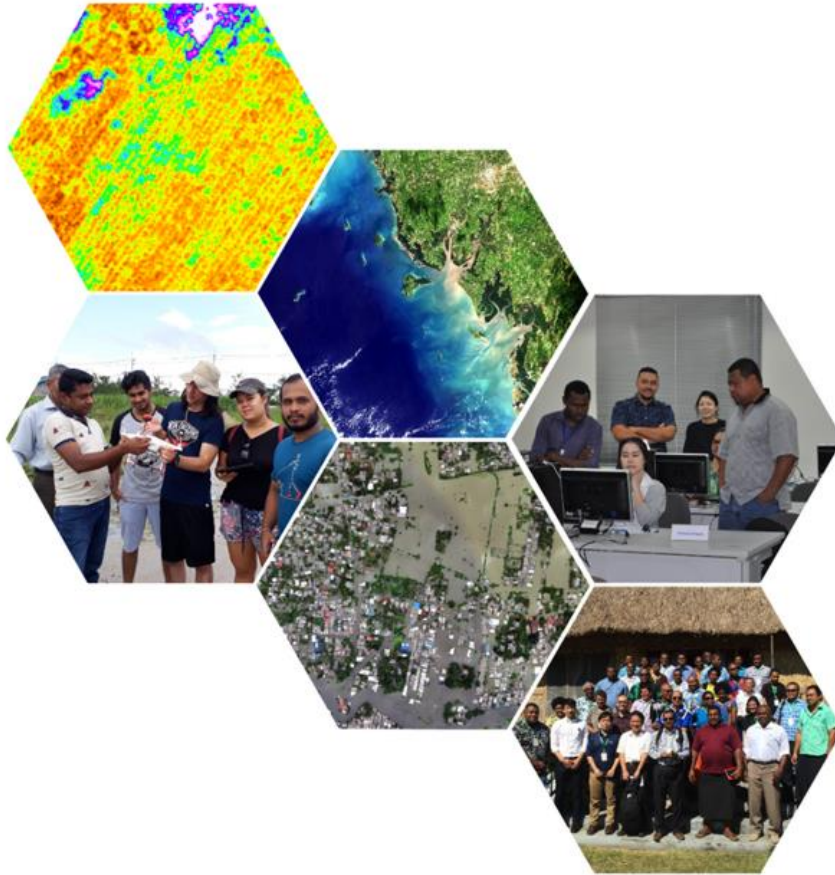


# Basic Data Handling using QGIS



Geoinformatics Center - AIT





# Overview

In this exercise, you will work with QGIS software to handle vector and raster data (specifically satellite data).

## 1. Getting Started with QGIS

- Software installation
- Graphical User Interface

## 2. Working with vector data

- Follow Along: Adding your first layer
- Follow Along: Save your work!
- Follow Along: Viewing layer attributes
- Follow Along: Loading other vector data
- Follow Along: Reordering the layers
- Follow Along: Select a feature from attribute
- Follow Along: Save selected feature to a new shapefile
- Follow Along: Changing colors for vector layer

## 3. Working with Raster Data

- Follow Along: Loading satellite data (Sentinel-2)
- Follow Along: Changing band combination
- Follow Along: Enhancing image visualization
- Follow Along: Using raster calculator
- Follow Along: Changing visualization color scheme
- Follow Along: Clipping raster image
- Follow Along: Transforming raster data

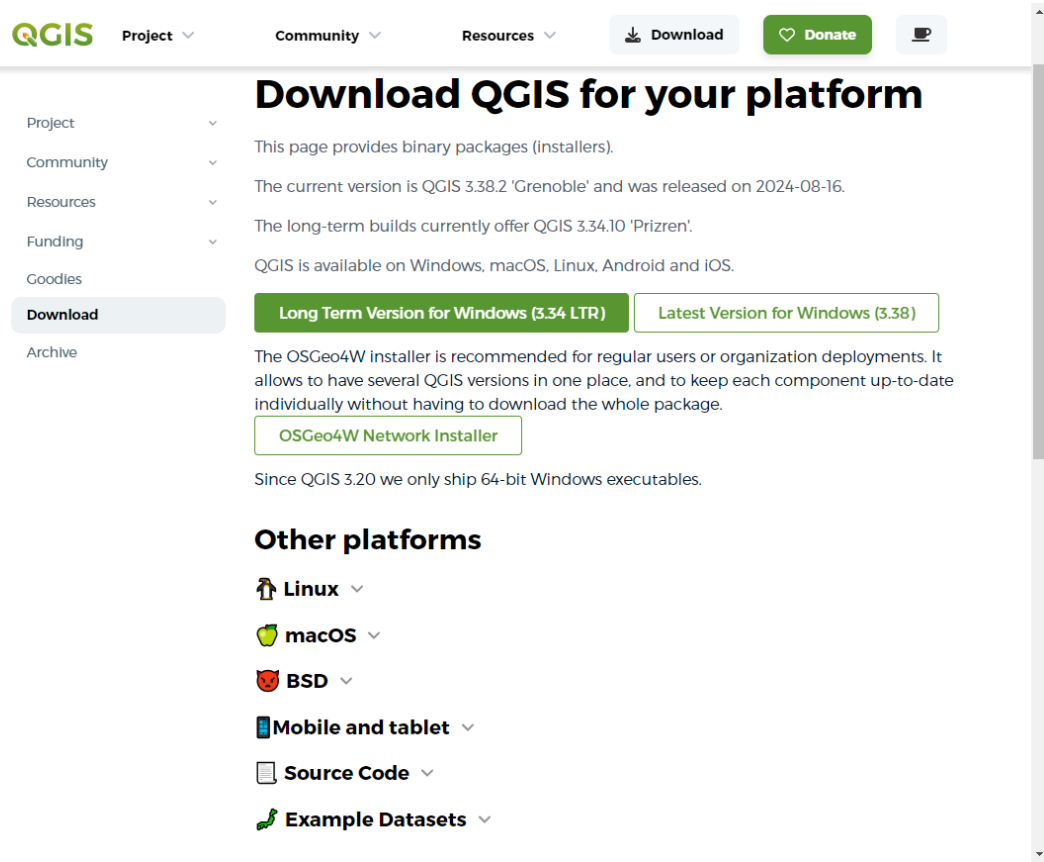
## 4. Plugins

- Follow Along: Installing a new plugin



# Getting Started with QGIS

## Software installation



The screenshot shows the QGIS website's download page. The header includes the QGIS logo and navigation links: Project, Community, Resources, Download, Donate, and a user icon. The left sidebar lists: Project, Community, Resources, Funding, Goodies, Download (highlighted), and Archive. The main content area is titled 'Download QGIS for your platform' and contains the following text:

This page provides binary packages (installers).

The current version is QGIS 3.38.2 'Grenoble' and was released on 2024-08-16.

The long-term builds currently offer QGIS 3.34.10 'Prizren'.

QGIS is available on Windows, macOS, Linux, Android and iOS.

Two download buttons are visible: 'Long Term Version for Windows (3.34 LTR)' and 'Latest Version for Windows (3.38)'. Below these, a paragraph states: 'The OSGeo4W installer is recommended for regular users or organization deployments. It allows to have several QGIS versions in one place, and to keep each component up-to-date individually without having to download the whole package.' A button for 'OSGeo4W Network Installer' is also present.

Below this, it says: 'Since QGIS 3.20 we only ship 64-bit Windows executables.'

The section 'Other platforms' lists the following options with expandable arrows:

- Linux
- macOS
- BSD
- Mobile and tablet
- Source Code
- Example Datasets

- QGIS is a free and open-source GIS software.

