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FOREST FIRE BURN ANALYSIS IN KAPPATAGUDDA HILLS, GADAG DISTRICT, KARNATAKA: A REMOTE SENSING AND GIS BASED STUDY

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ABSTRACT
Forest fires are one of the most significant environmental hazards affecting biodiversity, ecosystem services, soil fertility, and carbon storage. The Kappatagudda Hill Range of Gadag District experiences frequent seasonal forest fires due to prolonged dry conditions and anthropogenic activities. This study assesses the spatial distribution and severity of forest fires in Kappatagudda using Remote Sensing and Geographic Information System (GIS) techniques. Landsat satellite imagery was employed to calculate the Normalized Burn Ratio (NBR) and Delta Normalized Burn Ratio (dNBR), enabling the identification of burned areas and assessment of burn severity. The results demonstrate that satellite-based techniques provide an accurate, rapid, and cost-effective method for mapping burned areas and supporting forest management, ecological restoration, and conservation planning.
KEYWORDS: *Forest Fire, Burn Severity, Remote Sensing, GIS, Landsat, NBR, dNBR, Kappatagudda.*

1. INTRODUCTION

Forest ecosystems provide essential ecological services including biodiversity conservation, carbon sequestration, climate regulation, watershed protection, and livelihood support. However, forest fires have become a recurring environmental problem, causing extensive ecological and economic losses.

In India, forest fires occur annually during the dry season. According to the Forest Survey of India (FSI), approximately 54.40% of forests are susceptible to occasional fires, while 7.49% experience moderately frequent fires and 2.40% are highly fire-prone. These fires destroy vegetation, wildlife habitats, soil nutrients, and release significant quantities of greenhouse gases into the atmosphere.

The Kappatagudda Hill Range in Gadag District is one of Karnataka's ecologically important landscapes containing dry and moist deciduous forests rich in medicinal plant species. Seasonal fires threaten the biodiversity and ecological stability of this region. Therefore, mapping and monitoring burned areas using satellite remote sensing has become an effective approach for sustainable forest management.

2. STATEMENT OF THE PROBLEM

Frequent forest fires in the Kappatagudda Hill Range have resulted in significant degradation of vegetation cover, loss of biodiversity, soil erosion, and carbon emissions. Conventional ground-based fire assessment methods are time-consuming and expensive. Hence, there is a need for satellite-based techniques to rapidly detect burned areas and estimate fire severity.

3. OBJECTIVES

The major objectives of the study are:

- To identify and map forest fire affected areas.
- To analyse the spatial distribution of burnt areas.
- To estimate burn severity using satellite imagery.
- To evaluate the usefulness of Remote Sensing and GIS in forest fire assessment.
- To provide recommendations for forest restoration and management.

4. STUDY AREA

The study area is the **Kappatagudda Hill Range**, situated in Gadag District, Karnataka.

The hill range extends from **Binkadakatti** to **Shingtaloor** near Mundargi Taluk and almost reaches the **Tungabhadra River**. The elevation ranges between approximately **580 m and 900 m above mean sea level**. The region is characterized by dry deciduous and moist deciduous forests containing diverse flora, medicinal plants, and wildlife.

The area experiences a tropical climate with hot summers and seasonal rainfall. During prolonged dry periods, accumulated dry vegetation becomes highly susceptible to forest fires.

