake activities and programmes aimed at climate change adaptation and mitigation. These State Action Plans on Climate Change (SAPCC) should be in line with the objectives of the National Action Plan on Climate Change (NAPCC) and ensure its implementation at the state level. However, as of now there are no policy obligations for cities to follow the same.

II. **Accountability and transparency**: Achieving this becomes a challenge in case of multiple authorities. The JNNURM reforms include enacting the Community Disclosure Law (CDL) to bring in transparency in the government's transactions. However, this is applicable for JNNURM cities only. Other cities should also be encouraged to enact CDL.

III. **Participation and inclusion**: Community participation law (CPL), a mandatory reform under the JNNURM[19] refers to making appropriate provisions in the state-level municipal statute(s) for the establishment of three tiers of decision-making in a municipality, namely, the municipality, the ward committee, and the *Area Sabhas*[20]. It aims to involve citizens in municipal functions like setting priorities, budgeting provisions, exerting pressure on compliance of existing regulations. Though applicable to JNNURM cities, this model law can be adopted by states for non-JNNURM cities as well.

The urban poor forms the target group of MoHUPA policies. It has formulated the Rajiv Awas Yojana (RAY), a scheme that targets provision of low-cost housing to the urban poor. MoHUPA is also responsible for implementation of Basic Services to Urban Poor (BSUP) primer under JNNURM. But, it needs to go a step further to include the poor and marginalized groups in decision making, monitoring, and evaluation, which is a key to improving the living conditions of these vulnerable groups.

IV. **Relationship between different levels of authority**: The UN Habitat report also notes that, municipalities are more or less coherent and have varying degrees of autonomy from international policies and from regional and national governments, the relationship between these arenas of authority is critical in shaping

[19] The JNNURM makes it mandatory for states to either enact a separate CPL or make appropriate amendments to their existing municipal laws.
[20] *Area Sabhas* would consist of all registered voters of a polling booth in urban areas.

the capacity to govern climate change. In this context, it is important to understand the relation between centre, state, and local authorities. While the Centre transfers power to the State, more responsibilities need to be transferred to the local level as well. If the Centre directly offers assistance (city development funds) to cities by directing funds available through donor agencies, this may speed up the process. But the question that then arises is: Will this then dilute the powers of the state?

Capacity, accountability, coordination, and efficiency of institutions need foremost attention to ensure sustainable and resilient urban systems. For this, TERI proposes the following steps:

- It is essential that mechanisms and institutions are aligned not only to ensure quality and reliable services, but also to account for future vulnerabilities like that of climate change. Multiplicity of organizations in a single sector as well as overlapping jurisdictions of the development authorities and the municipal corporation creates a lot of confusion and affects the quality of services. Due to this, there is no single agency, which can be held accountable in case of non-delivery or poor quality of service provision. The law must also come up with a mechanism to introduce and ensure inter-departmental coordination. The 74th Constitution Amendment Act has suggested delegation of function of basic service provision to the Municipal Corporations (ULBs).
- There is no law that sets standards for service provision, let alone for accounting for climate change impacts on services. Hence, there is a need to introduce one that stipulates standards of service delivery and holds the municipal corporation responsible for quality and efficiency of services.
- As this study reveals, there is no dearth of guidelines that cities could use to plan the systems effectively; however, there is definitely lack of technical capacity and manpower that needs to be looked at.
- It is observed that there are many laws that address various issues like that of urban planning, disaster preparedness, housing, environment, etc. However, to make these regulations implementable, a city level charter of activity could be prepared that draws from all of these regulations and comes up with a clear plan of action with defined responsibilities.
- The Urban Development Acts of the state should be revised to incorporate all sustainability measures required for urban centres at one place, ensuring implementation of its provision in totality. The Acts must be translated in terms of implementable guidelines that specify important questions like who will do what (institutional mechanisms), how this will be done (technical capacity and know-how), where will the funds come from (economic and financial considerations), and necessary time lines and schedules to be able to monitor results. In a nutshell, a complete ecosystem should be derived from the guidelines that can help implementation of the laws.
- The National Mission on Sustainable Habitat would soon come up with legal habitat standards, which the city would have to implement. A chapter on climate change impacts in the Master plan would prove to be a beneficial instrument in drawing action plan for the implementation of the proposed habitat standards. Cities and states could tie up with experienced outside agencies to conduct impact assessment exercise for their respective cities. For JNNURM cities, City Development Plans (CDP) could incorporate the resilience chapter and provide for funding options under the investment plans proposed under the CDPs.
- There are four types of ICT tools, namely, Geographic Information Systems (GIS), E-Governance[21], early warning systems (including telemetry), and wireless communications commonly adopted by local governments worldwide for helping their cities adapt to the effects of climate change. Gorakhpur can follow these recommendations:

[21] E-Governance encompasses both computerization and Internet-based sharing of information by governments in order to improve efficiency, accuracy, reliability, and transparency in government services.

- Strengthen their e-governance systems (municipality database management). One such proposal has been made in Section 3.3 on *Drinking water*, which recommends the setting up of a database management system at the Jal Kal Department or the State Ground Water Department office at Gorakhpur.
- Build capacity of universities and institutes already applying ICT (like Gorakhpur University) as well as introduce it at other levels.
- ICT tools, such as online mapping and mobile phone-based applications can be applied to strengthen the coordination mechanisms of relief agencies during disasters.
- Topographical features (low lying areas) could be mapped with rainfall patterns and weather predictions for establishing early warning systems. Geographical Information System (GIS) is a recognized tool for this.
- ICT shows potential to enable participatory governance and transparency through facilitating sharing and updating of information between government and citizenry as well as allowing citizen monitoring and reporting of environmental status.

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