You can download the latest version here (select the supported operating system for your desktop/laptop):

<https://qgis.org/download/>

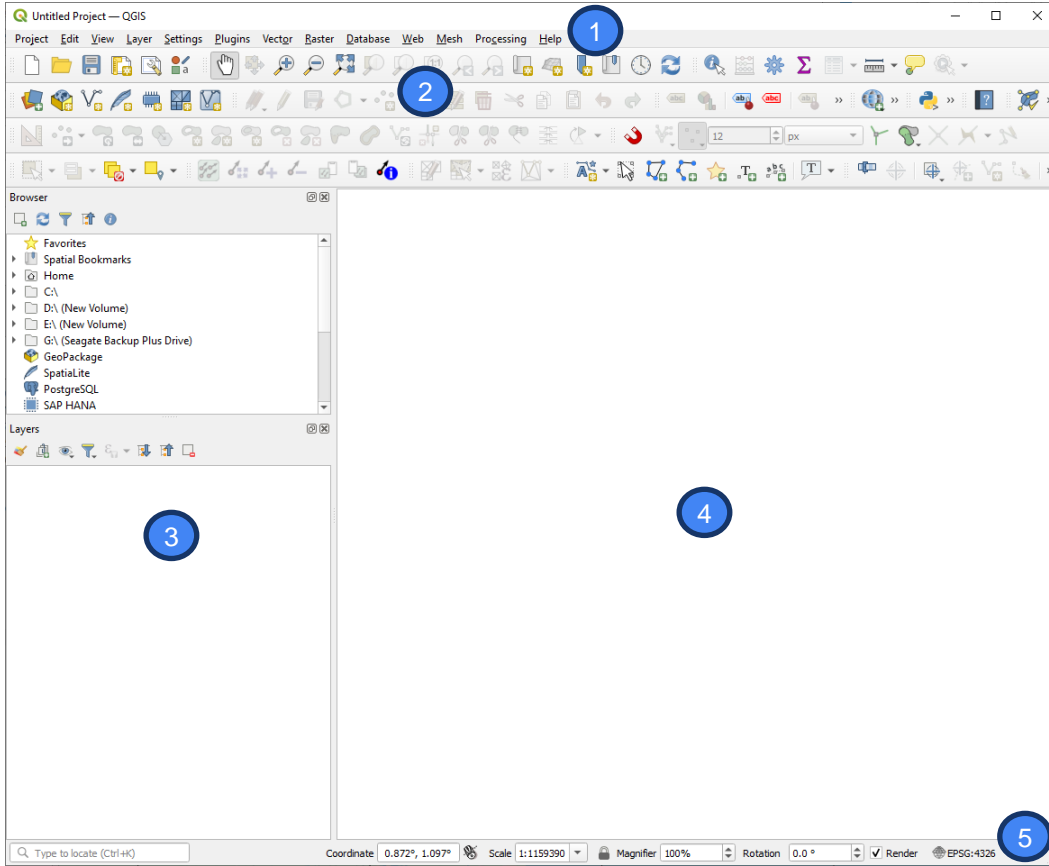
You can also check the official documentation/user guide/manual here:


[https://docs.qgis.org/3.34/en/docs/user\\_manual/index.html](https://docs.qgis.org/3.34/en/docs/user_manual/index.html)



# Getting Started with QGIS

## Graphical User Interface (GUI)



- Open QGIS Desktop in your laptop/PC:  QGIS Desktop
- You will have a new, blank map.

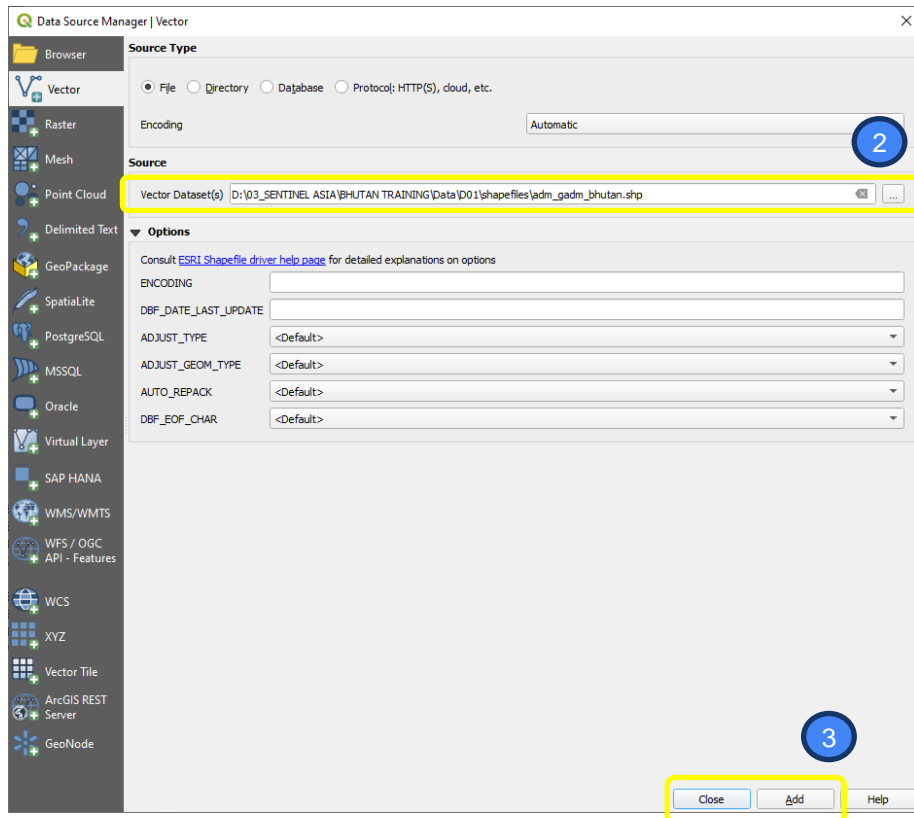
1. Menu Bar
2. Toolbars
3. Layers List / Browser Panel
4. Map View
5. Status Bar



# Working with Vector Data

## Follow Along: Adding your first layer

1. In the Menu Bar, click **Layer** → **Add Layer** → **Add Vector Layer**
2. In Data Source, click on the **Browse** button and navigate to the file (**adm\_gadm\_bhutan.shp**) in the data folder.
3. With this file selected, click **Add**, then **Close**. The data you specified will now load.






# Working with Vector Data

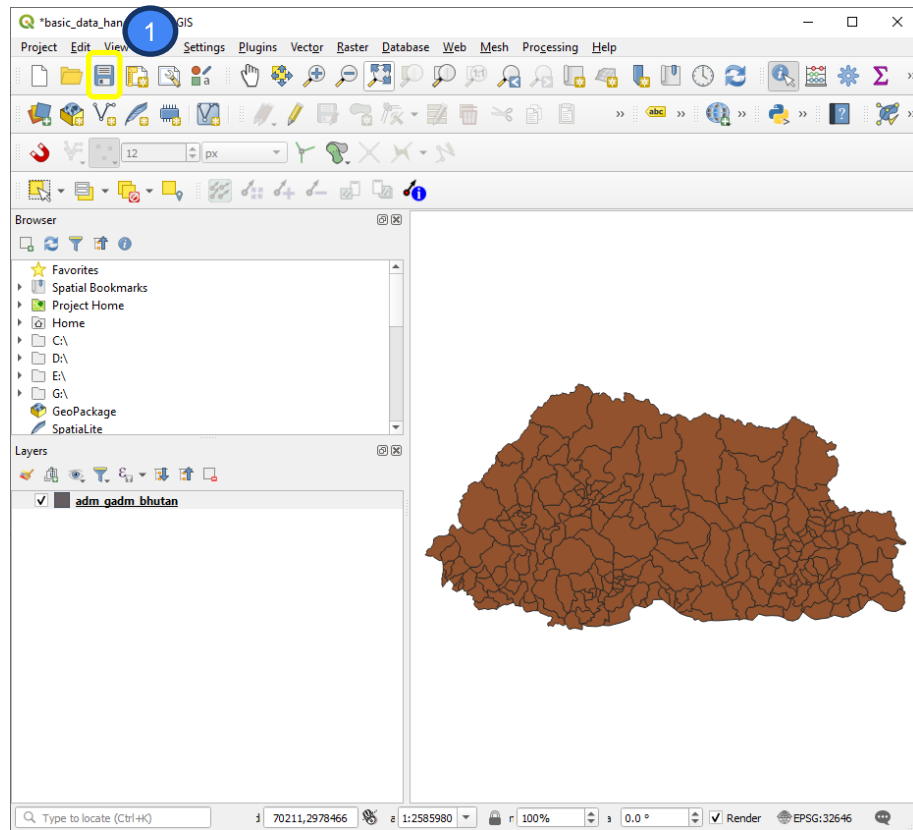
## Follow Along: Save your work!