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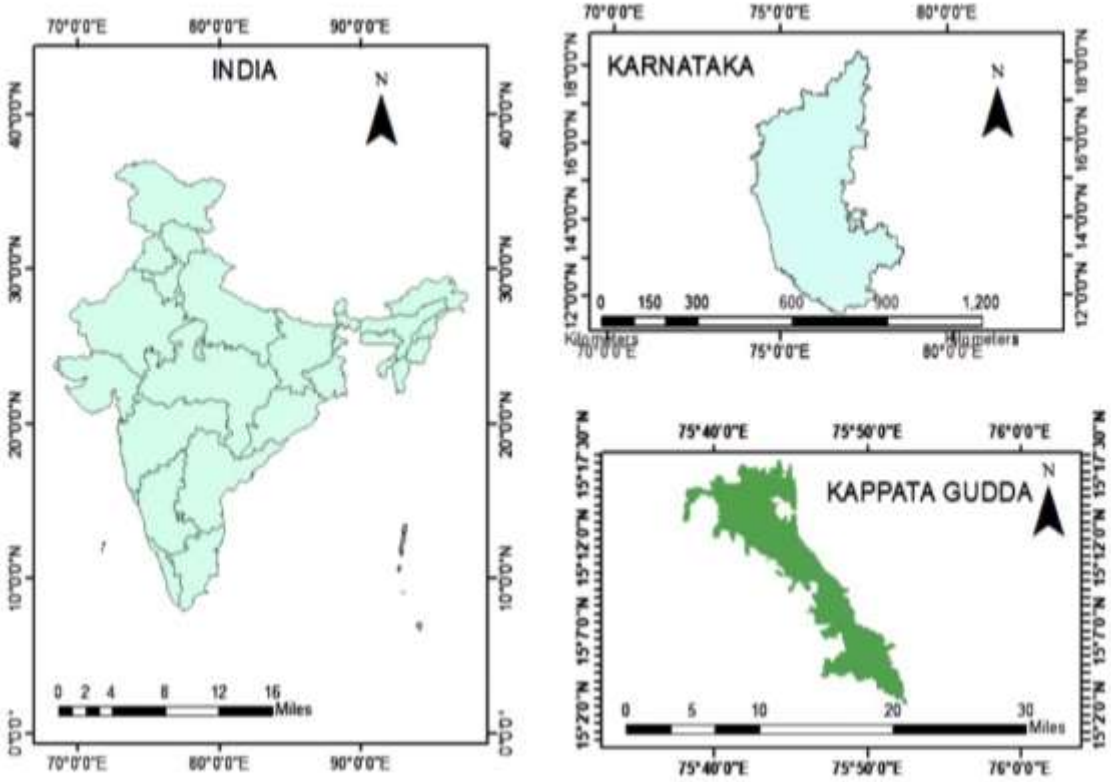
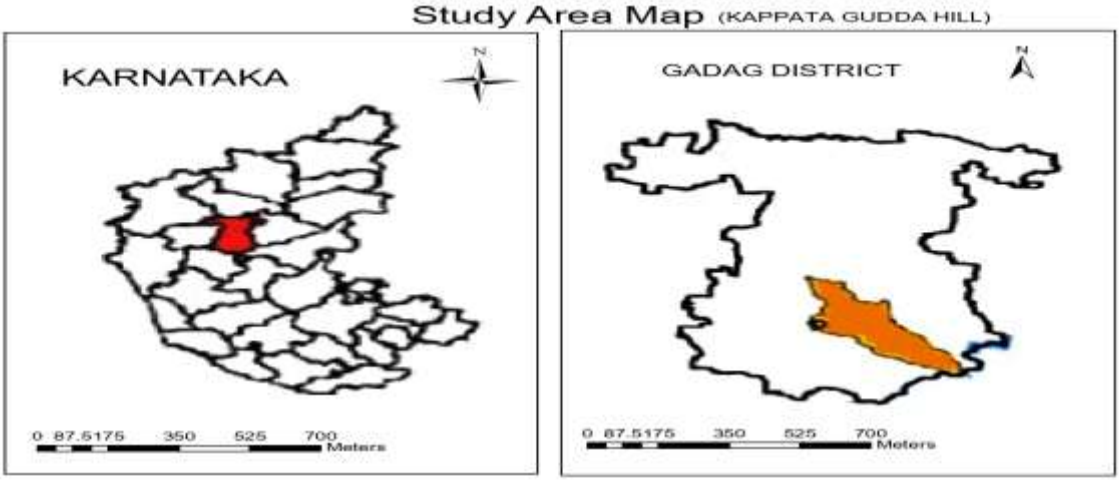
Location Map Of Study Area



