



ICIMOD

Empowering Women in Geospatial Information Technology

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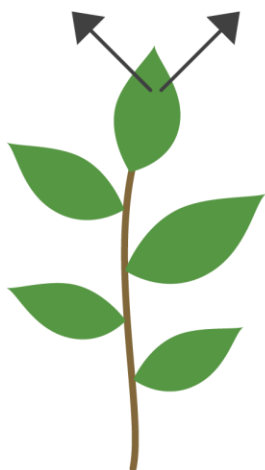
Remote Sensing based Indices

NDVI calculation

HEALTHY

VEGETATION REFLECTANCE

50% NIR 8% RED



NDVI = 0.72

STRESSED

VEGETATION REFLECTANCE

40% NIR 30% RED




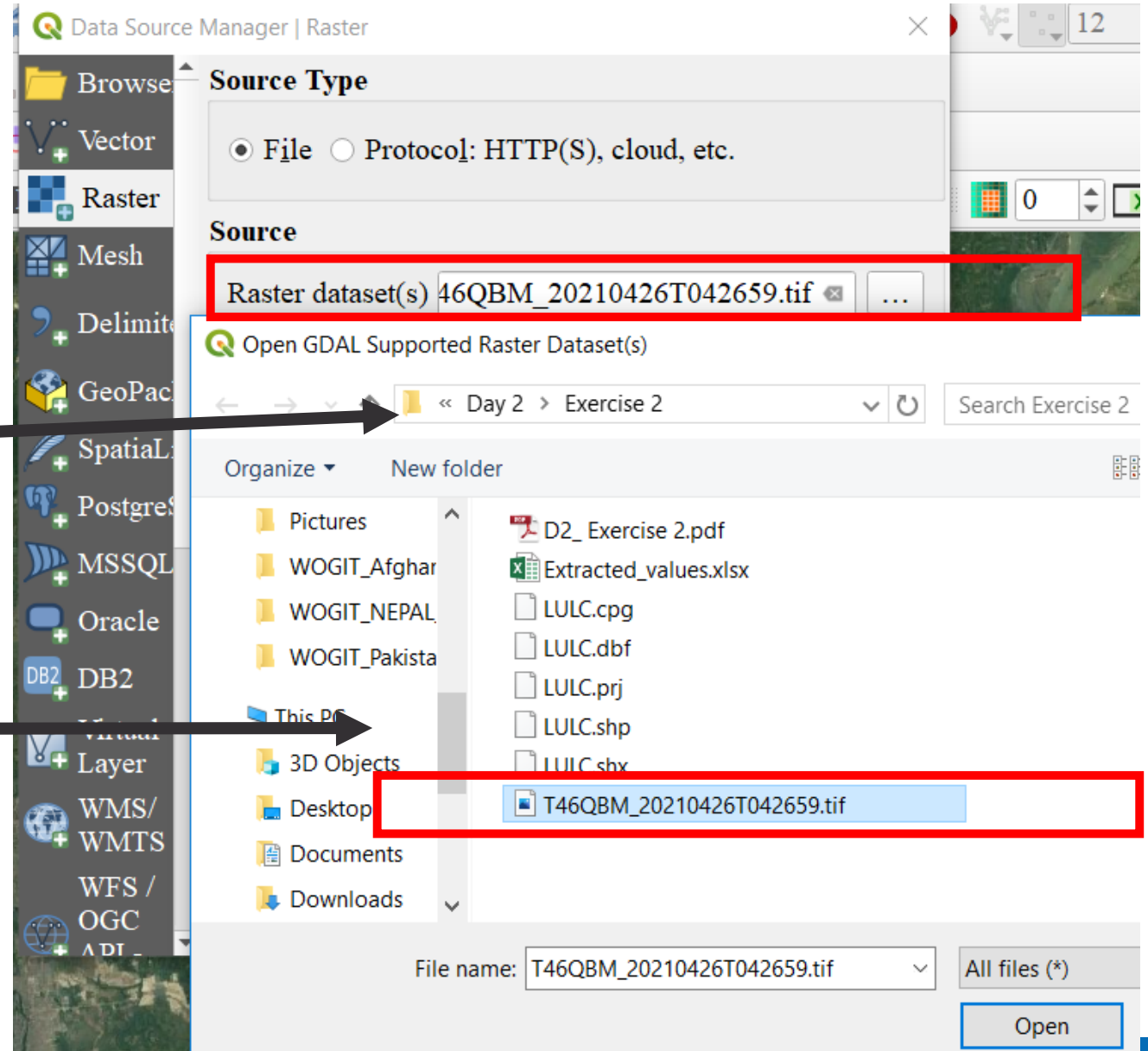
NDVI = 0.14

$$\text{NDVI} = \frac{\text{NIR} - \text{RED}}{\text{NIR} + \text{RED}}$$

Band	Resolution	Central Wavelength	Description
B1	60 m	443 nm	Ultra blue (Coastal and Aerosol)
B2	10 m	490 nm	Blue
B3	10 m	560 nm	Green
B4	10 m	665 nm	Red
B5	20 m	705 nm	Visible and Near Infrared (VNIR)
