



Climate Change Adaptation: Leveraging Urban Ecosystems in Bhubaneswar



Acknowledgement

Title

Climate Change Adaptation: Leveraging Urban Ecosystems in Bhubaneswar

About the Document

This document is a compilation of thematic maps relevant for leveraging the urban ecosystems for climate change adaptation in Bhubaneswar city. It illustrates the analysis of how urban development is taking place in Bhubaneswar vis-a-vis the impacts of climate change in terms of urban heat stress and urban flooding. Each ecosystem is explained in detail in terms of the variety of ecosystem services that it provides.

Team

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About the Project

Natural ecosystems undergo changes over time as a result of man-made or natural causes. Because land use is changing rapidly in urban areas, ecosystems are changing quickly as well. An emerging idea in the global and Indian contexts for climate resilience is ecosystem-based adaptation, or EbA.

Therefore, The National Institute of Urban Affairs (NIUA), under the MoHUA embarked upon a project “**Proliferating Ecosystem-based Adaptation Practices in Indian Cities OR in short EPIC**” with a support from the **Global EbA fund** under the International Union of Nature Conservation (IUCN). Prioritising urban ecosystems in Indian cities' climate change adaptation plans is the main objective of the EPIC project and it seeks to address two core challenges faced by most cities in the face of climate change i.e. water scarcity and urban flooding.

The overall vision of this project is to create an enabling environment for mainstreaming ecosystem-based adaptation (EbA) in a city's water management strategy by mainstreaming the agenda for EbA as a robust and sustainable approach for water management. It is centred around leveraging nature-based solutions for the restoration of degraded ecosystems, and their conservation for sustainable management that can help cities to adapt to mitigate climate change.

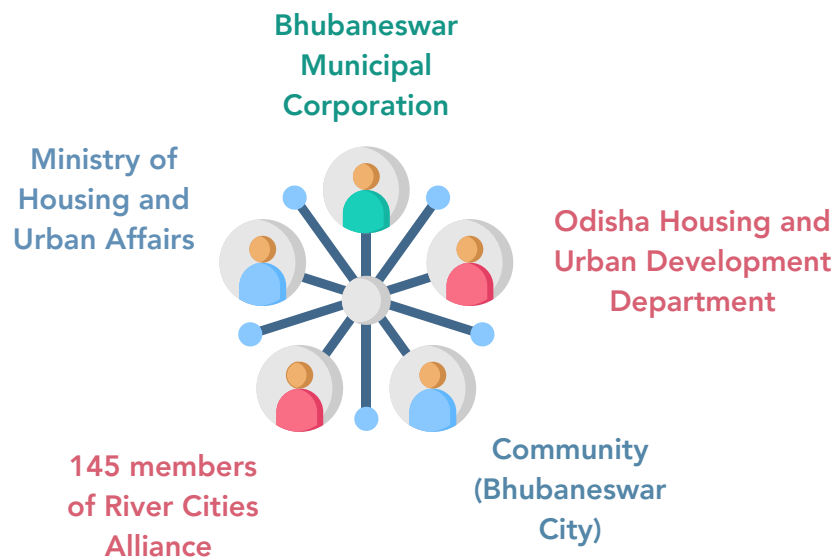
There are two phases to the EPIC project: the Phase-1 is to show the benefits in a pilot city, and the Phase-2 is to persuade more Indian towns to embrace the EbA method to climate adaptation.



Bhubaneswar: EPIC Project City

The Bhubaneswar city, located in the State of Odisha in India has been selected as the pilot city for the Phase-1 of the EPIC project. The city has several notable ecosystems like hills, forest, river, natural drains, wetlands & waterbodies, groundwater. Additionally, the government policies, programmes and missions have also given due importance to ecosystem conservation, protection of bio-diversity. There are examples of missions (Mukta mission) which has adhered to principles of EbA approaches by engaging communities to restore degraded ecosystems and linked livelihood aspect to support communities and self-help groups.

Key Stakeholders





Section 1

INTRODUCTION



Climate Change Adaption Initiatives

National

To mitigate the effects of climate change, Govt. of India has prepared **National Action Plan for Climate Change** in 2008. It outlines a national strategy that aims to enable the country to adapt to climate change and enhance the ecological sustainability of India's development path. There are eight —National Mission which form the core of the National Action Plan. They focus on promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation. **National Water Mission and National Mission for Green India** are two of eight missions related to EPIC project.

Odisha State

Being cognizance of impact of climate change, the forest and environment department of Govt. of Odisha has released two State Action Plan of Climate Change. The state climate action indicates that rainfall patterns in Odisha have been more erratic since the 1960s, with below-normal rainfall across all districts being recorded for most years. The "normal" 120 days of monsoon rain has shrunk to 60–70 days and unusual spikes in rainfall with torrential rainfall of over 200–250 millimeters/day, are more frequent during the monsoon, frequently resulting in floods.

Odisha State Climate Action Plan 2021-2030: The plan clearly highlights that the urban assets and life are exposed increasingly to the risk of cyclone, heat wave, urban flood, health and earthquake. Specifically for the Bhubaneswar; the plan suggests the rules and regulations of the building byelaws under Bhubaneswar Development Agency (BDA) is planned to be updated in accordance to the Climate Change and Disaster Risk Reduction factor. For the Urban areas, developing urban storm water drainage, and plan the green spaces parks are to be planned based on the climate change.



Bhubaneswar: Historical City of India

Bhubaneswar, the capital city of the Odisha State is famously known as the city of 'temples'; some date back to the 6th Century. It is also the most populous city of the State, with almost 9 lakh inhabitants during Census 2011.

The city is one of the first planned cities in India, and its modern outlook was envisioned by German architect Otto Königsberger in 1949. The city planning emphasised upon neighbourhood concept, parks and open spaces with ease of connectivity.

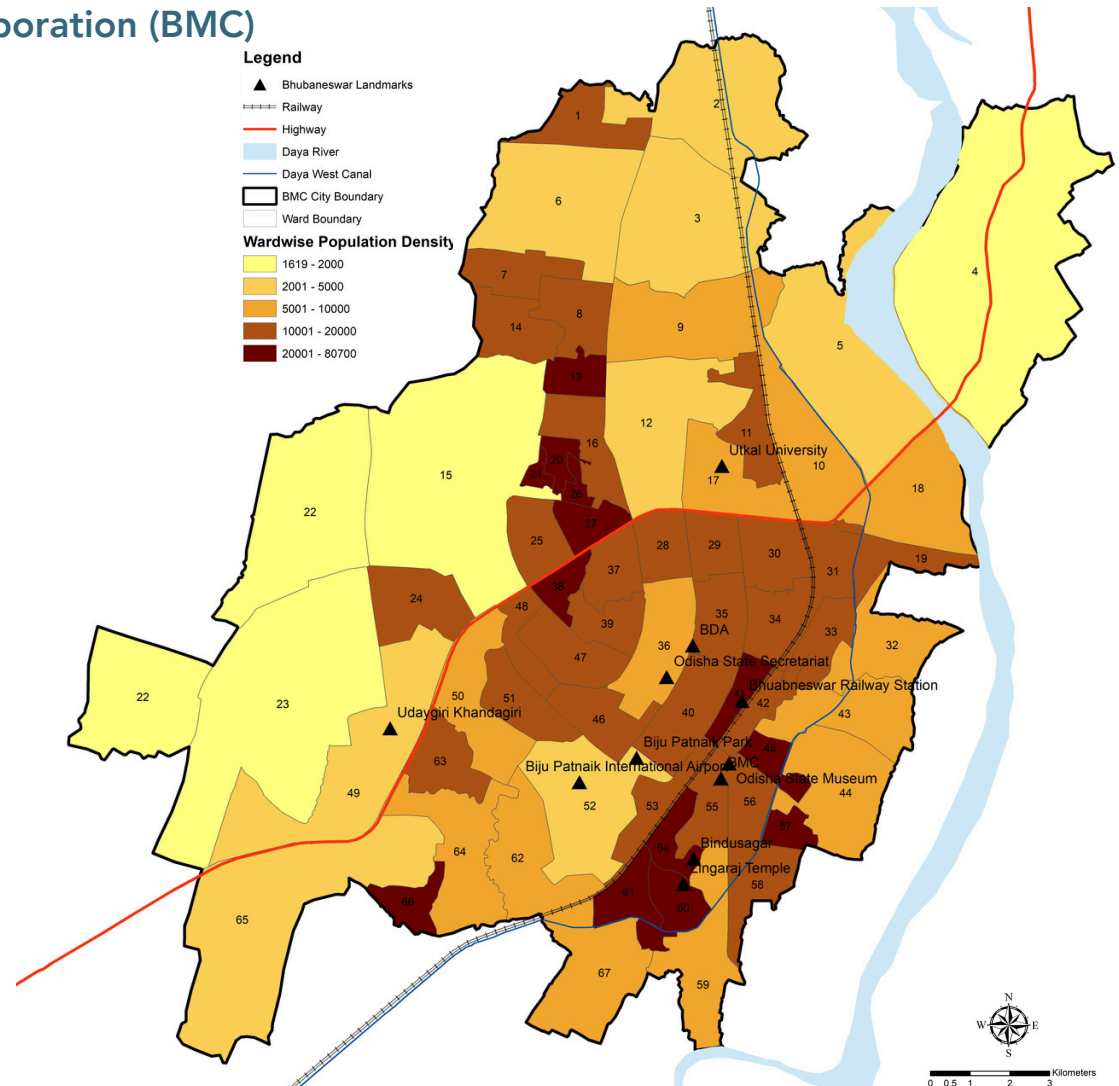
Geographically, the city is bounded by the Kuakhai River in the east, the Daya River in the south, and Chandaka Wildlife Sanctuary and Nandankananam Zoo in the northern and western parts. One of the conspicuous aspects of the city is its environmental assets like forests, rivers, waterbodies, natural drains, wetlands, marshes and riparian buffers. Like many other cities in India, these natural systems in the city are facing environmental degradation.

Introduction: Bhubaneswar Municipal Corporation (BMC)

The BMC area covers around 186 sq. km and accommodates approximately a million people. Thus, the city's average population density is around 5,400. The BMC boundary is divided into 67 administrative wards with significant variation in population density. The central wards are typically more populated than those in the periphery.

According to the 2011 Census, the average ward population was around 12,500. Ward 1, covering the old town area, is densely populated due to its historical significance, while newer wards on the city's outskirts have seen a surge in development due to industries, influencing the real estate and infrastructure sectors. The map highlights how wardwise population density in the BMC could exert pressure on Urban Ecosystem of the city.

Overall, being capital city of Odisha, providing more growth opportunities; city's population is expected to grow rapidly and exert more pressure on its environmental assets.



Map 1: Population Density of Bhubaneswar City

How Bhubaneswar is expanding

Bhubaneswar is transforming into an economic hub with the rise of IT, education, and healthcare sectors. Due to the rapid urban sprawl, city's boundaries are expanding beyond its planned limits. In past two decades the built up area in the city has increased around 30%.

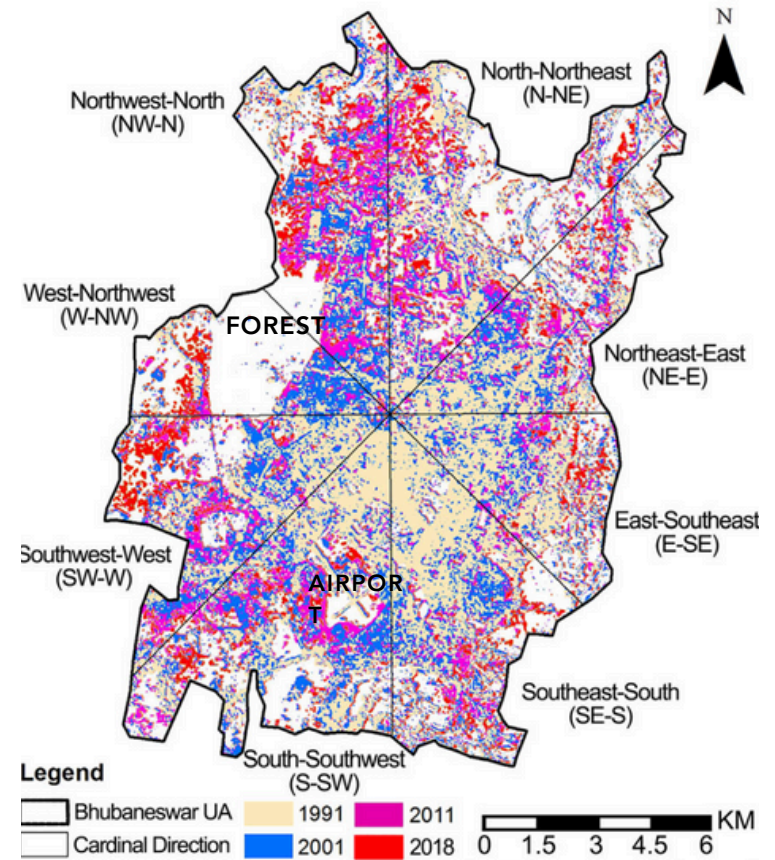
1991 to 2001 - Between this duration, the concentration of built-up area was witnessed in the southeast-south direction, mainly due to the presence of the central business district in the old city.