Study Area Map (KAPPATA GUDDA HILL)



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5. DATABASE AND MATERIALS

The present study utilizes:
Landsat 8 Satellite Imagery
Pre-fire satellite images
Post-fire satellite images
Digital Elevation Model (DEM)
Survey of India Topographic Maps
Forest Survey of India Reports
ArcGIS/QGIS Software

6. METHODOLOGY

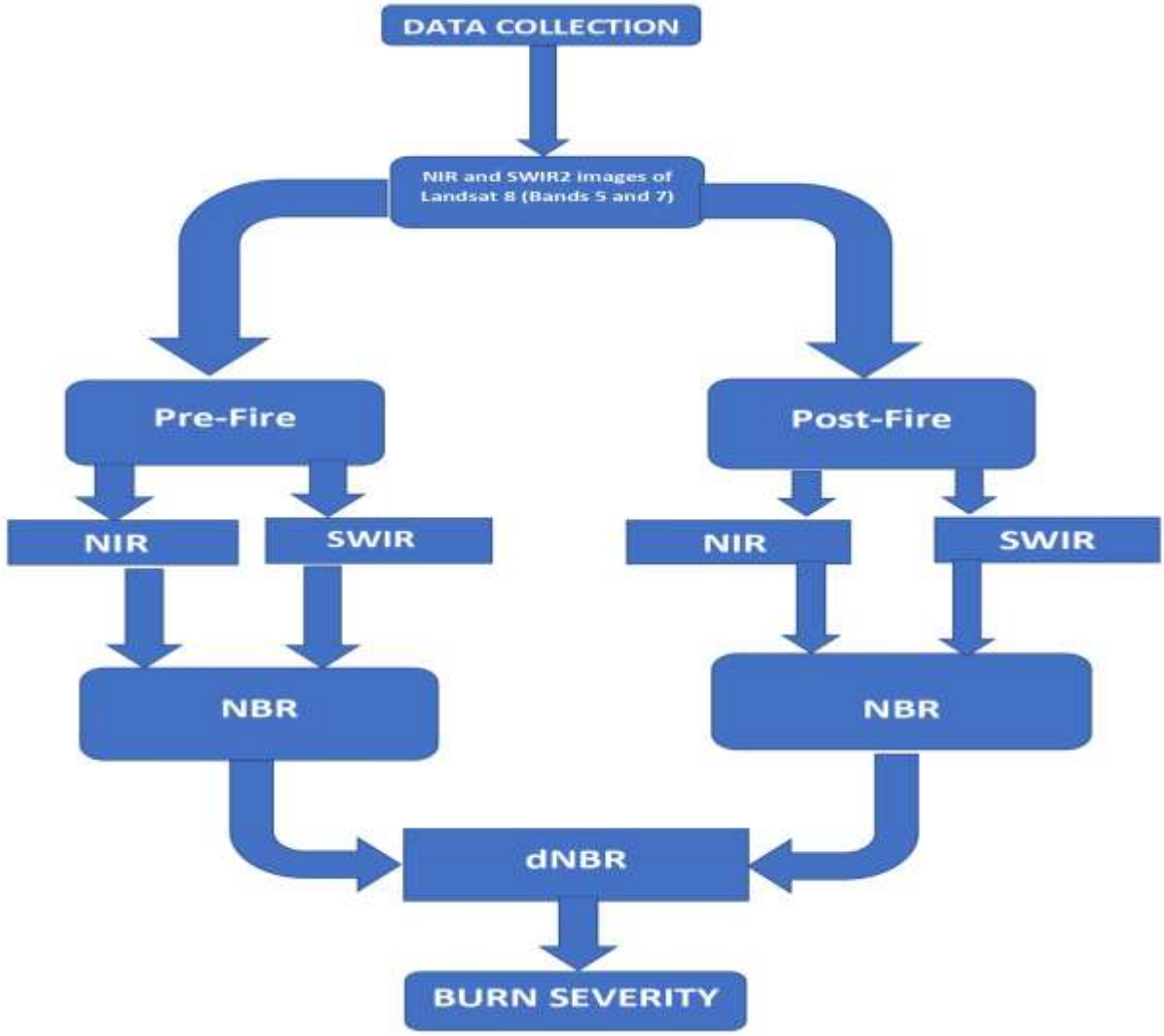
The methodology adopted in the study consists of the following steps:

