

REPORT for NDVI-LST Project



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Introduction

This project aims to analyze the relationship between the Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) in the parks of Hyderabad. The analysis will involve examining the correlation between NDVI and LST values. Additionally, the study will investigate the impact of water bodies on NDVI and LST, exploring how the presence of watery areas influences these variables. Furthermore, the project will explore the effects of parks and their surrounding areas on NDVI and LST, examining how the presence of parks influences these environmental indicators.

NDVI

NDVI (Normalized Difference Vegetation Index) is a widely used vegetation index that measures the health and vigor of vegetation cover on the Earth's surface. It is derived from remote sensing data, typically obtained from satellite imagery or aerial photographs. NDVI provides an indication of the density and abundance of green vegetation by quantifying the difference between the reflectance of near-infrared (NIR) and red light.

The formula for calculating NDVI is as follows:

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$$

In this formula, NIR represents the reflectance of near-infrared light, and Red represents the reflectance of red light. The resulting NDVI value ranges from -1 to +1, with higher values indicating healthier and more abundant vegetation.

NDVI is valuable for various applications, including monitoring agricultural productivity, assessing the impact of droughts and climate change on vegetation, identifying areas affected by deforestation, and mapping land cover changes. It is a versatile tool for scientists, ecologists, and land managers to study and manage vegetation dynamics over large areas.

LST

LST (Land Surface Temperature) refers to the temperature of the Earth's surface as measured from space or aircraft-based remote sensing technologies. It represents the temperature of the land, including natural surfaces like soil and vegetation, as well as human-made structures.

LST is obtained through the analysis of thermal infrared radiation emitted by the Earth's surface. This radiation falls within a specific range of wavelengths and can be captured by specialized sensors on satellites or airborne platforms. By measuring the intensity of this thermal radiation, scientists can estimate the temperature of the land surface.

LST data provides valuable insights into various environmental processes and phenomena. It helps in understanding the urban heat island effect, where cities exhibit higher temperatures compared to surrounding rural areas. LST is also crucial in studying climate change, as it enables the monitoring of temperature variations and trends over time. Additionally, LST data is employed in agriculture, hydrology, and ecology studies to evaluate vegetation stress, water availability, and habitat suitability.

By analyzing LST patterns, researchers can identify areas with elevated temperatures, assess the impact of urbanization on local climates, detect heat waves, and monitor the health of ecosystems. It is a powerful tool for understanding the thermal behavior of the Earth's surface and its interactions with the atmosphere.

Correlation of NDVI and LST

The correlation between NDVI and LST (Land Surface Temperature) is often studied in the field of remote sensing and environmental science. Theoretically, here are some key points regarding their correlation:

