सत्यमेव जयते

Ministry of Housing and Urban Affairs
Government of India

Proportion of Green Cover

TRAINING MANUAL

Climate Centre for Cities

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

Deutsches Institut für Urbanistik

ClimateSmart Cities Assessment Framework

Urban Planning, Green Cover & Biodiversity

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Proportion of Green Cover
Training module

Developed by:
Climate Centre for Cities, Internationale Zusammenarbeit (GIZ) and The Deutsches Institut für Urbanistik (DIFU) (English: German Institute of Urban Affairs).

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Photo Credit: Chandigarh city, Haranjal Kaur

Executive Summary

On one hand, cities are a significant contributor of carbon emissions aggravating climate change and on the other, cities are considerably impacted by climate disasters. The recently released Global Climate Risk Index 2021 ranks India as the 7th most affected country from climate related extreme weather events (storms, floods, heatwaves etc.). Further, studies indicate that poor planning and urban management are expected to cost Indian cities somewhere between $2.6 and $13 billion annually.[1] Cities are increasingly at the forefront of addressing both urbanization and climate change and to strengthen climate-sensitive urban development, a holistic understanding of the urban development from a climate lens is crucial. The ClimateSmart Cities Assessment Framework (CSCAF) launched in 2019 by the Ministry of Housing and Urban Affairs (MoHUA), Government of India aimed to address this gap. This first-of-its-kind assessment with 28 progressive indicators across 5 thematic areas helps cities to benchmark their development, understand the gaps and further prioritize climate relevant development.

With a focus on building local capacities to develop and adopt climate measures, the Climate Centre for Cities (C-Cube) at the National Institute of Urban Affairs (NIUA) initiated a series of training aligned to the thematic areas of CSCAF - Energy and Green Buildings, Urban Planning, Green Cover & Biodiversity, Mobility and Air Quality, Water Management, Waste Management. The focus of the training is to provide a step-by-step approach of conducting studies, assessments and stakeholder consultations, establishing committees, developing action plans and implementing relevant measures that not only makes the cities climate resilient but also helps them progress across the assessment of CSCAF.

[1] *Mani, M. et al., 2018. South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards, WashingtonD.C.: World Bank Group.*

Protected greenspaces and open areas in cities play crucial role in climate change mitigation as they reduce the impact of human activities on climate. The ecosystem services provided by the urban green spaces help the city in general and its citizens to adapt to the adverse effects of climate change and disasters. The intent of this module on 'Proportion of Green Cover' is to inform about the importance of green cover in reducing air pollution and tackling urban heat island effect besides highlighting the measures required to increase green cover. This manual has information on concepts and functions of urban green cover, assessment measures, land surface temperature, urban heat island effect, strategies for planning of proportion of green cover. This module is developed by the National Institute of Urban Affairs (NIUA) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) along with the Ministry of Housing and Urban Affairs (MoHUA), Government of India.

The intent of the training is to inform city officials the key concepts of urban environment and enable them to develop integrated plans to combat heat island effect besides sensitizing the larger stakeholders. The module also emphasizes on protecting native tree species and increasing their proportion.

Who is the training manual designed for?

What is the focus of the training manual?

How to make use of this manual?

What are the Learning outcomes of the training?

Scope and limitations of the training

The manual is designed primarily for urban local bodies and horticulture department, followed by town planning department/urban development agencies/infrastructure development agencies or state line departments and other district administration departments related to urban landscape.

The focus of the module is to establish the baseline for a city's green cover and introduce strategies to increase the proportion of green cover. Emphasis is given to conserving native tree specifies.

The manual can be used to determine the performance evaluation as per CSCAF. It contains concepts of urban green, assessment measures as well as implementation strategies in planning for increasing green cover.

- Understanding the indicator, how it is calculated and measured
- Understanding the importance of green cover and measures to increase the proportion of green cover
- Spatial mapping with Google Earth Pro
- Implementation strategies to increase the proportion of green cover
- Best practices related to greening initiatives

The interactive exercise focuses on a simple spatial mapping tool and the participants may refer to additional tools for scientific methods of mapping.

Contents

List of Figures

Abbreviations

C-Cube	Climate Centre for Cities
CSCAF	Climate Smart Cities Assessment Framework
DPR	Detailed Project Report
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GIM	National Mission for Green India
LST	Land Surface Temperature
MoHUA	Ministry of Housing and Urban Affairs
NAPCC	National Action Plan for Climate Change
NCAP	National Clean Air Programme
NIUA	National Institute of Urban Affairs
O&M	Operation and Monitoring
NGO	Non-governmental Organizations
UHI	Urban Heat Island
ULBs	Urban Local Bodies
URDPFI	Urban and Regional Development Plans Formulation and Implementation Guidelines
WHO	World Health Organization
SMC	Surat Municipal Organisation