2011 to 2018 - During this time period development of city shifted to the south-southwest, where residential and institutional development occurred around the airport. The rapid growth in this area was further accelerated by the establishment of the All India Institute of Medical Sciences (AIIMS) and other medical institutions.

Despite this shift, the southeast-south direction continued to show the most dense built-up from 1991 until 2018, mainly due to the old city set up and limited expansion opportunities, due to presence of river in the eastern, and forest in western side.

The urban area expanded by 16.52 km², particularly in the northern zone, driven by residential and institutional development near Infocity (Software Technology Park) and along the eastern bank of the Kuakhai River, in areas such as Pandra and Rudrapur.

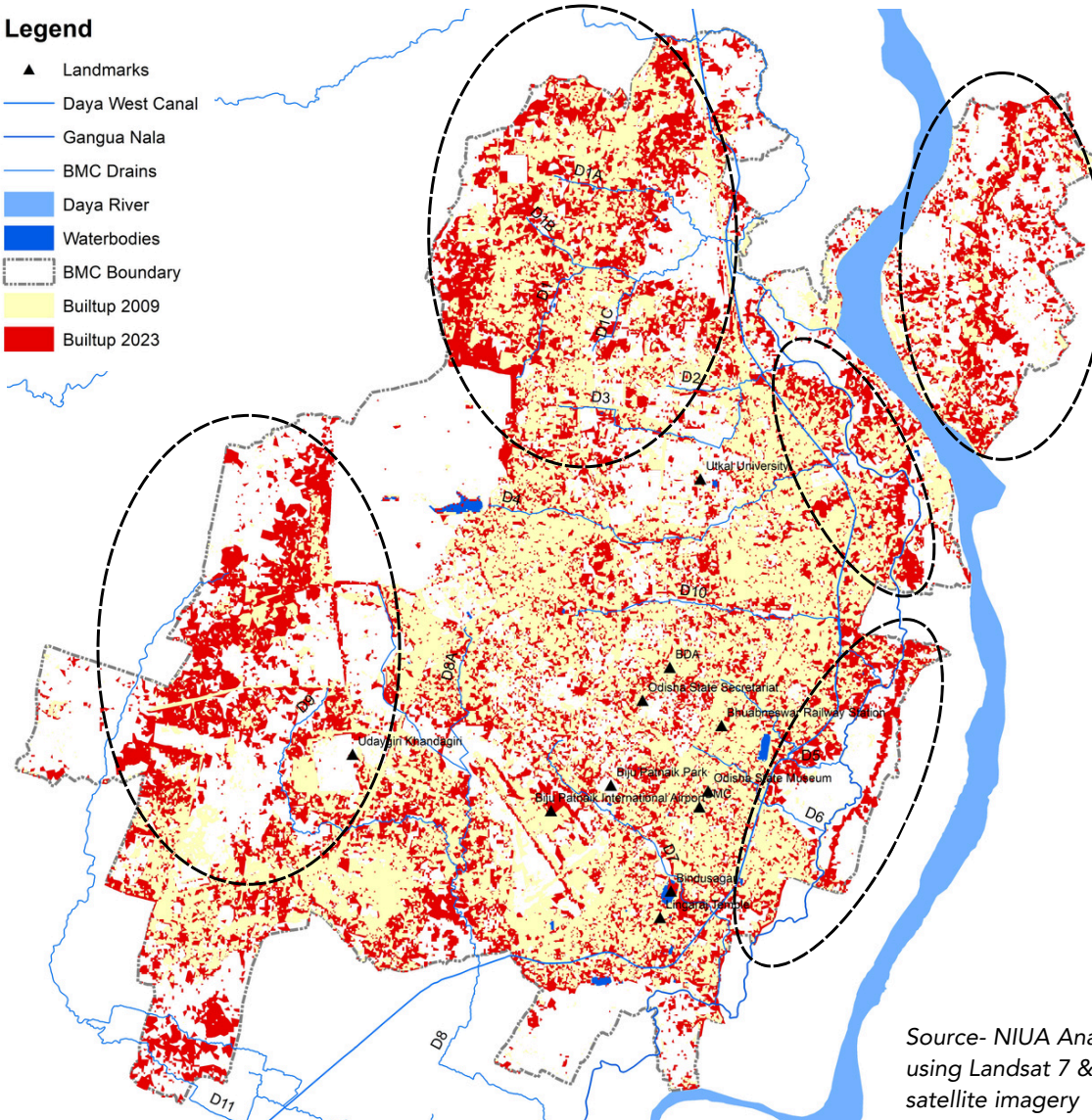
The population density of Bhubaneswar city increased from 8,241 persons/km² in 1991 to 9,567 persons/km² in 2018. However, there was a consistent decline in the growth rate of urban population density between these years.



Map 2: Growth Directions of Bhubaneswar City

Legend

- ▲ Landmarks
- Daya West Canal
- Gangua Nala
- BMC Drains
- Daya River
- Waterbodies
- BMC Boundary
- Builtup 2009
- Builtup 2023



Source- NIUA Analysis
using Landsat 7 & 8
satellite imagery

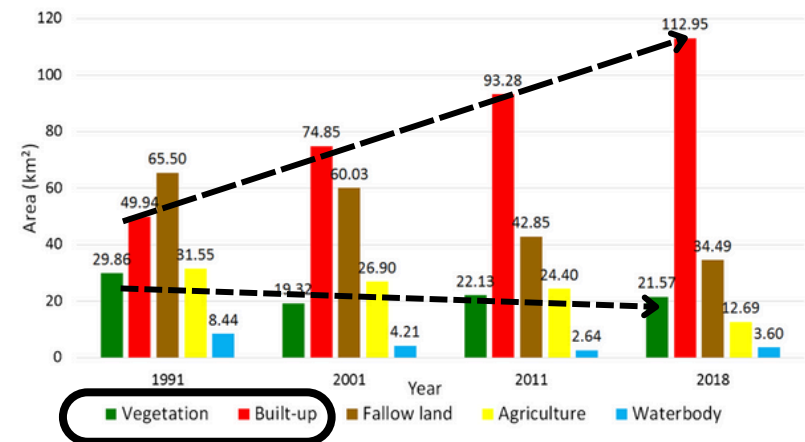
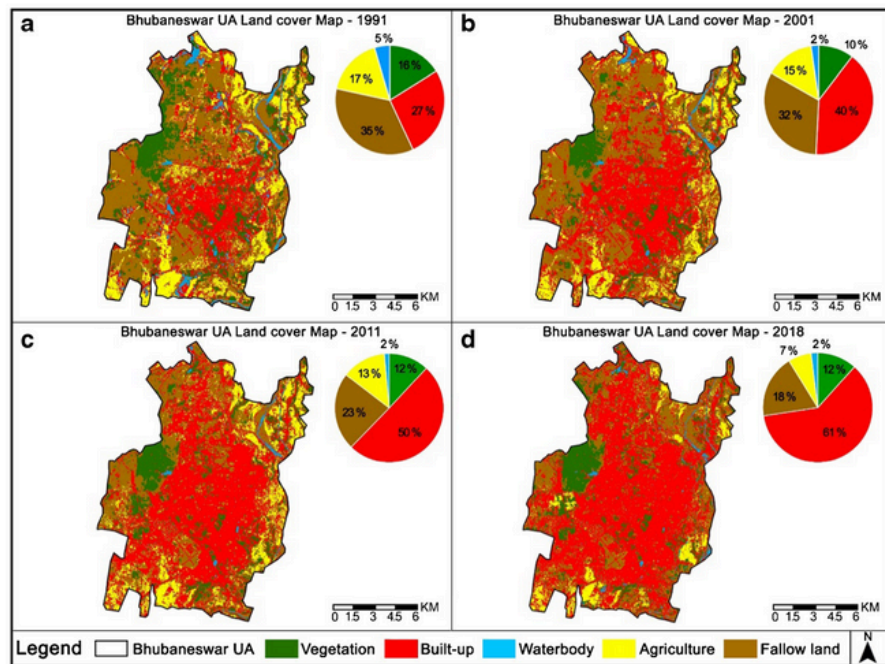
Urban Sprawl in Bhubaneswar

The Bhubaneswar Development Planning Area stretches across 422 sq.km. (an addition of 173 revenue villages) in which the municipal corporation area is spread into 148.1 sq. km. The 67 census wards in the city are experiencing very high growth in terms of urban development and population. There are around 116 authorised and 320 unauthorised slums. Black ovals indicate pockets where rapid increase in builtup area has taken place in last 15 years.

Map 3: Urban Sprawl in Bhubaneswar

Urbanisation and Climate Change Impacts on Ecosystems

Urbanisation in Bhubaneswar is imposing threats to its fragile Ecosystems within city limits and its periphery similar to other cities in India. For example, the Chandaka Wildlife Sanctuary, in the northwestern urban fringe of Bhubaneswar City, is an ecologically sensitive area being threatened by the growth of Bhubaneswar City. Being in the proximity of the highly populated urban clusters, the anthropogenic pressure on the Chandaka-Damapara Wildlife Sanctuary is tremendous and on the increase. The GIS-based analysis indicates that the total forest area of the sanctuary (including dense open and scrub forest) was 90.27 per cent of the total area during 1970 which has been reduced drastically in 2005 to 62.72 per cent (Rath, K.C and N.R., 2008). With rapid urban development, there is significant alterations of agricultural, forest land, river banks, etc. have occurred. Agricultural land is fast resulting in plotted land developments (acquired primarily for future residential requirements).



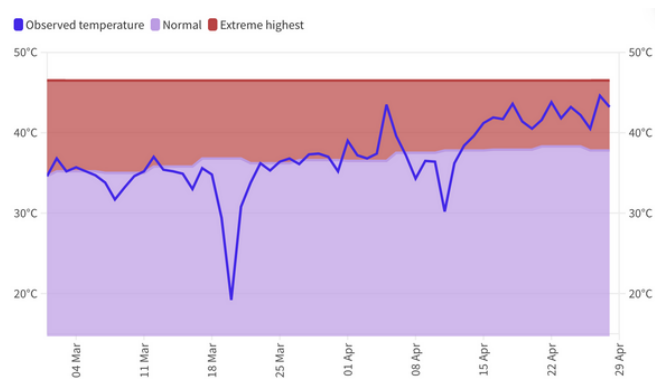
Land cover changes in Bhubaneswar (1991 to 2018)

Map 4: Landcover Change in Bhubaneswar

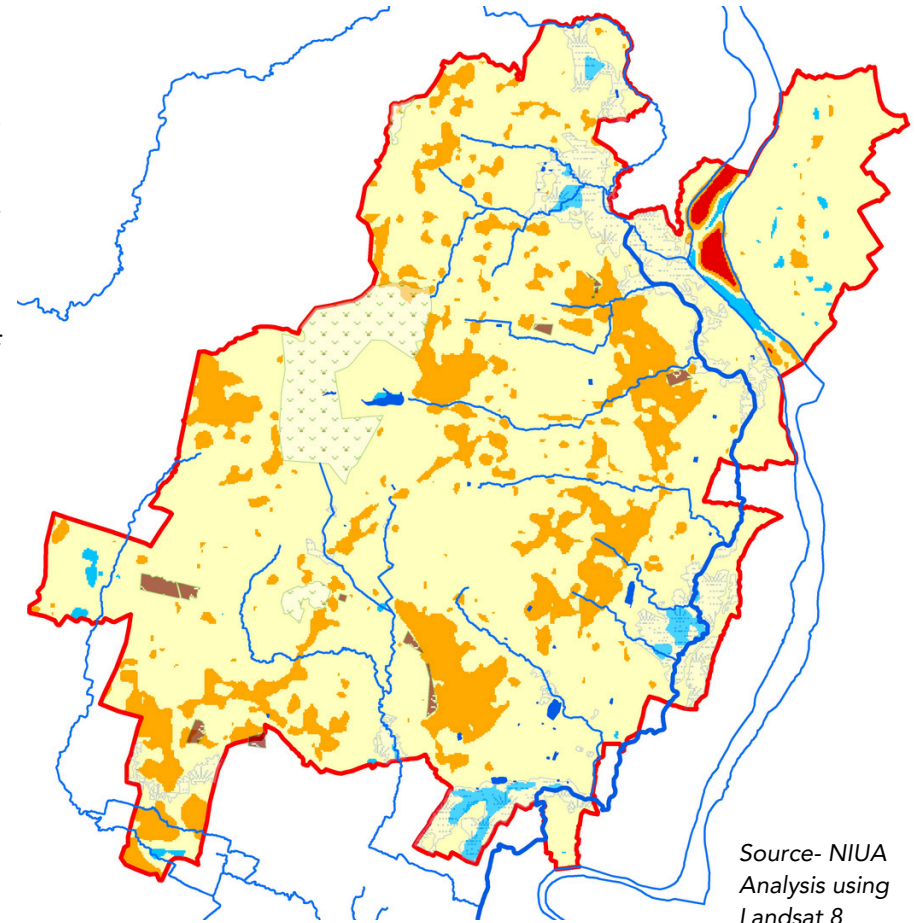
Heat Stress in Bhubaneswar

Bhubaneswar has been rapidly urbanizing, with built-up areas growing by 166% between 2004 and 2015. Satellite studies show the city has a nighttime heat dome, with temperatures about 1°C higher. Over the past two decades, Bhubaneswar's temperature has increased by around 0.68°C, especially in newly urbanized areas, which have warmed almost twice as much. The temperatures in Bhubaneswar remained above 40° Celsius for 17 consecutive days in April 2024, which shows the severity of the issue. This is also impacting the economy as people are less productive during hot weather, even if they work indoors, while children struggle to learn in extreme heat.

