ASSESSMENT OF ENVIRONMENTAL IMPACT OF INDUSTRIAL UNITS USING GEOSPATIAL TECHNIQUES IN DELHI NCT

ABSTRACT

This study assesses the environmental impact of industrial units in Delhi NCT using geospatial techniques and satellite-based indices. Industrial locations were digitized using GIS, and Sentinel-2 satellite imagery was used to derive environmental indicators including Normalized Difference Vegetation Index (NDVI), Normalized Difference Built-up Index (NDBI), and Normalized Difference Water Index (NDWI). Buffer zones of 500 m, 1000 m, and 2000 m were created around industrial units to analyze environmental variation with increasing distance. Zonal statistics were applied to extract mean index values within each buffer zone. The results indicate reduced vegetation cover, higher built-up intensity, and lower moisture availability in areas close to industrial clusters, suggesting localized environmental stress. Environmental conditions improve gradually with increasing distance from industrial areas. The study demonstrates the effectiveness of GIS and remote sensing techniques in evaluating industrial environmental influence in urban regions and provides a spatial framework for environmental monitoring and planning.

INTRODUCTION

Background

Delhi has experienced rapid industrial and urban expansion over the past decades. Industrial activities significantly influence surrounding environmental conditions through land transformation, reduction in vegetation cover, and alteration of surface moisture conditions. Monitoring such environmental changes is essential for sustainable urban planning.

Role of GIS and Remote Sensing

Remote sensing allows continuous monitoring of land surface conditions, while GIS enables spatial analysis of environmental parameters. Indices such as NDVI, NDBI, and NDWI are widely used to assess vegetation health, built-up intensity, and moisture availability respectively.

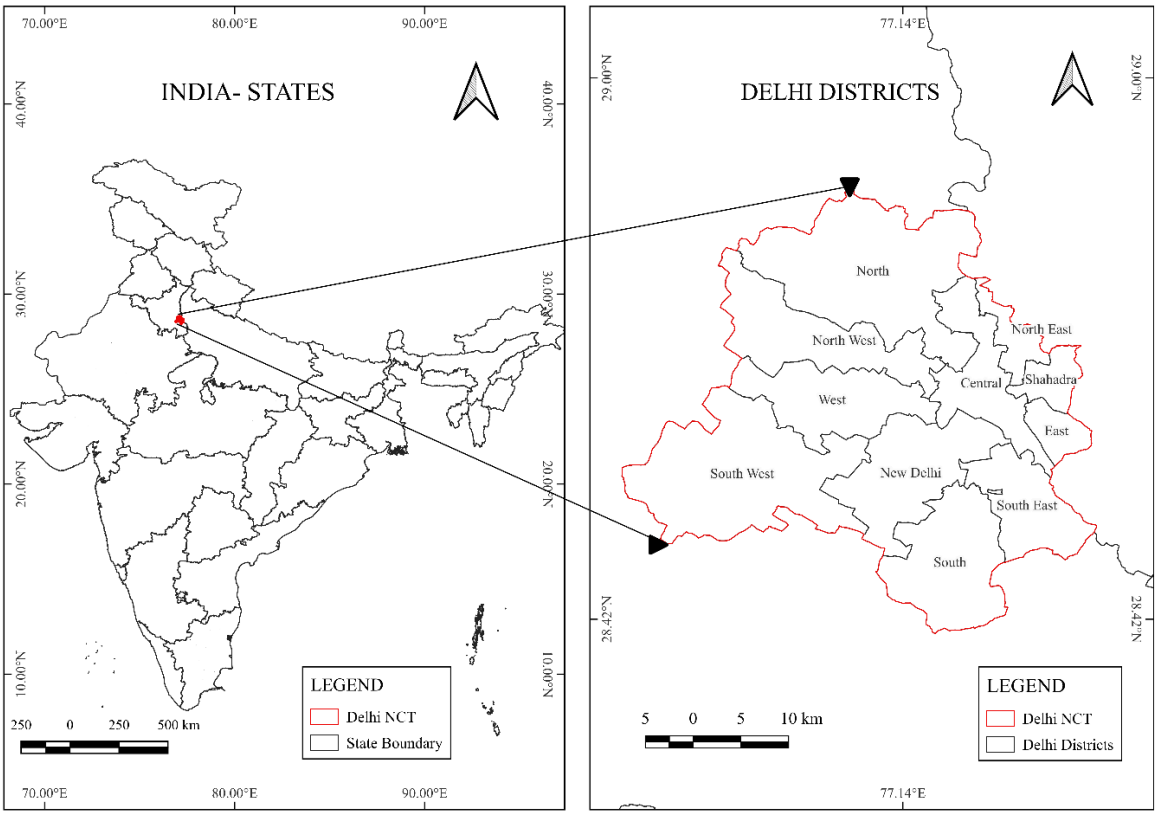
Objectives

1. To map industrial units in Delhi NCT using GIS.
2. To generate NDVI, NDBI, and NDWI using Sentinel-2 imagery.
3. To analyze environmental variation at different distances from industrial areas.
4. To assess environmental impact using spatial analysis techniques.

