

KATHMANDU UNIVERSITY

SCHOOL OF ENGINEERING

DEPARTMENT OF GEOMATICS ENGINEERING

DHULIKHEL, KAVRE



Project Report on Analysing the vegetation of a site in Dhulikhel through Normalized Difference Vegetation Index (NDVI)

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Introduction

Unmanned aerial vehicles (UAV) have become popular for taking aerial snapshots, and recent technological advances in UAV technology have increased interest in their application in precision agriculture. Monitoring of the state of agricultural crops and forecasting the crops development begin with aerial photography using a unmanned aerial vehicles and a multispectral camera. Vegetation indexes are selected empirically and calculated as a result of operations with values of different spectral wavelengths. When assessing the state of crops, especially in breeding, it is necessary to determine the limiting factors for the use of vegetation indexes. (Kurbanov & Zakharova, 2020)

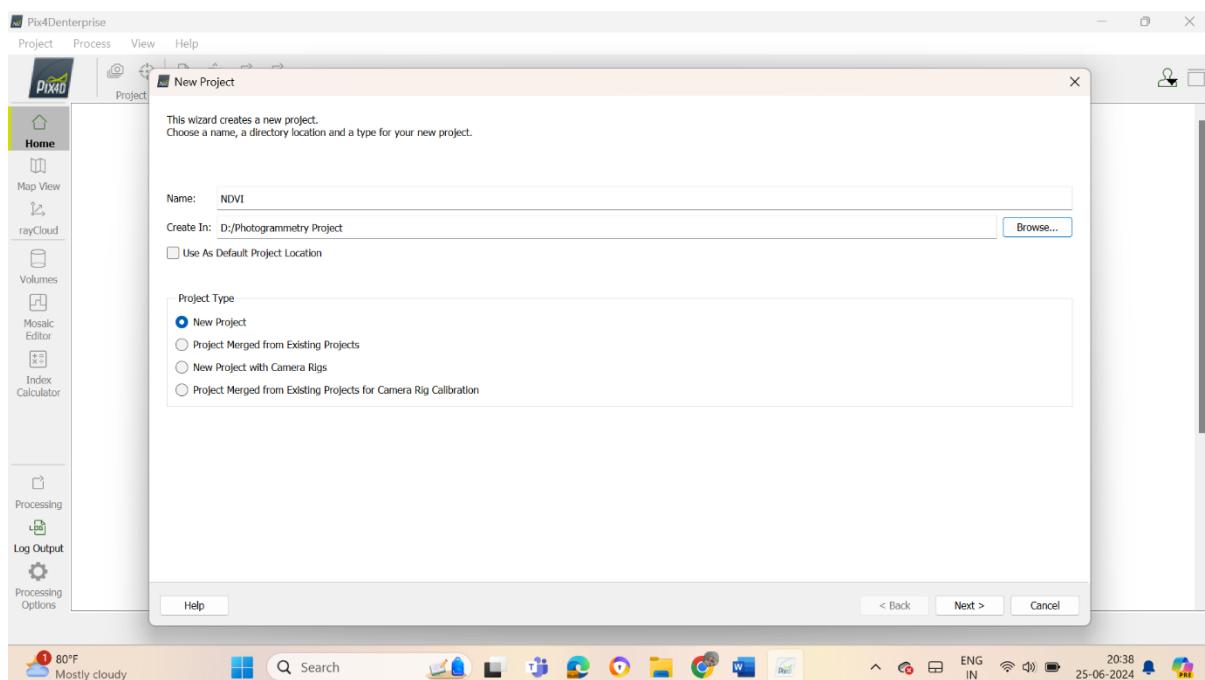
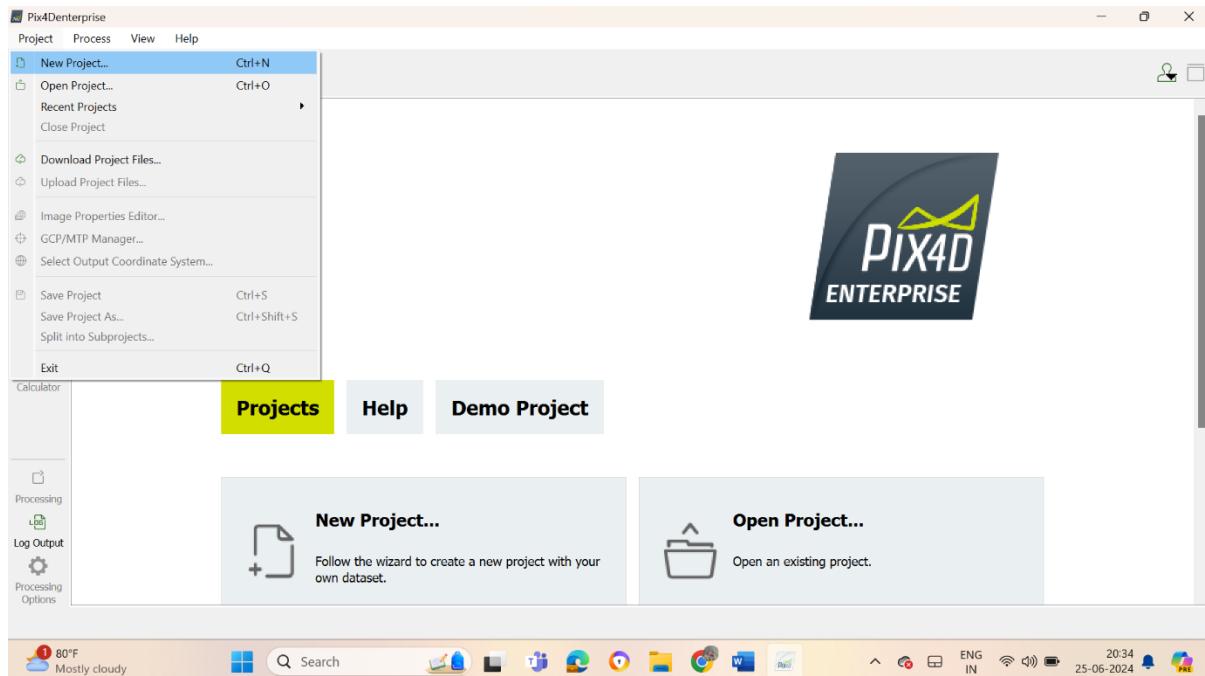
The vegetation monitoring of the development and the health condition of the field is extremely important for the quality of the production processes planning, as well as for the qualities of the production. Spectral plant (vegetation) indices are widely used to monitor and analyse the plant structure changes, as well as to determine the plant health status, to depict phenological changes, to assess the green biomass and the yield potential. Such indices also allow for the monitoring and assessment of the changes in plant biophysical properties. Some of the most famous indices are Enhanced Vegetation Index (EVI), Normalized Difference Vegetation Index (NDVI), Leaf Area Index (LAI), etc (Pap et al., 2020). For our project, we are using Normalized Difference Vegetation Index (NDVI).