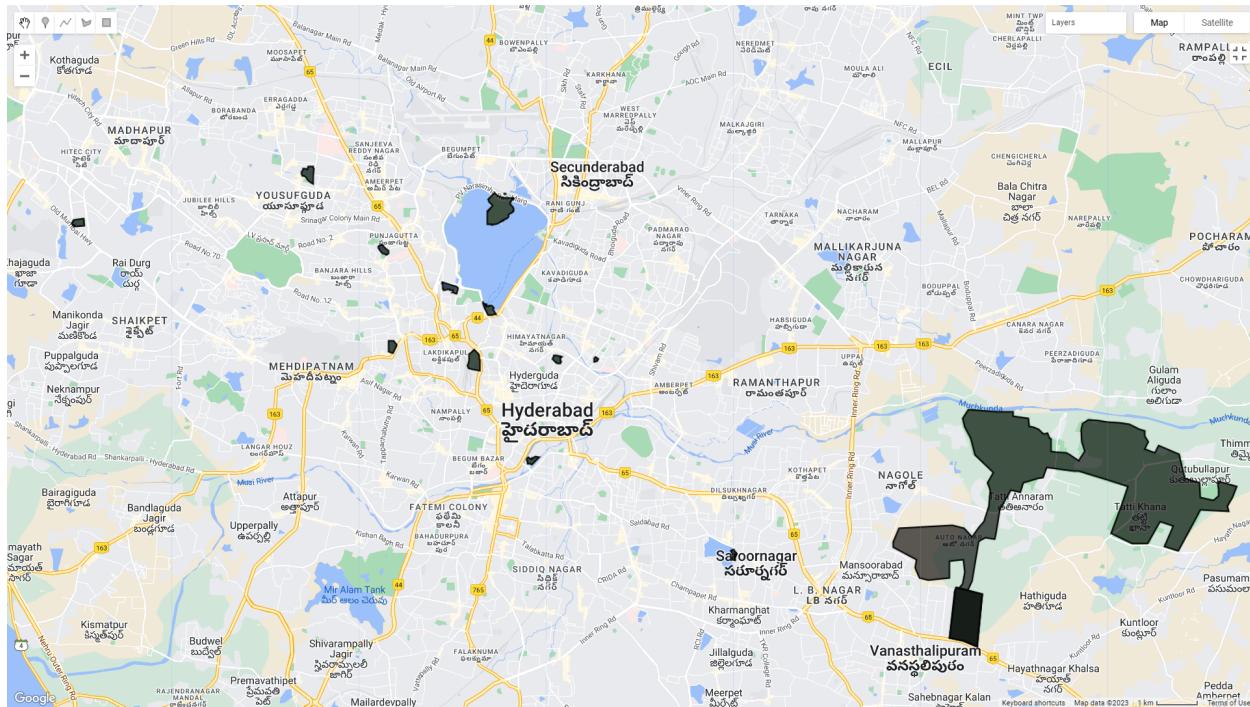
1. Inverse Relationship: NDVI and LST generally exhibit an inverse relationship. As vegetation density and health increase (higher NDVI values), the surface temperature tends to decrease (lower LST values). This is because healthy vegetation provides shade and transpires water, which cools the land surface.
2. Vegetation Stress: When vegetation undergoes stress, such as drought or disease, its NDVI values may decrease. This reduction in NDVI is often accompanied by an increase in LST. Unhealthy or sparse vegetation allows more solar radiation to reach the land surface, leading to higher temperatures.
3. Urban Areas: In urban areas, the correlation between NDVI and LST can be more complex. Urban environments often have lower NDVI values due to limited vegetation coverage. However, the presence of impervious surfaces like buildings and roads can contribute to higher LST values in urban areas.

It is important to note that while there is a general correlation between NDVI and LST, the relationship can be influenced by multiple factors and may not always hold true in every

scenario. Local conditions, data quality, and specific study objectives should be considered when interpreting the correlation between NDVI and LST.

The Dataset

A dataset consisting of 15 parks from Hyderabad was extracted using Overpass Turbo, a mapping tool. These parks were specifically chosen as they are among the most visited and prominent green spaces in the city. The dataset provides valuable information for analyzing and studying the characteristics, amenities, and spatial distribution of these parks. By examining the dataset, researchers and urban planners can gain insights into the recreational patterns, accessibility, and quality of green spaces in Hyderabad. This information can be crucial for making informed decisions regarding park management, infrastructure development, and enhancing the overall livability of the city. Analyzing the dataset can also contribute to understanding the relationship between urbanization, public health, and the availability of green spaces, thereby facilitating evidence-based strategies for sustainable urban development and improving the well-being of residents in Hyderabad.