Data Collection
Landsat satellite images
Forest boundary maps
Ancillary GIS datasets

Image Processing
Pre-processing included:

- Radiometric correction
- Atmospheric correction
- Image clipping
- Band stacking

Burn Severity Assessment
The following indices were calculated:



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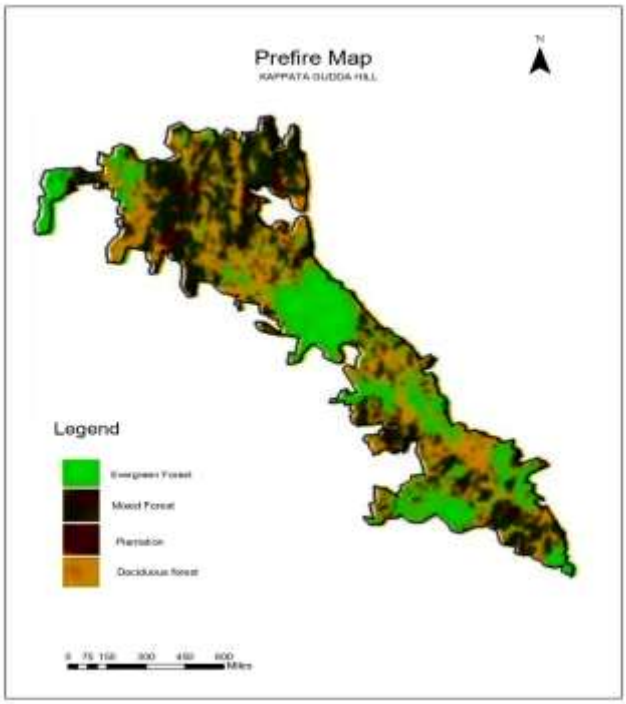