The normalized difference vegetation index (NDVI) is a widely-used metric for quantifying the health and density of vegetation using sensor data. It is calculated from spectrometric data at two specific bands: red and near-infrared. The spectrometric data is usually sourced from remote sensors, such as satellites. The metric is popular in industry because of its accuracy. It has a high correlation with the true state of vegetation on the ground. The index is easy to interpret: NDVI will be a value between -1 and 1. An area with nothing growing in it will have an NDVI of zero. NDVI will increase in proportion to vegetation growth. An area with dense, healthy vegetation will have an NDVI of one. NDVI values less than 0 suggest a lack of dry land. (Atanasov et al., 2023)

(Meivel & Maheswari, 2022) The Normalized Difference Vegetation Index (NDVI) is a commonly used index for measuring vegetation health. NDVI is calculated using the near-infrared (NIR) and red (R) bands of the electromagnetic spectrum. Here's a detailed guide on how to calculate NDVI using Pix4D:

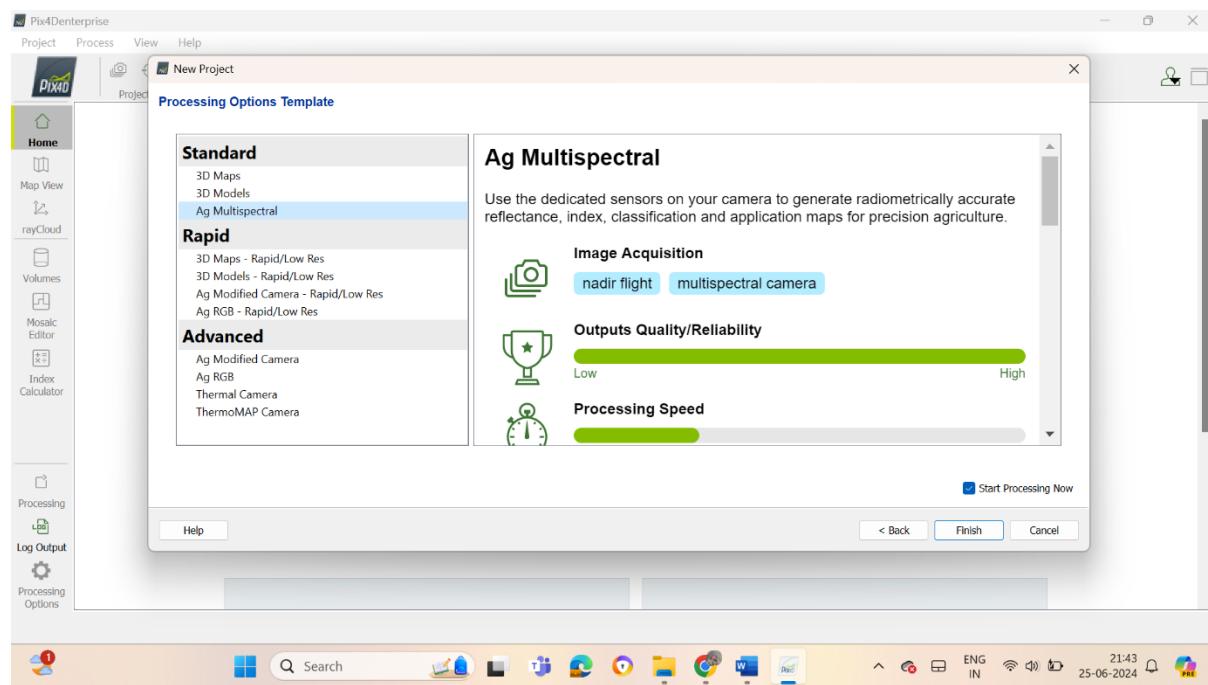
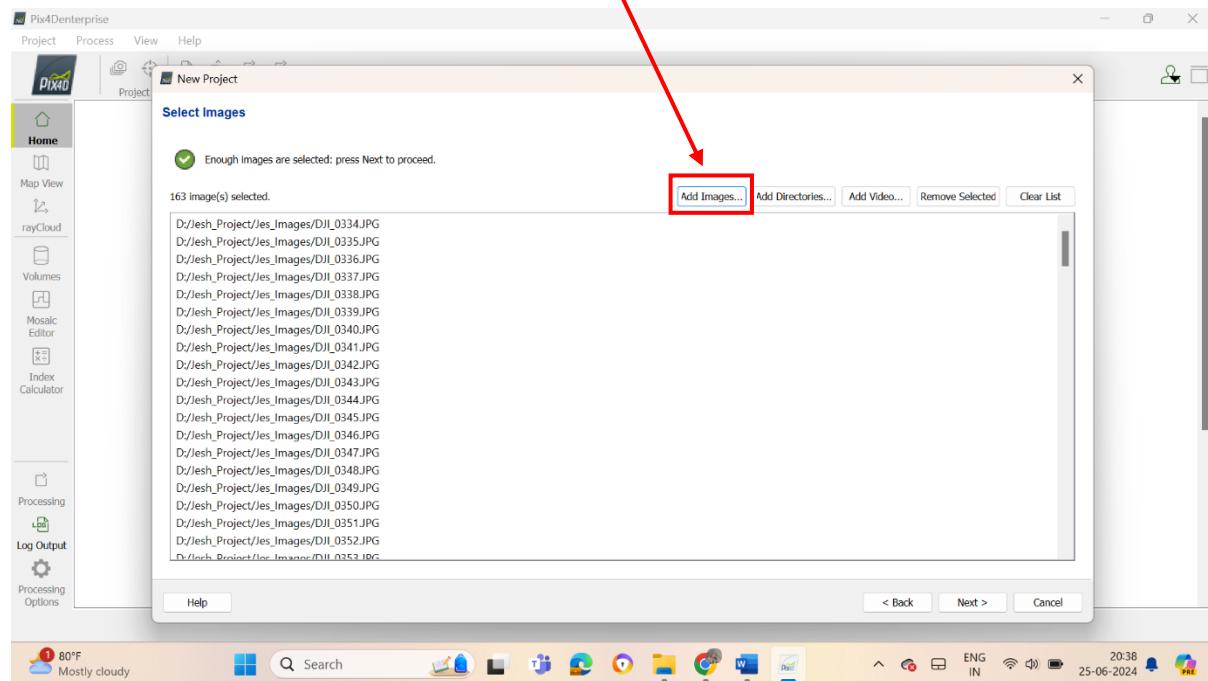
Step 1: Create a New Project

- **Open Pix4Dmapper:** Launch the Pix4Dmapper software on your computer.
- **Create New Project:** Click on Project -> New Project. Enter a project name and select a location to save your project files.