1

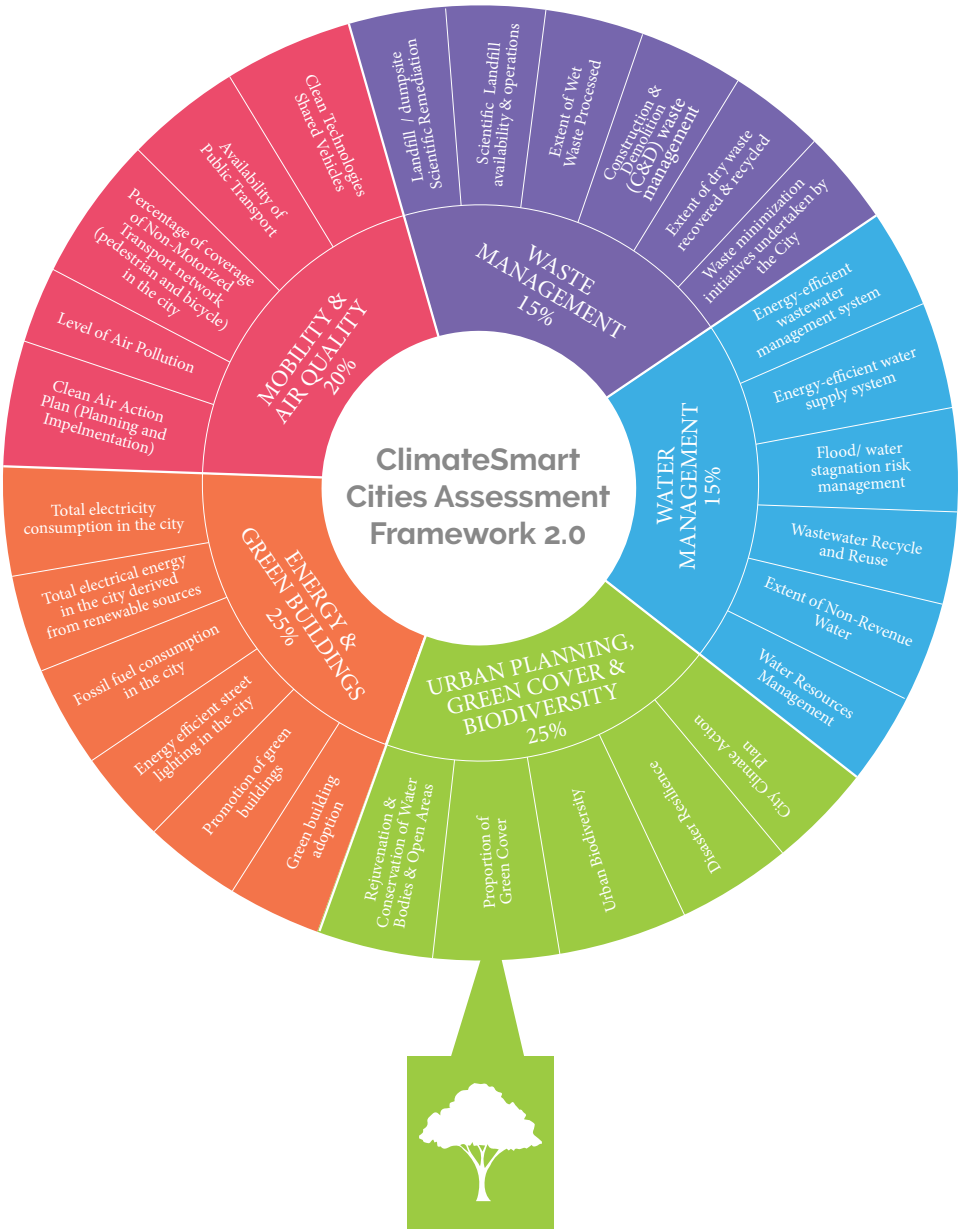
Introduction

Urbanisation leads to conversion of agricultural land to urban use, that adversely impact natural and environmental resources; therefore biggest challenge for cities is to urbanize without impacting the proportion of green cover. Preservation of vegetated areas or green spaces improves the quality of life and safeguard quality of basic resources such as air and water. It helps in carbon sequestration, and maintaining urban microclimate, improving air and water quality, buffering noise pollution and conserving biodiversity. The impact of green spaces can be viewed from the perspective of ecology, physical habitat, social and economic. Green cover helps to negate urban heat island effect by reducing surface air temperature.

To fight climate change and mitigate GHG emissions, the forest conservation as global efforts was recognized by Article 5 of the Pari Agreement. In the urban context, urban forests generally include green space/infrastructure, green belts, neighbourhood park, totlots, playgrounds, district park, protected forests or ridges, green strip; and there has been initiative on using native trees as green infrastructure for climate change adaptation and mitigation. Increased native species and diversity of trees in an urban ecosystem can play a key role in building urban resilience. For instance, mangroves in the coastal cities are vital to address the risks of flooding. Native tree species provide better ecosystem services with higher transpiration rate and provide diverse faunal biodiversity habitats. And many state authorities and urban local bodies have undertaken massive afforestation drive by planting native trees species which are more climate resilient and adaptable to the local conditions.

Therefore, realizing the importance of maintaining and preserving urban greens, this training is aligning to the CSCAF indicator wherein green areas are defined as man-made city level and zonal/district level greens: and reserved/protected areas as per MoHUA's Urban Green Guidelines, 2014 and areas under the Wildlife Protection Act, 1972.

Figure 1 ClimateSmart Cities Assessment Framework 2.0



For the indicator of Proportion of Green Cover, within the theme of Urban Planning, Green Cover and Biodiversity, cities are evaluated on five progressive levels based on the proportion of green as suggested by the URDPFI guideline. With an intent to promote native tree species, cities receive additional bonus marks for documenting native tree species, developing a plan to increase green cover aligning with NCAP and showing evidence of implementing some of the measures.

Formula:

$$\frac{\text{Green Cover in sq.km}}{\text{Municipal area in sq.km}} \times 100$$

Unit: %

Maximum Score: Total score for the indicator is 100. Cities will be marked in 5 levels with scores ranging from 0 – 100. In this indicator, certain bonus marks will be provided for cities that are taking additional desirable measures towards protection of green cover.

1. Additional 10 marks for reporting on additional qualitative data – list of native tree species, tree density, and tree canopy density. (Applicable for levels 1 to 4)
2. Additional 10 marks for developing the strategy for increasing Green Cover in the city in line with the National Clean Air Plan (NCAP). (Applicable for levels 1 to 4)
3. Additional 5 marks for providing evidence on action initiated for points 1 and 2 above. (Applicable for levels 1 to 4)

Figure 2 Performance Evaluation

	1	2	3	4	5
Progression Levels	0% to <5% Green Cover	5% to < 9% Green Cover	9% to < 12% Green Cover	12% to < 18% Green Cover	≥ 18% Green Cover
Evidence/ Data sources	• Map of green cover within municipal boundary for this year as a .kml file (polygon geometry)				
Responsible Department/ Agency	National Remote Sensing Centre, State Remote Sensing Centre, Urban Planning or Development Authority, Forest Department				
Score	0	25	50	75	100

Data available on area of urban greens analysed from satellite imagery (this can be procured from the state or National Remote Sensing Centre (NRSC). Comparative analysis using the formula given above on a yearly basis will help to understand the increase/ decrease over time.

Photo Credit: Raghavendra Prasad on Unsplash

2

Urban Green Cover

Urban green cover includes all types of visible green vegetation such as forests, agriculture, vegetation along streams and lakes, recreational park-gardens, vegetation along streets, inside plots and on roof tops and building facades. Broadly, all visible vegetation as seen from the satellite is called 'urban green cover'.

