KATHMANDU UNIVERSITY

SCHOOL OF ENGINEERING

DEPARTMENT OF GEOMATICS ENGINEERING

DHULIKHEL, KAVRE

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

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Photogrammetry

Department of Geomatics Engineering

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 diff erent 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)

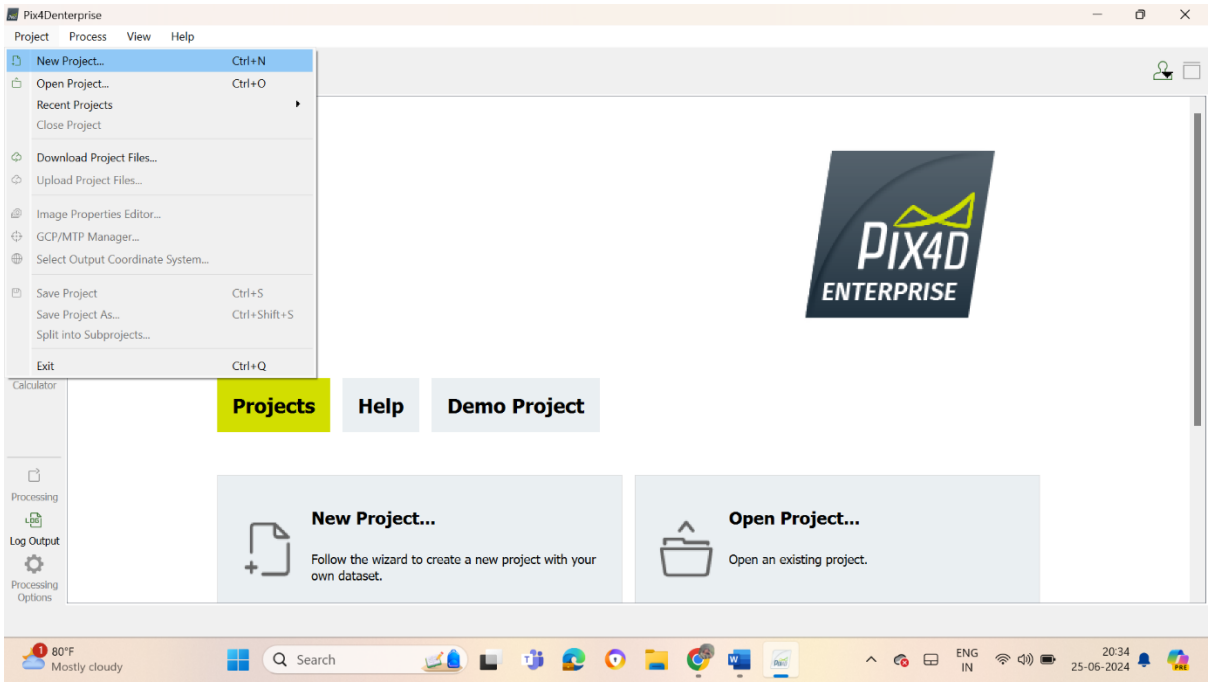
The vegetation monitoring of the development and the health condition of the field is extremely important for the quality of the production processes planning, as well as for the qualities of the production. Spectral plant (vegetation) indices are widely used to monitor and analyse the plant structure 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).

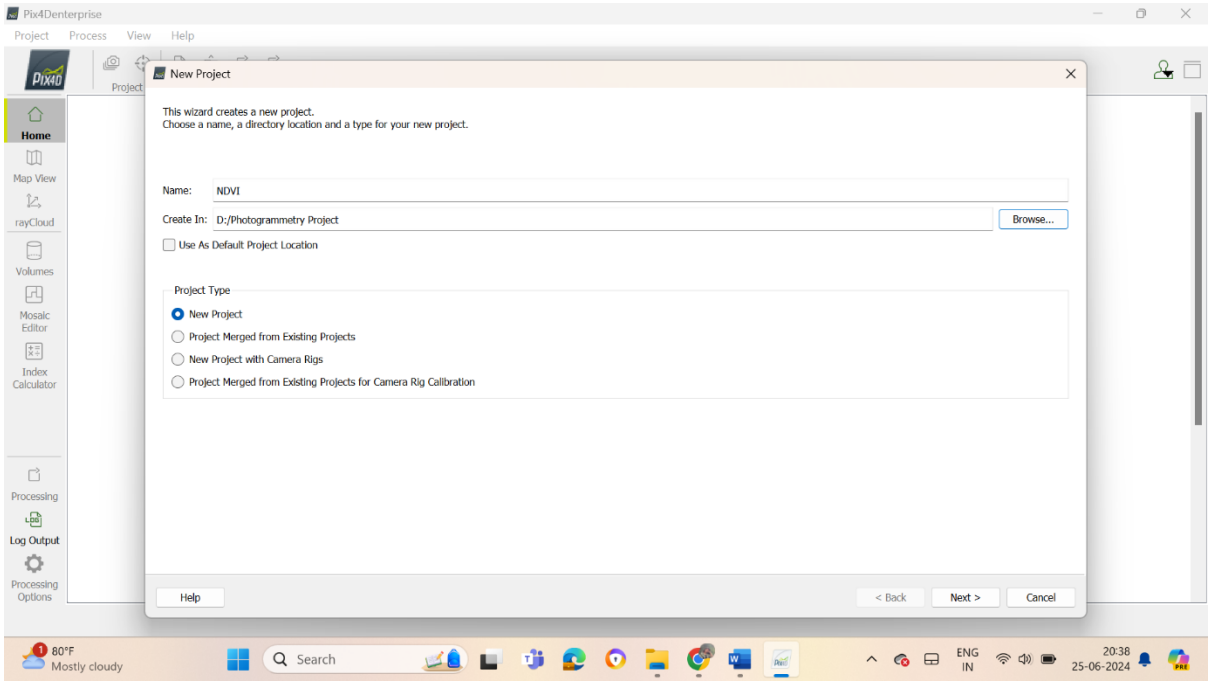
The normalized difference vegetation index (NDVI) is a widely-used metric for quantifying the health and density of vegetation using sensor data. It is calculated from spectrometric dataat two specific bands: red and near-infrared. The spectrometric data is usually sourced from remote sensors, such as 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 An area with nothing growing in it will have an NDVIof 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

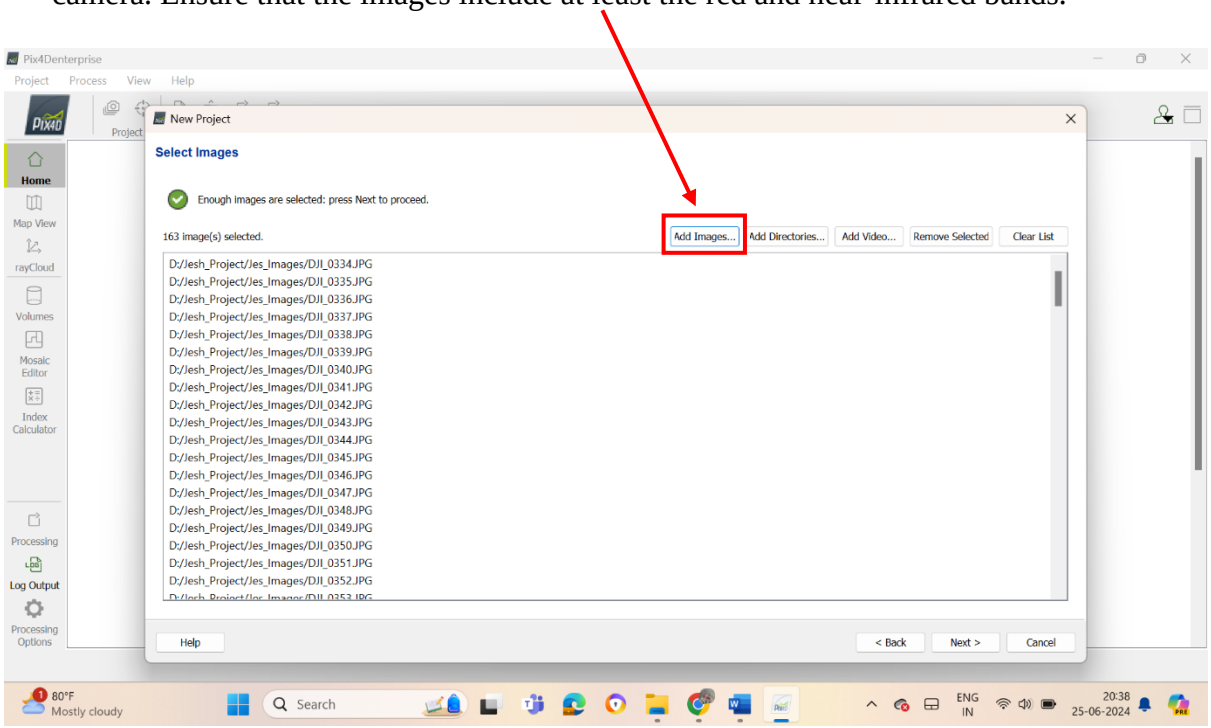
- **Open Pix4Dmapper**: Launch the Pix4Dmapper software on your computer.
- **Create New Project**: Click on `Project` -> `New Project`. Enter a project name and select a location to save your project files.