Congratulations! You now have opened your first GIS data. Now would be a good time to save your work.


1. Click on the **Save As** button: 
2. Save the map in the working folder and call it **basic\_data\_handling.qgs**

**Note:** The standard vector file format used in QGIS is the ESRI shapefile. A shapefile actually consists of several files. The following are required:

- .shp file, containing the feature geometries
- .dbf file, containing the attributes in dBase format
- .shx, index file
- .prj suffix, containing the projection information (optional)





1. Right-click on the `adm_gadm_bhutan` layer, then click **Open Attribute Table** 

adm\_gadm\_bhutan — Features Total: 205, Filtered: 205, Selected: 0

	GID_2	GID_0	COUNTRY	GID_1	NAME_1	NI_NAME_1	NAME_2	VARNAME_2	NI_NAME_2	TYPE_2	ENGTYPE_2	CC_2	HASC_2
1	BTN1.1.1	BTN	Bhutan	BTN1.1.1	Bumthang	འབྲུག་རྒྱལ་ཁབ་	Chhoekhor	Chhoekor	ཆེ་ལཱ་	Geowg	Village block	NA	BT.BU.CK
2	BTN1.2.1	BTN	Bhutan	BTN1.1.1	Bumthang	འབྲུག་རྒྱལ་ཁབ་	Chhume	Churney	ཆཱུམ་	Geowg	Village block	NA	BT.BU.CU
3	BTN1.3.1	BTN	Bhutan	BTN1.1.1	Bumthang	འབྲུག་རྒྱལ་ཁབ་	Tang	NA	ཁ་	Geowg	Village block	NA	BT.BU.TA
4	BTN1.4.1	BTN	Bhutan	BTN1.1.1	Bumthang	འབྲུག་རྒྱལ་ཁབ་	Uzo	NA	འུ་	Geowg	Village block	NA	BT.BU.UR
5	BTN2.1.1	BTN	Bhutan	BTN2.1.1	Chhukha	ཆཱུ་ཁྱཱ་	Bjacho	NA	པཱཱཱ་	Geowg	Village block	NA	BT.CX.BC
6	BTN2.2.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Bongo	NA	པཱཱཱ་	Geowg	Village block	NA	BT.CX.BO
7	BTN2.3.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Chapcha	Chapcha	གཙམ་	Geowg	Village block	NA	BT.CX.CP
8	BTN2.4.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Darla	NA	འུ་	Geowg	Village block	NA	BT.CX.DG
9	BTN2.5.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Dungna	NA	འུ་	Geowg	Village block	NA	BT.CX.DU
10	BTN2.6.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Geling	NA	འུ་	Geowg	Village block	NA	BT.CX.GL
11	BTN2.7.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Getana	Getena	འུ་	Geowg	Village block	NA	BT.CX.GT
12	BTN2.8.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Logchina	NA	འུ་	Geowg	Village block	NA	BT.CX.LO
13	BTN2.9.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Metap	Metakha	པཱཱཱ་	Geowg	Village block	NA	BT.CX.MT
14	BTN2.10.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Puentsholing	NA	པཱཱཱ་	Geowg	Village block	NA	BT.CX.PG
15	BTN2.11.1	BTN	Bhutan	BTN2.2.1	Chhukha	ཆཱུ་ཁྱཱ་	Sampheling	Bhalghosa	པཱཱཱ་	Geowg	Village block	NA	BT.CX.BL
16	BTN3.2.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Dorona	NA	ཏོ་	Geowg	Village block	NA	BT.DA.DO
17	BTN3.3.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Drugyelgang	Drujegang	འུ་	Geowg	Village block	NA	BT.DA.DI
18	BTN3.4.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Gesarling	NA	ཏོ་	Geowg	Village block	NA	BT.DA.GS
19	BTN3.5.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Goshi	Goshi	ཏོ་	Geowg	Village block	NA	BT.DA.GI
20	BTN3.6.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Kalidzangha	Kana	འུ་	Geowg	Village block	NA	BT.DA.KN
21	BTN3.1.1.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Karmaling	Deorali	ཏོ་	Geowg	Village block	NA	BT.DA.DR
22	BTN3.7.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Khaphisa	Khaphisa	ཏོ་	Geowg	Village block	NA	BT.DA.KB
23	BTN3.8.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Lagab	NA	ཏོ་	Geowg	Village block	NA	BT.DA.LI
24	BTN3.9.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Lhamoi Zingha	Lhamoizingha	ཏོ་	Geowg	Village block	NA	BT.DA.LG
25	BTN3.10.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Nichula	NA	ཏོ་	Geowg	Village block	NA	BT.DA.NI
26	BTN3.11.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Tashiding	Tashiding	ཏོ་	Geowg	Village block	NA	BT.DA.TD
27	BTN3.12.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Tsangzha	NA	ཏོ་	Geowg	Village block	NA	BT.DA.TK
28	BTN3.13.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Tsundagang	NA	ཏོ་	Geowg	Village block	NA	BT.DA.TG
29	BTN3.14.1	BTN	Bhutan	BTN3.1.1	Dagana	འབྲུག་རྒྱལ་ཁབ་	Tseza	Tseza	ཏོ་				



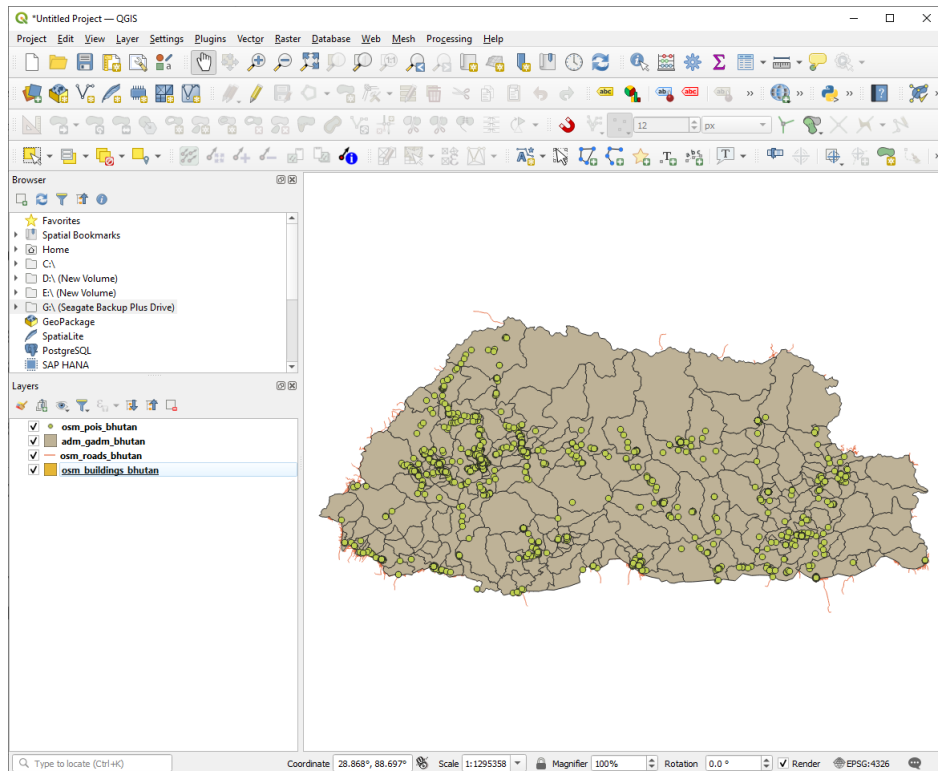
# Working with Vector Data

## Follow Along: Loading other vector data

The first vector data type you just opened is a polygon, and there are two other vector data types: point and line.

Following the same method, load the following data sets into your map. Can you identify the vector data type for each shapefile?

