**Savitribai Phule Pune University**

**Department of Geography**

**Project report**

# "Change Detection in Forest Cover Using Satellite Imagery of LISS-3 and GIS Techniques: A 2009-2019 Perspective"

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## Abstract:

*This study focuses on the change detection of forest cover between the years 2009 and 2019 using satellite imagery. The project utilized LISS 3 satellite images for both years, employing a series of geospatial analysis techniques to assess the alterations in forested areas over the decade. The methodology involved data preprocessing steps such as downloading, layer stacking, and study area clipping. Supervised classification was then applied to classify the satellite images into four distinct classes: forest, agriculture, water bodies, and other land cover. An accuracy assessment confirmed the reliability of the classification results. The forest class was further extracted and converted from raster to polygon format for both years. To ensure accuracy, polygons that resembled forest cover but were actually agriculture were carefully identified and removed. Calculations based on the polygon layers yielded forest area estimations for both 2009 and 2019. The results reveal a reduction in forest cover by 1000 square kilometres over the ten-year period, with forest area decreasing from 1500 square kilometres in 2009 to 500 square kilometres in 2019. The study sheds light on the significant change in forest cover and underscores the importance of continued monitoring and conservation efforts. The analysis was conducted using ArcGIS Pro and ERDAS software, demonstrating the effectiveness of geospatial tools in assessing environmental changes. This project contributes valuable insights into the dynamics of forest cover alteration and serves as a foundation for future research in the field of land cover change analysis.*

## INTRODUCTION

Over a period of ten years, from 2009 to 2019, our forests have changed a lot. With the guidance of Professor Sanjay Kale, this project looks closely at these changes using pictures from satellites and special maps. We're not just looking at how the green parts have shifted, but also trying to understand why this happened. We want to know how things like money and the environment have caused these changes. This involves not only seeing and measuring the changes in forests but also figuring out the reasons behind them. By doing this, we can learn more than just facts – we might find out important things that can help us take care of our environment better. This project uses special tools and the knowledge of Professor Sanjay Kale to learn more about how our changing forests are connected to how we live.

**Aim:**

The aim of this project is to analyse changes in forest cover from 2009 to 2019 using satellite imagery and geospatial tools, while understanding the driving factors behind these changes, thereby contributing to insights for conservation and sustainable land management.

## Objective:

1) To Quantify Change: By analysing satellite imagery, we aim to quantify the extent of forest cover change during the ten-year period.

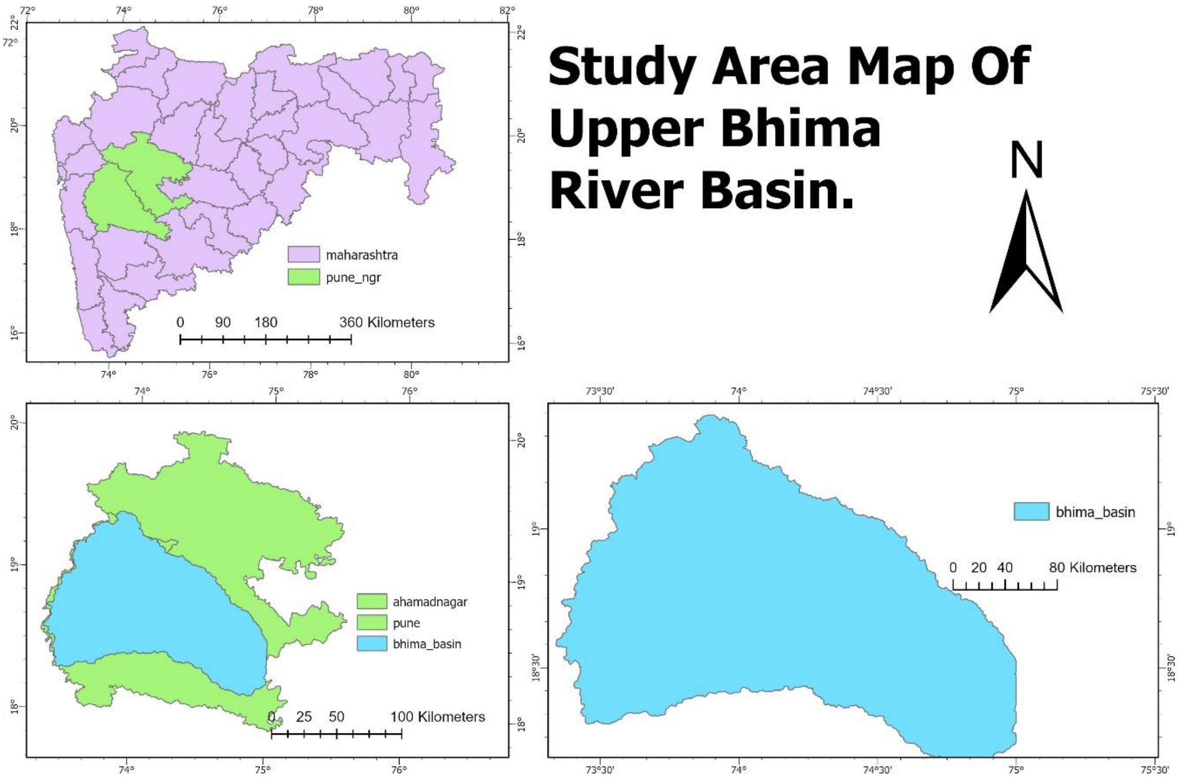
2) To dive into the socioeconomic and environmental factors contributing to observed changes in forest cover.