STUDY AREA

Include:

- Location of Delhi NCT
- Urban-industrial characteristics
- Major industrial zones (Narela, Bawana, Okhla, etc.)
- Climate and land use characteristics



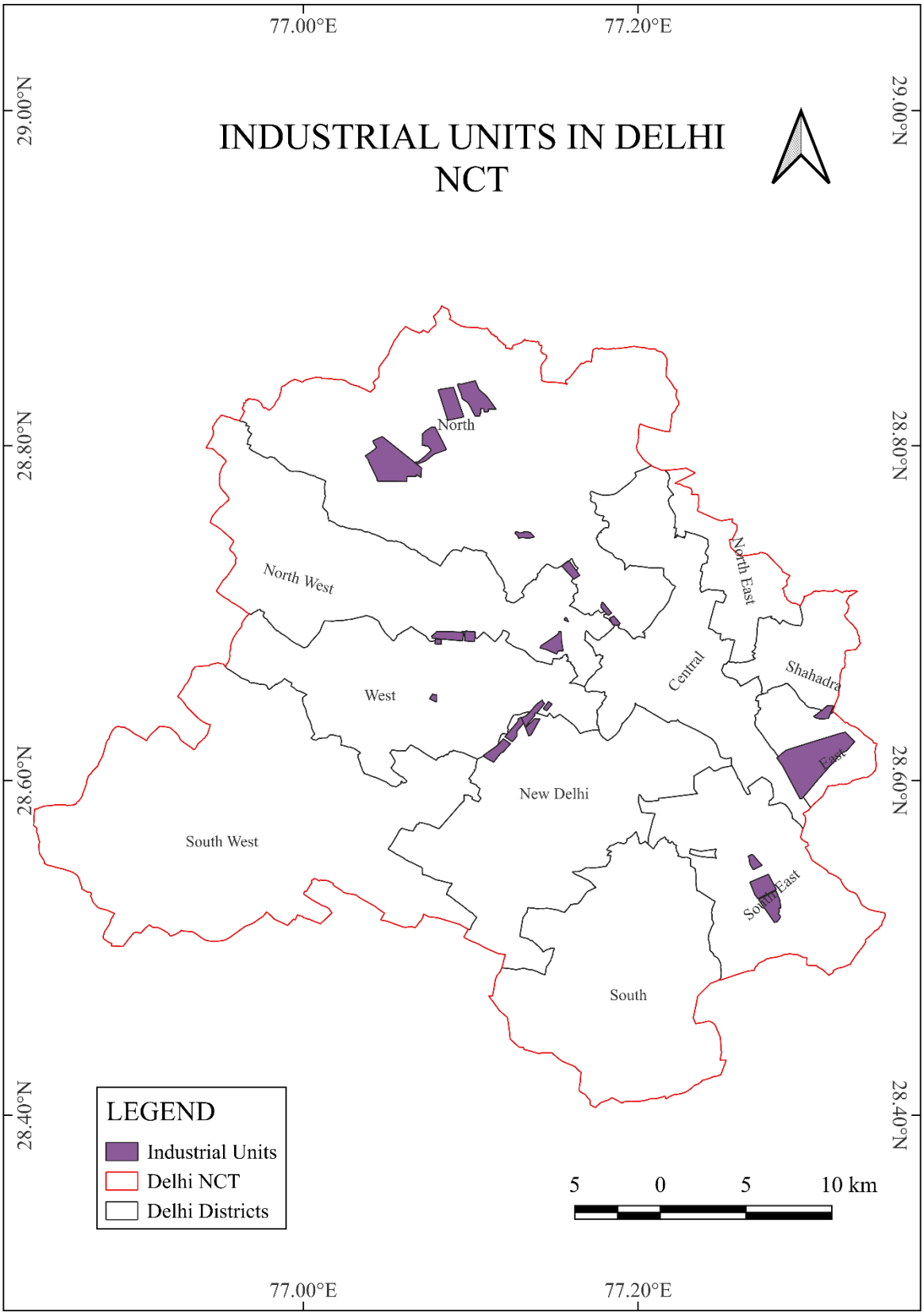
DATA USED

Data	Source	Purpose
Sentinel-2 Imagery	Copernicus Open Access	NDVI, NDBI, NDWI generation
LULC Data	Bhuvan Portal	Land use reference
Industrial Locations	Digitized in QGIS	Industrial analysis
Administrative Boundary	Open GIS Data	Study boundary