- [osm\\_pois\\_Bhutan.shp](#)
- [osm\\_roads\\_Bhutan.shp](#)
- [osm\\_buildings\\_Bhutan.shp](#)





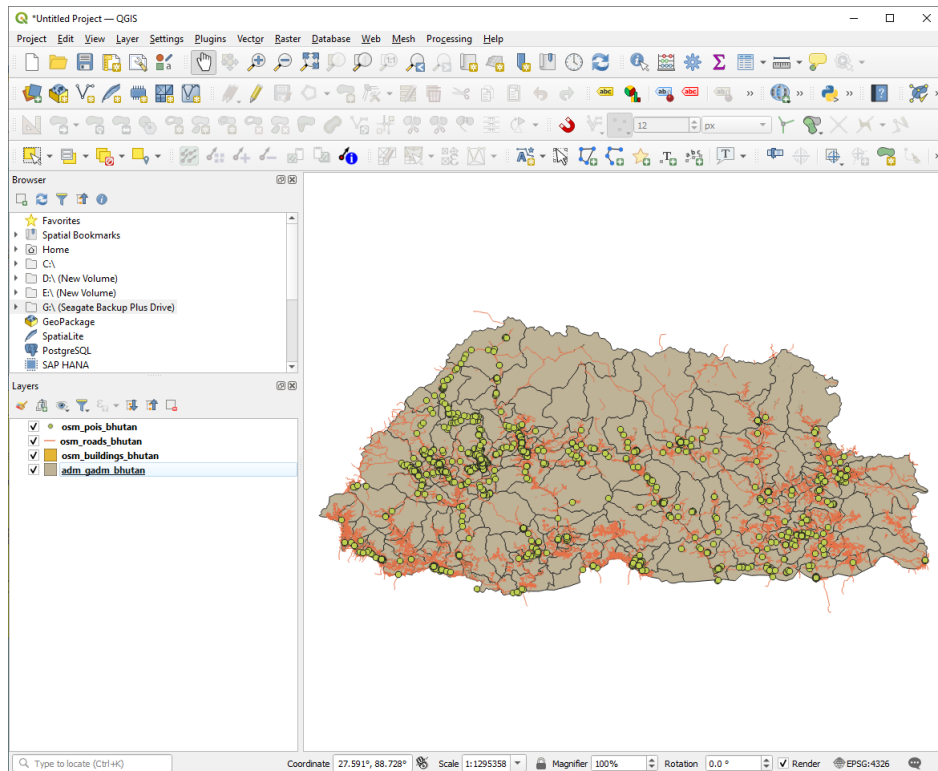
# Working with Vector Data

## Follow Along: Reordering the layers

The layers in your Layers list are drawn on the map in a certain order. The layer at the bottom of the list is drawn first, and the layer at the top is drawn last. By changing the order that they are shown on the list, you can change the order they are drawn.

Change the order of the layers so that roads and poi appearing above the admin boundary.

- Click and drag on a layer in the Layers list.





# Working with Vector Data

## Follow Along: Select a feature from attribute

1. Right-click on the **adm\_gadm\_bhutan** layer, then click **Open Attribute Table**:

2. In the Table Toolbars, click **Select features using an expression** button.

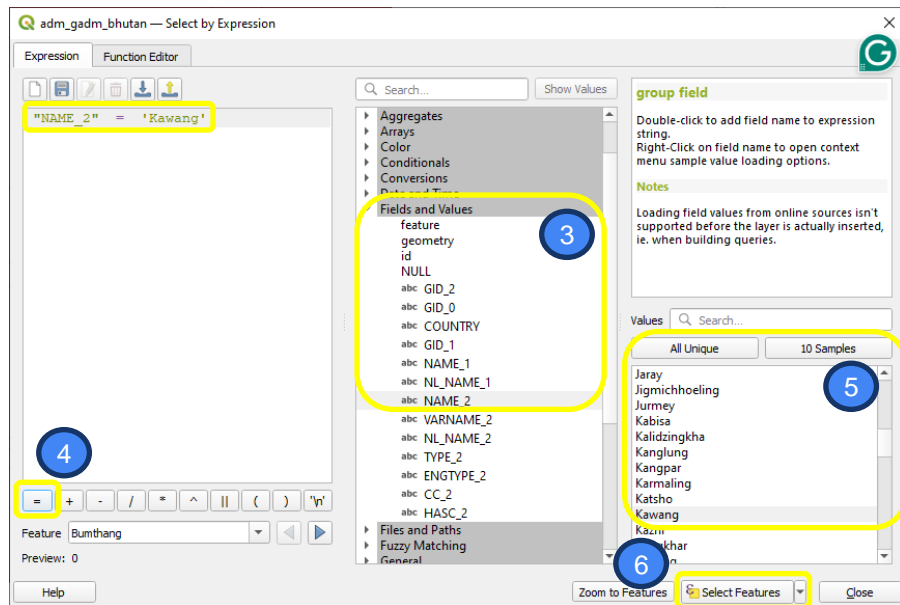
We will select a village admin feature by writing in the Expression box: **"NAME\_2" = 'Kawang'**

3. Expand the **Field and Values** and double-click **NAME\_2**. The text will be added to the Expression box.

4. Click **=** and the text in the Expression box will be updated.

5. Click **All Unique**, then double-click **Kawang**.

6. Click **Select Features**

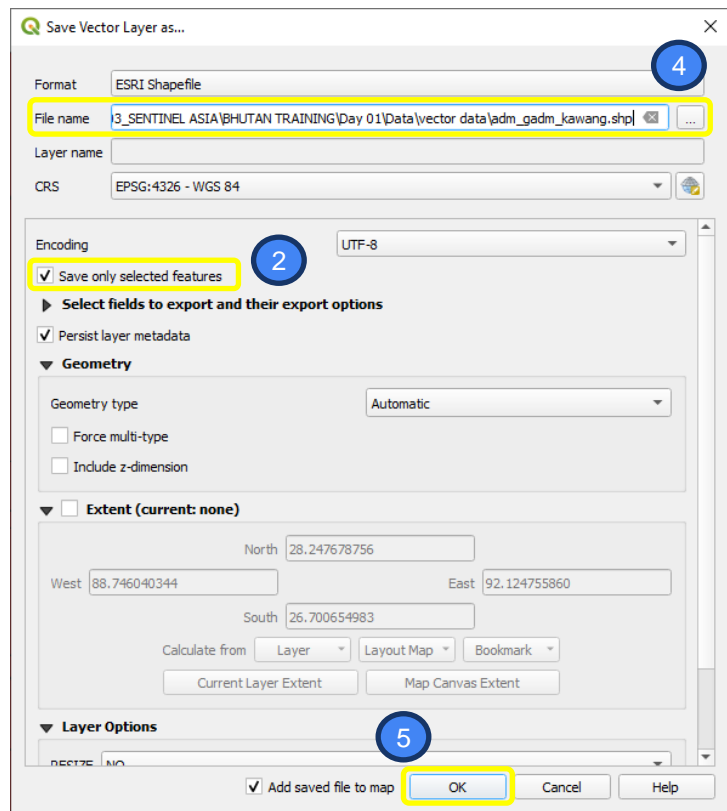




# Working with Vector Data

Follow Along: Save selected feature to a new shapefile

1. Right-click on the `adm_gadm_bhutan` layer in the Layers list, click **Export** → **Save Selected Features As...**
2. Make sure to checklist “**Save only selected features**”.
3. Save the result to `adm_gadm_kawang.shp`.
4. Click **OK**.