The Land Surface Temperature (LST) data analysis from year 2013 and 2023 shows that the maximum LST in the city has increased from 41° in 2013 to 49° in 2023. Also, the LST map indicates that the ecosystems (especially, forests, waterbodies and marshlands) have a critical role in regulating temperature of surrounding areas



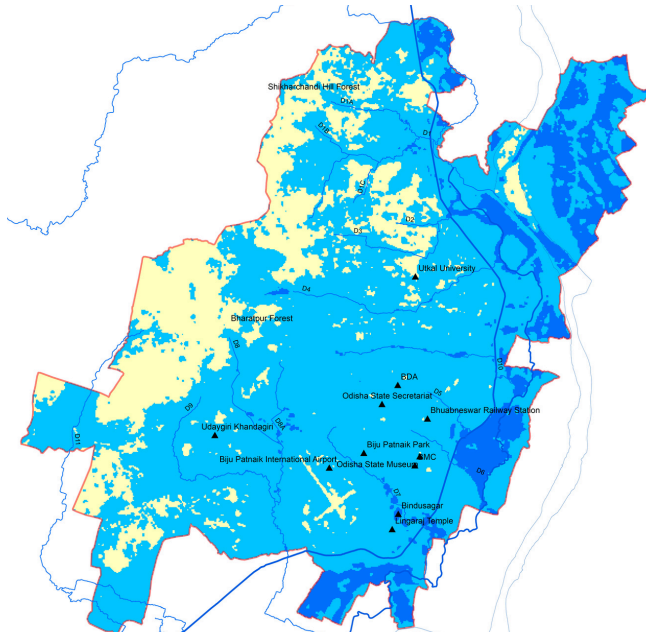
Temperature variations observed in Bhubaneswar in 2024, Source: The Hindu



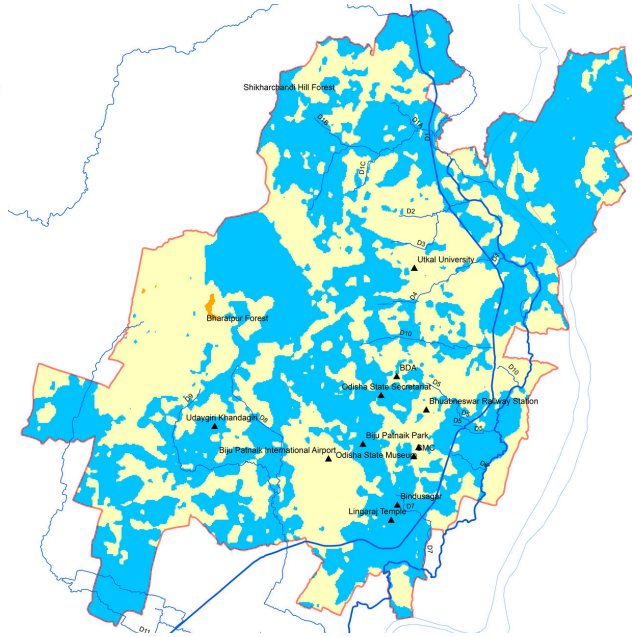
Source- NIUA
Analysis using
Landsat 8
satellite
imagery

Map 5: Land Surface Temperature 2023

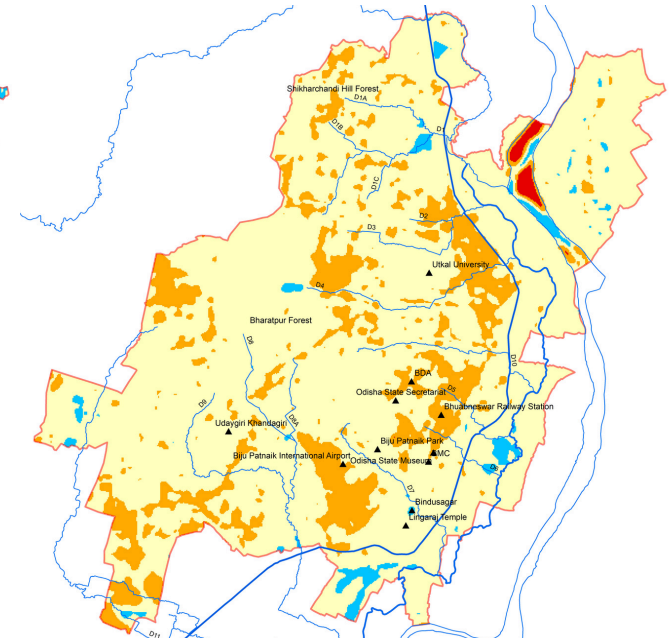
Land Surface Temperature 2000



Land Surface Temperature 2013



Land Surface Temperature 2023



Map 6: Temporal Change in Land Surface Temperature

ALERT CATEGORY	ALERT NAME	TEMPERATURE THRESHOLD (CELSIUS)
RED ALERT	Extreme heat alert day	Greater than or equal to 45
ORANGE ALERT	Heat alert day	43.1 – 44.9
YELLOW ALERT	Hot day advisory	41.1 – 43
WHITE ALERT	No alert	40
Source: NDMA guidelines ¹		

Legend

- ▲ Landmarks
- Daya River
- Gangua Nala
- City Drains
- Daya West Canal
- BMC Boundary

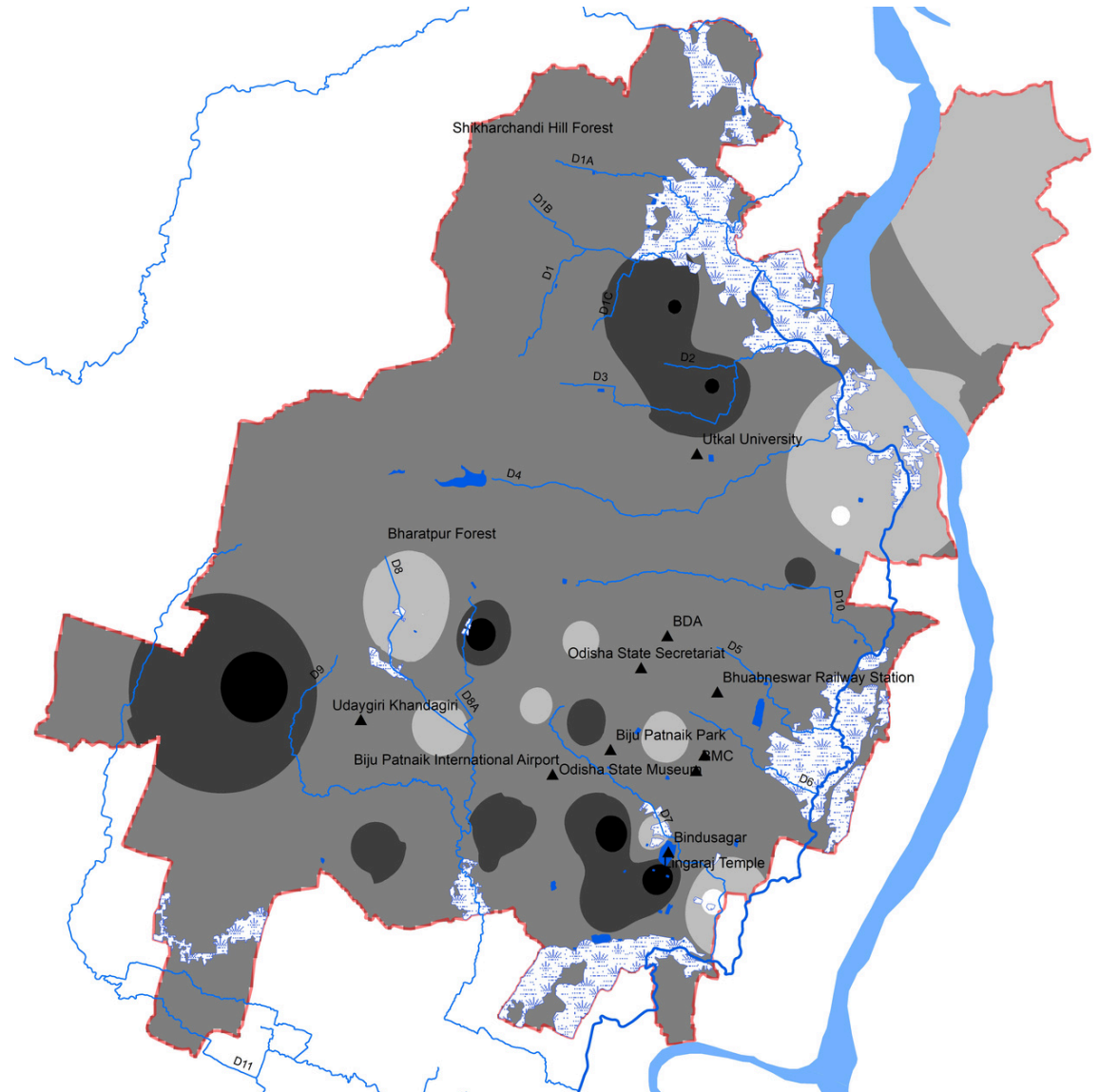
LST Degree C

- Upto 35
- 35 - 40
- 40 - 45
- More than 45

Source- NIUA
Analysis using
Landsat 5 & 8
satellite imagery

Groundwater Scenario in Bhubaneswar

Groundwater Level in Bhubaneswar varies from 1 to 8m. Different natural ecosystems especially the waterbodies and wetlands, low-lying marshlands etc. play an important role in improving groundwater level (regulating service) in Bhubaneswar city. So, in light of increasing water stress under changing climatic scenario, conserving these ecosystems is important. Though, groundwater stress is also dependent on other factors like population density, landuse etc.



Map 7: Depth to Groundwater Level



Urban Flooding in Bhubaneswar

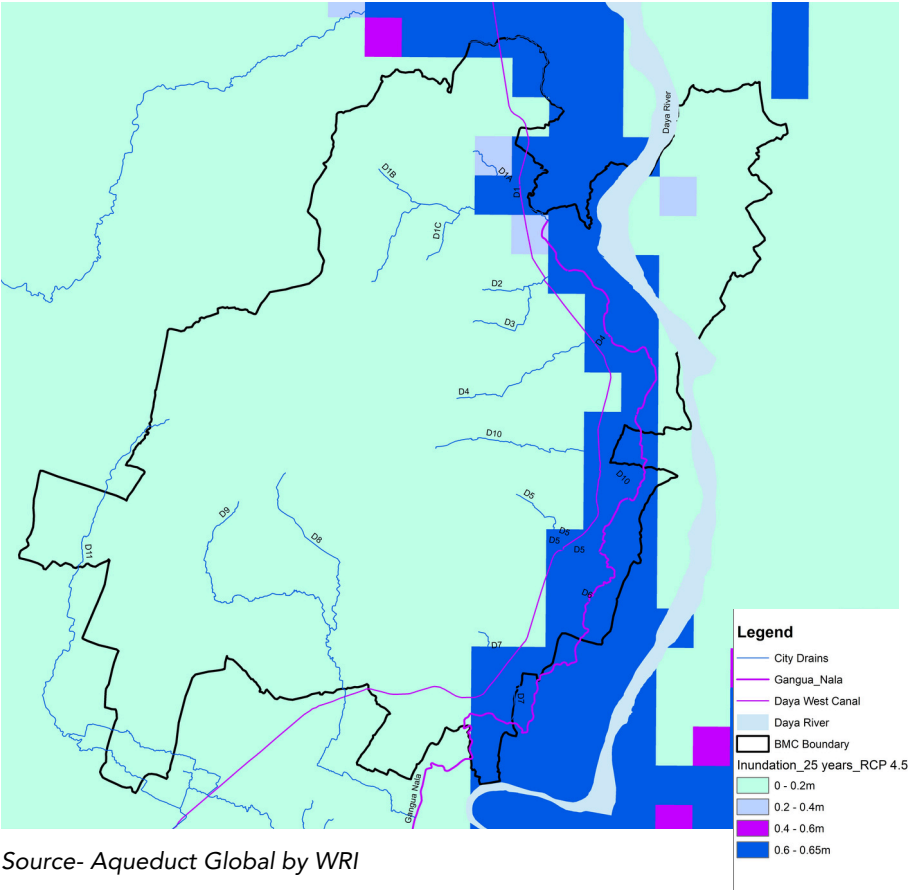
Urban flooding in Bhubaneswar has become a pressing concern due to rapid urbanization and inadequate drainage infrastructure. Climate change and the reduction of green spaces in Bhubaneswar are key contributors to the city's urban flooding issues. Climate change leads to more intense and unpredictable rainfall, resulting in heavy downpours that overwhelm the city's drainage systems, causing waterlogging and floods. For instance, during Cyclone Dana in October 2024, Bhubaneswar experienced significant rainfall that led to inundation in various areas.

