

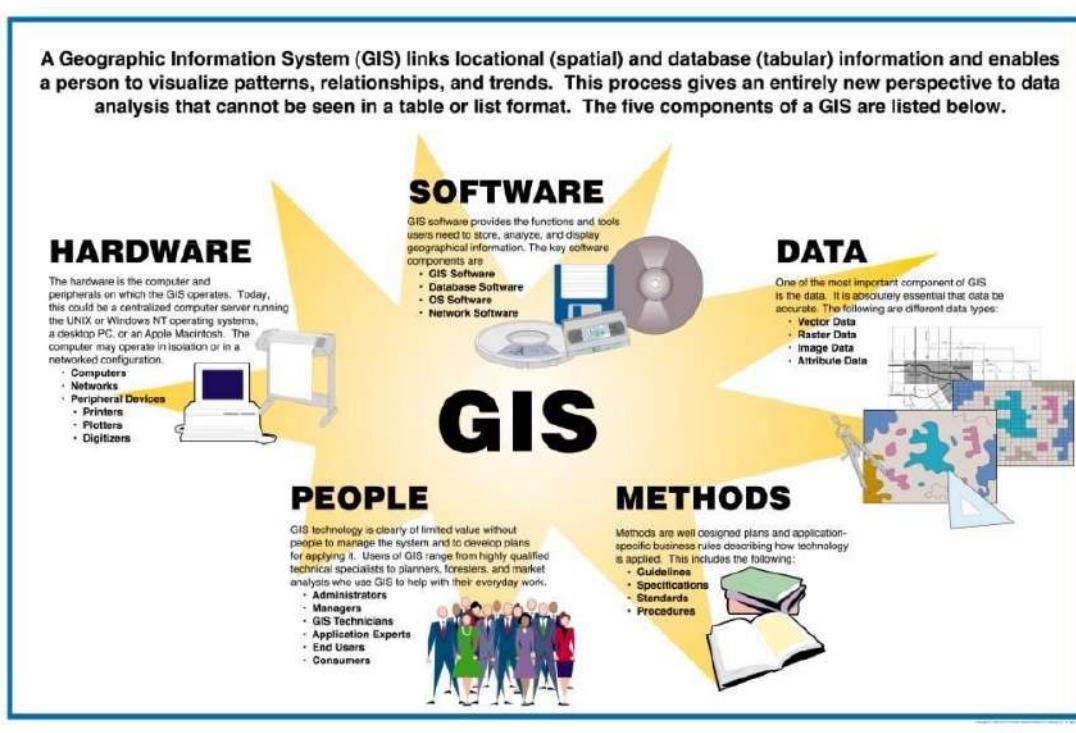
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Prerequisites to GIS Practical

What is a Geographic Information System (GIS)?

A Geographical Information System (GIS) is an organized collection of computer **hardware**, **software** and **data** used to link, analyze and display geographically referenced information.



The foundation of GIS is the ability to locate objects and events (streams, villages, disease cases) and link them with appropriate information in order to identify patterns and provide a basis for map making and analysis. Key types of geographical data, represented as separate map layers in a GIS, are outlined in the table below.

Sr. No	Data Type	Example	Layer on Map	
1	POINT	Building, Hospital, City, Well.	Points	
2	LINE	River, Road	Lines	
3	POLYGON	Administrative Boundaries, Census tracts.	Areas	
4	RASTER	Pixel or grid data		

Vector data: A representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets.

Point features: A map feature that has neither length nor area at a given scale, such as a city on a world map or a building on a city map.

Line features: A map feature that has length but not area at a given scale, such as a river on a world map or a street on a city map.

Polygon features: A map feature that bounds an area at a given scale, such as a country on a world map or a district on a city map.

Raster data. A representation of the world as a surface divided into a regular grid of cells. Raster models are useful for storing data that varies continuously, as in an aerial photograph, a satellite image, a surface of chemical concentrations, or an elevation surface.

With a GIS application you can open digital maps on your computer, create new spatial information to add to a map, create printed maps customised to your needs and perform spatial analysis.

Understanding QGIS

What is Quantum GIS?

Quantum GIS (QGIS) is a user friendly Open Source GIS application licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.

Like all GIS applications, QGIS provides a graphical user interface allowing display of map layers and manipulation of data for analyses and map-making.

A Geographical Information System (GIS) is a collection of software that allows you to create, visualize, query and analyze geospatial data. Geospatial data refers to information about the geographic location of an entity. This often involves the use of a geographic coordinate, like a latitude or longitude value. Spatial data is another commonly used term, as are: geographic data, GIS data, map data, location data, coordinate data and spatial geometry data. Applications using geospatial data perform a variety of functions. Map production is the most easily understood function of geospatial applications. Mapping programs take geospatial data and render it in a form that is viewable, usually on a computer screen or printed page. Applications can present static maps(a simple image) or dynamic maps that are customized by the person viewing the map through a desktop program or a web page.

Many people mistakenly assume that geospatial applications just produce maps, but geospatial data analysis is another primary function of geospatial applications. Some typical types of analysis include computing:

1. Distances between geographic locations
2. The amount of area (e.g., square meters) within a certain geographic region
3. What geographic features overlap other features?
4. The amount of overlap between features
5. The number of locations within a certain distance of another
6. and so on...

These may seem simplistic, but can be applied in all sorts of ways across many disciplines. The results of analysis may be shown on a map, but are often tabulated into a report to support management decisions. The recent phenomena of location-based services promises to introduce all sorts of other features, but many will be based on a combination of maps and analysis. For example, you have a cell phone that tracks your geographic location. If you have the right software, your phone can tell you what kinds of restaurants are within walking distance. While this is a novel application of geospatial technology, it is essentially doing geospatial data analysis and listing the results for you.

System Requirements

Windows OS:

Minimum: Pentium III / 256 MB RAM.

Recommended: 1 GB of RAM and 1.6 GHz processor.

Operation System: Platforms Windows and Linux (Win XP or newer, Linux Suse 8.2/9.0/9.2, Linux Debian (Lliurex))

MAC OS:

PC/Desktop with at least Pentium IV

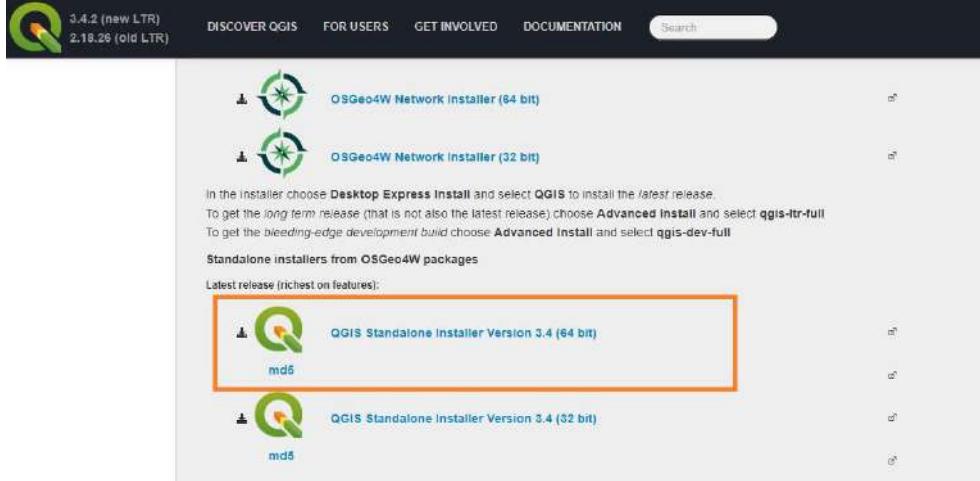
Tiger OS, Leopard OS.

Installation of QGIS

Step By step procedure

- 1) Create a folder on your D:/ drive on your computer called QGISlab by right clicking on the D: drive and navigating down to the New / Folder.
- 2) Go to the QGIS download page and download the latest 64bit version of QGIS for windows which is QGIS 3.4 'Madeira' by clicking once.
- 3) If you have a 32 bit machine or using another operating system search the bottom of the page for your operating system and download the correct operating system version of QGIS.

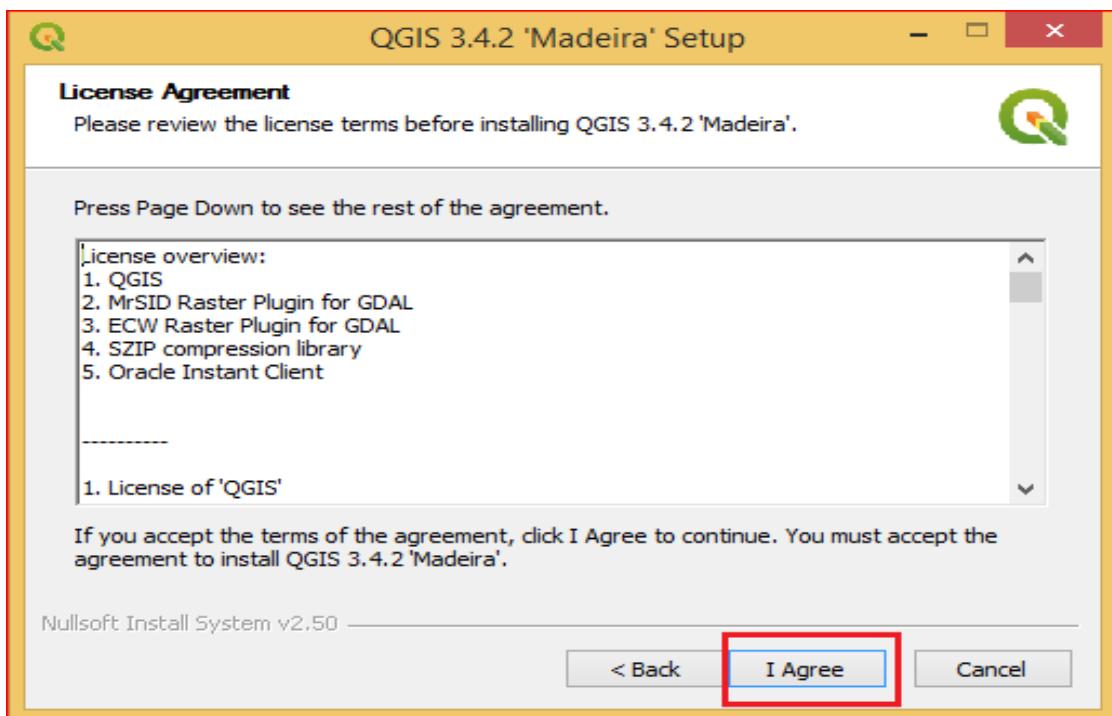
<http://www.qgis.org/en/site/forusers/download.html>



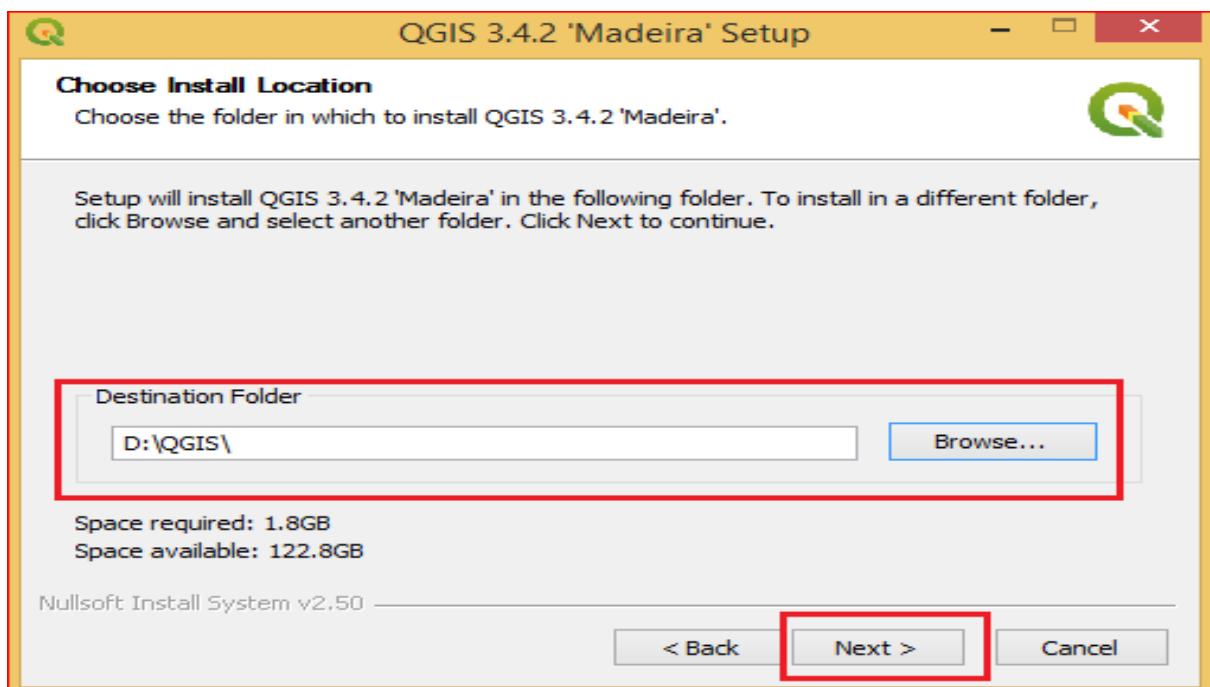
- 4) Your browser will download the file to the browser's default download directory. By pressing the control key and the letter J at the same time a popup window will show you the folder where the QGIS file has been downloaded. The QGIS file will be called:
QGIS-OSGeo4W-3.4.2-1-Setup-x86.exe
- 5) Move or copy the above file to your C:/QGISlab folder and double click on the file. You will get a popup window with a security warning.
- 6) Hit the run button to start the installation process and follow the prompts. There is no need to install the data sets suggested by QGIS.



- 7) From the above window, click Next button and continue with the installation.
- 8) Please go through the license agreement and click on the button > I agree and proceed with the installation as shown in the screen.

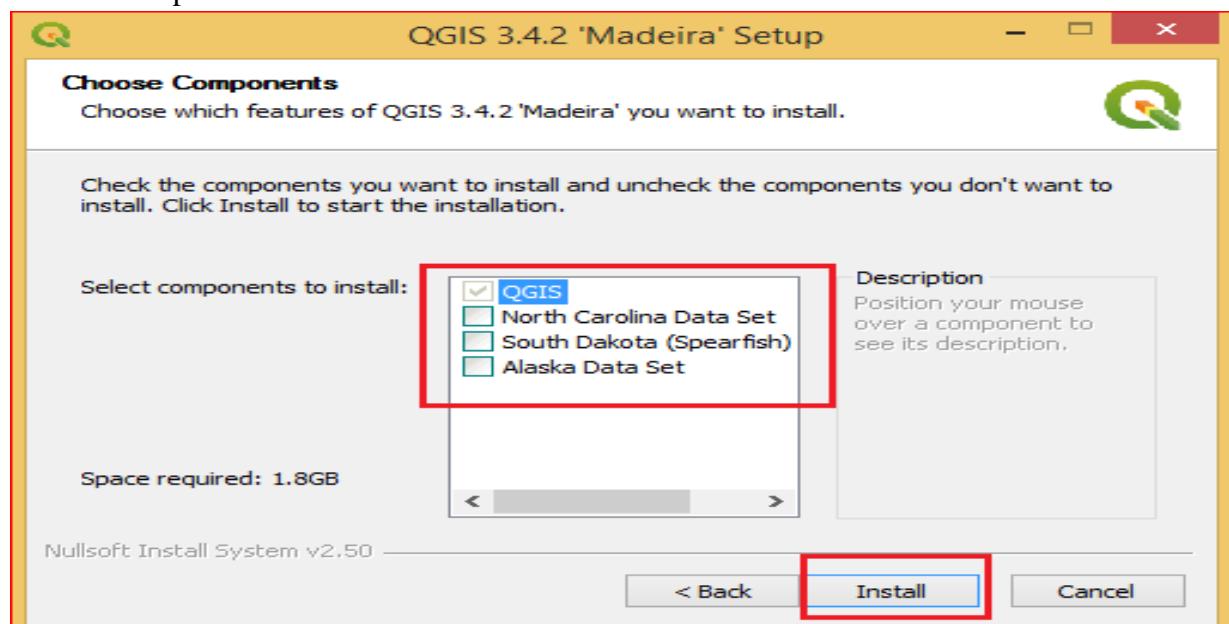


- 9) As the software is very heavy it is advisable to install it in the different drive other than the windows drive. As per our example, we will be installing in QGIS folder on D:\ drive.

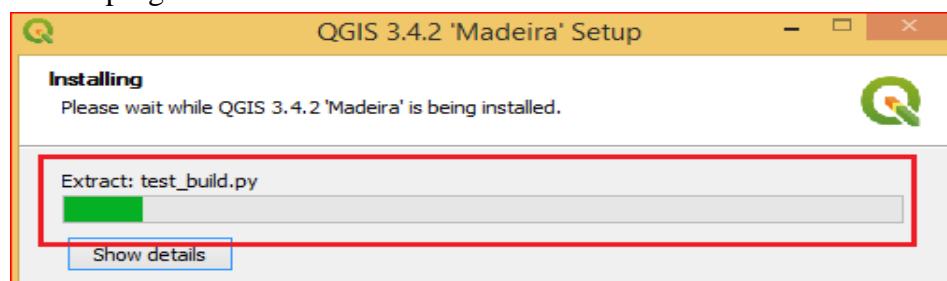


10) After browsing the folder click the Next button and proceed with the installation as shown in above figure.

11) By default QGIS component is selected. Do not install any other data set at this point. Click Install to proceed with installation.



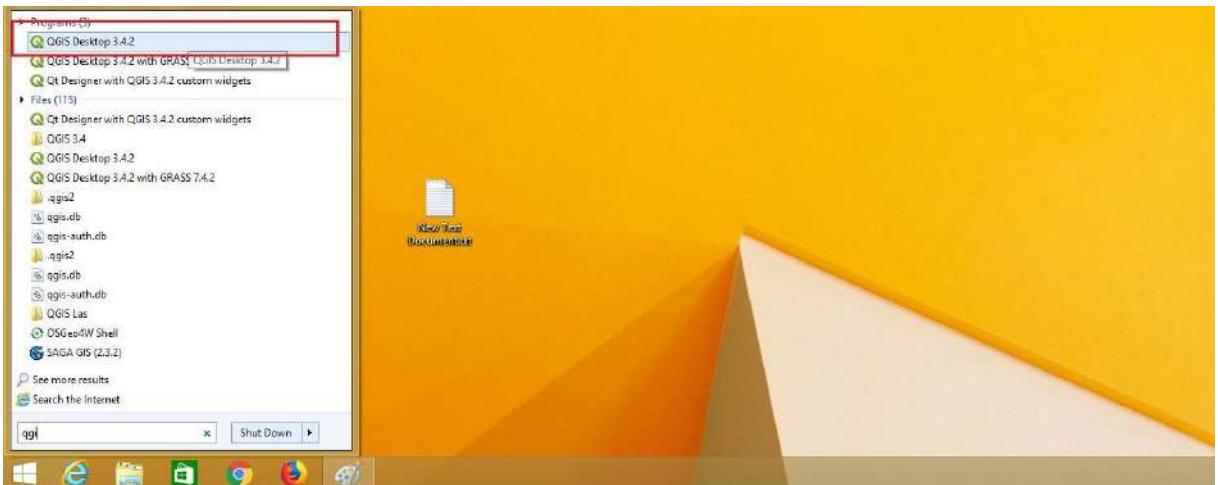
12) You will see the progress of the installation on the screen.



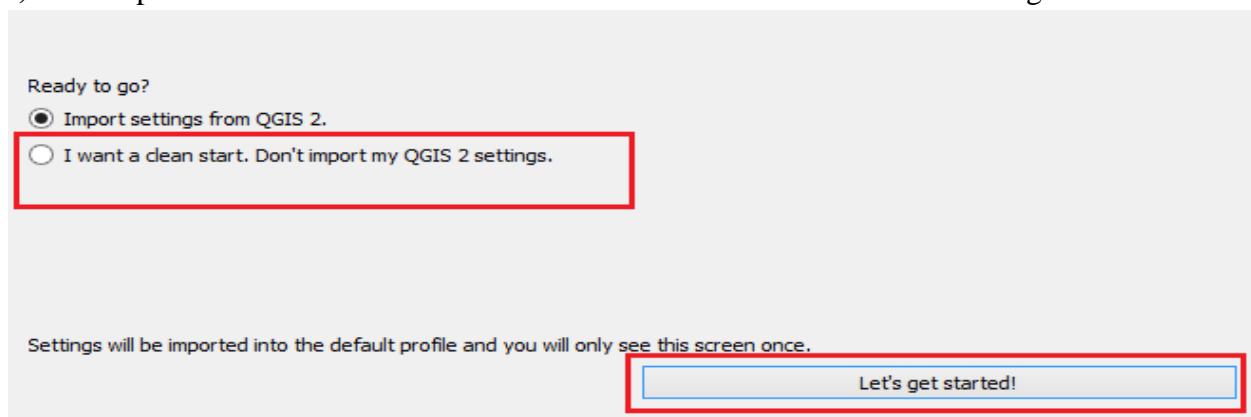
- 13) Please reboot your machine once the installation is completed. Click finish to complete the installation.



- 14) After machine is restarted, type QGIS on Run and open QGIS Desktop 3.4.2.

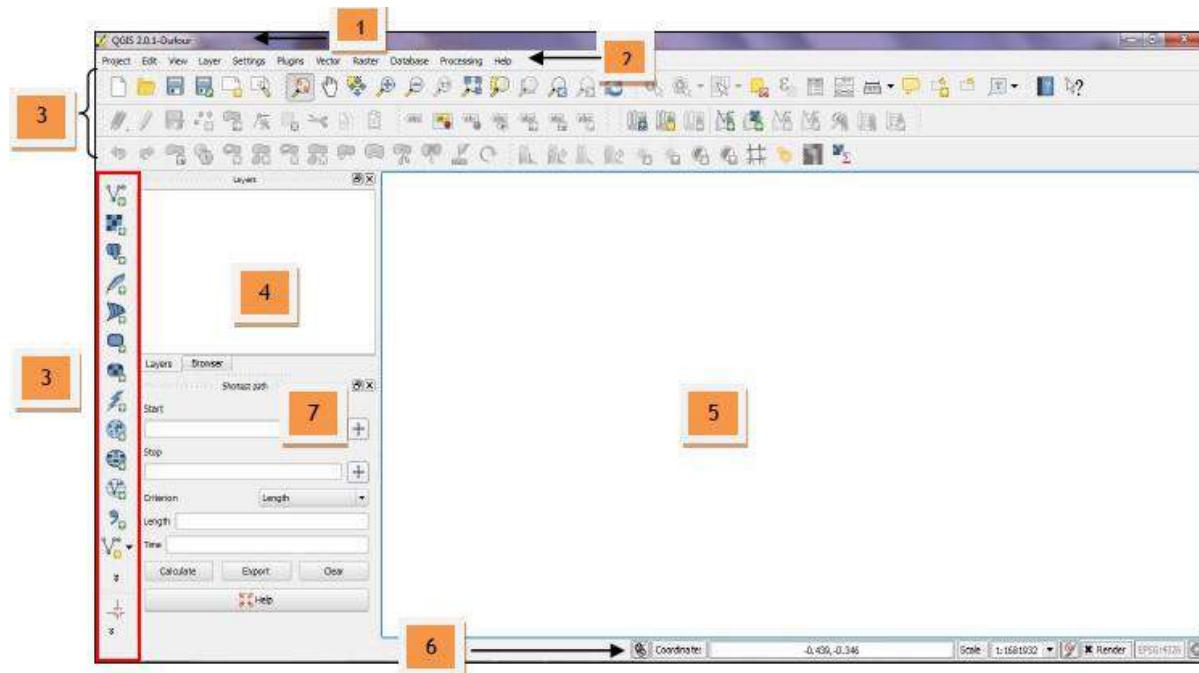


- 15) It will open a new wizard for the first time after installation as shown in the figure below.



- 16) Select I want a clean start. Don't import my QGIS 2 settings and click on let's get started button. You will be redirected now to the home screen of QGIS Desktop.

Understanding QGIS Desktop Environment.

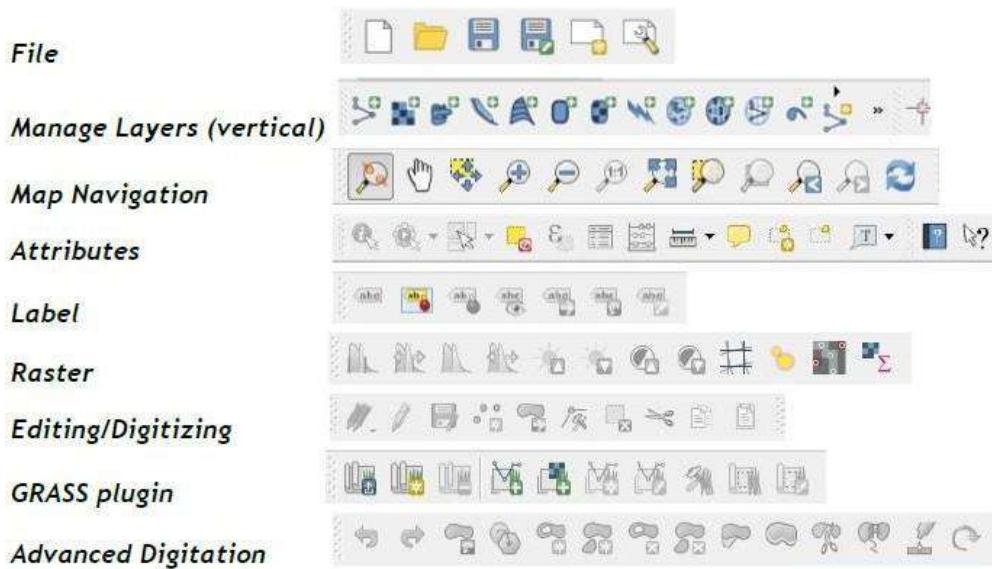


Quantum GIS interfaces change from one project to another depending on the required interface of the project. Below are the basic menus that you will encounter in Quantum GIS during the practicals.

- 1. Title of the Project** - Shows the title of project that you are going to view.
- 2. Menu Bar** – This provides access to various Quantum GIS features using a standard hierarchical menu.
- 3. Toolbars** – These provide access to most of the same functions as the menus, plus additional tools for interacting with the map. It shows the command for zoom in, zoom out, pan, back to original view, go back to previous extent, go to next extent, object-information, coordinate read-out, measure, print and help.
- 4. Table of Contents/Map Legend (TOC)** - Shows the layers that can be turned on or off and the legend, attributes symbols and query symbols available for the corresponding project.
- 5. Display Window** - Shows the feature/s that you have turn on from the TOC.
- 6. Status Bar** - Shows you your current position in map coordinates (e.g. metres or decimal degrees) as the mouse pointer is moved across the map view. To the left of the coordinate display in the status bar is a small button that will toggle between showing coordinate position or the view extents of the map view as you pan and zoom in and out.
- 7. Data sources browser** – In previous versions, QGIS browser was only provided as an external application which enables us to explore our spatial data sets. In QGIS 2.0.1-Dufour this application is also integrated in the QGIS framework as an additional panel just below the Table of Contents.

Quantum GIS toolbars and some other components

Toolbars are divided by thematic (greyed icons means they are inactive because the appropriate conditions to use them are not fulfilled). Some of them are included by default in QGIS and others can be added/removed from the interface:



Key functions:

Here, you will learn how to QGIS' different mapping tools and other components that you'll be using in this practical.

File Options

- New Project**
Enables you to create a new project.
- Open Project**
Tool used to open an existing/previous project created in Quantum GIS.
- Save Project**
Enables you to save the project.
- Save Project As**
Enables you to save the project in another format.
- New Print Composer**
Enables you to print the map/layers including the title, TOC, map overview, scale bar, graph/attributes present in the layer, author and map information, logo, toolbar, and other components present in the main page of the project.
- Composer Manager**
Enables you to access to the different composition in progress and manage them; showing, removing, closing, and so on.

Displaying Layers

- Add Vector Layer**
Enables you to add any readable existing vector format layer.
- Add Raster Layer**
Enables you to add any readable existing raster format layer.

Table of Contents. Menu

Turns layer on or off

Click the box to turn on or off the layer/s.



Folder icon in the TOC

This represents a group of layers in the TOC.



Grayed colour means only selected layers are visible in the group of layers.



Navigation toolbars

Zoom in

Click once in the map to zoom in or drag a box over the particular area.



Zoom out

Click once in the map.



Panning

Click in the map, hold down the mouse button, and drag in any direction.



Zoom to Full

Click to return to default view or view the full map layer/s.



Zoom to Selection

Click to view the selected part of map layer/s.



Zoom to Layer

Click to view a particular map layer.



Object Information

Identify Features

Click to activate and point to the layers you want to view the information.



Open Attribute Table

Click to open the attribute table of a layer.



Principles of GIS T. Y. B. Sc. IT Semester VI
List of Sample/Data files used for Practical

Practical No.	Data set Name
1D	IND_rails.zip IND_adm0.zip
2A	gl_gpwv3_pdens_00_ascii_one.zip gl_gpwv3_pdens_90_ascii_one.zip
2C	FAS_India1.2018349.terra.367.2km.tif FAS_India2.2018349.terra.367.2km.tif FAS_India3.2018349.terra.367.2km.tif FAS_India4.2018349.terra.367.2km.tif
3B	Sample.csv
4A	ne_10m_populated_places_simple.zip
4B	GMTED2010N10E060_300.zip

5A	ne_10m_populated_places_simple.zip
6A	IND_adm0.zip Bombay_1990.jpg
6B	GateWay_Aerial_Imagery.tif
6C	Christchurch Topo50 map.tif
7A	tl_2013_06_tract.zip ca_tracts_pop.csv
7B	OEM_NursingHomes_001.zip nybb_12c.zip
7C	EarthQuakeDatabase.txt ne_10m_admin_0_countries.zip ne_10m_populated_places_simple.zip
7D	ne_10m_populated_places_simple.zip ne_10m_rivers_lake_centerlines.zip
8A	ca_tracts_pop.csv EarthQuakeDatabase.txt ne_10m_populated_places_simple.zip tl_2013_06_tract.zip
8B	us.tmax_noahads_ll_20140525_float.tif 2013_Gaz_ua_national.txt tl_2013_us_county.shp
8C	tl_2013_us_county.shp Boundary2004_550_stpl83.shp
9A	ne_10m_admin_0_countries.shp ne_10m_admin_0_District.shp ne_10m_admin_0_port.shp ne_10m_admin_0_railroads.shp
9B	LC_hd_global_2001.tif.gz
9C	HI_Wetlands.shp.zip
10	Kenya admin.shp Kenya_epidemiological_data.xls Kenya_epidemiological_dict.xlsx Kenya_school_dict.xlsx Kenya_school_location.csv

The above data can be downloaded from:

www.muresults.net → TYBSc IT Sem VI eBooks →GIS→ Practicals

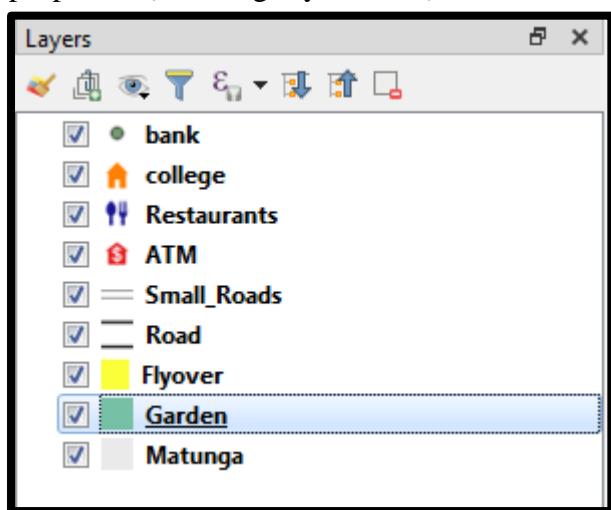
Or directly from: <https://drive.google.com/drive/folders/191tJ4L7O-VJm2Q2AB8dZDpIj7vyvPM3I?usp=sharing>

PRACTICAL - 1**B. AIM :- Creating and Managing Vector Data:**

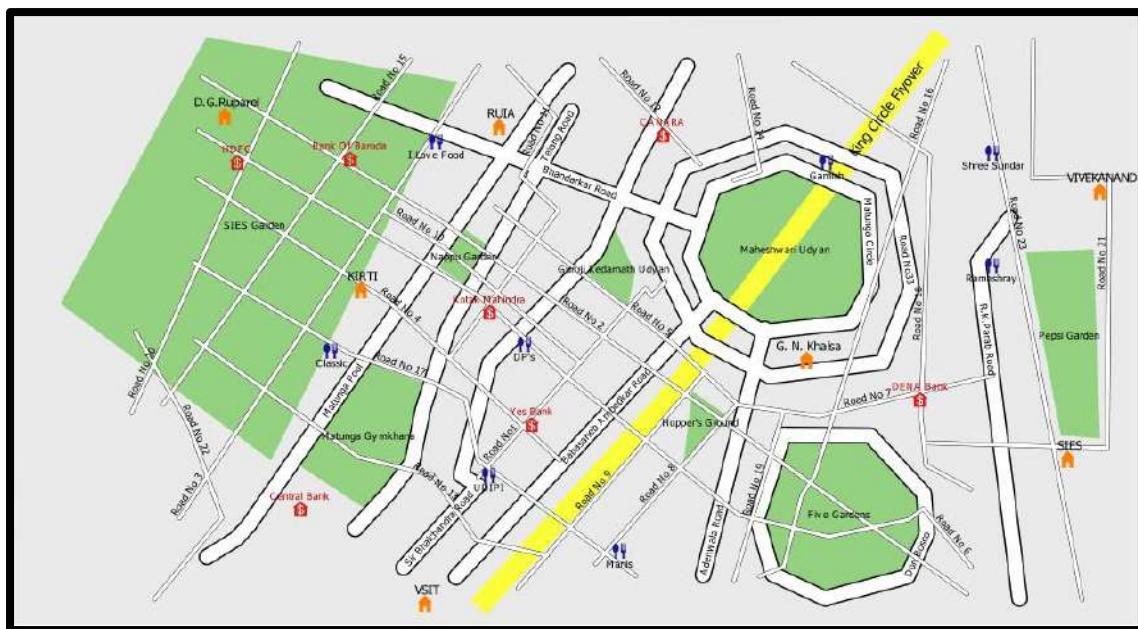
- Adding vector layer
- Setting properties
- Vector Layer Formatting

Procedure:

- Adding vector layers (Polygon, Line, Points)
 - Polygon layers (We have taken **2** layers Matunga, Garden)
 - Line layers (We have taken **3** layers Small_Roads, Road, Flyover)
 - Point layers (We have taken **4** layers bank,college,Restaurants,ATM)
- Setting properties (Labeling, Symbolism)

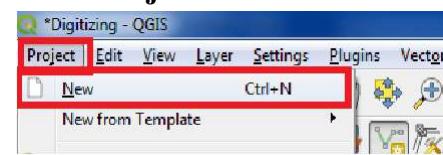


- Our aim is to create map representing a location and its surrounding as follows:

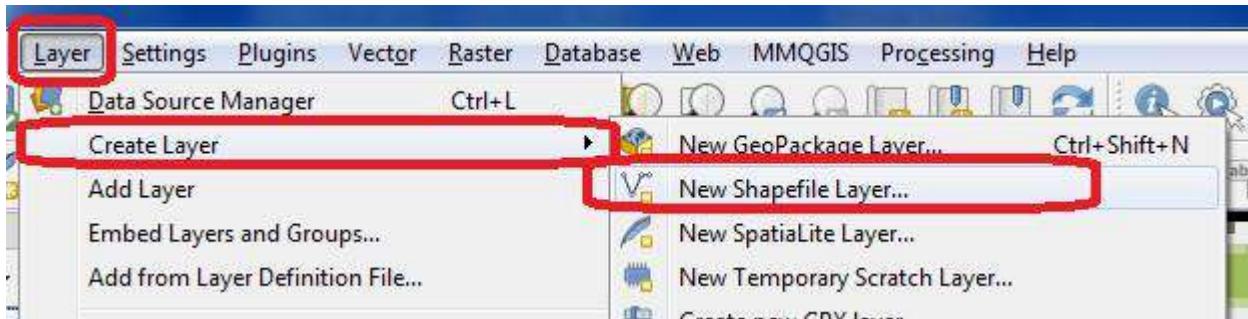


a) Creating Polygon vector layer

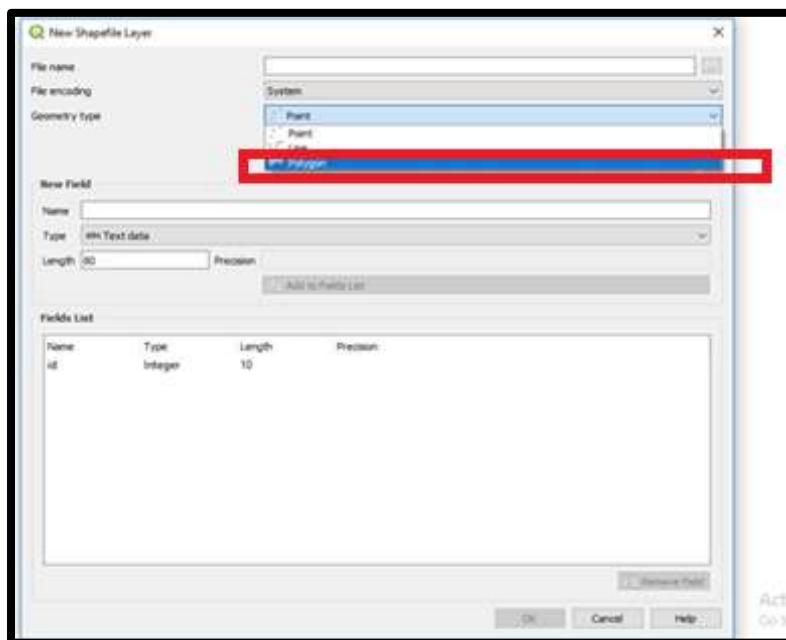
➤ Select Project→New



➤ Select Layer→Create Layer→New Shapefile Layer



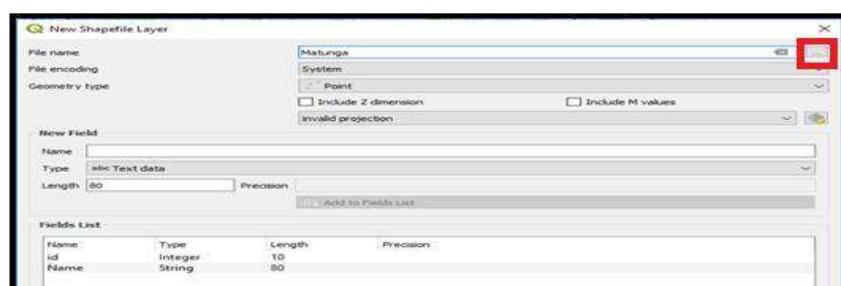
➤ Following dialog box will appear on the screen. Select Polygon option from Geometry type.

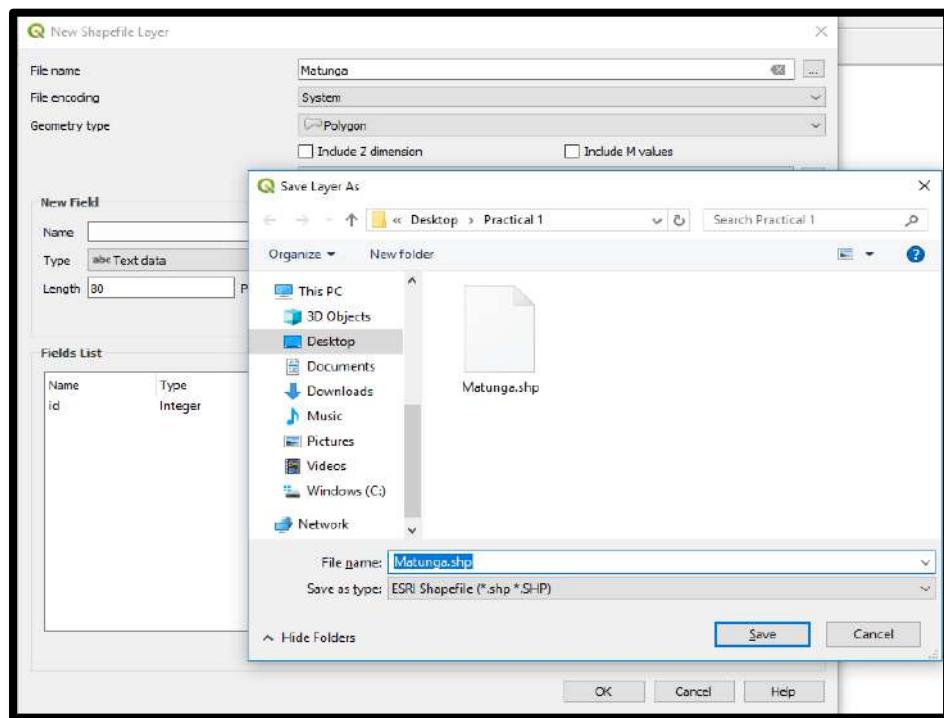


➤ Fill the appropriate information in each text box.