B6	20 m	740 nm	Visible and Near Infrared (VNIR)
B7	20 m	783 nm	Visible and Near Infrared (VNIR)
B8	10 m	842 nm	Visible and Near Infrared (VNIR)
B8a	20 m	865 nm	Visible and Near Infrared (VNIR)
B9	60 m	940 nm	Short Wave Infrared (SWIR)
B10	60 m	1375 nm	Short Wave Infrared (SWIR)
B11	20 m	1610 nm	Short Wave Infrared (SWIR)
B12	20 m	2190 nm	Short Wave Infrared (SWIR)

NDVI calculation

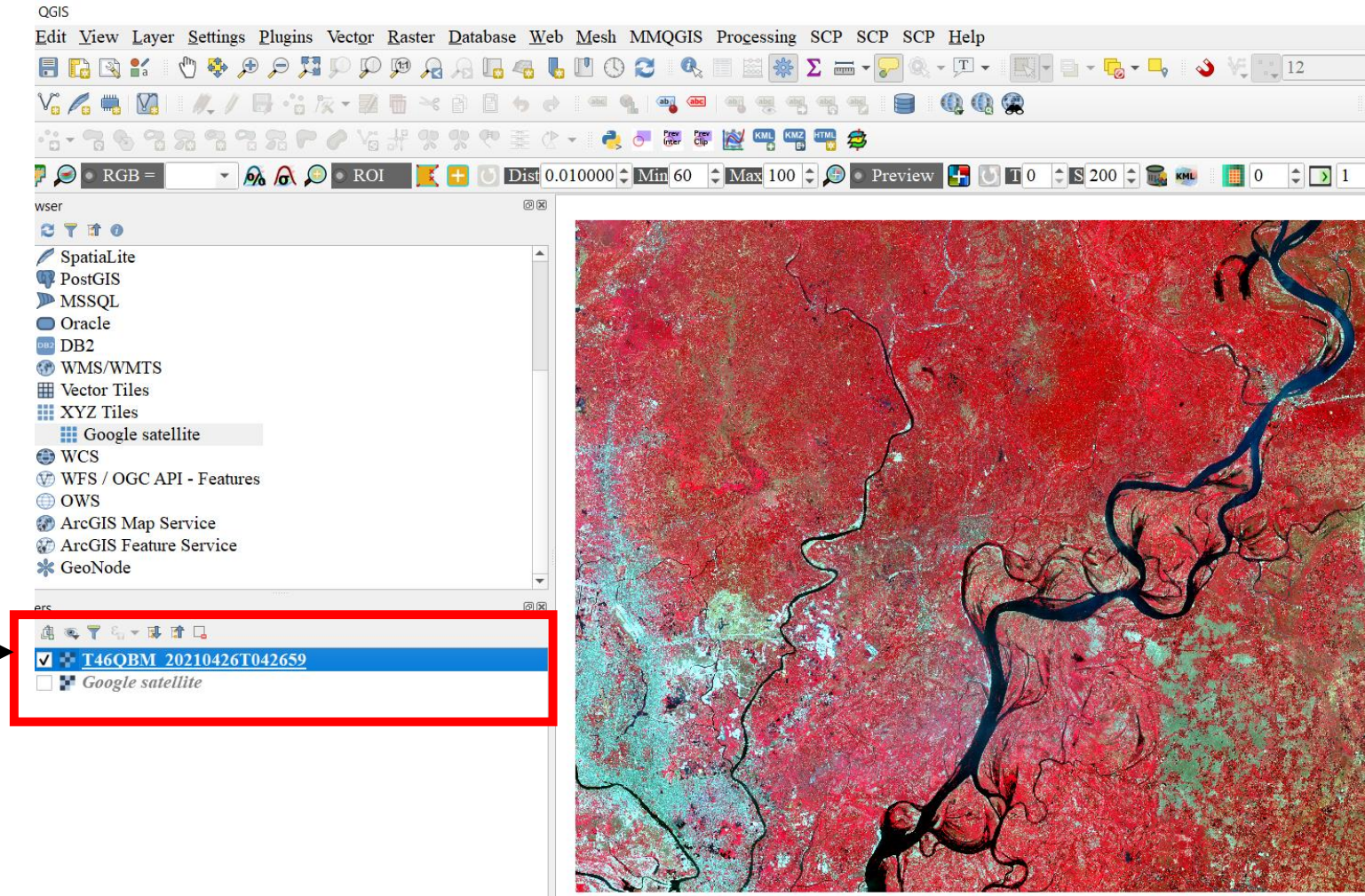
- Open QGIS in your system
- Click on the  icon in the **manage layers toolbar** panel
- A window opens
- Navigate to your image data folder (**Day2\exercise2**)
- Select the **T46QBM_20210426T042659.tif** in the QGIS