In August 2022, Bhubaneswar experienced significant flooding as a result of extensive monsoon rains and the release of water from the Hirakud Dam. Low-lying areas, such as Sundarpada, Kesora etc. were submerged, leading to damage of drains, roads, and older houses.

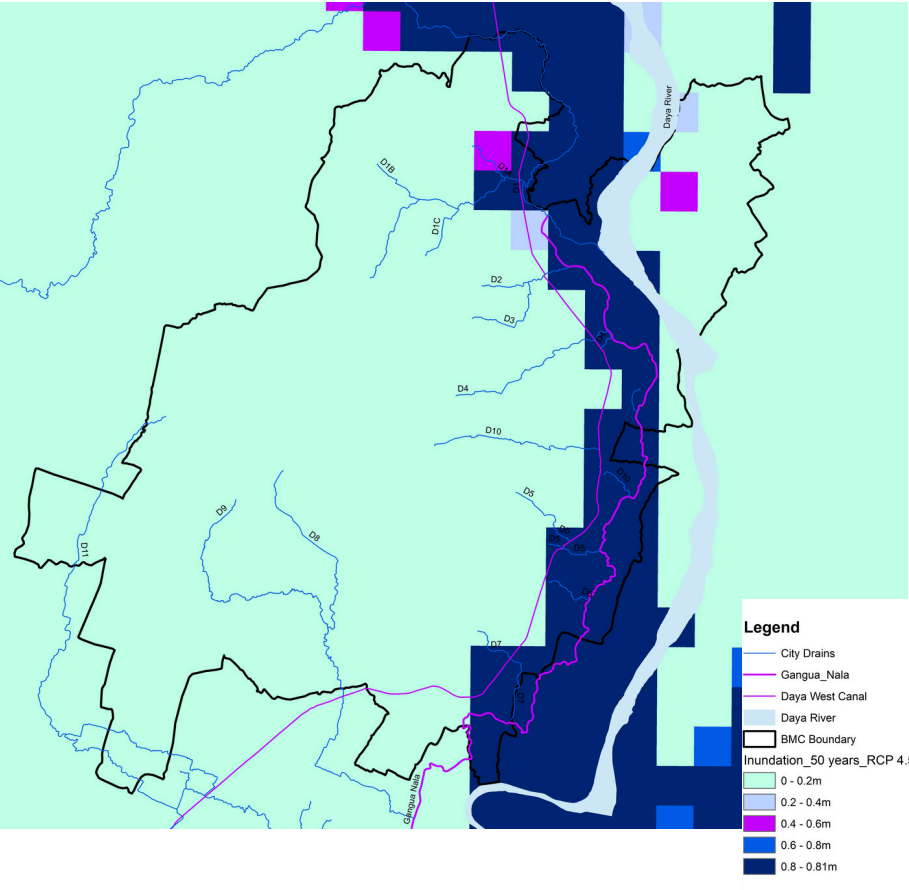
The fluvial flooding projection was done for the city for the return period of 25 years and 100 years. The projection maps show inundation depths for the two return periods.

Medium Emission Scenario (RCP 4.5)

25 Years Return Period



100 Years Return Period

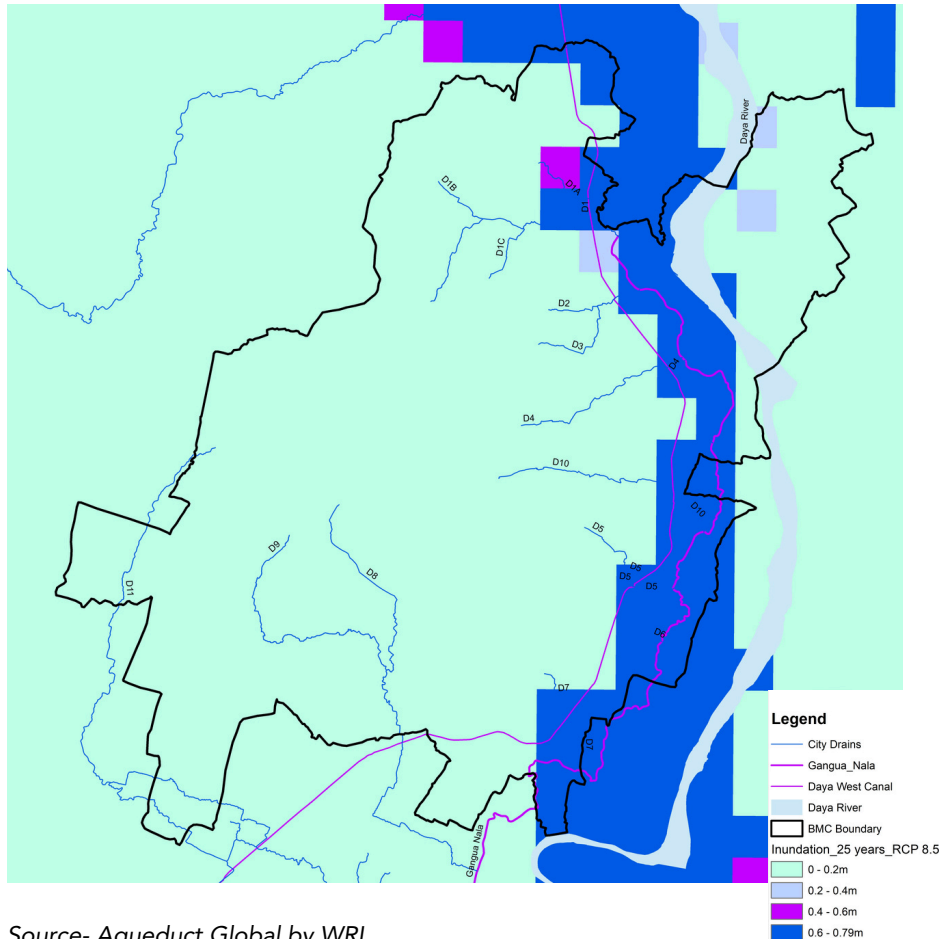


Source- Aqueduct Global by WRI

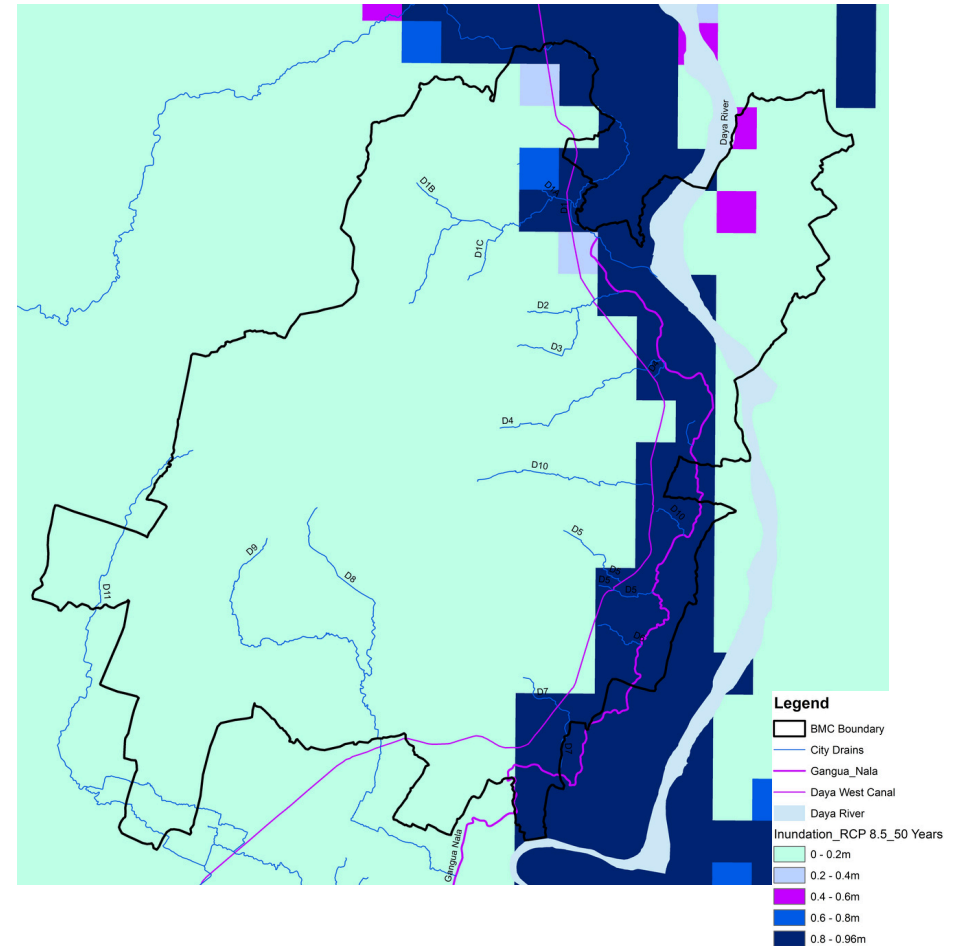
Map 8: Projected Fluvial Flood Inundation for 25 and 100 Years Return Period under Medium Emission Scenario

High Emission Scenario (RCP 8.5)

25 Years Return Period



100 Years Return Period



Source- Aqueduct Global by WRI

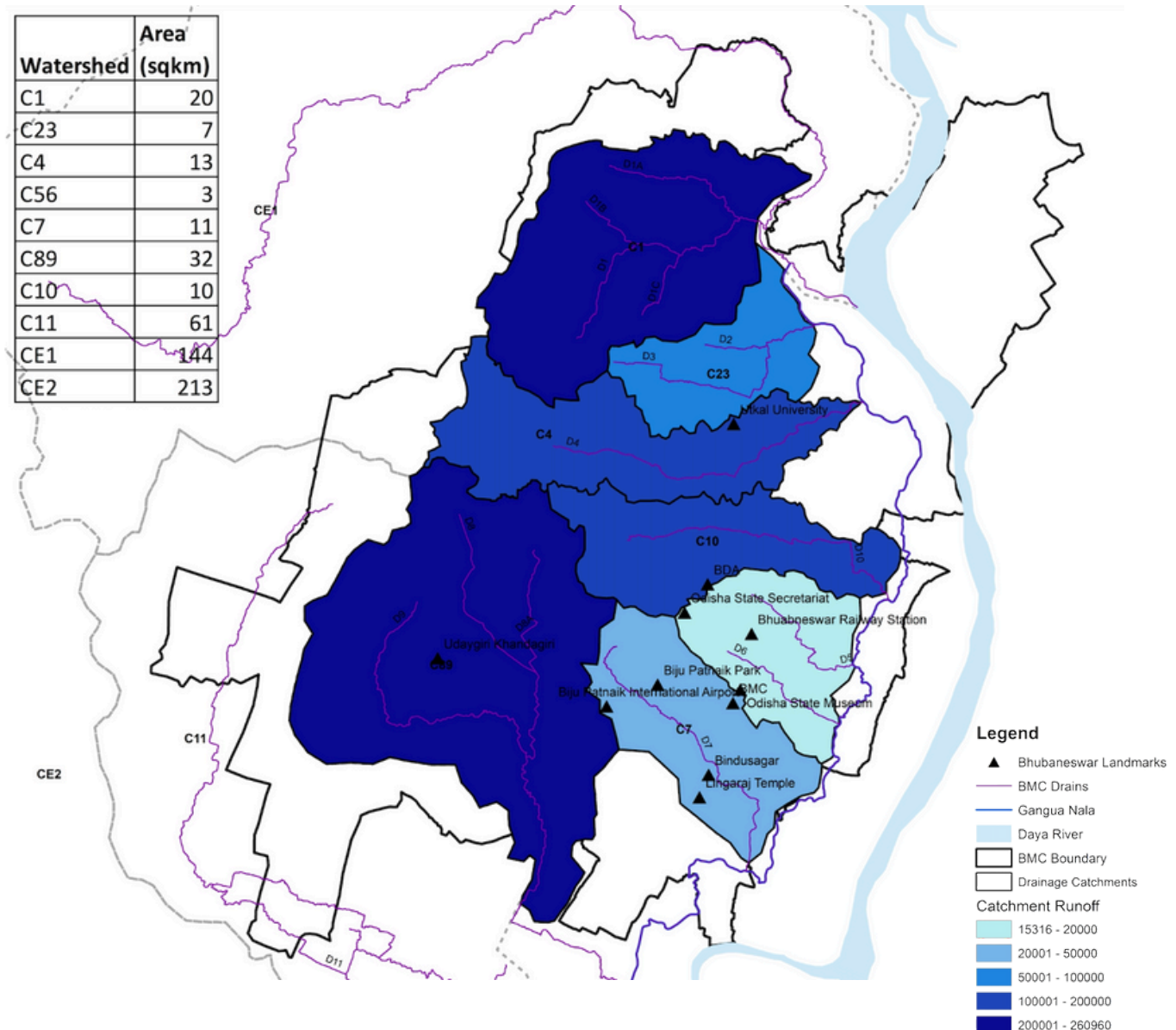
Map 9: Projected Fluvial Flood Inundation for 25 and 100 Years Return Period under High Emission Scenario