- File name :

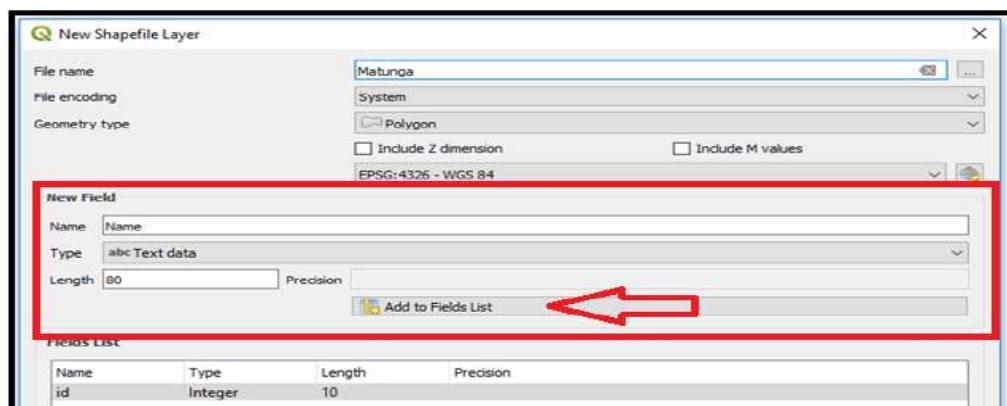
- By default the file will be saved in bin folder.
- To avoid it click on following button to change the location of file.





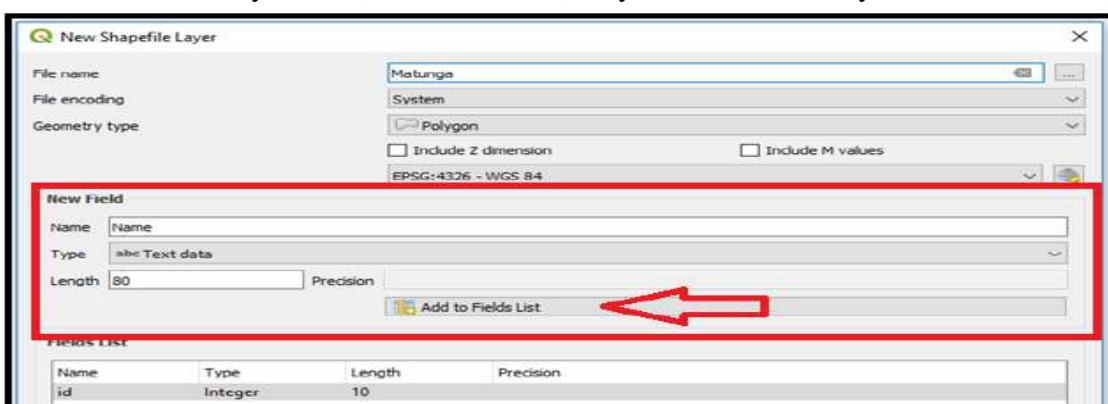
➤ **Field Panel**

- Add the **Attribute** you want to show. (**Column Name** for Table)
- b. Specify **Type** (**Data Type**: Text Data/Decimal Data/Whole Number/Date) of Attribute
- c. Specify the **Length** of the Attribute. Specify **Precision** (If Data Type is Decimal)

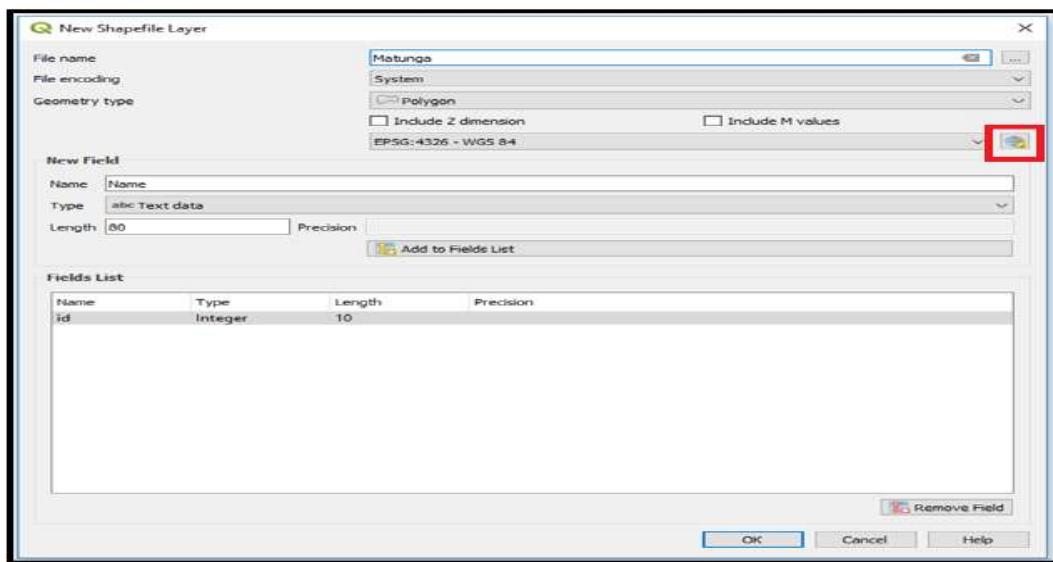


➤ Click on **Add to Field List** Button.

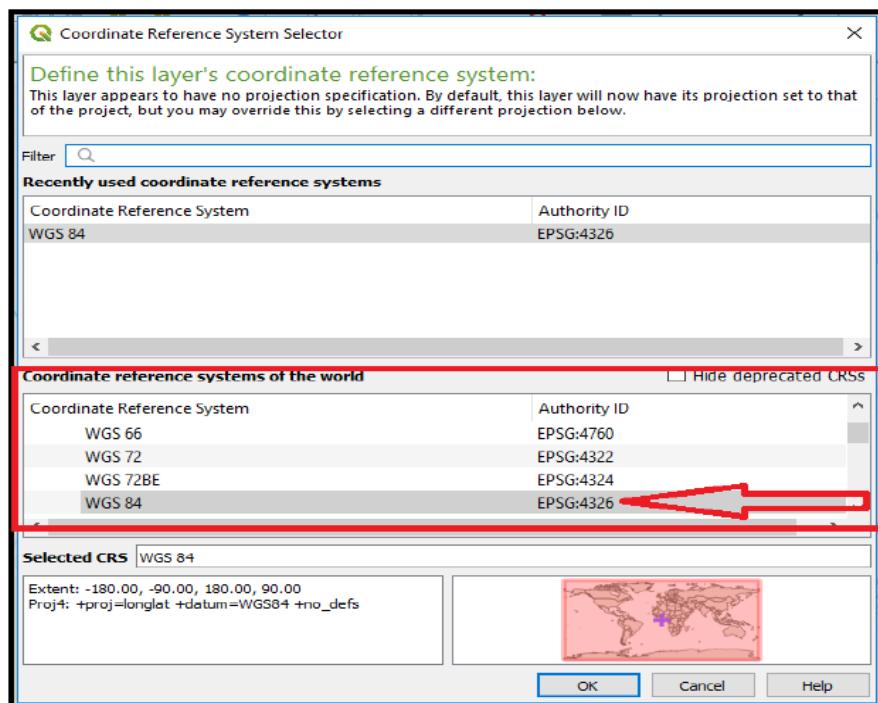
➤ You can add as many **fields** (**Column Name**) as you want for the layer.



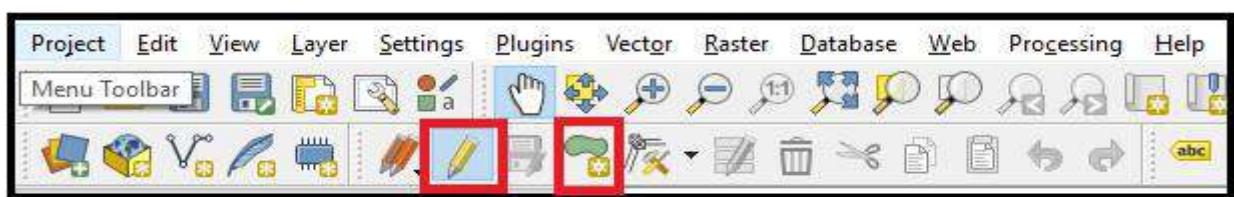
- Select Geometry Type as follows
 - Click on the following button



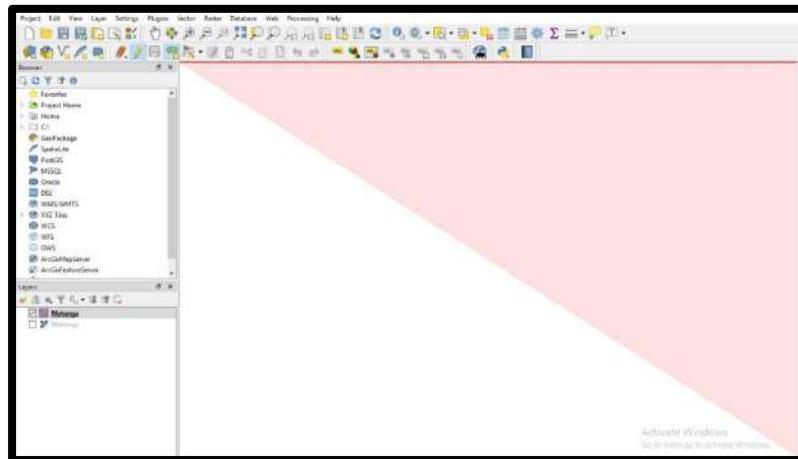
- The CRS dialog box will appear on screen. Click on the WGS84 option and it will be selected as follows. click on **OK**



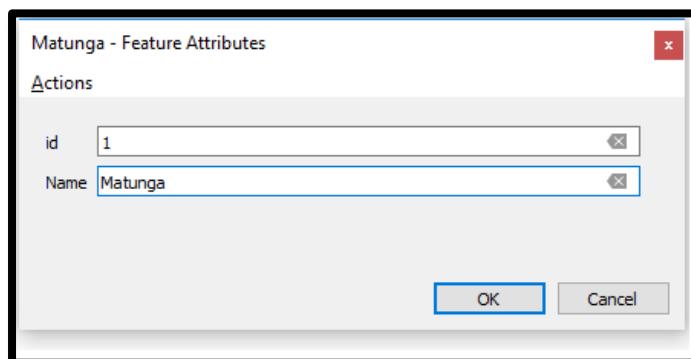
- a) Follow the steps to plot **Polygon features**.
- Select the **Polygon Feature** (In our case it is **Matunga** for background) from layer panel



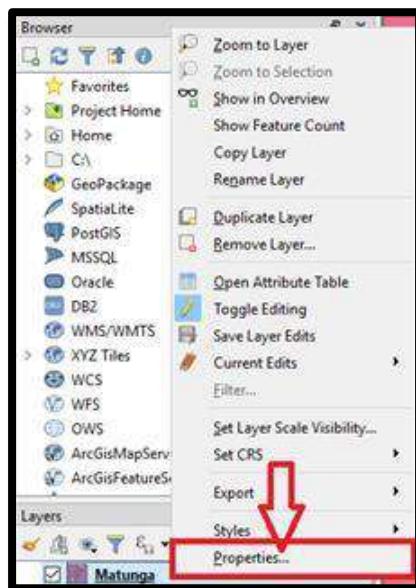
- Click **Toggle Editing Button** → Click on **Add Polygon** → Now place the cursor at the location where you want to place the polygon. for **Polygon** layer **minimum 3 points** should be selected



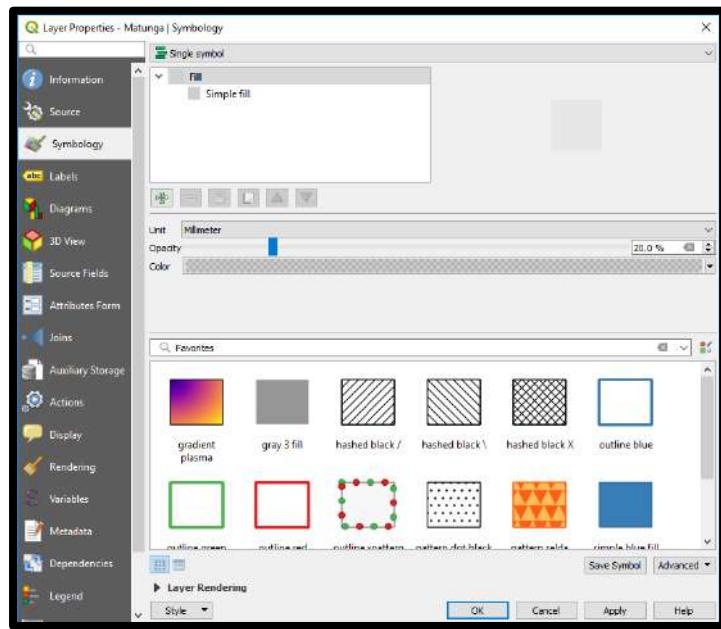
- Save the newly added polygon as follows.



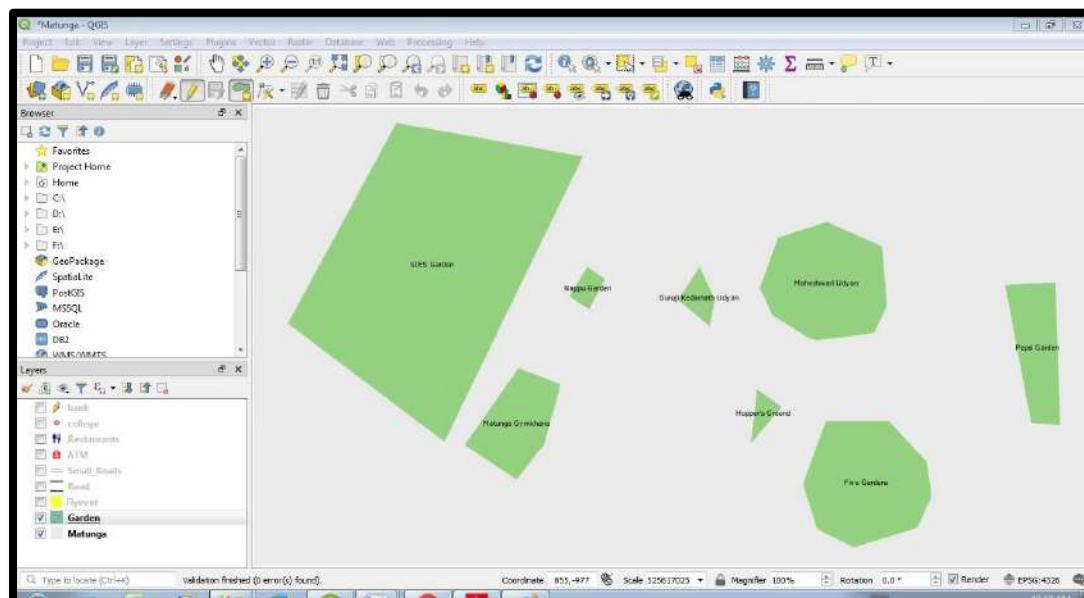
- Set **style** for polygon by using property window(**Right click** on Matunga Layer)



- Following screen will appear on the screen. Select **pattern** as you want and **click on OK**.

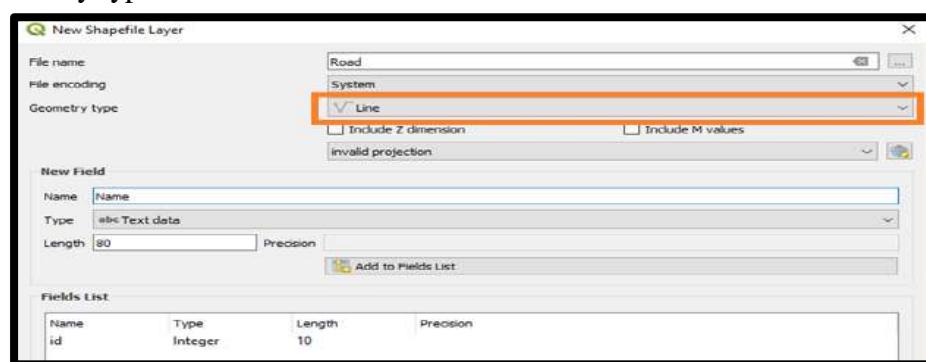


- Same way we can add one more polygon layer for Gardens.



b) Creating Line vector layer

- Repeat the same steps as we have done for polygon layer.
- Select geometry type Line.

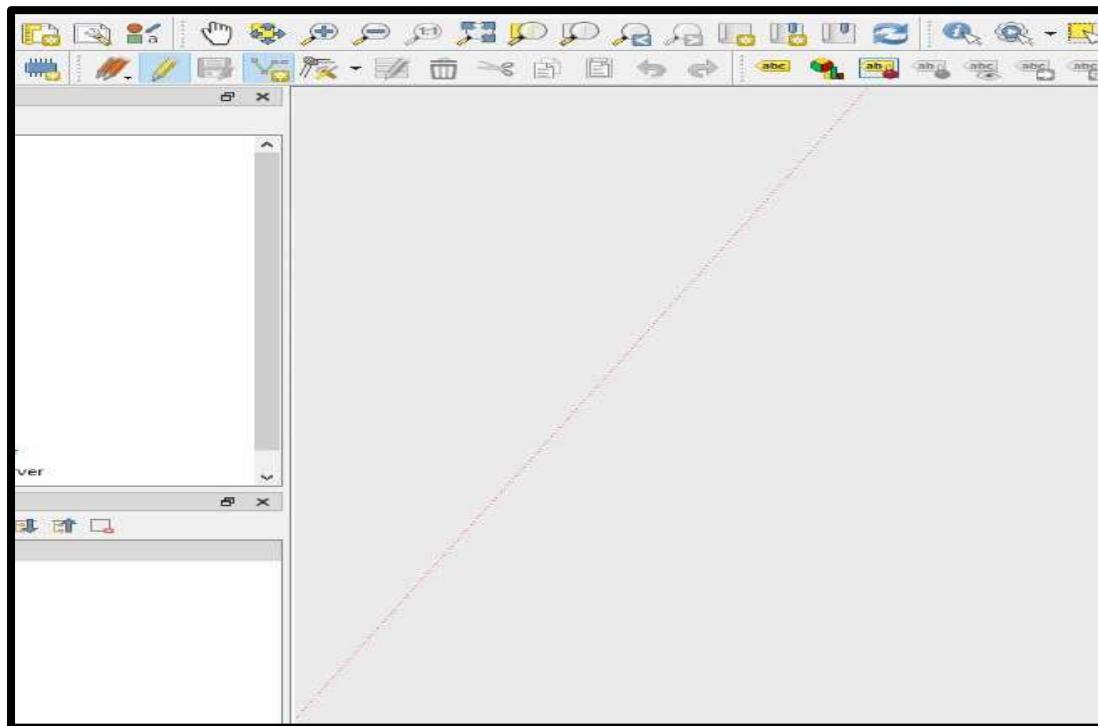


➤ **Road layer :**

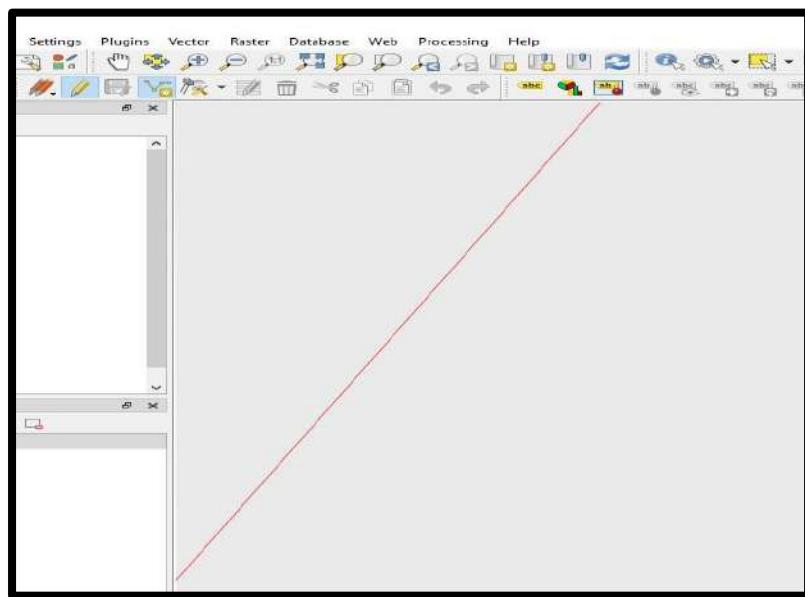
- To plot road click on Add Line Feature.



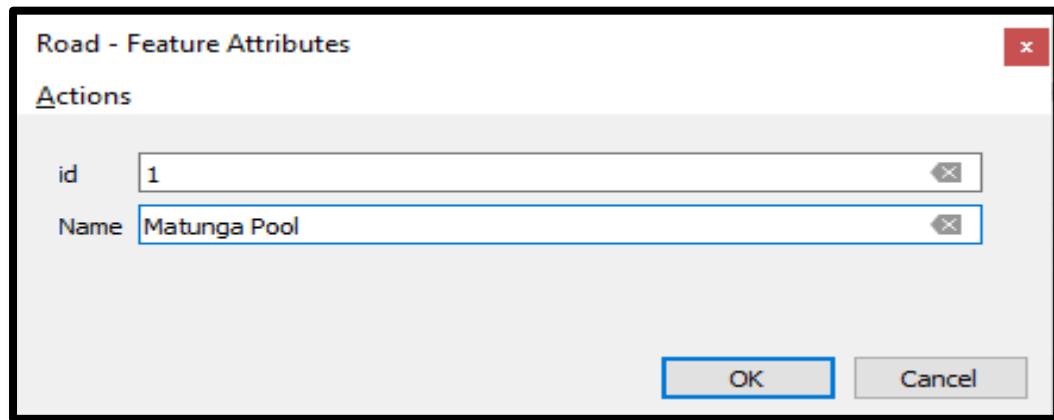
- Click on the map where you want to draw line.



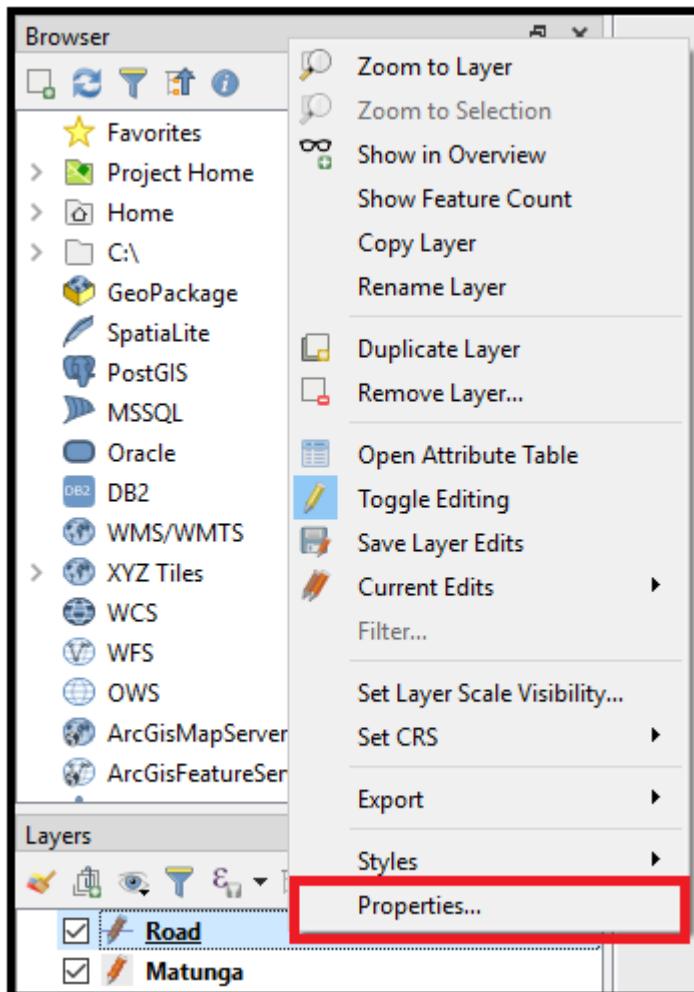
- Once you are done then right click on map (**Dotted line turn into solid line**)

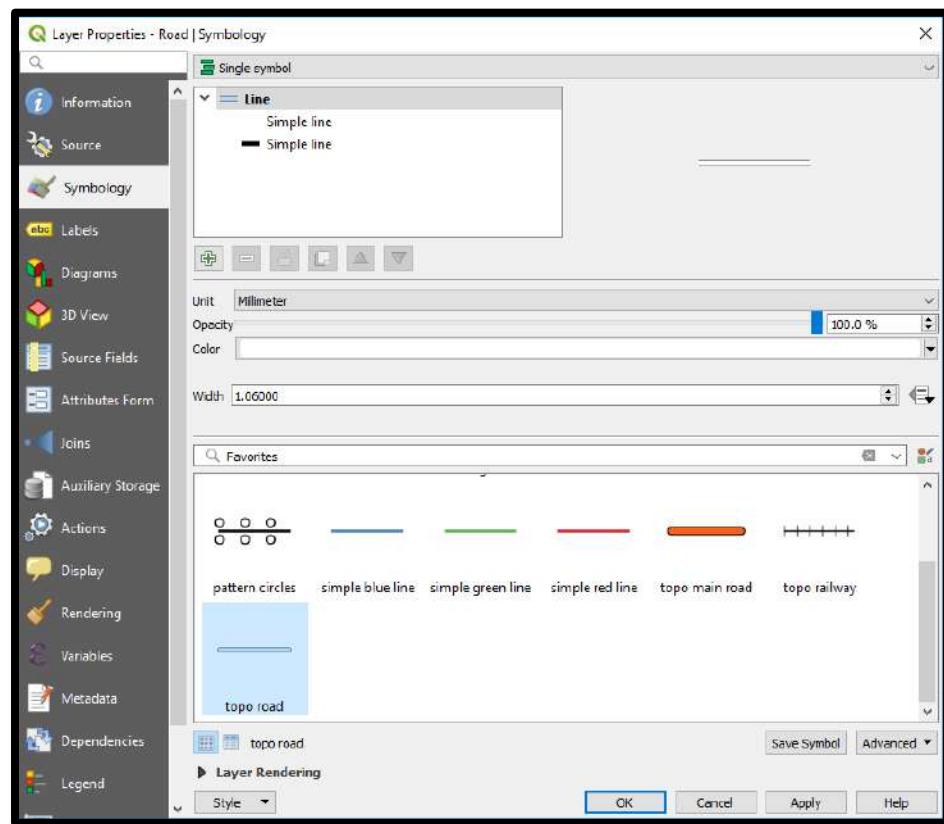


- **save** your data

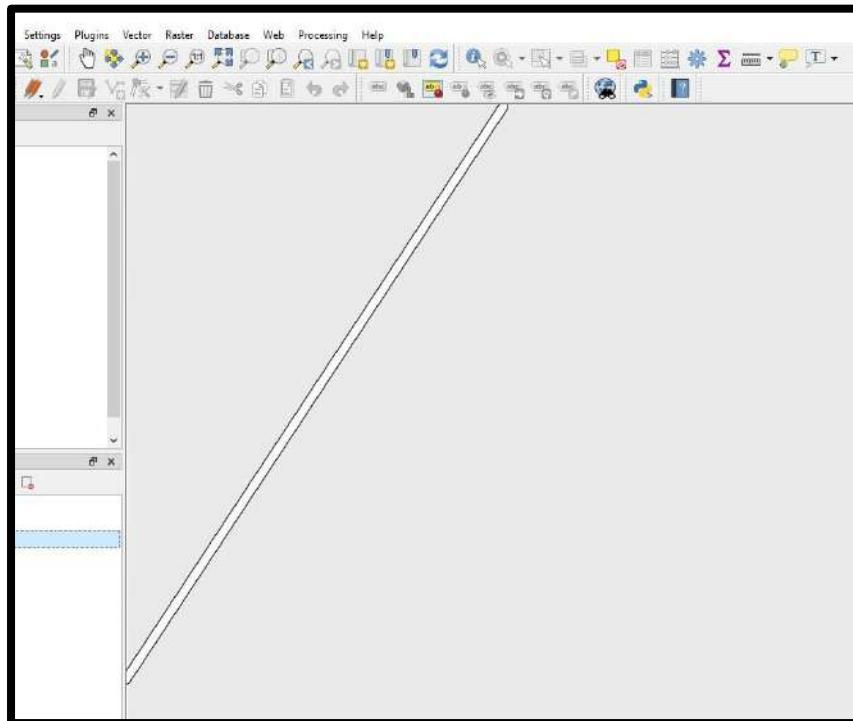


- set **style** for Roads in the same way as we have done for polygon

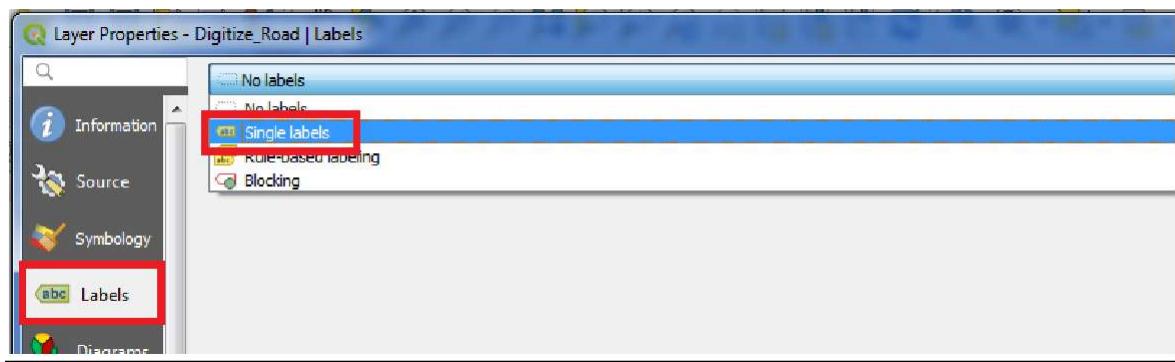




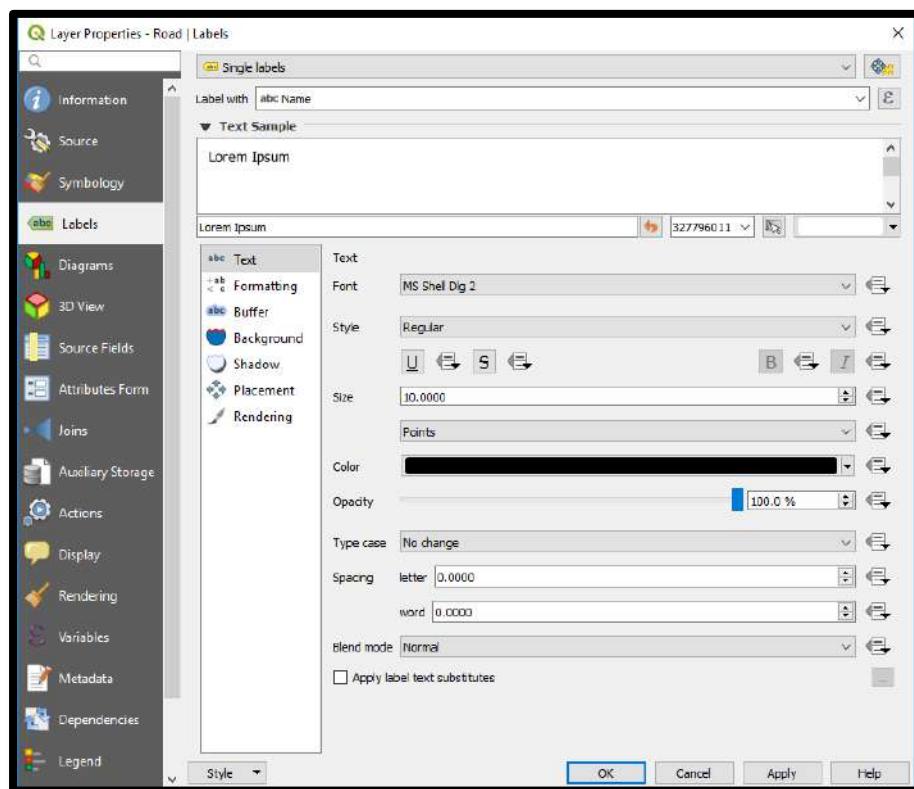
- Road will look as below



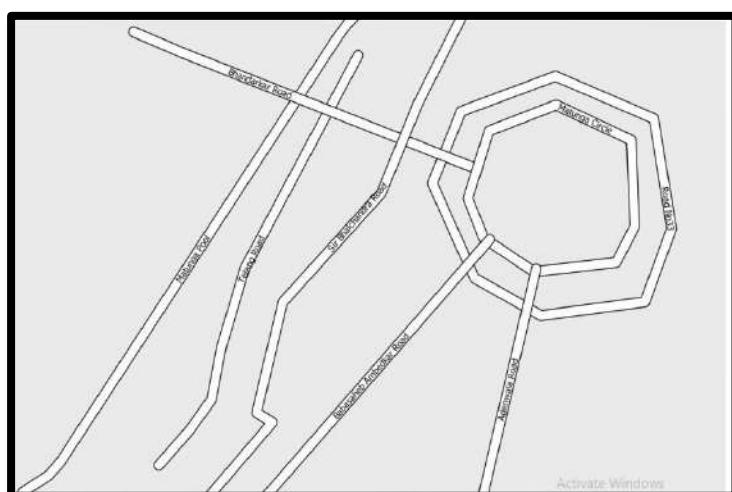
- To label your roads **Right click on Road layer**. Go to **properties** window then select label and set single **label property**



- Following window will appear on the screen

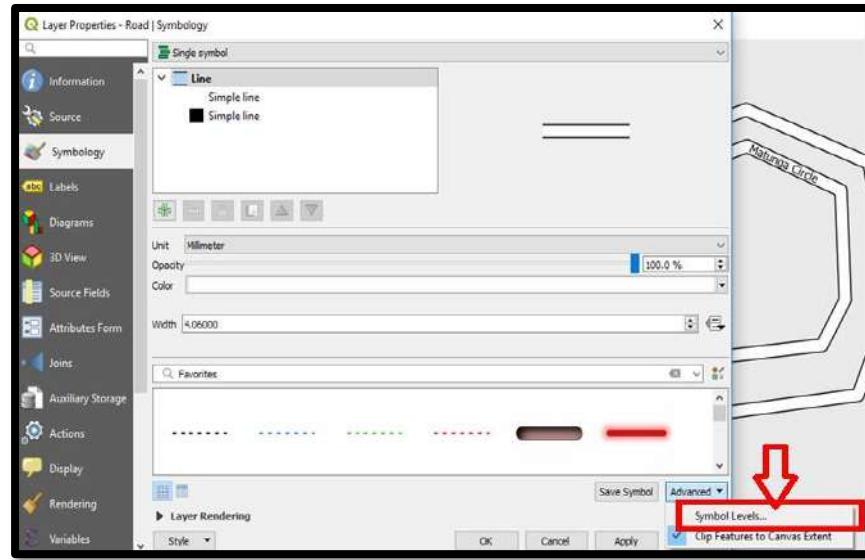


- Roads will look like these

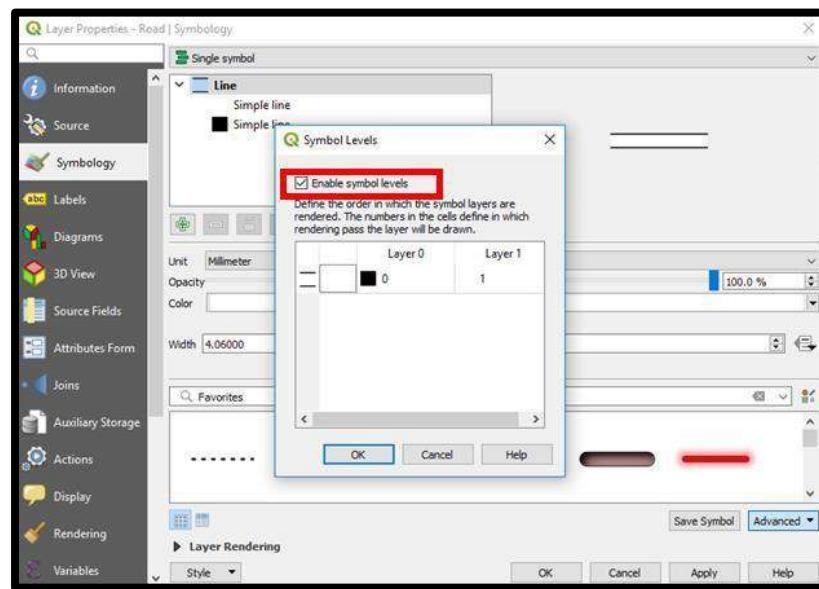


➤ To merge roads

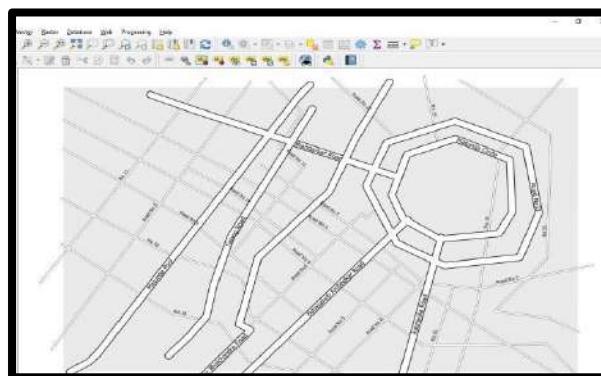
- Go to properties of road then select **symbology**. Click on **Advanced** button select Symbol levels.