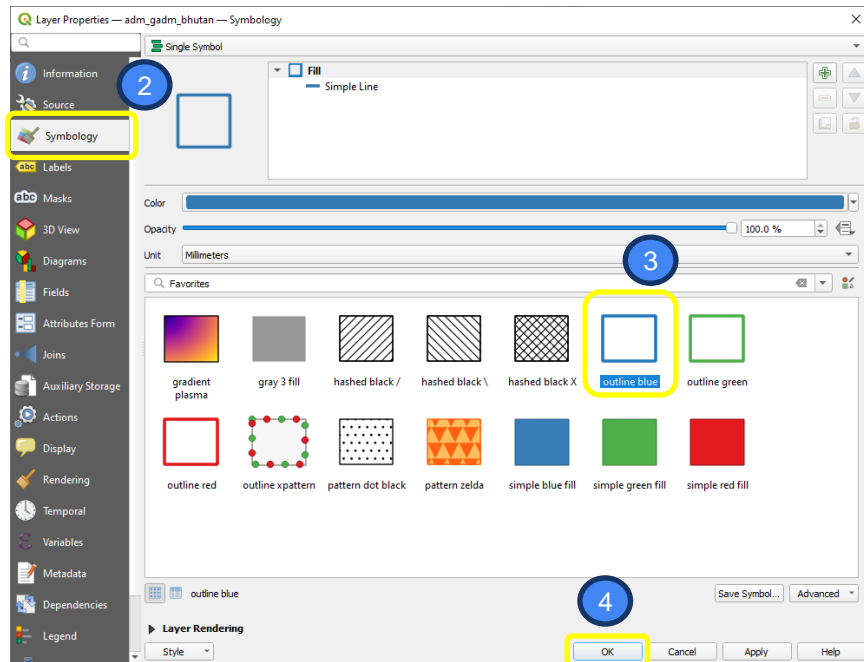


# Working with Vector Data

## Follow Along: Changing colors for vector layer

The symbology of a layer is its visual appearance on the map. The basic strength of GIS over other ways of representing data with spatial aspects is that with GIS, you have a dynamic visual representation of the data you're working with.

1. Right-click on the `adm_gadm_bhutan` layer in the Layers list and select the menu item **Properties** in the menu that appears.
2. In the Properties window, select the **Symbology**.
3. Look at the favorite symbol list at the bottom. For example, select `outline_blue`.
4. Click **OK**, and you will see the admin layer becomes transparent with a blue outline.

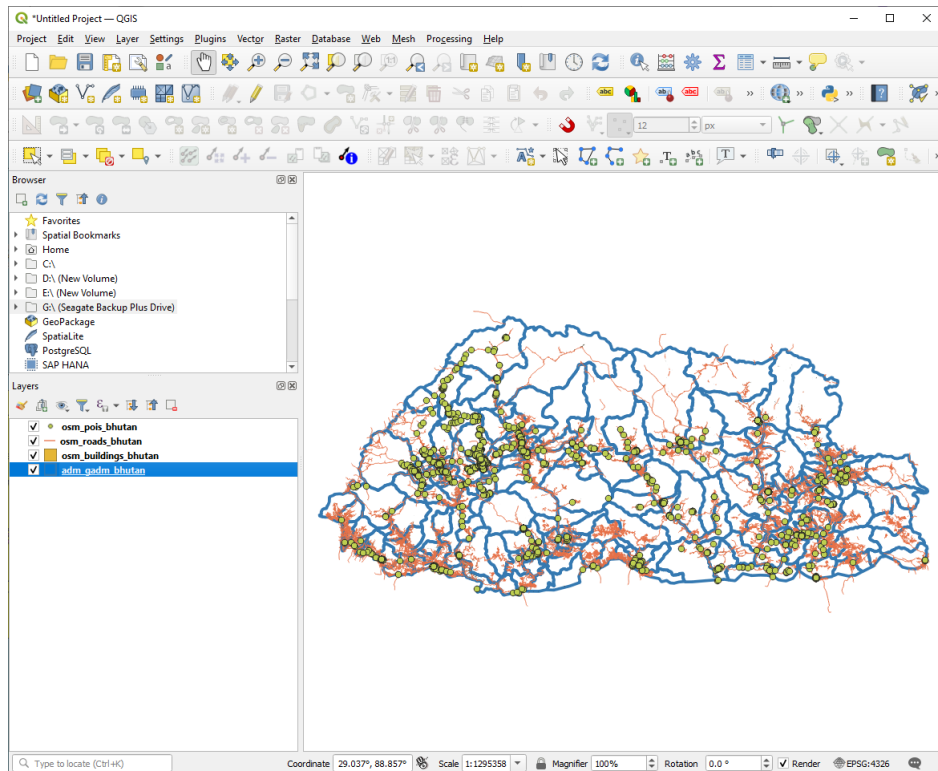




# Working with Vector Data

## Follow Along: Changing colors for vector layer

There's more to a layer's symbology than just changing its color. Mostly, we will work with raster data for this exercise, so we are not going to further discuss this symbology right now.



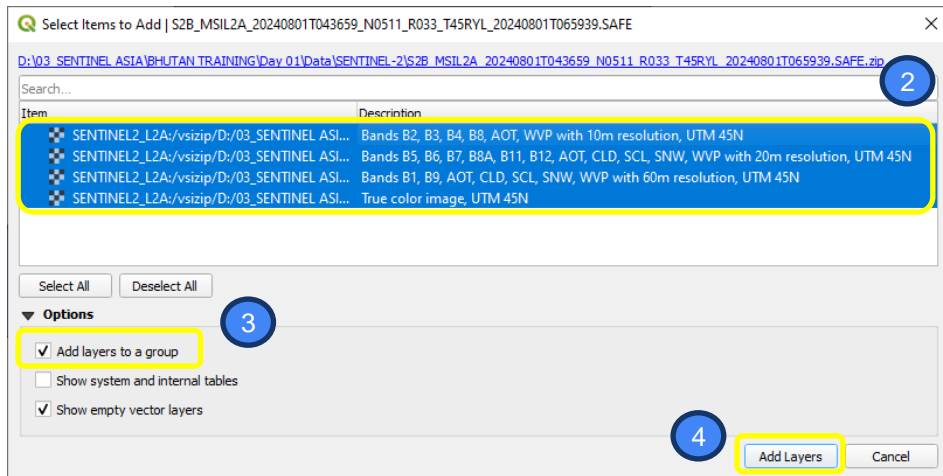


# Working with Raster Data

## Follow Along: Loading Sentinel-2 data

Sentinel-2 products are made available to Users in Sentinel-SAFE format, including image data in JPEG2000 format, quality indicators (e.g. , defective pixels mask), auxiliary data, and metadata. It wraps a zip folder containing image data in a binary data format and product metadata in XML.

1. Drag and drop the [Sentinel-2 zip file](#) to the Map View or Layer List.
2. Select All layers.
3. Checklist “[Add layers to a group](#)” option
4. Click [OK](#).





# Working with Raster Data

## Follow Along: Loading Sentinel-2 data

You will have several layers that contain a number of band combinations, including a True Color Composite layer (RGB combination: B4, B3, B2).

10 m:

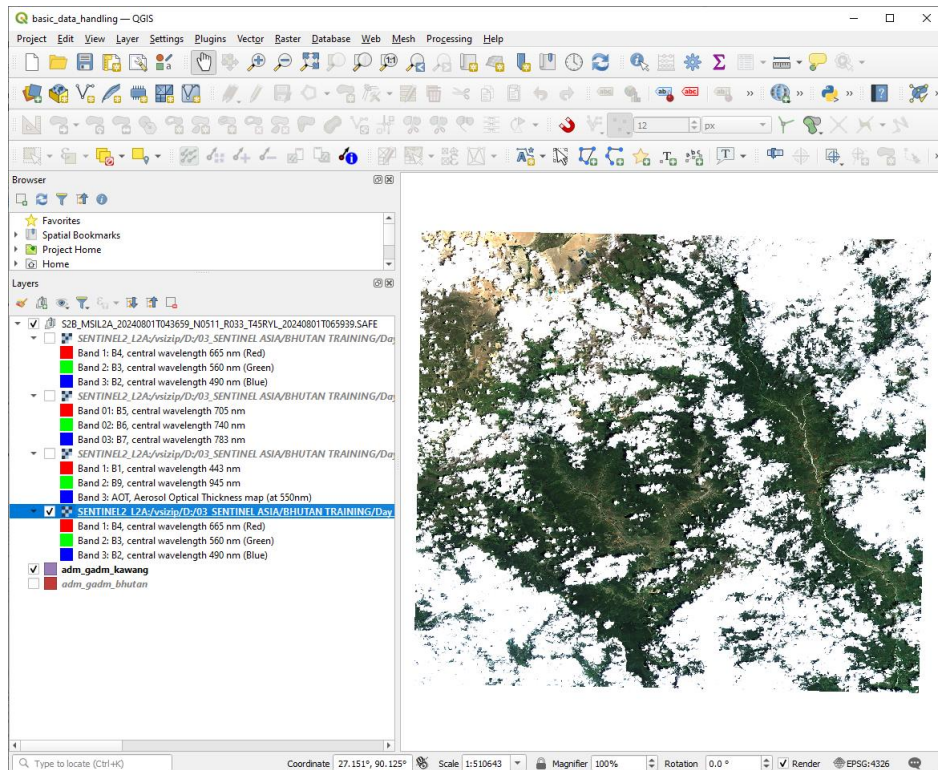
- Band 2: 490 nm (blue)
- Band 3: 560 nm (green)
- Band 4: 665 nm (red)
- Band 8: 842 nm (near-infrared)