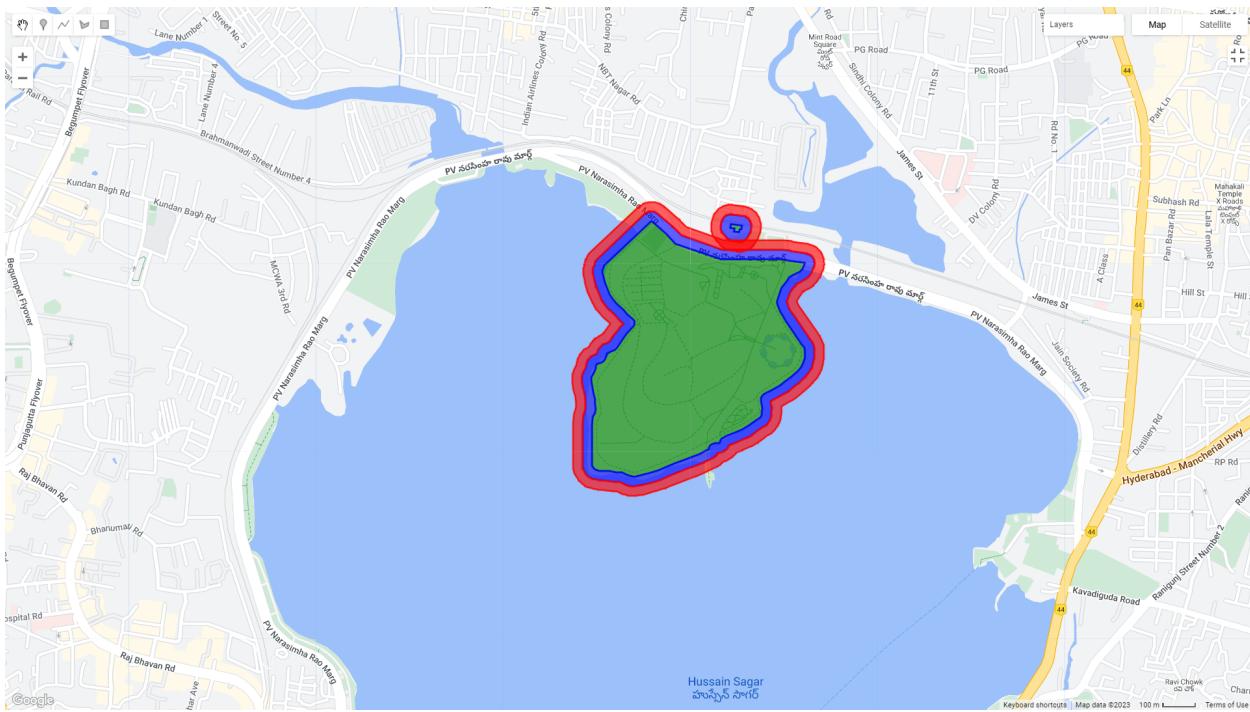
List of Parks

- Sanjeevaiah Park
- Lake view Park
- Biodiversity Park
- Jalagam Vengal Rao Park
- Krishnakanth Park
- Lumbini Park
- Panchatantra Park
- Saroor Nagar Park
- Mahavir Harina Vanasthali National Park
- Sundarayya Park
- Imlibun Park
- Gachibowli park
- Melkote Park
- Chacha Nehru Park
- Public Garden Park
- Rural Technology Park

Analysis of Results

All the NDVI and LST results are mailed in format of bar-graphs year-wise. Results include the values inside the parks and with a buffer region R of radius 30 m around the park and another buffer region of 30m around R as shown in figure.

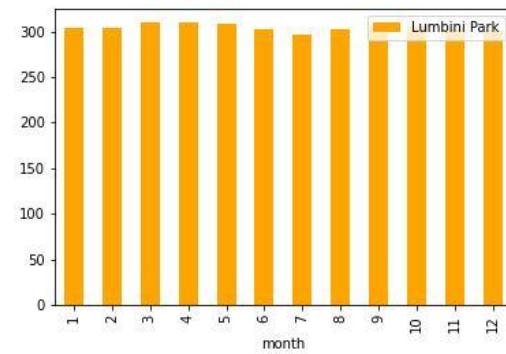
As the main focus of the project is to analyze the correlation, the Report focuses on analyzing the same. The seasonal variation of NDVI and LST values can be easily inferred from the bar graphs submitted. And also, for maintaining uniformity in the report, only the 2020 year's results were documented. However, other results can be found in the submission.



Inside the Parks

LST vs NDVI

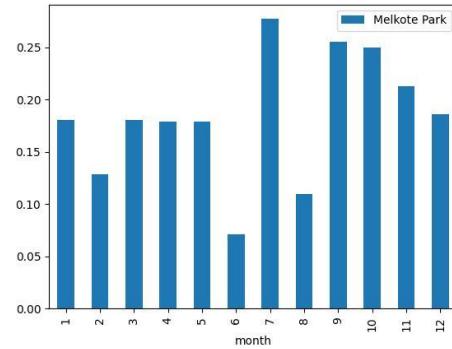
When we compare solely the LST and NDVI, as said theoretically they are inversely proportional. This is because areas with higher greenery tend to be cooler.



