PRACTICAL - 1

B. AIM : - Creating and Managing Vector Data:

a) Adding vector layer

b) Setting properties

c) Vector Layer Formatting

Procedure:

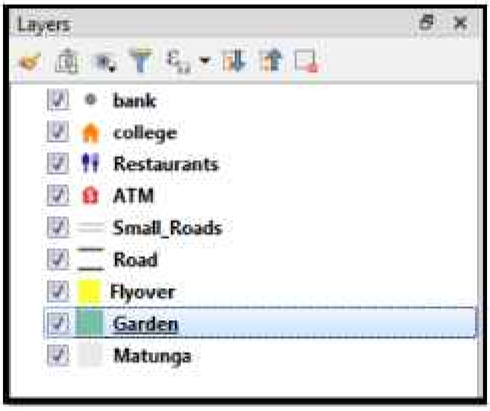
a. Adding vector layers (Polygon, Line, Points)

➢ Polygon layers (We have taken **2** layers Matunga, Garden)

➢ Line layers (We have taken **3** layers Small_Roads, Road, Flyover)

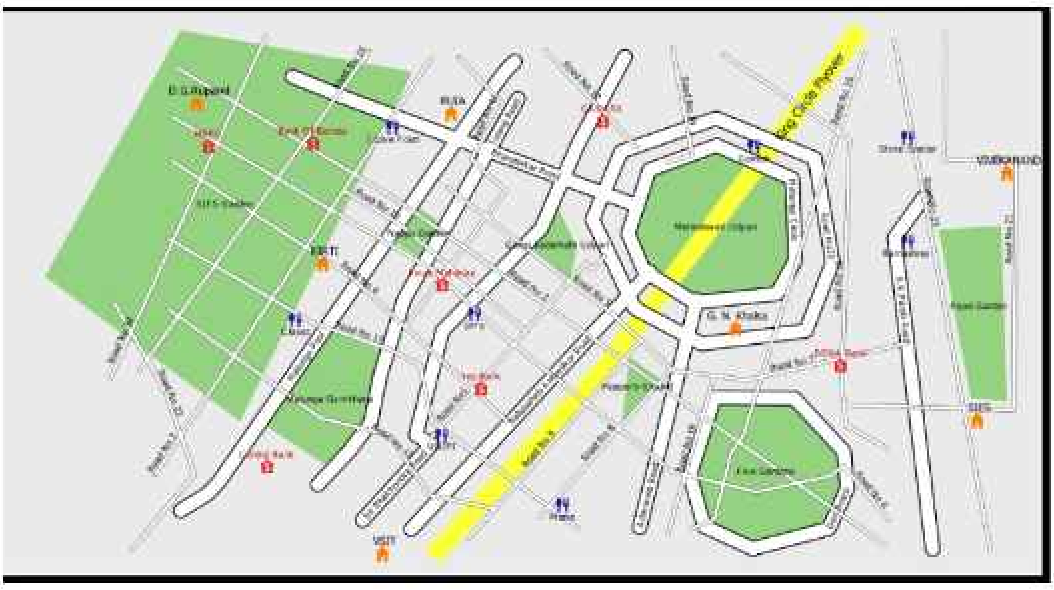
➢Point layers (We have taken **4** layers bank,college,Restaurants,ATM)

b. Setting properties (Labeling, Symbolism)



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

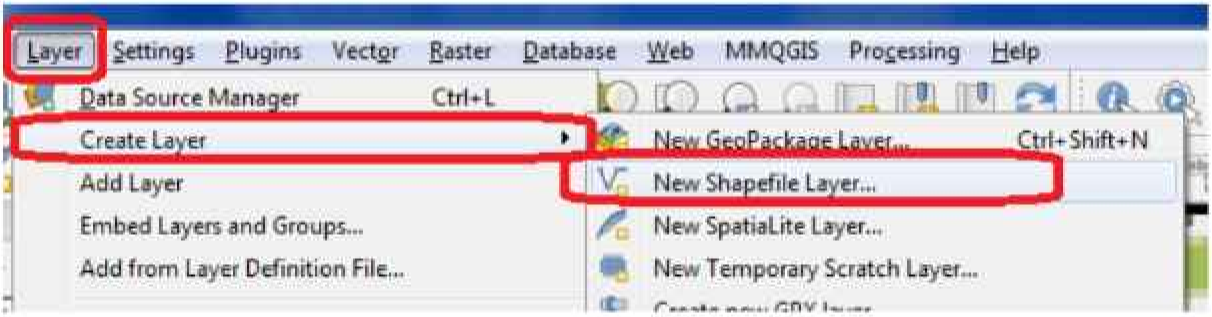
a)