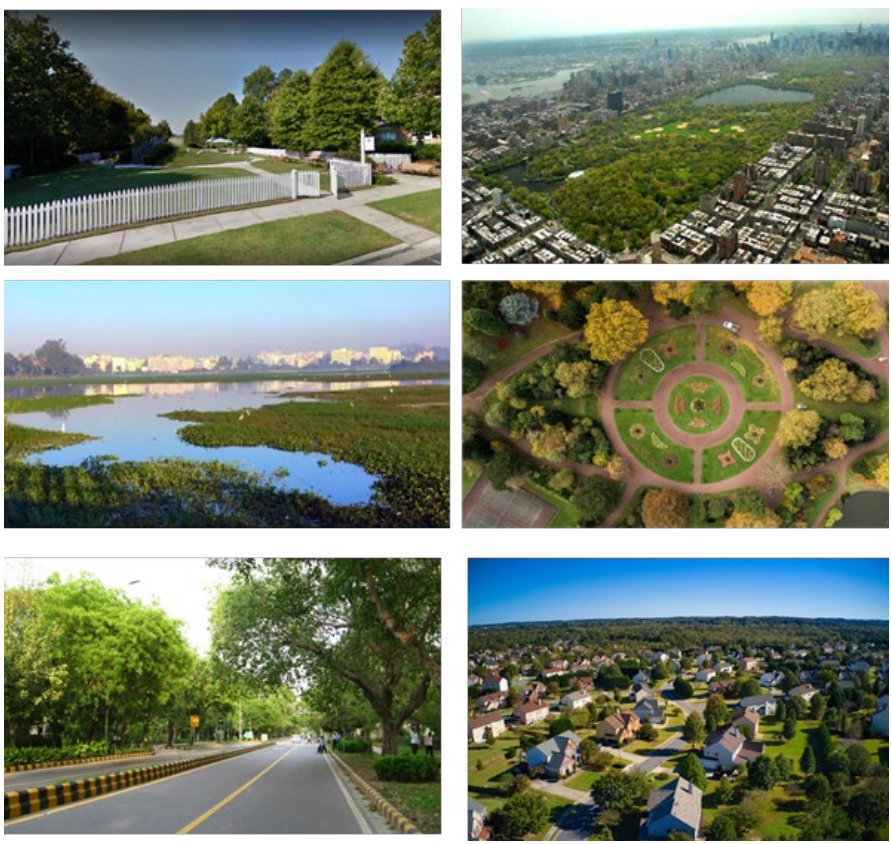
Further categorization of green cover can be done as district parks, totlots, natural green along rivers, recreational parks, vegetation along streets, neighbourhood park, etc.

2.1. Functions of Urban Green Cover

By increasingly integrating green spaces in cities and towns, multiple benefits can be achieved. Such as:

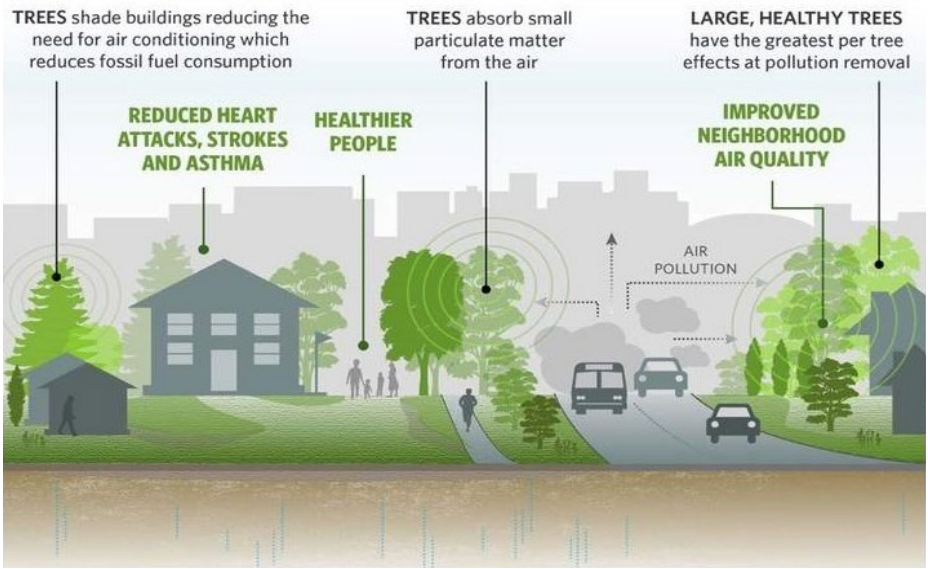
- Heat mitigation: Urban green cover acts as a reflective surface for sunlight and can reduce air temperatures through transpiration, while providing shade and passive cooling through canopy cover. This also provides health benefits such as reducing the incidence of heat related illnesses.
- Energy efficiency: The heat mitigating features of increased green cover can reduce the need for air conditioning in offices and homes.
- Improved air quality: Trees can trap and remove carbon dioxide and pollutants from the urban atmosphere.
- Water absorption and improved water quality: Urban green cover and the soil or substrate in which it grows can capture storm water, reduce peak flows and can also moderate localised flooding.
- Noise reduction: Urban green cover protects against urban noise pollution.
- Biodiversity protection: They provide important habitat and corridors for birds and animals.
- Promote sense of community: Green cover can enhance a community's sense of pride, and ownership. Active involvement in tree planting programs leads to a stronger

Figure 3 Categorisation of green cover (top-left to right) totlots, district park, green along water bodies, recreational parks, vegetation along streets, and vegetation inside plots



sense of community and the promotion of environmental responsibility and ethics. Planting programs also project a visible sign of change and provide the impetus for other community renewal and action programs. (NSW Govt, 2015)

Figure 4 Urban green and impacts



Graphic credit-Erica Simek Sloniker

Photo Credit: Ravi Sharma on Unsplash

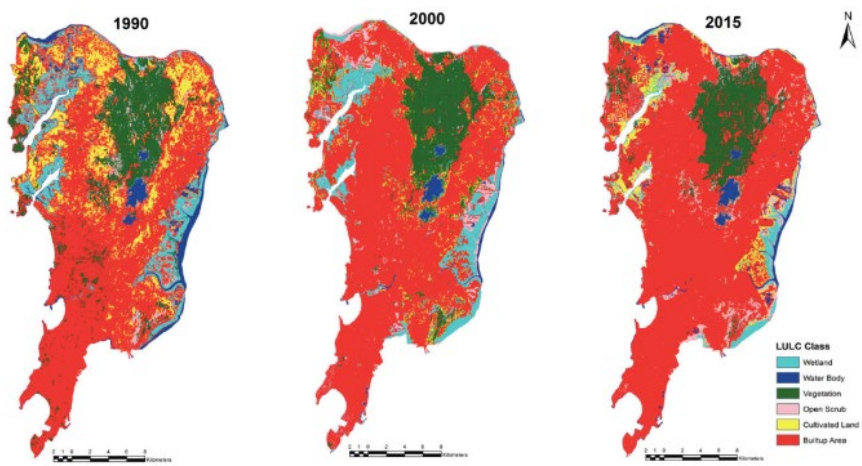
3

Assessment Measures

3.1. Land Surface Temperature

Land surface temperature (LST) is a measure of earth's surface temperature experienced through contact in a particular location. From a satellite's point of view, the "surface" is whatever is visible when seen through the atmosphere. It could be snow and ice, the grass on a lawn, the roof of a building, or the leaves in the canopy of a forest. LST is mapped by Remote Sensing method.