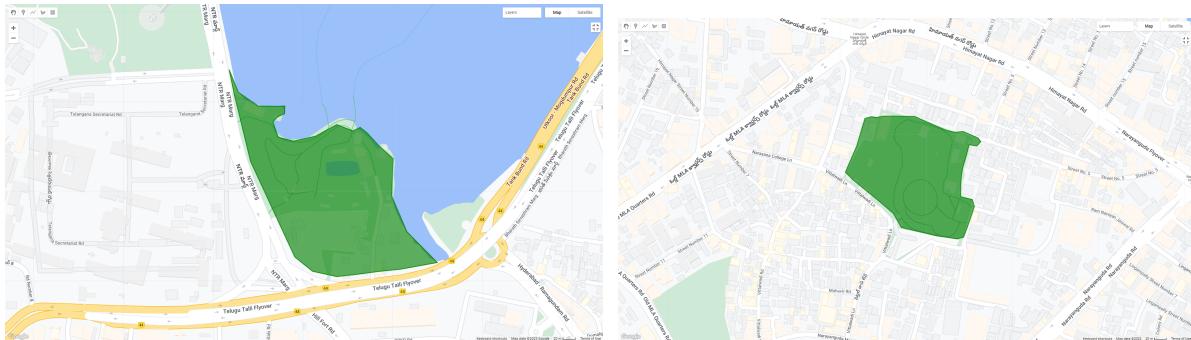
If you observe the NDVI values, the highest value is recorded in the month of July. The corresponding value for LST is recorded relatively low.

Effect of water on NDVI

Due to factors like Shadowing, Absorption and Reflectance of water, parks surrounded by waters have potentially lower NDVI.

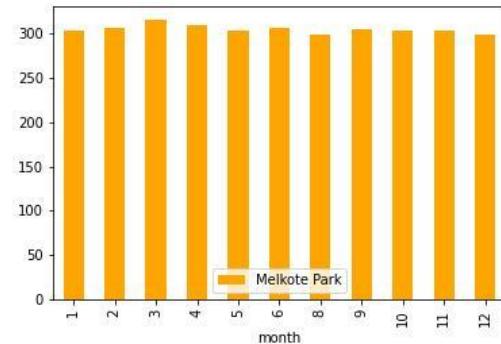


Lumbini Park is surrounded by water whereas Melkote Park is not surrounded by water. We can observe the NDVI values at Lumbini park didn't cross 0.200 in the total year whereas NDVI at Melkote has crossed 0.250 in the month of July. The locations of parks are:



Effect of water on LST

If we take **Melkote Park** in Hyderabad as an example, a park without any water bodies around it, it is likely that the LST values in the park will be relatively high compared to parks surrounded by water bodies. Without the cooling effect of the water body, the park will be exposed to the full impact of solar radiation and will absorb and retain more heat. This results in higher LST values.

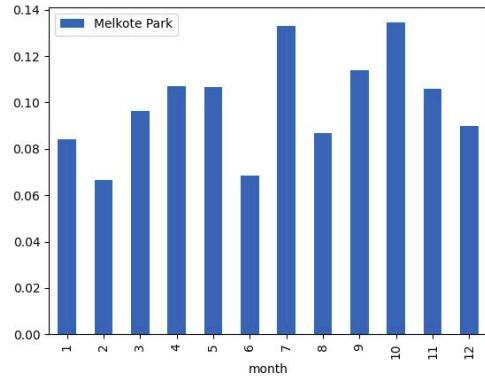
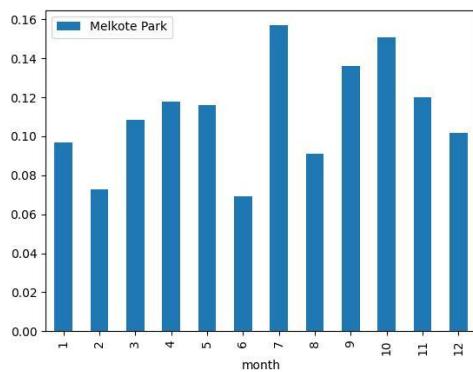