3) To provide valuable insights into the implications of forest cover changes for conservation and management efforts.

## study area:

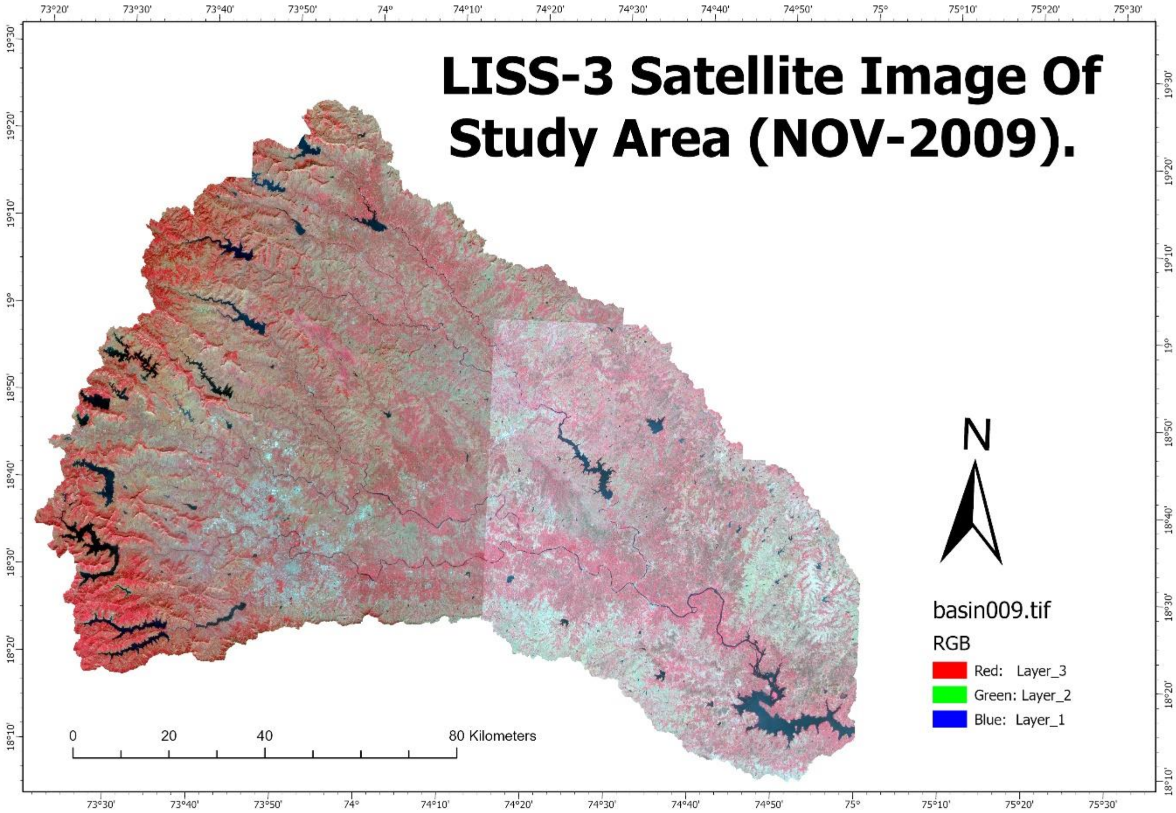
The study area, encompassing the Upper Bhima River Basin, is positioned within the geographic coordinates of approximately 17.5°N to 18.5°N latitude and 74.5°E to 76.5°E longitude. Covering an extensive land area of about 20,000 square kilometres, this region holds geographical significance.