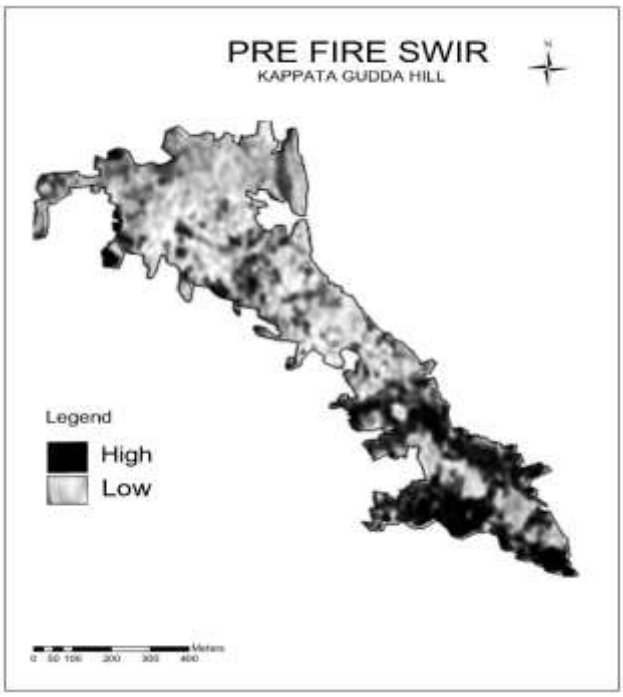

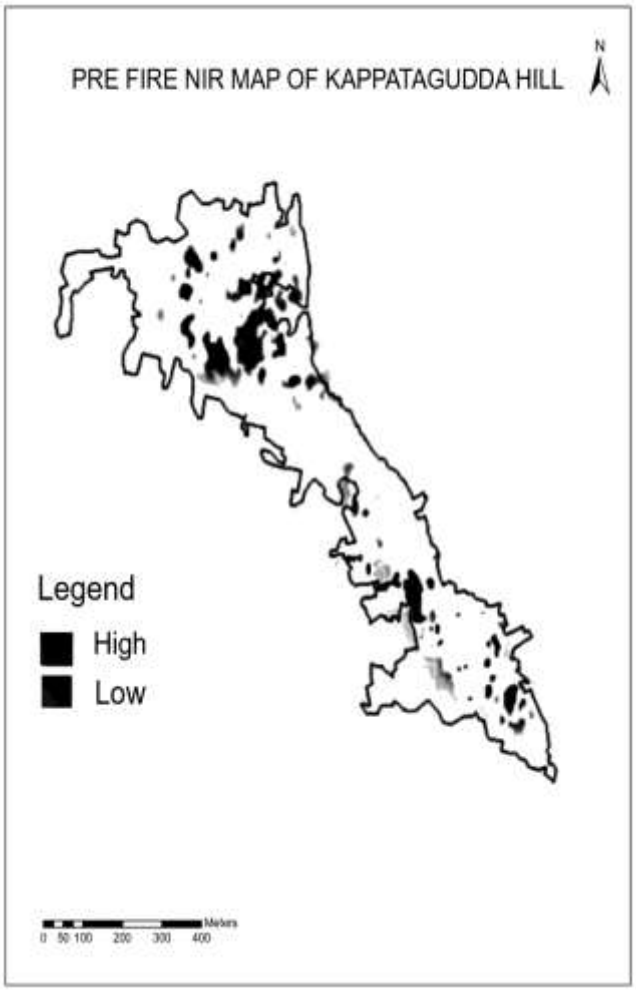

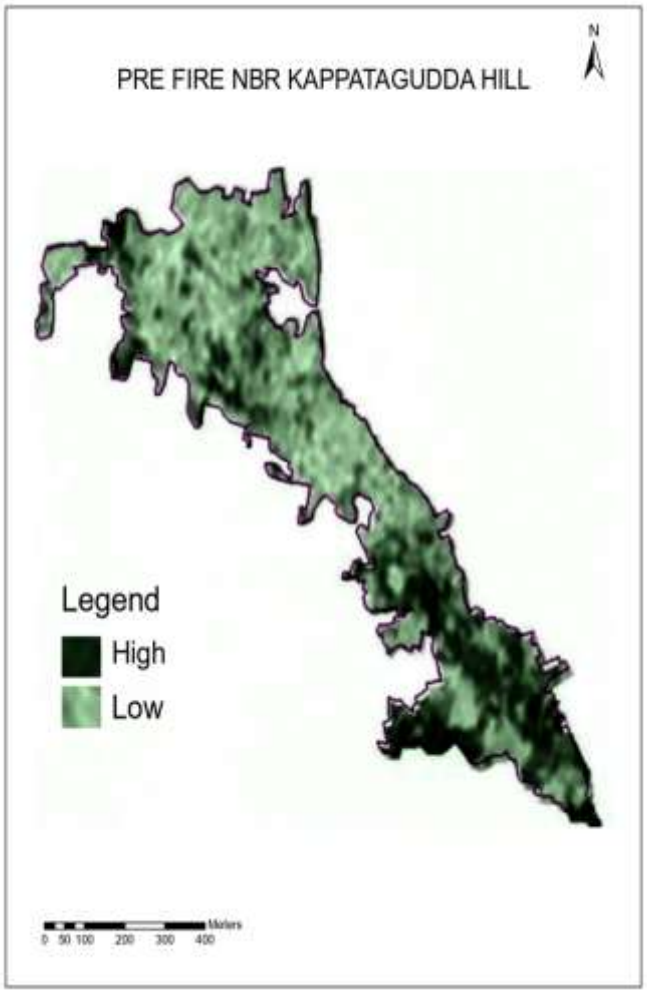