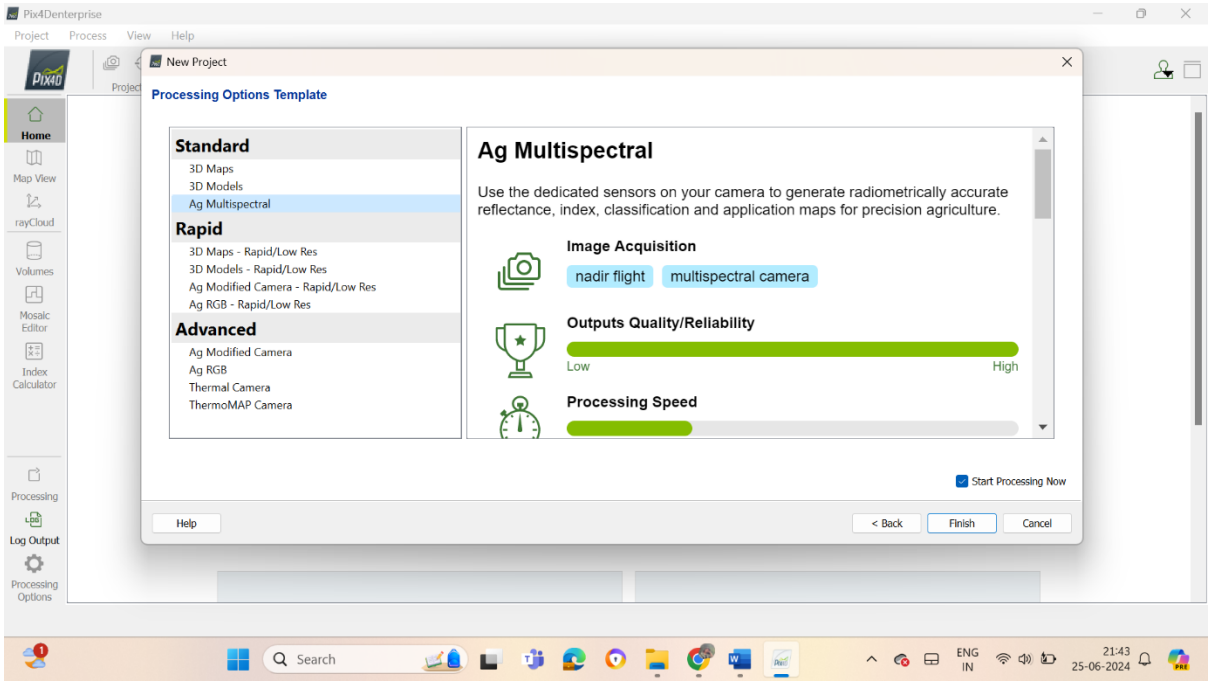




Step 2: Import Images

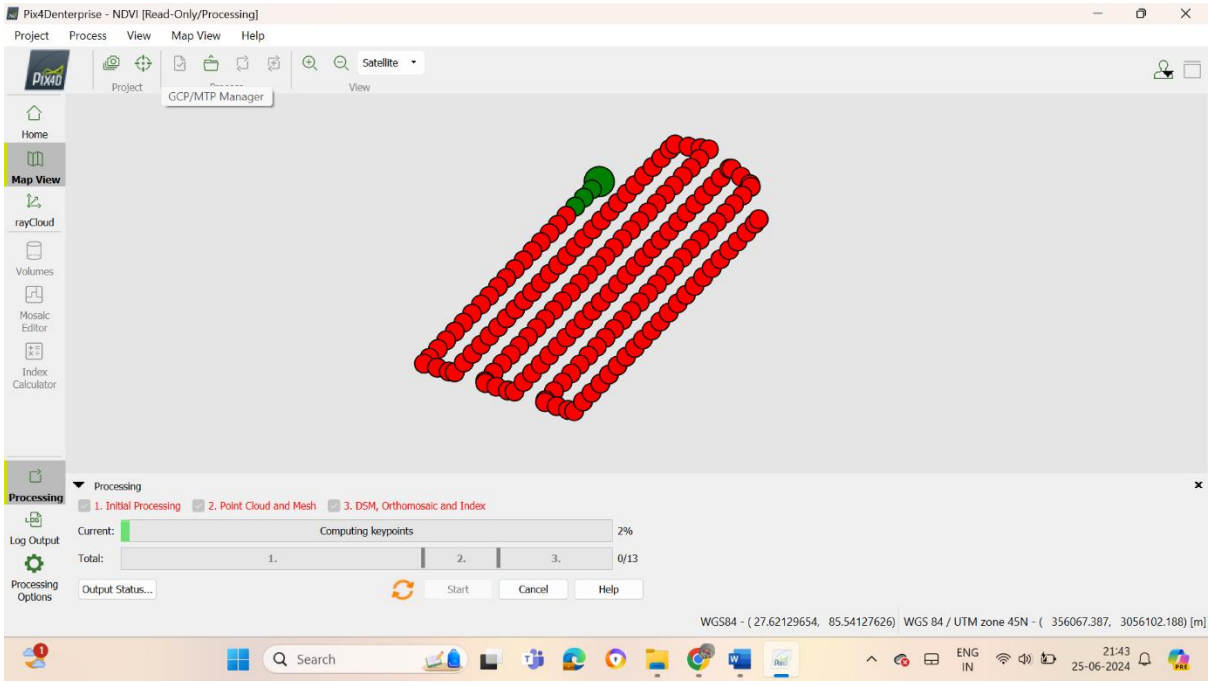
- **Add Images**: Click on `Add Images` and select the images captured by your multispectral camera. Ensure that the images include at least the red and near-infrared bands.