METHODOLOGY

Step 1: Data Preparation

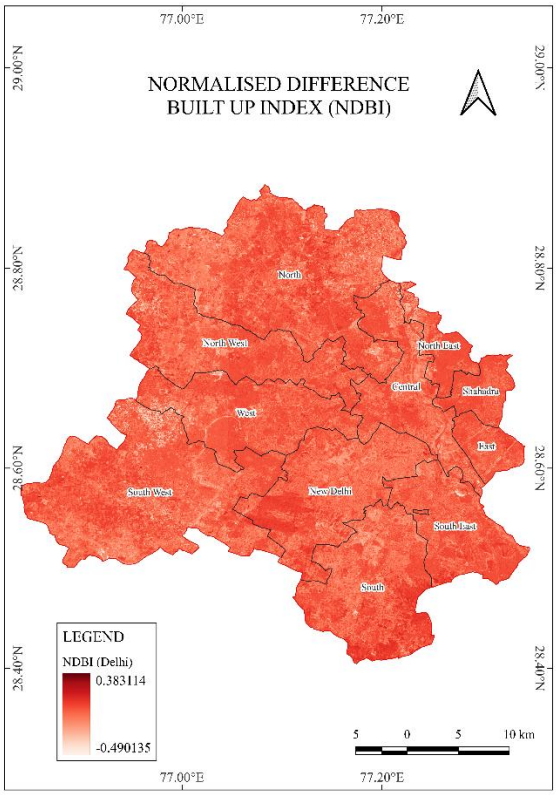
- Delhi boundary prepared
- Industrial units digitized in QGIS

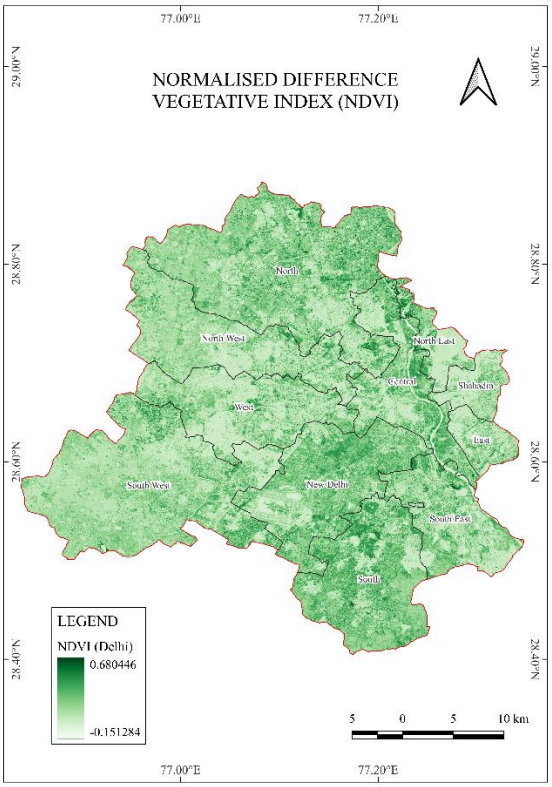

INDUSTRIAL UNITS IN DELHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
North East
West
Central
Shahadra
East
New Delhi
South West
South East
South
LEGEND
Industrial Units
Delhi NCT
Delhi Districts
5 0 5 10 km