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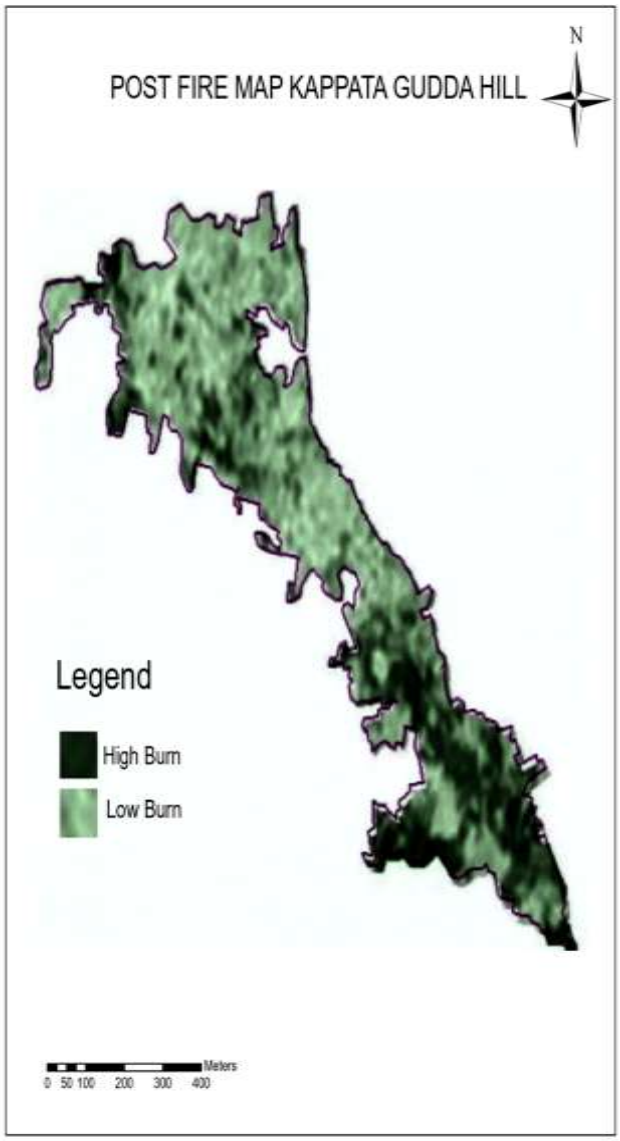