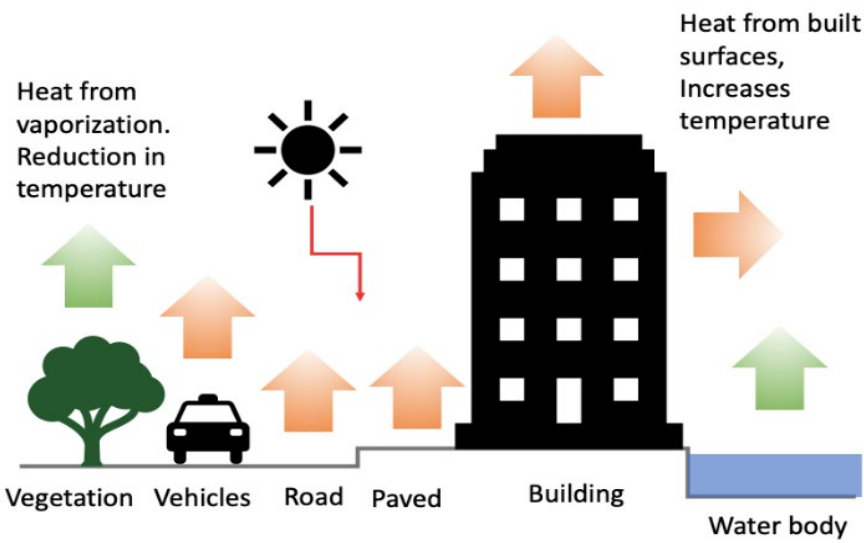
Figure 5 LULC (top) and LST (bottom) Maps of Mumbai 1990-2015



The various causes for increase in land surface temperature are

- Global increase in greenhouse gas emissions
- Increase in impervious surfaces - Vegetation replaced by asphalt and concrete for roads, buildings and paved public places or large scale infrastructure projects. These surfaces absorb—rather than reflect—the sun's heat, causing surface temperatures and overall ambient temperatures to rise.
- Exposed bare soil – dried agricultural land or open plots

Figure 6 Causes of increase in LST



The impact of varying Land Surface Temperature can be significant. Such as:

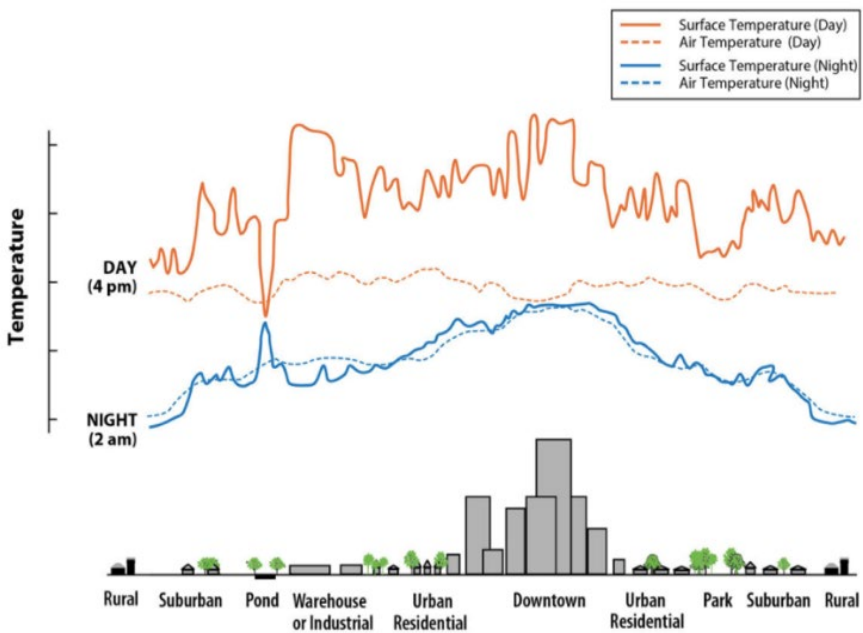
- Changing weather patterns, frequent hot days
- Storms, floods, droughts due to changing precipitation patterns
- Ecosystems (plants and animals) existing in particular climatic zones get affected
- People living in vulnerable zones get affected
- Heat strokes and death due to hotter summers and frequent fires
- Rising land surface temperatures affect glaciers, ice sheets, permafrost, and the vegetation in Earth's ecosystems.

3.2. Canopy Cover

Tree canopy cover is the measure of the area of tree canopy cover when viewed from above. Canopy cover is important to understand strategic goal setting. It can be used to benchmark, manage and evaluate the urban vegetation as a whole. Canopy cover is measured as the proportion of a fixed area of the ground covered by tree crowns. The canopy cover will be determined by the tree species, as they have different crown sizes, shapes, and heights.

3.3. Urban Heat Island (UHI) Effect

Figure7 Diurnal variation of LST with urban form



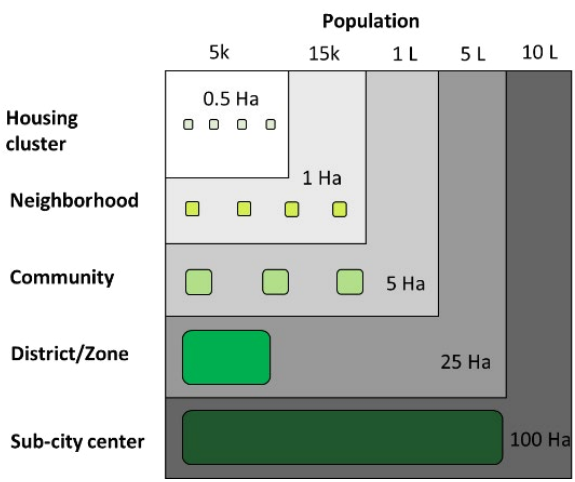
A heat island is simply an area, volume, or region in which the temperature is higher than that of the surroundings. UHI is the difference between the temperature in a certain urban location and that at a given reference point in a nonurban location. Heat islands occur in urban areas because of the following reasons - thermal bulk and surface radiation properties of concrete and asphalt, lack of shading and cooling effect of trees, increased reflective and absorptive surfaces of tall buildings, higher levels of pollution and wind blocking by high rises. Land surface temperature and air temperature at various spots has to be recorded to calculate UHI

3.4. National and International Guidelines as benchmarks

As per the URDPFI guidelines, there should be 10 12 sqm of per-capita green space in urban areas and 1.2 to 1.4 Ha of green space per 1,000 population. This is in line with WHO standards which recommends 9 square metres of urban green space for each person. WHO guidelines also suggest that an ideal amount of urban green space can be provided as much as 50 sqm per person. The URDPFI guidelines also suggest accessibility parameters for green spaces where it states that green spaces should be present within walking distances of 5-15 m (300 – 500 m).