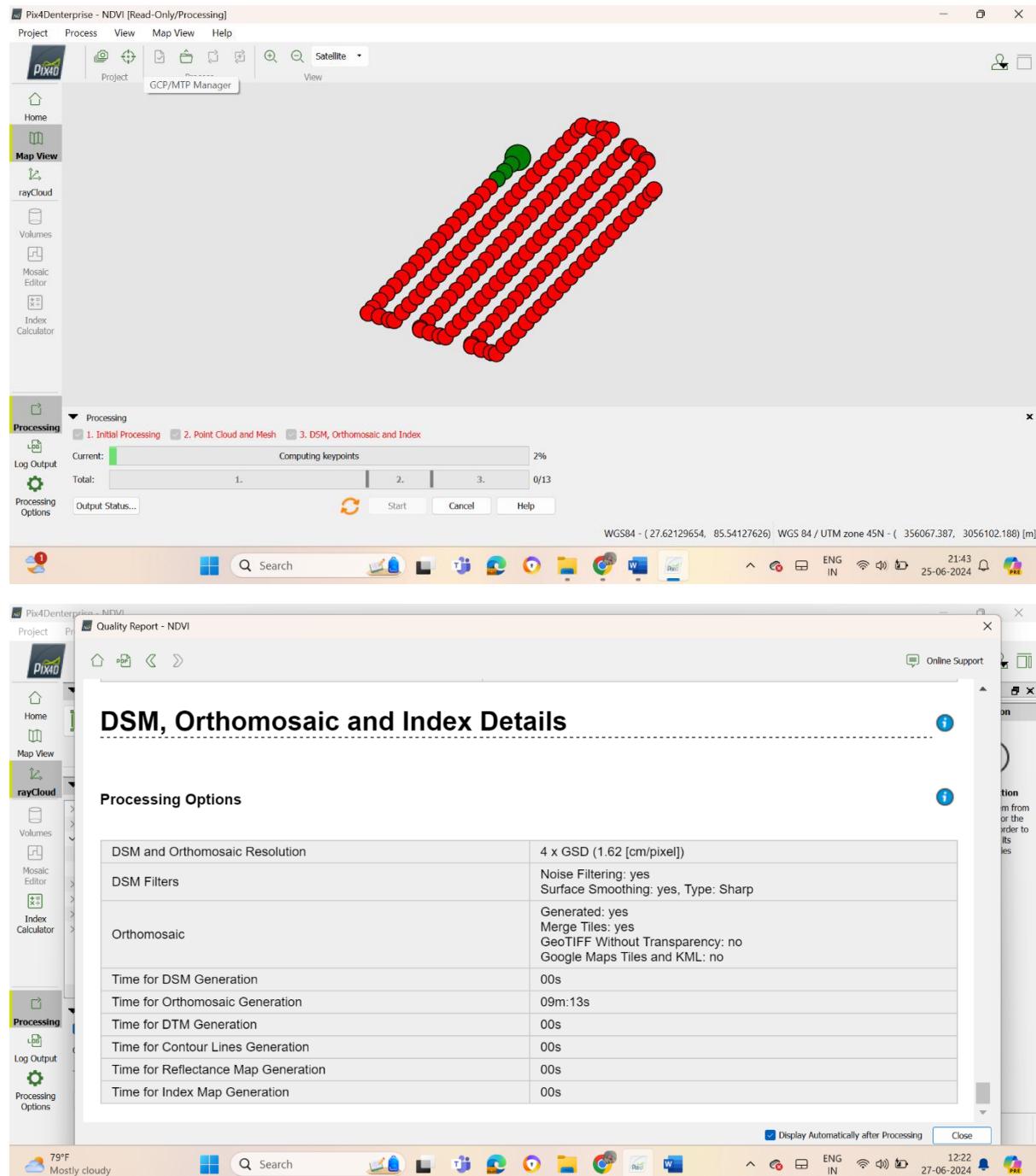
Step 2: Import Images

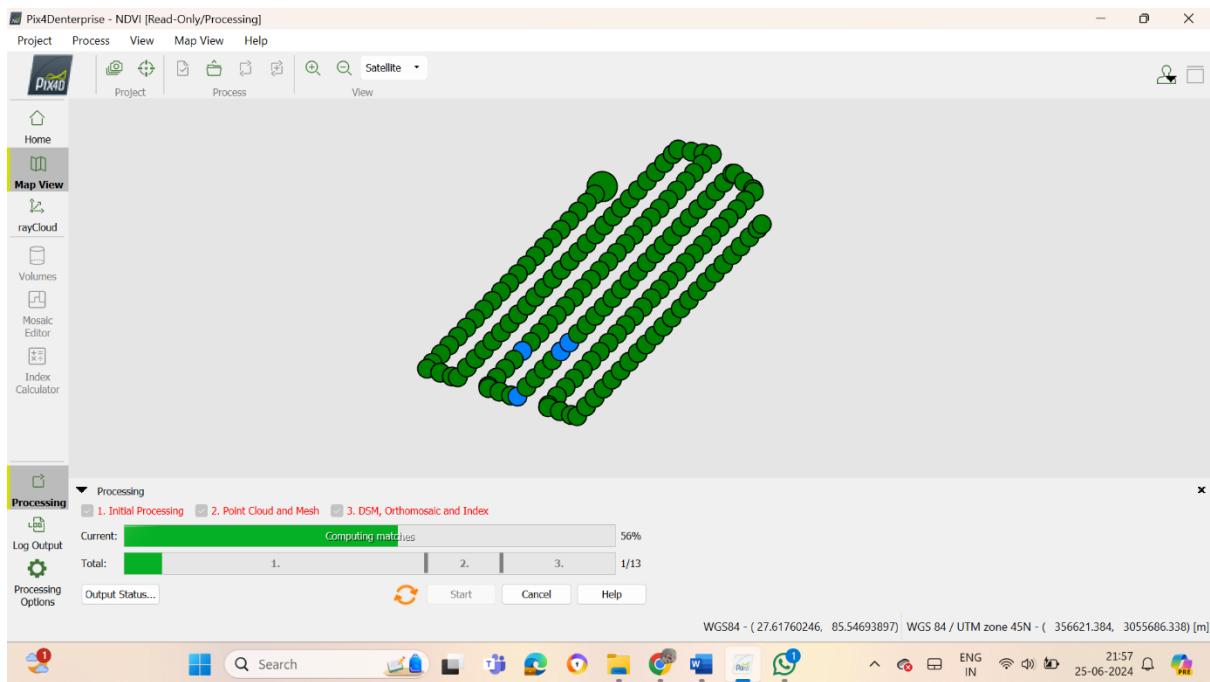
- **Add Images:** Click on Add Images and select the images captured by your multispectral camera. Ensure that the images include at least the red and near-infrared bands.



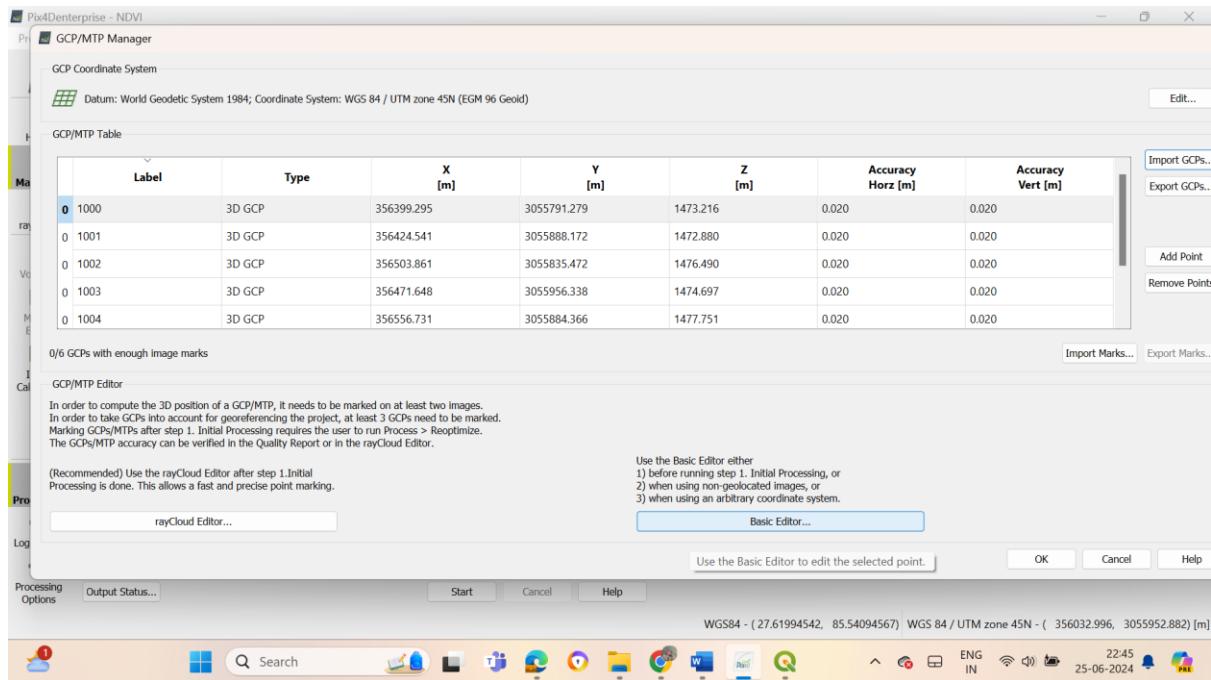
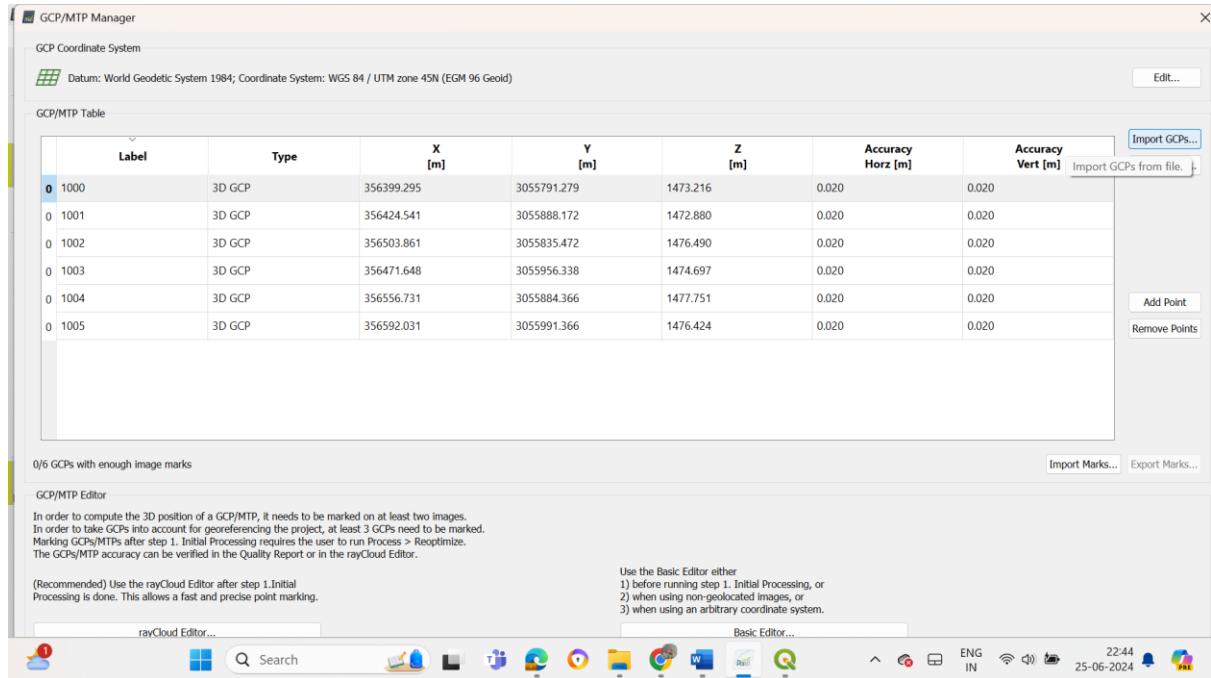
Step 3: Initial Processing