Natural drainage network in the city

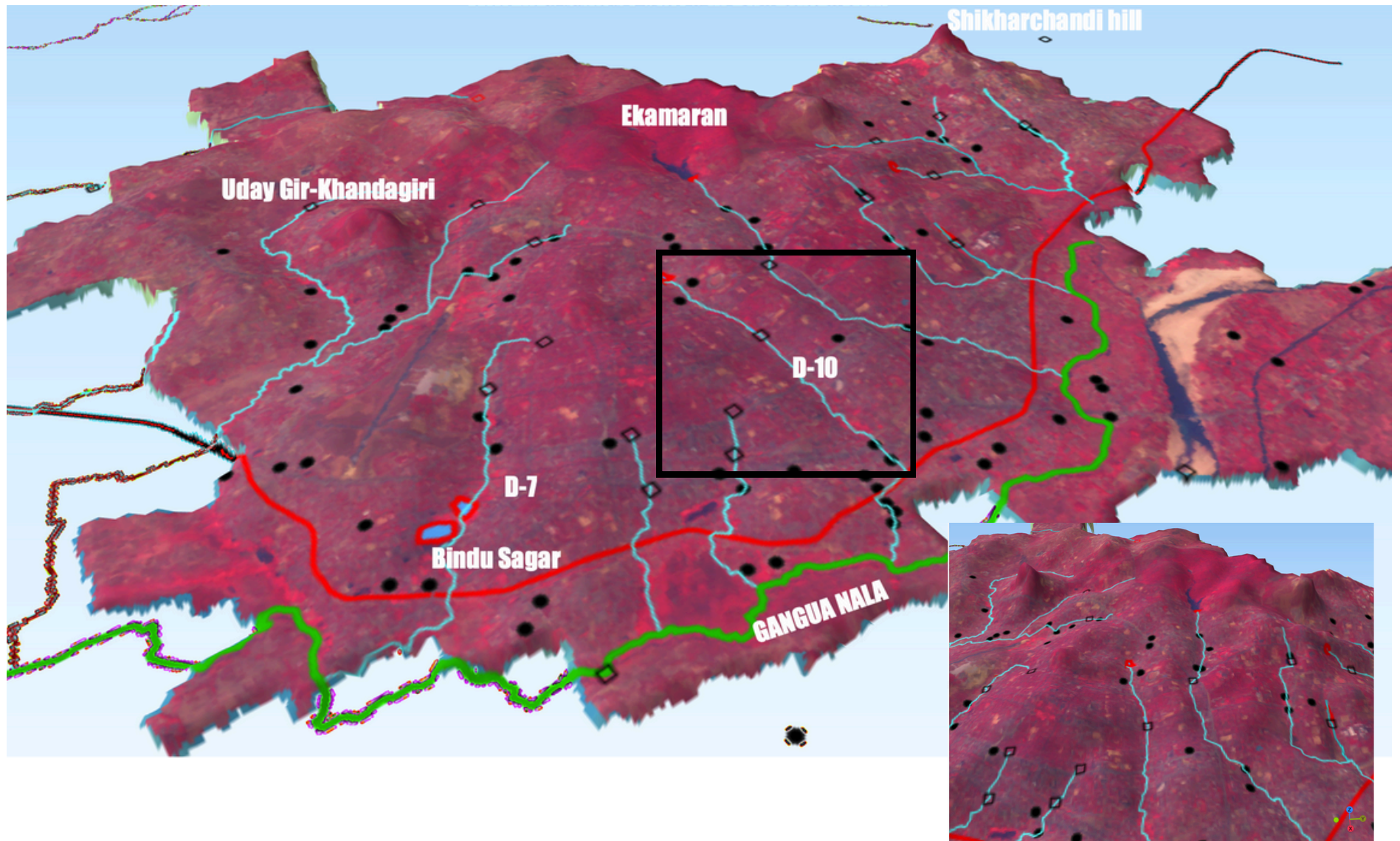
The city features 11 major drains flowing from West to East which converge with the Gangua Nala. To assess the runoff generated from each catchment area, a detailed mapping of the drains and their corresponding catchment zones was conducted.

The map on the right provides a comprehensive overview of the seven major catchments, highlighting the runoff within each catchment area.

Watershed	Area (sqkm)
C1	20
C23	7
C4	13
C56	3
C7	11
C89	32
C10	10
C11	61
CE1	144
CE2	213



Map 10: Runoff Generated from different Drainage Catchments



Map 11: Topography of Bhubaneswar



Section 2

URBAN
ECOSYSTEMS OF BHUBANESWAR

Urban Ecosystems and Climate Adaptation

Role of Ecosystems

Ecosystems have been long studied in non-urban or regional scale for livelihood opportunities, climate regulation and bio-diversity proliferation. They can play same role at urban scale where climate induced stress is increasingly witnessed. In an urban setup especially under the changing climatic scenario, regulating services become more important. Given the occurrences of variety of Ecosystems in Bhubaneswar, they can be leveraged to address key Climate Challenges faced by the city.

Urban Floods



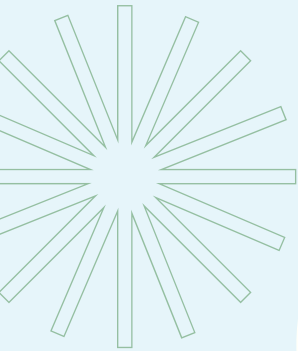
Bio-Diversity Loss



Heat Waves

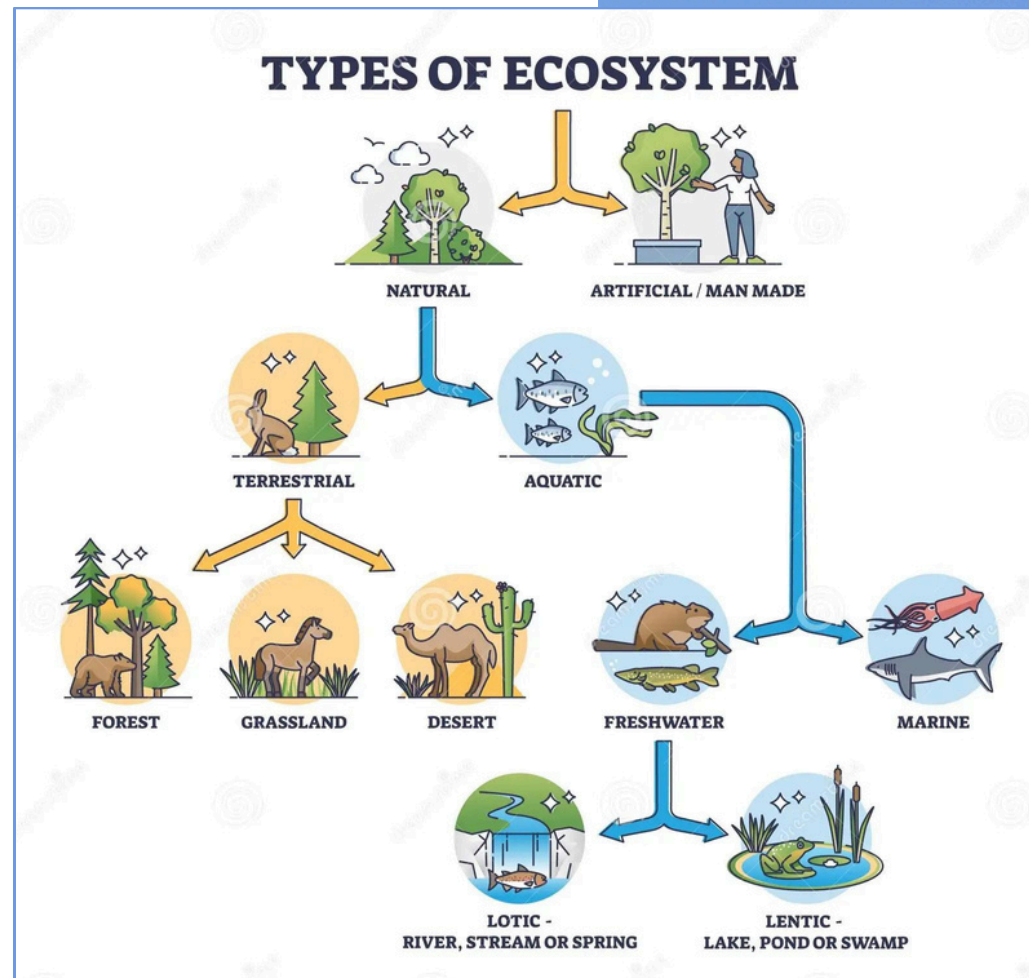


Decreasing Groundwater Levels



Ecosystem is a community of living organisms interacting with each other and their physical environment.

- Includes biotic (living) and abiotic (non-living) components, such as plants, animals, soil, water, air, and climate.
- It can be diverse, ranging from forests, grasslands, and wetlands to deserts, oceans, and freshwater bodies.
- Provide essential services like food, water, clean air, pollination, nutrient cycling, and climate regulation.



Services offered by the Ecosystems

The Millennium Ecosystem Assessment (MEA) framework proposed four ecosystem services that enhance human well-being, all grounded in biodiversity. These services are classified into 'Provisioning,' 'Regulating,' 'Cultural,' and 'Supporting.'

Provisioning Services – Food, Crops, Fresh Water and Plant-based Medicines;

Regulating Services – Filtration of pollutants by wetlands, climate regulation through carbon storage and water cycling, pollination and protection from disasters;

Cultural Services – Recreational, Spiritual and Aesthetic Values, Education;

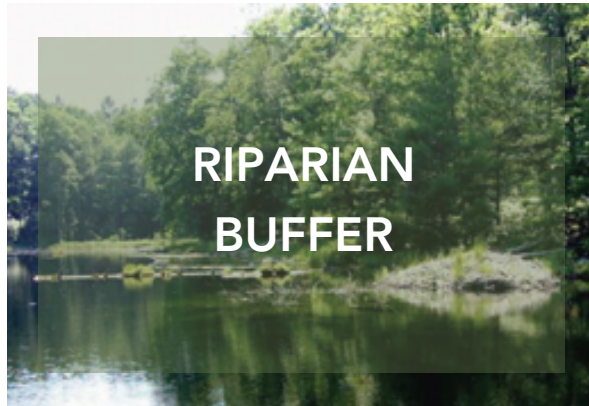
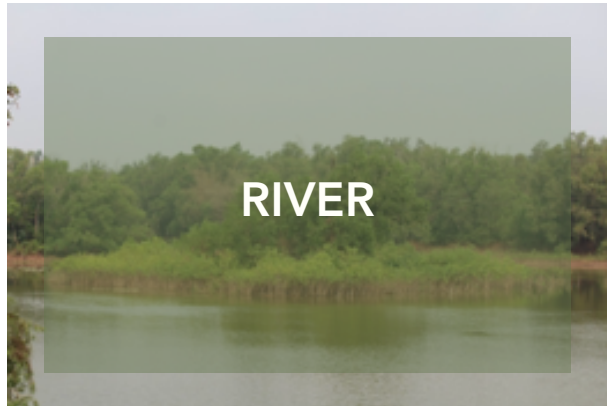
Supporting Services – Soil Formation, Photosynthesis and Nutrient Cycling.