➤ Check **Enable symbol levels** option

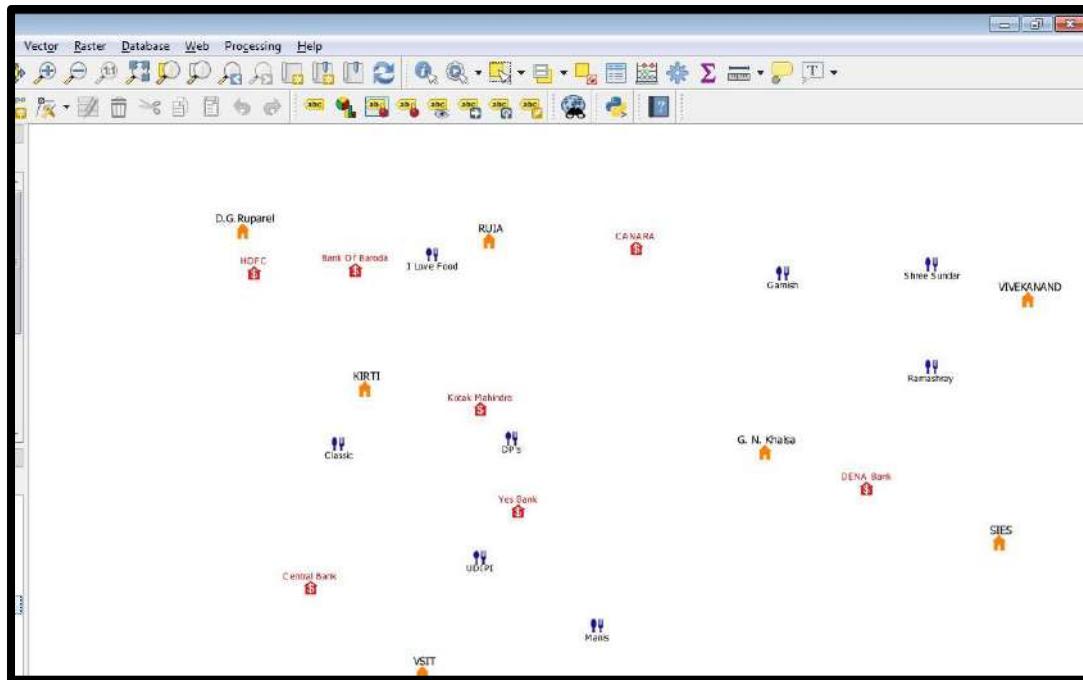


➤ Click ok & Road will appear as follows

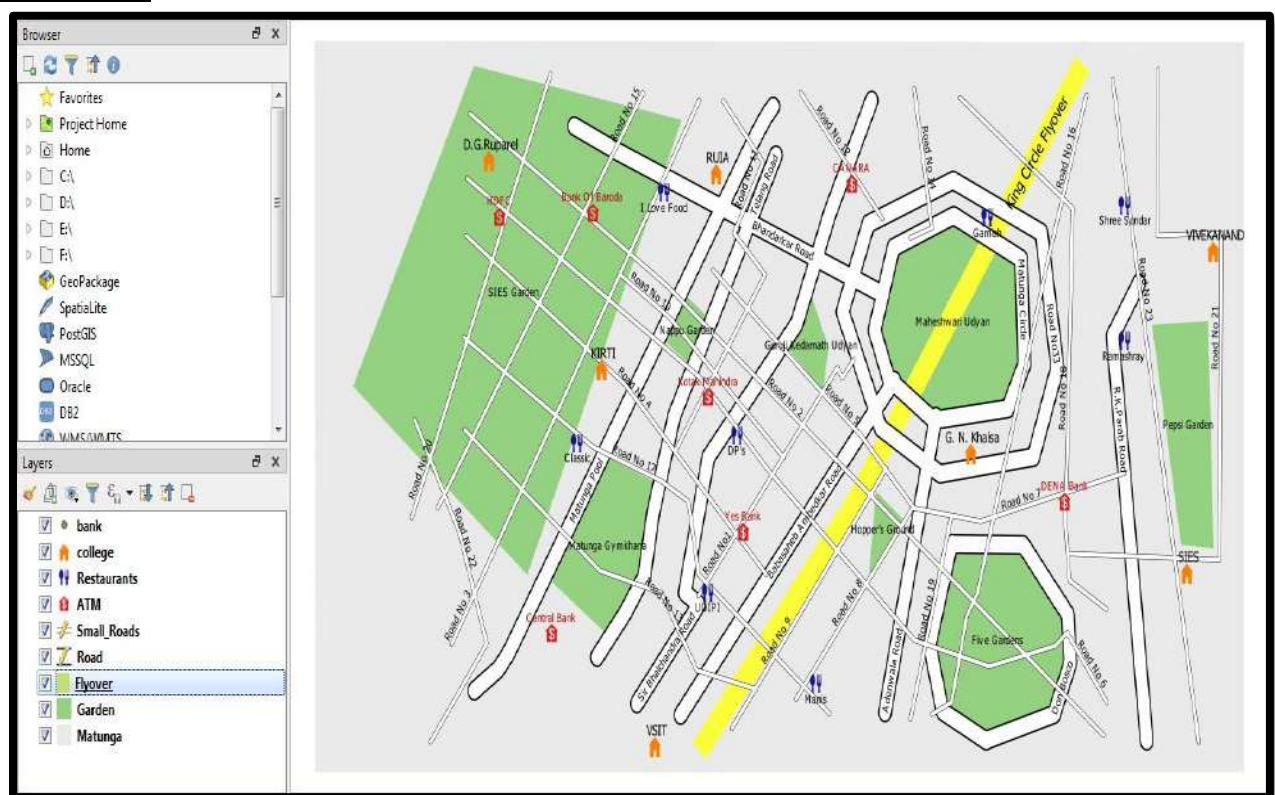


C. Create Point vector layer

- Repeat same steps to add point layers as we have done in previous layers.(For ATM, Restaurants, Banks, Bus Stops etc)

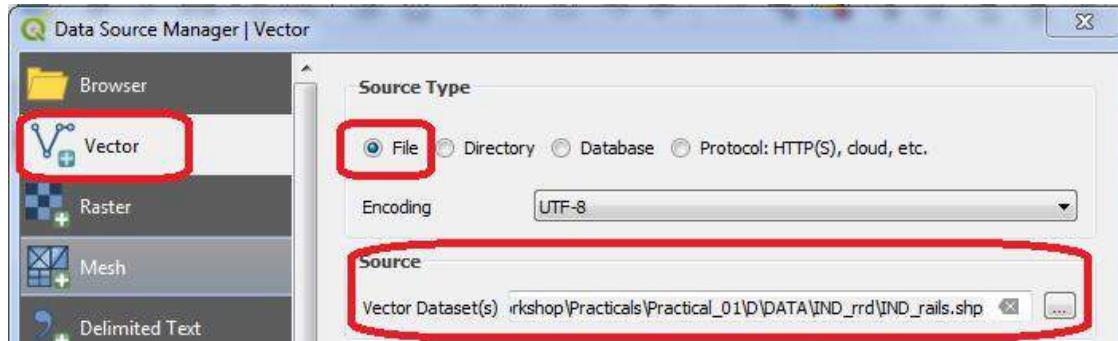


Final output:



d) Calculating line lengths and statistics

- Go to Layer → Add Layer → Add Vector Layer
- Add the following file to project



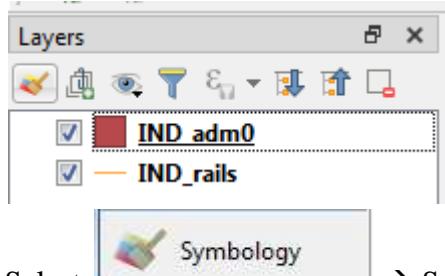
"\GIS_Workshop\Practicals\Practical_01\DATA\IND_rrd\IND_rails.shp"

Press "ADD"

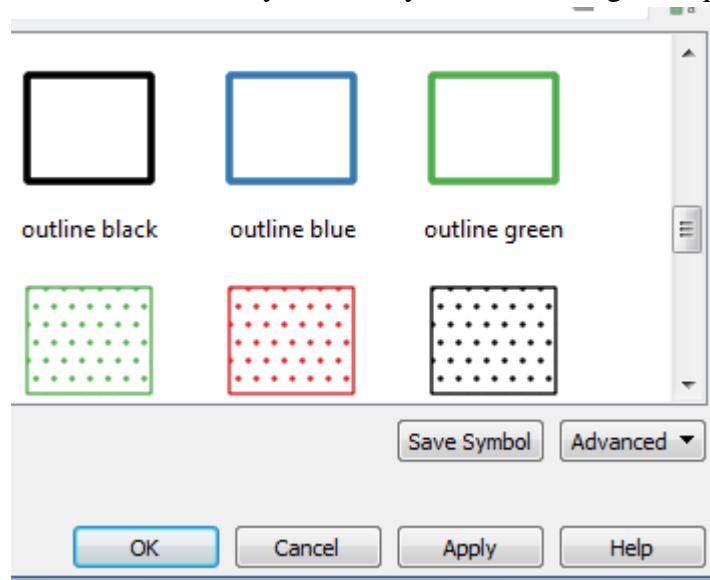
- Also add India Administrative Map

"\GIS_Workshop\Practicals\Practical_01\DATA\IND_adm\IND_adm0.shp"

- Double Click on IND_adm0



Select **Symbology** → Select any outline style from below given options.



Press OK

- The display window will appear like

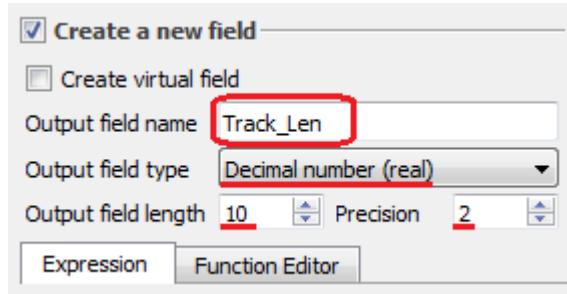


- In Layer Pane, Right click on IND_rails → Open Attribute Table

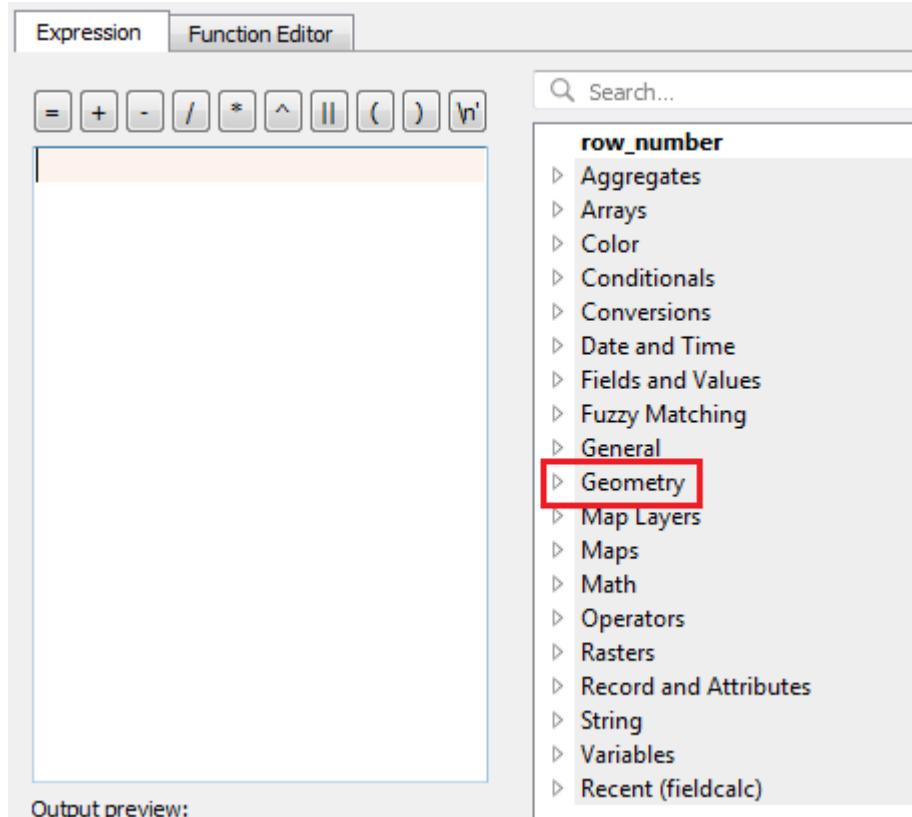
FID_rail_d	F_CODE_DES	EXS_DESCRI	FCO_DESCRI	FID_countr	ISO	ISOCOUNTRY	Route_len
1	162738	Railroad	Operational	Single	102	IND	INDIA

- Press Toggle Editing button using button, on Attribute table window toolbar.

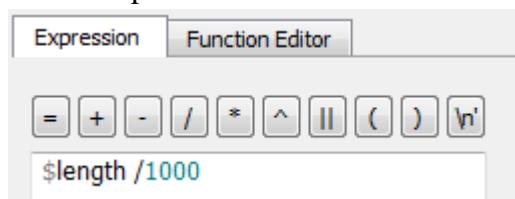
- Press Open Field Calculator using  button.
- Set the output field as “Track_Len”, field type to “Decimal Number”.



- From Function List search \$length or go to Geometry → Select \$length

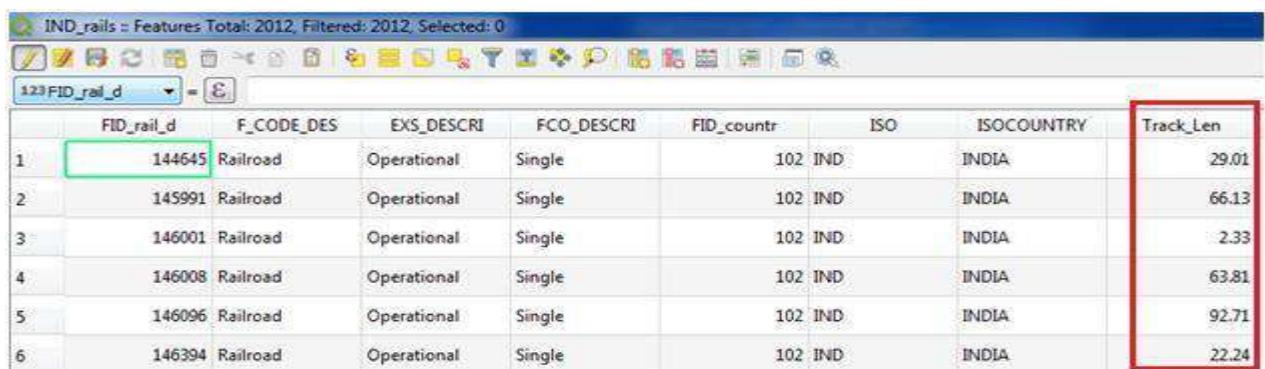


- Set expression as



Press “OK”

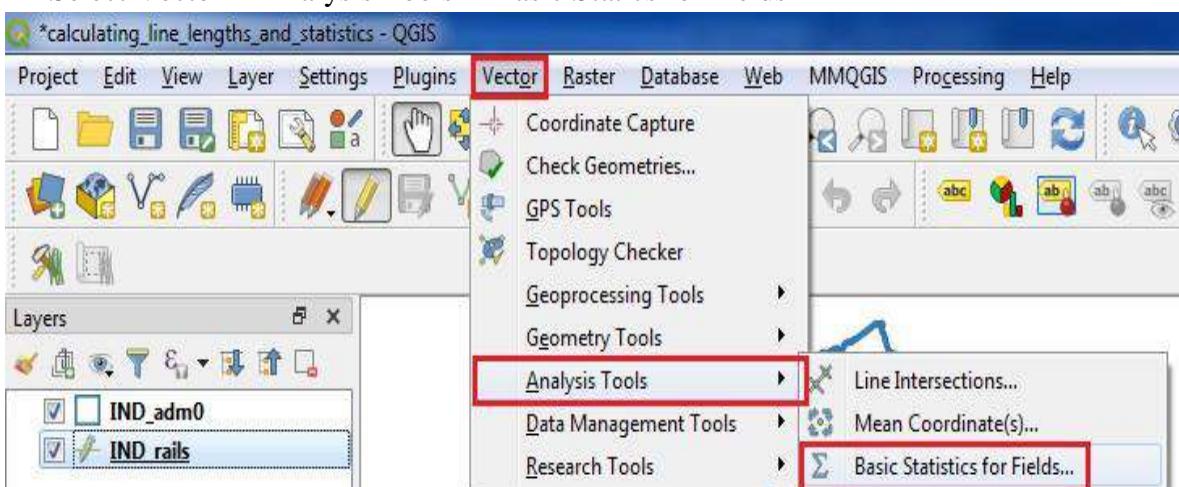
- A new column is added to the attribute table with value representing the length of track in KM.



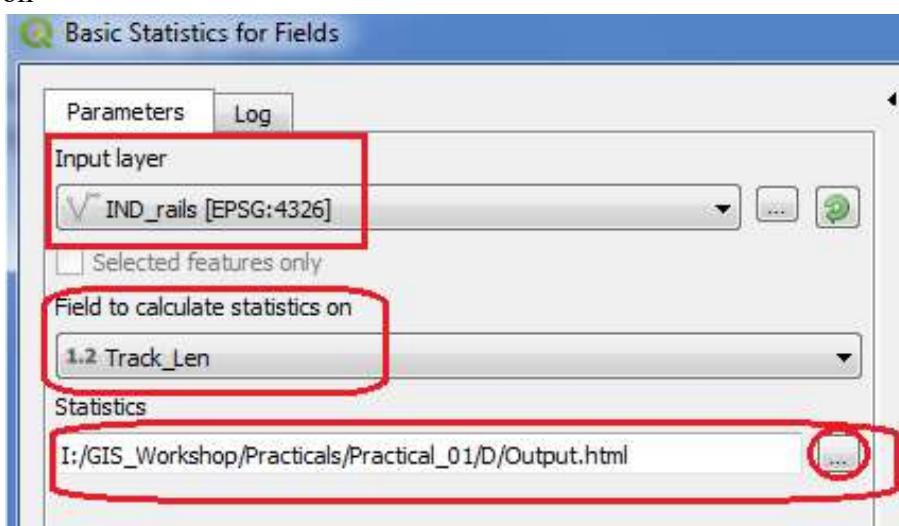
The screenshot shows the QGIS attribute table for the 'IND_rails' layer. The table has columns: FID_rail_d, F_CODE_DESC, EXS_DESCRI, FCO_DESCRI, FID_countr, ISO, ISOCOUNTRY, and Track_Len. The last column, 'Track_Len', is highlighted with a red border. The data shows various railway features across India, with total lengths ranging from 22.24 to 92.71.

	FID_rail_d	F_CODE_DESC	EXS_DESCRI	FCO_DESCRI	FID_countr	ISO	ISOCOUNTRY	Track_Len
1	144645	Railroad	Operational	Single	102	IND	INDIA	29.01
2	145991	Railroad	Operational	Single	102	IND	INDIA	66.13
3	146001	Railroad	Operational	Single	102	IND	INDIA	2.33
4	146008	Railroad	Operational	Single	102	IND	INDIA	63.81
5	146096	Railroad	Operational	Single	102	IND	INDIA	92.71
6	146394	Railroad	Operational	Single	102	IND	INDIA	22.24

- Press CTRL+S or click on Save Edits option on tool bar
- Close the attribute table window.
- For calculating the total length of Railway tracks in India.
- Select Vector → Analysis Tools → Basic Statistics for Fields

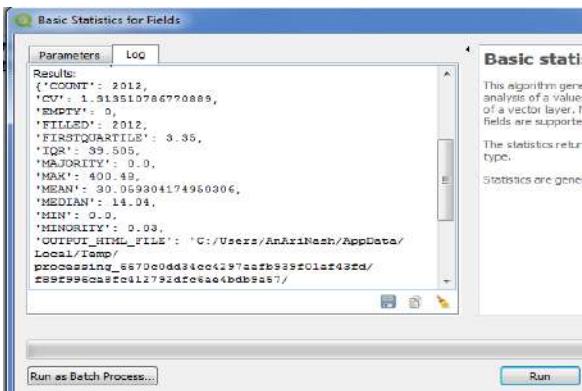


- Select IND_rails layer from input layer. And select Track_Len in "Field to Calculate statistics on"



- Press RUN

➤ The Result is



➤ Open the “**output.html**” file to get the field statistics.

Analyzed field: Track_Len

Count: 2012

Unique values: 1608

NULL (missing) values: 0

Minimum value: 0.0

Maximum value: 400.48

Range: 400.48

Sum: 60479.320000000014

Mean value: 30.059304174950306

Median value: 14.04

Standard deviation: 39.483220276624444

Coefficient of Variation: 1.313510786770889

Minority (rarest occurring value): 0.03

Majority (most frequently occurring value): 0.0

First quartile: 3.35

Third quartile: 42.855000000000004

Interquartile Range (IQR): 39.505

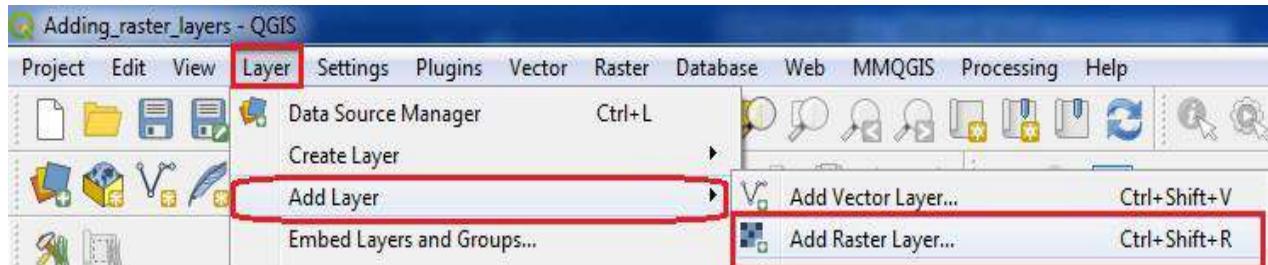
➤ The above statistics show that the total length of Railway track in India is **60,479.32 KM**.

PRACTICAL - 2

Exploring and Managing Raster data:

a) Adding raster layers

- From menu bar select Layer → Add Layer → Add Raster Layer



- Select Gridded Population of the World (GPW) v3 dataset from Columbia University, Population Density Grid for the entire globe in ASCII format and for the year 1990 and 2000.
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds90ag60.asc"
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds00ag60.asc"

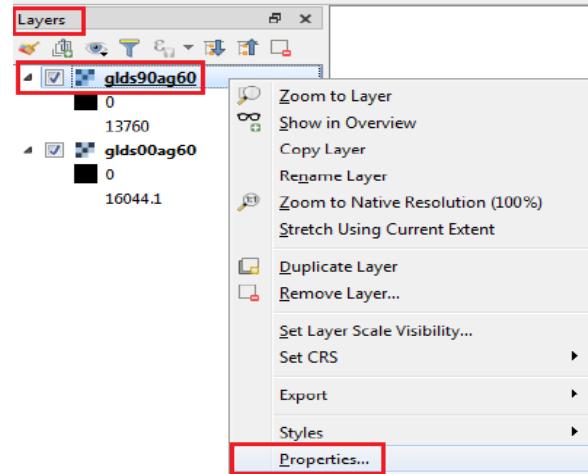


- Go to Project → Properties OR Press the right corner.
Select WGS 84 EPSG: 4326 and Press OK

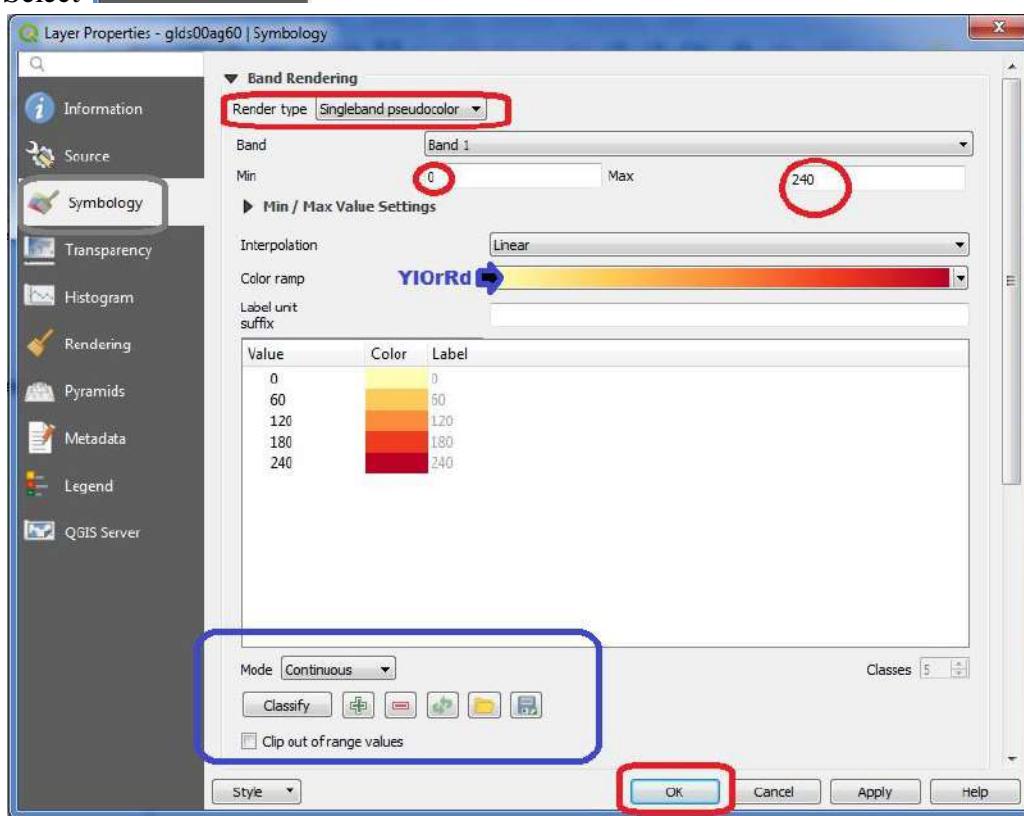
Set CRS option on bottom

b) Raster Styling and Analysis

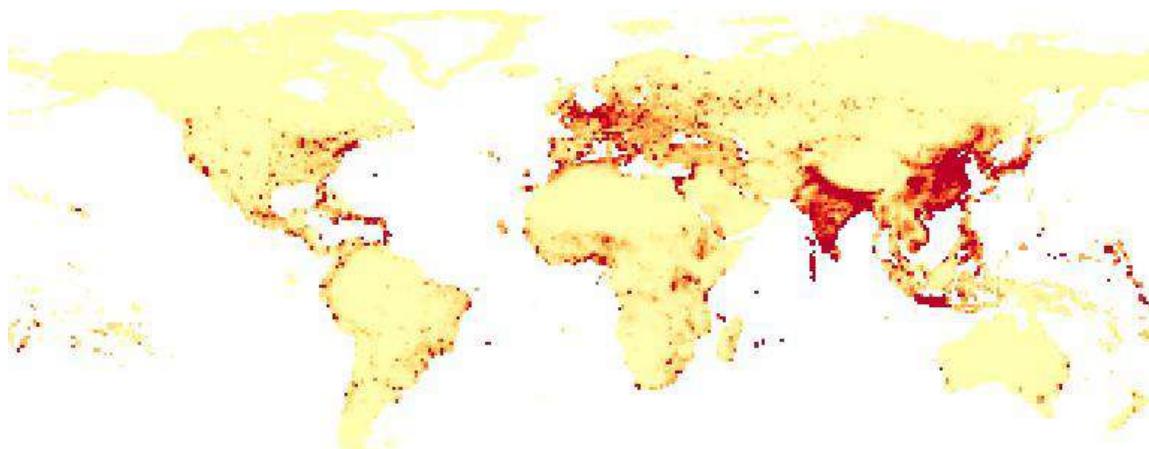
- To start with analysis of population data, convert the pixel from grayscale to Color.
- Select “glds90ag60.asc” Layer form layer Pane → select property OR double click on it.



- Select

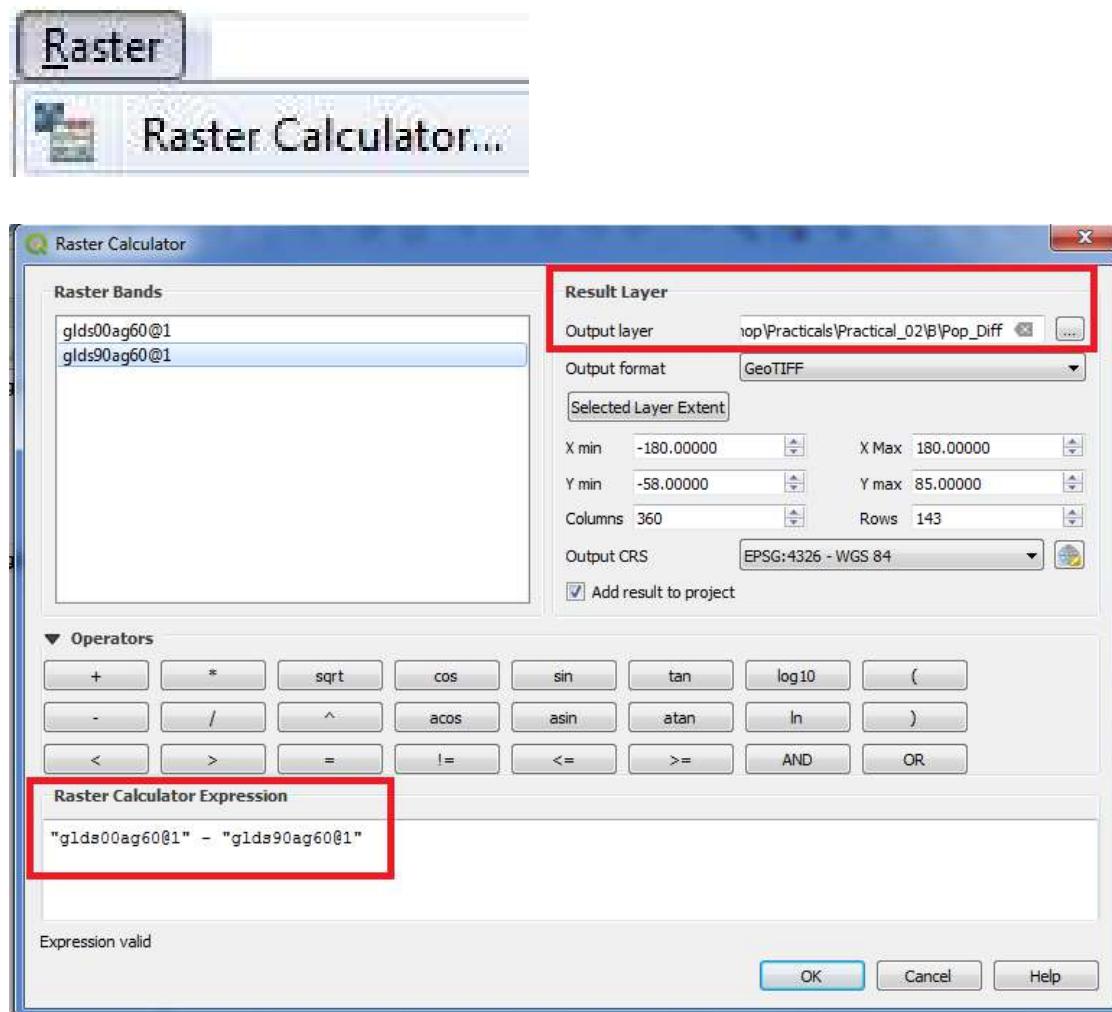


- Press “APPLY”
- Repeat the same for “glds00ag60.asc” Layer



Layer output after applying style.

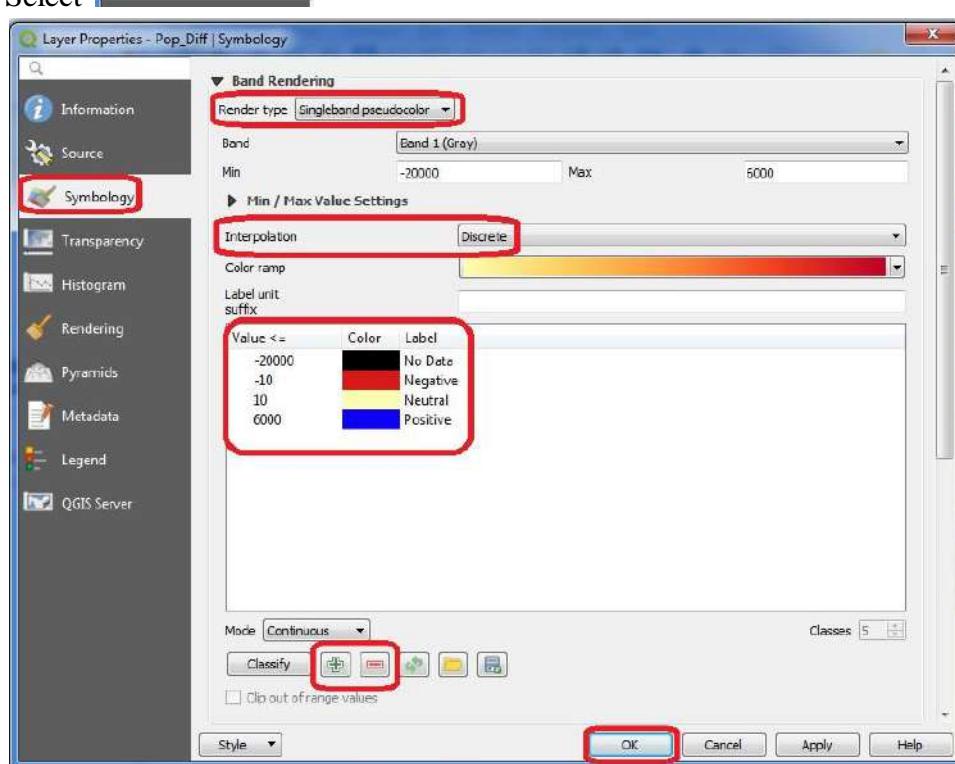
- The objective of this experiment is to analyze raster data, as an example we will find areas with largest population change between 1990 and 2000, by calculating the difference between each pixel values.
- Go to Raster → Raster Calculator



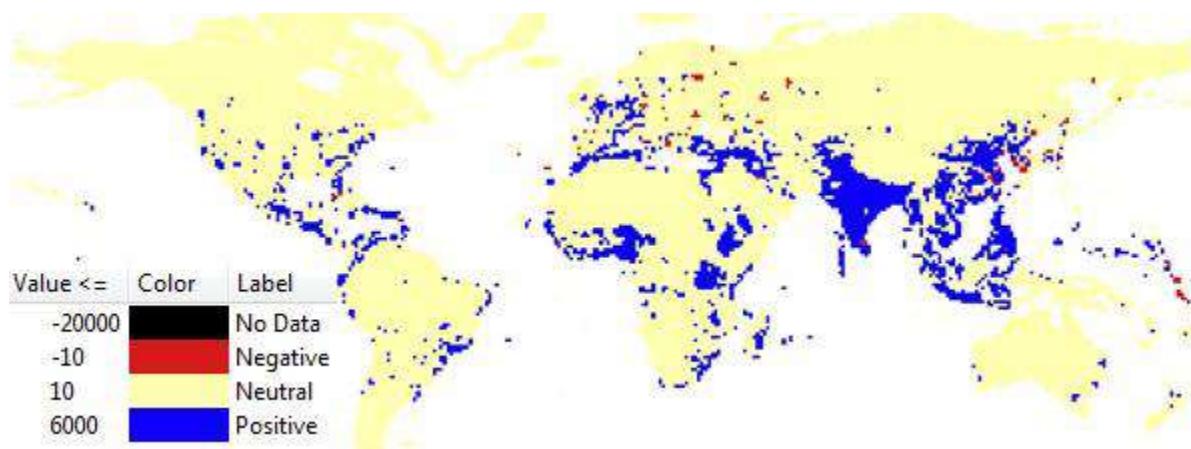
- Put the expression "glds00ag60@1" - "glds90ag60@1"
- Select the output file location & name and Press OK.

- Remove the other two layers i.e. glds00ag60.asc and glds90ag60.asc
- Double click on pop_diff layer.

- Select



- Set Render Type to “Single band Pseudo color”, Interpolation as Discrete, and remove all classification and add as shown in figure above using button. After all settings press “OK”.
- Layer will appear like

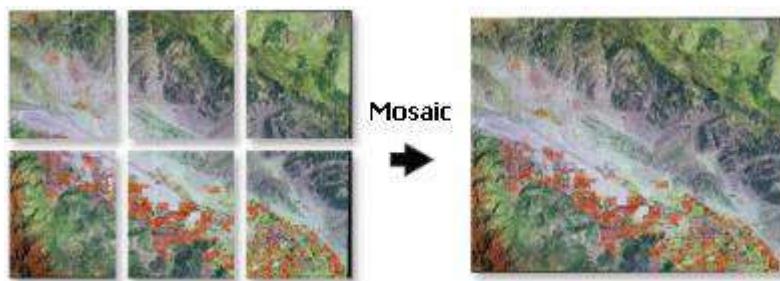


- Explore an area of your choice and check the raster band value using to verify the classification rule.
- The red pixel shows negative changes and blue shows positive changes.

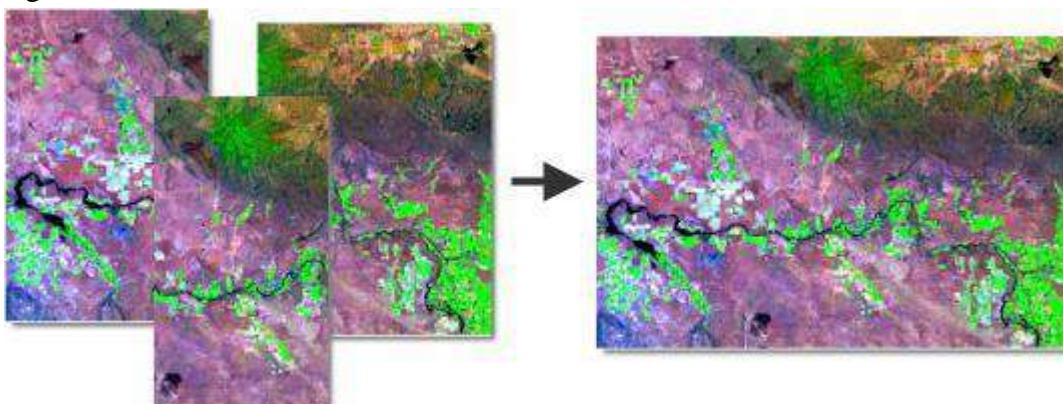
c) Raster Mosaicking and Clipping

A **mosaic** is a combination or merge of two or more images.

In GIS, a single raster dataset can be created from multiple raster datasets by mosaicking them together.

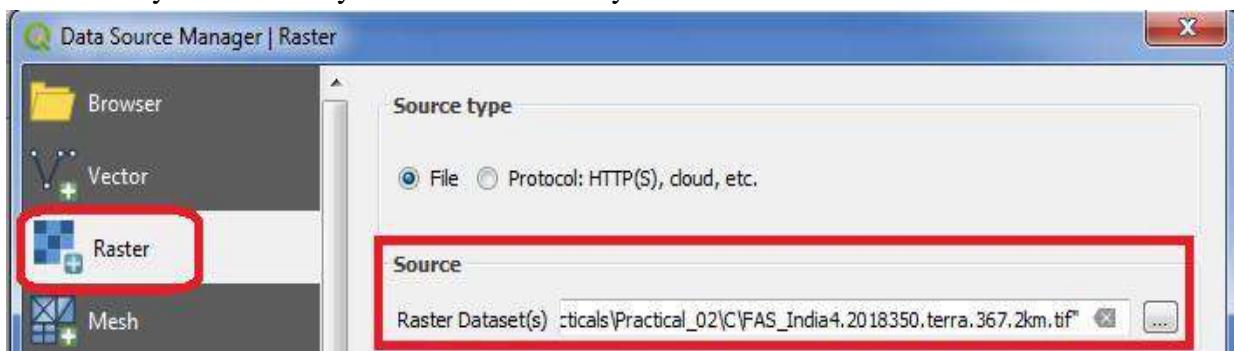


In many cases, there will be some overlap of the raster dataset edges that are being mosaicked together, as shown below.



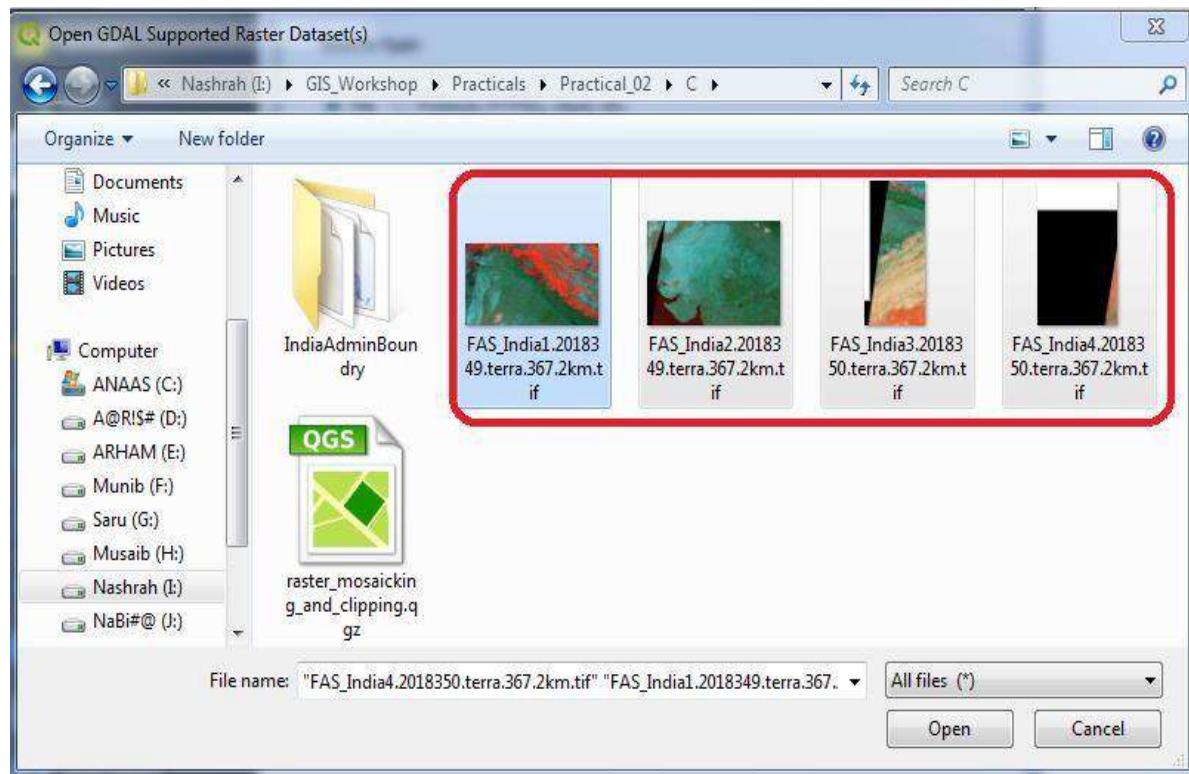
These overlapping areas can be handled in several ways; for example, you can choose to only keep raster data from the first or last dataset, you can blend the overlapping cell values using a weight-based algorithm, you can take the mean of the overlapping cell values, or you can take the minimum or maximum value. When mosaicking discrete data, the First, Minimum, or Maximum options give the most meaningful results. The Blend and Mean options are best suited for continuous data. If any of the input rasters are floating point, the output is floating point. If all the inputs are integer and First, Minimum, or Maximum is used, the output is integer.