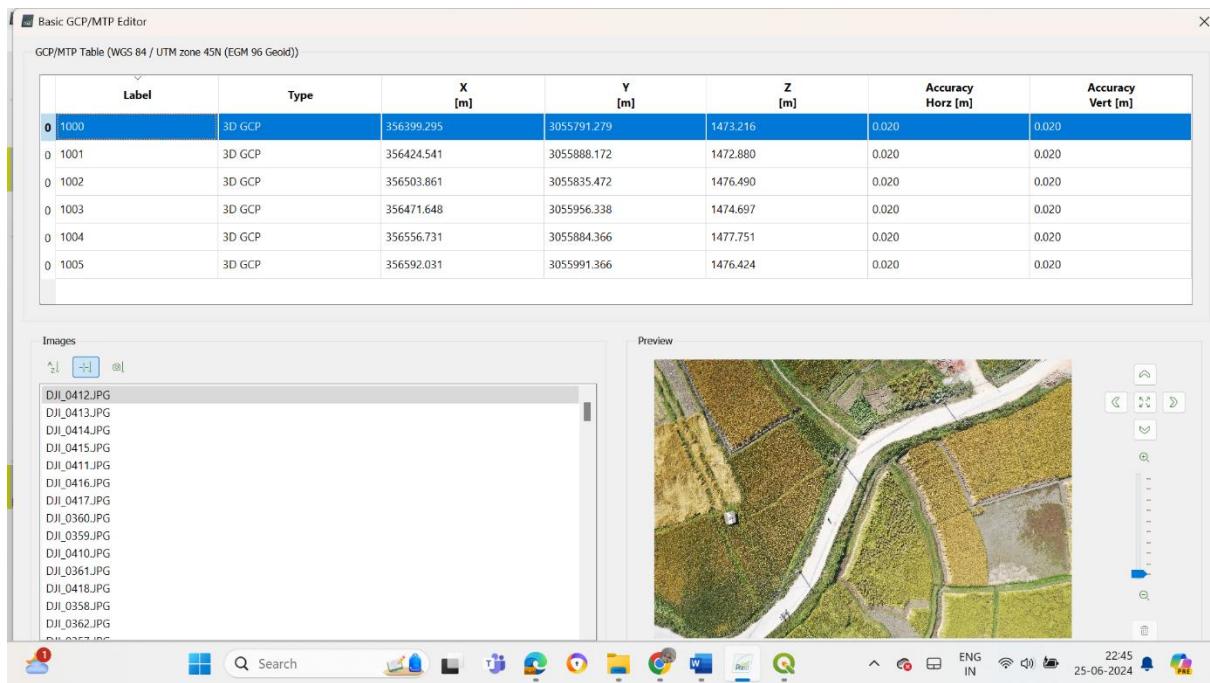
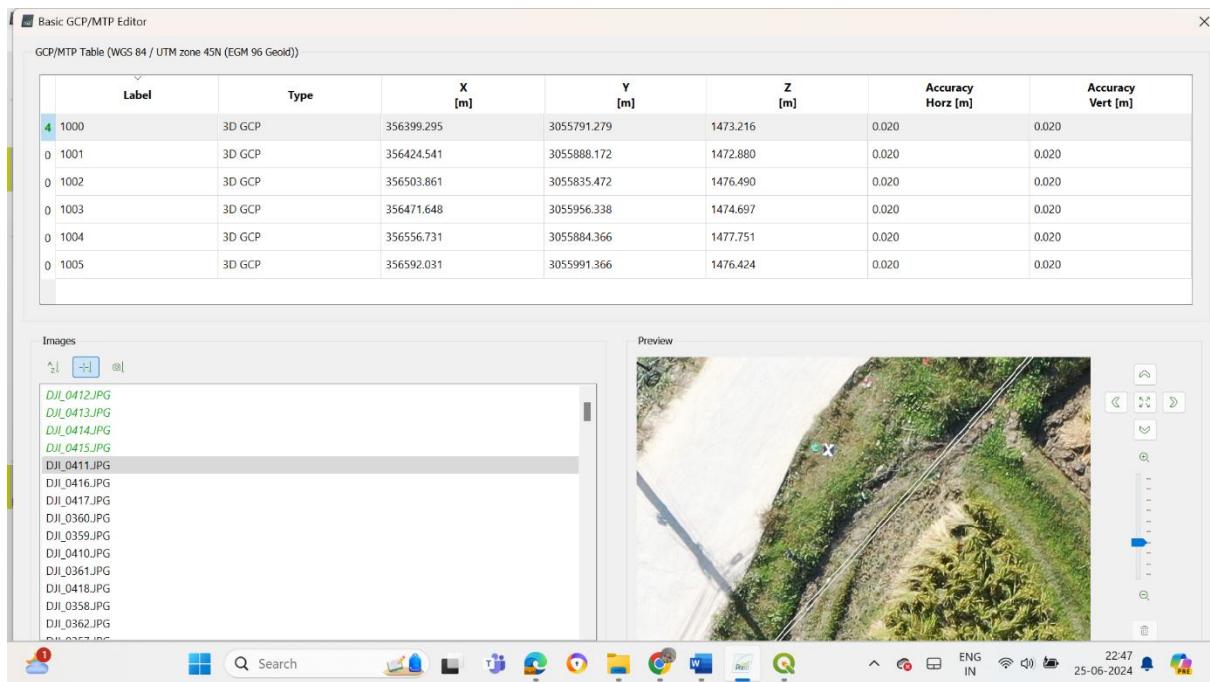
- **Select Processing Options:** In the processing options, select 1. Initial Processing. This step aligns the images and generates a sparse point cloud.
- **Start Processing:** Click Start to begin initial processing. This will create a preliminary model and align the images.