1	month	Biodiversit	Chacha	Né	Imlibun	Pa	Jalagam	Vi	Krishnakar	Lumbini	Pe	Mahavir	H	Melkote	P	Public	Gari	Rural	Tech	Sanjeevai	Saroor	Naj	Sundarayy	lake	view	park
2	0	304	301.5	303	303	303	303	305	305	303	303	303	303	303	303	301.5	302	302	303	306.5	306					
3	1	308	306.5	307	306	307	304.5	309.5	307	307	307.5	302	305	305	305	306.5	306	306	309	312.5	314.5					
4	2	317	315.5	315.5	314.5	316	312	319	316.5	315.5	318.5	310	312.5	314.5	314.5	314.5	314.5	314.5	314.5	314.5	314.5					
5	3	310	309.5	309.5	308.5	309.5	308	312	309.5	310	311	307	308	308	308	308	309	309	309	309	309					
6	4	303	303	303	303	303	303	303	303	303	303	303	303	303	303	303	303	303	303	303	303					
7	5	301.5	306	305	304.5	303.5	305.5	306.5	307	307	303	305	303	305	305	305	305.5	304.5	304.5	304.5	304.5					
8	6	303	297	303	303	303	303	294	300	297	303	303	298	301	301	301	303	303	303	303	303					
9	7	304	304.5	305	304	304	304.5	303	305	305	305	303.5	303	304	304	304	304	304	304	304	304.5					
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11	9	11	303.5	298.5	302.5	298.5	299.5	299	302.5	303.5	299.5	302.5	298.5	303	303	303	299	303	303	303	303					
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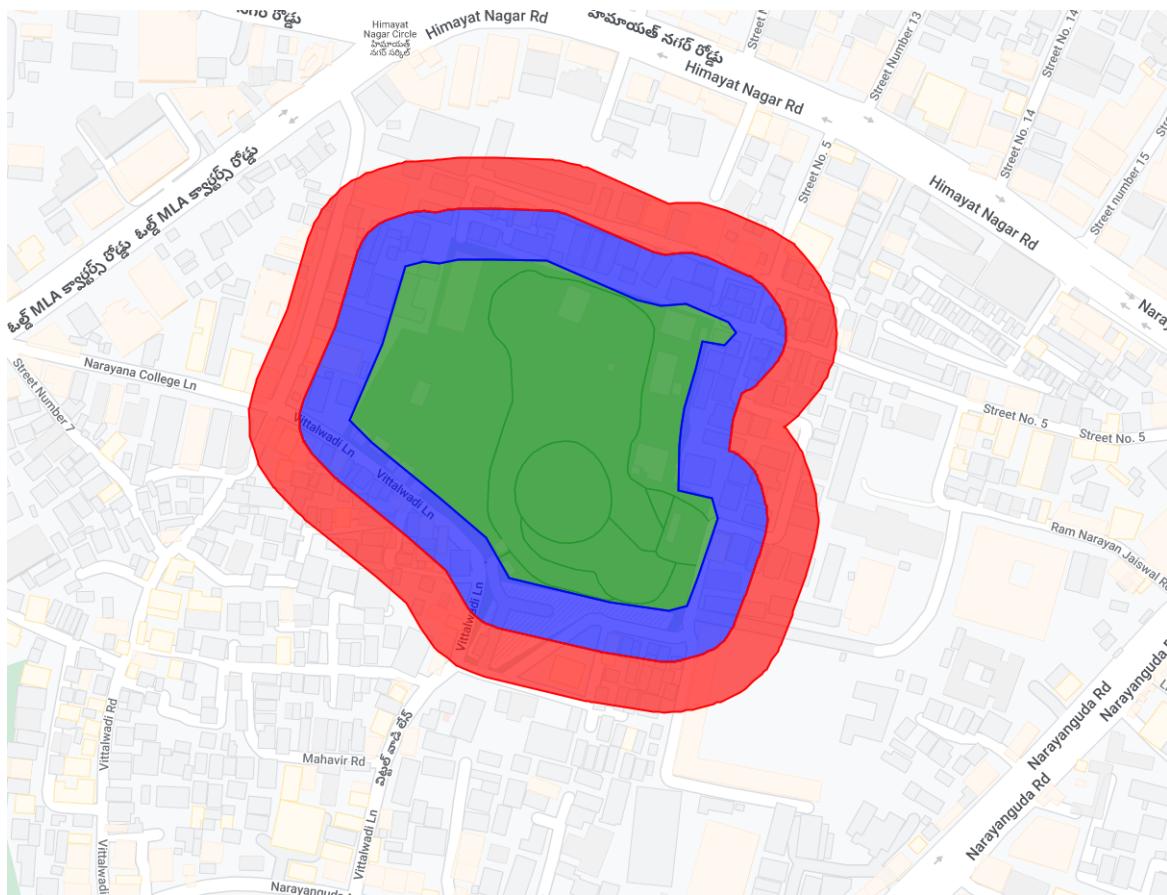
Buffer Region