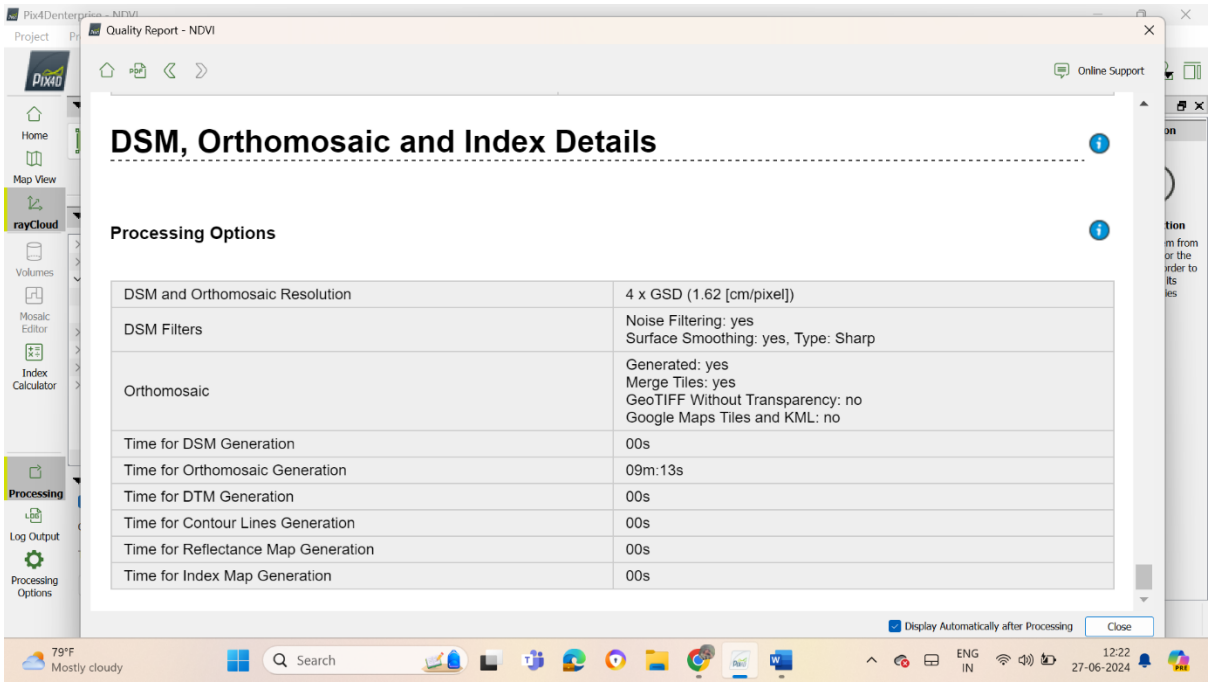


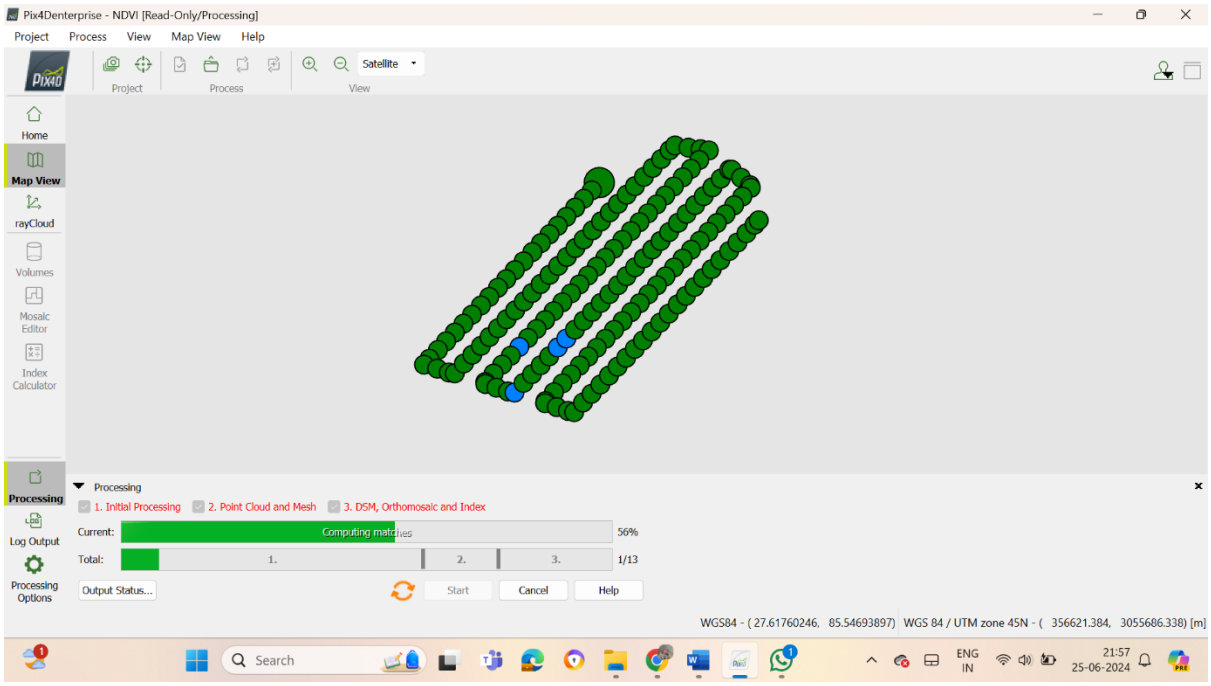


Step 3: Initial Processing

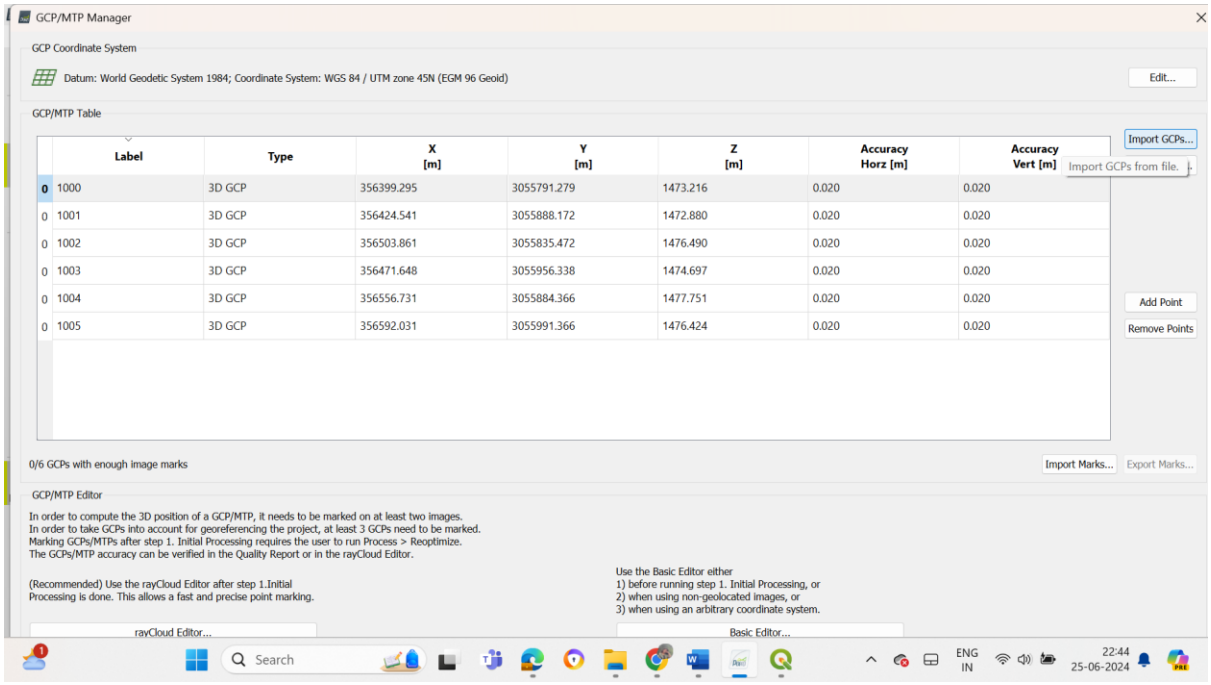
- **Select Processing Options**: In the processing options, select `1. Initial Processing`. This step aligns the images and generates a sparse point cloud.
- **Start Processing**: Click `Start` to begin initial processing. This will create a preliminary model and align he images.