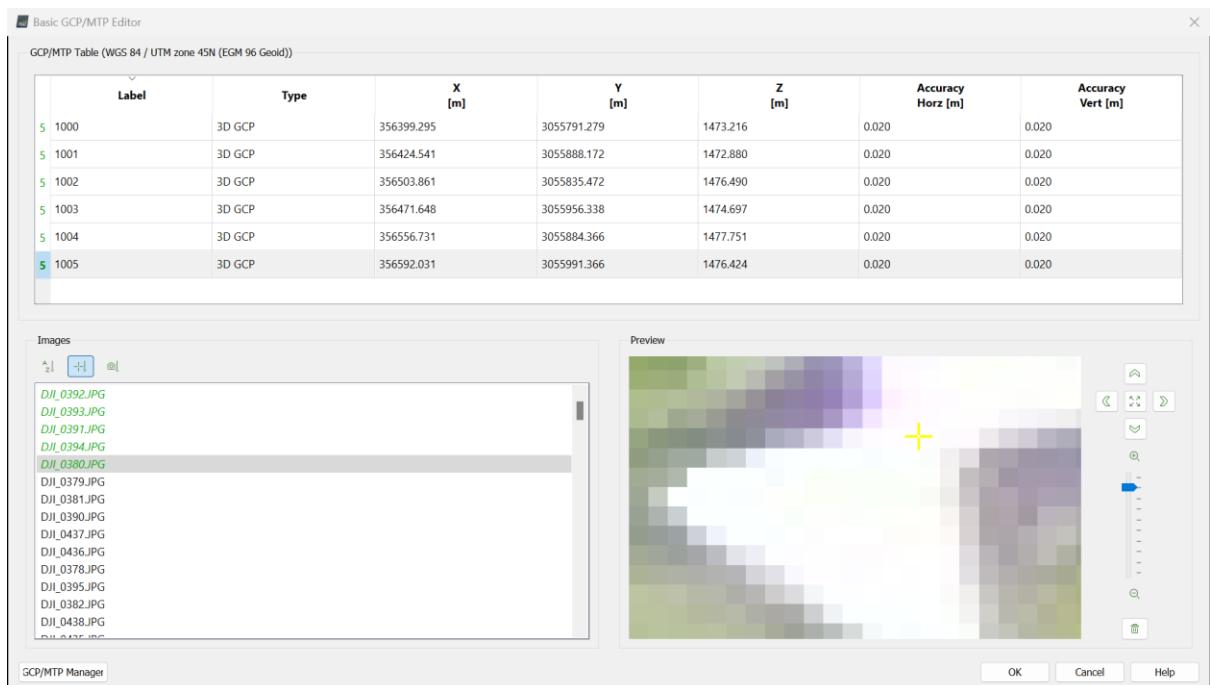
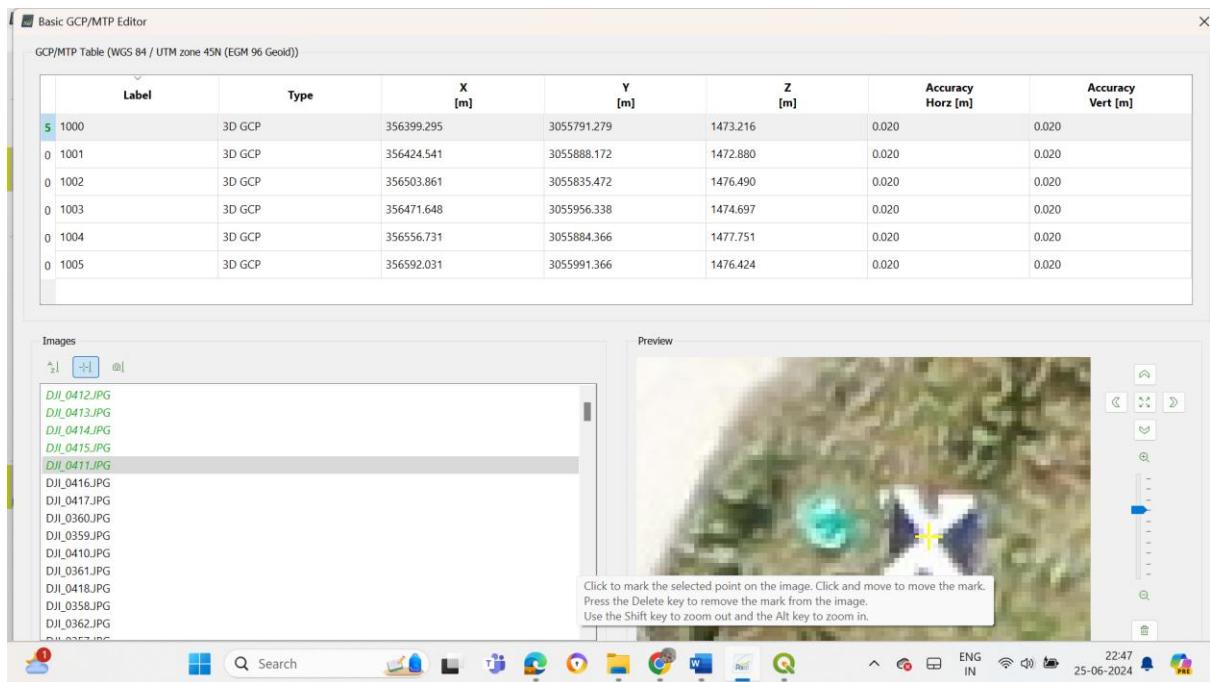




Step 4: Georeferencing and Orthomosaic







Quality Report - NDVI

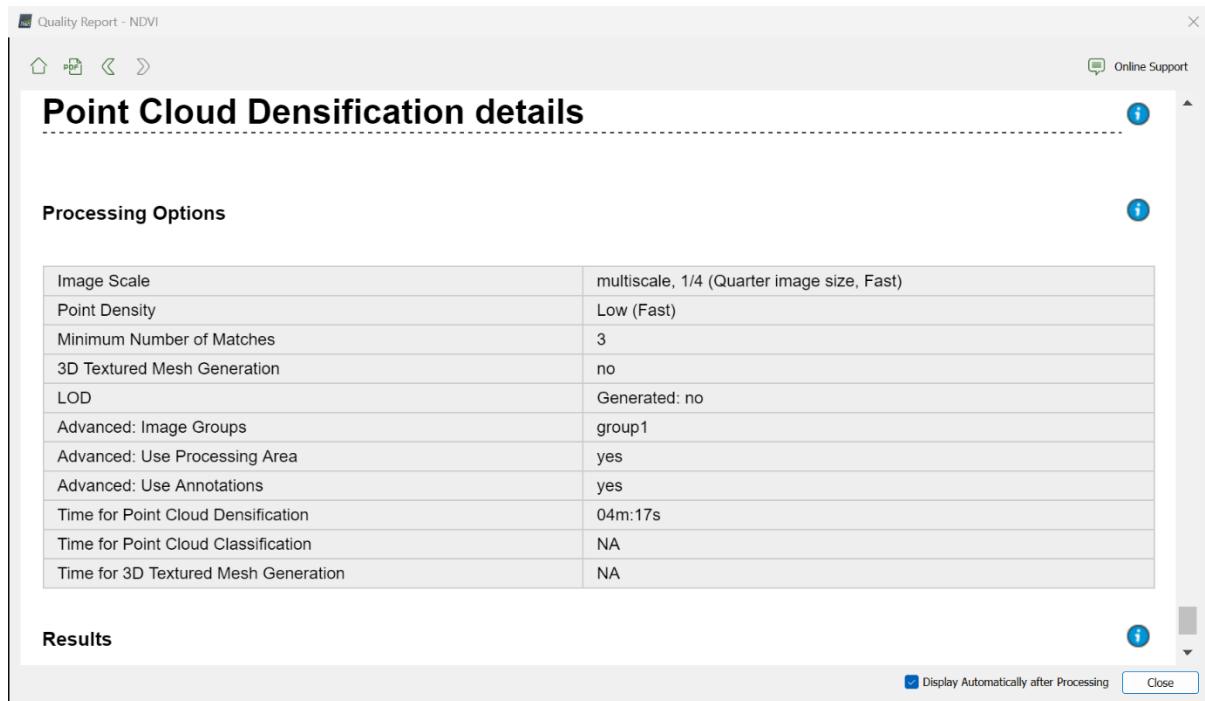
Point Cloud Densification details

Processing Options

Image Scale	multiscale, 1/4 (Quarter image size, Fast)
Point Density	Low (Fast)
Minimum Number of Matches	3
3D Textured Mesh Generation	no
LOD	Generated: no
Advanced: Image Groups	group1
Advanced: Use Processing Area	yes
Advanced: Use Annotations	yes
Time for Point Cloud Densification	04m:17s
Time for Point Cloud Classification	NA
Time for 3D Textured Mesh Generation	NA