NDVI calculation

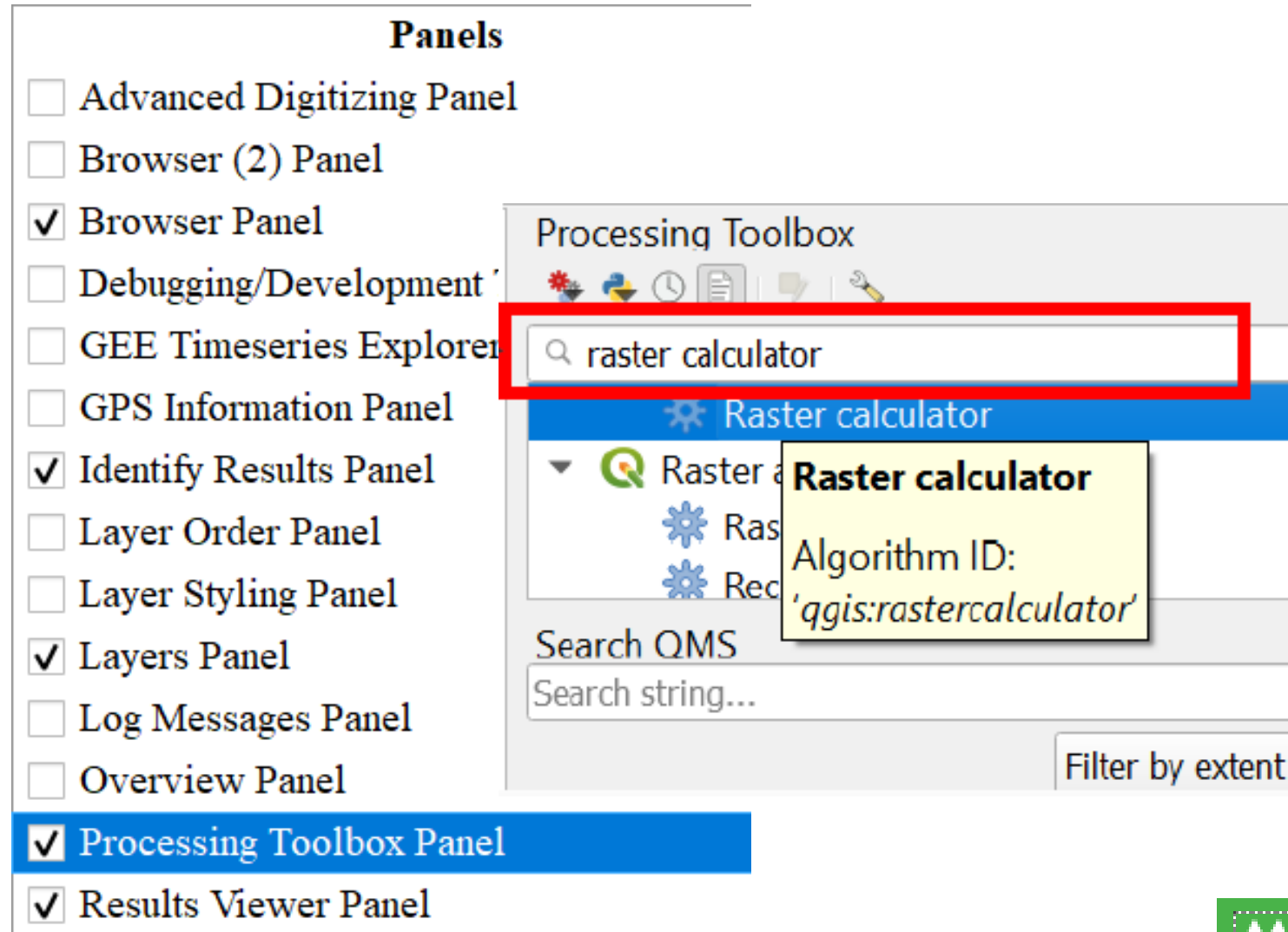
➤ Click **ADD**

➤ The layer is added in
the layer panel



NDVI calculation

- Add **Processing Toolbox Panel** in your QGIS interface
- Type **Raster calculator** in the search bar of Processing Toolbox
- Double click and open the **Raster calculator**
- A window opens



NDVI calculation

➤ In the Expression tab type the expression for NDVI as given below:

➤ **Example** ("T46QBM_20210426T042659@8" -
"T46QBM_20210426T042659@4") / (
"T46QBM_20210426T042659@8" +
"T46QBM_20210426T042659@4")

➤ Click on the **Output** and select the output folder and name the output file as **NDVI.tif**

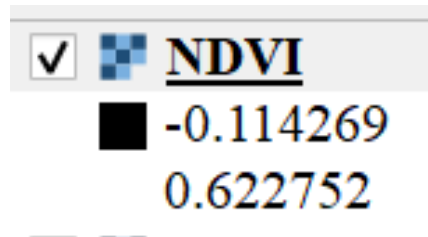
➤ Make sure the **expression is valid**

➤ Click **Run**

The screenshot shows the QGIS Raster Calculator dialog box. The 'Expression' tab is active, and the expression `("T46QBM_20210426T042659@8" - "T46QBM_20210426T042659@4") / ("T46QBM_20210426T042659@8" + "T46QBM_20210426T042659@4")` is entered in the 'Expression' field. A red box highlights this field, and a blue arrow points to it with the text 'Select reference layer'. Below the expression field, the 'Predefined expressions' list shows 'NDVI'. A red box highlights the 'Reference layer(s)' field, and a blue arrow points to it with the text 'Specify output layer'. The 'Output' field at the bottom is also highlighted with a red box, showing the path `D:/ICIMOD/TO do/2021/CB Trainings/WOGIT/Bangladesh/Rough/NDVI.tif`. The 'Run' button is visible at the bottom right.