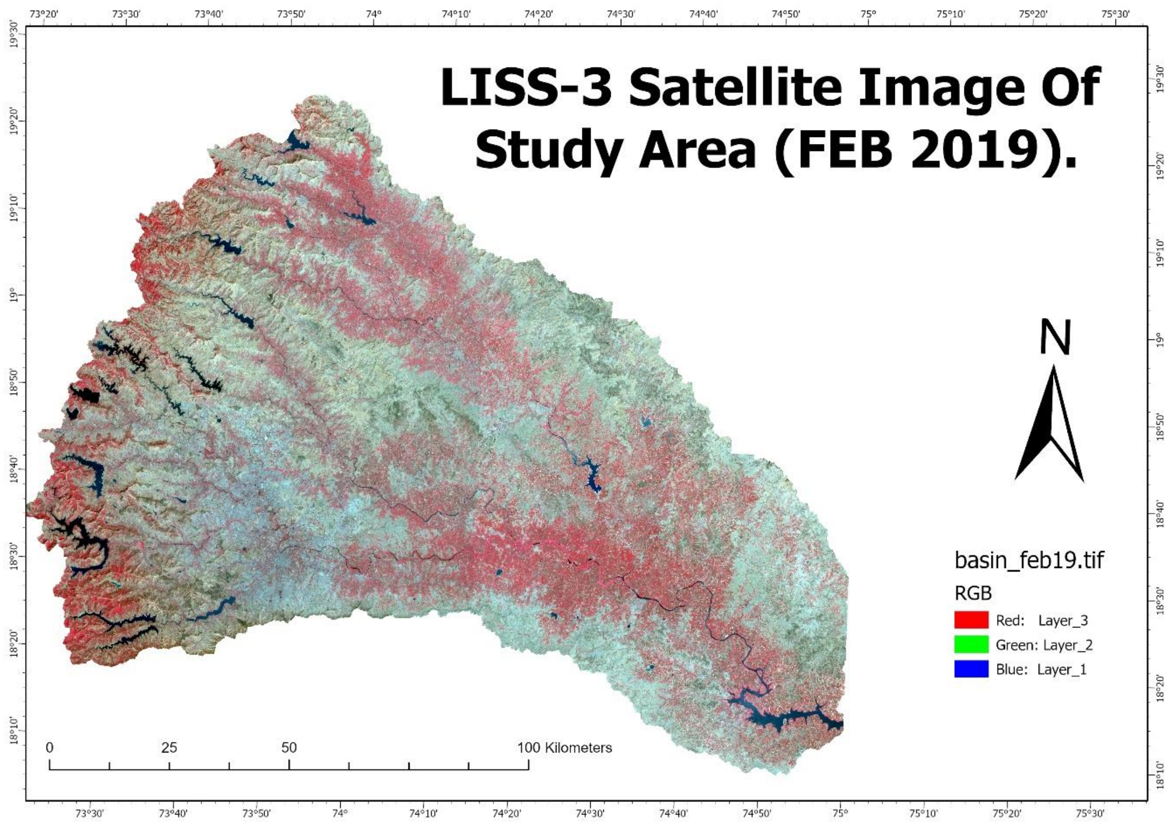
This area observes a semi-arid climate with distinct seasons. Summers are hot and dry, with temperatures reaching 40°C. Monsoons (June-September) bring heavy rainfall, vital for agriculture and water sources. Post-monsoon months offer pleasant weather, while winters (December-February) are mild with temperatures around 8-25°C. Pune's climate, influenced by its Western Ghats location, shapes agricultural cycles and water availability., shapes agricultural cycles and water availability.