In this section, we will analyze the NDVI and LST in the surrounding regions of the park. Analyzing the relationship between NDVI and LST in the regions surrounding a park can aid urban planners, environmentalists, and policymakers in assessing the quality and functionality of the green spaces and implementing strategies to enhance their ecological, social, and economic value. However, this comparison becomes useful when we compare it on the urban buffer as the buffer area with water in it obviously records low NDVI and LST as water itself has a significant effect on them.

Effect of NDVI



The left figure shows the NDVI values recorded at buffer of 30m and right shows the buffer of 60m around the Melkote park (see below figure for buffer regions)

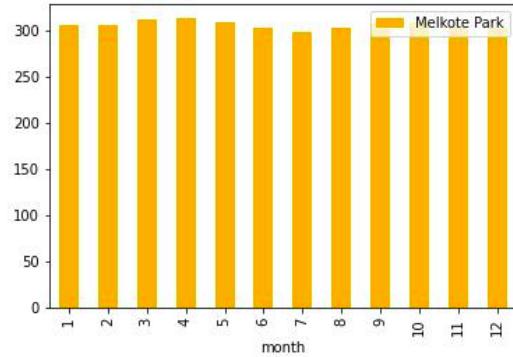
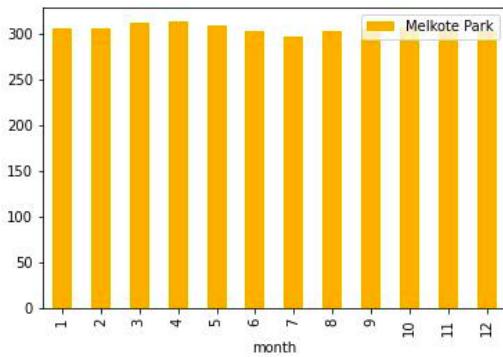


From the bar graph we can clearly observe that NDVI value is higher for the regions near the park. As we move away from the park there is a significant drop in the NDVI.

Please note that the highest values depicted in the bar graphs were not the same. They look similar as the regions are close and the monthly variation will obviously be the same.

Effect on LST

To assess the effect on the LST due to the presence of park in the region, let us take the regions around the Melkote Park.



The figure on the left is the seasonal graph of LST at the buffer of 30m around Melkote Park. The figure on right is the same for the buffer of 30m around the buffered region (refer figure on previous page)

We can observe that the effect of park on the LST value around the park as we move a little away is not as significant as in the case of NDVI. This is obvious because greenery is the major constituent of NDVI but it is not the main for LST.

But, from [here](#), we have gathered the monthly average temperature of Hyderabad in 2020. (See the figure below). For example, in the month of May 2020, the temperature of the city was recorded with an average of 38°C (311K). But the area around Melkote Park, which is an Urban area, has only 303K. So, it is evident that parks cool the areas around them.

Conclusion

In conclusion, our project findings shed light on the relationship between greenery, temperature, and the overall well-being of cities. Through our analysis, it became evident that locations with higher NDVI (Normalized Difference Vegetation Index) exhibit lower temperatures. This observation provides a clear explanation for the cooler climate experienced in cities like Hyderabad and Bangalore, despite their dense population and technological advancements.

Furthermore, our research highlights the significant impact of greenery on temperature. Not only does vegetation influence the local climate, but it also plays a crucial role in maintaining lower temperatures within urban areas. As demonstrated by external data, parks and green spaces consistently exhibit noticeably lower temperatures compared to the city's average.

In the words of Rachel Carson, a renowned environmentalist, "In every conceivable manner, the family is linked to our past, bridge to our future." This quote resonates with the essence of our project, emphasizing the vital importance of greenery, vegetation, and afforestation in shaping a healthier lifestyle and creating a cooler and more sustainable environment within cities.

Team

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Link to project's result: [GitHub](#)

Link to NDVI code: [GEE code for NDVI](#)

Link to LST code: [GEE code for LST](#)