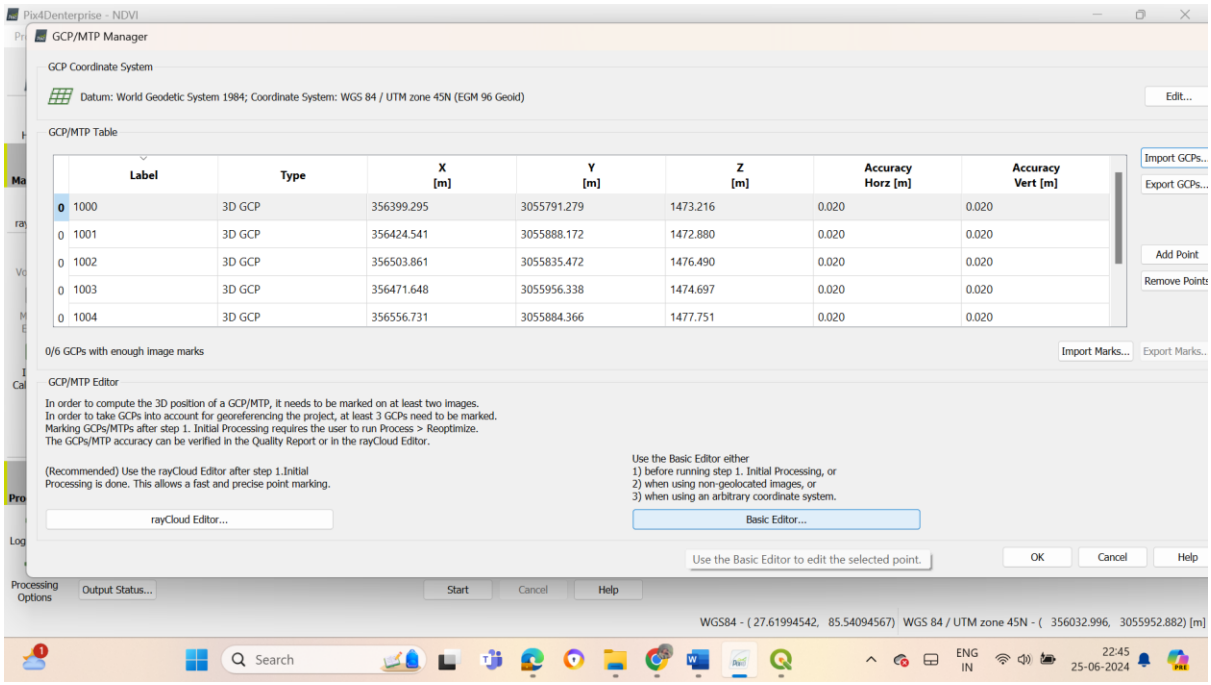


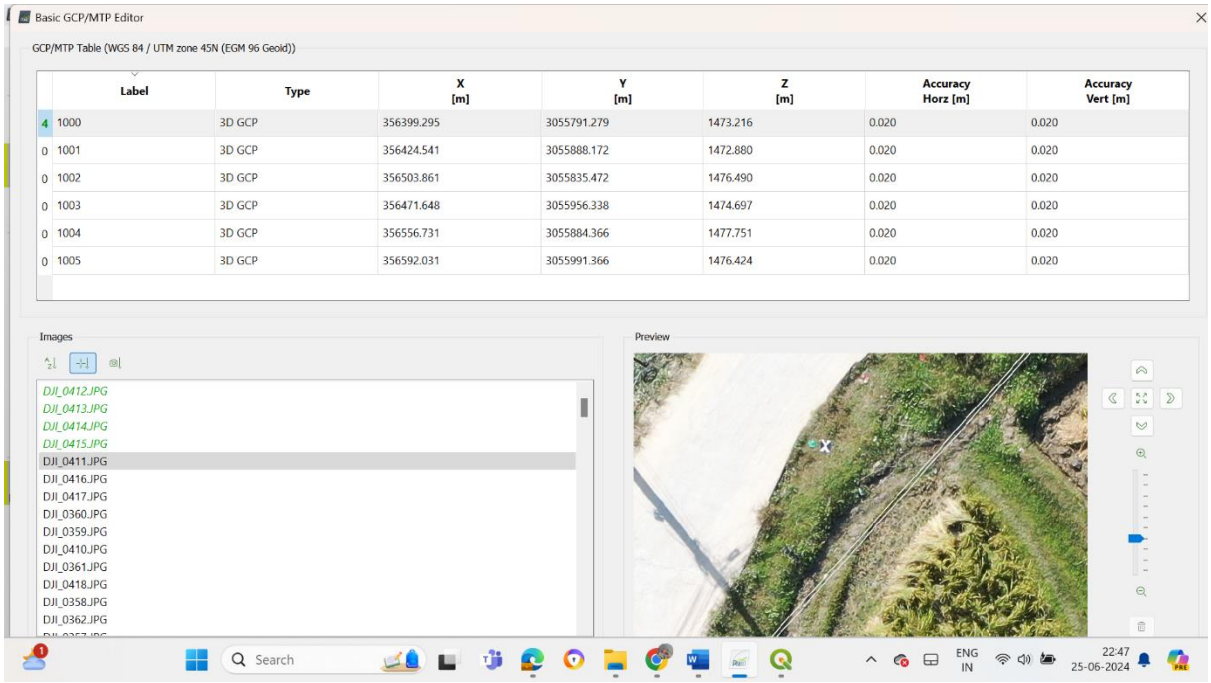


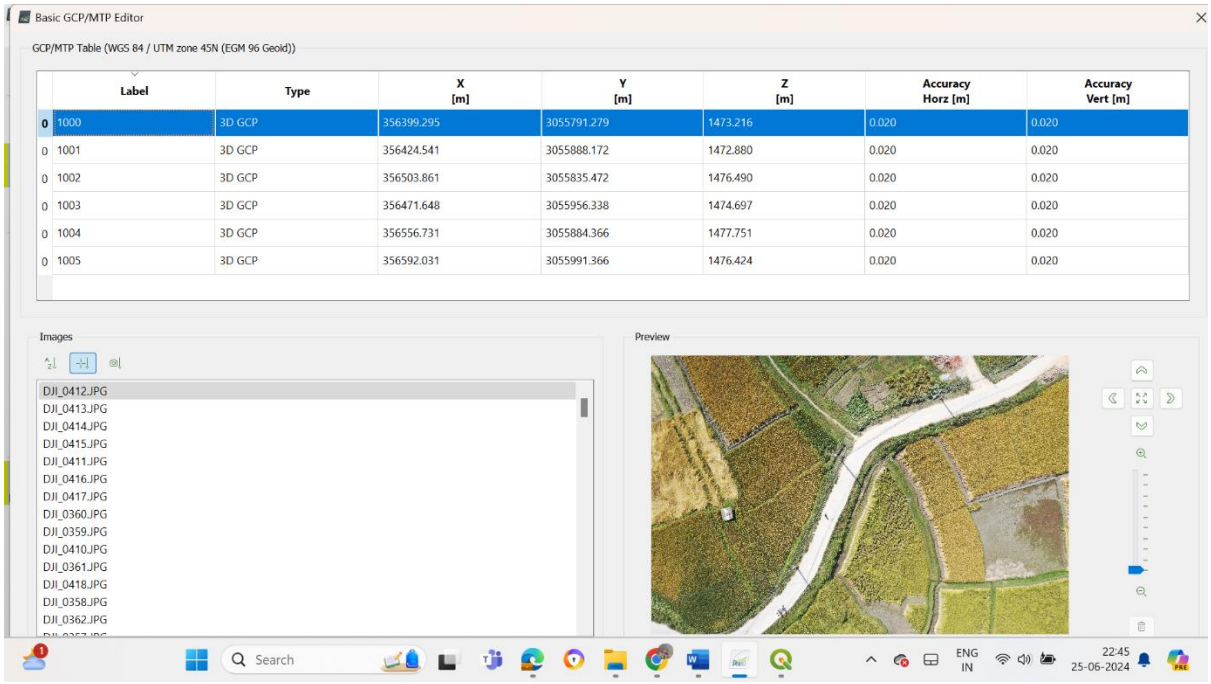

Pix4Denterprise - NDVI [Read-Only/Processing]
Project Process View Map View Help
Satellite
Home
Map View
rayCloud
Volumes
Mosaic Editor
Index Calculator
Processing
Log Output
Processing Options
Processing
1. Initial Processing
2. Point Cloud and Mesh
3. DSM, Orthomosaic and Index
Current:
Computing matches
56%
Total:
1.
2.
3.
1/13
Output Status...
Start
Cancel
Help
WGS84 - (27.61760246, 85.54693897) WGS 84 / UTM zone 45N - (356621.384, 3055686.338) [m]
Search
ENG
IN
21:57
25-06-2024

Step 4: Georeferencing and Orthomosaic






Basic GCP/MTP Editor
GCP/MTP Table (WGS 84 / UTM zone 45N (EGM 96 Geoid))
Label | Type | X [m] | Y [m] | Z [m] | Accuracy Horz [m] | Accuracy Vert [m]
4 1000 | 3D GCP | 356399.295 | 3055791.279 | 1473.216 | 0.020 | 0.020
0 1001 | 3D GCP | 356424.541 | 3055888.172 | 1472.880 | 0.020 | 0.020
0 1002 | 3D GCP | 356503.861 | 3055835.472 | 1476.490 | 0.020 | 0.020
0 1003 | 3D GCP | 356471.648 | 3055956.338 | 1474.697 | 0.020 | 0.020
0 1004 | 3D GCP | 356556.731 | 3055884.366 | 1477.751 | 0.020 | 0.020
0 1005 | 3D GCP | 356592.031 | 3055991.366 | 1476.424 | 0.020 | 0.020
Images
DJI_0412.JPG
DJI_0413.JPG
DJI_0414.JPG
DJI_0415.JPG
DJI_0411.JPG
DJI_0416.JPG
DJI_0417.JPG
DJI_0360.JPG
DJI_0359.JPG
DJI_0410.JPG
DJI_0361.JPG
DJI_0418.JPG
DJI_0358.JPG
DJI_0362.JPG
Preview
Search
ENG IN
22:47
25-06-2024


Basic GCP/MTP Editor
GCP/MTP Table (WGS 84 / UTM zone 45N (EGM 96 Geoid))
Label | Type | X [m] | Y [m] | Z [m] | Accuracy Horz [m] | Accuracy Vert [m]
0 1000 | 3D GCP | 356399.295 | 3055791.279 | 1473.216 | 0.020 | 0.020
0 1001 | 3D GCP | 356424.541 | 3055888.172 | 1472.880 | 0.020 | 0.020
0 1002 | 3D GCP | 356503.861 | 3055835.472 | 1476.490 | 0.020 | 0.020
0 1003 | 3D GCP | 356471.648 | 3055956.338 | 1474.697 | 0.020 | 0.020
0 1004 | 3D GCP | 356556.731 | 3055884.366 | 1477.751 | 0.020 | 0.020
0 1005 | 3D GCP | 356592.031 | 3055991.366 | 1476.424 | 0.020 | 0.020
Images
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DJI_0413.JPG
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DJI_0417.JPG
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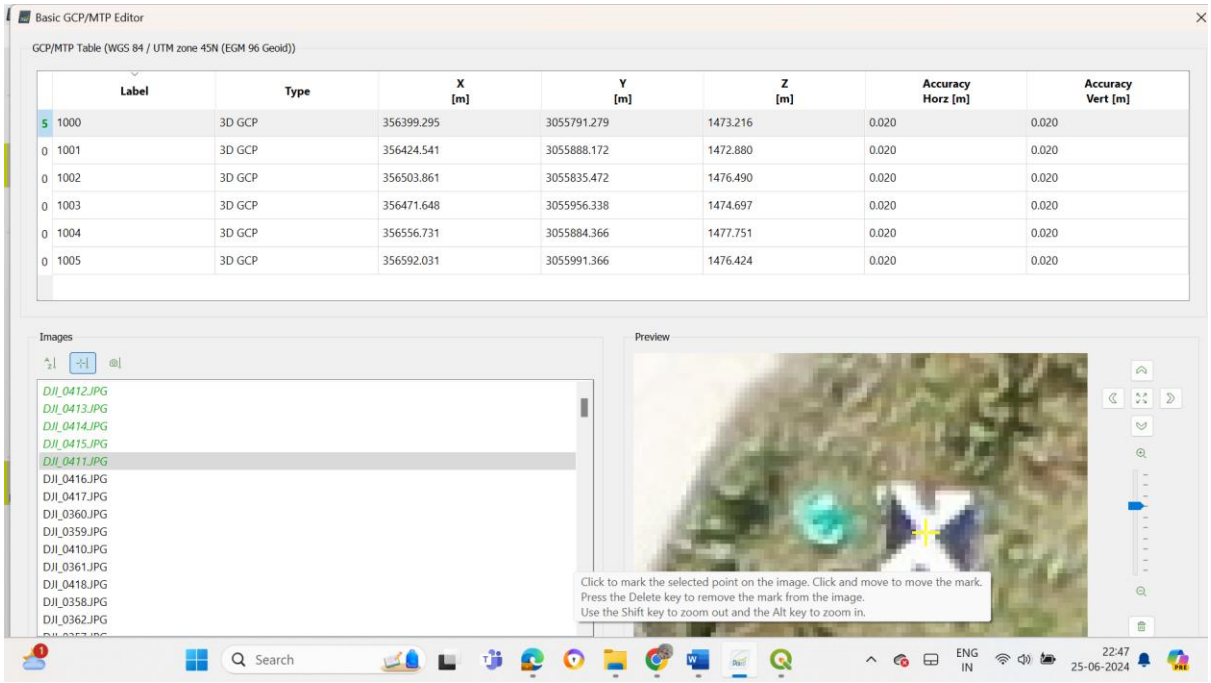
DJI_0359.JPG
DJI_0410.JPG
DJI_0361.JPG
DJI_0418.JPG
DJI_0358.JPG
DJI_0362.JPG
Preview
Search
ENG IN
22:45
25-06-2024