➤ Go to Layer → Add Layer → Add Raster Layer.

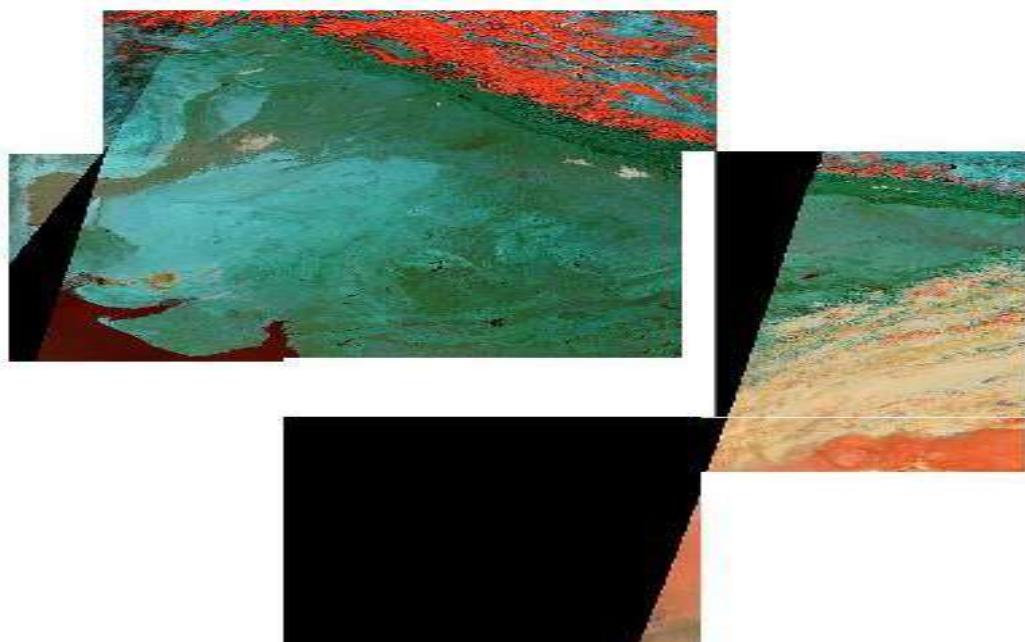


- Select the following “.tif” raster images for India from data folder.

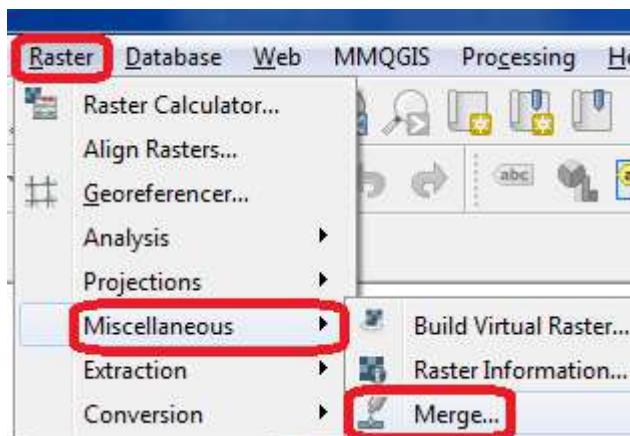
FAS_India1.2018349.terra.367.2km.tif
 FAS_India2.2018349.terra.367.2km.tif
 FAS_India3.2018349.terra.367.2km.tif
 FAS_India4.2018349.terra.367.2km.tif



- Press open
- In data source manager | Raster window click Add.



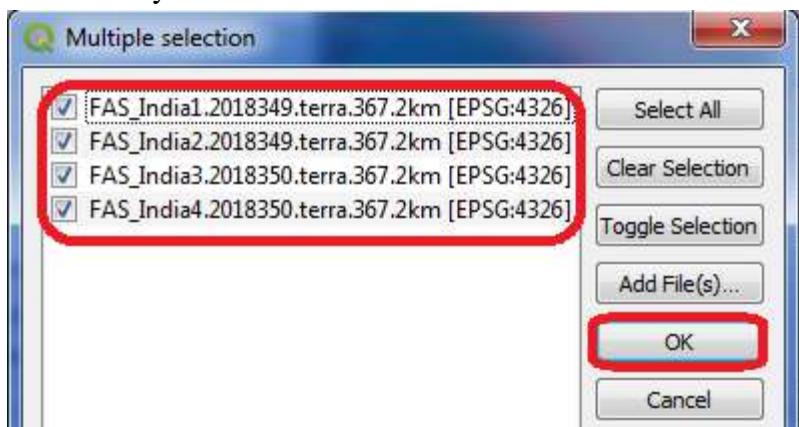
- Go to Raster → Miscellaneous → Merge



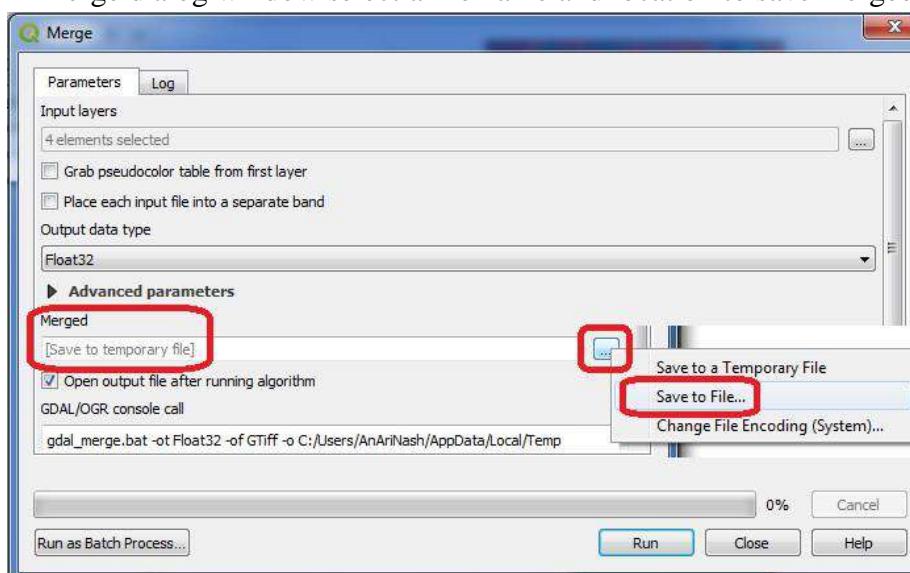
- In the Merge dialog window



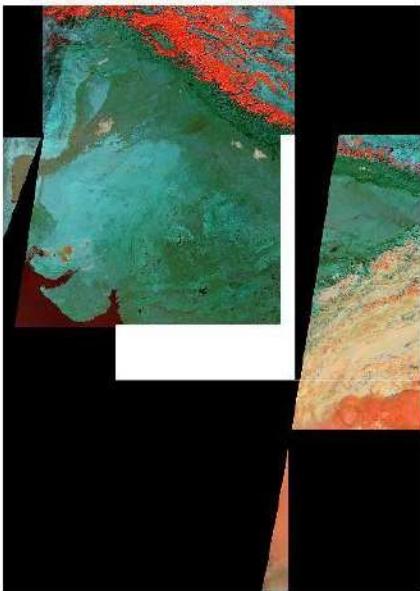
- Select all layers and Press OK.



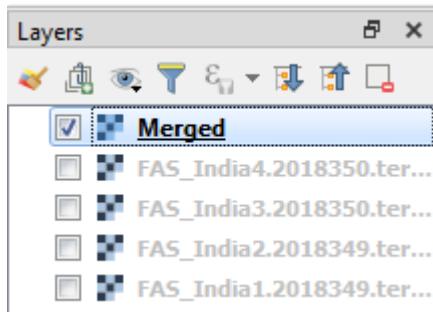
- In Merge dialog window select a file name and location to save merged images.



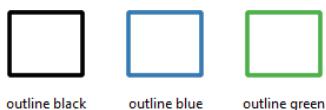
- Save the file to “GIS_Workshop/Practicals/Practical_02/C/” location with the name as Merge_Files.tif
- Press Run and after completion of operation close the Merge window dialog box.



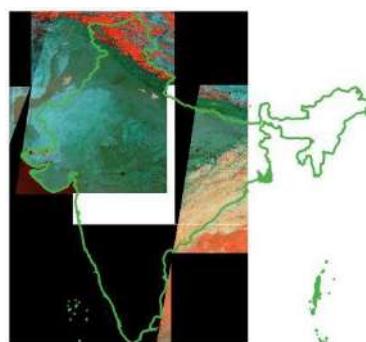
- You can now deselect individual layers from layer pane and only keep the merged raster file.



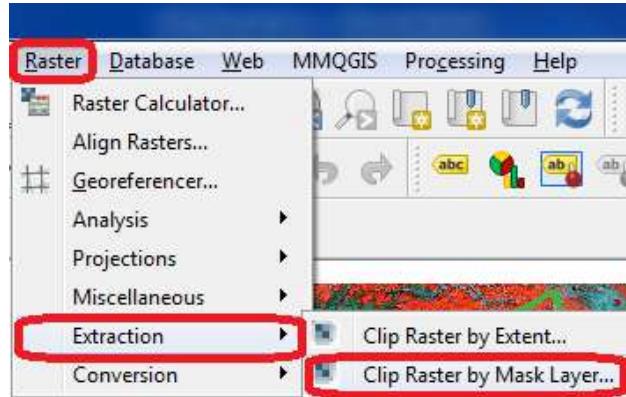
- Go to Layer → Add Vector Layer → Select
|GIS_Workshop\Practicals\Practical_02\C\IndiaAdminBoundary\IND_adm0.shp file.
- From layer properties → select → select any one of the following



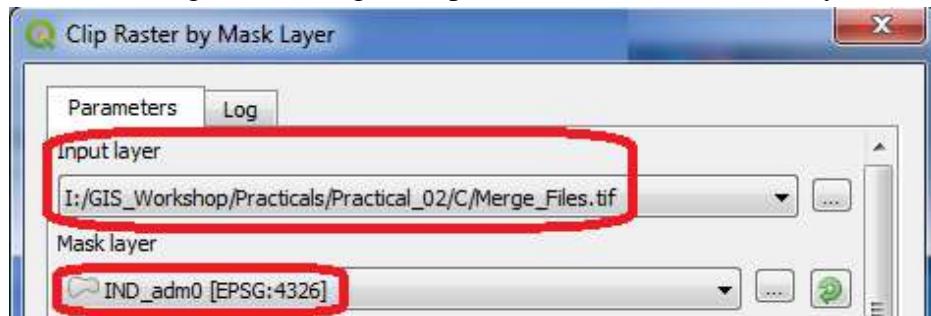
- The result will be



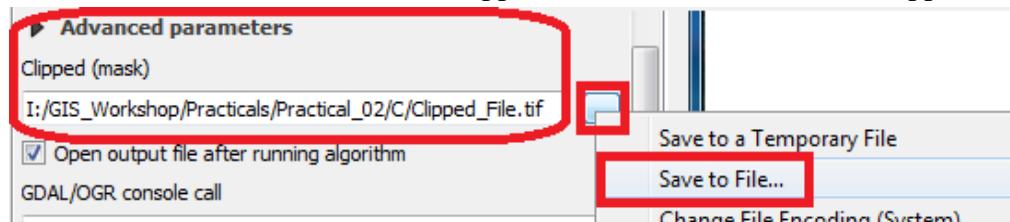
- Go to Raster → Extraction → Clip Raster by Mask Layer



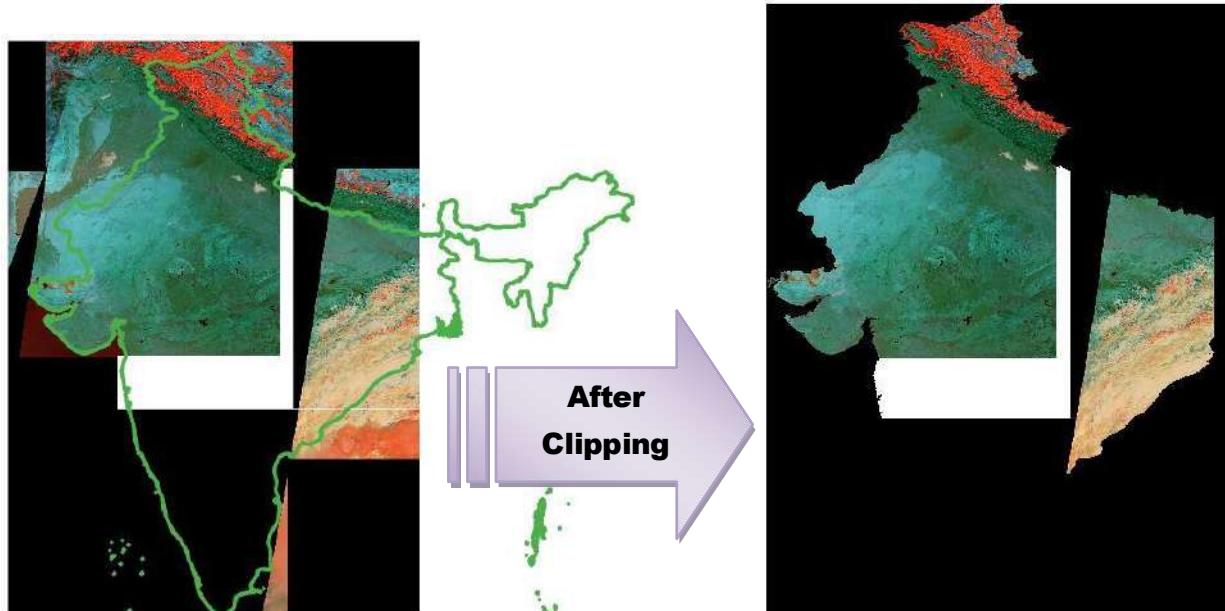
- Select the merge raster image as input and Ind_adm0 as mask layer.



- Select a file name and location for clipped raster as /Practical_02/C/Clipped_File.tif.



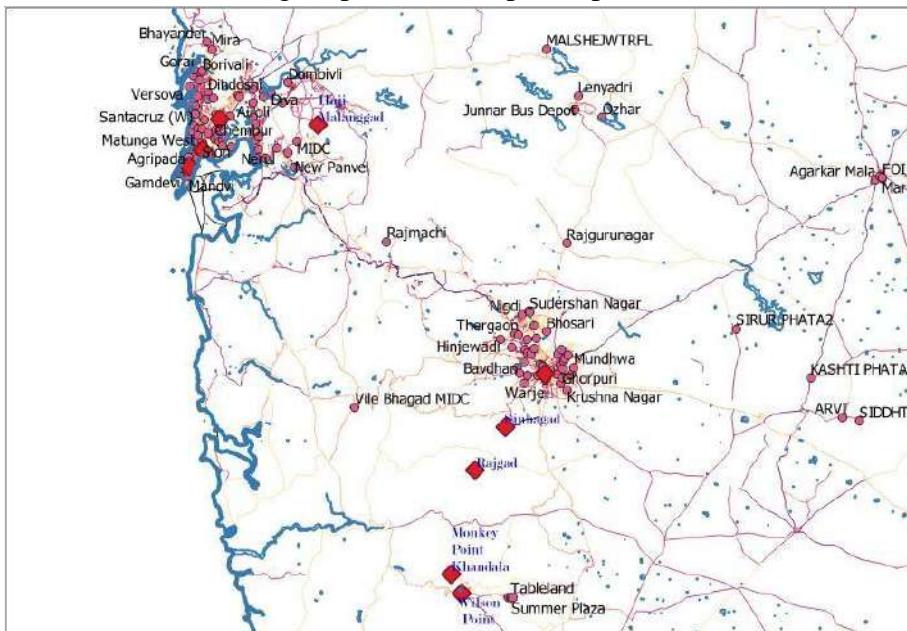
- Press RUN.



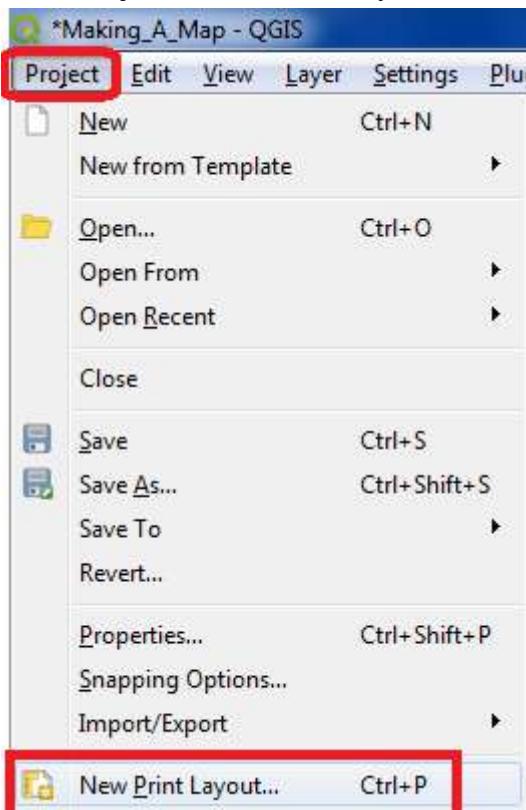
PRACTICAL - 3

a) Making a Map

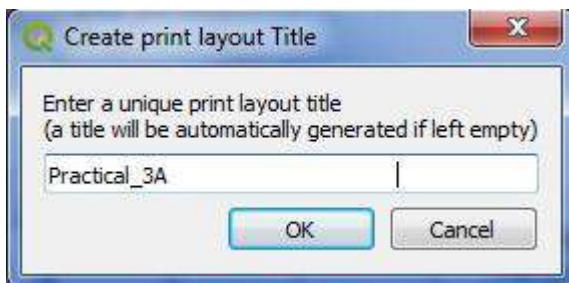
- Create a new Thematic Map or open an existing one
- Consider the following map as an example map



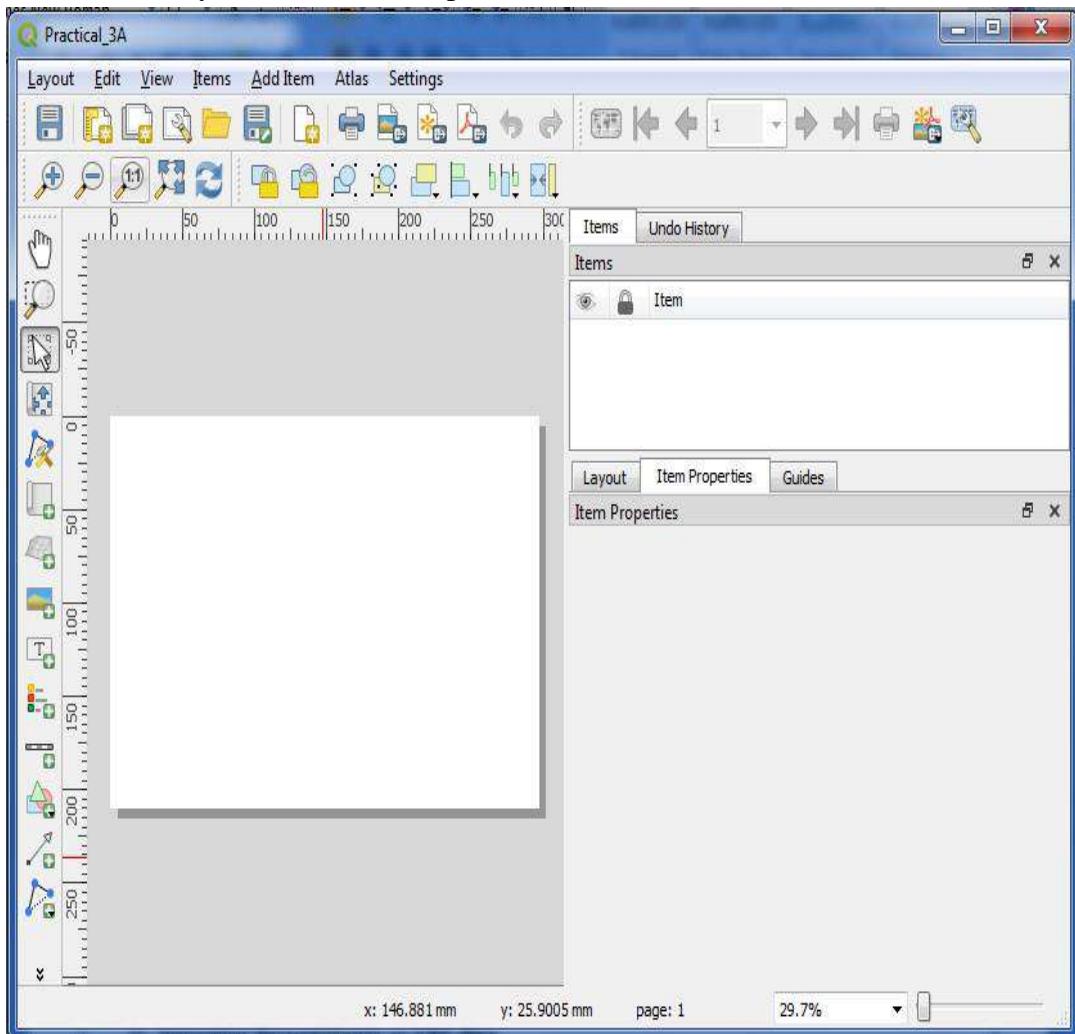
- Go to Project → New PrintLayout



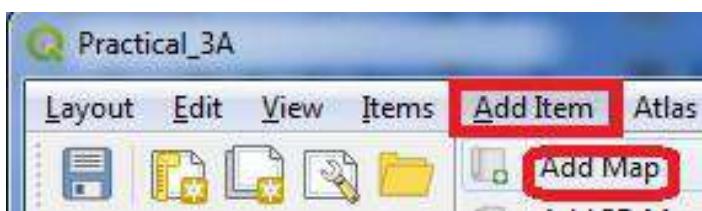
- Insert a suitable title and press "OK".

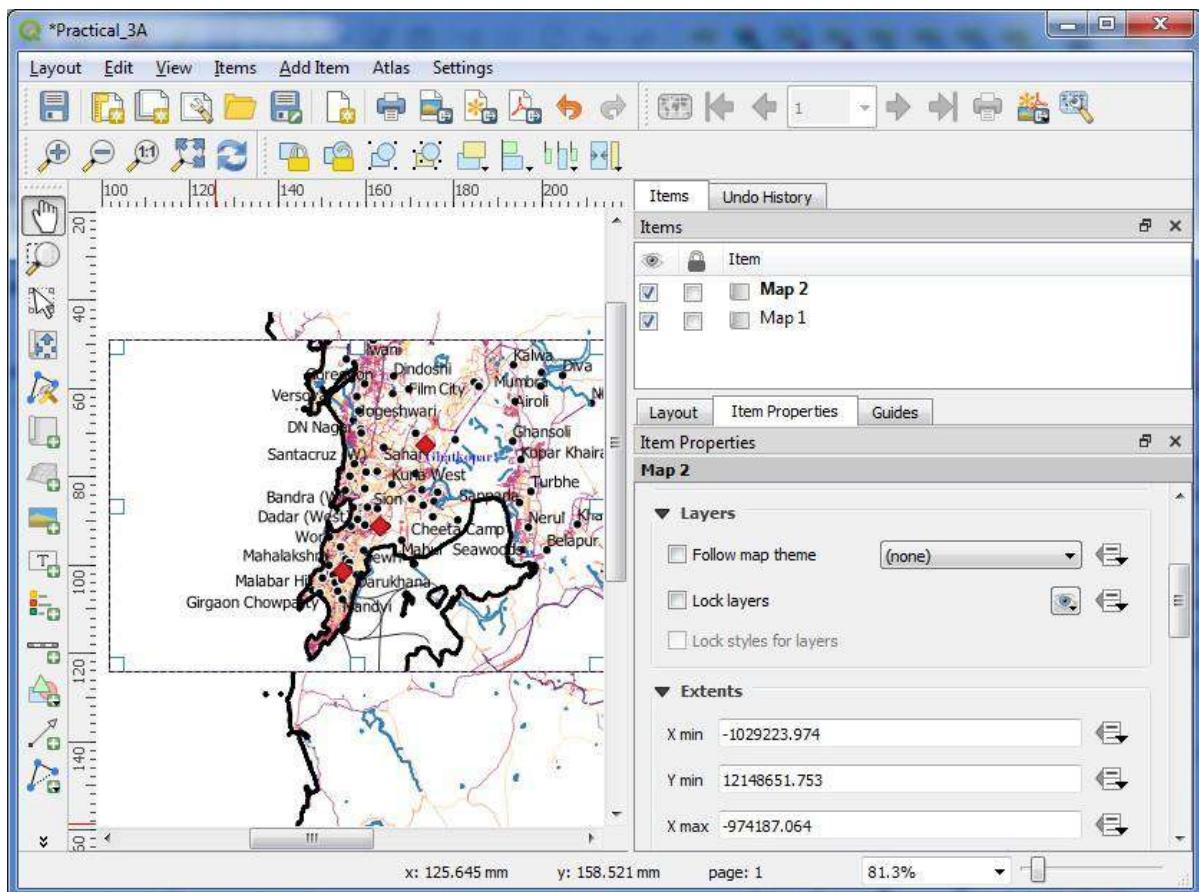


- A new Print Layout window will open

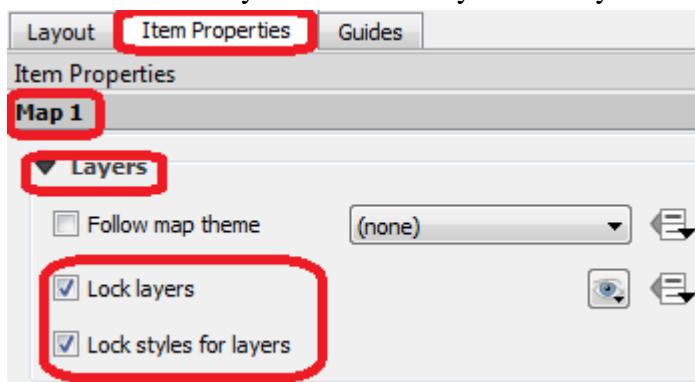


- Select Add Item → Add Map



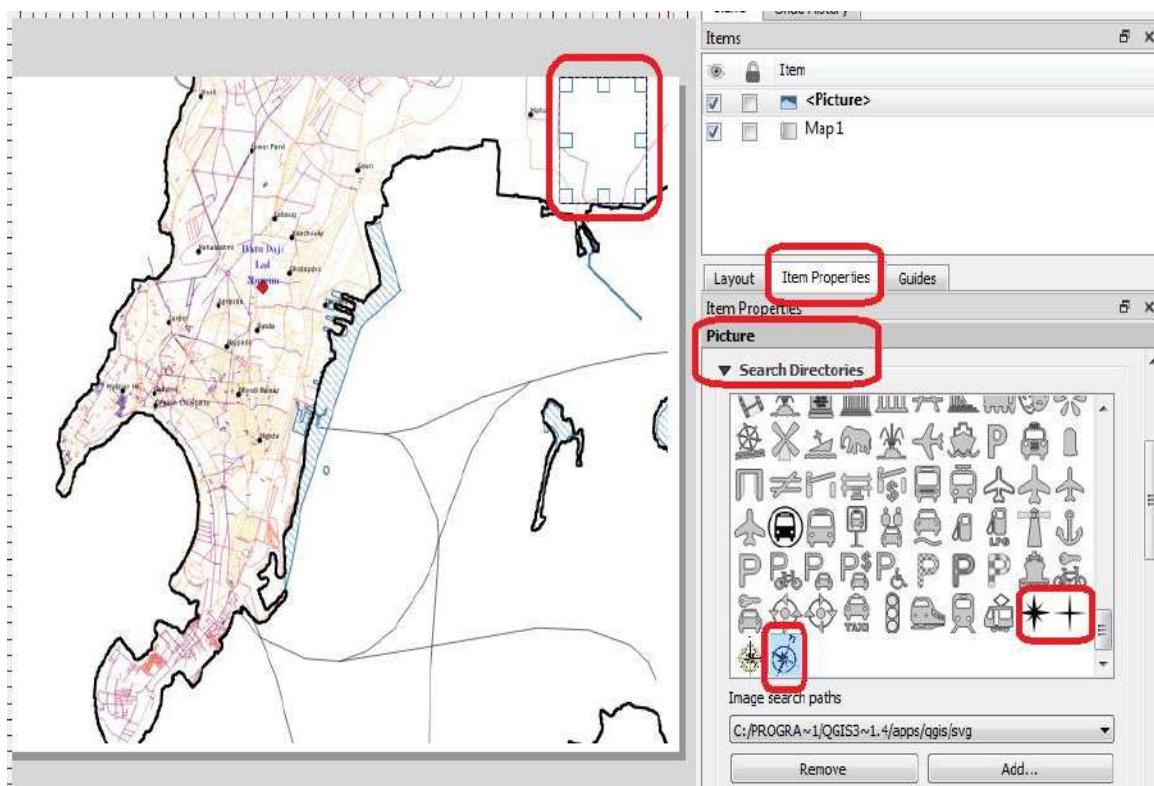


- After adding map go to ItemProperties → Map1 → Layers
Check on Lock Layers and Lock Styles for Layers

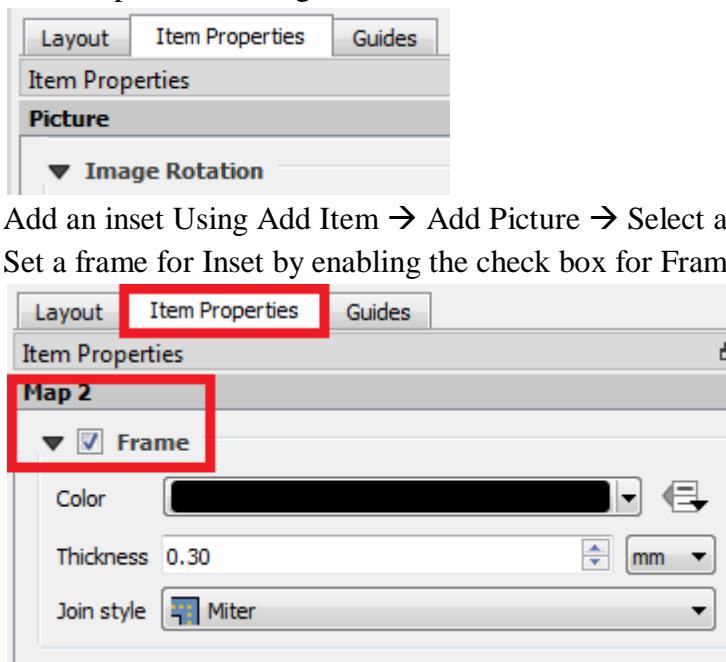


This will ensure that if any change in layers or change their styles, the Print Layout view will not change.

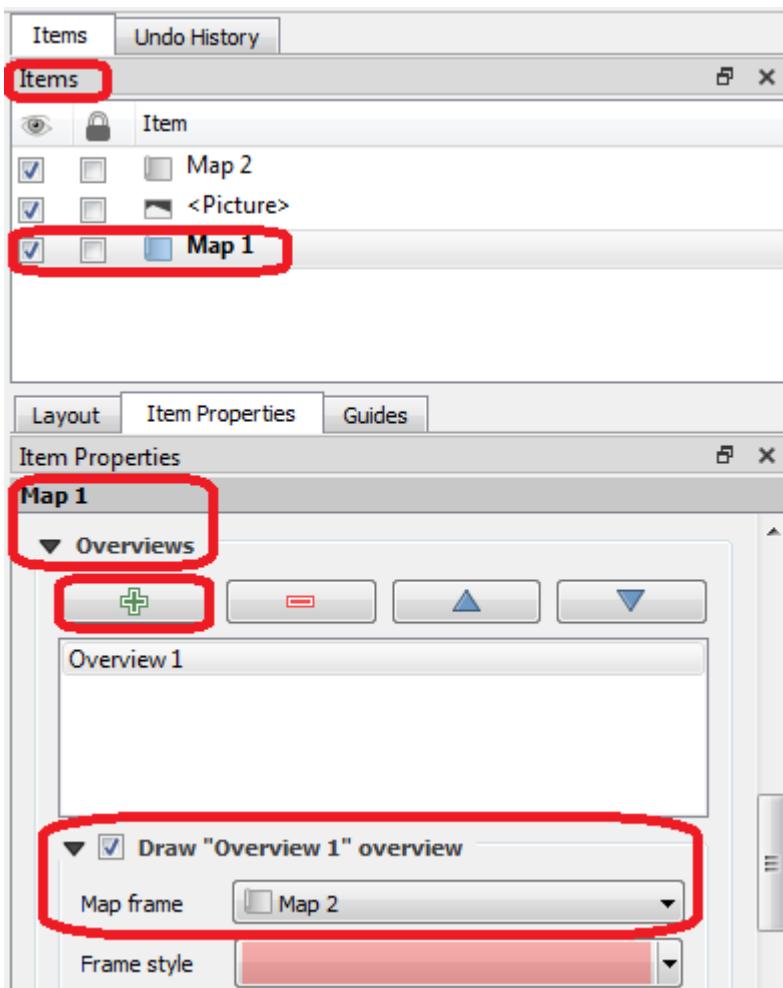
- Go to Add Item → Add Picture → Place a picture box at appropriate location.



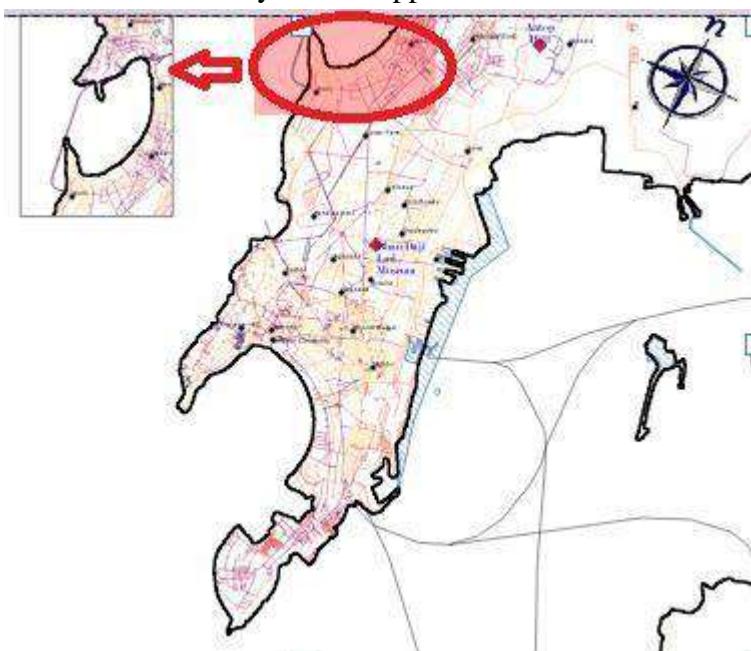
- Also adjust Image Rotation to its appropriate value.
- Item Properties → Image Rotation



- To highlight the area shown in Inset
- Select the Picture representing main Map from Items pane.
- In Item Properties → Overviews → using icon add an overview.
- Select the checkbox Draw Overview
- Name the Picture object representing inset (Map1 in our case).

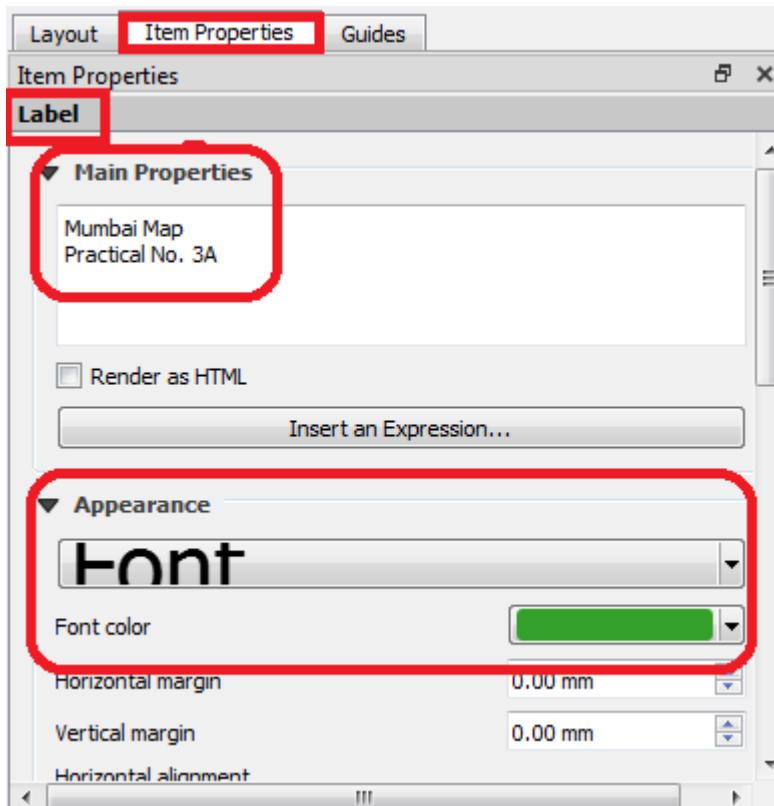


➤ The Print Layout will appear like

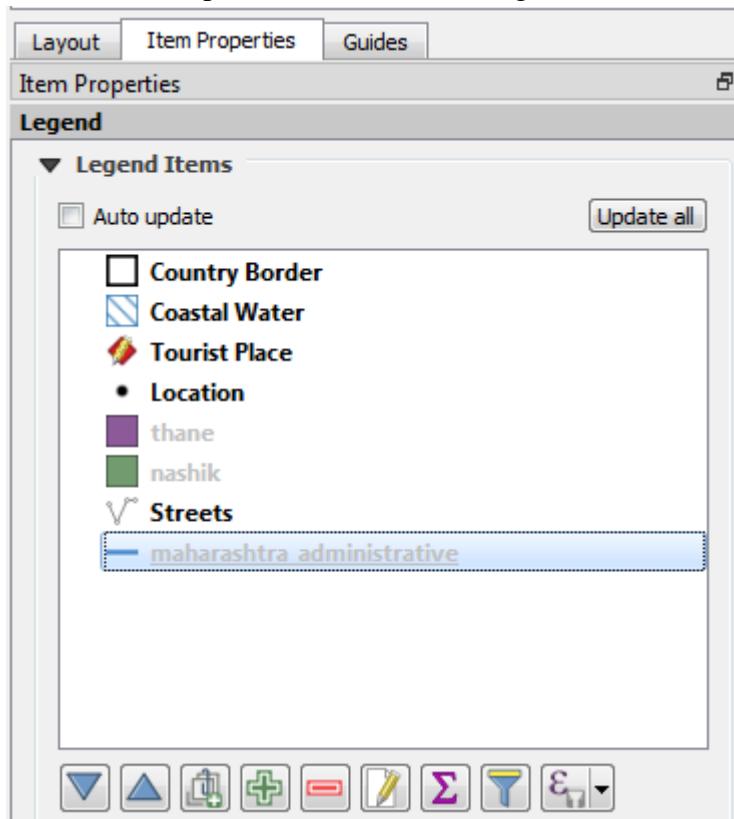


➤ Add Item → Add Label

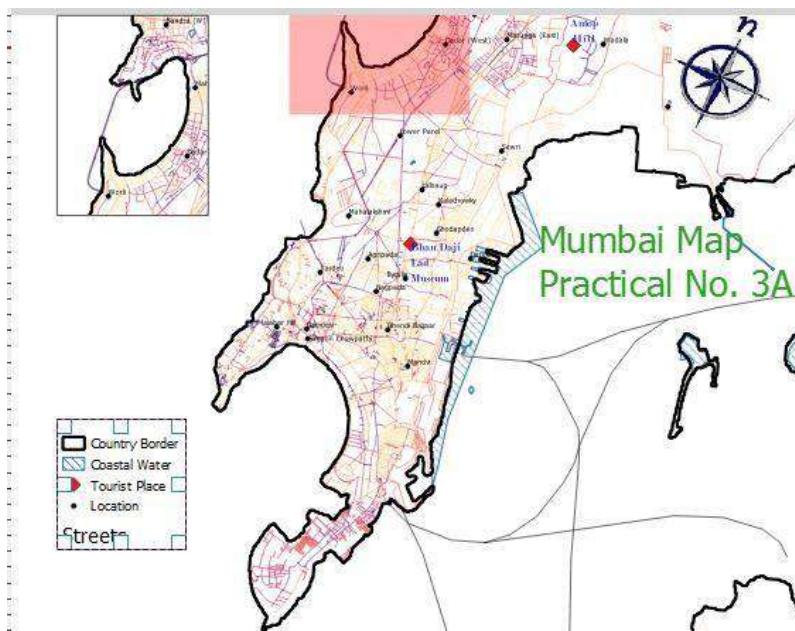
- Change the Label text To “Mumbai Map”, Set appropriate font size and color using Item Properties → Main Properties.