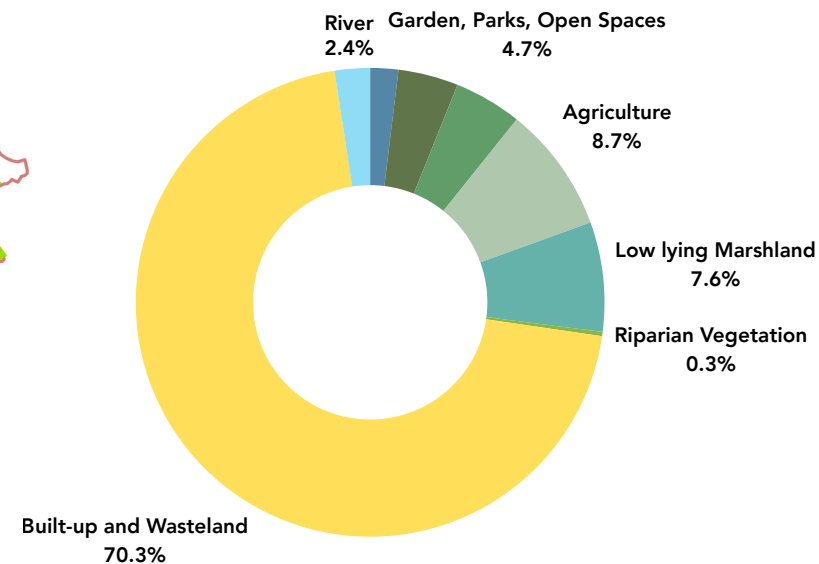
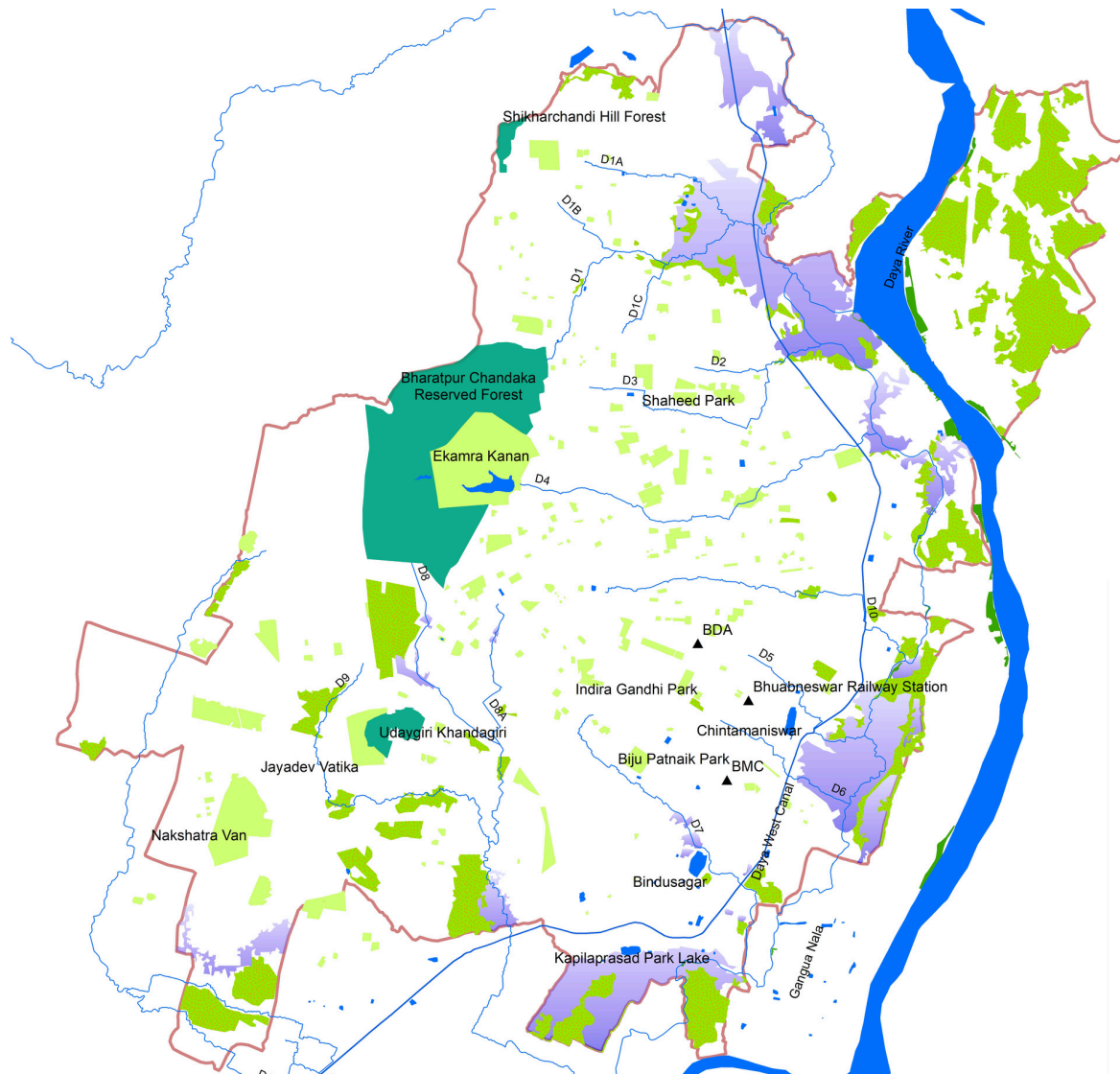


Source- UNEP, UNDP & IUCN (2010)

Key Urban Ecosystems of Bhubaneswar

The city is dotted with a number of distinct ecosystems— hills (*Shikharchandi & Udaigiri-Khandagir*), natural forest (*Chandaka*), wetlands (*Gautamnagar, Sampriti vihar*), water bodies/pokharis (*Bindusagar, Chintamaneshwar*), natural drains (*D-10, D-7*), marsh/grass-lands (*Kesora-Badagada-Jharpara*), riparian zones (*along Daya river*), and urban greens (Jaydev Vatika) and parks (Nikko park).





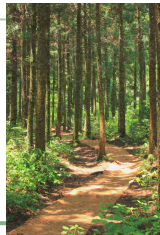
Legend

- ▲ Landmarks
- Daya River
- Daya West Canal
- Drains & Nalas
- Waterbodies
- Forests
- Agricultural Areas
- Parks-Gardens-Open Spaces
- Riparian Vegetation
- Low Lying Marshy Areas
- BMC Boundary

Map 12: Different Ecosystems of Bhubaneswar

Total Area: 7.15 SqKm
Bharatpur Chandaka Elephant Sanctuary, Udaygiri
Khandagiri Caves, Shikharchandi

HILLS & FORESTS



Total Area: 3.32 SqKm
City is spotted with multiple waterbodies and
wetlands like Chintamaneswar, Bindusagar etc.

WATERBODY & WETLAND



Total Area: 13 SqKm
Dotted with eco-sensitive low lying marshy lands like
Gautam nagar and south of Kapileshwar park lake

MARSH LAND



Total Area: 8.05 SqKm

City consists of 69 major parks like biju patnaik, IG
park, Ekamrakanan Botanical Garden etc.

PARKS, GARDENS, OPEN SPACES



Total Length: 125.5 Km

There are 11 major drains that flow through the city
that meet the Gangaua Nala, which is a major drain

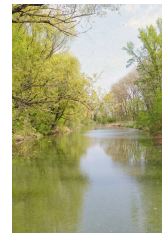
NATURAL DRAINS AND CANAL



Total Area: 3 SqKm

Daya River, which is a tributary of Kuakhai River flows
along the city

RIVER



Total Area: 0.5 SqKm

The vegetation along the Daya River serves as eco-
sensitive floodplain zone

RIPARIAN BUFFER



Kuakhai River

The Kuakhai River is a significant distributary of the Kathajodi River, part of the vast Mahanadi River system in Odisha. Flowing along the eastern outskirts of Bhubaneswar, the state capital, the Kuakhai serves as a vital waterway for the region, playing a key role in its hydrology, ecology, and cultural heritage. The river branches off into the Daya River and Kushabhadra River near Baliana village. The river covers a distance of approximately 18 Km from its origin from the Kathajodi River to its bifurcation at Baliana.

Economically, Kuakhai river is crucial for the surrounding communities. It supports agriculture by providing water for irrigation, facilitating the cultivation of rice, vegetables, and other crops in the fertile lands along its banks. Additionally, it serves as a source of livelihood for local fishermen and is also a site for sand mining, which contributes to construction activities in the region. Rapid urbanization around Bhubaneswar has led to encroachments on the riverbanks, altering its natural flow and increasing the risk of floods during the monsoon season.

Ecosystem Services

Provisioning Services

- **Employment/ Livelihood Generation** - supports the fishing community
- **Food production** - supports in floodplain agricultural activities



Cultural Services

- **Recreation** - host events like Baliyatra, a nine-day fair featuring numerous stalls and cultural programs
- **Religious** - The river serves as a site for various rituals and ceremonies like celebration of Ganesh Puja etc.



Regulating and Supporting Services

- **Flood management** - Plays a crucial role in managing floodwaters, the floodplains help to absorb excess rainfall, reducing the risk of flooding in urban areas
- **Carbon sequestration** - By supporting riparian vegetation and wetlands, the Kuakhai River contributes to local climate regulation. Riparian buffer along the river, with trees and shrubs support the carbon sequestration
- **Groundwater recharge** - Serves as a water storage system resulting in a high groundwater level in this area relative to the city's average
- **Temperature regulation** - The temperature level in the area is relatively lower than the city's average.



Glimpses of Kuakhai River





Chandaka Forest

Chandaka Forest, also known as the Chandaka-Dampara Wildlife Sanctuary, is a protected forest area located on the outskirts of Bhubaneswar, Odisha. Spanning an area of approximately 193.39 sq. km., it is a vital green lung for the region and a heaven for biodiversity. Established in 1982, the sanctuary is renowned for its lush landscapes, diverse wildlife, and ecological significance. The sanctuary is home to a wide range of fauna and flora, the forest has around 700 varieties of Flora and 300 Fauna and 14 Elephants under protection. Prominent species include Kochila, Kumbhi, Kalidia, gilichi, satabadi, bamboo, boro, lachakuli.

Bharatpur and Jaganath Prasad Forest patch is spread over an area of 21.27 sq km., in south eastern part of the Chandaka-Dampara Wildlife Sanctuary. It falls under the tropical-deciduous forest biome. Chandaka-Dampara Wildlife Sanctuary is a popular destination for eco-tourism. It offers activities like wildlife safaris, birdwatching, and trekking. The area also has the Bharatpur Nature Tourism Destination (jungle safari), which is spread over a land area of appx. 20 sq.km.