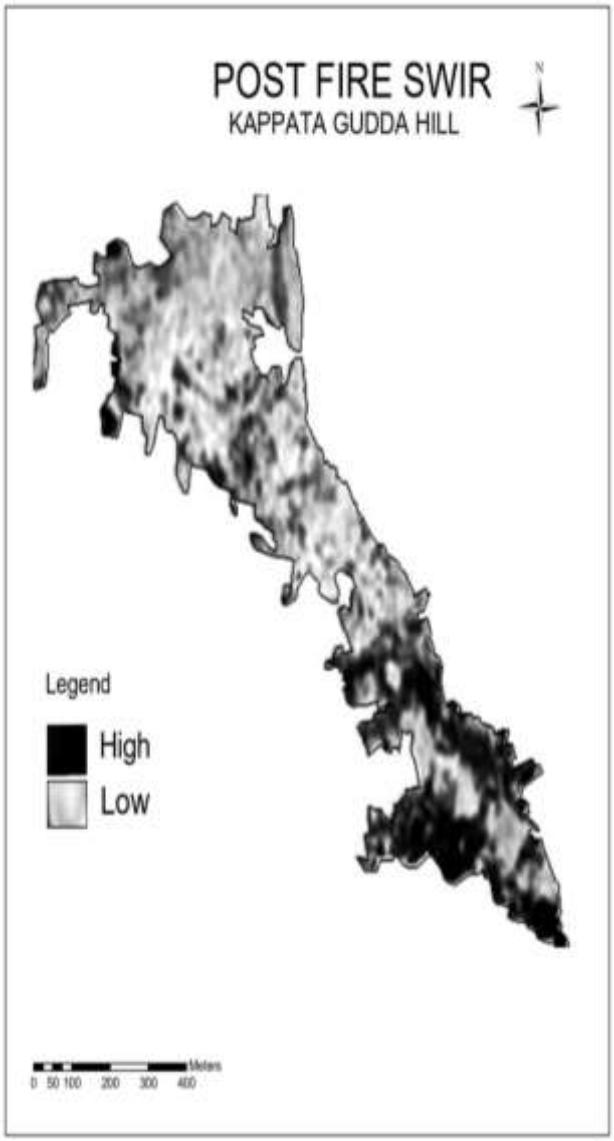

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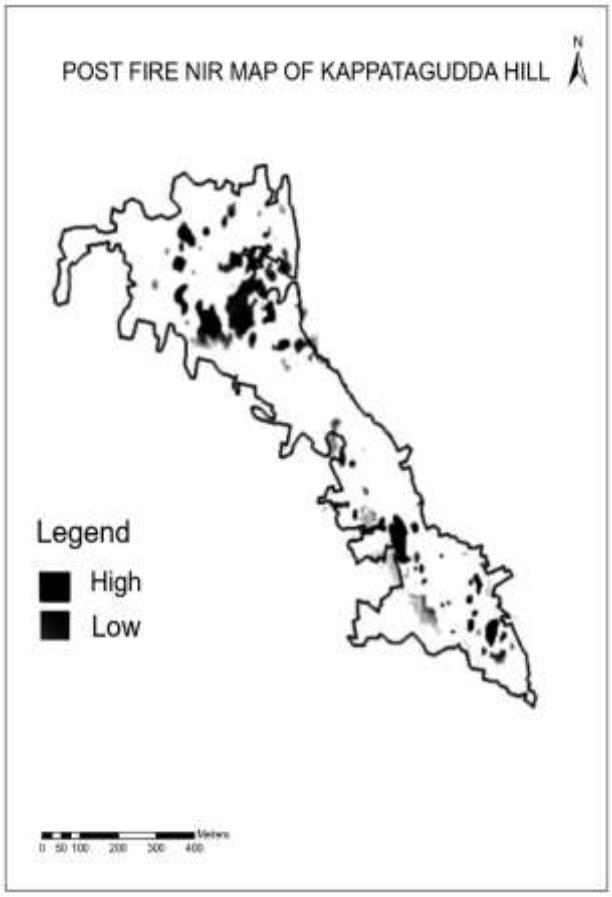