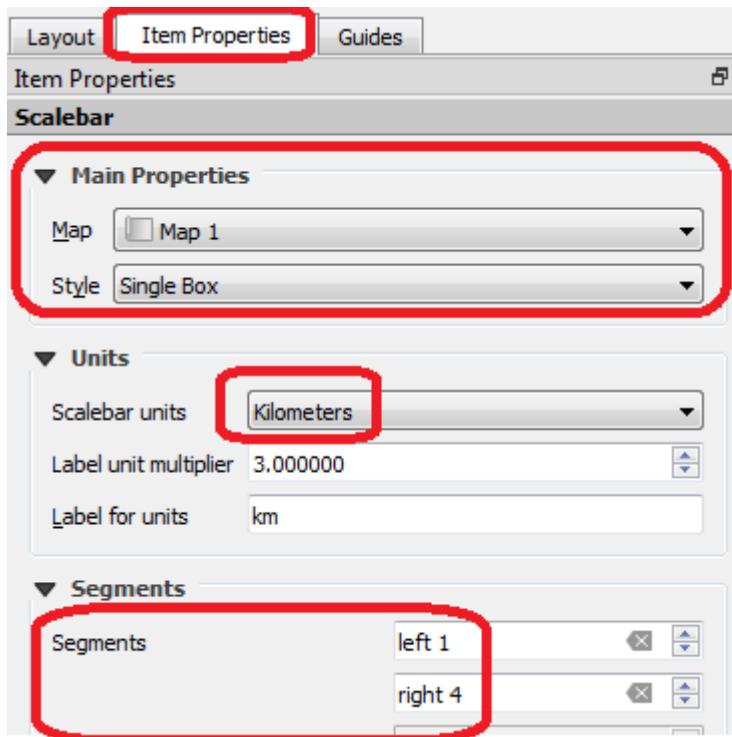
- Add Item → Add Legend → Place the legend indicator at appropriate location.
- Uncheck auto update and use suitable legend indicator label.



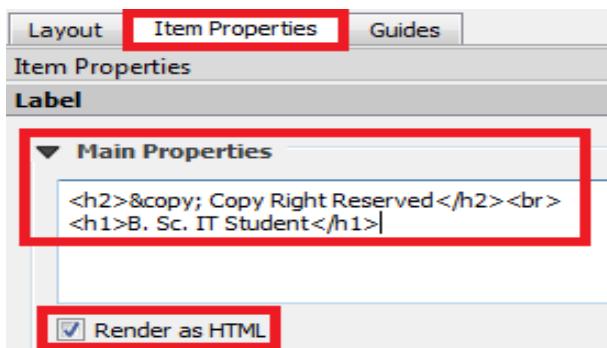
- The Print Layout will appear



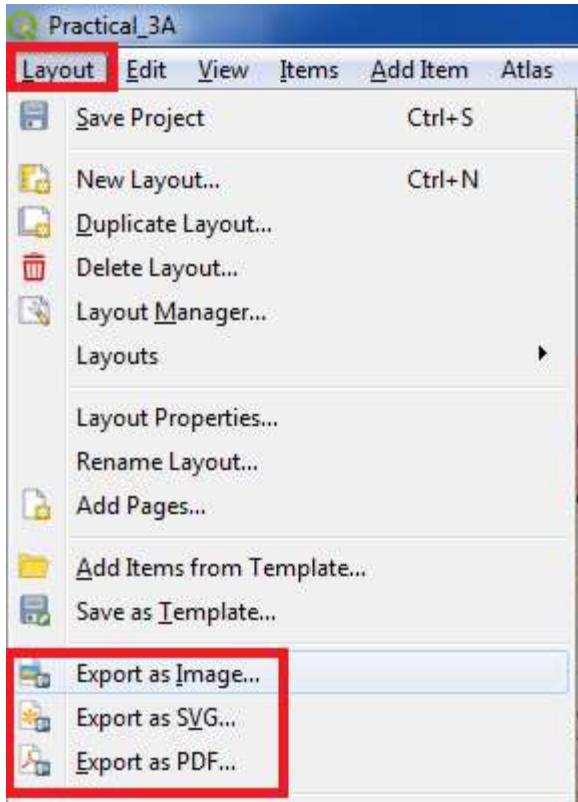
- Add Item → Add Scale Bar



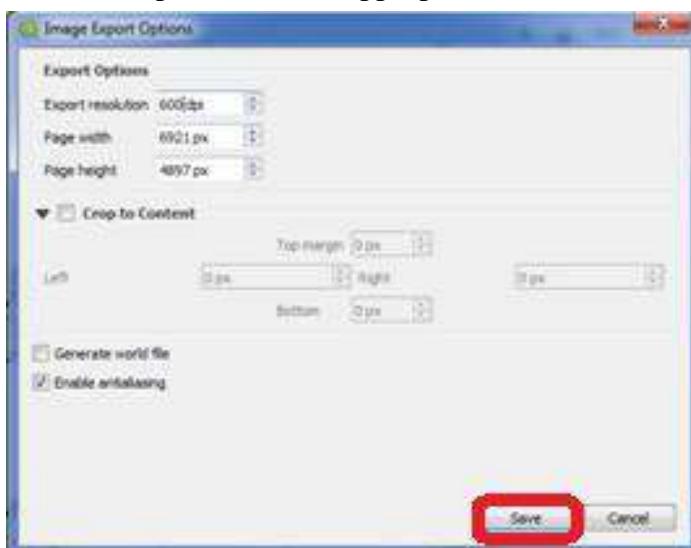
- Add Item → Add Label → Add a Label using HTML rendering



- A Map can be saved in Image or PDF using Layout → Export as Image / Export as PDF



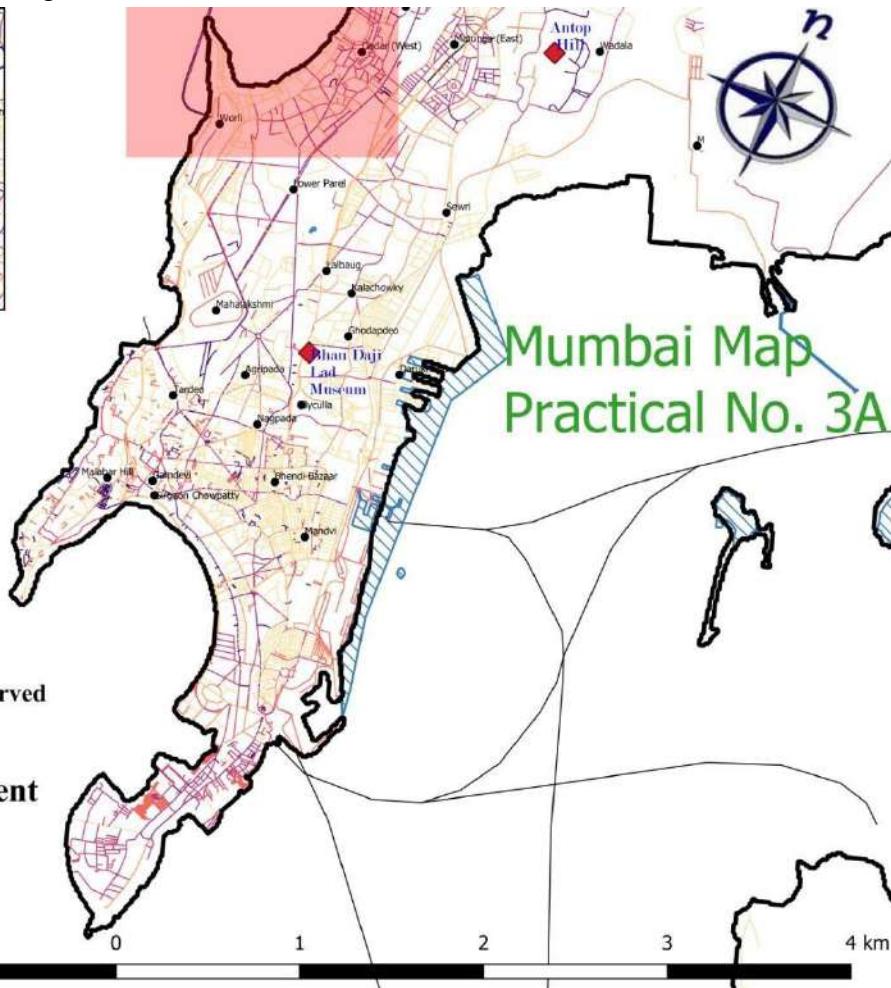
- Save the Map to a location appropriate location as PDF or Image.



- Open the PDF or Image from location.

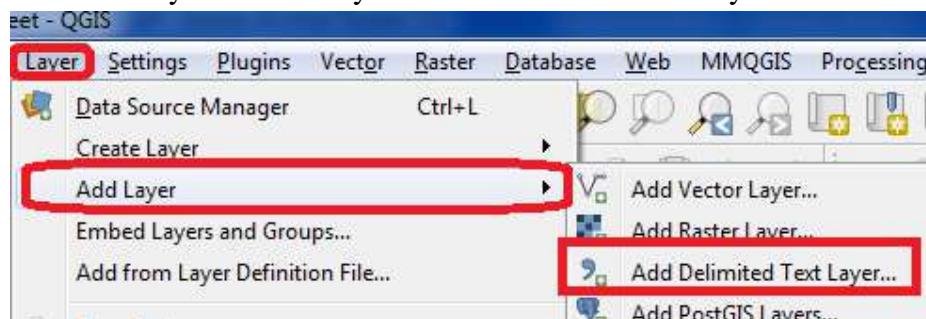


■ Country Border
■ Coastal Water
◆ Tourist Place
• Location
Streets

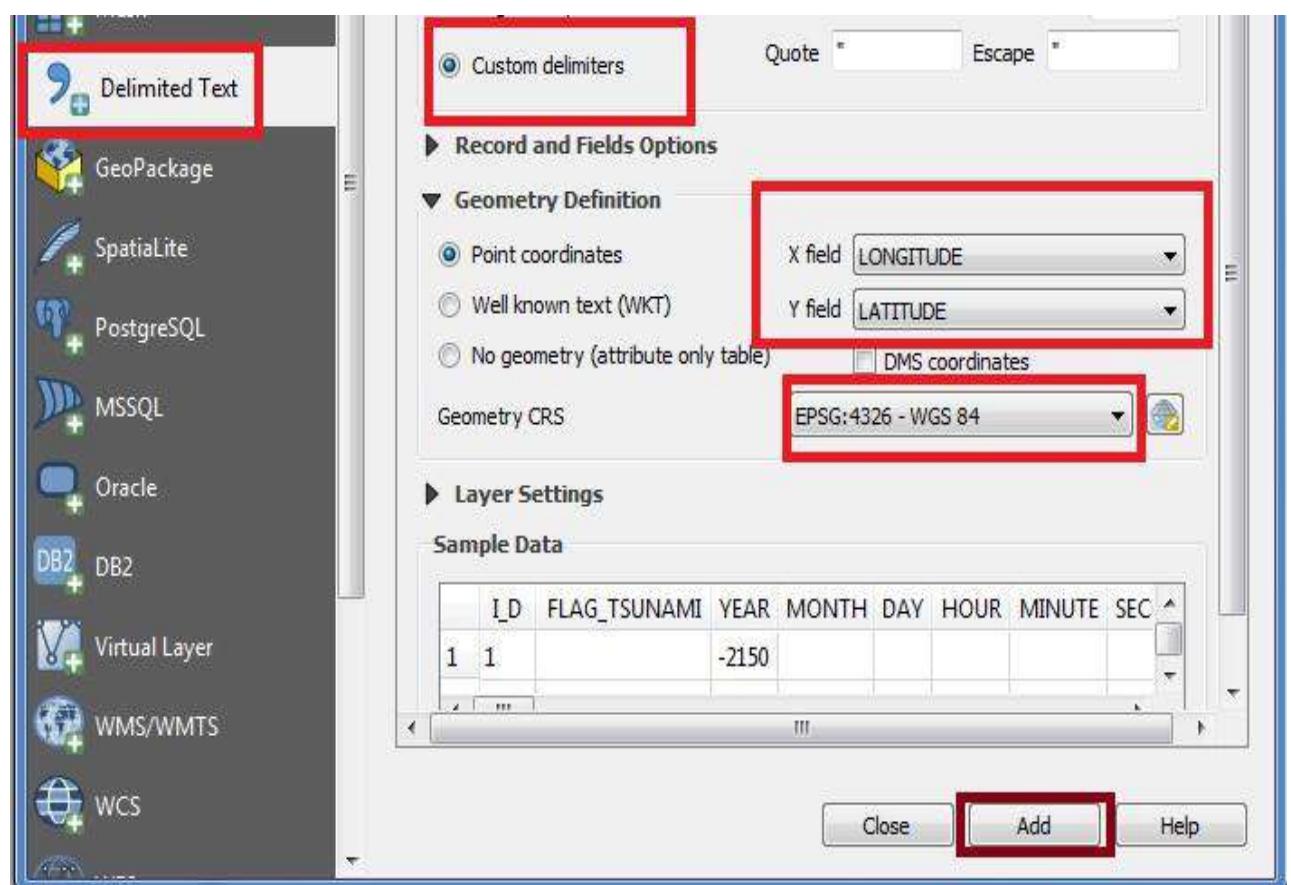
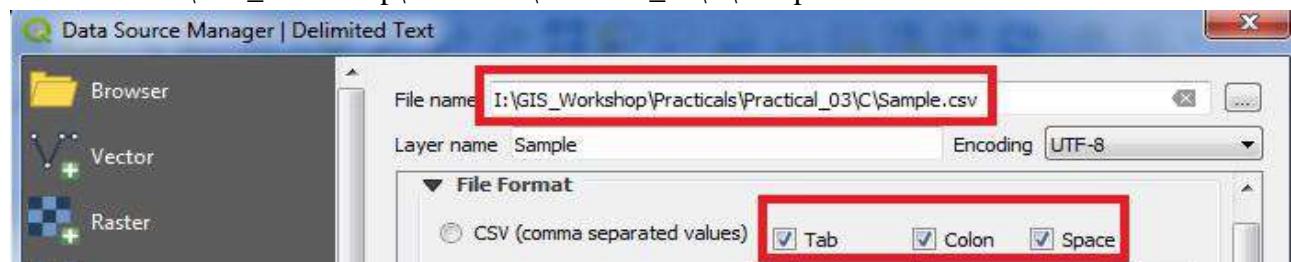


b) Importing Spreadsheets or CSV files

- Many times the GIS data comes in a table or an Excel spreadsheet or a list lat/long coordinates, therefore it has to be imported in a GIS project.
- Sample file for Earthquake data will be used in this practical.
- Go to Layer → Add Layer → Add Delimited text Layer



- Data Source Manager | Delimited Text window will appear
- Select the \GIS_Workshop\Practicals\Practical_03\C\Sample.csv file from data folder.

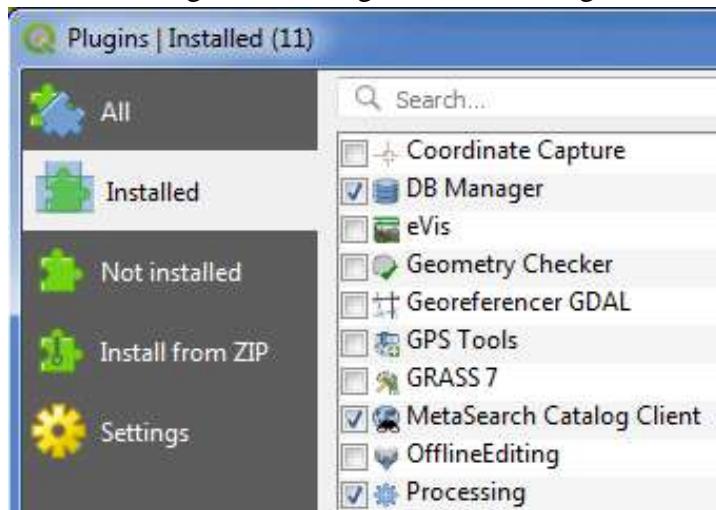


- Press ADD and close the window.
- Output:

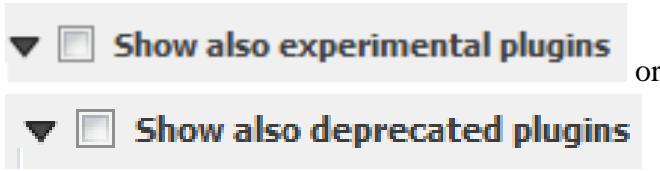


c) Using Plugins

- Core plugins are already part of the standard QGIS installation. To use these, just enable them.
- Open QGIS. Click on Plugins → Manage and Install Plugins....



- **To enable a plugin**, check on the checkbox next to Plugin. This will enable the plugin to use it.
- **External plugins** are available in the QGIS Plugins Repository and need to be installed by the users before using them.
- Click on Not Installed or Install from ZIP.
- Once the plugin is downloaded and installed, you will see a confirmation dialog.
- Click on Plugins → <<new Plugin Name>>
- The Plugin if marked **Experimental plugin** can be installed, from Setting → check on

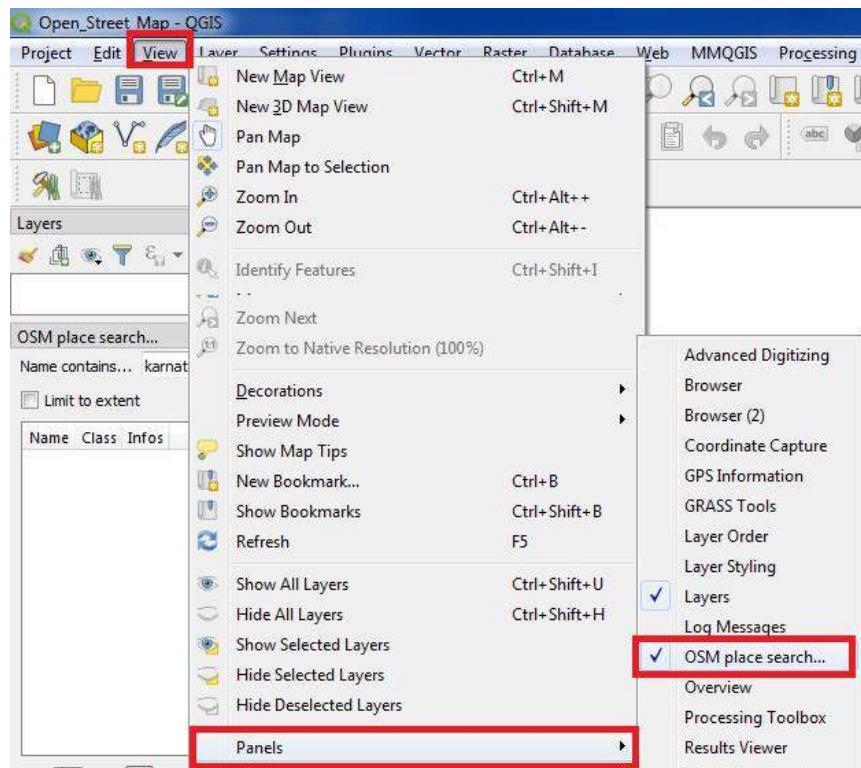


- A  tab will be added to Plugin Manager Window.
- Click on a plugin name and Click Install.

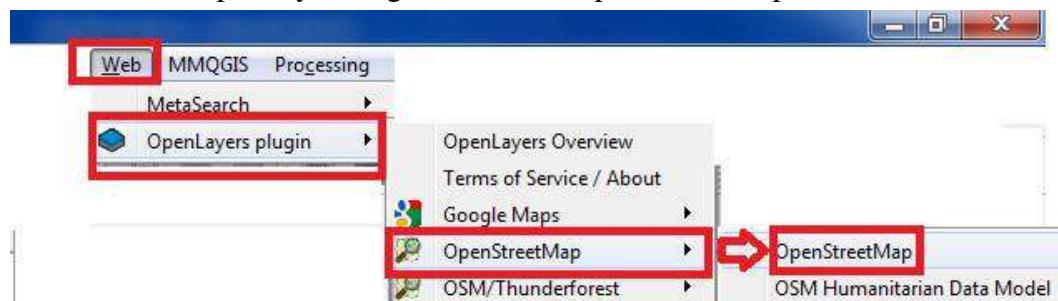
d) Searching and Downloading OpenStreetMap Data

OpenStreetMap (OSM) created by Steve Coast in the UK in 2004 is a collaborative project to create a free editable map of the world. Rather than the map itself, the data generated by the project is considered its primary output. The creation and growth of OSM has been motivated by restrictions on use or availability of map information across much of the world, and the advent of inexpensive portable satellite navigation devices.

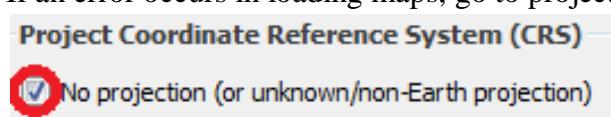
- Add “**Open Layer**” and “**OSM Search**” Plugin from Not Installed option from Plugin Manager Dialog Box.
- The **OSM Place Search** plugin will install itself as a *Panel* in QGIS, if not go to View → Panels → select OSM Place Search.

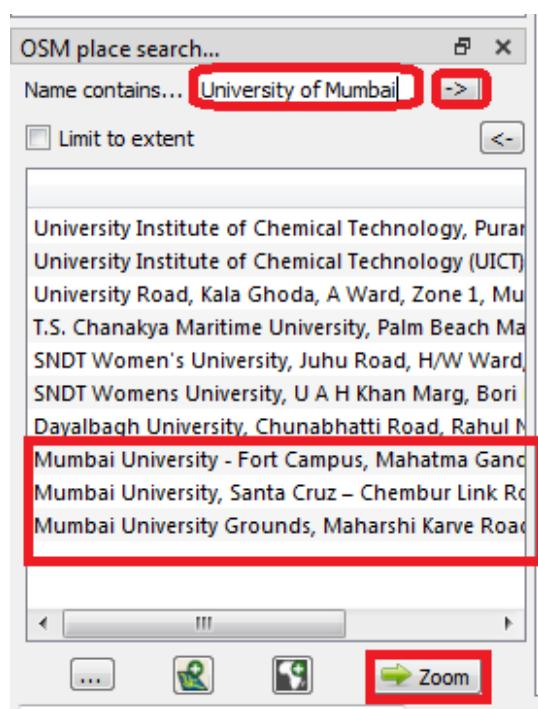


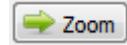
- Go to Web → OpenLayer Plugin and select Open Street Map



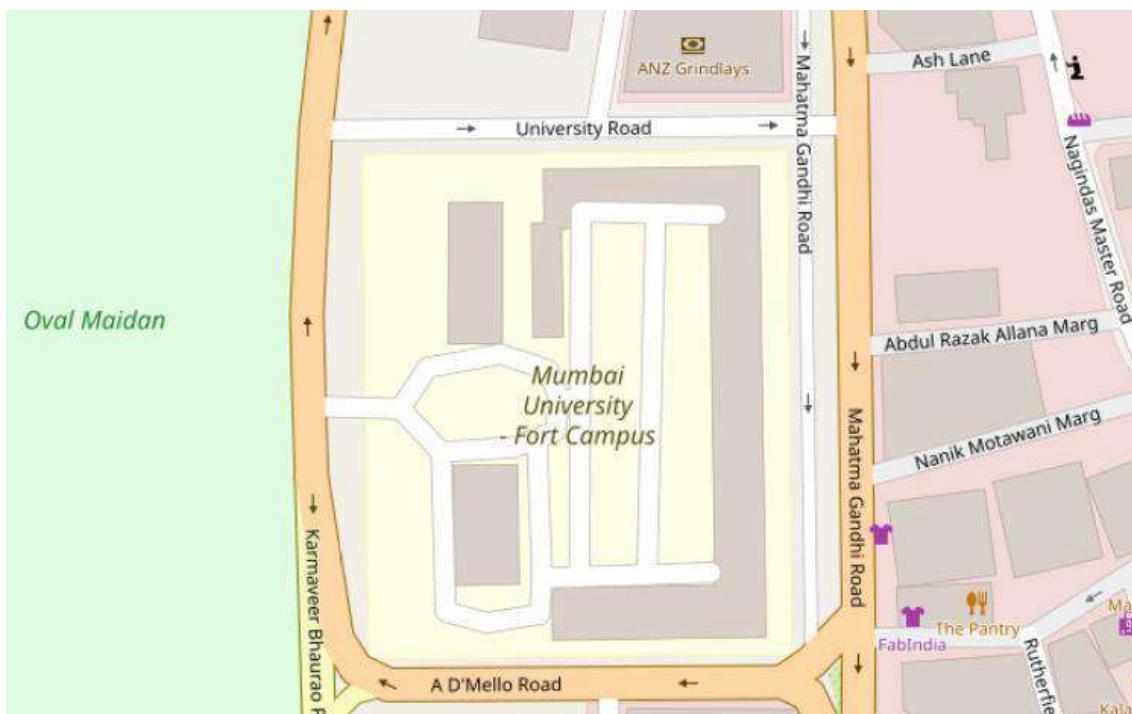
- A World map will appear on screen.
- If an error occurs in loading maps, go to project properties → CRS →





- In OSM Place search Pane → Enter Mumbai or any place name to search
- Double click on the desired place in OSM Place search Panel or Click and press 

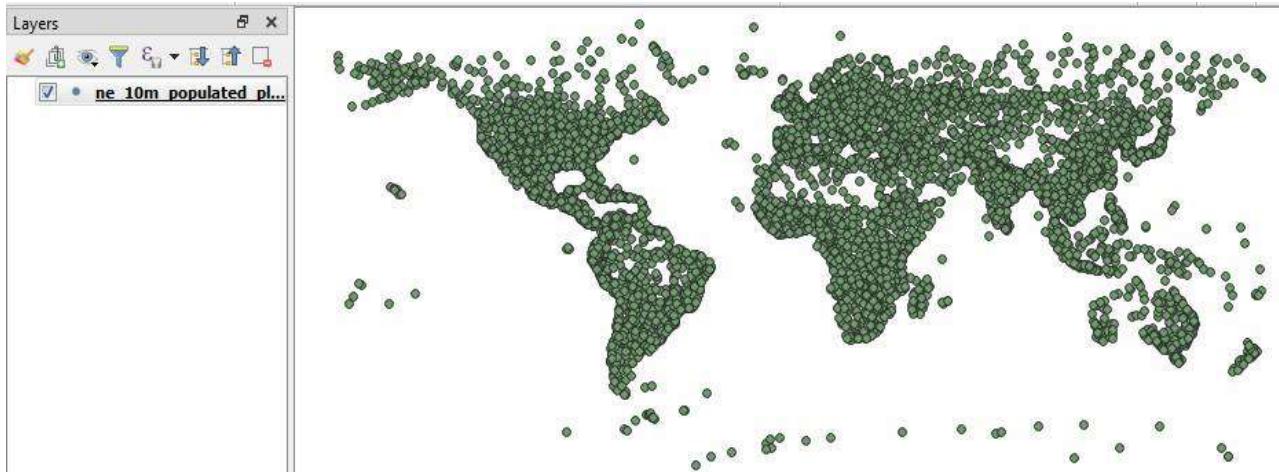
Output:



PRACTICAL - 4

A. Working with attributes

- Start a new project.
- Go to Layer → Add Layer → Add Vector Layer
- Select “\GIS_Workshop\Practicals\Practical_04\A\Data\ne_10m_populated_places_simple.zip”

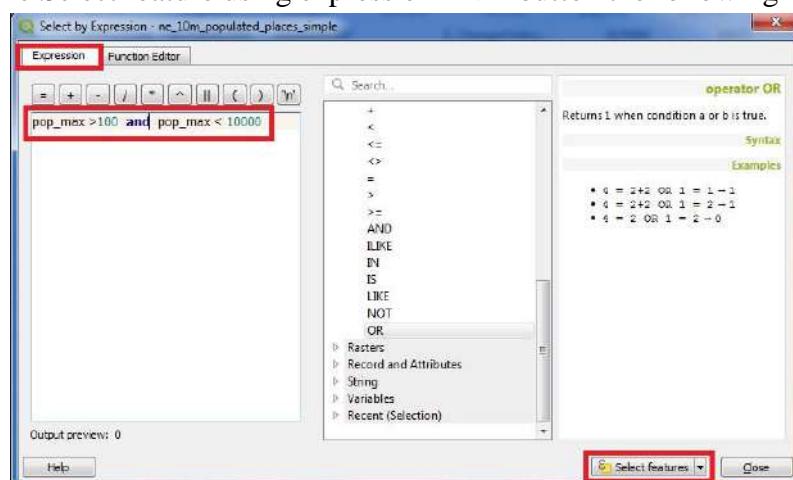


- Right click on Layer in Layer Panel → Open Attribute Table.
- Explore various attributes and their values in the Attribute table.
- To find the Place with maximum population click on “pop_max” file

ne_10m_populated_places_simple :: Features Total: 7322, Filtered: 7322, Selected: 0

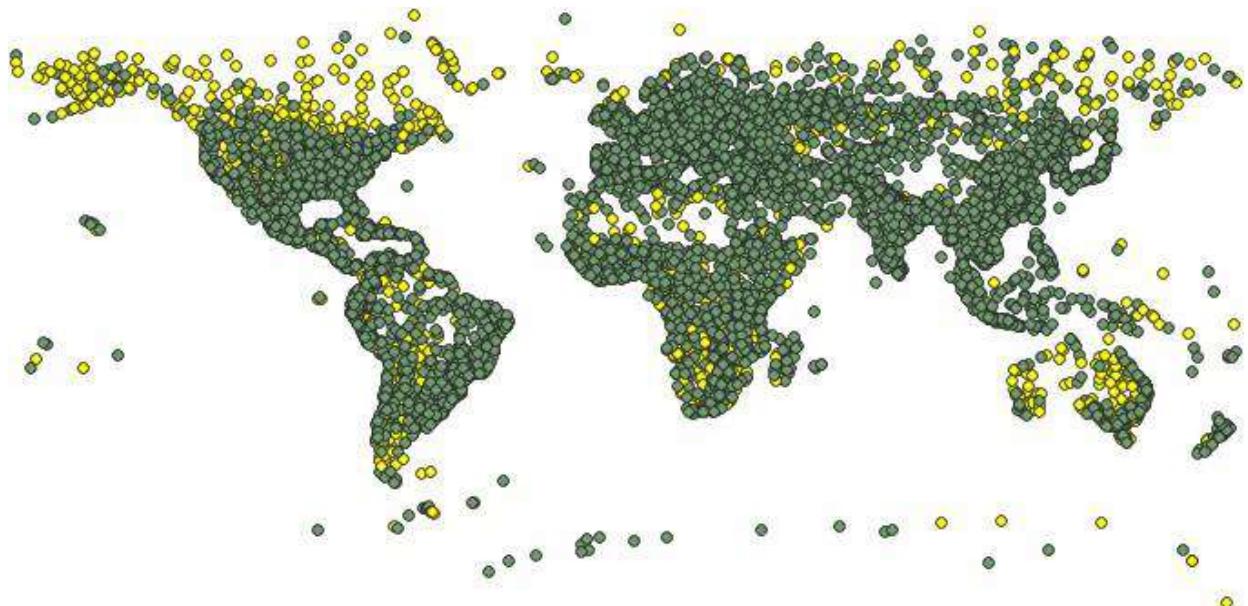
	latitude	longitude	changed	namediff	diffnote	pop_max	pop_min	pop_other
1	35.68501690580	139.75140742900	0.00000000000		0	35676000	8336599	1294525
2	40.74997906400	-73.98001692880	0.00000000000		0	19040000	8008278	929260
3	19.11211211280	93.12000000170	0.00000000000		0	19020000	10011002	1001311
4	19.01699037570	72.85698929740	0.00000000000		0	18978000	12691836	1242608

- On clicking the Select feature using expression button the following window will appear.

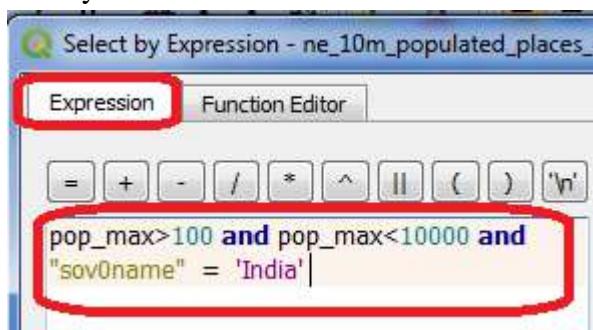


- Enter pop_max>100 and pop_max<10000 and click button to get all the places with population between 100 and 10000.

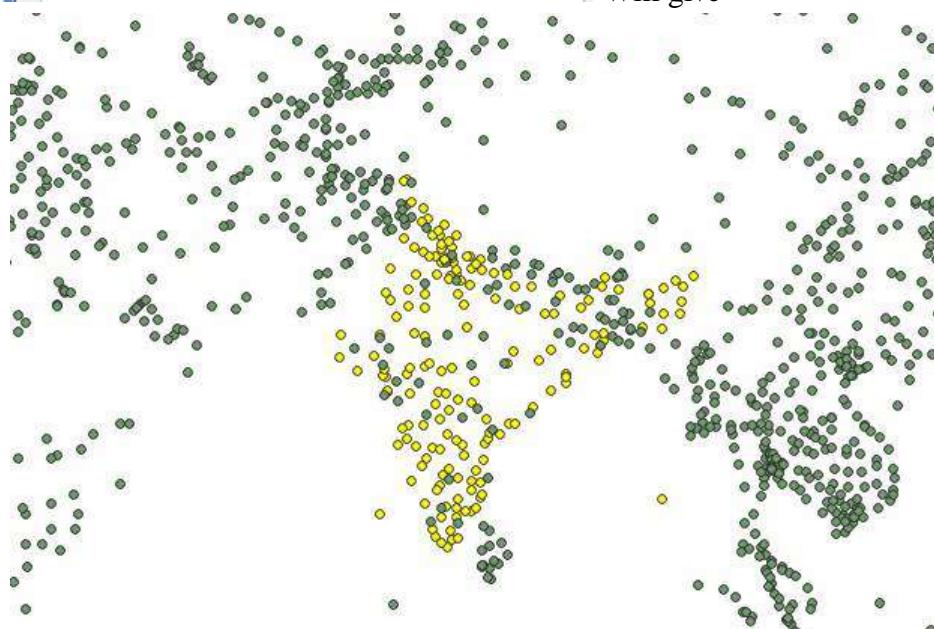
- The places matching the criteria will appear in different color.



- Different queries can be performed using the dataset.
- Try this



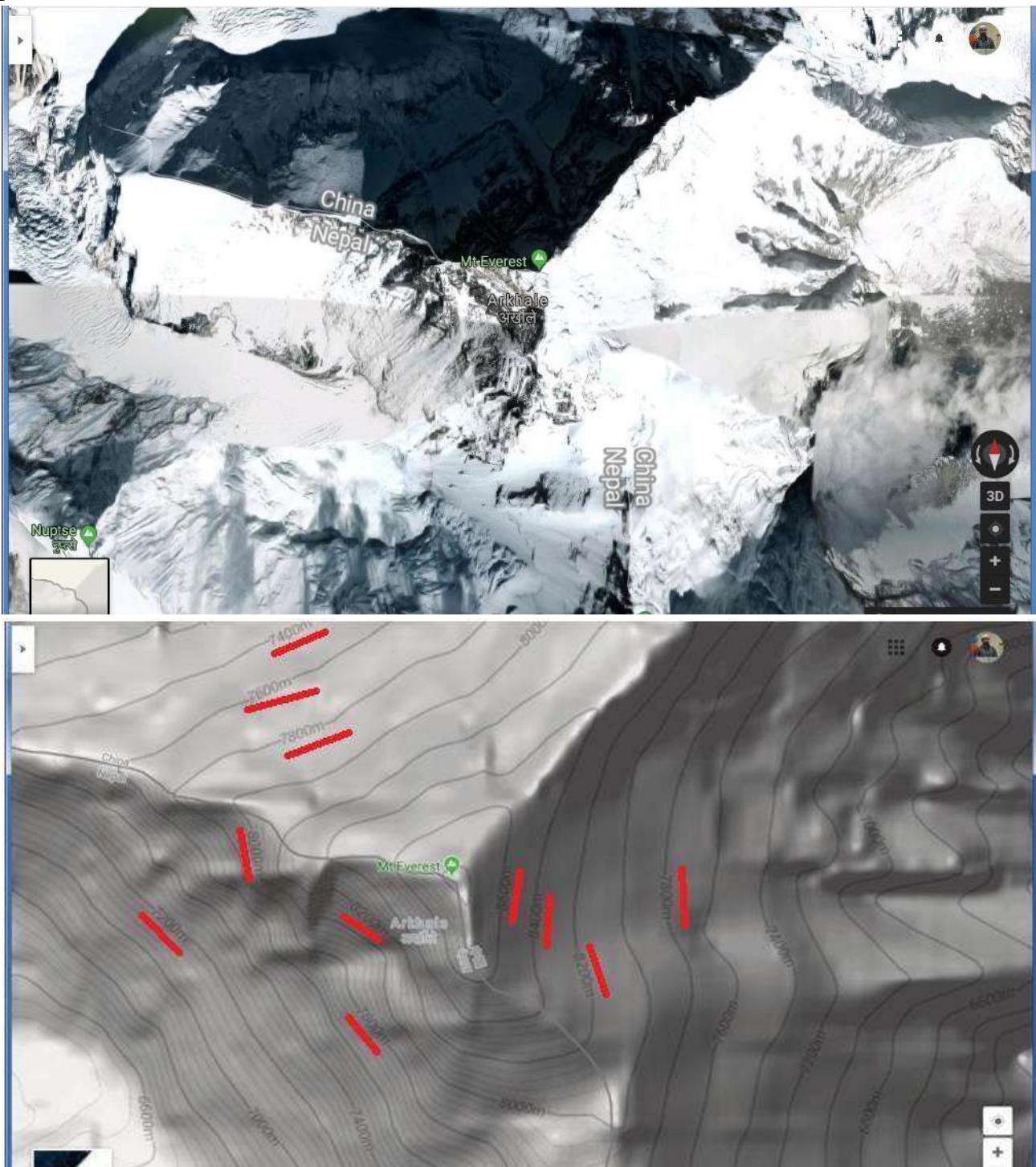
Will give



- Use the deselect button to deselect the feature to be rendered in original color.

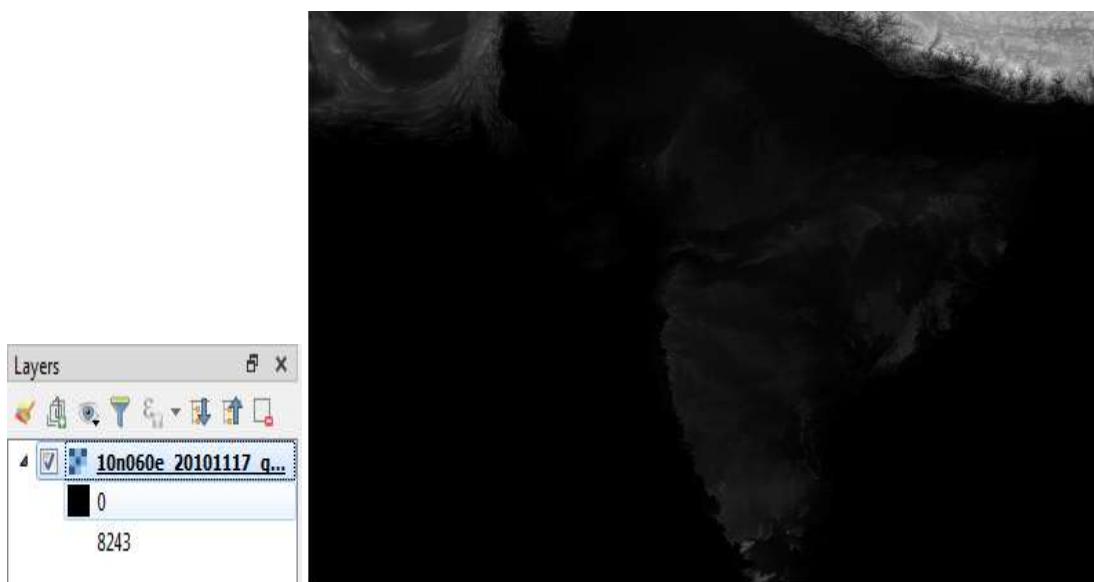
b) Terrain Data and Hill shade analysis

A terrain dataset is a multiresolution, TIN-based surface built from measurements stored as features in a geodatabase. Terrain or elevation data is useful for many GIS Analysis like, to generate various products from elevation data such as contours, hillshade etc.