Results

Display Automatically after Processing Close

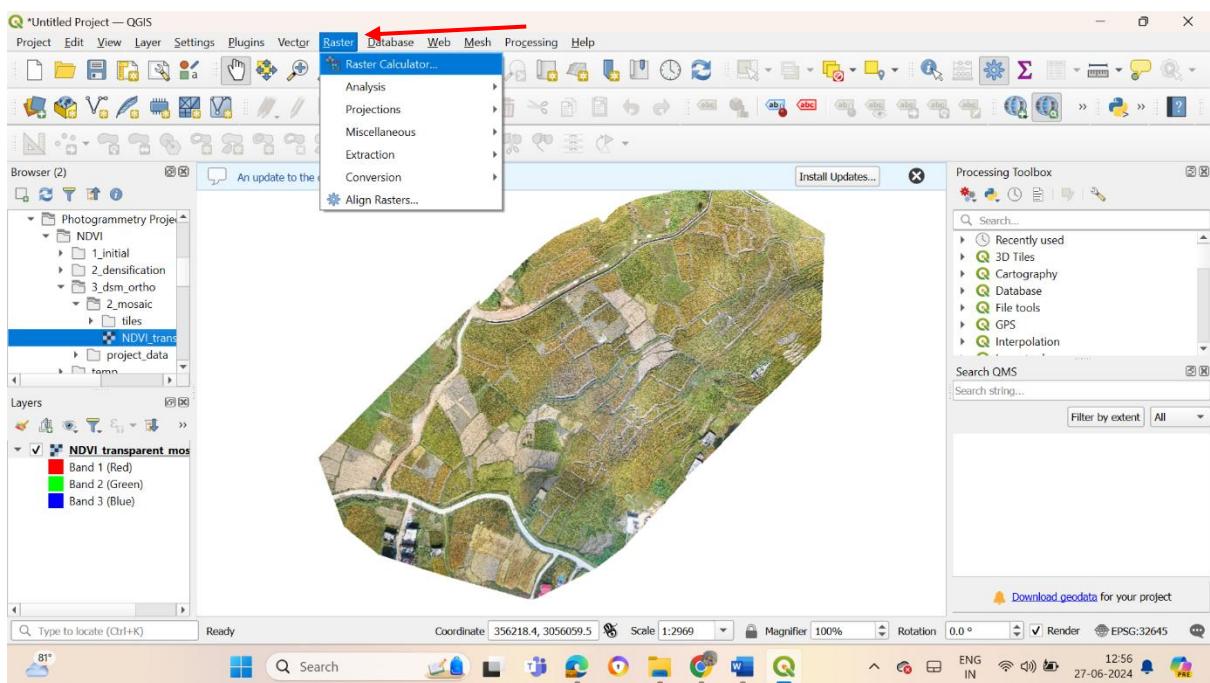
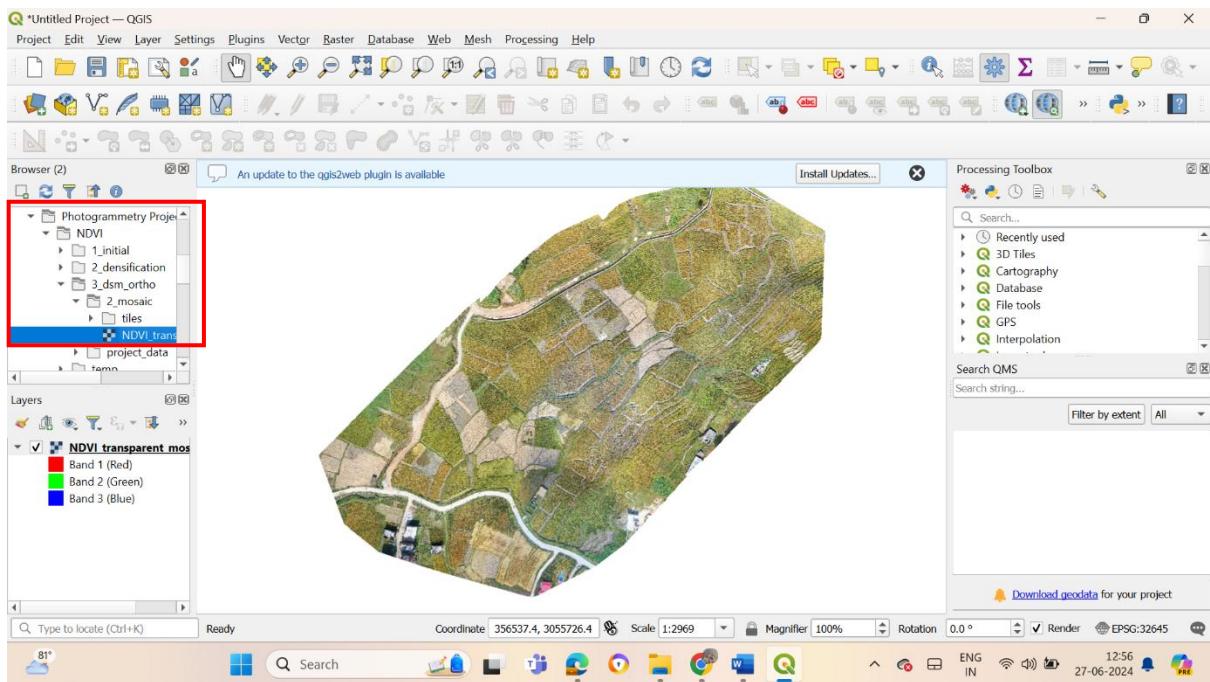