20 m:

- Band 5: 705 nm (vegetation red edge)
- Band 6: 740 nm (vegetation red edge)
- Band 7: 783 nm (vegetation red edge)
- Band 8A: 865 nm (narrow near-infrared)
- Band 11: 1610 nm (short-wave infrared)
- Band 12: 2190 nm (short-wave infrared)

60 m:

- Band 1: 443 nm (coastal aerosol)
- Band 9: 940 nm (water vapour)
- Band 10: 1375 nm (short-wave infrared + cirrus)

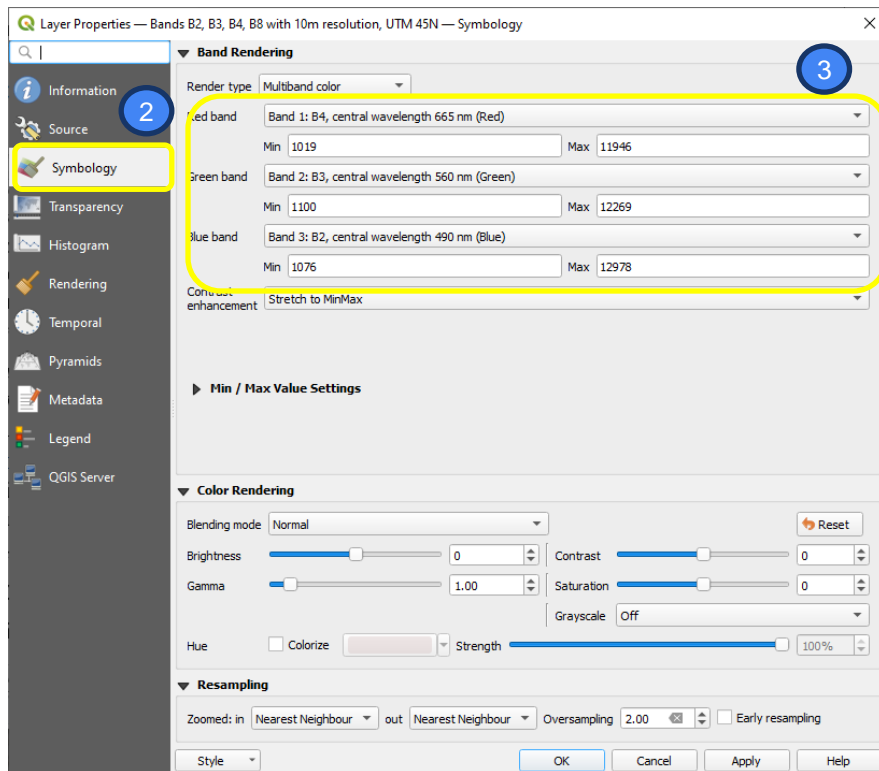




# Working with Raster Data

## Follow Along: Changing band combination

1. Open the Layer Properties dialog for the raster layer by right-clicking on the layer in the Layer tree and selecting the **Properties** option.
2. Switch to the **Symbology** tab.
3. Change the Band Rendering combination to your desired output.





# Working with Raster Data

## Follow Along: Enhancing image visualization

If the visualization of the composite image is not very clear, it's essential to enhance the data correctly to make it properly visible and useful.

1. Zoom to the extent of the image layer by right-clicking on it in the Layer List and selecting *Zoom to Layer Extent*.
2. Enabling Raster Toolbar by go to [View](#) → [Toolbars](#) → [Raster Toolbar](#)



- The third button from the left, *Local Histogram Stretch*, will automatically stretch the minimum and maximum values to give you the best contrast in the local area that you're zoomed into.
- The button on the most left, *Local Cumulative Cut Stretch ...* will stretch the minimum and maximum values to constant values across the whole image.



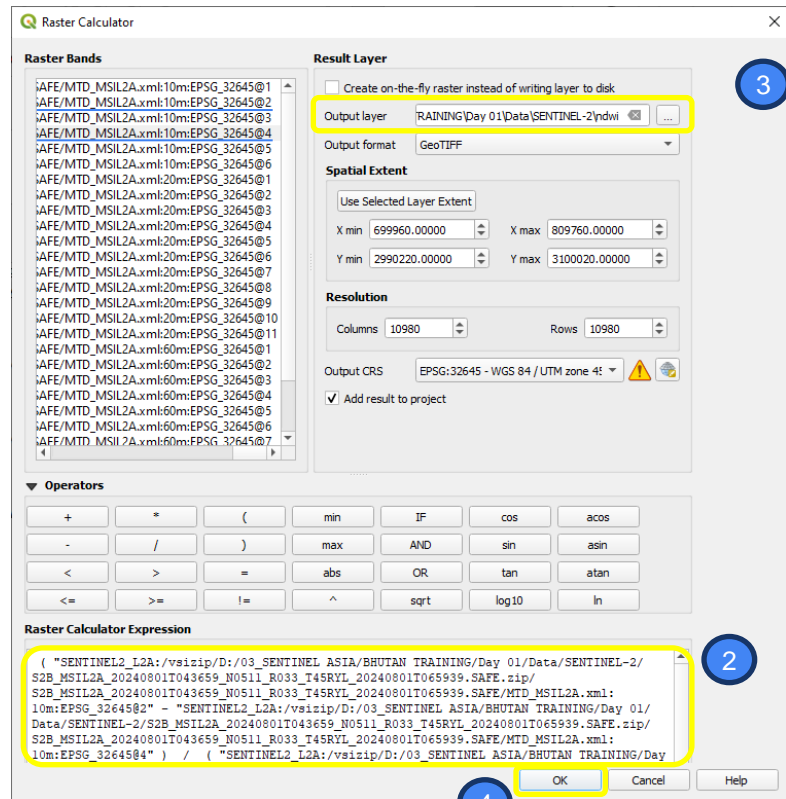
# Working with Raster Data

## Follow Along: Using raster calculator

The Raster Calculator in the Raster menu allows you to perform calculations based on existing raster pixel values. The results are written to a new raster layer.

As an example for this exercise, we will calculate a Normalized Difference Water Index (NDWI). The formula for Sentinel-2 10m layer is: (Band2: B3 – Band4: B8) / (Band2: B3 + Band4: B8)

1. In the Menu Bar, go to **Raster** → **Raster calculator**...
2. Write the formula in the Raster calculator expression.
3. In the Result layer, enter **ndwi** as the output file name and **GeoTIFF** as the output format.
4. Click **OK**.