Basic GCP/MTP Editor
GCP/MTP Table (WGS 84 / UTM zone 45N (EGM 96 Geoid))
Label | Type | X [m] | Y [m] | Z [m] | Accuracy Horz [m] | Accuracy Vert [m]
1000 | 3D GCP | 356399.295 | 3055791.279 | 1473.216 | 0.020 | 0.020
1001 | 3D GCP | 356424.541 | 3055888.172 | 1472.880 | 0.020 | 0.020
1002 | 3D GCP | 356503.861 | 3055835.472 | 1476.490 | 0.020 | 0.020
1003 | 3D GCP | 356471.648 | 3055956.338 | 1474.697 | 0.020 | 0.020
1004 | 3D GCP | 356556.731 | 3055884.366 | 1477.751 | 0.020 | 0.020
1005 | 3D GCP | 356592.031 | 3055991.366 | 1476.424 | 0.020 | 0.020
Images
DJI_0412.JPG
DJI_0413.JPG
DJI_0414.JPG
DJI_0415.JPG
DJI_0411.JPG
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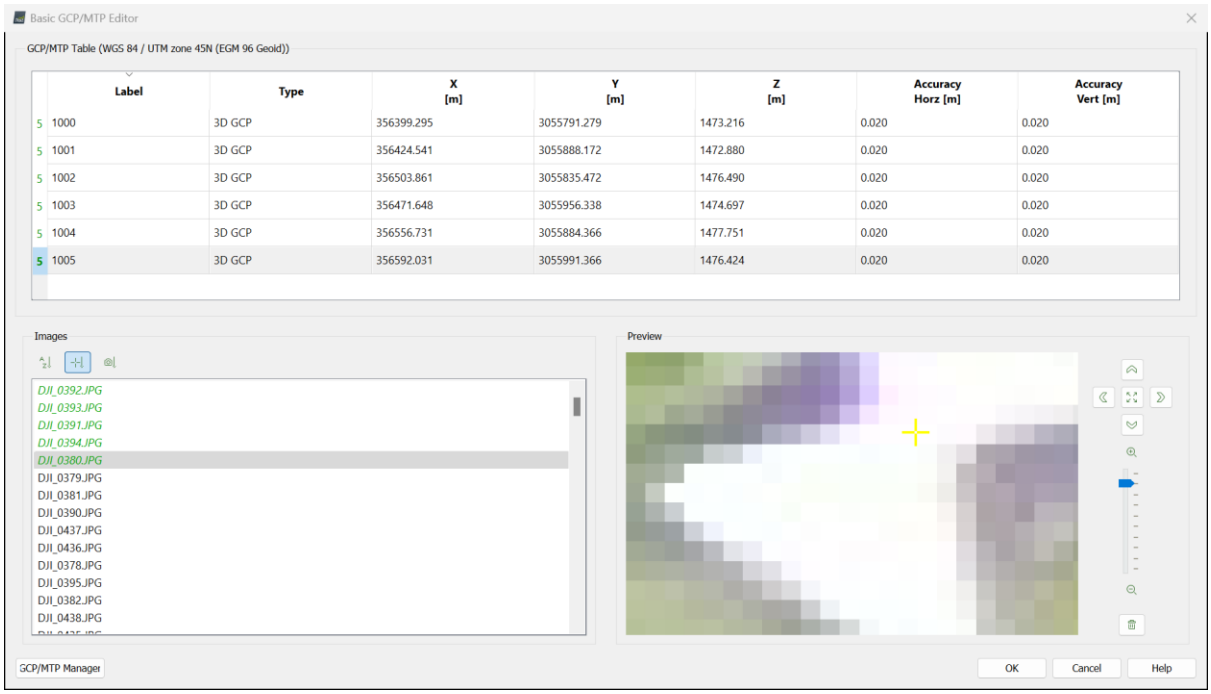
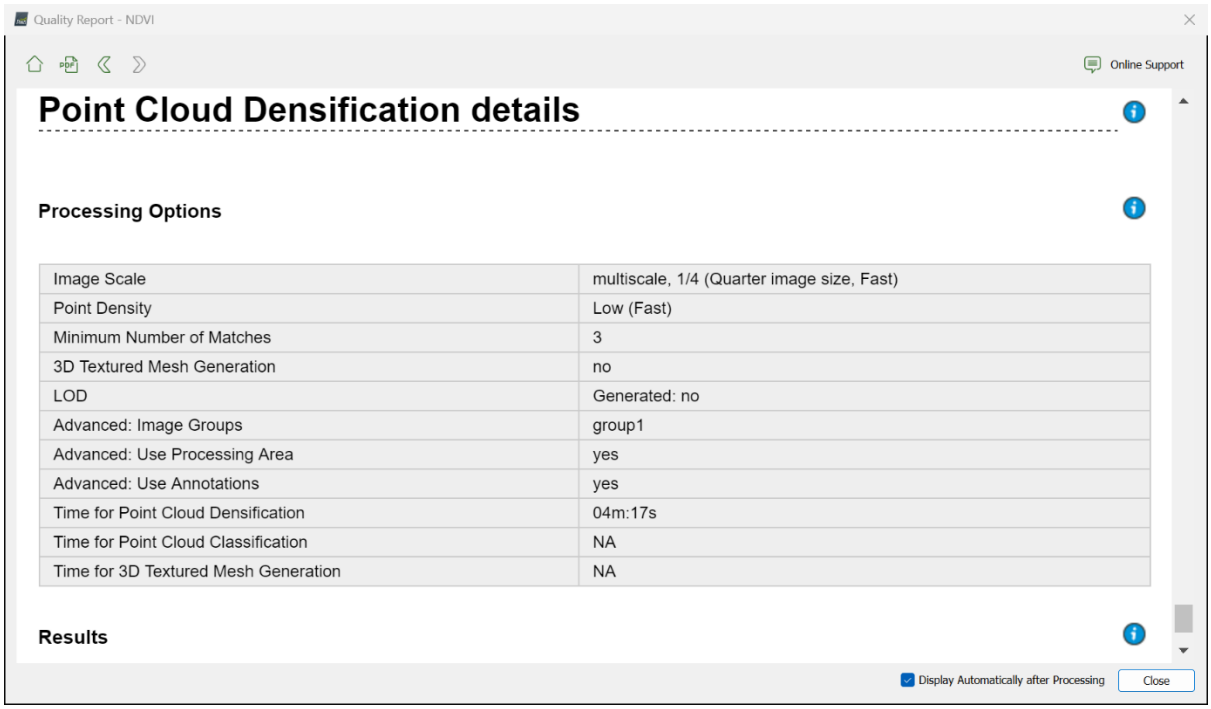
DJI_0417.JPG
DJI_0360.JPG
DJI_0359.JPG
DJI_0410.JPG
DJI_0361.JPG
DJI_0418.JPG
DJI_0358.JPG
DJI_0362.JPG
Preview
Click to mark the selected point on the image. Click and move to move the mark.
Press the Delete key to remove the mark from the image.
Use the Shift key to zoom out and the Alt key to zoom in.
Search
ENG IN
22:47
25-06-2024

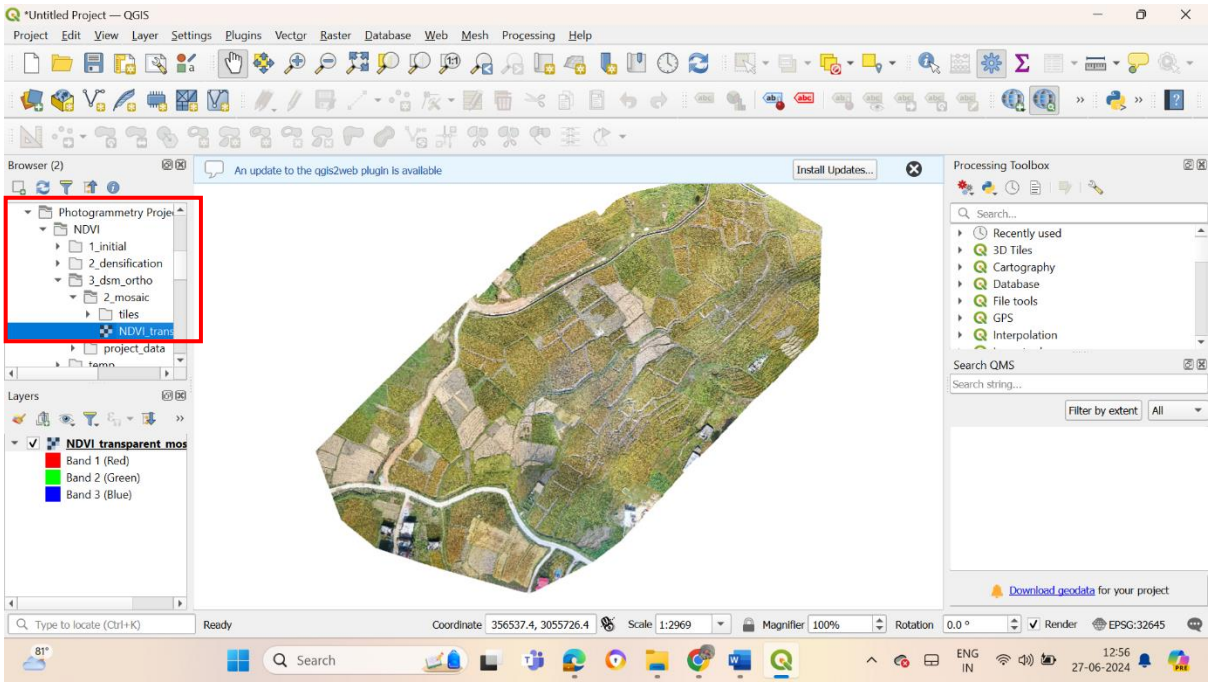

Basic GCP/MTP Editor
GCP/MTP Table (WGS 84 / UTM zone 45N (EGM 96 Geoid))
Label | Type | X [m] | Y [m] | Z [m] | Accuracy Horz [m] | Accuracy Vert [m]
1000 | 3D GCP | 356399.295 | 3055791.279 | 1473.216 | 0.020 | 0.020
1001 | 3D GCP | 356424.541 | 3055888.172 | 1472.880 | 0.020 | 0.020
1002 | 3D GCP | 356503.861 | 3055835.472 | 1476.490 | 0.020 | 0.020
1003 | 3D GCP | 356471.648 | 3055956.338 | 1474.697 | 0.020 | 0.020
1004 | 3D GCP | 356556.731 | 3055884.366 | 1477.751 | 0.020 | 0.020
1005 | 3D GCP | 356592.031 | 3055991.366 | 1476.424 | 0.020 | 0.020
Images
DJI_0392.JPG
DJI_0393.JPG
DJI_0391.JPG
DJI_0394.JPG
DJI_0380.JPG
DJI_0379.JPG
DJI_0381.JPG
DJI_0390.JPG
DJI_0437.JPG
DJI_0436.JPG
DJI_0378.JPG
DJI_0395.JPG
DJI_0382.JPG
DJI_0438.JPG
Preview
GCP/MTP Manager
OK
Cancel
Help