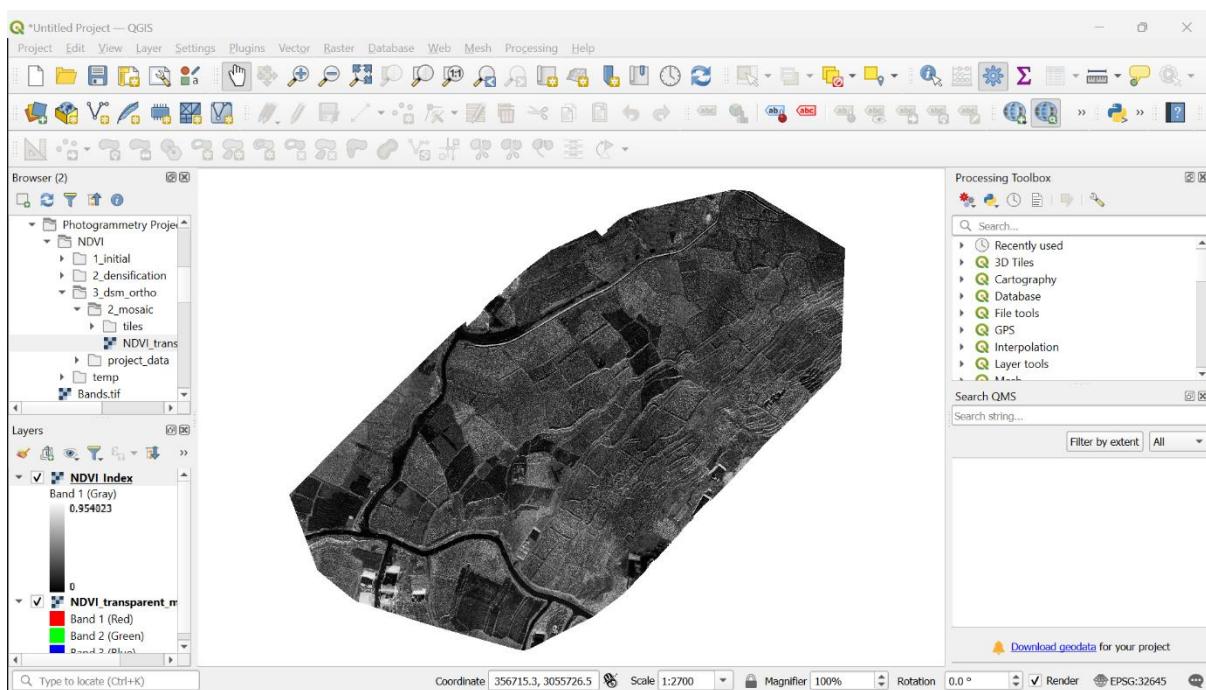
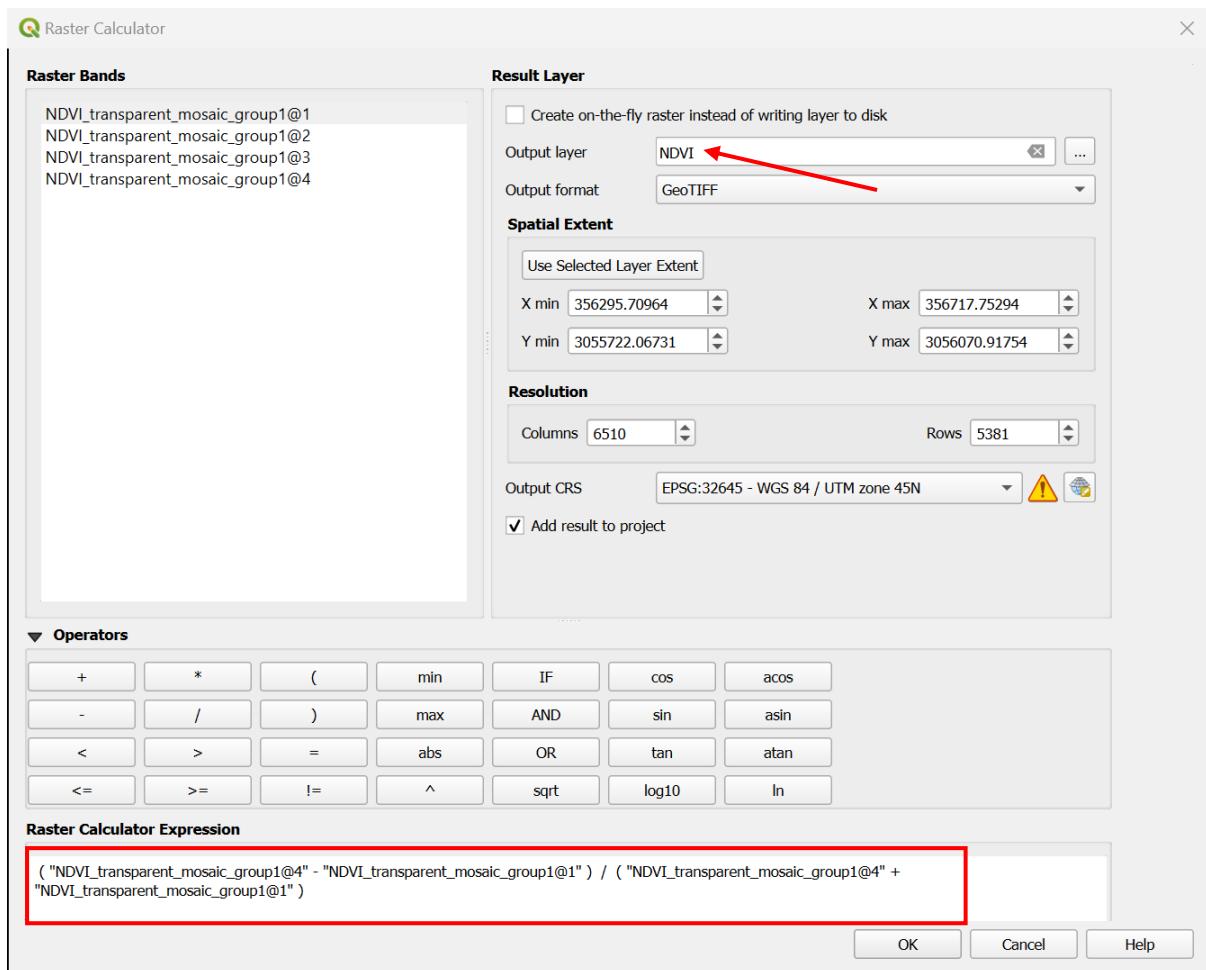
Step 6: Calculate NDVI

- Load the mosaic file in QGIS
- Go the raster -> raster calculator -> and
- Define NDVI Formula: Enter the NDVI formula: $NDVI = (NIR - Red) / (NIR + Red)$.
- Export the new NDIV layer as tif file and generate a NDIV map.