# Working with Raster Data

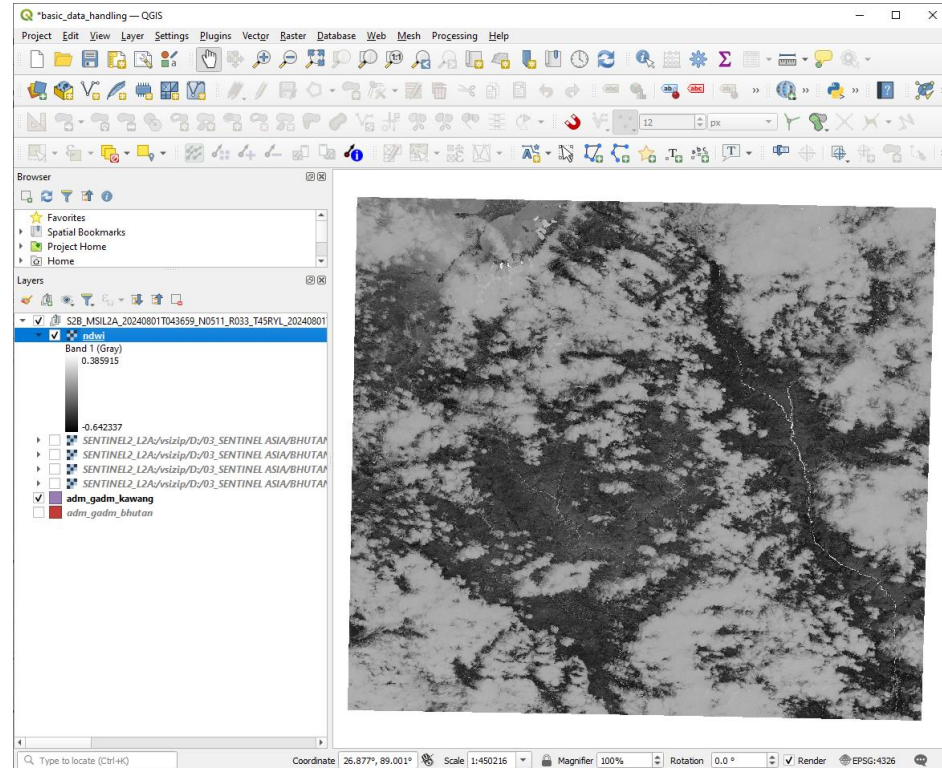
## Follow Along: Using raster calculator

Normalized Difference Water Index (NDWI) refers to remote sensing-derived indexes related to liquid water to detect and monitor changes in the water content of the water bodies.

$$NDWI = (Green - NIR) / (Green + NIR)$$

The NDWI values correspond to the following ranges:


- 0,2 – 1 → Water surface,
- 0.0 – 0,2 → Flooding, humidity,
- -0,3 – 0.0 → Moderate drought, non-aqueous surfaces,
- -1 – -0.3 → Drought, non-aqueous surfaces

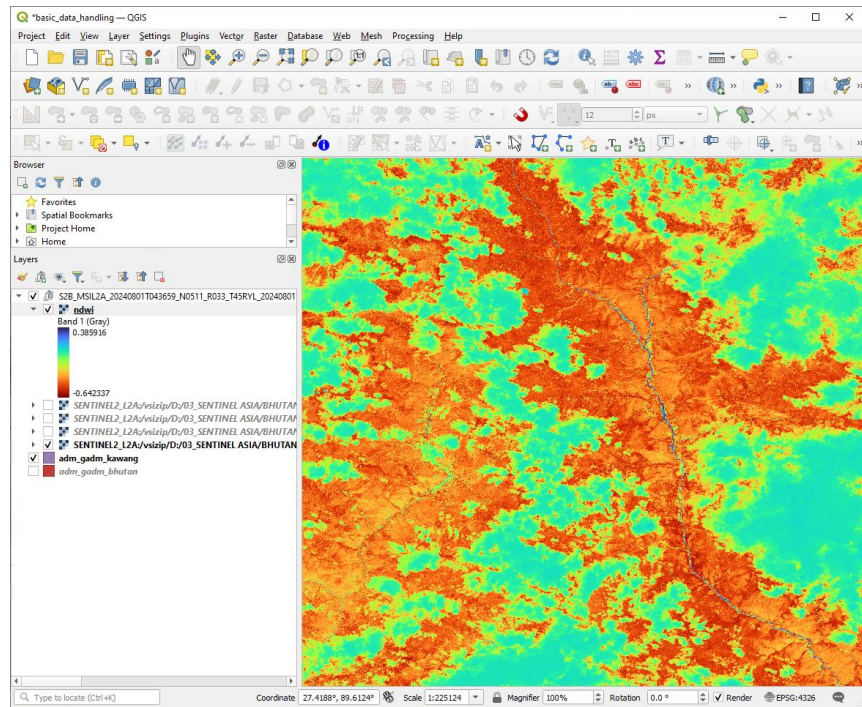
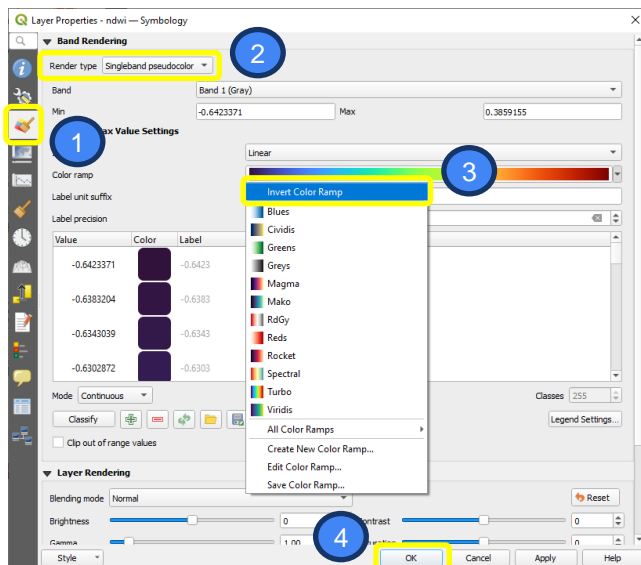




# Working with Raster Data

## Follow Along: Changing visualization color scheme

1. Go to Layer Properties and switch to the **Symbology** 
2. Change Render type to **Single band pseudocolor**.
3. Go to Color map, click **Invert Color Ramp**.
4. Click **OK**.



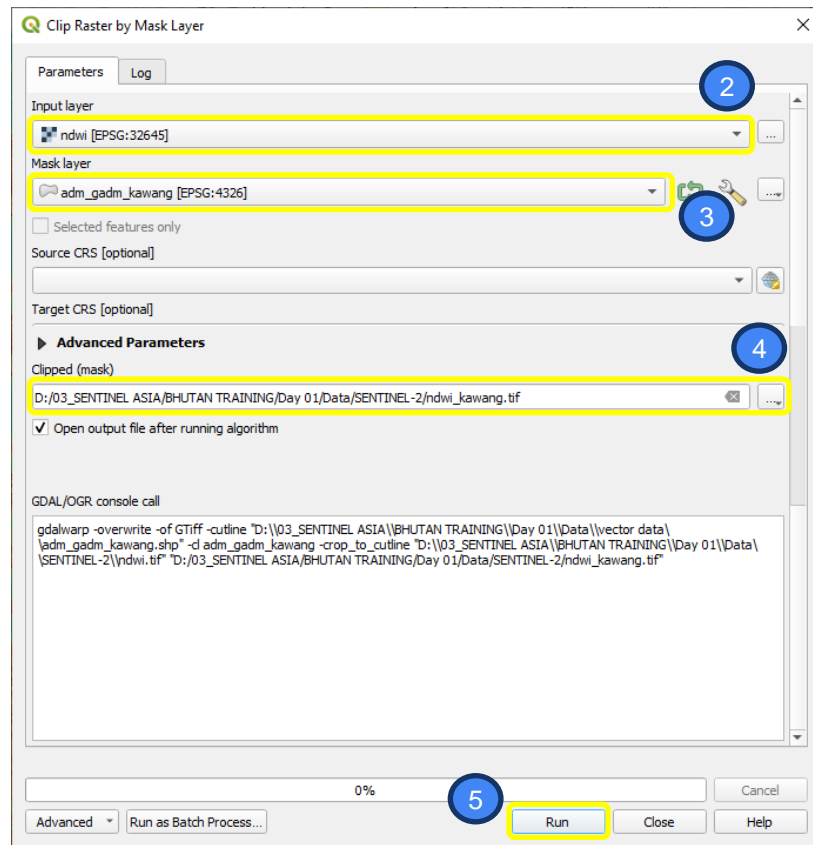
Note that the clouds may interfering with the NDWI interpretation.



# Working with Raster Data

## Follow Along: Clipping raster image

1. In the Menu Bar, click on **Raster** → **Extraction** → **Clip Raster by Mask Layer**.
2. In the Input Layer, select **ndwi**.
3. In the Mask Layer, select: **adm\_gadm\_kawang**.
4. Save the result to **ndwi\_kawang.tif**.
5. Click **Run**.