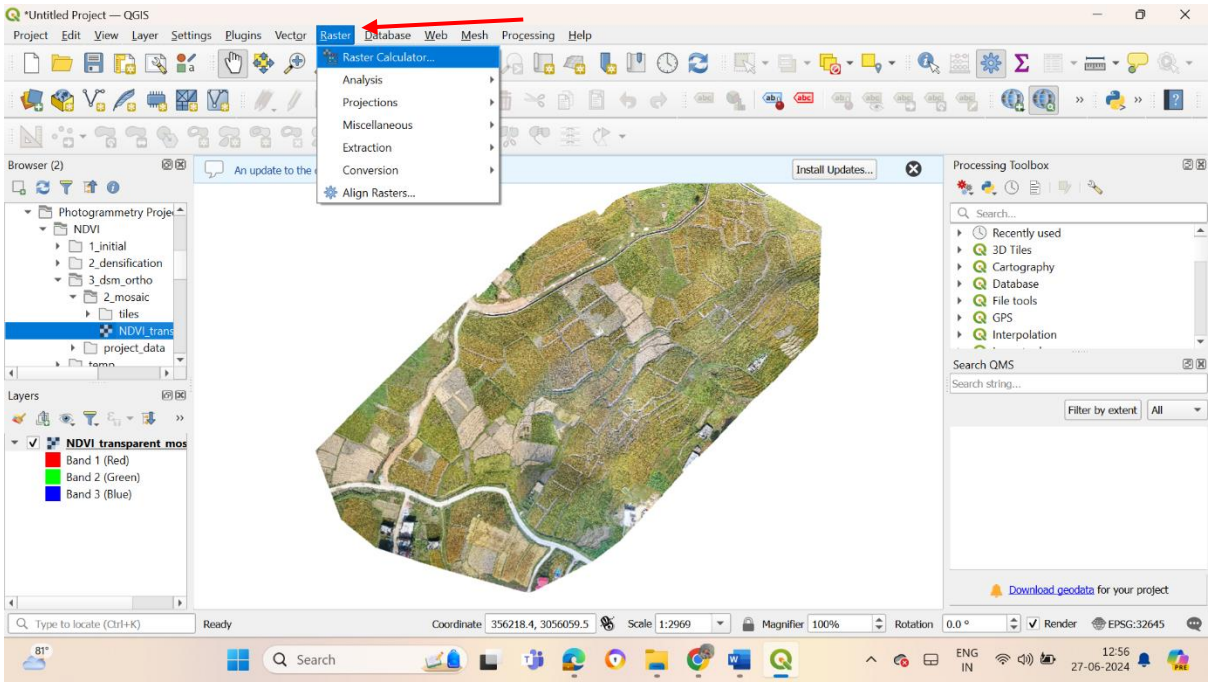

Quality Report - NDVI
Online Support
Point Cloud Densification details
Processing Options
Image Scale
multiscale, 1/4 (Quarter image size, Fast)
Point Density
Low (Fast)
Minimum Number of Matches
3
3D Textured Mesh Generation
no
LOD
Generated: no
Advanced: Image Groups
group1
Advanced: Use Processing 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

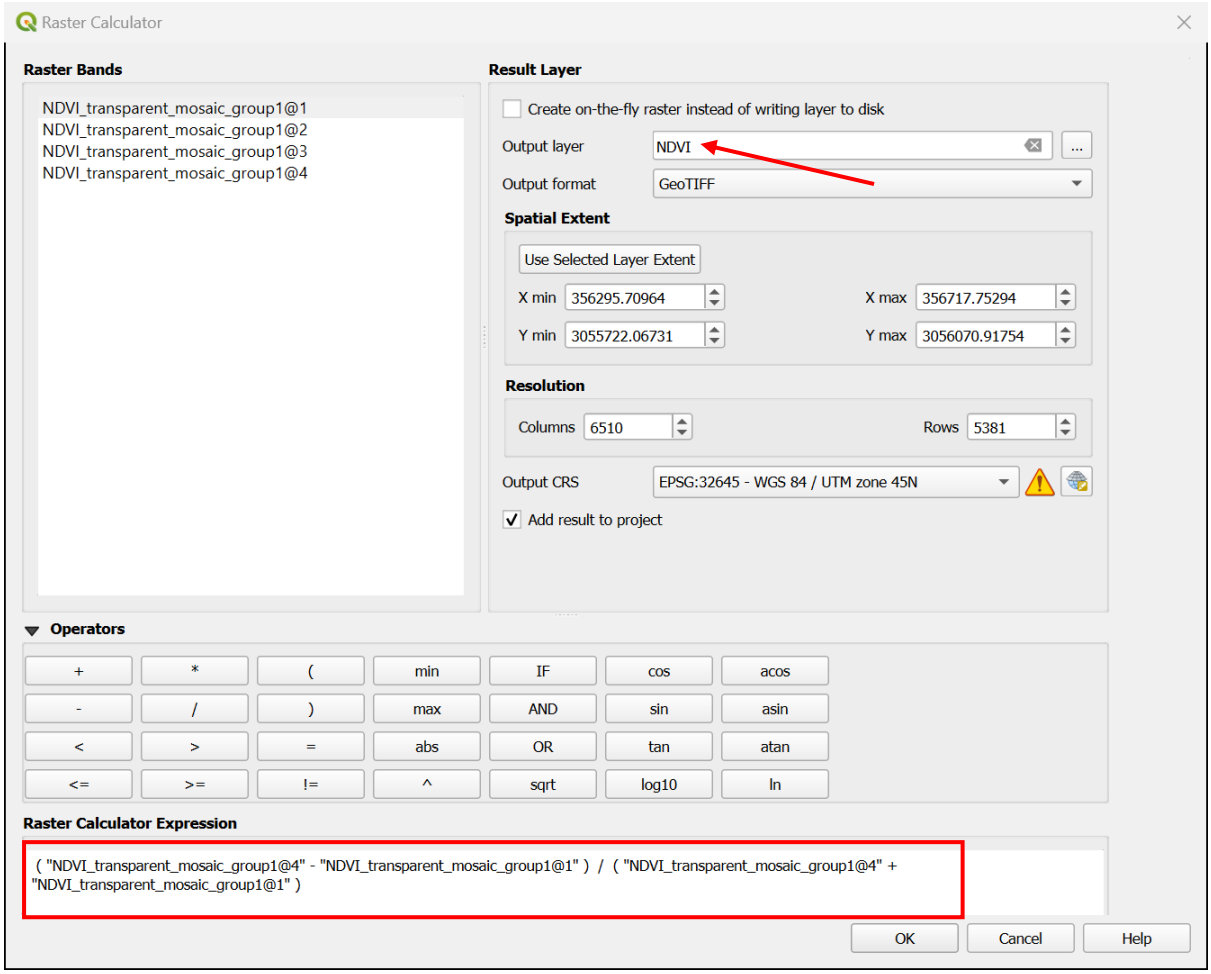
Step 6: Calculate NDVI

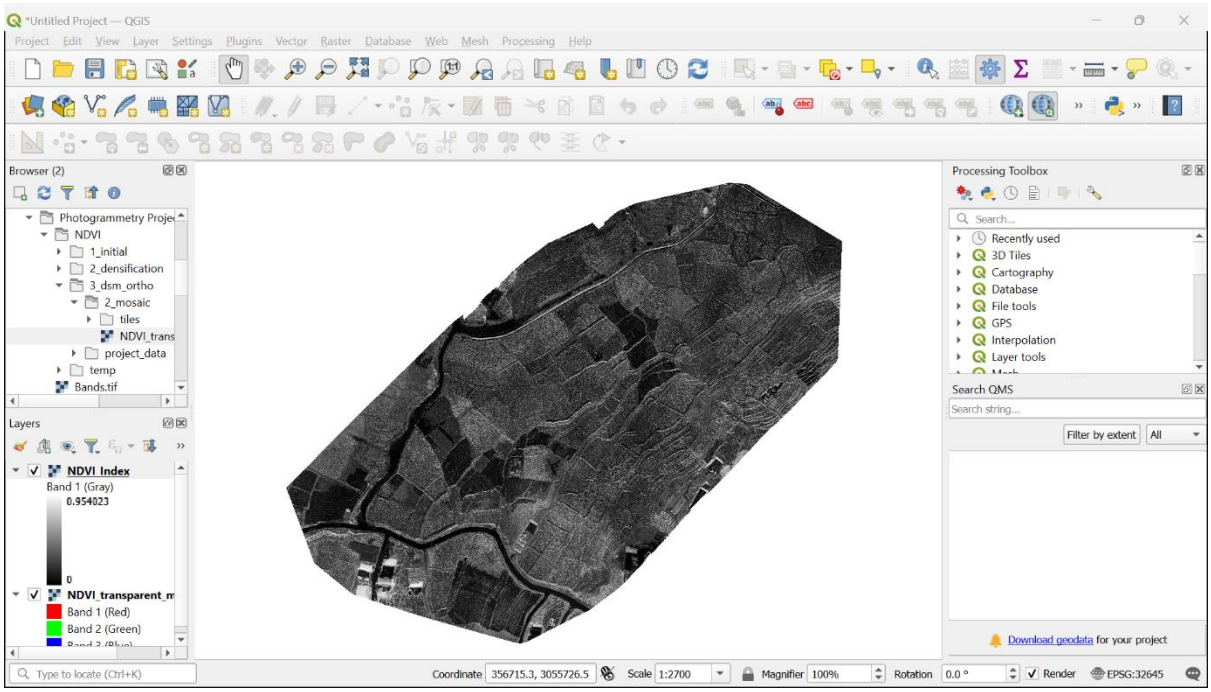
- Load the mosaic file in QGIS
- Go the raster -> raster calculator –> and
- Define NDVI Formula: Enter the NDVI formula: `NDVI = (NIR - Red) / (NIR + Red)`.
- Export the new NDIV layer as tif file and generate a NDIV map.