Other policies and guidelines, including MoHUA's Urban Greening Guidelines, 2014, the National Mission for Green India (GIM) under the National Action Plan for Climate Change (NAPCC), and the National Clean Air Programme (NCAP) also provide spatial standards for city level green cover and identify key stakeholders for implementing greening initiatives like eco-restoration in urban and peri urban areas and plantation schemes for pollution hotspots. In addition, the state horticulture policies and city master plans provide context specific policies and regulations based on the city's growth pattern.

Figure 8 URDPFI Guidelines accessibility parameters for green spaces

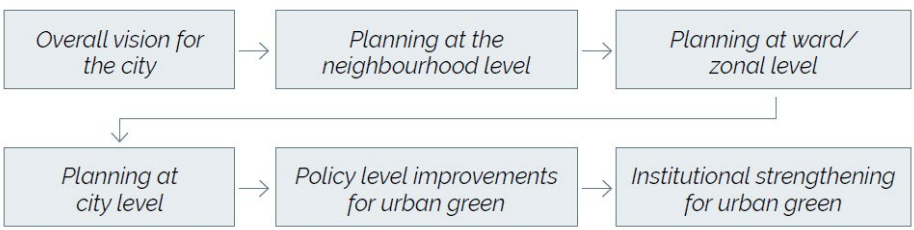


4

Implementation Strategies

Planning for the proportion of green cover requires consideration of the different planning levels within the city. The following considerations need to be made while planning for it:

Figure 9 Different Planning Levels for implementation strategies



Defining what "green cover" means for the city. Ideally green cover can be defined by all visible vegetation natural or planted as seen from the satellite. Broadly it includes forests, agriculture, vegetation along water bodies, along streets, dedicated parks- gardens, reservations on plots and vegetation on building roofs or vertical surfaces.

Mapping and understanding the green cover and its impact on city's climate. Any loss in green in and around the urban area has a direct impact on the rising temperature and in turn impacts the local climate. Understanding the changes in the Land Surface Temperature gives an indication on the changing weather patterns and frequent hot days impacting the macro-climate of the city. Mapping the green cover and correlating that with LST would provide for better diagnosis and action plan.

Understanding the institutional set up and other stakeholders that contribute to the city's green cover. There are multiple stakeholders working in the city and which are engaged in some way or the other to plan various measures related to urban planning including

green cover. These generally include the state Environment Department, Municipal Corporations, the Horticulture Department, the Town Planning Department, etc.

Analysing the policies and regulatory framework that contribute to the city's green cover. Any plan that ought to be implemented in the urban context will require the framework of existing policy and regulatory guidelines/laws. It is important to have a thorough knowledge of such framework conditions in the context of Urban Planning, Green Cover and Biodiversity (UPGCB). Providing recommendations to improve the urban green cover of a city will be based on the spatial and policy analysis. Any plans that would be drawn up from these analyses require a clear road map for implementation. Strategies should be short, medium, and long term and identify the stakeholders who will be able to implement them and also follow the usual principles of preparing Detailed Project Report (DPR) and Policy recommendations, along with financial budgeting for both capital expenditure and Operation and Maintenance (O&M).

5

Case Studies

5.1. Thane Greening Initiatives

Thane city, located near Mumbai in the state of Maharashtra, is a rapidly growing city due to extensive immigration and urbanization. In view of this, there has been a fast depletion of green spaces within the city as well as on its outskirts. Tree Census carried out in the year 2011 recorded 4, 55,070 trees in the city, but in order to cope up with the fast-growing concretization, Thane Municipal Corporation planned a drive of planting 5 Lakh trees in 3 years starting from 2015. Considering the scarce availability of land within the city, degraded forest land was identified within the city limits for the plantation drive in association with the Forest Department. The key stakeholders in the project were the Garden Department and Tree Authority, Thane Municipal Corporation. The project was funded through the annual budget of the Thane Municipal Corporation (NIUA, 2019).

The main objectives of the project were as follows:

- Regeneration of degraded forest land within the city limits
- Plantation of local forest tree species in all the areas identified for the plantation drive
- Restricting soil erosion in identified hilly areas
- Minimization of fresh water wastage and adoption of techniques to ensure ground water recharge

The salient features of the project include:

- Thane Municipal Corporation obtained 50 Hectares hilly areas through tri-party agreement
- Free saplings distributed to the local leaders, Citizens, Schools and colleges and NGOs
- Geotagging of the planted trees
- Using technology for real-time monitoring of plantations
- Extensive campaigns with media and community engagement

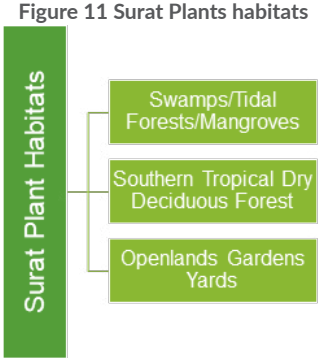
- Planting about 40,000 numbers of mangrove species on the marshy land
- Adoption of soil and water conservation measures

Figure 10 Achievements of the Project, Thane Greening Initiatives

5.2. Urban Green Spaces planning & designing in Surat[1]

Surat is one of India's most dynamic cities, with large-scale immigration from Gujarat and other Indian states. Jointly with GIZ, Surat Municipal Corporation (SMC) initiated landscaping project. Tree plantation is an effective way of enhancing the environmental quality along with preventing air pollution. The effort began with the identification of pollution hotspots, followed by the provision of plantation in the identified hotspots. Two hotspots were identified under the project: Canal Road and the Pandesara Industrial Estate. Landscaping plan was developed and designs were prepared for the identified hotspots. Also 'Plant Catalogue and Plant Palette' was prepared to provides information of native trees and aided in undertaking plantation work in Surat.