<https://www.google.com/maps/@27.9857765,86.9285378,14.75z/data=!5m1!1e4?hl=en-US>

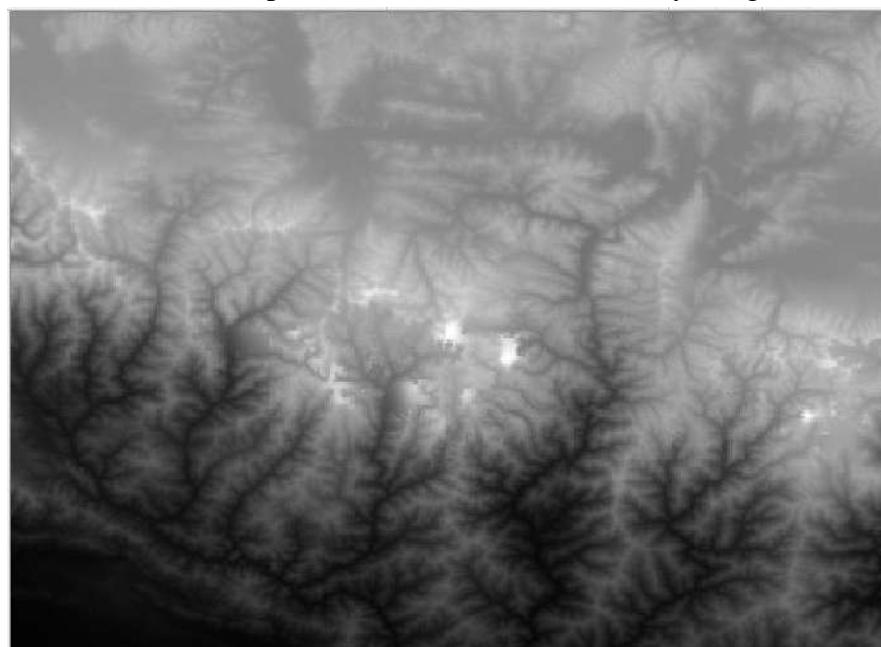
- Go to Layer → Add Raster Layer → select “10n060e_20101117_gmted_mea300.tif”, from Data folder



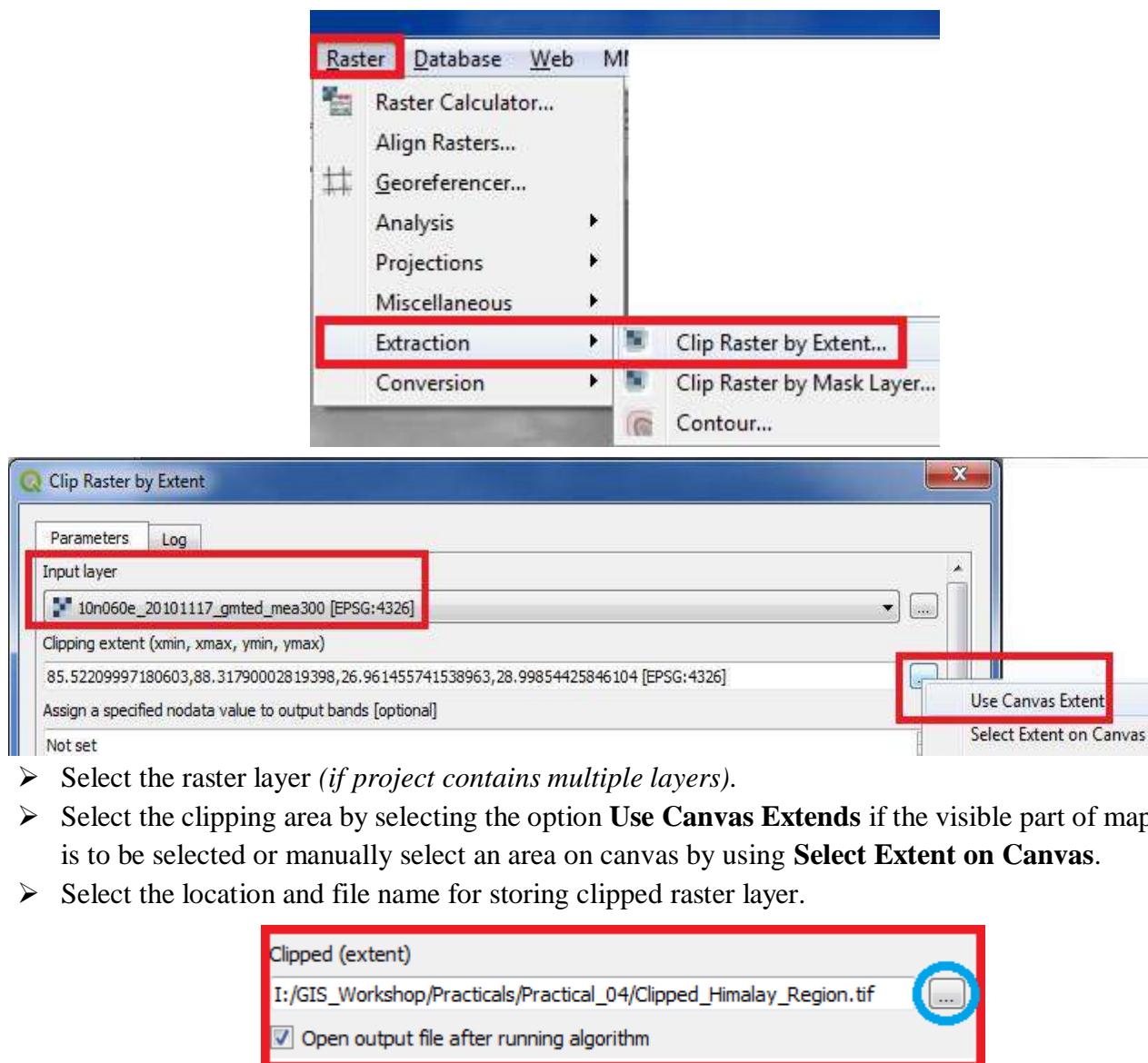
- The Lower altitude regions are shown using dark color and higher using light shade as seen on top region containing Himalaya and Mt Everest.
- Mt. Everest - is located at the coordinates 27.9881° N, 86.9253° E.
- Enter 86.92, 27.98 in the coordinate field, Scale 900000 and Magnifier 100% at the bottom of QGIS.



- Press enter the view port will be centered on Himalaya Region.

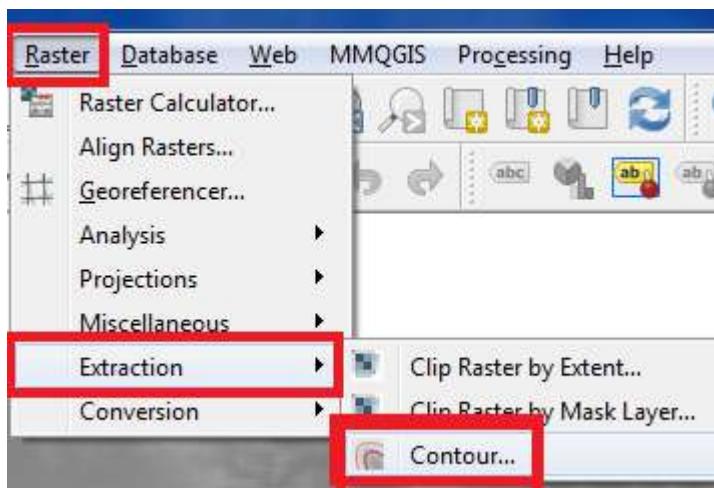


- Crop the raster layer only for the region under study.
- Go to Raster → Extraction → Clip Raster by Extent

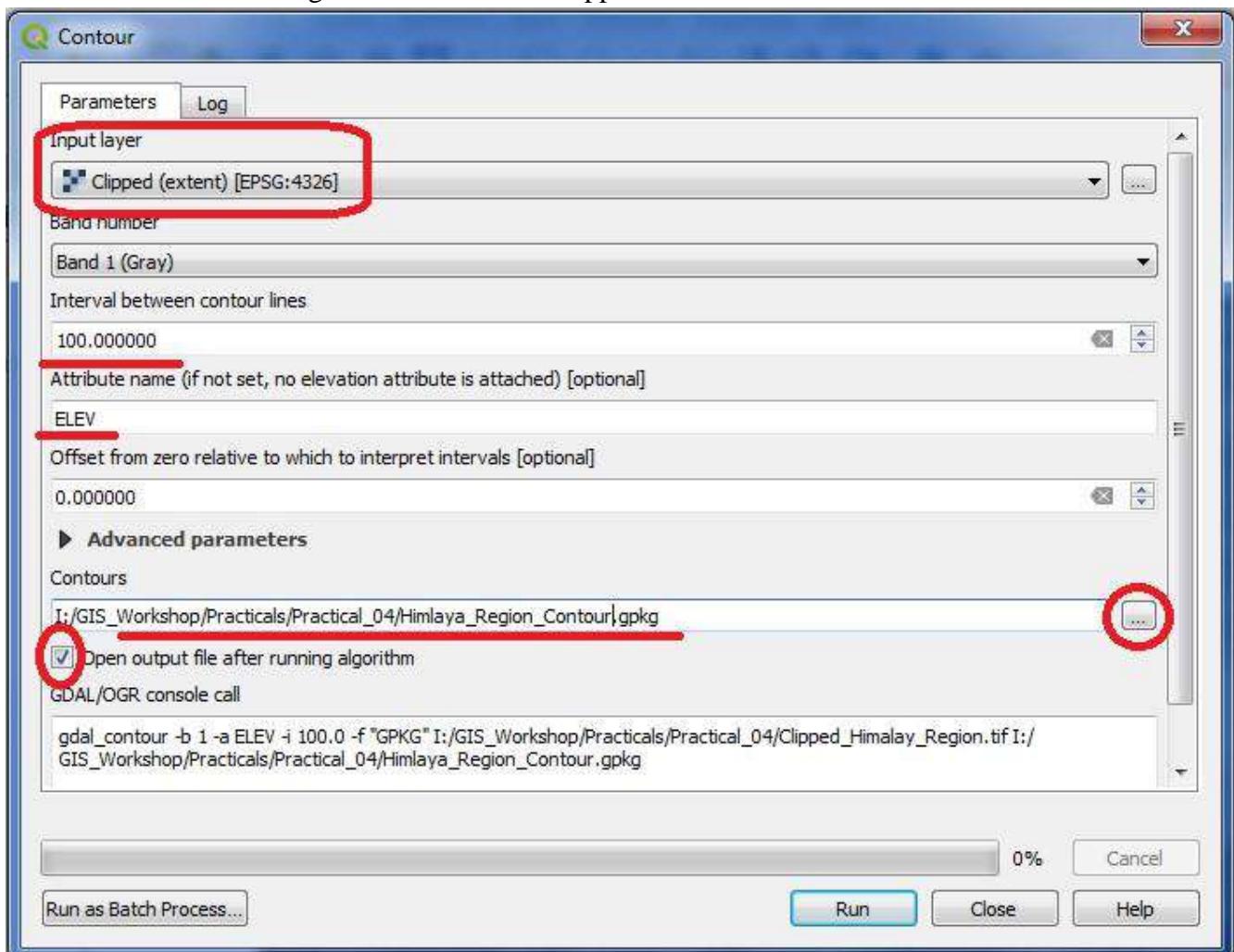


- Select the raster layer (*if project contains multiple layers*).
- Select the clipping area by selecting the option **Use Canvas Extends** if the visible part of map is to be selected or manually select an area on canvas by using **Select Extent on Canvas**.
- Select the location and file name for storing clipped raster layer.

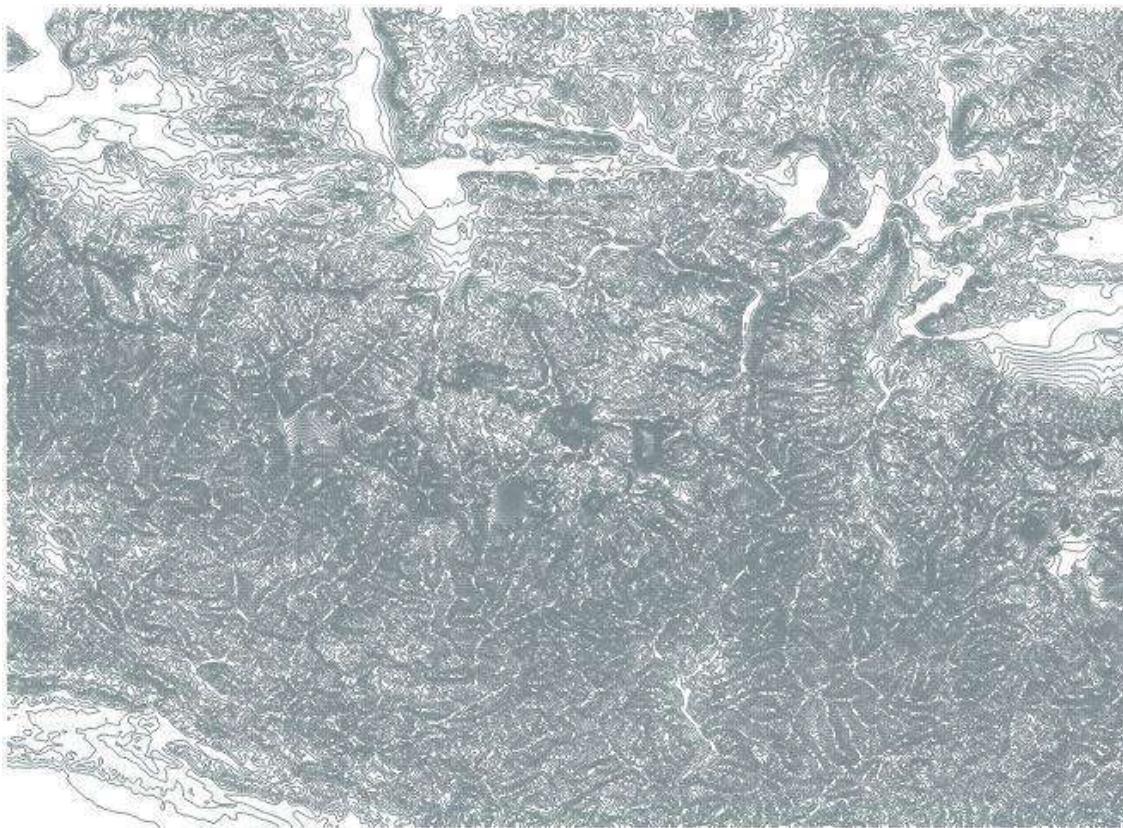
-
- The screenshot shows the QGIS 'Layers' panel. On the left, under 'Original Raster', there is one layer named '10n060e_20101117_gmted_meal300' with a value of '8243'. On the right, under 'Clipped Raster', there are two layers: 'Clipped (extent)' with a value of '103' labeled 'Lower Region' and '8625' labeled 'Higher Region'.
- Press RUN.
 - Deselect the original layer and keep the clipped one.
 - The Clipped raster layer is representing altitude are from 103 Meters.
 - Counter lines are the lines on a map joining points of equal height above or below sea level. A **contour interval** in surveying is the vertical distance or the difference in the elevation between the two **contour** lines in a topographical map.
 - To derive counter lines from given raster.
 - Go to Raster → Extraction→ Contour



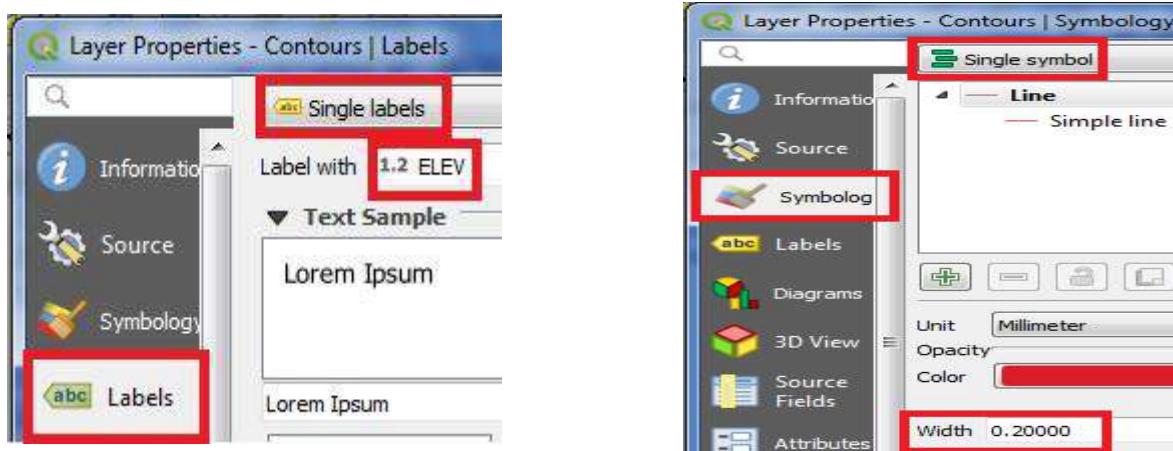
- The Contour configuration window will appear



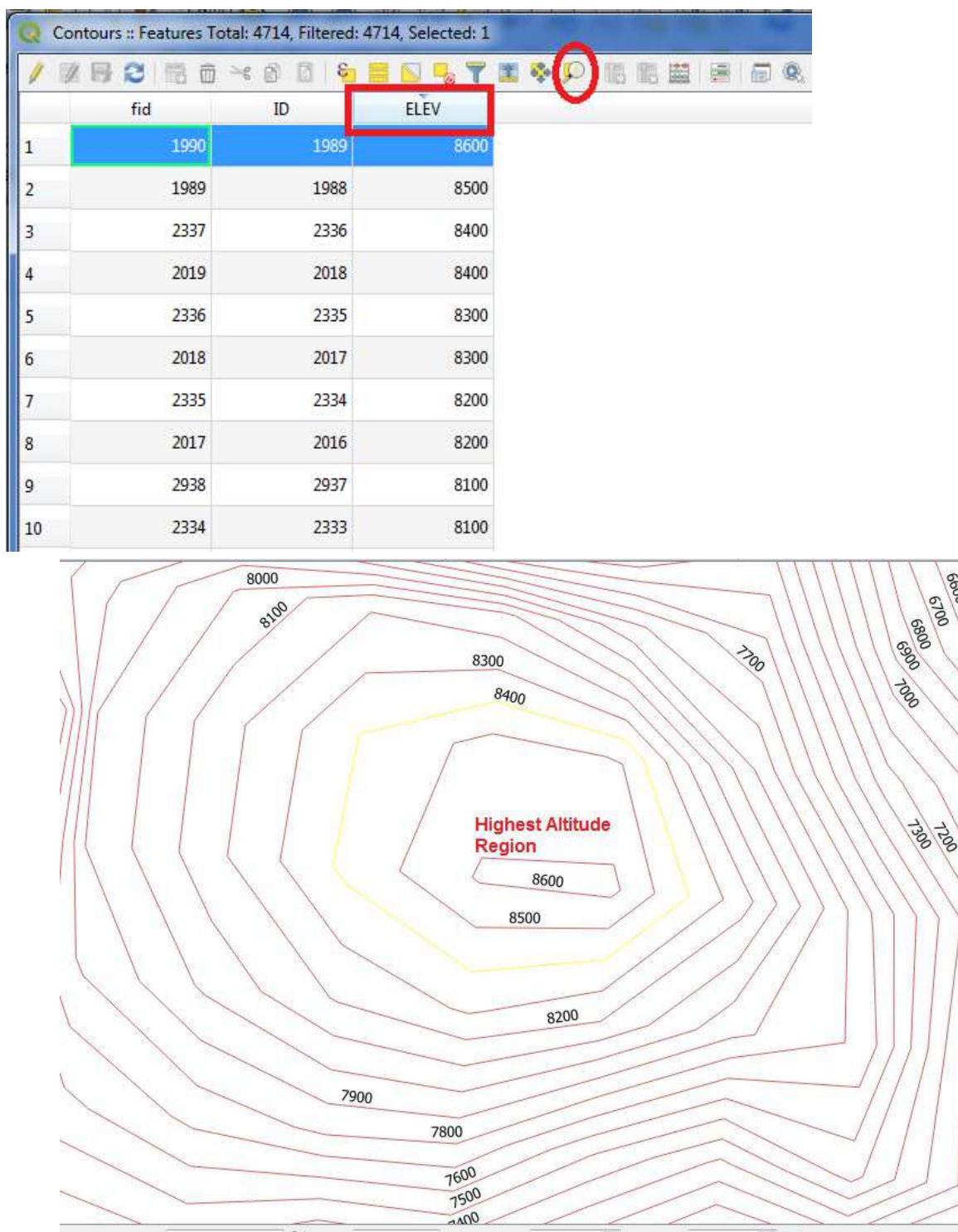
- Select the input raster layer name. Set contour interval 100.00 meters, select the output file name & location and check the option to add output file to project after processing.
- Press "RUN".
- The contour layer will appear like this



- Label the layer using “ELEV” field and set appropriate symbols for line.

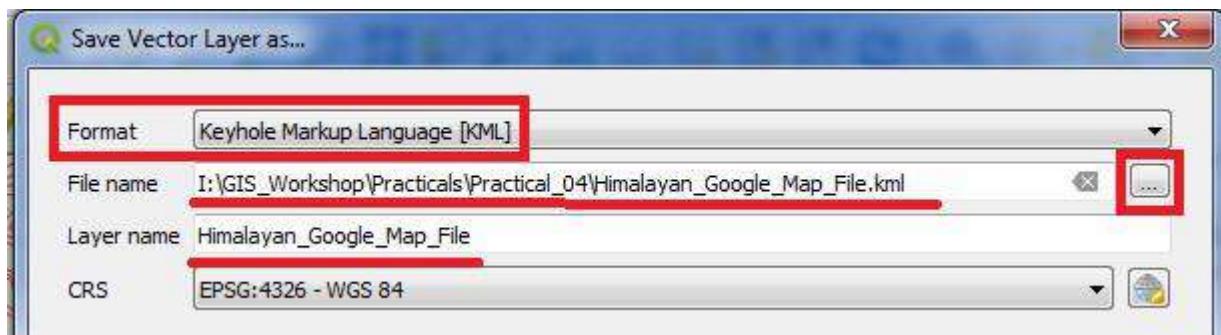


- In the Layer panel right click on Contour Raster Layer and select “Open Attribute table”,
- Arrange the table in descending order based on the value of “ELEV” column.
-



Compare the above counter line raster layer with the previous Google map image or visit
<https://www.google.com/maps/@27.9857765,86.9285378,14.75z/data=!5m1!1e4?hl=en-US>

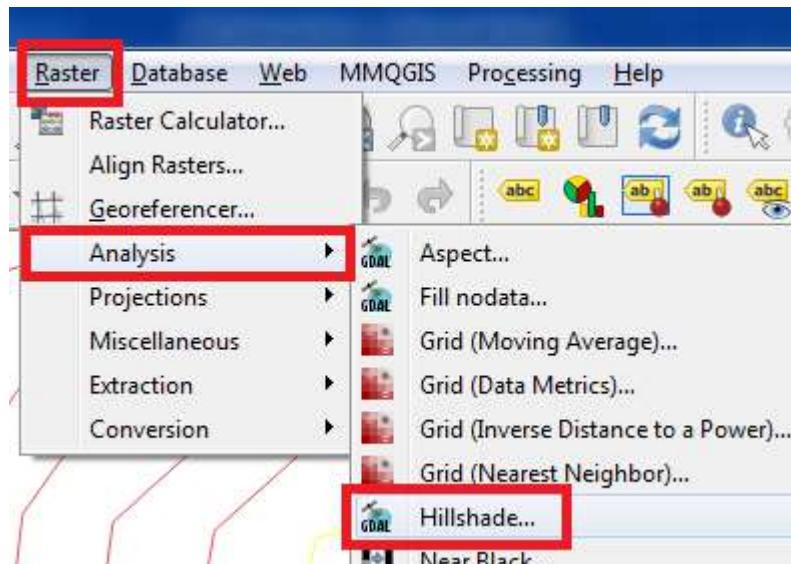
- To verify the above contour files using Google Map
- Make a copy of Contour Layer, Go to Layer → Save As
- Select file format as “Keyhole Markup Language”, set file name, location and Layer Name.
- Also set CRS to WGS 84 EPSG:4326



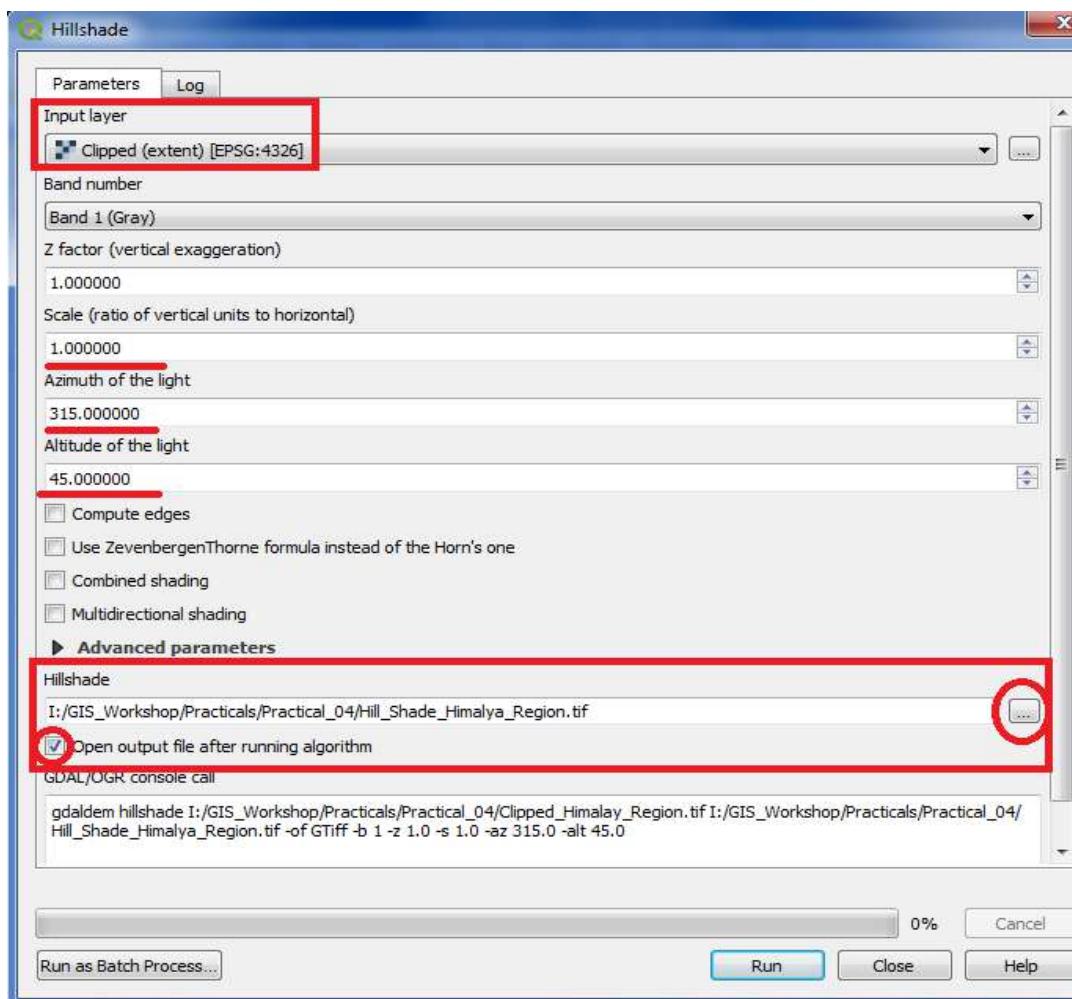
- Go to the stored location on Hard Disk and open the “Himalayan_Google_Map_File.kml” with Google Map.\

A **Hillshade** is a grayscale 3D representation of the surface, showing the topographical shape of hills and mountains using shading (levels of gray) on a map, just to indicate relative slopes, mountain ridges, not absolute height.

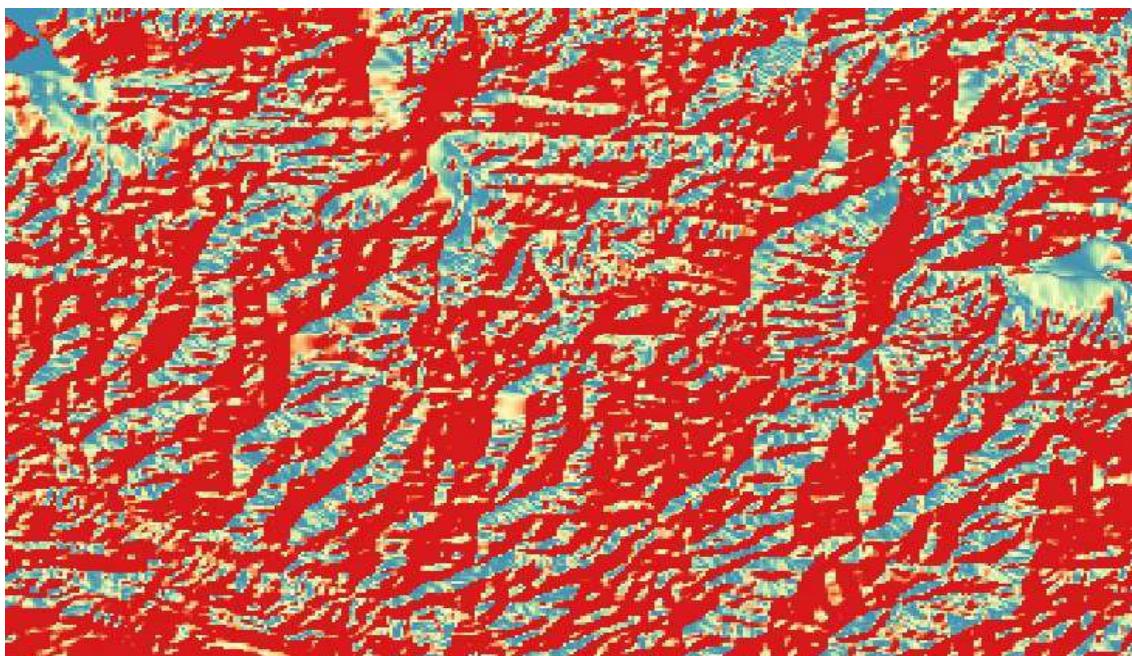
- For Hill Shade surface analysis
- Go to Plugin → Install Georeferencer GADL.
- After successful installation of plugin Go to Raster → Analysis → Hill Shade



- Select the input raster layer, select file name and location for storing Hill Shade output file.



- Press “RUN” and Close the Hill Shape Dialog window.
- After Raster styling the Output will appear like this.

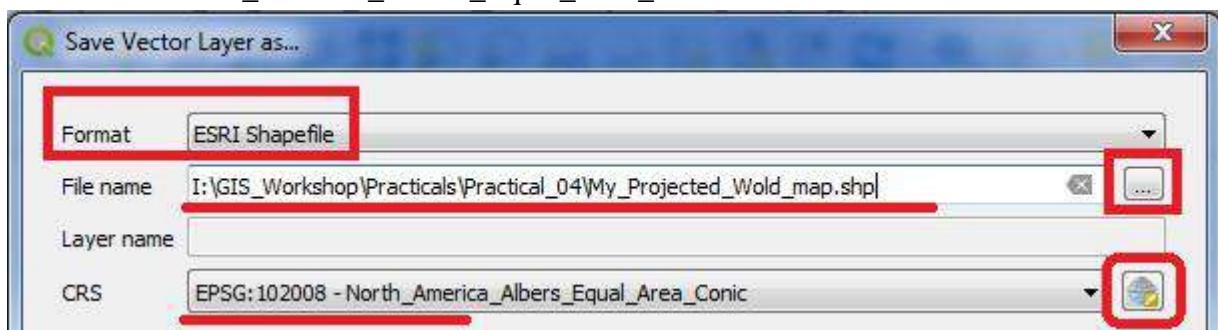


PRACTICAL - 5

Working with Projections and WMS Data

A **Web Map Service (WMS)** is a standard protocol developed by the Open Geospatial Consortium in 1999 for serving georeferenced map images over the Internet. These images are typically produced by a map server from data provided by a GIS database

- Start a new Project.
- Layer → Add Layer → Vector Layer
- Select “ne_10m_admin_0_countries.zip” Layer from data folder.
- Go to Layer → Save As
Select format as ESRI Shape File
Select folder location and file name
Set CRS North_America_Albers_Equal_Area_Conic EPSG: 102008



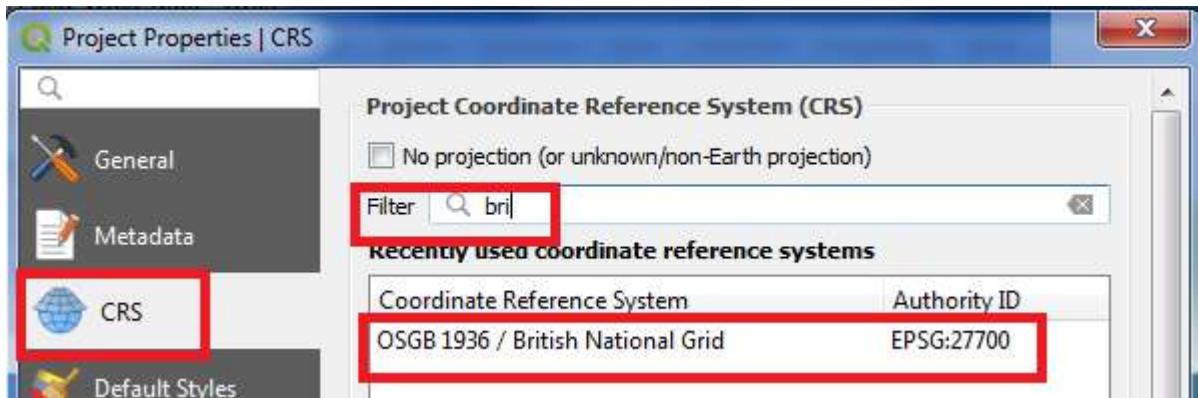
- Press “OK”.
- Deselect the original Image and keep the projected layer visible.



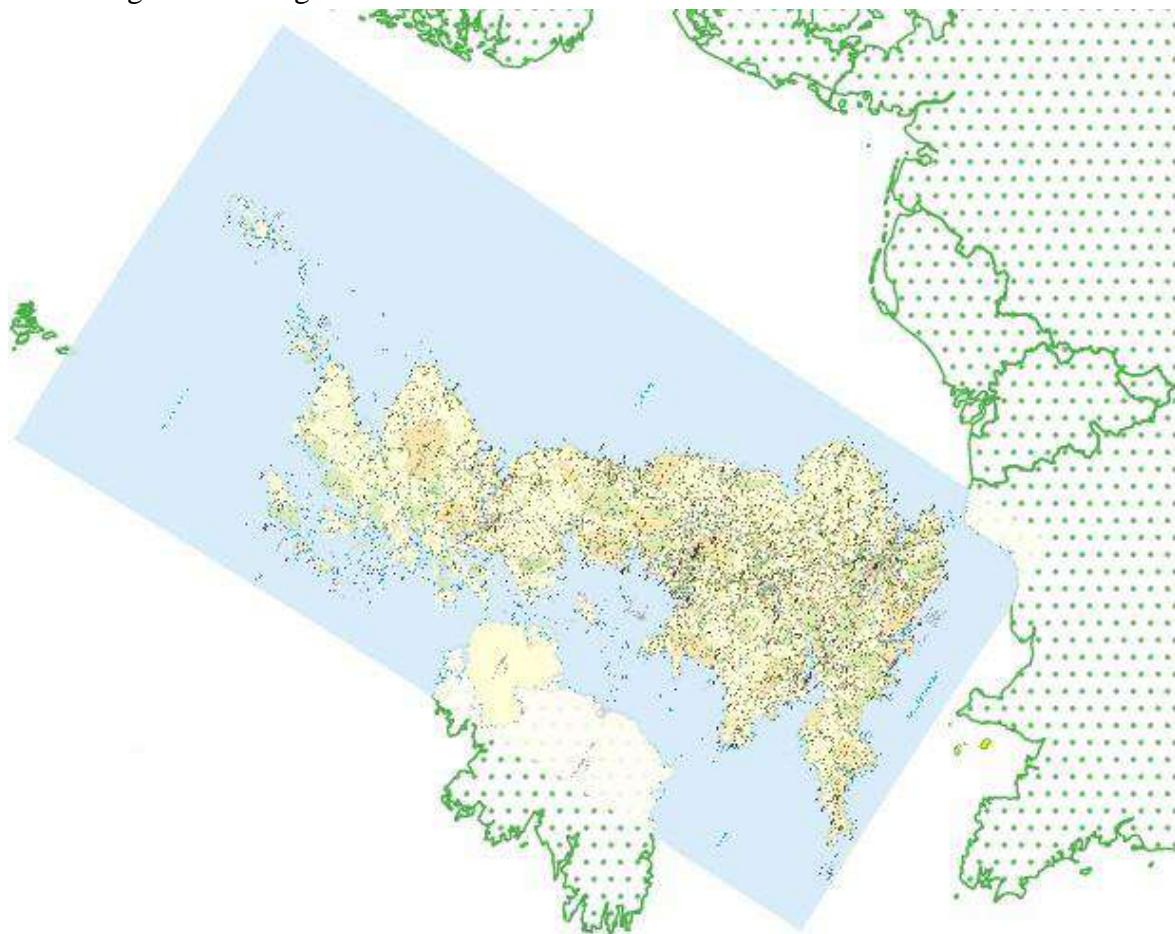
- Select Layer → Add Layer → Add Raster Layer → Select MiniScale_(standard)_R17.tif from Location

"GIS_Workshop\Practicals\Practical_05\DATA\minisc_gb\minisc_gb\data\RGB_TIF_compressed\MiniScale_(standard)_R17.tif"

- The Layer appears on a different location than the location where Great Britain is shown on Map.



- Open Layer Properties → CRS → Search bri → select British National Grid EPSG 27700.
- Processing may take some time.
- Locate United Kingdom on Layer; the vector layer exactly coincides by the raster layer covering United Kingdom.



PRACTICAL - 6

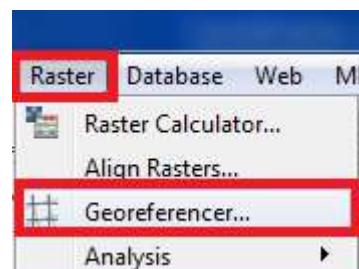
➤ Georeferencing

A. Georeferencing Topo Sheets and Scanned Maps

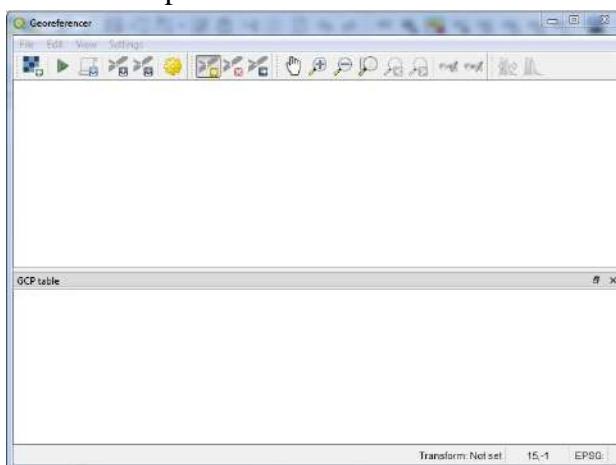
- Start a new project
- Go to Layers → Add Layer → Add vector Layer
- Select GIS_Workshop\Manual\Prac06\IND_adm0.shp
- Zoom in to Mumbai region in the layer.