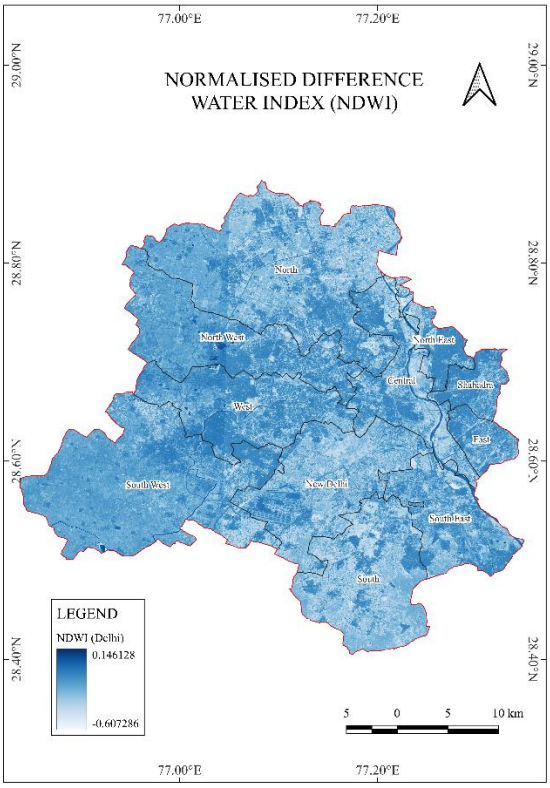
Step 2: Satellite Image Processing

Sentinel-2 imagery was used to derive environmental indices:

NDVI for vegetation condition
NDBI for built-up intensity
NDWI for moisture condition