Figure 11 Surat Plants habitats



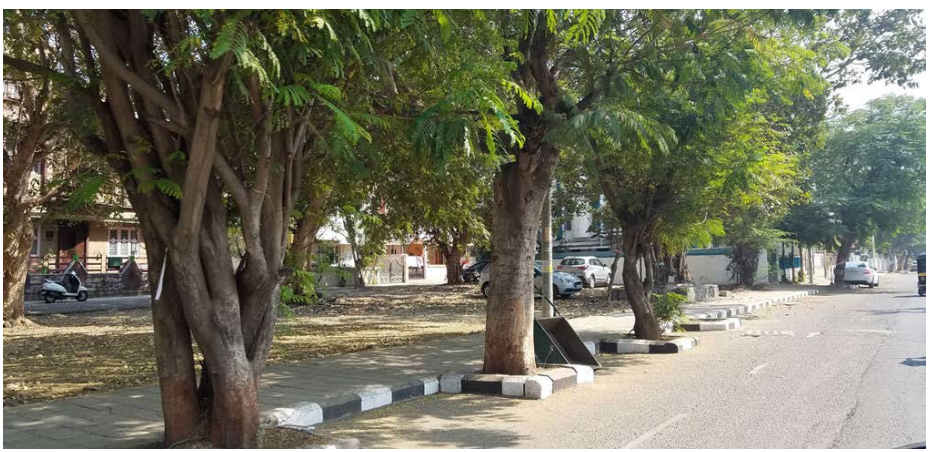
The study identifies type of air pollutants to be targeted and estimation of potential level of reduction in air pollutants. Additionally, the study recommend plant species for plantation in Surat city to mitigate the pollution.

The solutions proposed for the two identified hotspots were:

- Canal Road: A vegetation strip along the canal road in the city was proposed.
- Triangular area along the creek in Pandesara Industrial Estate: It was proposed to convert the space into a garden. One of the efficient and effective options for preventing air pollution hazards as well as for enhancing the environmental quality, including enrichment of human microbiome that reduces health risks and public health burden is the development of native parks.

To improve the canopy cover, Surat Municipal Corporation (SMC) undertook intensive tree plantation and intensive agroforestry and horticulture practices in peri-urban areas. This project adopted a two-fold approach – plantation and robust monitoring. According to the study, there was a need to increase tree population by about seven to eight lakh; and about two lakh tall seedlings were planted in available space, along Tapi River and institutional lands.

[1]*Preparation of plantation/landscape design for the identified location in Surat City, September 2020*



6

Interactive Exercise – Spatial Mapping of Green cover

Mapping of green cover and open spaces aides in understanding the efforts taken, or are required to be taken, for increasing green cover. The spatial information provided by the maps not only helps in urban planning but also in monitoring the various indicators during and after the implementation of initiatives.

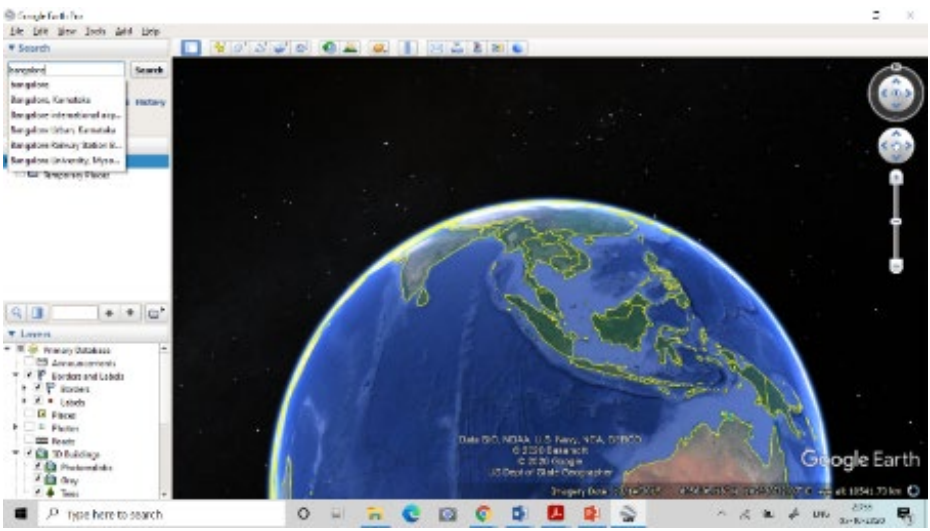
The objectives of the exercise were as follows:

1. Mapping green cover to assess their proportion
2. Extent to which the land use and land cover has changed over the years especially focusing on the green cover and open spaces

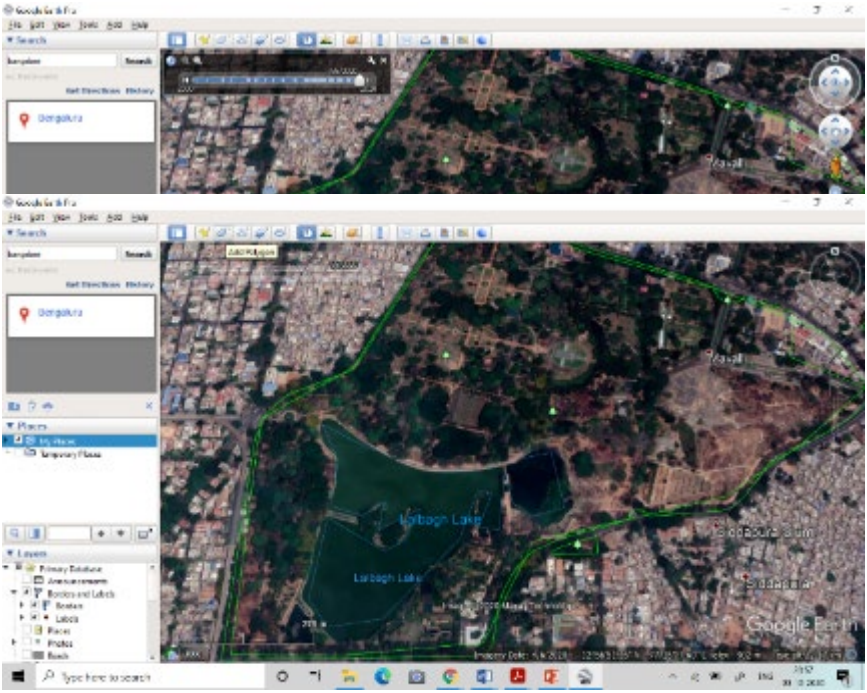
The following steps are part of the exercise:

Step 1 Search for a region/city
Step 2 Locate a area of interest and zoom in using the slider
Step 3 From the tool bar, click on 'Add Polygon' and edit the specification as per the requirements.
Step 4 Select multiple points around the green cover and close the polygon/outline by selecting the starting point again.
Step 5 In the dialog box, click on 'Measurement' tab and note the area.
Step 6 On the 'Places' window, right click the name of the green area/open space and save file as .kmz
Step 7 From the tool bar, select the option to print and save file as pdf