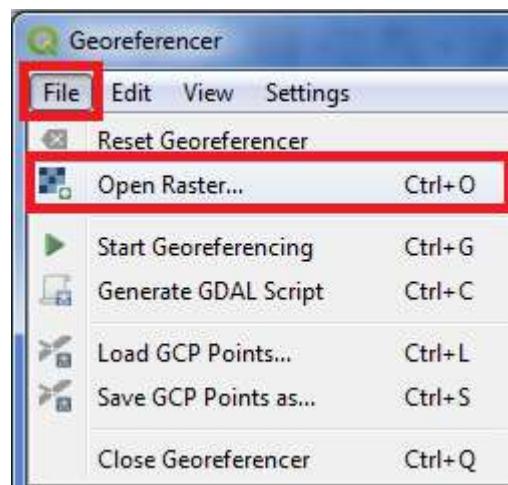
- Go to Plugins → Manage and Install Plugins
- Ensure that Georeferencer GDAL is checked, if not install Georeferencer GDAL plugin.
- Go to Raster → Georeferencer



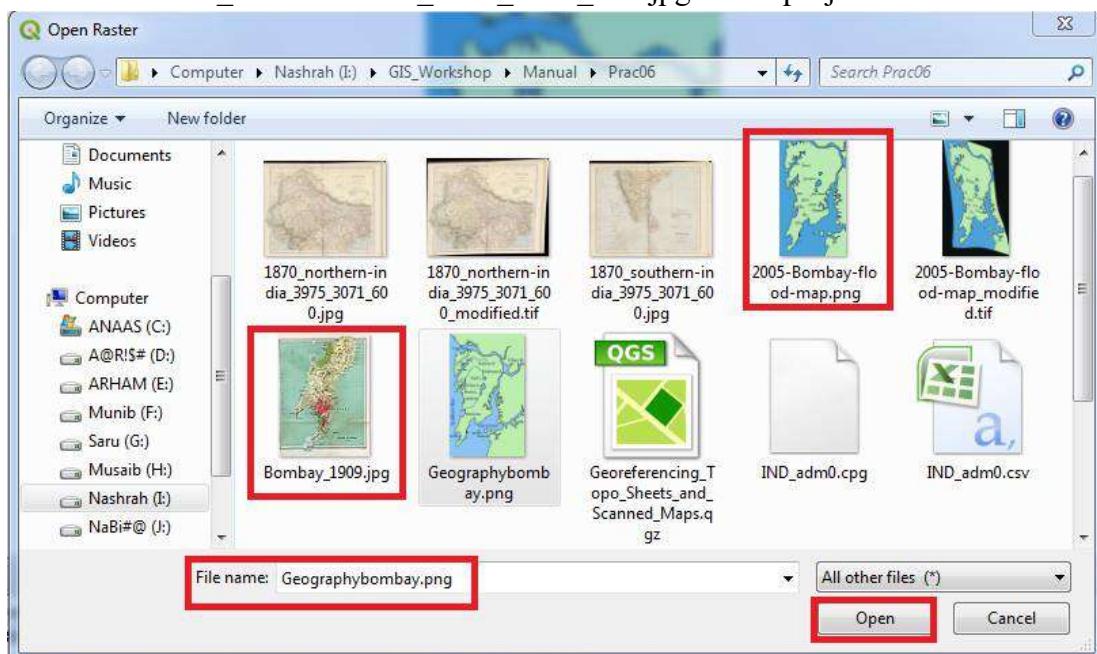
- A new Georeferencer window will open



- File → Open Raster



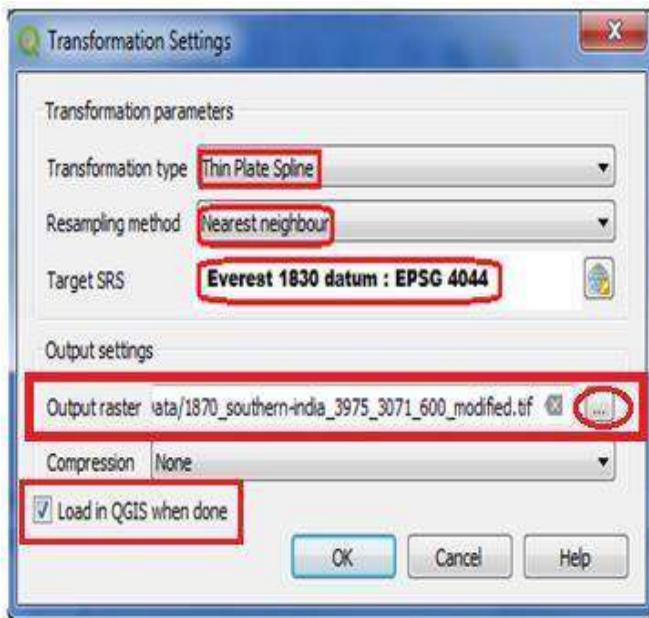
- Select file "1870_southern-india_3975_3071_600.jpg" from project data folder



- Go to Settings → Transformation Settings

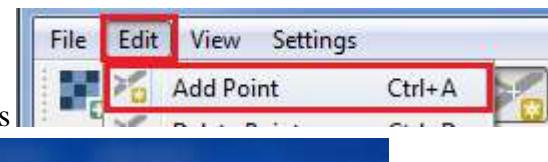


- In the Transformation Settings window



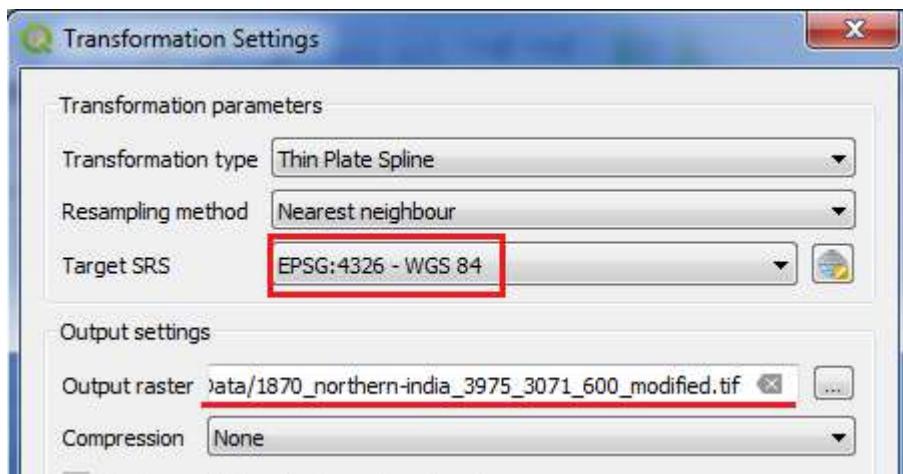
- Select Transformation type → Thin Plate Spline
- Re-sampling Method → Nearest Neighbour
- Target TRS → Everest 1830 datum: EPSG 4044
- Select Output Raster Name and Location
- Check the Load in QGIS When Done Option
- Press “OK”.

- In Georeferencer window Go to Edit → Add Points



Visible	ID	Source X	Source Y	Dest. X	Dest. Y	dX (pixels)	dY (pixels)	Residual (pixels)
<input checked="" type="checkbox"/>	0	313.914	-1438.08	72.7915	18.9415	4.93856e-10	5.25915e-10	7.21443e-10
<input checked="" type="checkbox"/>	1	925.421	-1482.13	72.8413	18.9178	5.16366e-10	5.32054e-10	7.41428e-10
<input checked="" type="checkbox"/>	2	490.111	-880.985	72.8177	19.0436	4.92491e-10	5.23755e-10	7.18935e-10
<input checked="" type="checkbox"/>	3	938.377	-844.709	72.8835	19.009	5.30804e-10	5.23301e-10	7.45383e-10

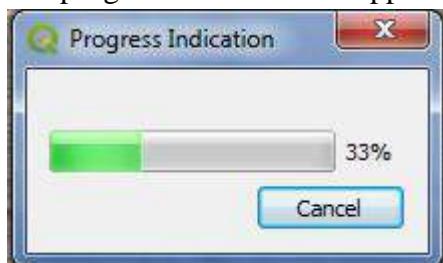
- Select the set of control points.
➤ Go to, Setting → transformation settings.



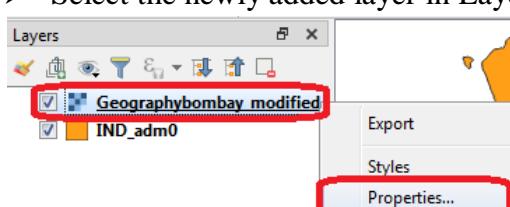
- Press “RUN”
- In Georeferencing window go to → File → Start Georeferencing



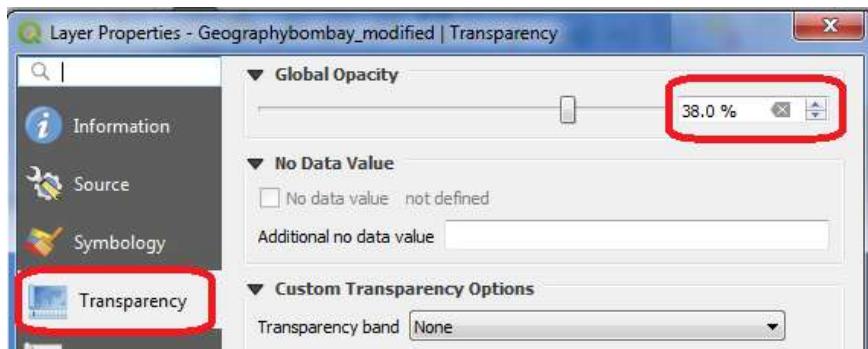
- The progress indicator will appear



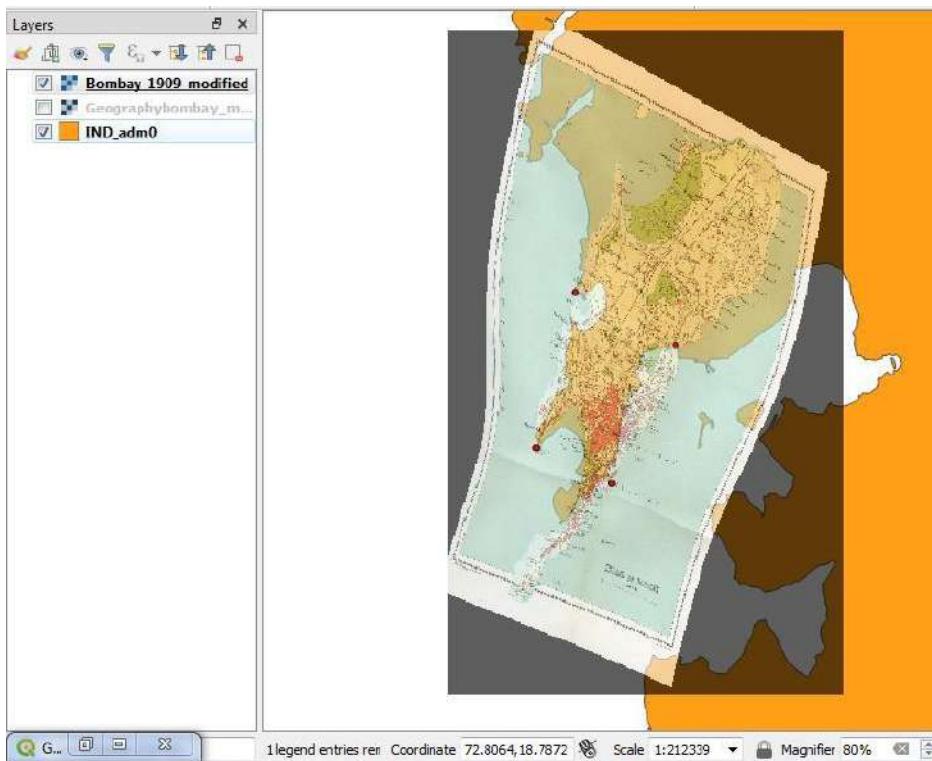
- The canvas area will now have the scanned map of Mumbai referenced with control points.
- Select the newly added layer in Layer Panel Right click and go to property.



- Set Transparency level of raster layer to appropriate level.



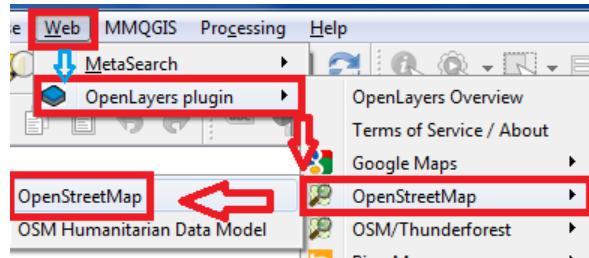
Output:



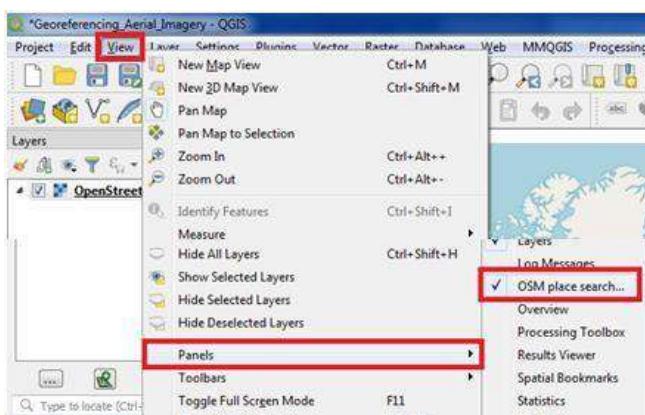
- The Scanned Image map coincides with the existing map.

A. Georeferencing Aerial Imagery

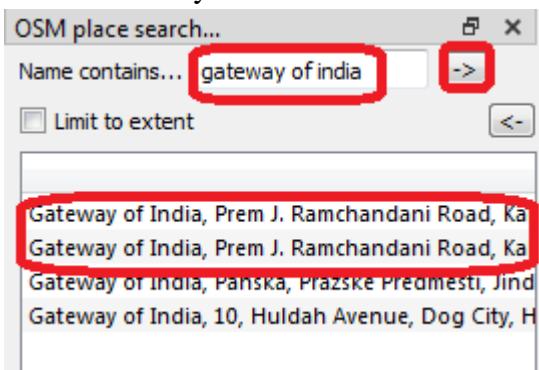
- Install plugin OpenStreetMap
- Go to Web Menu → OpenLayerPlugin → OpenStreetMap → OpenStreetMap



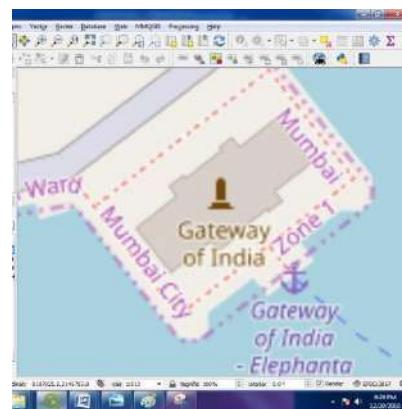
- Go to Project → Properties → Set CRS to EPSG 3857
- Go to View → Panels → select OSM Place search



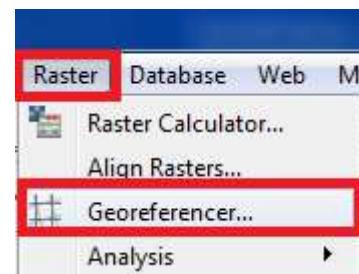
- The Gateway of India, Mumbai is located at 18.92°N 72.83°E
- Search Gateway of India in OSM Search Panel



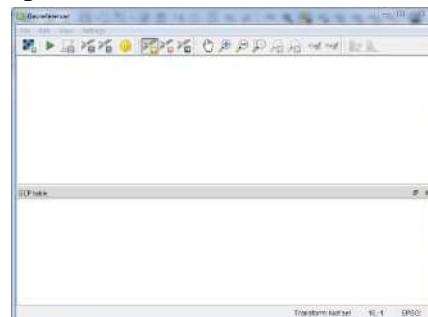
- Zoom in to appropriate level.
- The map will appear like this



- Go to Raster → Georeferencer



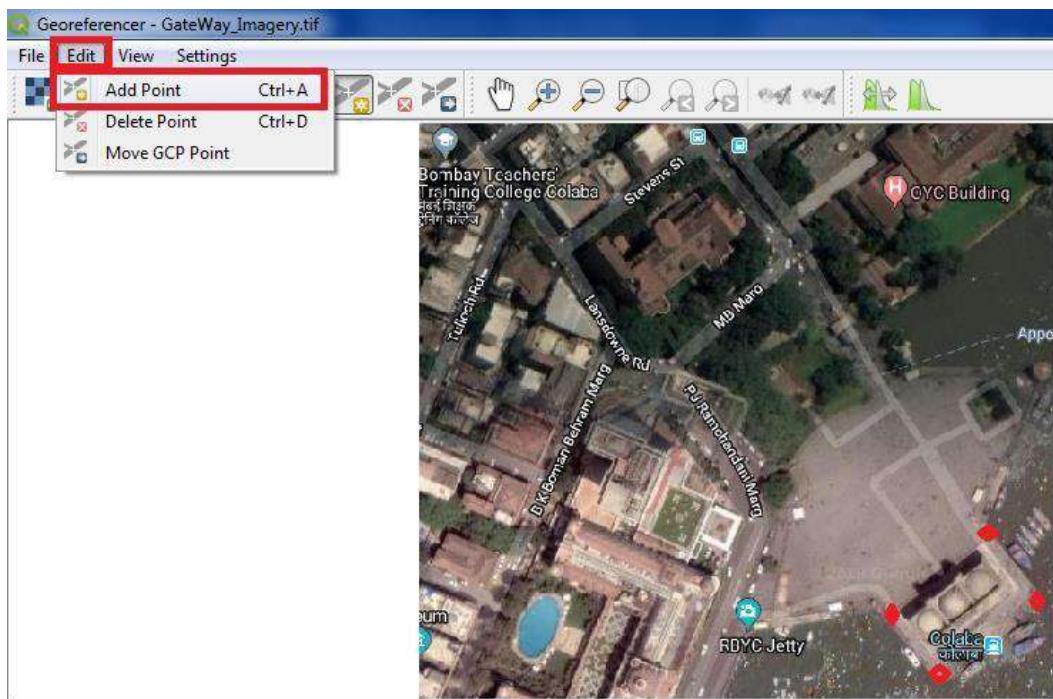
- A new Georeferencer window will open



- File → Open Raster

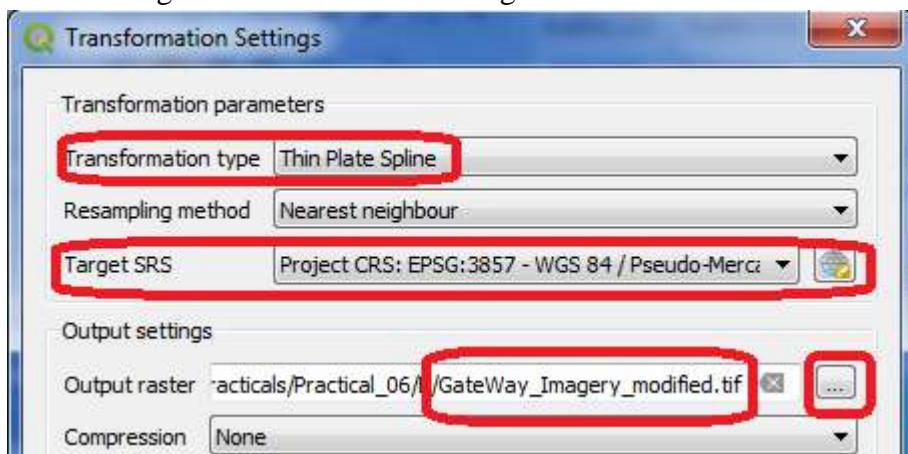


- Select file "Gateway_Imagery.tif" from project data folder

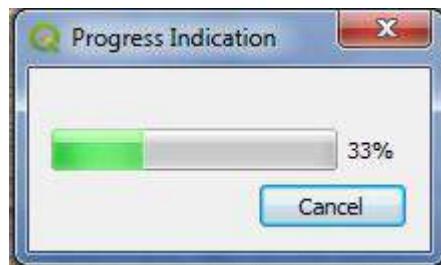


- Go to Edit → Add Point
- Select control points from map (Indicated in red color).

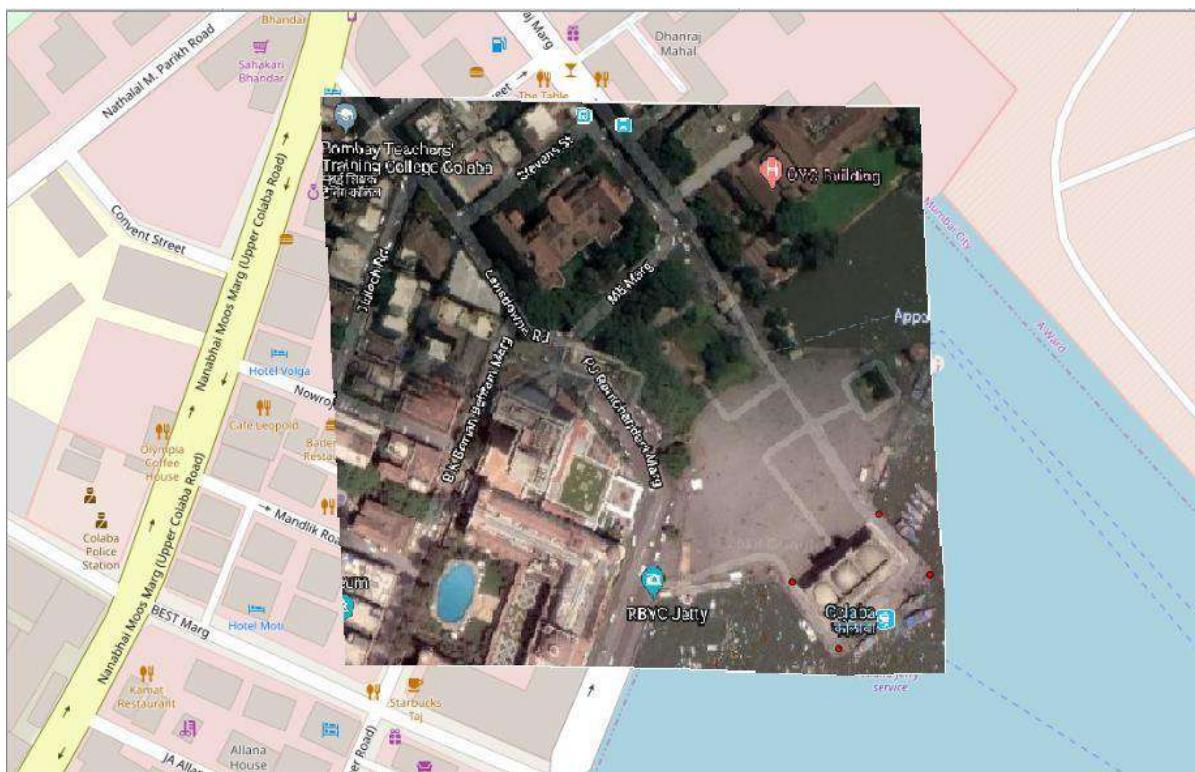
- Go to Setting → Transformation Setting



- Go to File → Start Georeferencing or Press the button in Georeferencing Window.
- The progress indicator will appear



- Observe that the aerial image of the Gateway of India is georeferenced on OSM in the map canvas.

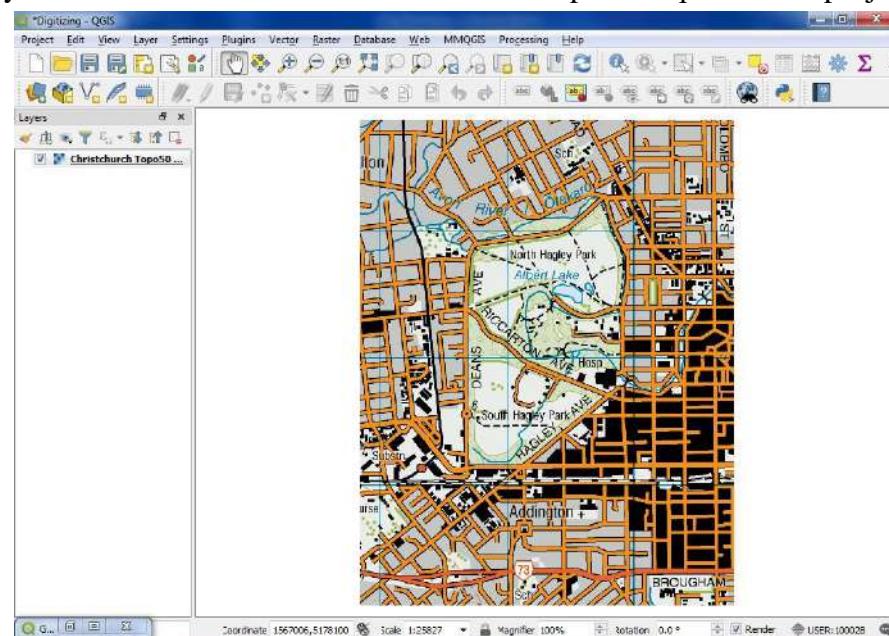


C. Digitizing Map Data

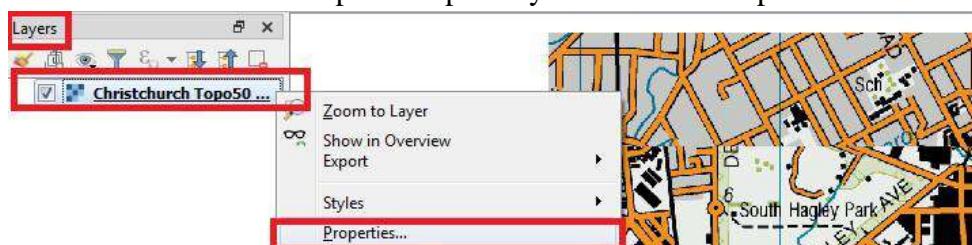
Spatialite is an open database format similar to ESRI's geodatabase format. Spatialite database is contained within a single file on your hard drive and can contain different types of spatial (point, line, polygon) as well as non-spatial layers. This makes it much easier to move it around instead of a bunch of shapefiles.

Digitizing Map Data

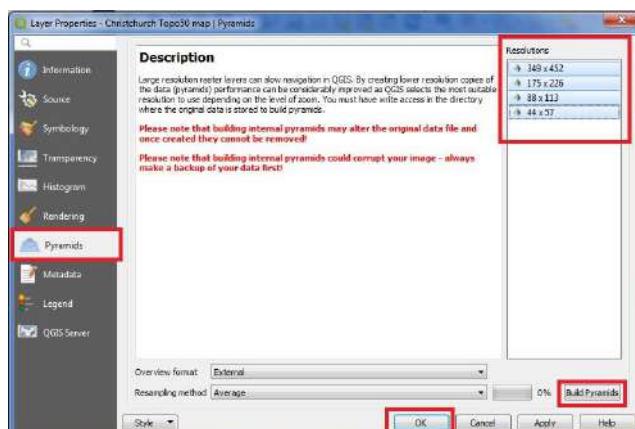
- Go to Layer → Add Raster → Select “Christchurch Topo50 map.tif” from project Folder.



- QGIS offers a simple solution to make raster load much faster by using **Image Pyramids**.
- Right-click the Christchurch Topo50 map.tif layer and select Properties.



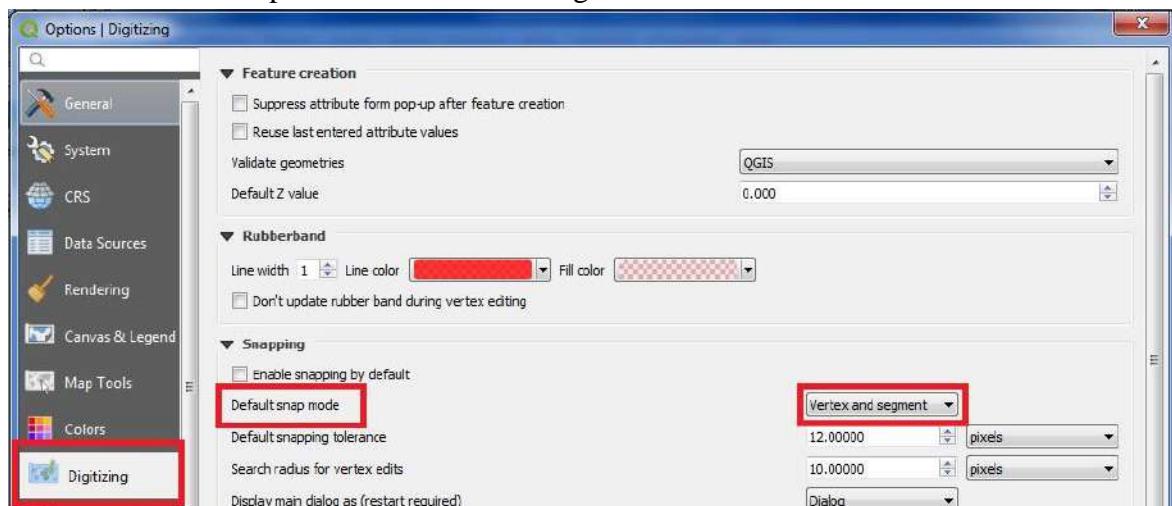
- Choose the Pyramids tab. Hold the Ctrl key and select all the resolutions offered in the Resolutions panel.



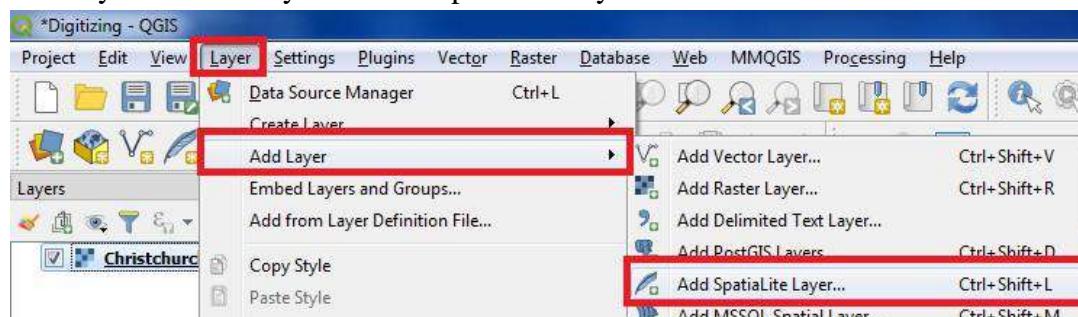
- Click Build pyramids. Then click OK.
- Go to Settings → Options.... Select the Digitizing tab in the Options dialog.



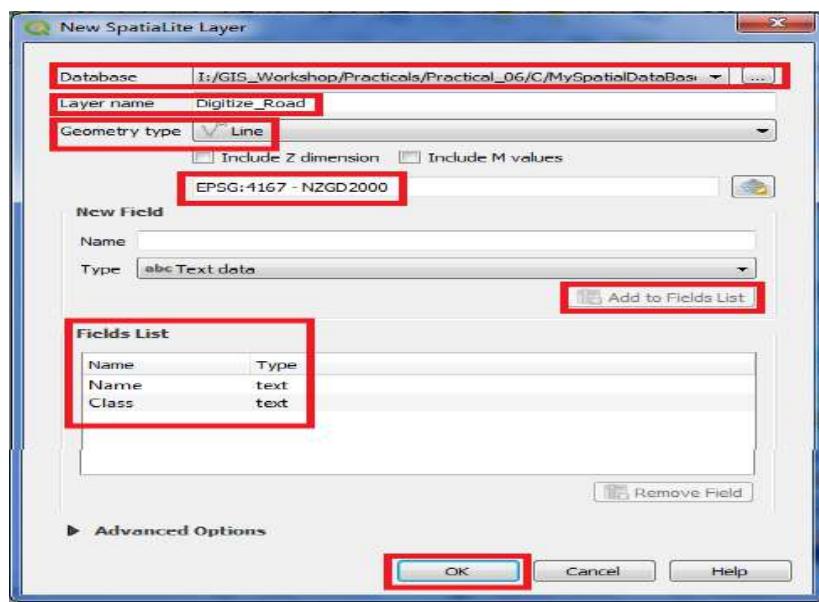
- Set the Default snap mode to vertex and segment.



- Press OK.
- Go to Layer → Add Layer → Add Spatialite Layer.



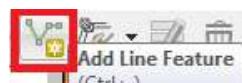
- Select the name and location for Spatial database eg:
“GIS_Workshop\Practicals\Practical_06\C\MySpatialDataBase.sqlite”.
- Name the Layer as “Digitized_Road”
- Set Geometry type as “Line”
- Set CRS EPSG:4167 – NZGD2000



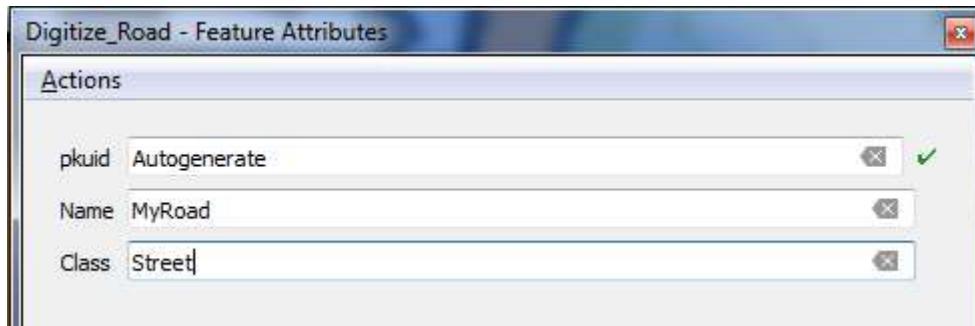
- Add “Name” and “Class” fields using “Add to Fields List”.



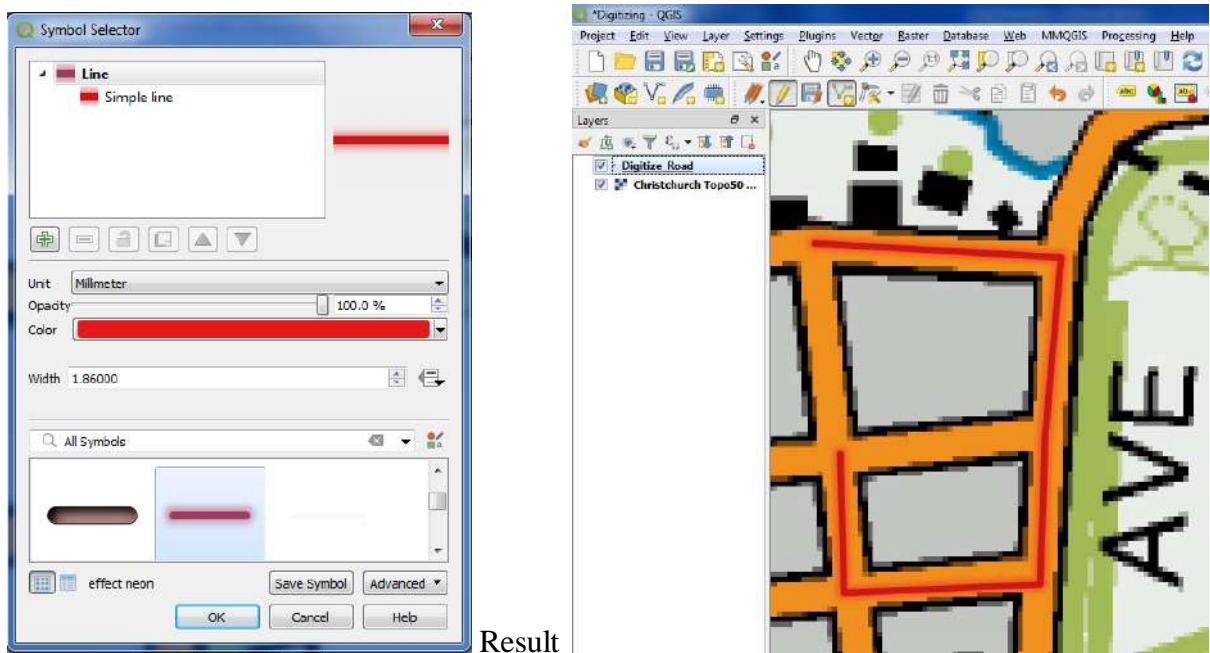
- Once the layer is loaded, click the Toggle Editing button to put the layer in editing mode.



- Click the Add feature button. Click on the map canvas to add a new vertex. Add new vertices along the road feature. Once you have digitized a road segment, right-click to end the feature.

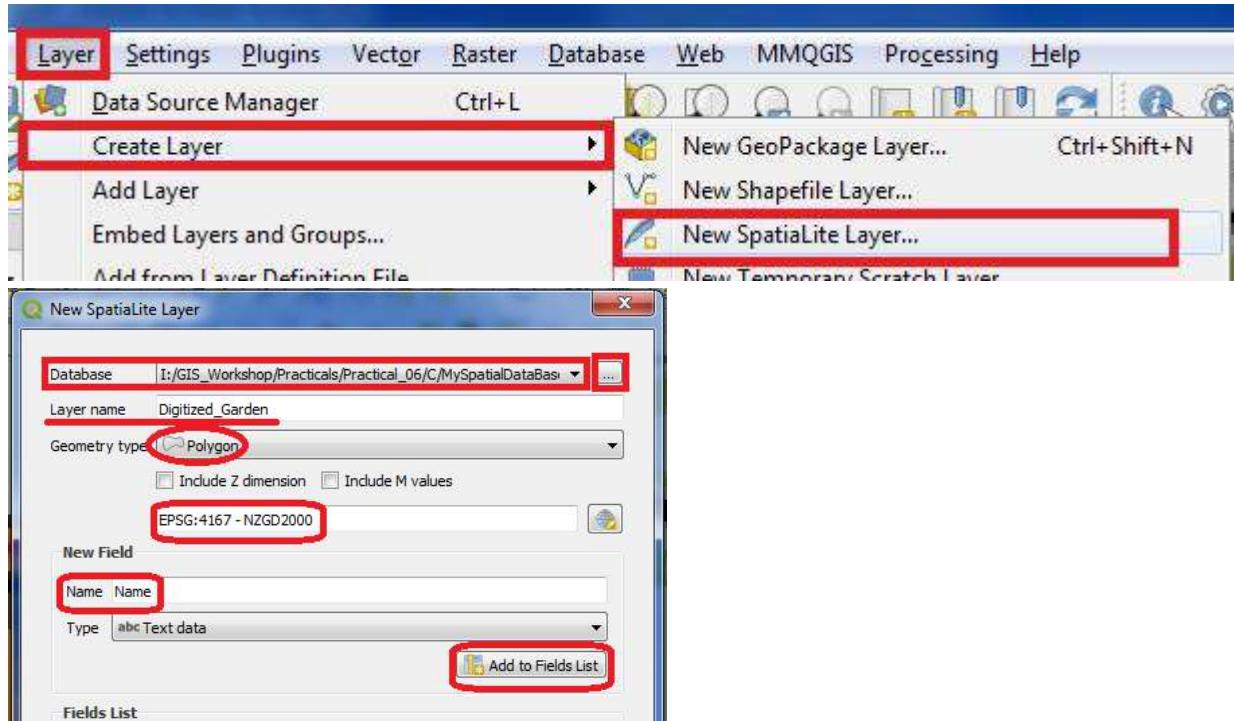


- On Layer Panel Right Click on Digitze_Road, Select the Style tab in the Layer Properties dialog.

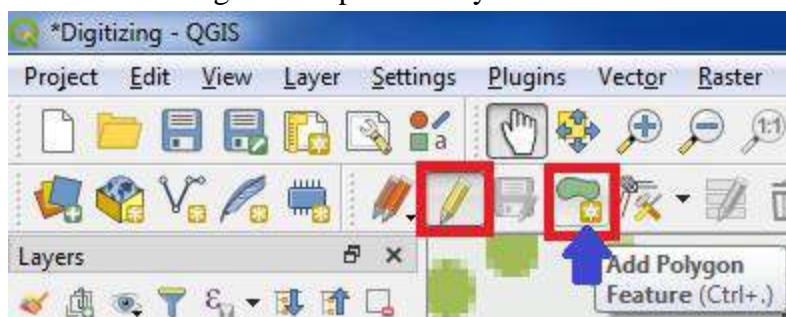


Result

- Select appropriate style to see the digitized road feature clearly.



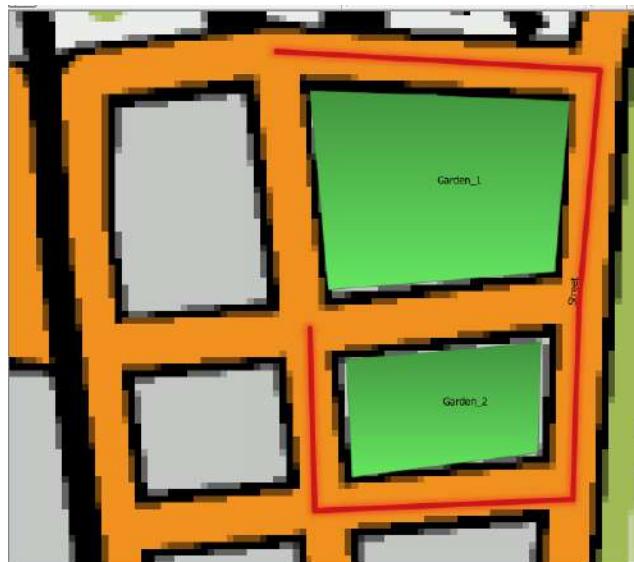
- After creating a new Spatialite layer



- Select Digitized_Garden layer in Layer Panel and click on Toggle Editing  button and then Add Polygon Feature  button on Tool bar.
- Add two gardens to the region by adding polygon.