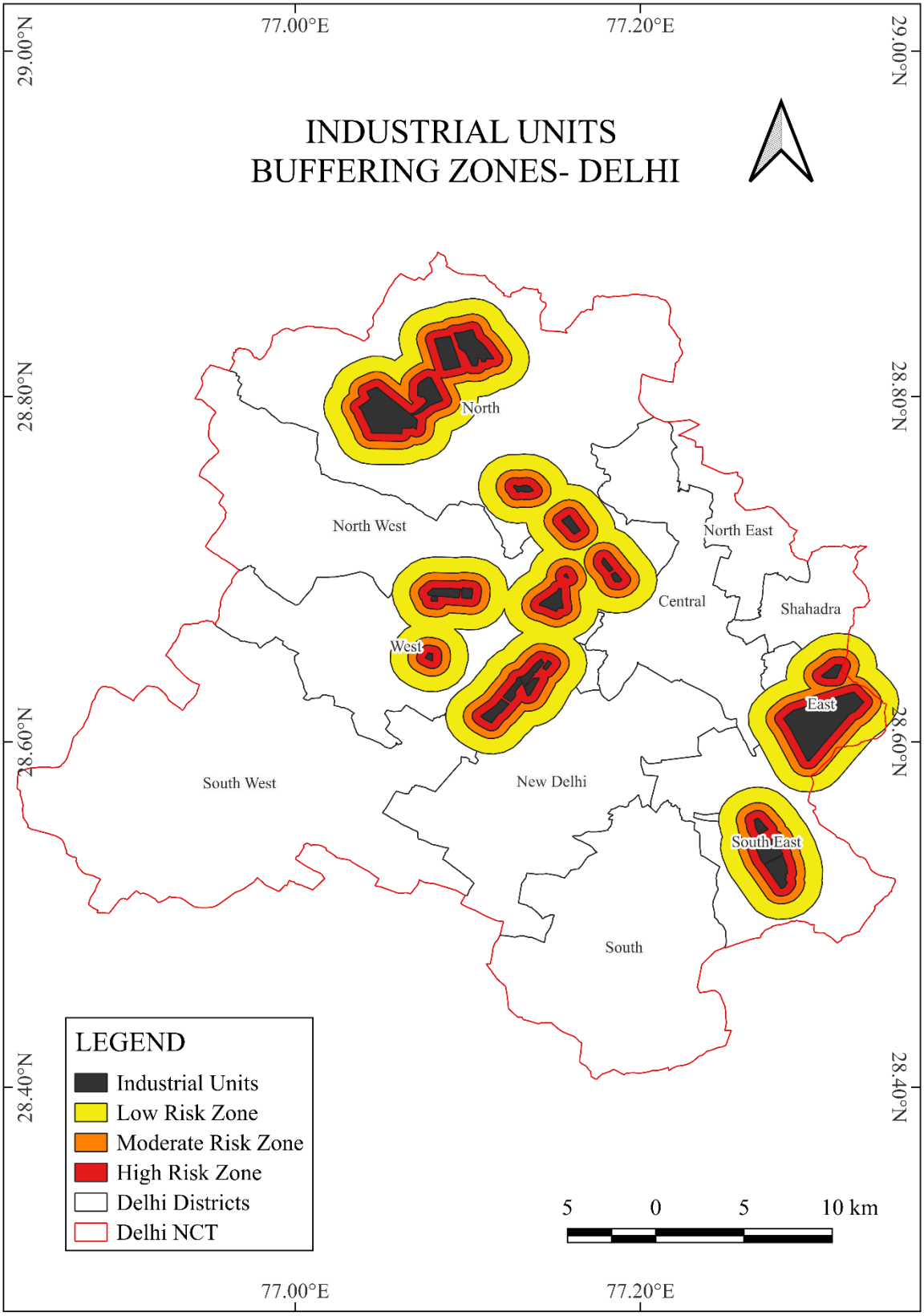






Step 3: Buffer Analysis

Buffers of 500 m(high risk zone), 1000 m(moderate risk zone), and 2000 m(low risk zone) were created around industrial units to assess environmental variation with distance.

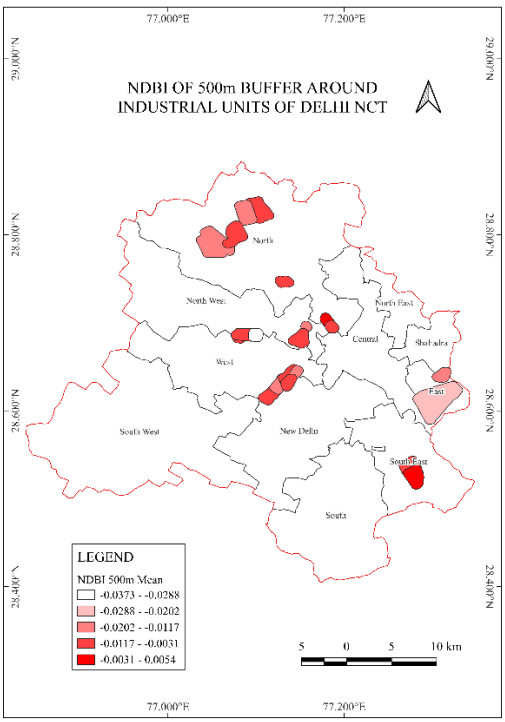


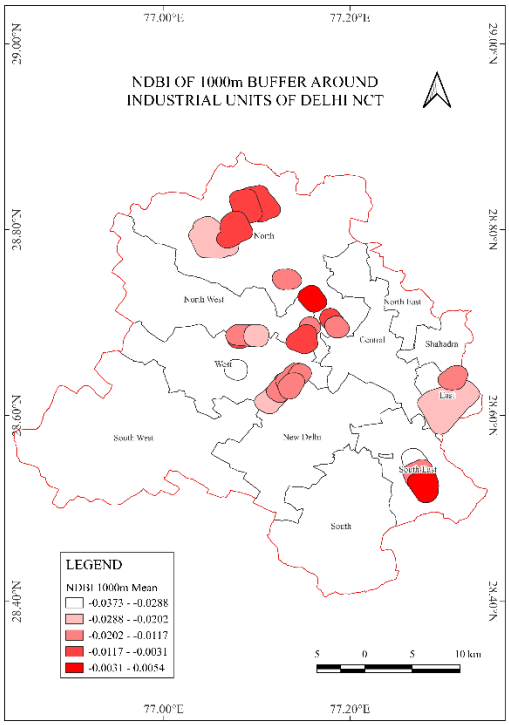
Step 4: Zonal Statistics

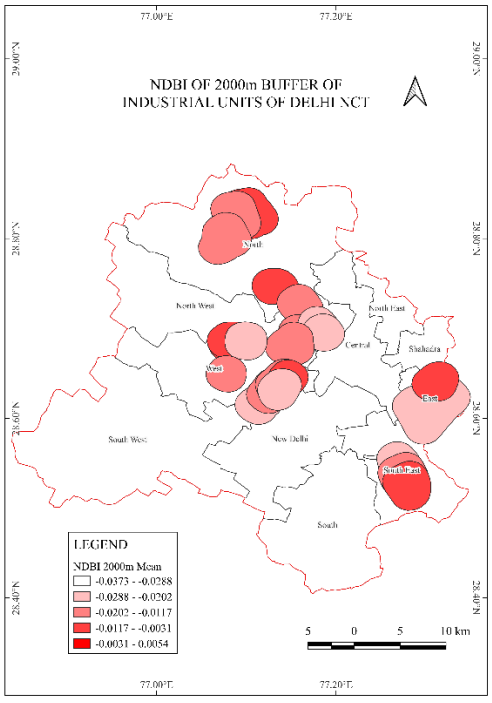
Mean NDVI, NDBI, and NDWI values were calculated within each buffer zone using zonal statistics to quantify environmental conditions.