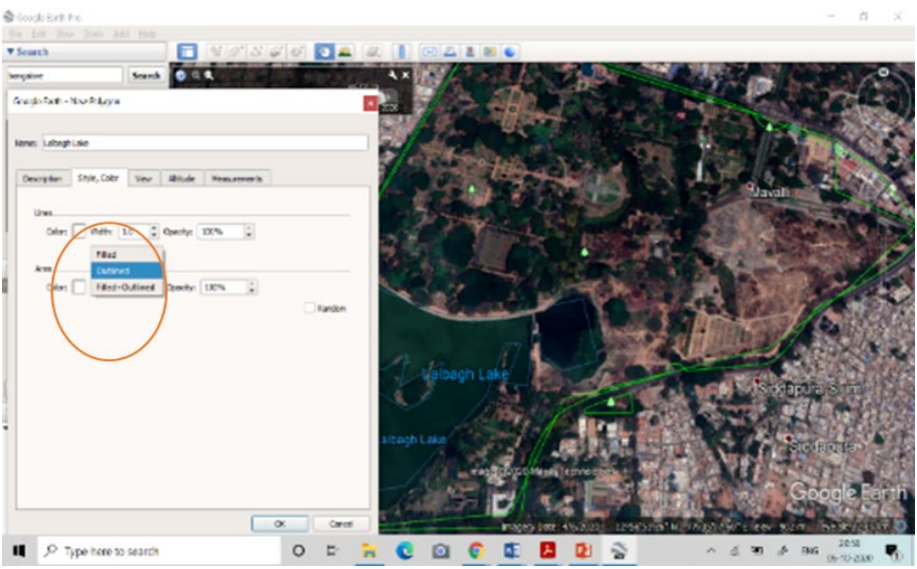
Step 1: Click on the search tab and enter a region/city



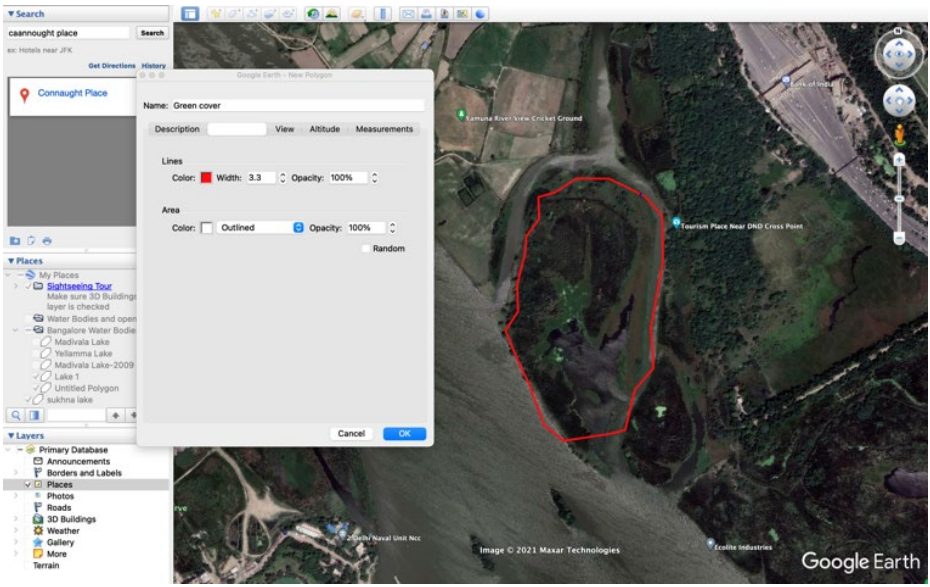
Step 2: Locate a green area or open space of interest and zoom in using the slider



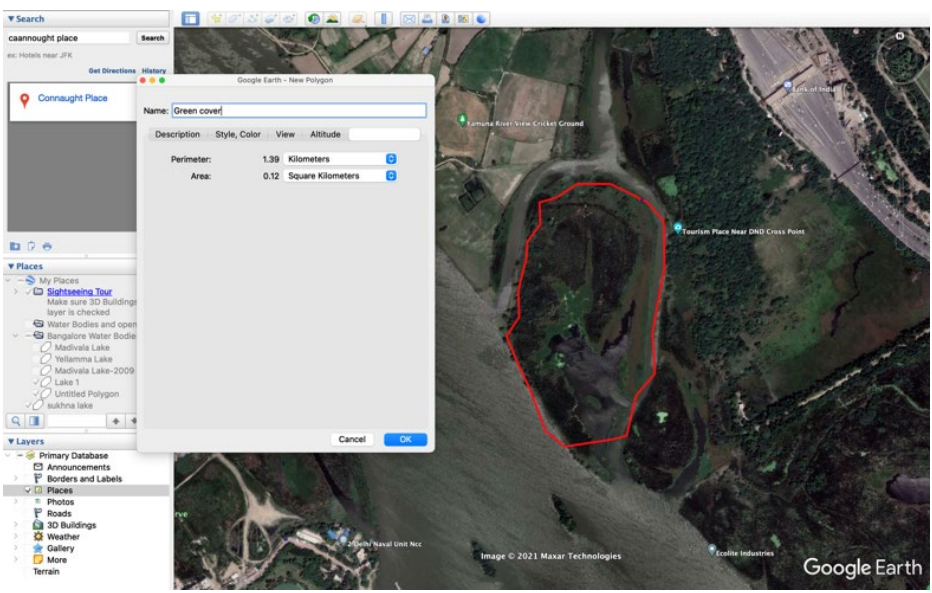
Step 3: From the tool bar, click on 'Add Polygon' and edit the specification as per the requirements. Rename the polygon.



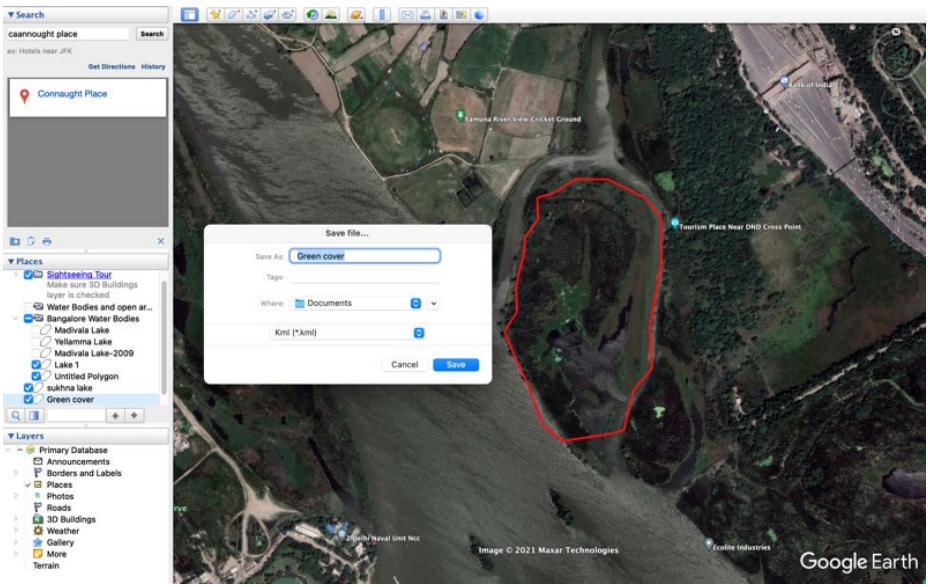
Step 4: Select multiple points around the green area or open space and close the polygon/ outline by selecting the starting point again