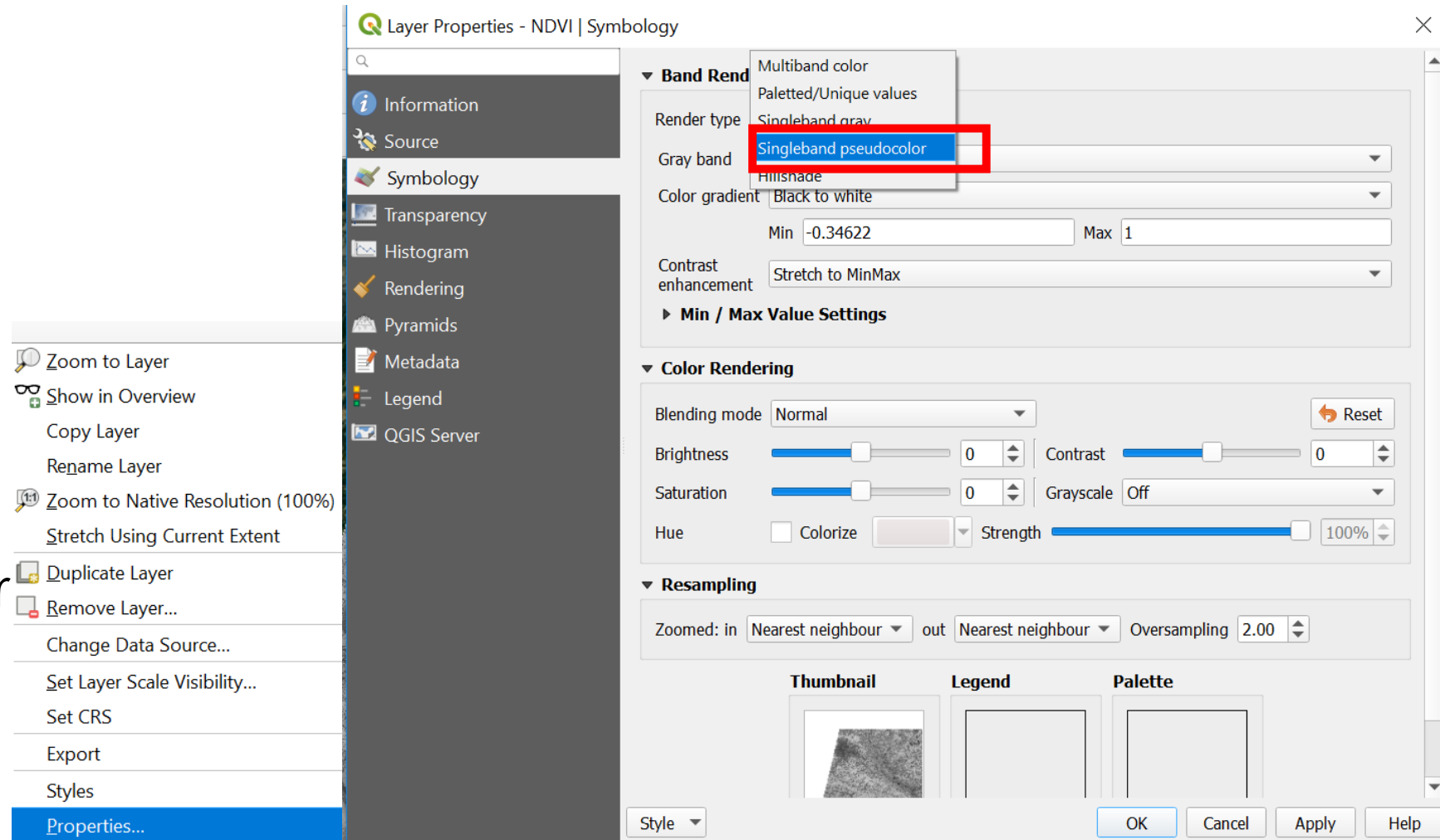
NDVI calculation

- Calculated NDVI image appears in the **layers panel**
- The range varies from -0.11 to 0.6