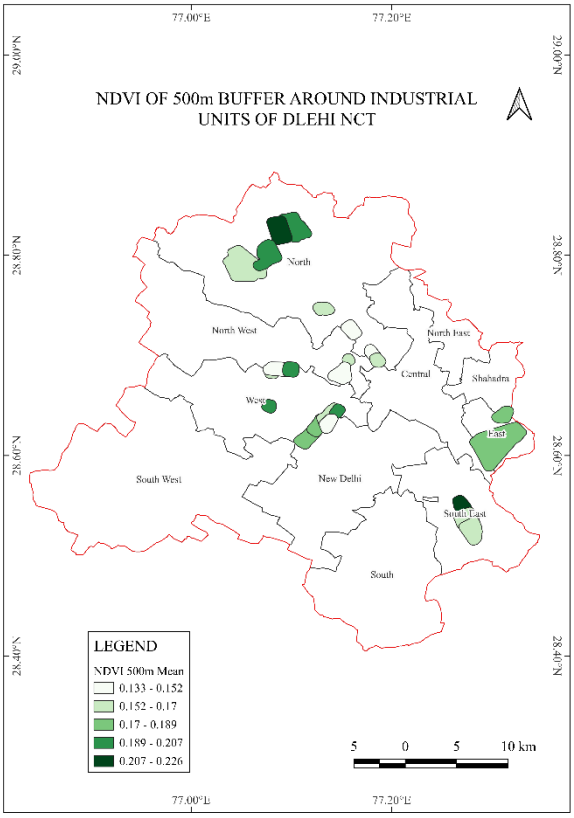
Step 5: Thematic Mapping

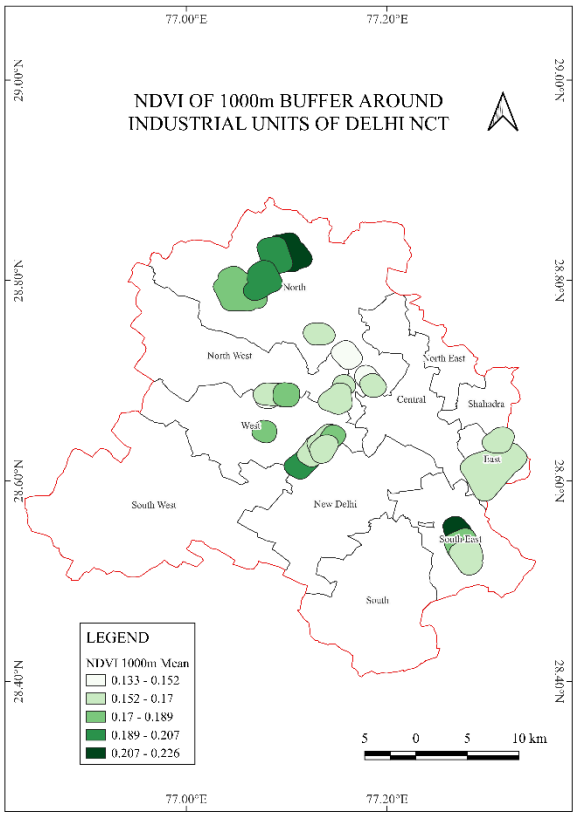
Graduated thematic maps were prepared using mean index values to visualize spatial variation in environmental conditions.