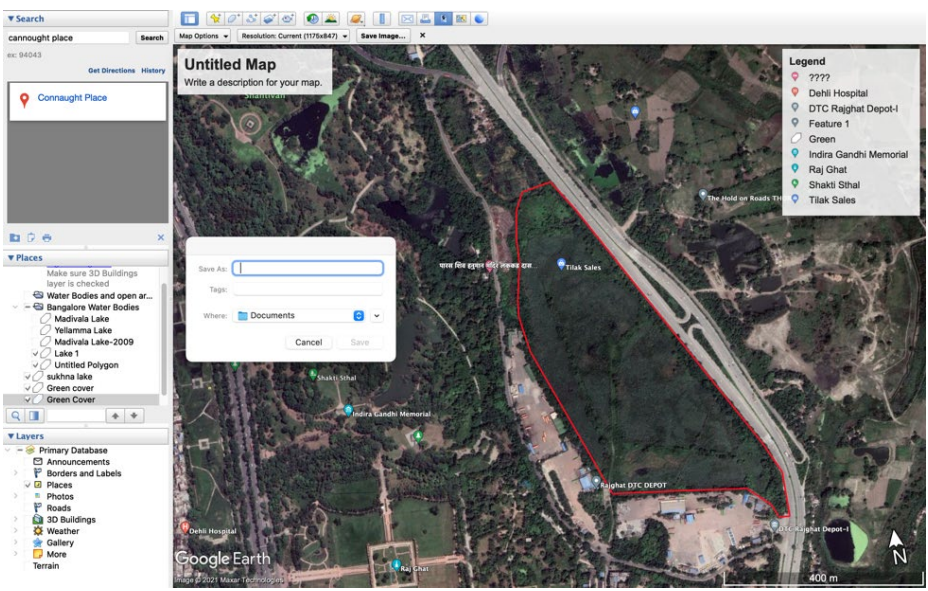
Step 5: In the dialog box, click on 'Measurement' tab and note the area.



Step 6: On the 'Places' window, right click the name of the green area/open space and save file as .kmz.

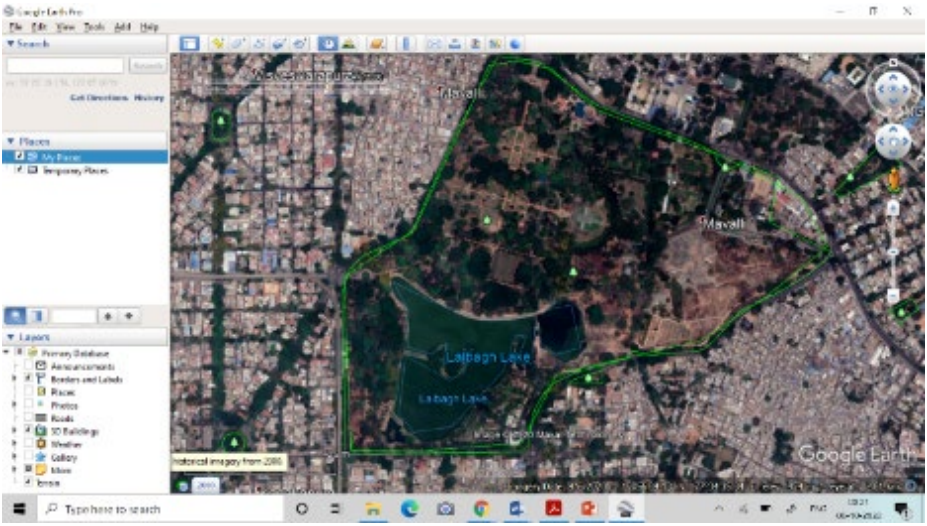


Step 7: From the tool bar, select the option to print and save file as pdf. x,

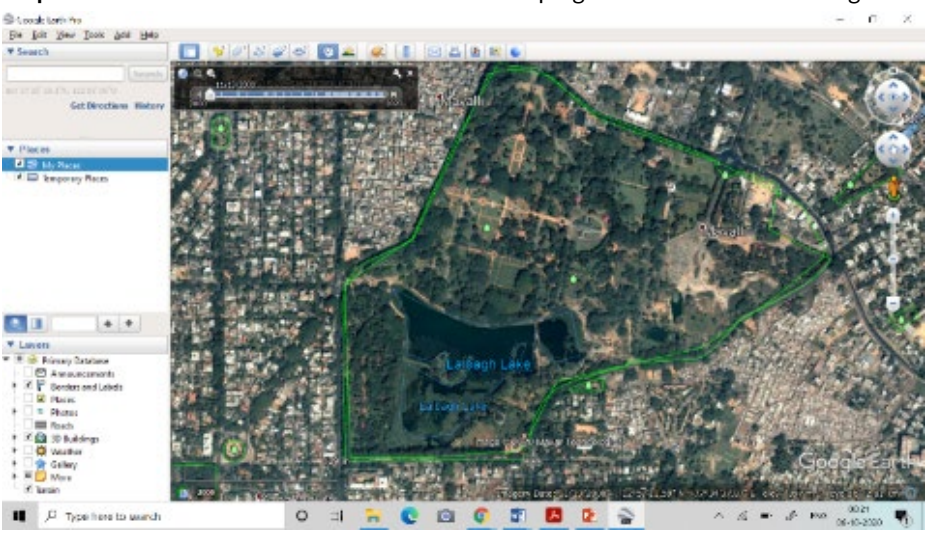


Steps to assess the Change

Step 1: Click on the tab for historical imagery at the bottom left of the window



Step 2: Select the timeline to from the bar at the top right corner to view the images



7

List of Additional Materials

Technical Guidelines

1. (2021). ClimateSmart Cities Assessment Framework 2.0. Ministry of Housing and Urban Affiars, Climate Centre for Cities, National Institute of Urban Affairs. New Delhi: National Institute of Urban Affairs.
   C-Cube Documents | C-cube (niua.org)
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Notes:

सत्यमेव जयते

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