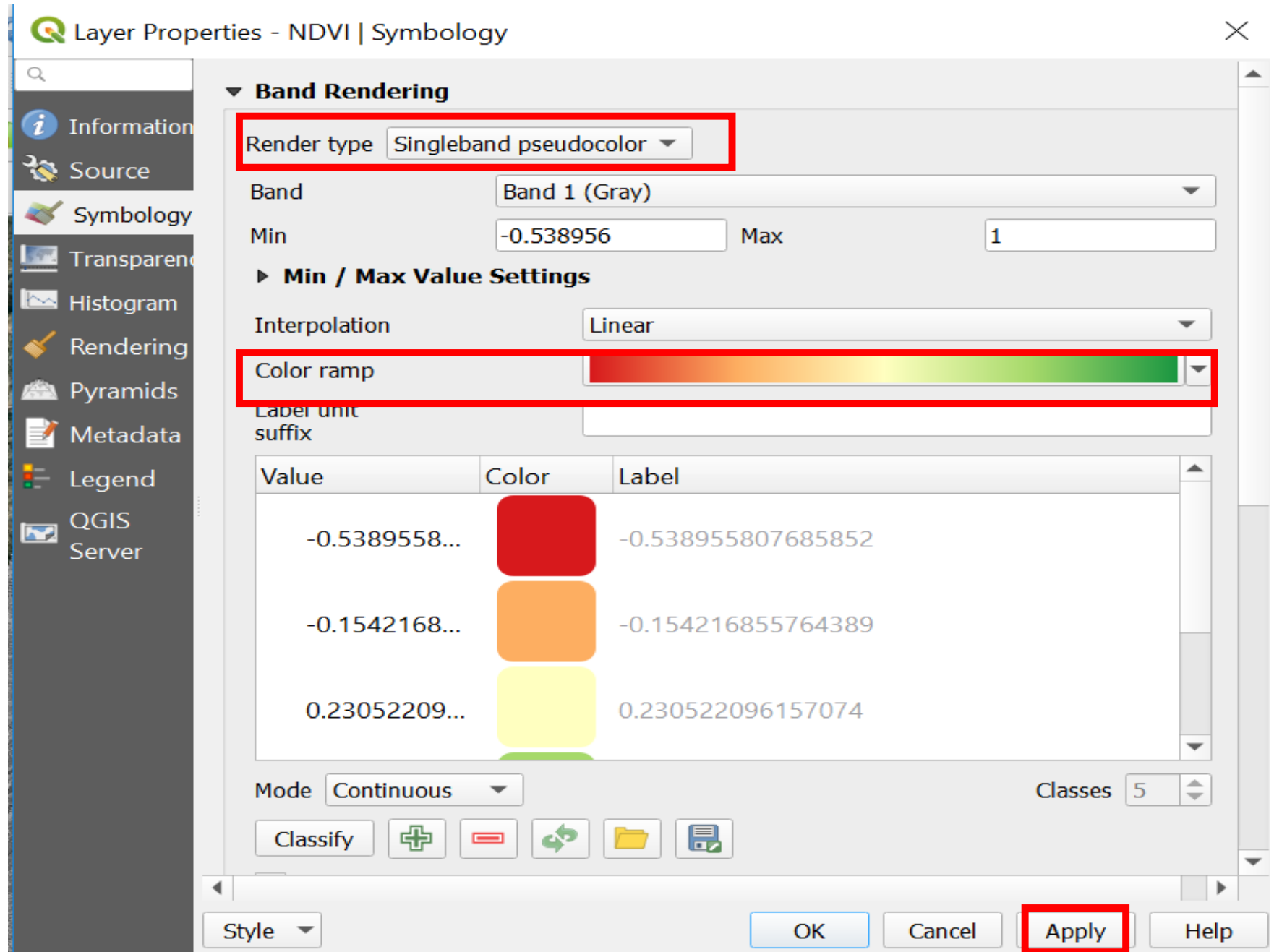
NDVI calculation

- **Right click** on the NDVI layer-➔ **Properties**
- Click on **Symbology** and select **Singleband pseudocolor** from the **Render type**
- Choose a suitable color ramp
- Click on **Apply** and **OK**