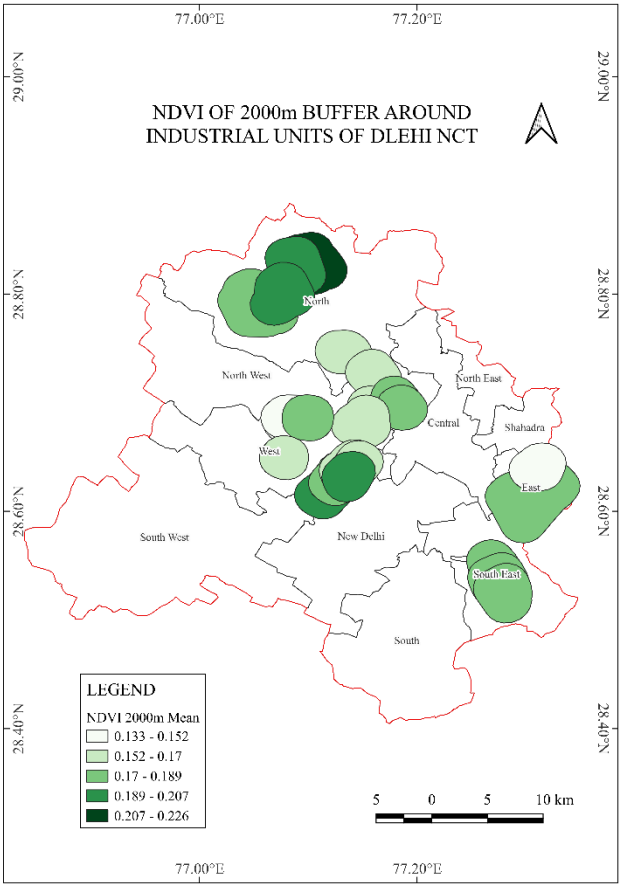


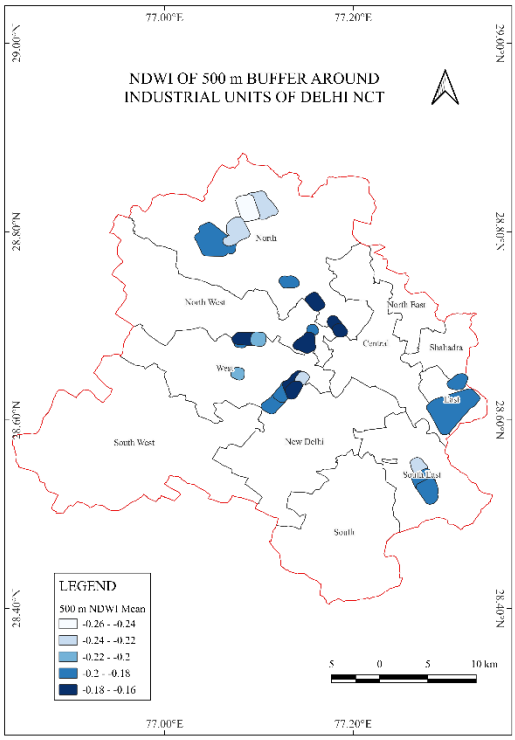


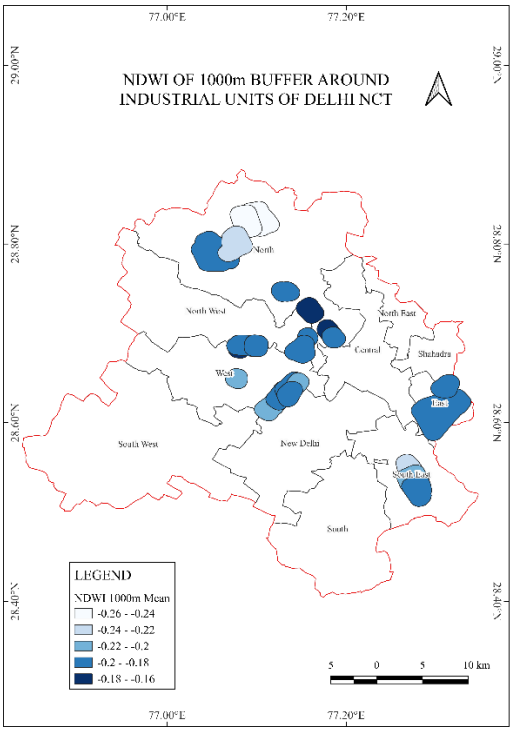


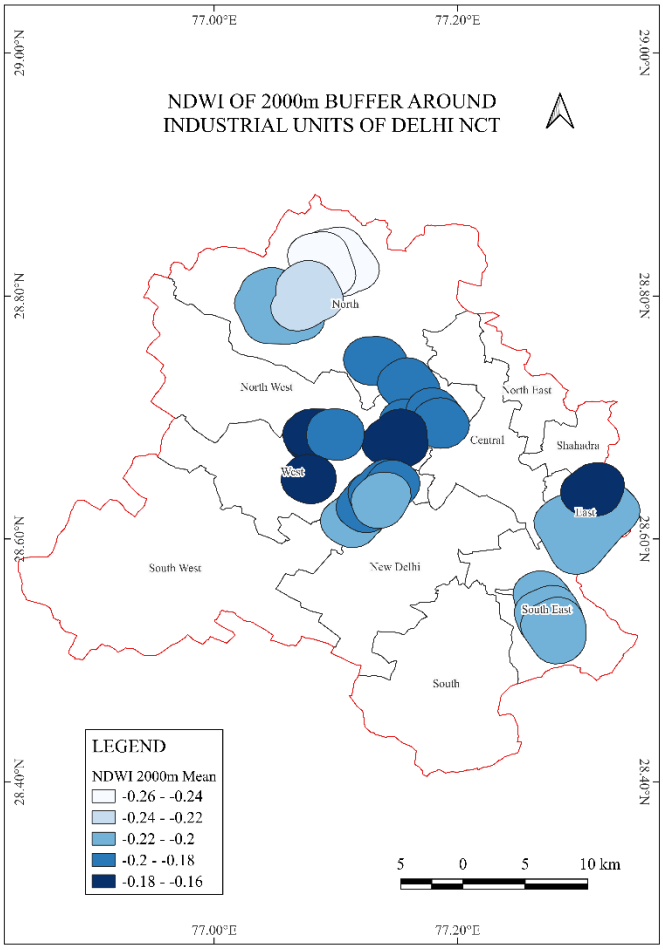

NDVI OF 500m BUFFER AROUND INDUSTRIAL UNITS OF DLEHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
North East
Central
Shahadra
West
East
South West
New Delhi
South East
South
LEGEND
NDVI 500m Mean
0.133 - 0.152
0.152 - 0.17
0.17 - 0.189
0.189 - 0.207
0.207 - 0.226
5 0 5 10 km


NDVI OF 1000m BUFFER AROUND INDUSTRIAL UNITS OF DELHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
Central
West
East
South West
New Delhi
South East
South
LEGEND
NDVI 1000m Mean
0.133 - 0.152
0.152 - 0.17
0.17 - 0.189
0.189 - 0.207
0.207 - 0.226
5 0 5 10 km


NDVI OF 2000m BUFFER AROUND INDUSTRIAL UNITS OF DLEHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
North East
Central
Shahadra
West
East
South West
New Delhi
South East
South
LEGEND
NDVI 2000m Mean
0.133 - 0.152
0.152 - 0.17
0.17 - 0.189
0.189 - 0.207
0.207 - 0.226
5 0 5 10 km


NDWI OF 500 m BUFFER AROUND
INDUSTRIAL UNITS OF DELHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
North East
Central
Shahadra
West
East
South West
New Delhi
South East
South
LEGEND
500 m NDWI Mean
-0.26 - -0.24
-0.24 - -0.22
-0.22 - -0.2
-0.2 - -0.18
-0.18 - -0.16
5 0 5 10 km


NDWI OF 1000m BUFFER AROUND
INDUSTRIAL UNITS OF DELHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
North East
Central
Shahadra
West
East
South West
New Delhi
South East
South
LEGEND
NDWI 1000m Mean
-0.26 - -0.24
-0.24 - -0.22
-0.22 - -0.2
-0.2 - -0.18
-0.18 - -0.16
5 0 5 10 km


NDWI OF 2000m BUFFER AROUND
INDUSTRIAL UNITS OF DELHI NCT
77.00°E
77.20°E
29.00°N