Figure 1: Orthomosaic


*Untitled Project — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
Browser (2)
An update to the qgis2web plugin is available
Install Updates...
Photogrammetry Proje
NDVI
1_initial
2_densification
3_dsm_ortho
2_mosaic
tiles
NDVI_trans
project_data
Layers
NDVI transparent mos
Band 1 (Red)
Band 2 (Green)
Band 3 (Blue)
Processing Toolbox
Search...
Recently used
3D Tiles
Cartography
Database
File tools
GPS
Interpolation
Search QMS
Search string...
Filter by extent
All
Download geodata for your project
Type to locate (Ctrl+K)
Ready
Coordinate 356537.4, 3055726.4
Scale 1:2969
Magnifier 100%
Rotation 0.0 °
Render
EPSG:32645
Search
ENG IN
12:56
27-06-2024


*Untitled Project — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
Raster Calculator...
Analysis
Projections
Miscellaneous
Extraction
Conversion
Align Rasters...
Browser (2)
Install Updates...
Photogrammetry Proje
NDVI
1_initial
2_densification
3_dsm_ortho
2_mosaic
tiles
NDVI_trans
project_data
Layers
NDVI transparent mos
Band 1 (Red)
Band 2 (Green)
Band 3 (Blue)
Processing Toolbox
Search...
Recently used
3D Tiles
Cartography
Database
File tools
GPS
Interpolation
Search QMS
Search string...
Filter by extent
All
Download geodata for your project
Type to locate (Ctrl+K)
Ready
Coordinate 356218.4, 3056059.5
Scale 1:2969
Magnifier 100%
Rotation 0.0 °
Render
EPSG:32645
Search
ENG IN
12:56
27-06-2024


Raster Calculator
Raster Bands
NDVI_transparent_mosaic_group1@1
NDVI_transparent_mosaic_group1@2
NDVI_transparent_mosaic_group1@3
NDVI_transparent_mosaic_group1@4
Result Layer
Create on-the-fly raster instead of writing layer to disk
Output layer
NDVI
Output format
GeoTIFF
Spatial Extent
Use Selected Layer Extent
X min
356295.70964
X max
356717.75294
Y min
3055722.06731
Y max
3056070.91754
Resolution
Columns
6510
Rows
5381
Output CRS
EPSG:32645 - WGS 84 / UTM zone 45N
Add result to project
Operators
+ * (min IF cos acos
- /) max AND sin asin
< > = abs OR tan atan
<= >= != ^ sqrt log10 ln
Raster Calculator Expression
("NDVI_transparent_mosaic_group1@4" - "NDVI_transparent_mosaic_group1@1") / ("NDVI_transparent_mosaic_group1@4" + "NDVI_transparent_mosaic_group1@1")
OK
Cancel
Help


*Untitled Project — QGIS
Browser (2)
Layers
NDVI_Index
Band 1 (Gray)
Band 1 (Red)
Band 2 (Green)
Processing Toolbox
Search QMS
Download geodata for your project
Coordinate
Scale
Magnifier
Rotation
Render
EPSG:32645

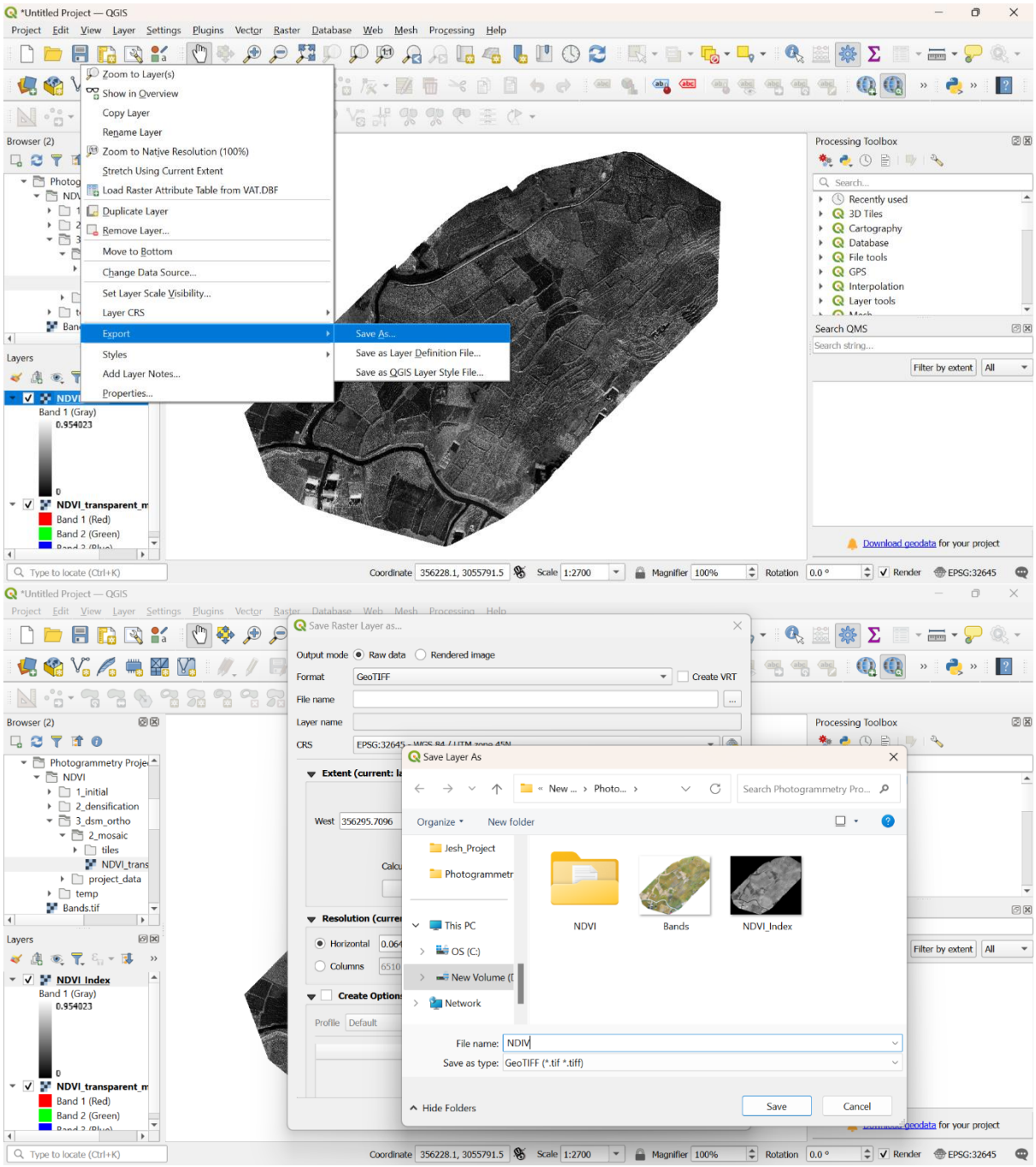
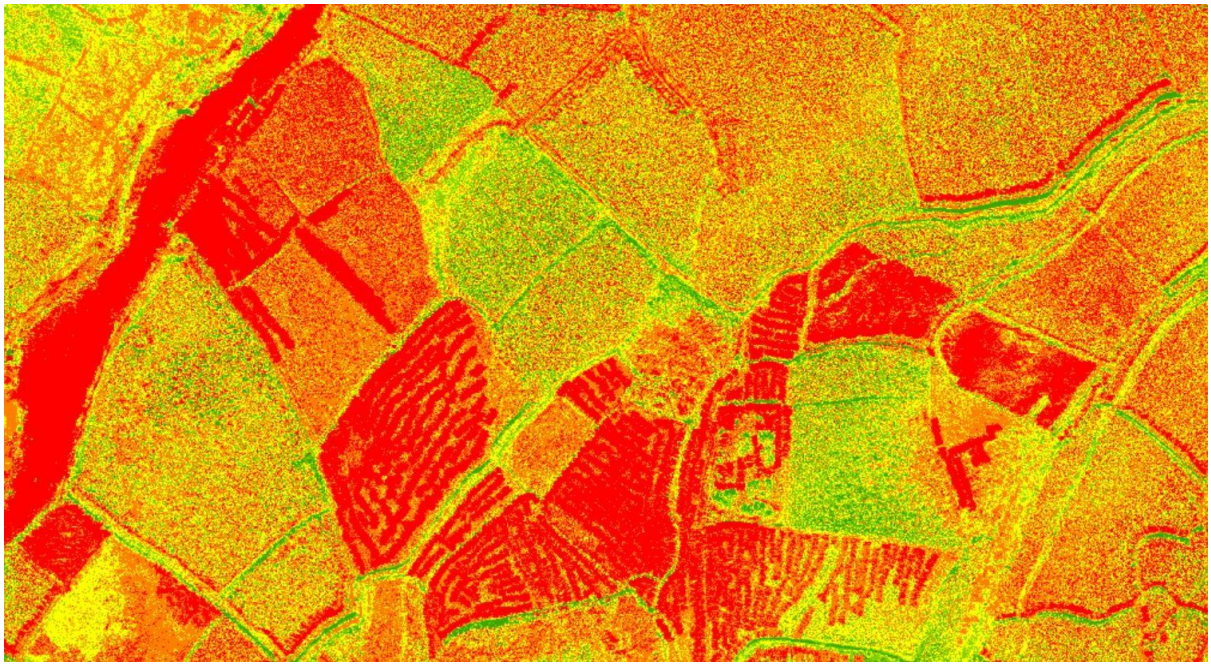
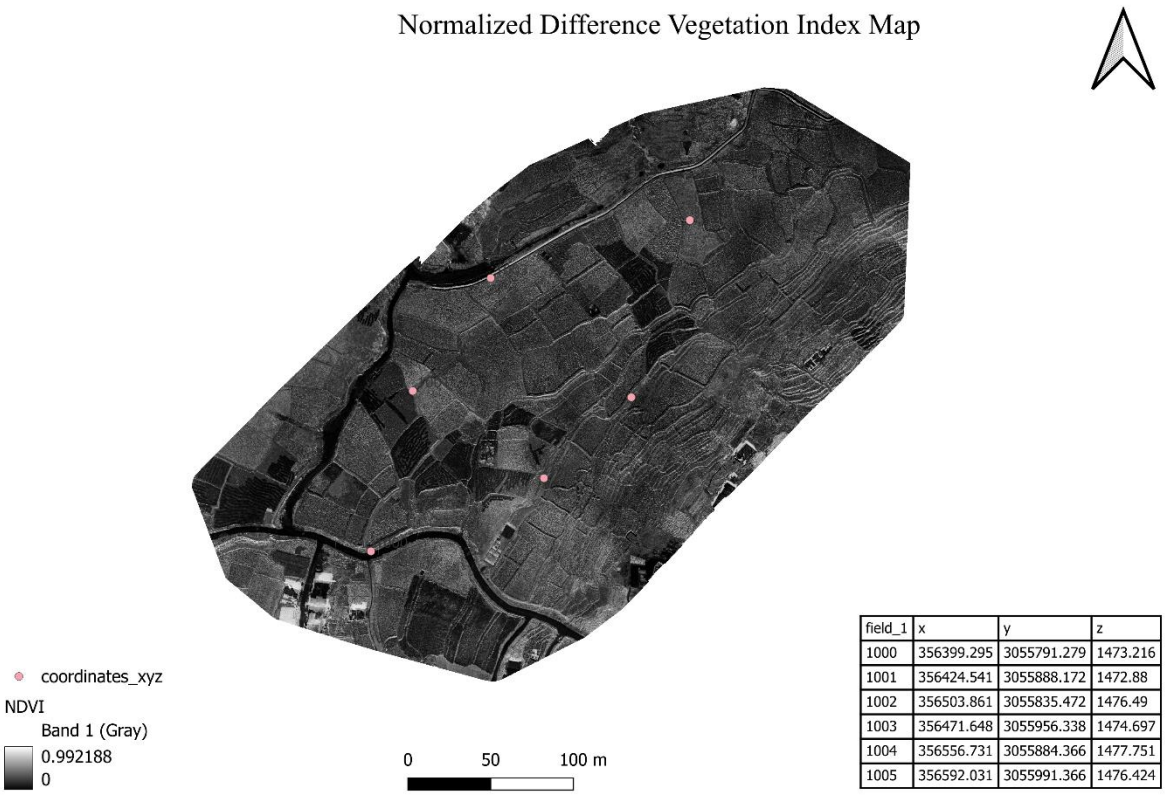