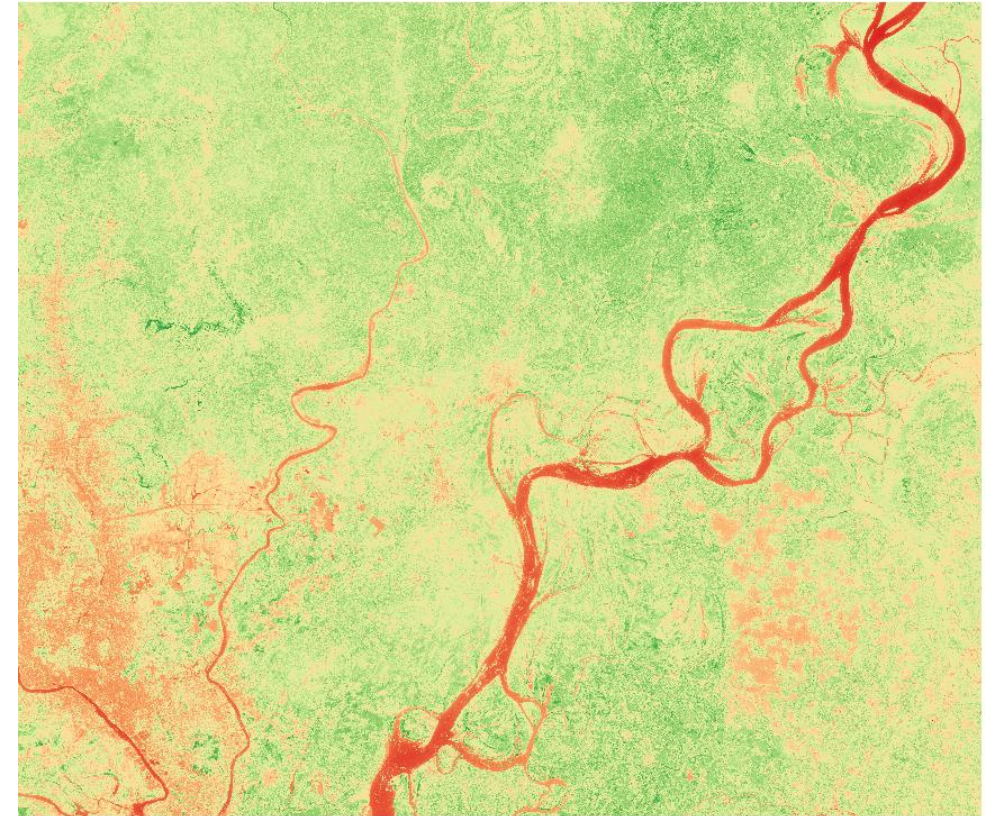
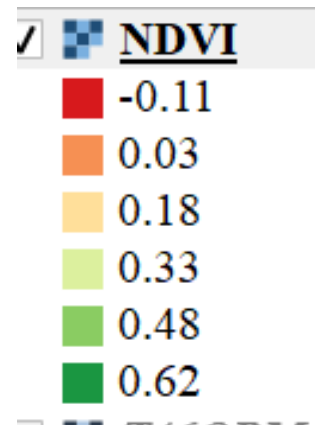
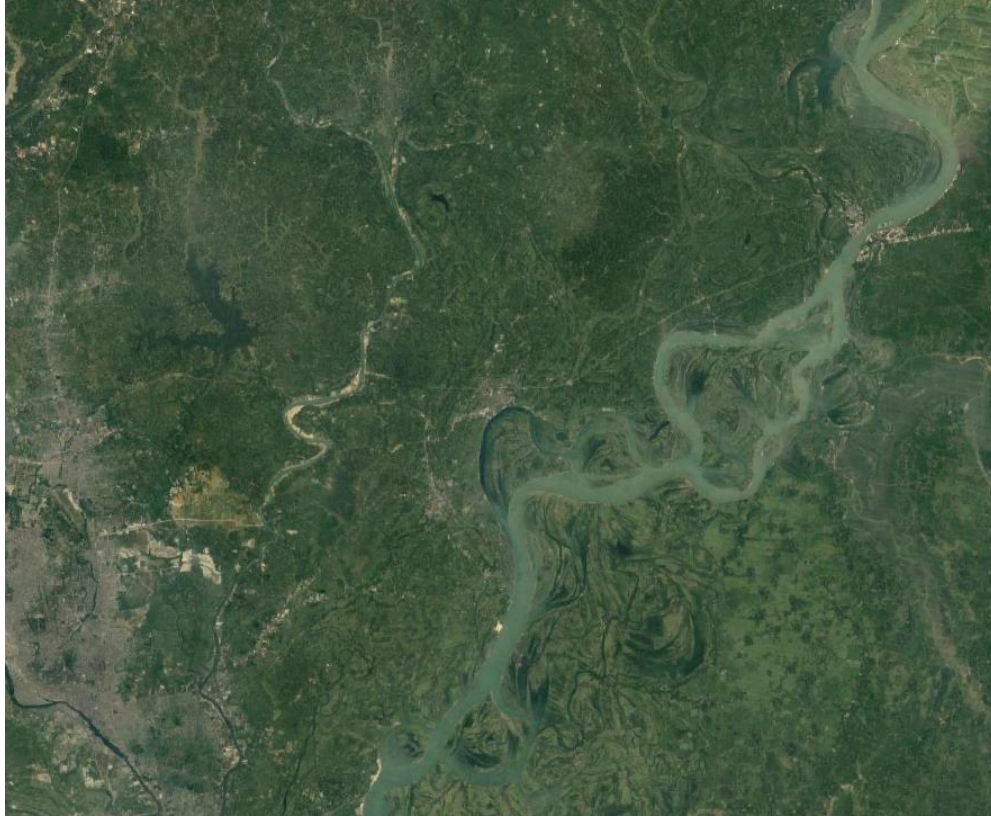


NDVI calculation

- Choose a suitable **color ramp**
- Click **Apply** and analyze the image



NDVI calculation



**Do the similar exercises for
water extraction**

Indices and Formula

Vegetation

1. Enhanced Vegetation Index (EVI 2): $2.5 * ((\text{NIR} - \text{RED}) / (\text{NIR} + 2.4 * \text{RED} + 1))$

Formula: $2.5 * ((\text{"T46QBM_20210426T042659_B08.jp2"} - \text{"T46QBM_20210426T042659_B04.jp2"}) / (\text{"T46QBM_20210426T042659_B08.jp2"} + 2.4 * \text{"T46QBM_20210426T042659_B04.jp2"} + 1))$