28.80°N
28.60°N
28.40°N
North
North West
North East
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Shahadra
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East
South West
New Delhi
South East
South
LEGEND
NDWI 2000m Mean
-0.26 - -0.24
-0.24 - -0.22
-0.22 - -0.2
-0.2 - -0.18
-0.18 - -0.16
5 0 5 10 km

RESULTS AND ANALYSIS

6.1 NDVI Analysis

Lower NDVI values were observed within 500 m buffer zones, indicating reduced vegetation cover near industrial areas. Vegetation conditions improved gradually at 1000 m and 2000 m distances.

6.2 NDBI Analysis

Higher NDBI values were observed near industrial clusters, reflecting higher built-up density and urban-industrial concentration.

6.3 NDWI Analysis

NDWI values were predominantly negative near industrial zones, indicating lower surface moisture conditions. Slight improvement was observed at larger distances.

6.4 Distance-Based Environmental Variation

Comparison of index values across buffer distances indicates that environmental stress decreases with increasing distance from industrial units, suggesting localized industrial influence.

CONCLUSION

The study demonstrates that industrial activities significantly influence surrounding environmental conditions in Delhi NCT. Areas closer to industrial units exhibit reduced vegetation, higher built-up intensity, and lower moisture availability. Environmental conditions improve with increasing distance from industrial zones, indicating spatially limited industrial impact. The integration of GIS and remote sensing techniques proved effective in assessing environmental conditions and can support urban environmental monitoring and planning.