## Data

IRS LISS 3 satellite images for 2009 and 2019 were meticulously collected from Bhuvan. These images were further processed to create composite images by Layer stacking Blue, Green, Red and NIR bands, ensuring a holistic representation of the study area in False colour combination. These composite images were subsequently clipped to match the exact boundaries of the designated study area, minimizing extraneous information.


LISS-3 Satellite Image Of Study Area (NOV-2009).
N
basin009.tif
RGB
Red: Layer_3
Green: Layer_2
Blue: Layer_1
0
20
40
80 Kilometers


LISS-3 Satellite Image Of Study Area (FEB 2019).
N
basin_feb19.tif
RGB
Red: Layer_3
Green: Layer_2
Blue: Layer_1
0
25
50
100 Kilometers

## Methodology

### Supervised Classification:

Training samples, meticulously chosen to represent the diverse land cover classes, were employed in the supervised classification process. Software like ERDAS Imagine was utilized to apply classification algorithms that learn from these training samples to categorize the pixels in the satellite images. To ensure accurate results, the parameters of these algorithms were fine-tuned, taking into account the unique characteristics of the study area.

### Accuracy Assessment:

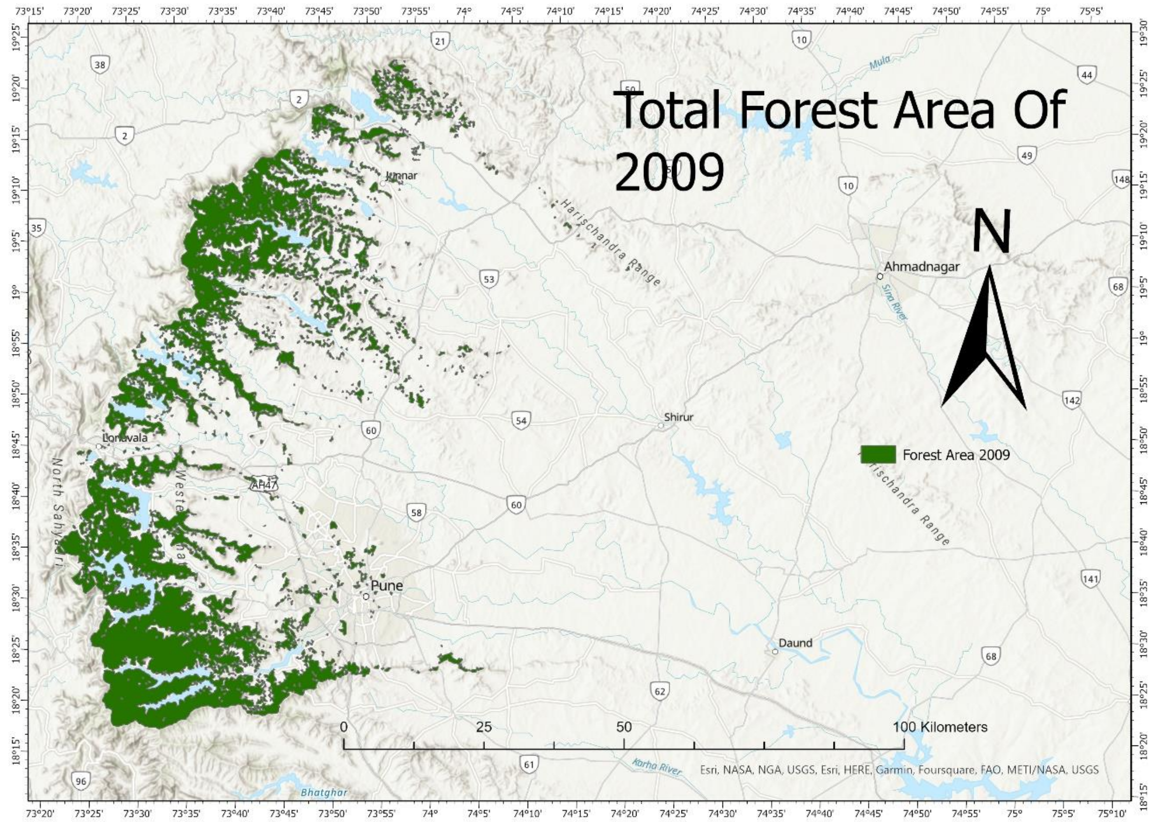
Validation points were strategically positioned across the study area. This set of validation data was used to compare the classified results with real-world conditions. Accuracy metrics like Overall Accuracy and the Kappa coefficient were then calculated, providing statistical measures of the classification's reliability.