Ecosystem Services

Provisioning Services

- **Employment/ Livelihood Generation**
 - small shops and kiosks in the vicinity
- **Food production** - Provides resources like wood, medicinal plants, and herbs



Cultural Services

- **Recreation** - Offers ecotourism, trekking, and nature walks.
Provision of jungle safari



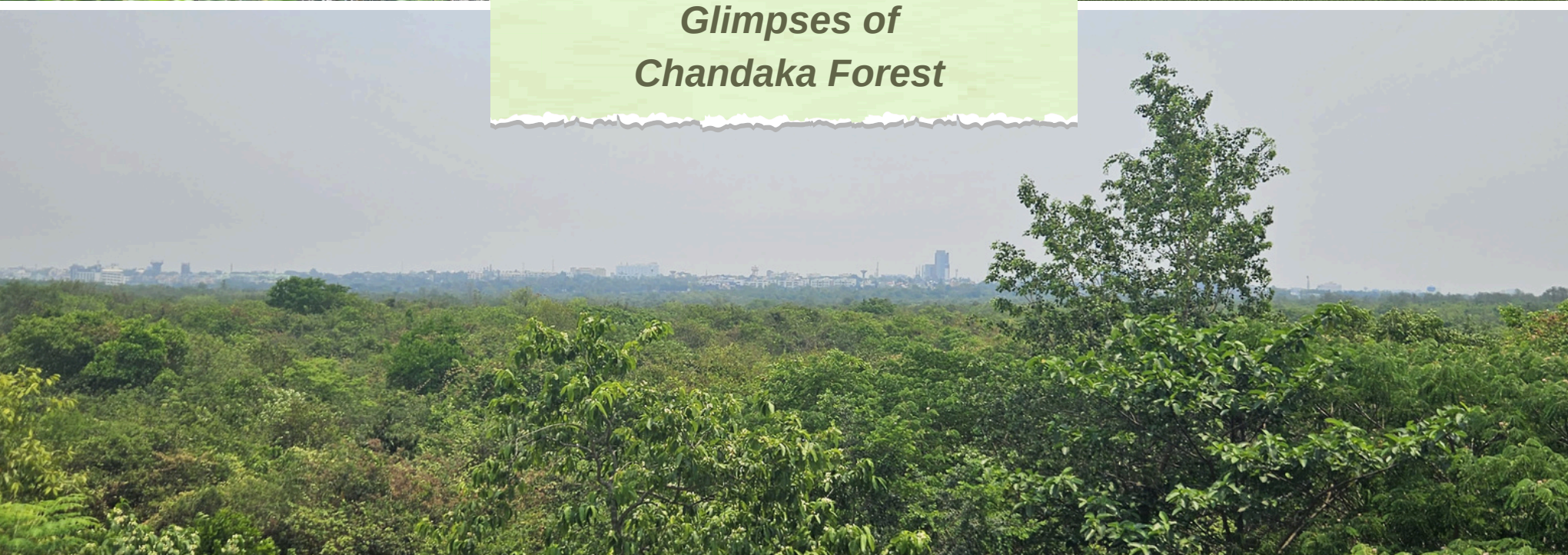
Regulating and Supporting Services

- **Flood management** - Reduces the runoff generated in the catchment area
- **Carbon sequestration** - The dense plantation, helps in carbon sequestration
- **Biodiversity habitat** - Home to 700 species of flora and 300 species of fauna, including the majestic Asiatic elephants
- **Groundwater recharge** - Helps in regulating the groundwater levels in and around the forest areas
- **Temperature regulation** - The temperature level in the area is relatively lower than the city's average.
- **Soil Formation and Nutrient Cycling** - Contributes to soil fertility and the recycling of nutrients, supporting plant growth
- **Pollination** - Home to pollinators like bees and butterflies, aiding in the reproduction of plants and surrounding agricultural areas.





***Glimpses of
Chandaka Forest***





Bindusagar Lake

This lake is considered as a sacred water body located very near the Lingaraja temple (the most important tourist attraction in the city). Also known as "*Ocean Drop Tank*", the lake is elongated and is 1,300 feet long and 700 feet wide. It consists of a small island with several shrines in its middle. It serves as a popular destination for picnics and recreational spots in the city, having deep cultural significance and offering ample livelihood opportunities for various classes of society. and is also one of the top places to visit in Bhubaneswar. The sound and light show in the evening attracts visitors to this lake. The tank has embankments on all four sides.

According to legends, Bindu Sagar Lake was created by Lord Shiva by bringing water from all the holy places to quench the thirst of Goddess Parvati. Hence it is believed that a dip in the Bindu Sagar Lake would wash away all the sins and get rid of all their diseases by drinking the holy water. The annual festival is held in the Bindu in which the procession consists of a lot of energy and enthusiasm and makes for a memorable sight. Overall, the lake observes several human activities (cultural) around it apart from offering ecosystem services like recharge, and climate cooling.

Ecosystem Services

Provisioning Services

- **Employment/ Livelihood Generation** - small shops and kiosks in the vicinity
- **Food production** - Fishing done by local community



Cultural Services

- **Recreation** - attracts thousands of visitors each year for several activities like fishing, bathing etc.
- **Religious** - used for religious rituals and festivals, especially during Kartik Purnima



Regulating and Supporting Services

- **Water Supply** - Source of water for domestic use for the nearby area
- **Biodiversity habitat** - Provides a habitat for various aquatic species, supporting local biodiversity
- **Groundwater recharge** - Serves as a water storage system resulting in a high groundwater level in this area relative to the city's average
- **Temperature regulation** - The temperature level in the area is relatively lower than the city's average.





*Glimpses of
Bindusagar Lake*

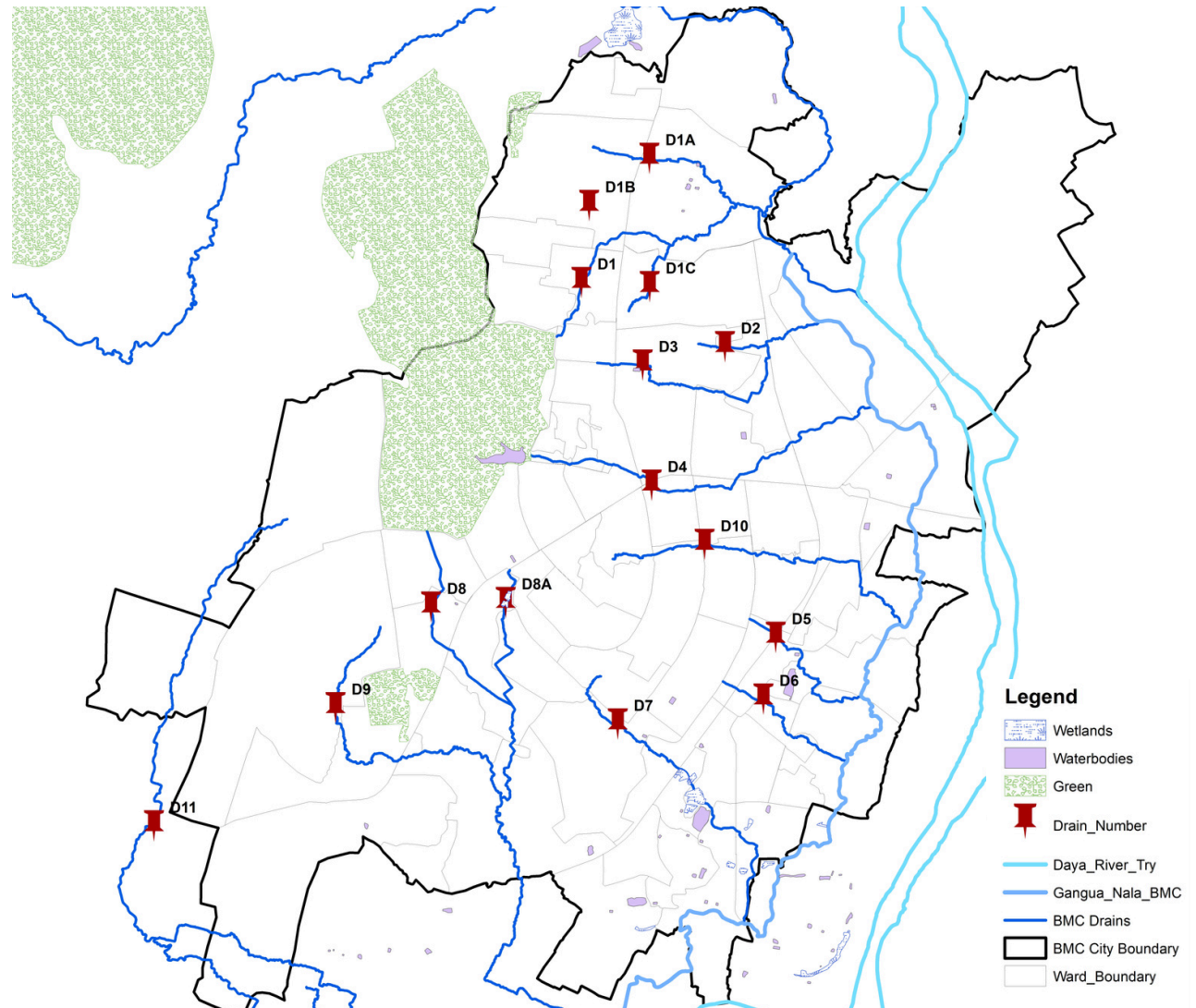


Natural Drains

The city has an undulating topography, with a major slope direction from Northwest and West to East. A number of natural drainages follow this slope and merge in the lowland marshy areas, and ultimately drains into the Gangua nala.

All the natural drains flowing west to east crisscrossing the city, contribute to the Daya and Kuakhai Rivers flow which are critical for city's water supply.

There are 11 small to medium natural drains varying in their lengths and widths, some of which pass through high-density settlements. These natural drains play a vital role in discharging stormwater during the monsoon season to protect the city from urban flooding. However significant alteration in terms of natural banks and slope has resulted due to urbanisation.



Map 13: Drains and Waterbodies of Bhubaneswar



Drain No. 10

The drain No. 10 passes through the central part of the city with a catchment area of appx. 10 sqkm. The drain finally discharges into the Gangua nala, which merges with the Daya River in southwest of city. The drain is critical for the city's flood management and also regulating the quality and quantity of flow in Daya River. The D-10 faced issues of encroachment, pollution which were addressed by the Government by rejuvenation of drain for multiple benefits.

The rejuvenation of D-10 is being carried out between Vidyut Marg to Sachivalya Marg for 900 meter stretch in a phased manner. Rejuvenation is implemented by the Bhubaneswar Municipal Corporation (BMC) in the first phase. A small water body is being developed at the end of this stretch under the smart cities project, which will be used for recreational purposes. The estimated implementation cost for the rejuvenation of this stretch is around 1.25 cr. The rejuvenation process is primarily done by adopting Nature Based Solutions (NbS) instead of conventional methods and also engages communities (Self Help Group members) for implementation.

Ecosystem Services

Provisioning Services

- **Employment/ Livelihood Generation** - The human resource engaged for the management of the drain help in creating livelihood



Cultural Services

- **Recreation** - Children's park developed along drain 10 attracts local people for recreational purposes
- **Education** - Serve as case study for environmental researchers



Regulating and Supporting Services

- **Flood management** - Helps in absorbing the the runoff generated in the catchment area
- **Biodiversity habitat** - Supports local floral and faunal biodiversity
- **Wastewater Discharge** - Provide a system for the disposal and transportation of wastewater
- **Temperature regulation** - Helps in regulating the temperature along the drain area
- **Groundwater Recharge** - Facilitate groundwater recharge through infiltration, supporting the replenishment of local aquifers