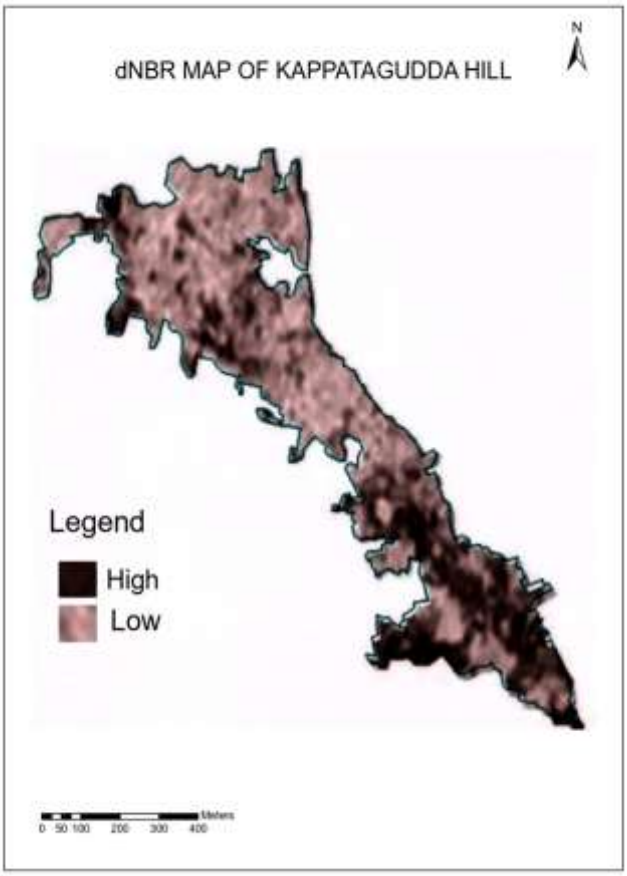

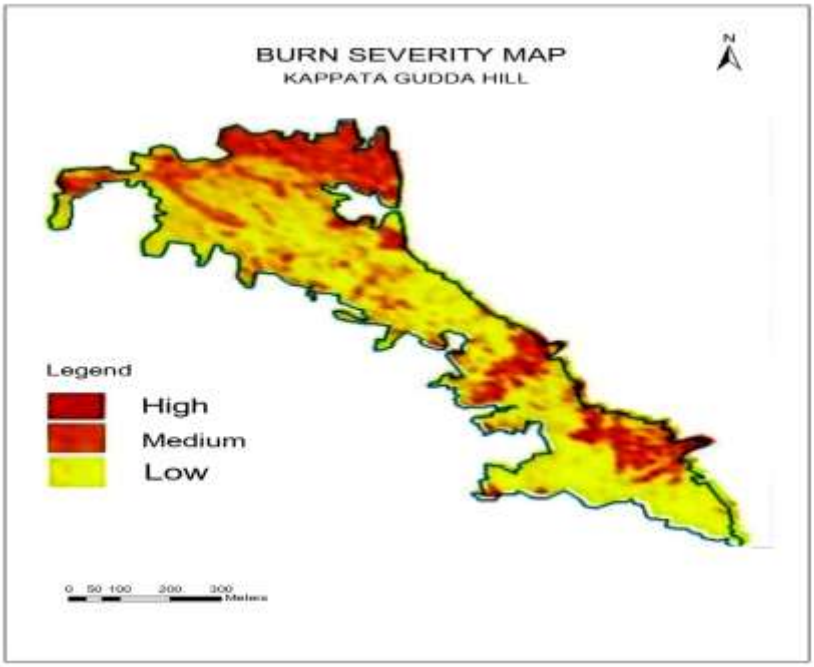

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7. RESULTS AND DISCUSSION

The satellite-based analysis successfully identified the forest fire affected regions in the Kappatagudda Hill Range.

Major observations include:

- Burned areas were concentrated in dry deciduous forests.
- Moderate to high burn severity was observed in several hill slopes.
- Fire spread followed vegetation density and topographic conditions.
- Significant vegetation loss occurred in the affected areas.
- Burn severity mapping provides valuable information for rehabilitation planning.

The NBR and dNBR indices effectively distinguished burned from unburned vegetation and can be used for long-term forest monitoring.

8. ENVIRONMENTAL IMPACTS OF FOREST FIRE

Forest fires cause:

- Loss of biodiversity
- Destruction of wildlife habitats
- Soil erosion
- Reduction in soil fertility
- Air pollution
- Carbon dioxide emissions
- Reduction in forest productivity
- Disturbance of ecological balance

9. MANAGEMENT STRATEGIES

The following measures are recommended:

- Establish an early warning system.
- Continuous satellite monitoring.
- Construction of fire lines.
- Community awareness programmes.
- Controlled burning where appropriate.
- Strengthening forest patrols.
- Afforestation and ecological restoration.
- GIS-based forest fire risk mapping.

10. CONCLUSION

This study demonstrates the effectiveness of Remote Sensing and GIS techniques in mapping forest fire affected areas and assessing burn severity in the Kappatagudda Hill Range. Landsat-based NBR and dNBR indices provide reliable information for rapid fire assessment with reasonable accuracy. The methodology is cost-effective, scientifically robust, and suitable for supporting forest management, biodiversity conservation, and post-fire restoration planning. The adoption of satellite-based monitoring systems can significantly improve decision-making for sustainable forest management in Karnataka.

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