2. Soil Adjusted Vegetation Index (SAVI): $(\text{NIR} - \text{RED}) * (1.0 + L) / (\text{NIR} + \text{RED} + L)$

Formula: $((\text{"T46QBM_20210426T042659_B08.jp2"} - \text{"T46QBM_20210426T042659_B04.jp2"}) * (1.0 + 0.5)) / (\text{"T46QBM_20210426T042659_B08.jp2"} + \text{"T46QBM_20210426T042659_B04.jp2"} + 0.5)$

Here L is a constant and varies by the amount or cover of green vegetation: in very high vegetation regions, L=0; and in areas with no green vegetation, L=1; default: 0.5

Vegetation/Crop Water index

3. Normalized Difference water index (NDWI): $(\text{NIR} - \text{SWIR}) / (\text{NIR} + \text{SWIR})$

Formula: $(\text{"T46QBM_20210426T042659_B08.jp2"} - \text{"T46QBM_20210426T042659_B12.jp2"}) / (\text{"T46QBM_20210426T042659_B08.jp2"} + \text{"T46QBM_20210426T042659_B12.jp2"})$

Absorption by vegetation liquid water in the NIR channel is negligible, while in the SWIR channel it is very high. If Vegetation Water Content (VWC) decreases, then reflectance in the SWIR channel increases significantly. Thus, the Normalized Difference Water Index (NDWI) value – that combines information from the NIR and the SWIR bands – decreases, reflecting dry vegetation that is experiencing drought stress

Indices and formula

WATER

1. Normalized Difference Water Index (NDWI): $(\text{Green} - \text{NIR}) / (\text{Green} + \text{NIR})$

$$(\text{"T46QBM_20210426T042659_B03.jp2"} - \text{"T46QBM_20210426T042659_B08.jp2"}) / (\text{"T46QBM_20210426T042659_B03.jp2"} + \text{"T46QBM_20210426T042659_B08.jp2"})$$

2. Water Ratio Index (WRI): $(\text{Green} + \text{Red}) / (\text{NIR} + \text{SWIR})$

$$(\text{"T46QBM_20210426T042659_B03.jp2"} + \text{"T46QBM_20210426T042659_B04.jp2"}) / (\text{"T46QBM_20210426T042659_B08.jp2"} + \text{"T46QBM_20210426T042659_B011.jp2"})$$

SNOW

1. Normalized Difference Snow Index (NDSI): $(\text{Green} - \text{SWIR}) / (\text{Green} + \text{SWIR})$

$$(\text{"T46QBM_20210426T042659_B03.jp2"} - \text{"T46QBM_20210426T042659_B12.jp2"}) / (\text{"T46QBM_20210426T042659_B03.jp2"} + \text{"T46QBM_20210426T042659_B12.jp2"})$$

2. Snow Water Index (SWI): $\text{Green}(\text{NIR} - \text{SWIR}) / (\text{Green} + \text{NIR})(\text{NIR} + \text{SWIR})$

$$((\text{"T46QBM_20210426T042659_B03.jp2"} * (\text{"T46QBM_20210426T042659_B08.jp2"} - \text{"T46QBM_20210426T042659_B12.jp2"}))) / ((\text{"T46QBM_20210426T042659_B03.jp2"} + \text{"T46QBM_20210426T042659_B08.jp2"}) * (\text{"T46QBM_20210426T042659_B08.jp2"} + \text{"T46QBM_20210426T042659_B12.jp2"}))$$

Others

1. Normalized difference built-up index (NDBI) : $\text{SWIR} - \text{NIR} / \text{SWIR} + \text{NIR}$

2. Bare Soil Index (BSI): $(\text{SWIR} + \text{RED}) - (\text{NIR} + \text{BLUE}) / (\text{SWIR} + \text{RED}) + (\text{NIR} + \text{BLUE})$

A photograph of a rugged, snow-capped mountain peak under a clear sky. The mountain's face is dark and rocky, with patches of white snow and ice. A large, white, stylized chevron graphic is overlaid on the left side of the image. The foreground shows a steep, rocky slope with some sparse vegetation.

Thank you

**Let's protect
the pulse.**