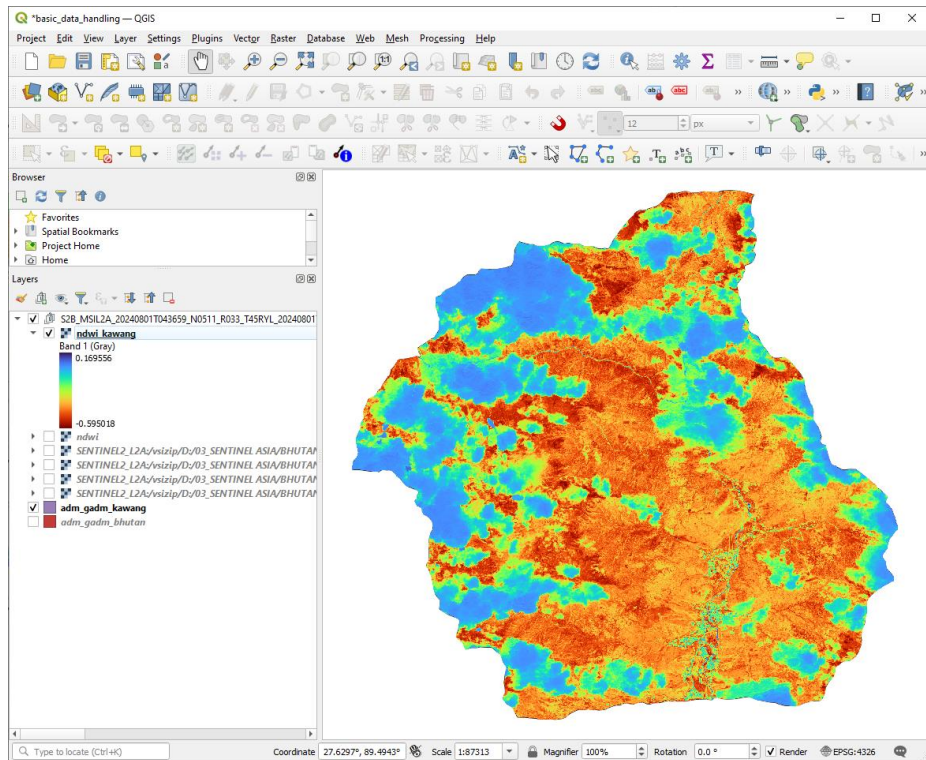




# Working with Raster Data

## Follow Along: Clipping raster image

Once the clip is created, the new raster file will be loaded to the Map View.



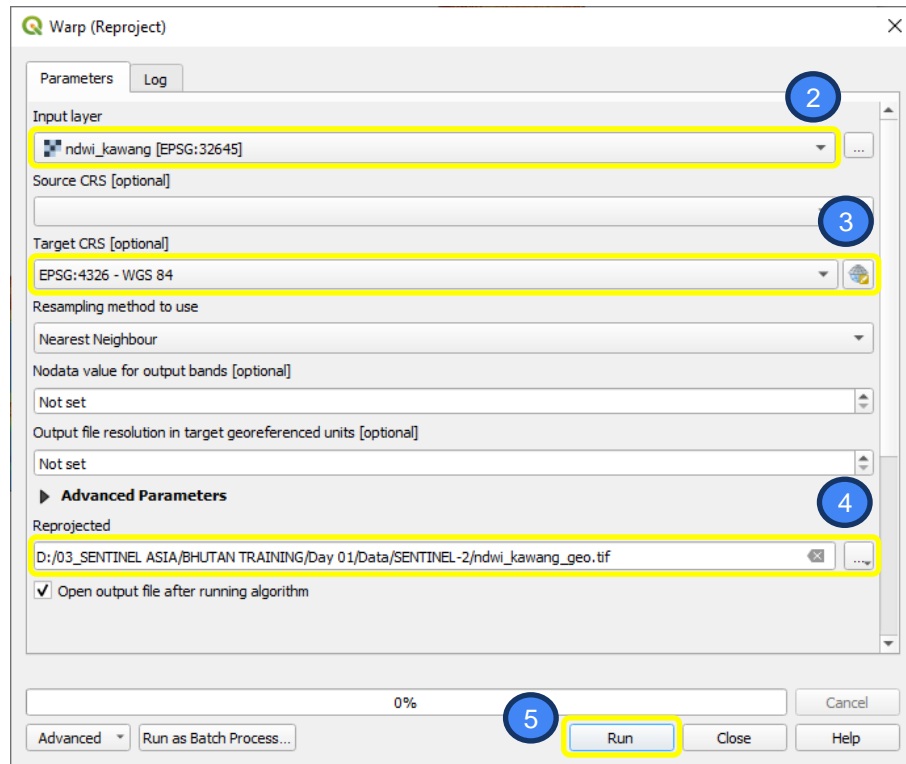


# Working with Raster Data

## Follow Along: Transforming raster data

QGIS is capable of overlaying two datasets in different projections by reproject them “on the fly”. However, you may want to transform raster data to another CRS (Coordinate Reference System) to ensure that all your datasets are in the same CRS.

1. In the Menu Bar, click on **Raster** → **Projections** → **Warp (Reproject)**.
2. In the Input Layer, select **ndwi\_kawang**.
3. In the Target CRS (optional), select **EPSG:4326 – WGS 84**.
4. Save the result to **ndwi\_kawang\_geo.tif**.
5. Click **Run**.





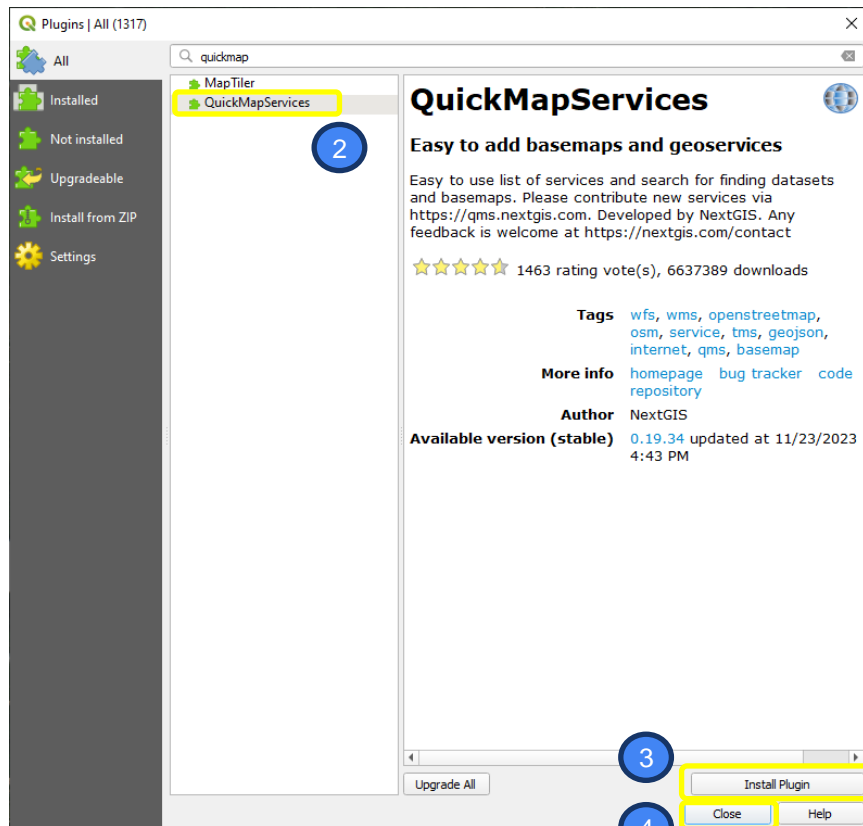
# Plugins

## Follow Along: Installing a new plugin

Plugins allow you to extend the functionality QGIS offers.

1. In the Menu Bar, click on **Plugins → Manage and Install Plugins**.
2. In the dialog that opens, find the **QuickMapServices** plugin. It is a simple, easy-to-use plugin that adds base maps to your QGIS project.
3. Click **Install Plugin**.
4. Click **Close**.

Your new plugin is installed. In the Menu Bar, go to **Web → QuickMapServices** to see the list of base maps that are available from this plugin.





# THANK YOU

Geoinformatics Center, Asian Institute of Technology



**Credit:**

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