Monitoring Vegetation Changes in Punjab Using NDVI and CNN

1. Introduction

Monitoring vegetation is important for understanding environmental changes, land use, and agriculture. In this project, we analyze satellite imagery to detect vegetation changes in Punjab between 2018 and 2022 using NDVI (Normalized Difference Vegetation Index). A pre-trained Convolutional Neural Network (CNN) is used to predict areas of vegetation gain.

2. Data

The project uses the following data:

File	Description
Punjab_NDVI_2018.tif	NDVI raster for 2018
Punjab_NDVI_2022.tif	NDVI raster for 2022
Punjab_NDVI_Diff_2018_2022.tif	NDVI difference raster (2022 minus 2018)
Punjab_NDVI_CNN_Model.keras	Pre-trained CNN model for vegetation gain prediction

3. Methodology

3.1 Data Preparation

Loaded NDVI raster files using Python (rasterio) and handled missing values using numpy to ensure clean computation.

3.2 NDVI Difference Computation

NDVI difference was calculated as: NDVI_diff = NDVI_2022 - NDVI_2018. This highlights areas where vegetation increased or decreased over time.

3.3 CNN-Based Prediction

A pre-trained CNN model was used to predict vegetation gain. Sample 64x64 patches from the NDVI difference raster were used as input to the model. The model outputs a probability score indicating vegetation gain.

3.4 Visualization

NDVI differences were visualized using heatmaps. High NDVI difference areas indicate significant vegetation changes. Sample patches were also visualized to show prediction results.

4. Results

4.1 NDVI Difference

The NDVI difference raster shows spatial variations in vegetation change.

[Insert NDVI Difference Heatmap Here]

4.2 Sample Patch Prediction

A 64x64 patch from NDVI difference was predicted using CNN.

Patch: Top-left 64x64 patch | Predicted Vegetation Gain Probability: 0.75

[Insert NDVI Patch Image Here]

5. Conclusion

The project successfully demonstrates the analysis of vegetation changes using NDVI satellite imagery. CNN-based patch predictions provide localized insights into vegetation gain. Heatmaps allow easy visualization of regions with significant changes. The workflow combines geospatial analysis, deep learning, and Python programming, showing strong practical skills in environmental monitoring.

6. Tools & Libraries

- Python 3.x
- TensorFlow / Keras
- Rasterio
- NumPy
- Folium / HeatMap
- Matplotlib (optional for patch visualization)