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NDVI-Based Vegetation Analysis Using Landsat Satellite Imagery in QGIS

Venkata Mahesh Babu Batta
M.Tech, Department of CSE
https://orcid.org/0000-0002-1029-6402
University College of Engineering, Osmania University, Hyderabad, Telangana, India

Abstract: *Normalized Difference Vegetation Index (NDVI) is a widely used remote sensing metric for vegetation monitoring and land cover classification. This study demonstrates the use of QGIS, an open-source Geographic Information System, to calculate NDVI using Landsat 8 imagery for a selected area of interest. The approach involves loading satellite bands, performing raster calculations, and visualizing NDVI values to assess vegetation health. The method provides a cost-effective solution for environmental monitoring, agricultural planning, and urban green space analysis.*

Keywords: Remote sensing, Image Processing, QGIS, NDVI

I. INTRODUCTION

Vegetation plays a critical role in maintaining ecological balance. NDVI has become a standard index for quantifying vegetation greenness using remote sensing data. With the availability of free satellite imagery and open-source GIS tools like QGIS, NDVI analysis has become accessible for research and decision-making in forestry, agriculture, and climate studies.

II. OBJECTIVES

- To download and use Landsat Collection 2 Level-1 imagery.
- To calculate NDVI using QGIS Raster Calculator.
- To interpret the NDVI values for vegetation health assessment.

III. STUDY AREA

The study area includes **Osmania University, Hyderabad, India** (Latitude: 17.4037° N, Longitude: 78.5286° E), a region with a mix of urban and green spaces.

IV. DATA AND TOOLS

- **Satellite Data**: Landsat 8 Level-1 imagery (Bands B4 and B5).
- **Software**: QGIS (version 3.28 or later).
- **Data Source**: USGS EarthExplorer (https://earthexplorer.usgs.gov)

V. METHODOLOGY

5.1 Downloading Satellite Imagery

- A region of interest (ROI) was selected around Osmania University.
- Landsat 8 imagery was downloaded for a recent date.
- The imagery was unzipped to obtain individual bands.

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5.2 Bands Used

- **Band 4 (B4)** – Red spectral band.
- **Band 5 (B5)** – Near-Infrared (NIR) spectral band.

5.3 NDVI Formula

- NDVI=(NIR−RED)(NIR+RED)NDVI = \frac{(NIR - RED)}{(NIR + RED)}

5.4 NDVI Calculation in QGIS

- **Load B4 and B5 TIFF files** using *Layer → Add Raster Layer*.
- Open **Raster Calculator** from the *Raster* menu.

Use the formula:

- ("B5@1" - "B4@1") / ("B5@1" + "B4@1")
- Save the output as ndvi_osmania.tif.
- Style the NDVI layer with a green-to-red pseudocolor ramp.
- Use the **Identify Tool** and **Statistics** to interpret NDVI values.

VI. RESULTS

The NDVI ranged from **–0.15 to +0.72**, indicating water bodies, bare land, and healthy vegetation.
Dense green areas had NDVI > 0.5.
Urban structures and roads showed values < 0.2.

NDVI Range	Land Cover Type
< 0	Water or cloud
0.0 – 0.2	Urban or bare soil
0.2 – 0.5	Sparse vegetation or grass
> 0.5	Dense, healthy vegetation

FILES DOWNLOADED FROM earthexplorer.usgs.gov
LC09_L1TP_012048_20250119_20250119_02_T1_B5.tif
LC09_L1TP_012048_20250119_20250119_02_T1_B4.tif

Using the raster calculator in QGIS ndvi.osmania.tif is created to calculate NDVI value