*Untitled Project — QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh Processing Help
Zoom to Layer(s)
Show in Overview
Copy Layer
Rename Layer
Zoom to Native Resolution (100%)
Stretch Using Current Extent
Load Raster Attribute Table from VAT.DBF
Duplicate Layer
Remove Layer...
Move to Bottom
Change Data Source...
Set Layer Scale Visibility...
Layer CRS
Export
Styles
Add Layer Notes...
Properties...
Save As...
Save as Layer Definition File...
Save as QGIS Layer Style File...
Browser (2)
Layers
Processing Toolbox
Search QMS
Save Raster Layer as...
Output mode Raw data Rendered image
Format GeoTIFF
File name
Layer name
CRS
Save Layer As
Organize New folder
Jesh_Project
Photogrammetr
This PC
OS (C:)
New Volume (
Network
NDVI
Bands
NDVI_Index
File name: NDIV
Save as type: GeoTIFF (*.tif *.tiff)
Hide Folders
Save
Cancel
Coordinate 356228.1, 3055791.5
Scale 1:2700
Magnifier 100%
Rotation 0.0 °
Render
EPSG:32645

Figure 2: NDVI





field_1	x	y	z
1000	356399.295	3055791.279	1473.216
1001	356424.541	3055888.172	1472.88
1002	356503.861	3055835.472	1476.49
1003	356471.648	3055956.338	1474.697
1004	356556.731	3055884.366	1477.751
1005	356592.031	3055991.366	1476.424

Figure 3: Normalized Difference Vegetation Index Map

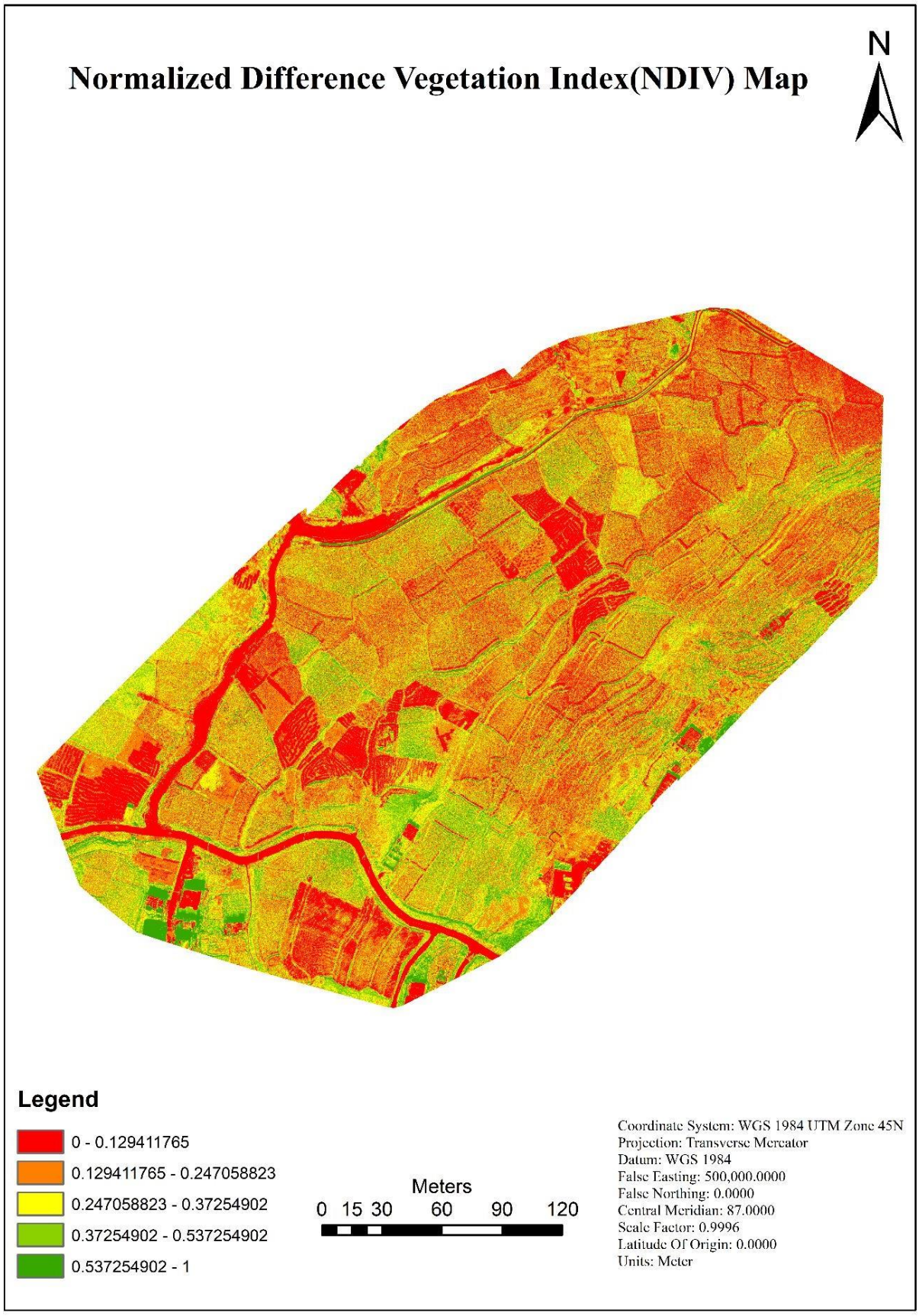


Figure 4: Normalized Difference Vegetation Index Map

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). https://doi.org/10.22314/2073-7599-2020-14-4-4-11

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). https://doi.org/10.1007/s11045-021-00809-5

Pap, M., Király, S., & Molják, S. (2020). Analysing the vegetation of energy plants by processing UAV images. *Annales Mathematicae et Informaticae*, *52*. https://doi.org/10.33039/ami.2020.01.001