- The Layer will appear on map canvas



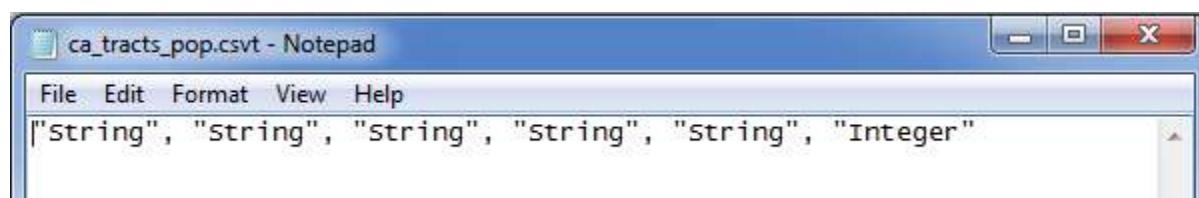
- Using the above procedure a point feature can also be digitized.
- The digitizing task is now complete. You can play with the styling and labeling options in layer properties to create a nice looking map from the data you created.

PRACTICAL - 7

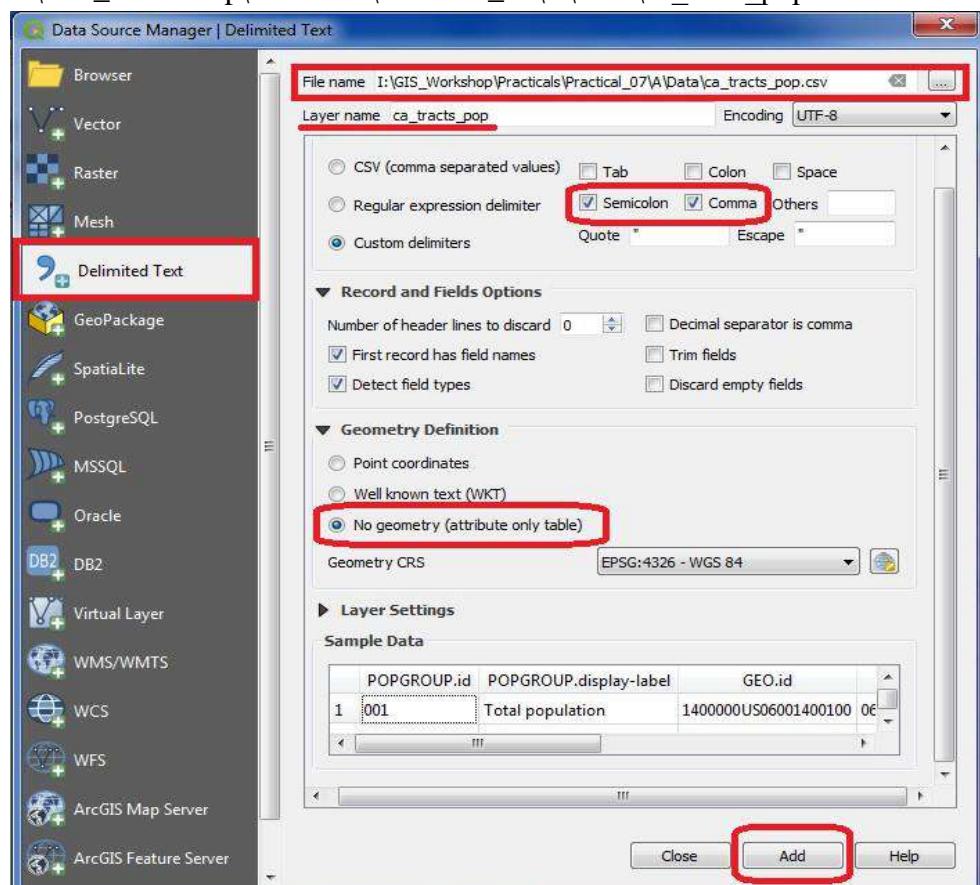
Managing Data Tables and Saptial data Sets:

a) Table joins

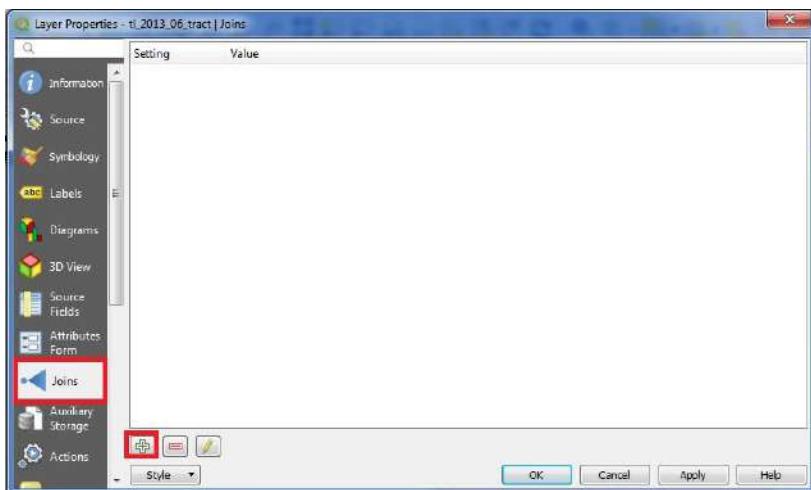
- Start a new project
- Go to Layer → Add Layer → Add new Vector Layer "I:\GIS_Workshop\Practicals\Practical_07\A\Data\tl_2013_06_tract.zip"
- We could import this csv file without any further action and it would be imported. But, the default type of each column would be a *String* (text). That is ok except for the *D001* field which contains numbers for the population. Having those imported as text would not allow us to run any mathematical operations on this column. To tell QGIS to import the field as a number, we need to create a *sidecar* file with a *.csvt* extension.



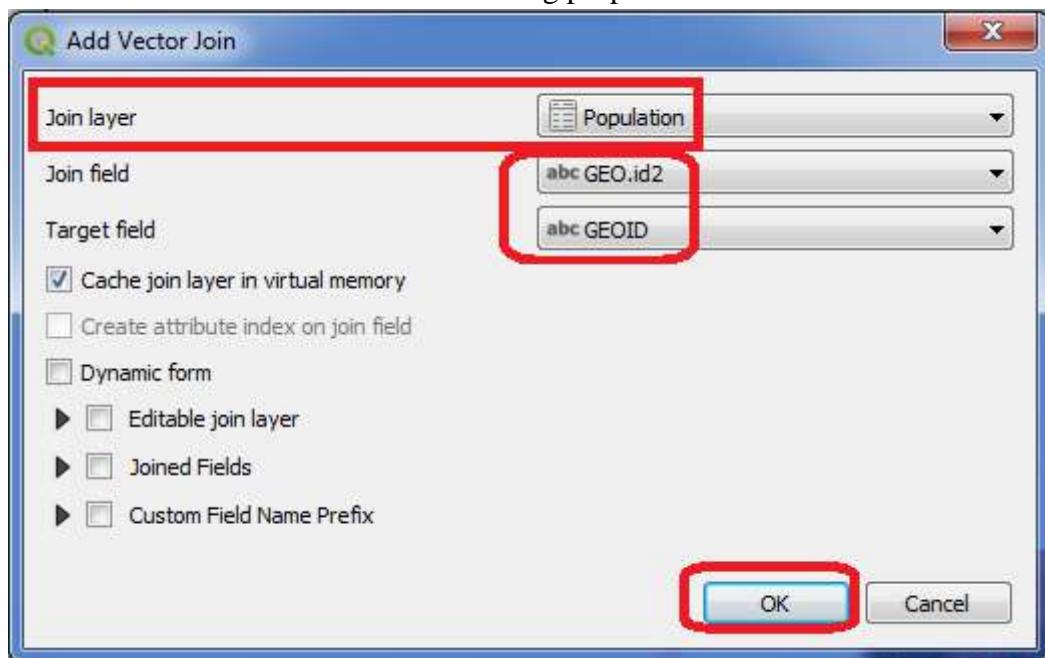
- This file will have only 1 row specifying data types for each column. Save this file as *ca_tracts_pop.csvt* in the same directory as the original *.csv* file.
- Go to Layer → Add Layer → Add Delimited Text Layer
And add I:\GIS_Workshop\Practicals\Practical_07\A\Data\ca_tracts_pop.csvt"



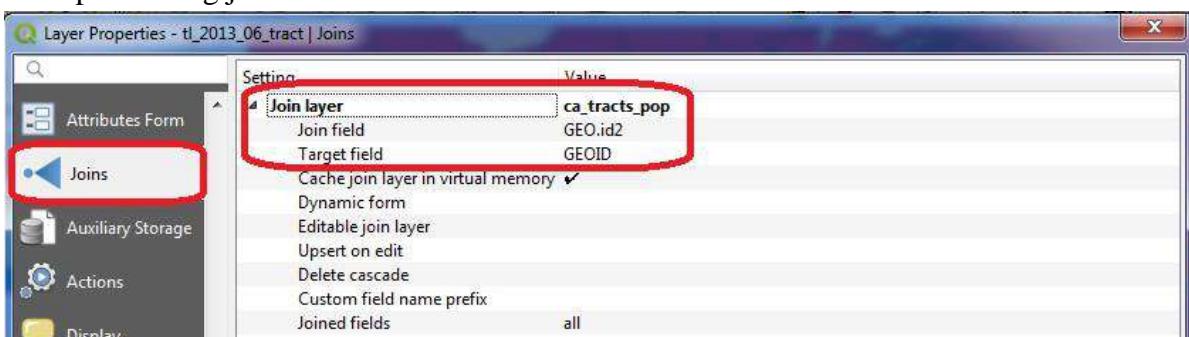
- In the layer panel, Right click on "tl_2013_06_tract", layer and select Properties



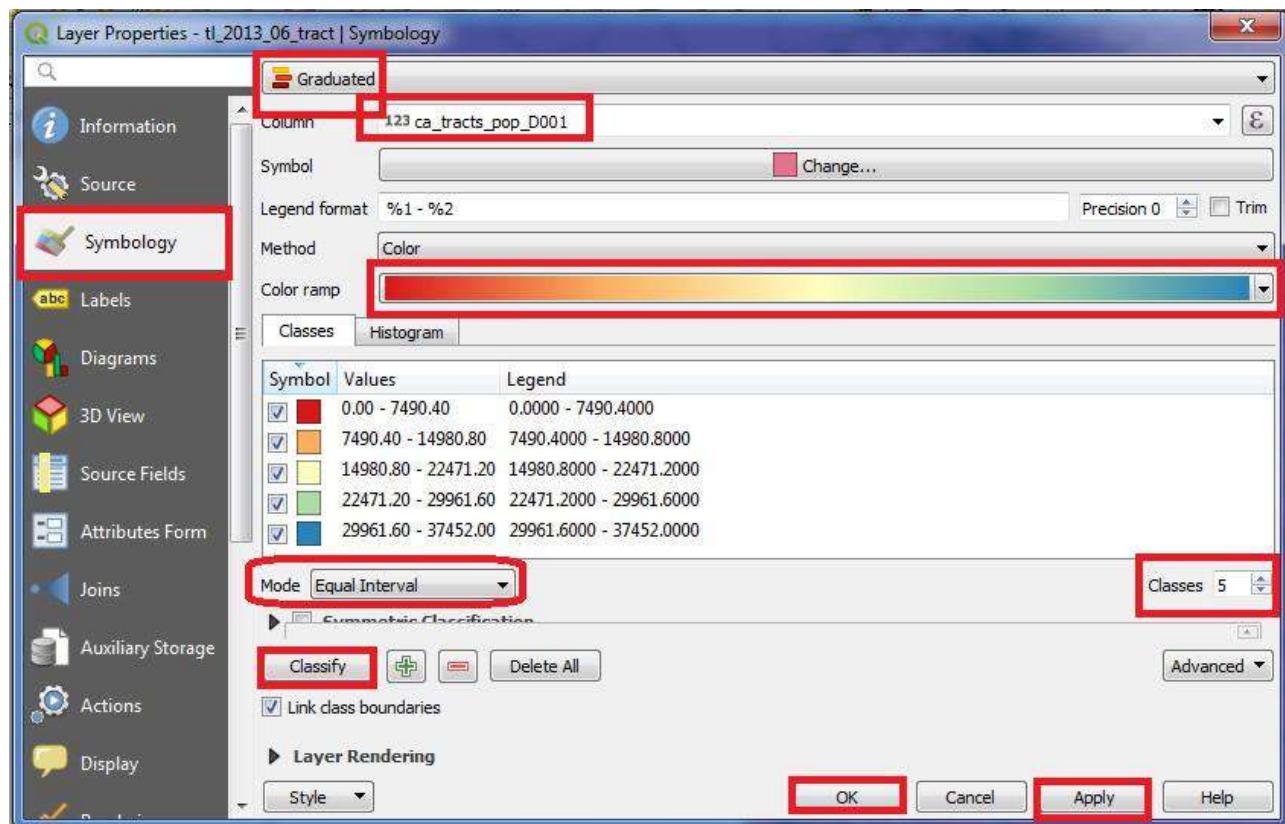
- Select the option in Properties, and click on button to add new table join.
- In the Add Vector Join window set the following properties and click OK.



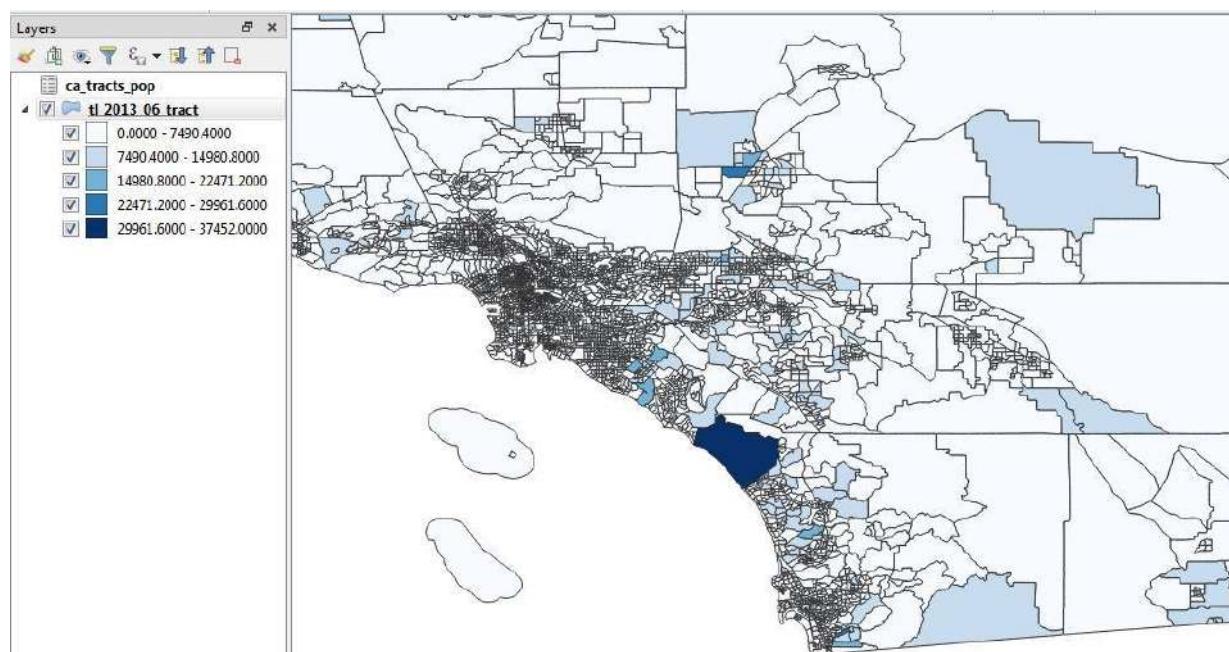
- After performing join



- For more clear output, select "tl_2013_06_tact" from Layer Panel, right click and select properties. Go to Symbology and set the following properties.

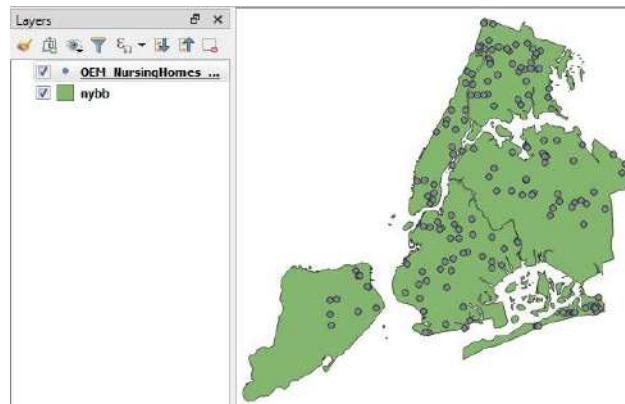


- A detailed and accurate population map of California can be seen as the result. Same technique can be used to create maps based on variety of census data.



b) spatial joins

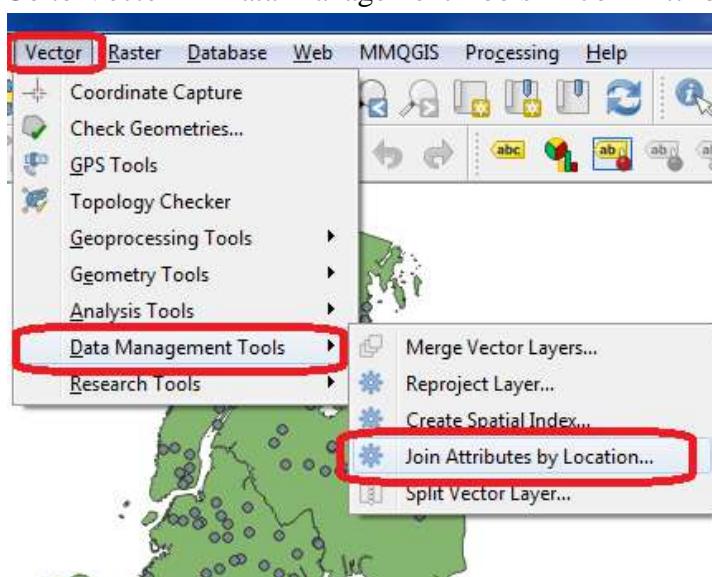
- Go to Layer → Add Layer → Add Vector Layer → Select “I:\GIS_Workshop\Practicals\Practical_07\B\Data\nybb_12c\nybb_13c_av\nybb.shp” and “I:\GIS_Workshop\Practicals\Practical_07\B\Data\OEM_NursingHomes_001\OEM_NursingHomes_001.shp”, from data folder.

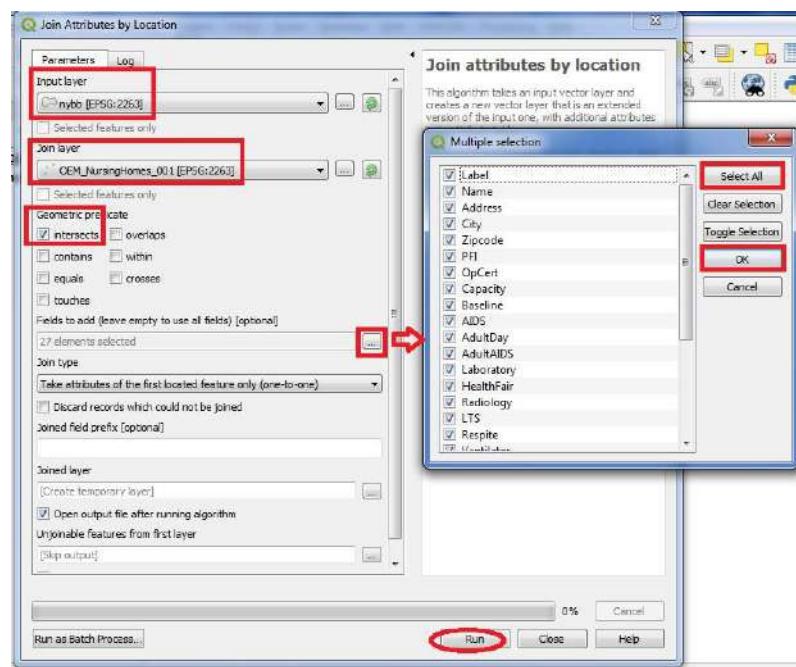


- Go to attribute table and observe the data.
- Table before performing Join

OEM_NursingHomes_001 :: Features Total: 177, Filtered: 177, Selected: 0						
	Address	City	Zipcode	PFI	OpCert	Capacity
1	66 VAN CORTL...	BRONX	10463	1217.000000000000	7000307.000000...	264
2	2505 GRAND AVE	BRONX	10468	1244.000000000000	7000337.000000...	46
3	2401 LACONIA ...	BRONX	10469	1245.000000000000	7000338.000000...	200
4	3200 BAYCHES...	BRONX	10475	1242.000000000000	7000356.000000...	236
5	700 WHITE PLA...	BRONX	10473	856.000000000000	7000361.000000...	240
6	3400 CANNON ...	BRONX	10463	1234.000000000000	7000374.000000...	400
7	612 ALLERTON ...	BRONX	10467	1218.000000000000	7000308.000000...	520
8	666 KAPPOCK S...	BRONX	10463	1233.000000000000	7000385.000000...	200
9	3518 BAINBRID...	BRONX	10467	1227.000000000000	7000319.000000...	200
10	801 CO-OP CIT...	BRONX	10475	1260.000000000000	7000389.000000...	480
11	2266 CROPSEY ...	BROOKLYN	11214	1364.000000000000	7001303.000000...	271
12	2865 BRIGHTO...	BROOKLYN	11235	1399.000000000000	7001342.000000...	320

- Go to Vector → Data Management Tools → Join Attributes by Location

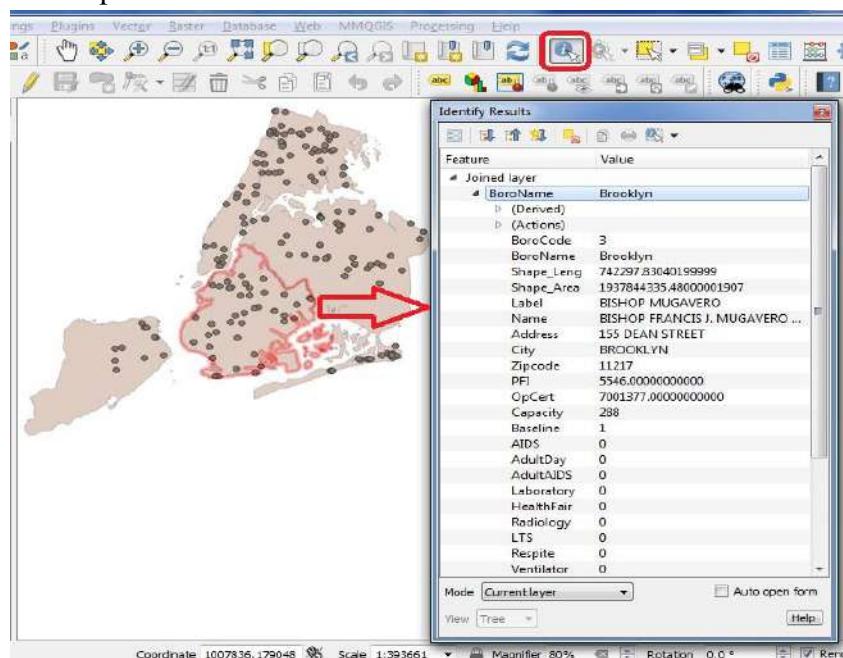




- Attribute table after join

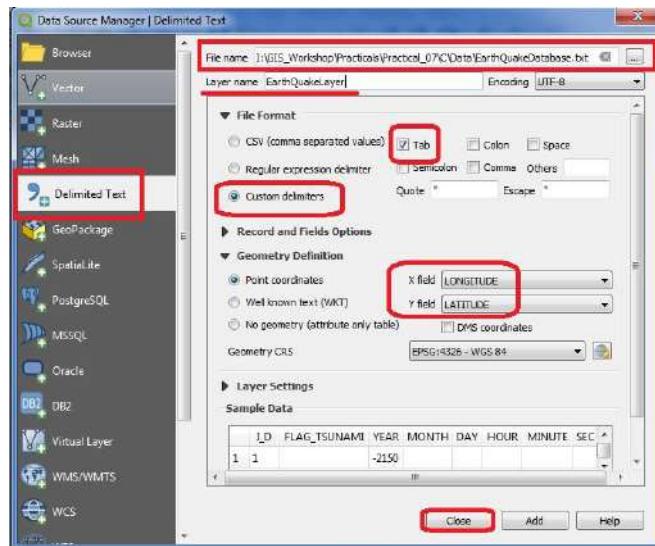
City	Zipcode	PFI	OpCert	Capacity
ASTORIA	11102	6384.000000000000	7003405.000000...	280
BROOKLYN	11217	5546.000000000000	7001377.000000...	288
BRONX	10472	1251.000000000000	7000381.000000...	200
STATEN ISLAND	10304	1755.000000000000	7004310.000000...	300
NEW YORK	10003	4807.000000000000	7002351.000000...	28

- Use the Identify Feature  Button to select a region to view join data on map Layer.
- Output

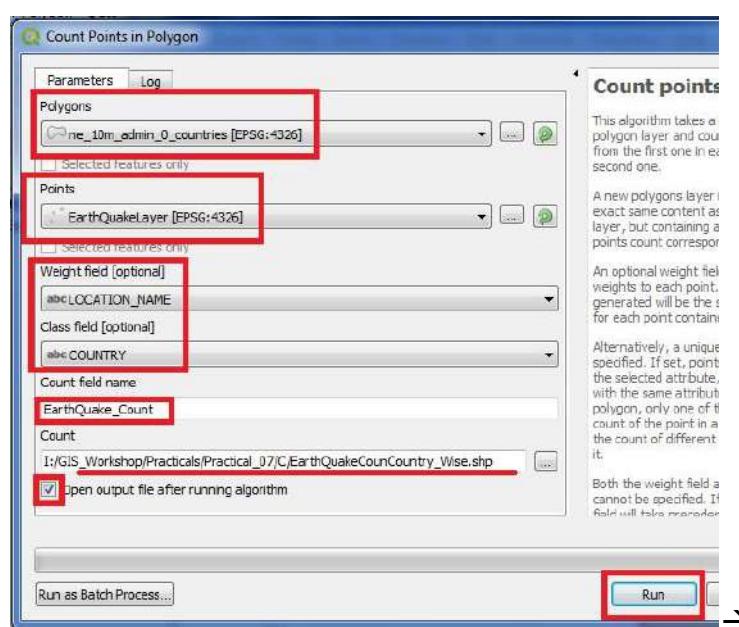
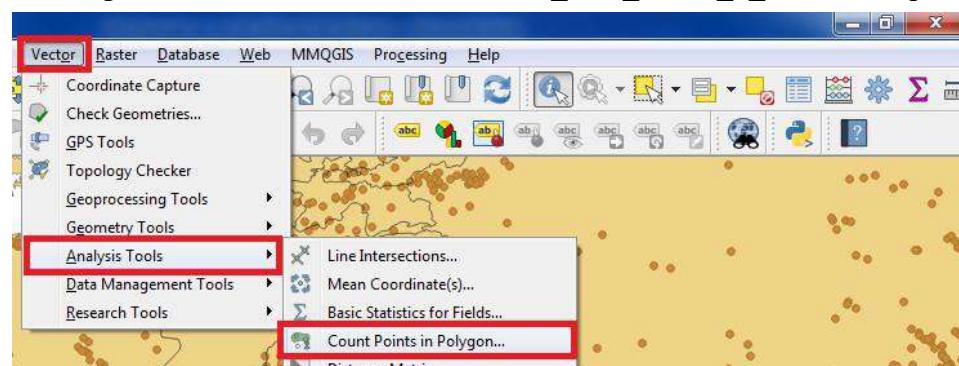


c) Points in polygon analysis

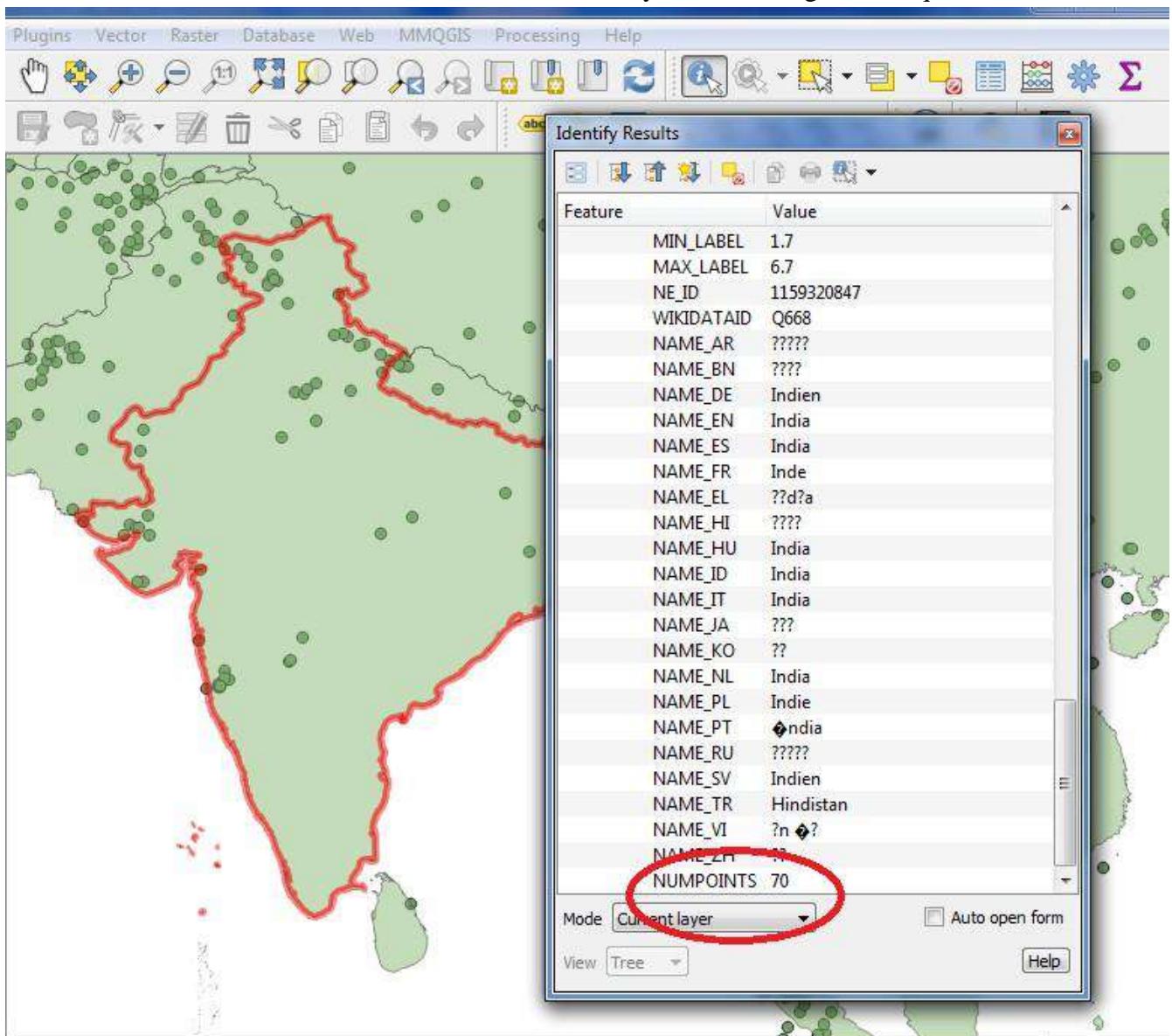
- Go to Layer → Add Layer → Add Delimited Text Layer
Select “EarthQuakeDatabase.txt”



- Go to Layer → Add Layer → Add Delimited Text Layer
“I:\GIS_Workshop\Practicals\Practical_07\C\Data\ne_10m_admin_0_countries.zip”



- Use the select Feature  button to check country wise counting of Earthquakes.



- Also a new column is added to attribute table “NumPoints” indicating number of earth quake points in each country.

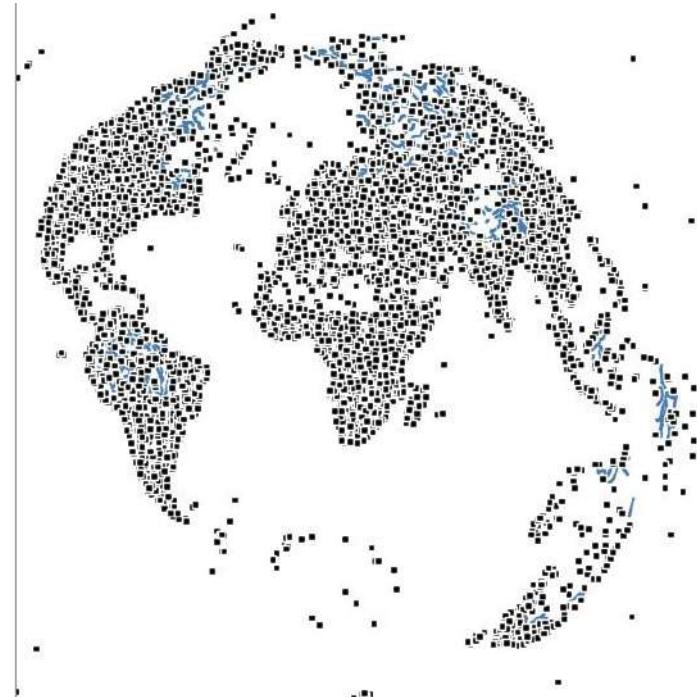
NUMPOINTS
0
64
53
13
0
9
0
10
5
57
0
12
4
0
2
5
8
152
0

d) Performing spatial queries

- Go to Layer → Add Layer → Add Vector Layer and load “\GIS_Workshop\Practicals\Practical_07\D\Data\ne_10m_populated_places_simple\ne_10m_populated_places_simple.shp” and “I:\GIS_Workshop\Practicals\Practical_07\D\Data\ne_10m_rivers_lake_centerlines\ne_10m_rivers_lake_centerlines.shp” from project data folder.



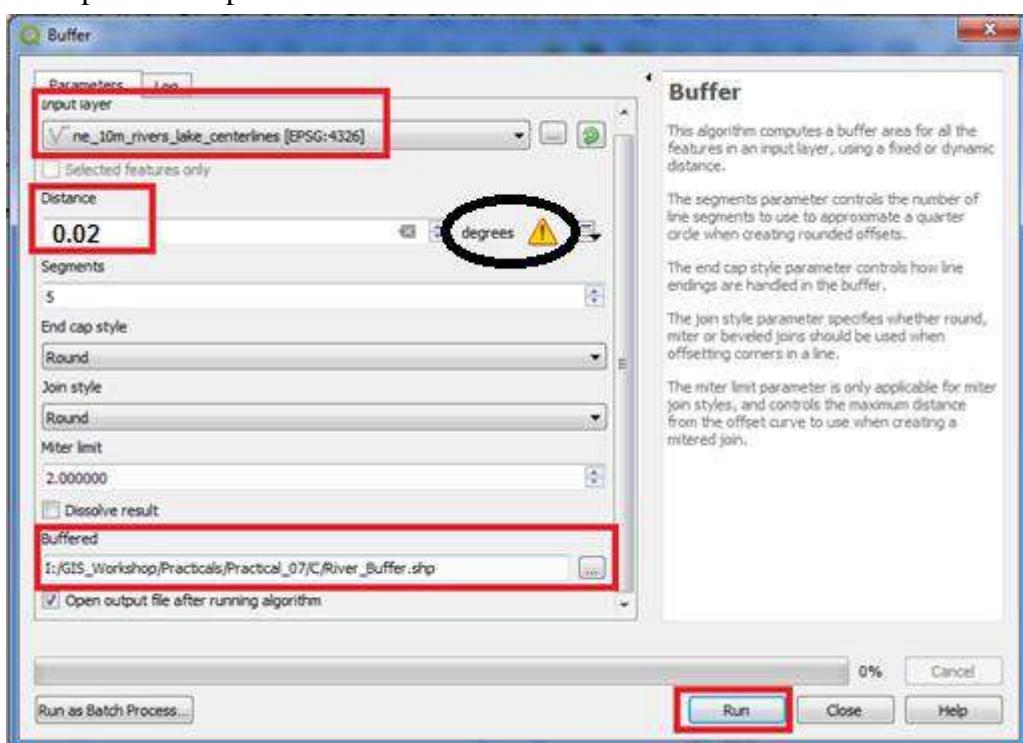
- Open project Properties → Set CRS “World_Azimuthal_Equidistant EPSG 54032”. The map will be re-projected as



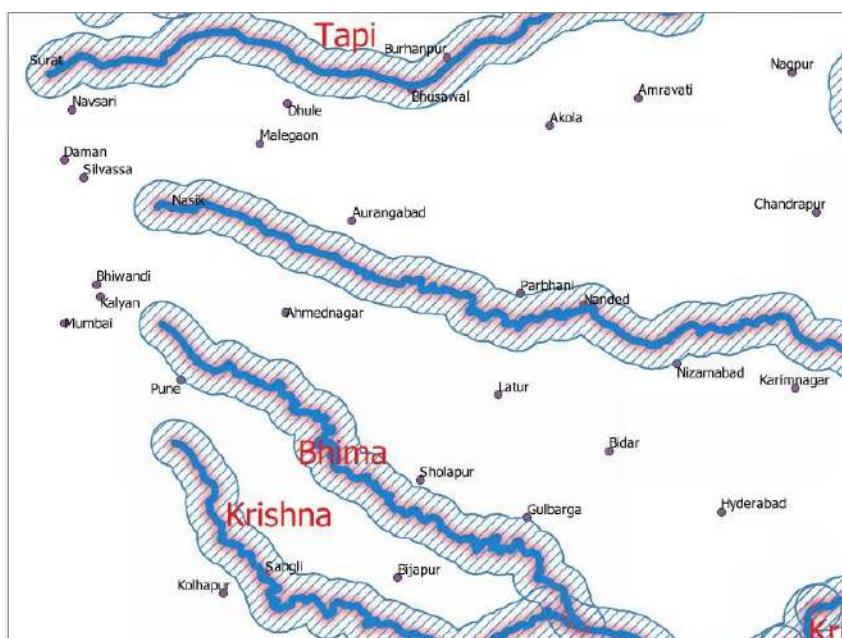
- Go to Vector → Geoprocessing Tool → Buffer



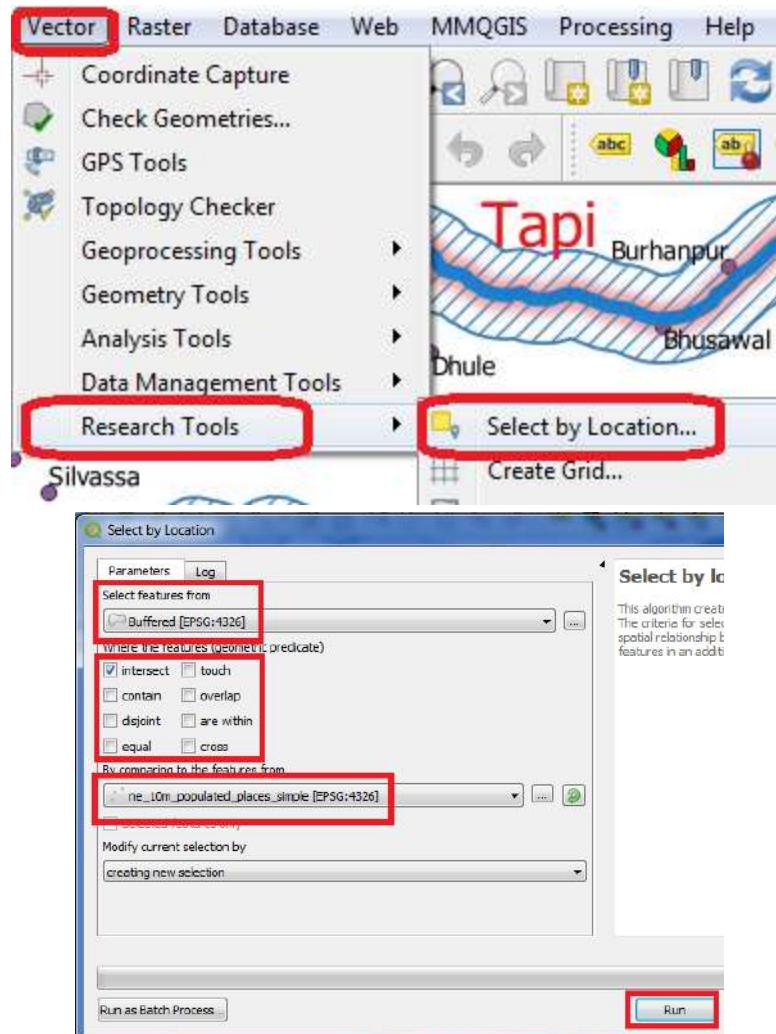
- Repeat the step to create River Buffer



- Create a buffer for River



- Go to Vector → Research Tool → Select By Location



- This will highlight only those rivers containing a populated place within 2 KM