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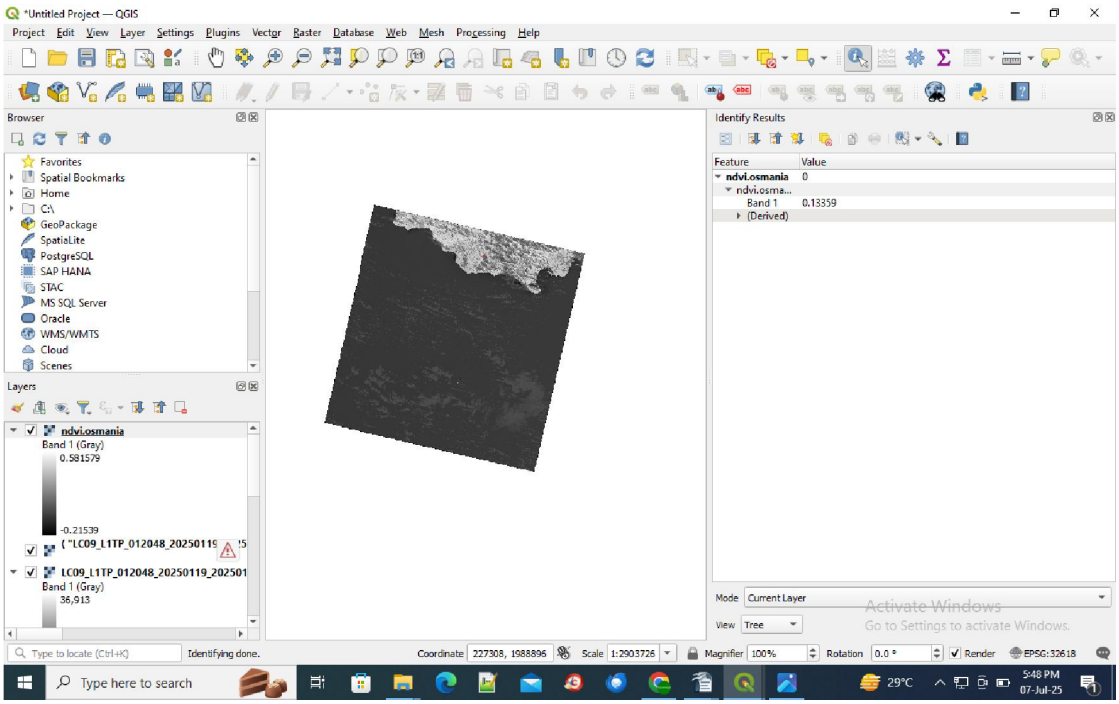
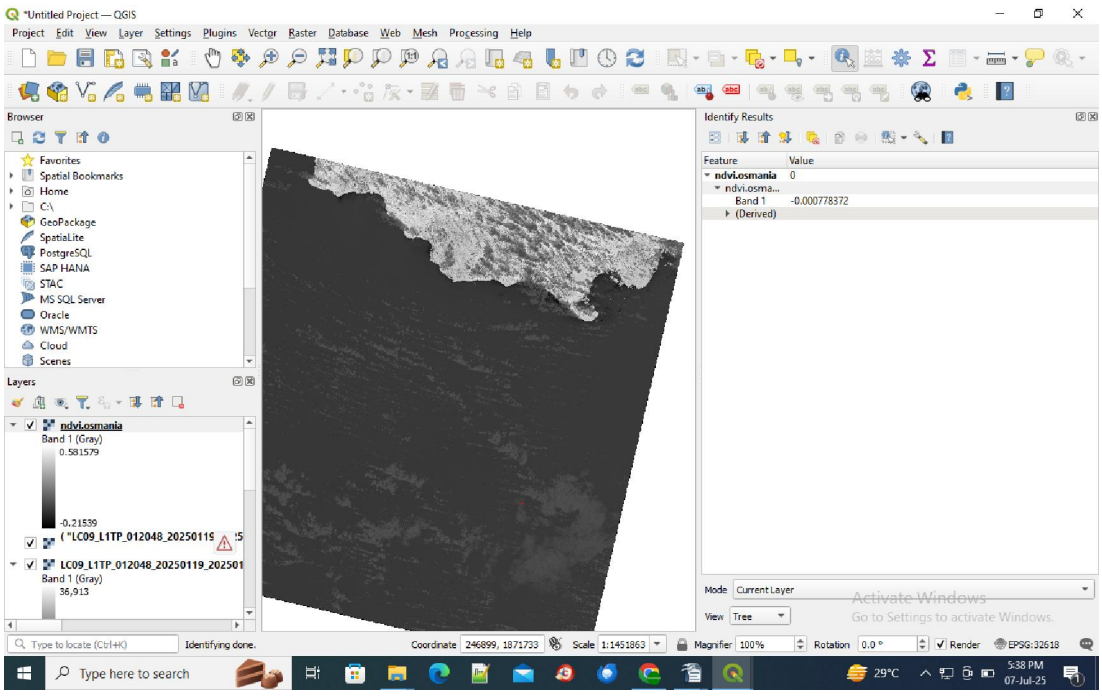


the NDVI value is 0.13359



NDVI value is -000778372

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VII. DISCUSSION

The NDVI map successfully identified various land cover types within Osmania University. Vegetated zones, such as parks and tree-lined avenues, were clearly distinguishable from built-up and barren areas. This methodology is replicable and can support urban greening initiatives, drought monitoring, and ecosystem studies.

VIII. CONCLUSION

This study demonstrated a straightforward and reproducible workflow to compute NDVI using QGIS. The open-source platform enables users to analyze satellite imagery without proprietary tools. NDVI derived from Landsat imagery is valuable for vegetation mapping and monitoring in urban, agricultural, and forested landscapes.

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