Figure 1: Orthomosaic





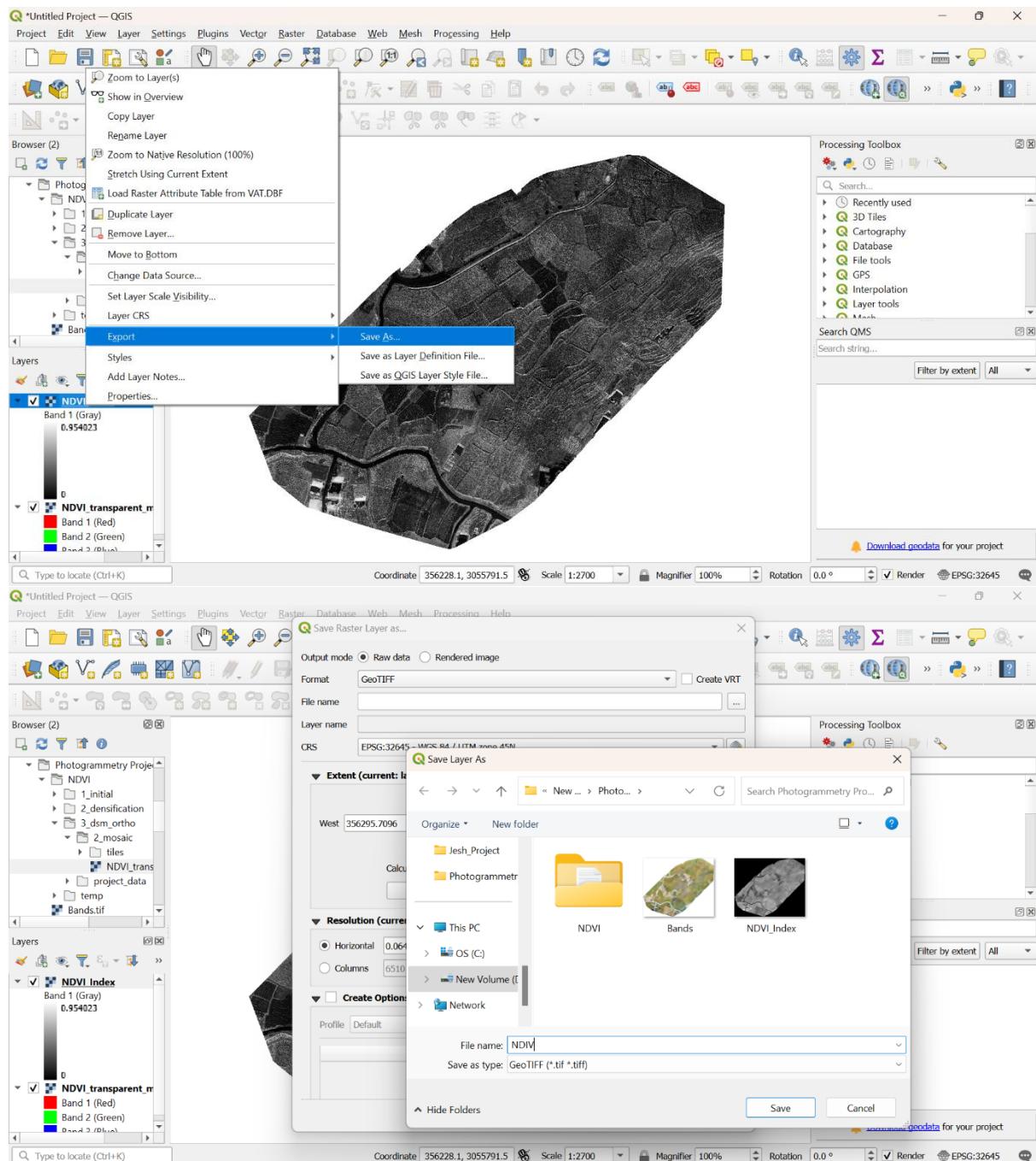
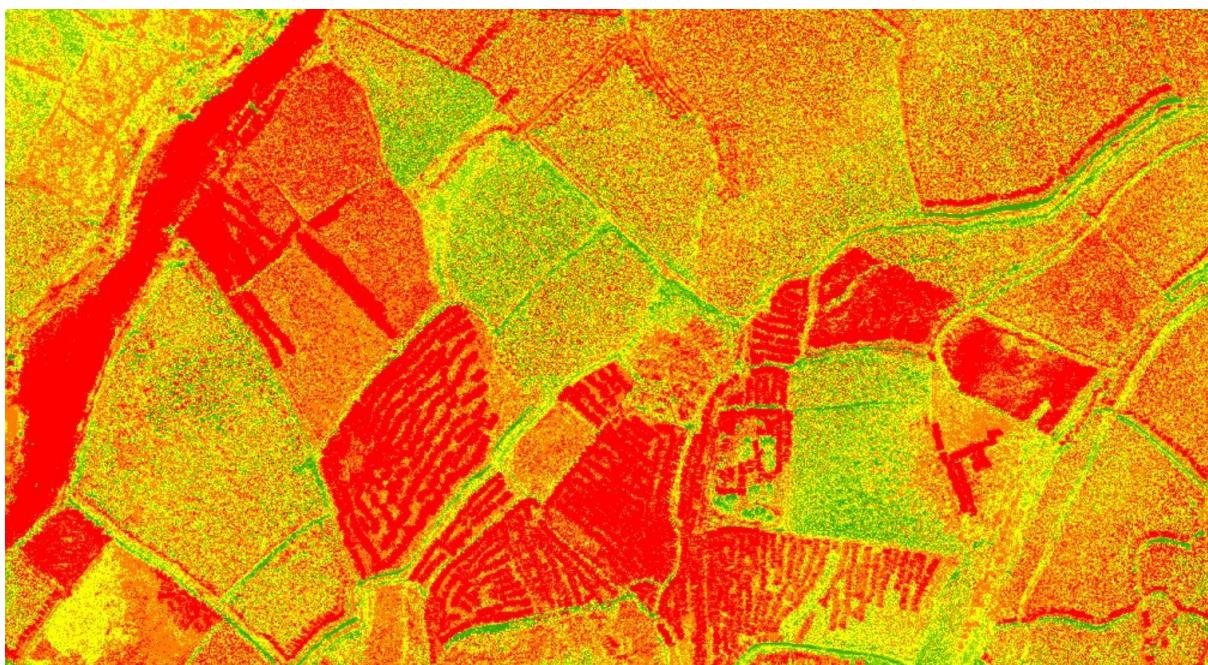




Figure 2: NDVI

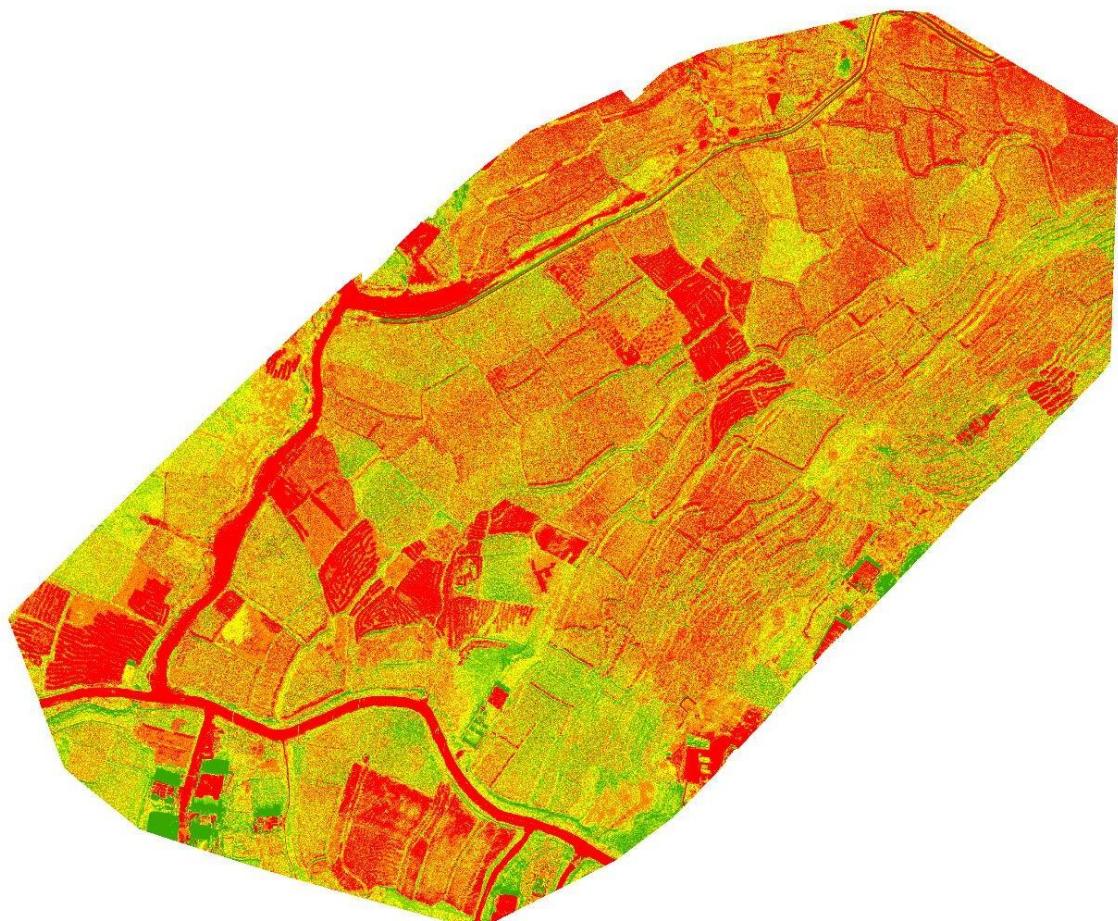


Normalized Difference Vegetation Index Map

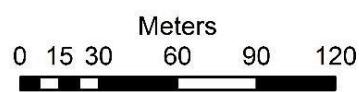
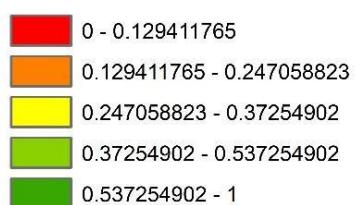


Figure 3: Normalized Difference Vegetation Index Map

Normalized Difference Vegetation Index(NDIV) Map



Legend



Coordinate System: WGS 1984 UTM Zone 45N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

Figure 4: Normalized Difference Vegetation Index Map

References

- Atanasov, A., Bankova, A., & Zhecheva, G. (2023). Vegetation data processes, registered by remote sensing with a small aerial vehicle. *Bulgarian Journal of Agricultural Science*, 29(3).
- Kurbanov, R. K., & Zakharova, N. I. (2020). Application of Vegetation Indexes to Assess the Condition of Crops. *Agricultural Machinery and Technologies*, 14(4).
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- Meivel, S., & Maheswari, S. (2022). Monitoring of potato crops based on multispectral image feature extraction with vegetation indices. *Multidimensional Systems and Signal Processing*, 33(2).
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