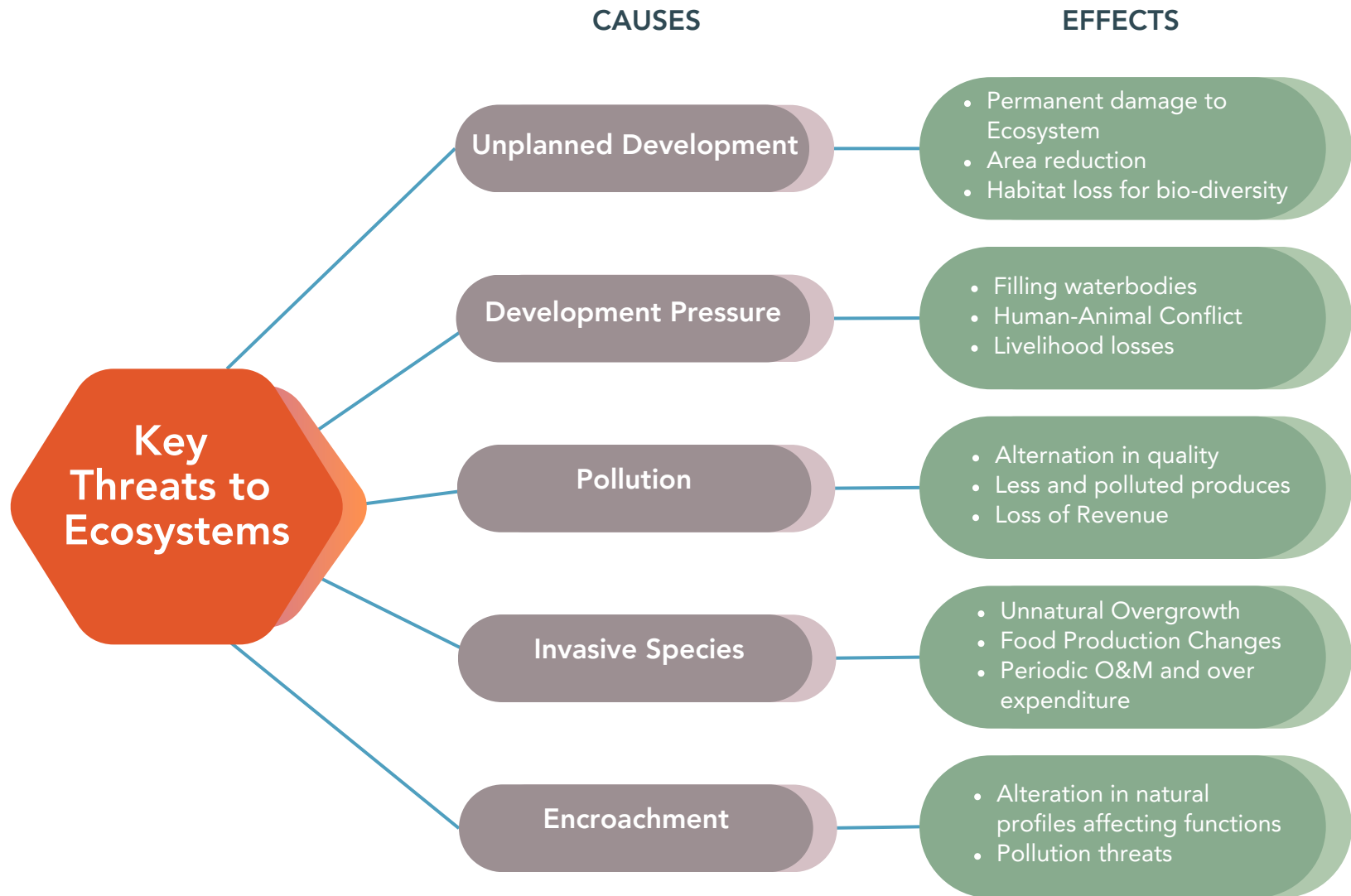


***Glimpses of
Drain No. 10***

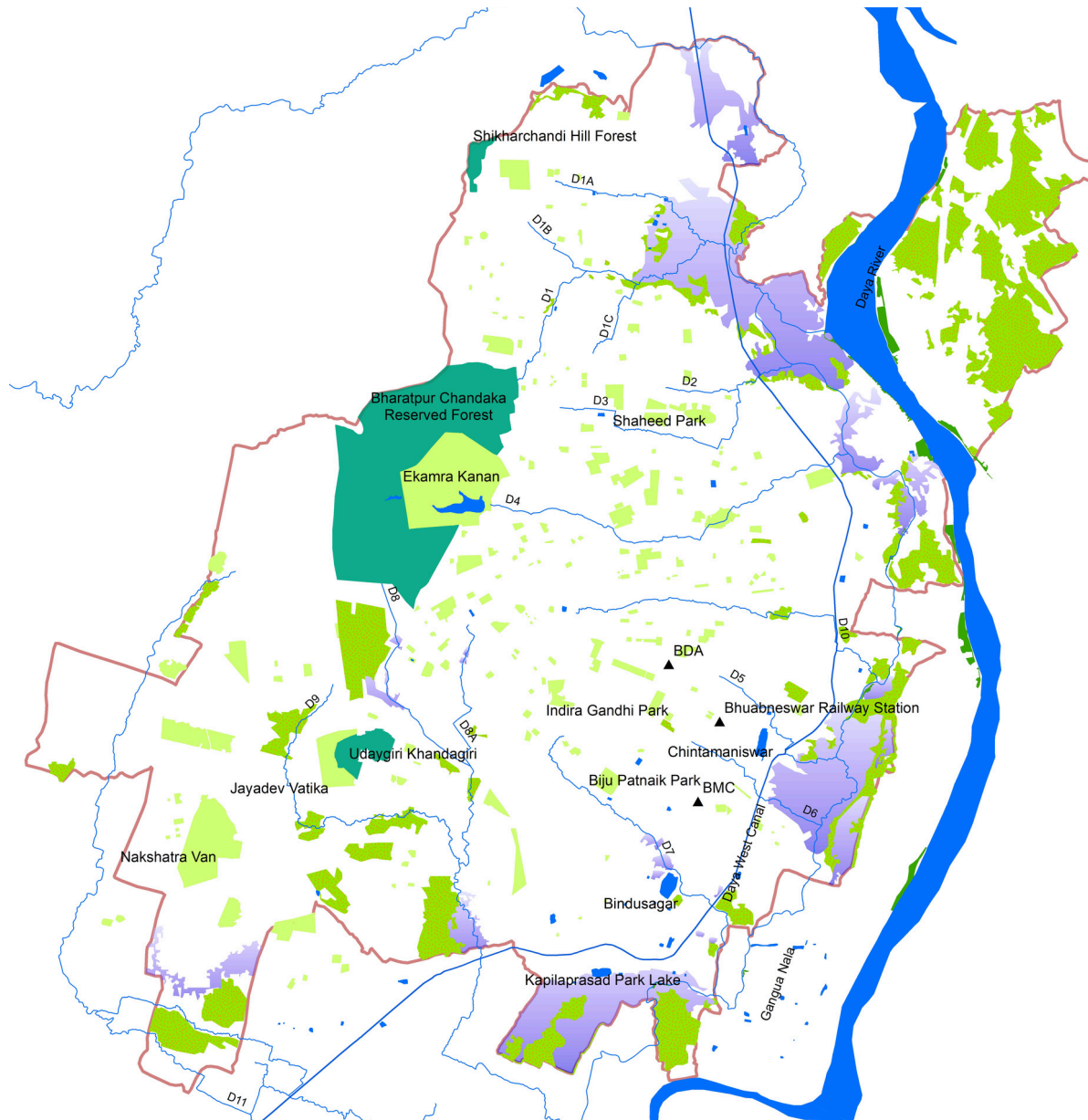


Section 3

THREATS TO URBAN ECOSYSTEMS IN
BHUBANESWAR



Types of Ecosystems in the city under urbanisation's pressure



Legend

- ▲ Landmarks
- Daya River
- Daya West Canal
- Drains & Nalas
- Waterbodies
- Forests
- Agricultural Areas
- Parks-Gardens-Open Spaces
- Riparian Vegetation
- Low Lying Marshy Areas
- BMC Boundary

Ecosystems under threat and development pressures

- Urbanisation Pressure
- Stress to Bio-diversity
- Human-Animal Conflict

FORESTS



- Encroachment, Pollution
- SWM in buffer areas
- Less Food Produce

WATERBODIES AND WETLAND



- Encroachment
- Siltation
- Modification of natural profile
- Pollution

NATURAL DRAINS



MARSHLAND



- Agricultural Runoff Pollution
- Over-grazing
- Flooding and Encroachment
- Invasive Species

PARKS AND GARDENS



- Invasive and exotic species
- Poor maintenance

RIARIAN BUFFER



- Invasive Species
- Reduction in area

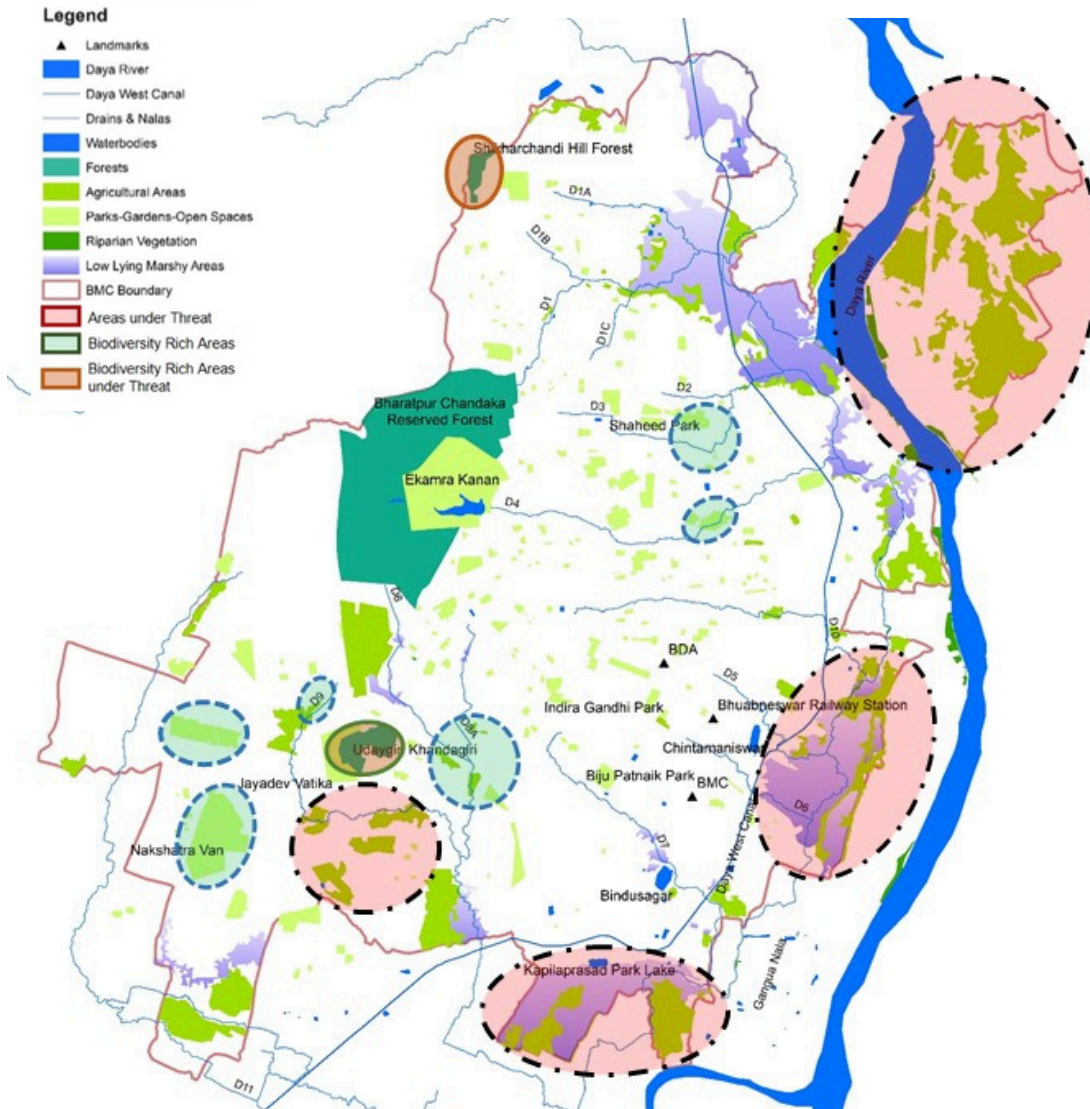
Preparing Ecosystem and Bio-diversity map

A Focused Group Discussion (FGD) was held in Bhubaneswar on 19th March 2024, with a group of six local biodiversity experts- representatives from the City Forest Department, Odisha Biodiversity Board, Bhubaneswar Municipal Corporation, Aacademia and NGO. An Ecosystem and Bio-diversity map was prepared from inputs of experts. With the inputs from the experts, the ecosystems that are under threat due to various reasons were also identified so that, those ecosystems can be taken up for restoration on priority.

Following are some ecosystems under threat in Bhubaneswar city

- 1.Forest area in Shikhar Chandi Hills
- 2.Forest area in Khandagiri
- 3.Marshy lands - Gautam Nagar wetlands,
4. Water bodies (Pokharies), Tanks and Wetlands
- 5.Agricultural areas (due to overuse of insecticides)





Ecosystem and Bio-Diversity Map of Bhubaneswar Municipal Corporation

The officials and experts provided inputs to come up with a suggestive map depicting status of Ecosystems and Bio-diversity in the Bhubaneswar city.

BMC has about six small patches which are flourishing in terms of bio-diversity which indicates that the Ecosystems are healthy. However, there are larger patches in the city which indicates threats to the Ecosystem and Bio-diversity

Peoples' Biodiversity Register

The Odisha State Bio-diversity Board is carrying preparing a People's Biodiversity Register for the Bhubaneswar Municipal Corporation area.

Map 14: Ecosystem and Biodiversity Map of Bhubaneswar

Key Recommendations

Use of native species for plantation



Native species should be used in all plantation drives undertaken across the city by different agencies. To support this initiative, saplings may be procured from nurseries managed by the City Forest Department. Even the local nurseries can be directed to supply native species.

Integrating greens in every development project



A small area can be dedicated for plantation under each development project undertaken within the city. These small patches have the potential to enhance the overall biodiversity of the city.

Developing a city level plantation strategy



A city level plantation strategy or greening guideline shall be developed, detailing selection of appropriate species, planting pattern and density, zonation based on soil type/ moisture content, maintenance, etc.

Forming a biodiversity expert group



A group of experts from different departments working in this sector, can be engaged as advisors to facilitate action on ground. Additionally, some sectoral experts shall also be a part of the infrastructure development team at government organisations like BMC.

Mandating biodiversity assessment in all large scale projects



All large-scale projects, like construction of drains, shall ensure a detailed scientific assessment of the biodiversity (flora and fauna) of the site.

Creating a biodiversity facilitation centre



A facilitation centre shall be established at the Bhubaneswar Municipal Corporation, to engage and support citizens interested in undertaking smaller initiatives (like local park or kitchen garden) at the neighbourhood or household level.

Stakeholder consultations with city officials and site visits



NOTES



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