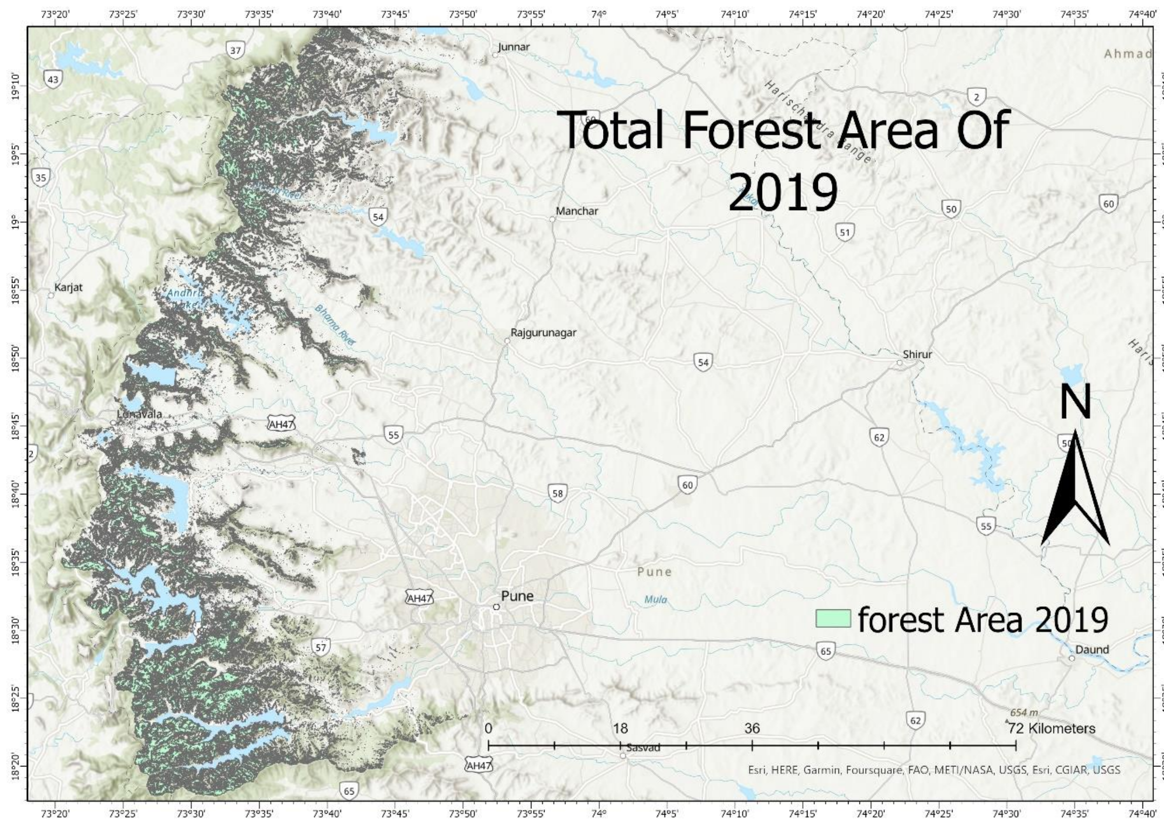
### Forest Cover Extraction:

From the classified images, the forest class was singled out and represented as a raster layer. To further enhance the accuracy and detail of analysis, this raster forest layer was converted into vector polygons.

### Polygon Cleaning and Area Calculation:

A meticulous review of these polygons was conducted to ensure accuracy. Misclassified or outlier polygons were identified and removed. The area of each remaining forest polygon was calculated using geospatial tools, resulting in accurate estimates of forested area in square kilometres.


Total Forest Area Of 2009
N
Forest Area 2009
0
25
50
100 Kilometers
Esri, NASA, NGA, USGS, Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS
Junnar
Ahmadnagar
Shirur
Lonavala
Pune
Daund
Harischandra Range


Total Forest Area Of 2019
N
forest Area 2019
0
18
36
72 Kilometers
Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS, Esri, CGIAR, USGS
Junnar
Manchar
Karjat
Rajgurunagar
Shirur
Lonavala
Pune
Daund
Sasvad

**Change Detection and Analysis**:

By comparing the calculated forest areas for 2009 and 2019, we could effectively quantify the changes that occurred over the decade. Absolute change, derived by subtracting the 2019 area from the 2009 area, provided a concrete measure of the alteration. Additionally, the percentage change, calculated by expressing the absolute change as a percentage of the 2009 area, offered a comprehensive perspective on the scale of change.

## Analysis and Results:

The analysis revealed a substantial reduction in forest cover over the ten-year period. The forest area decreased from 1570.728617 square kilometres in 2009 to 554.924812 square kilometres in 2019, indicating a concerning reduction of 1015.80 square kilometres. This stark change highlights the vulnerability of forested areas to the pressures of urbanization, deforestation, and other human interventions.

## Discussion:

The observed reduction of 1015.80 square kilometres in forest cover between 2009 and 2019 raises critical concerns about ecological health and human well-being. This decline reflects a dynamic interplay of factors, including urbanization and deforestation, impacting both biodiversity and ecosystem services. Aligning with existing research, the findings highlight the urgent need for balanced land management strategies that address these multifaceted challenges. By comparing results with previous studies, this discussion reinforces the validity of the observed trends and underscores the imperative for proactive conservation measures in the face of evolving landscapes.

## Future Work:

Temporal Analysis: Extending the analysis to include more time periods, creating a time series of forest cover changes. This could provide insights into the trends and patterns of changes over a longer period.

Conducting a more in-depth investigation into the specific socioeconomic and environmental factors contributing to forest cover changes. This might involve field surveys, interviews, and socio-economic data analysis.

Predictive Modelling: Use the historical data and identified drivers to develop predictive models that project future forest cover changes. This could assist in proactive planning and policy formulation.

## e) Conclusion:

In a world where conservation of natural resources is paramount, this project underscores the importance of robust methodologies and technologies in understanding the dynamics of forest cover change. By employing satellite imagery and geospatial analysis, we've not only quantified change but also begun to unravel the complex web of socioeconomic and environmental factors driving these shifts. The observed reduction in forest cover serves as a clarion call for immediate action and the implementation of sustainable land management practices and policies that prioritize the preservation of our planet's invaluable forests.

## Acknowledgments:

I extend my sincere gratitude to Professor Sanjay Kale for his unwavering guidance and mentorship throughout this project.

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My heartfelt thanks go to my family and friends for their constant encouragement and belief in my abilities.

Lastly, I extend my appreciation to all who participated in validation activities and contributed to data collection

Here's an example of a references/bibliography section that you can use for your project report:

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