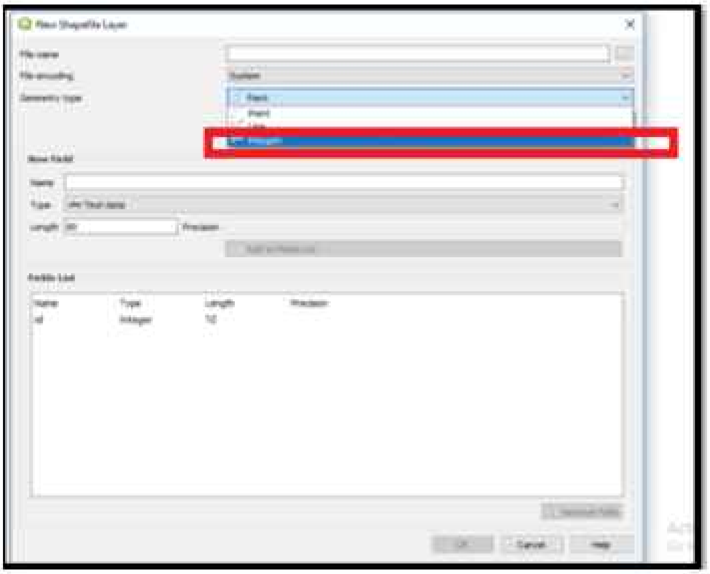
Creating Polygon vector layer

➢Select **Project→New**

➢Select **Layer→Create Layer→New Shapefile Layer**

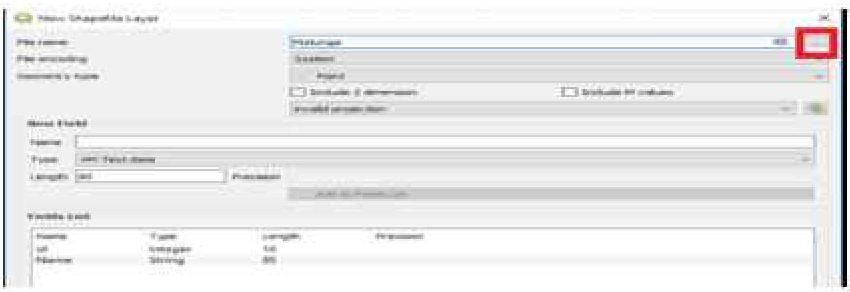


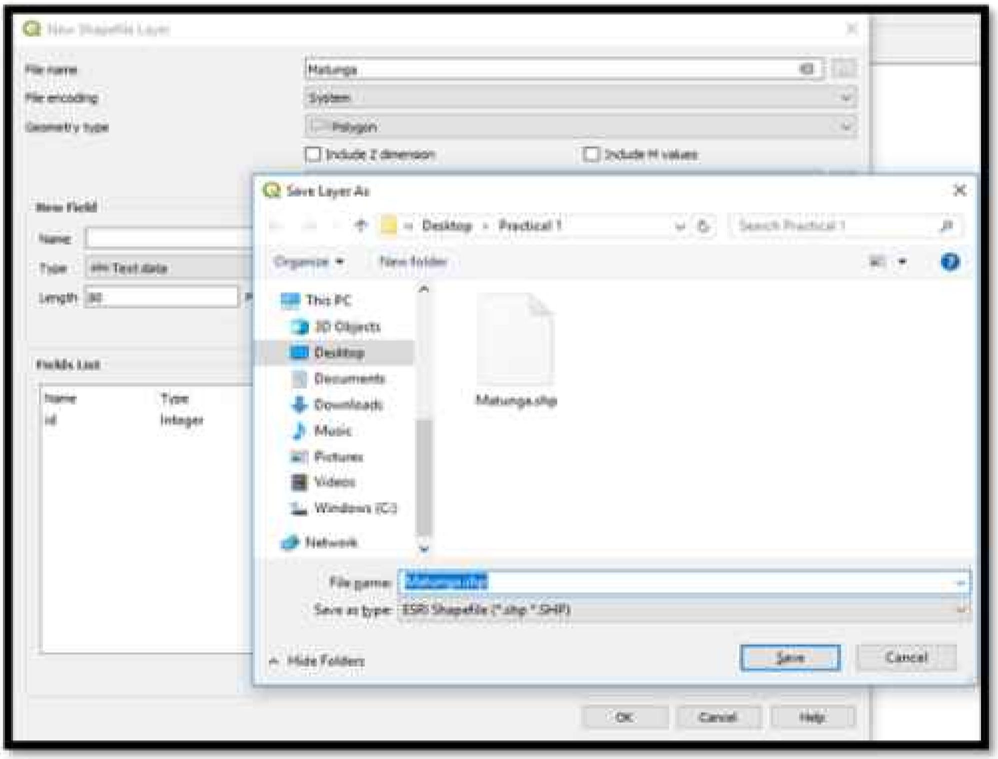
➢Following dialog box will appear on the screen. Select Polygon option from Geometry type.



➢ 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.

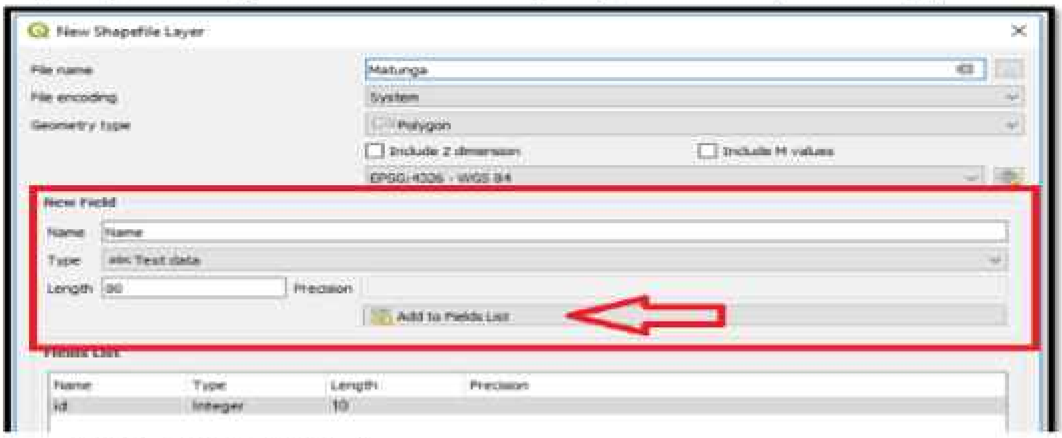




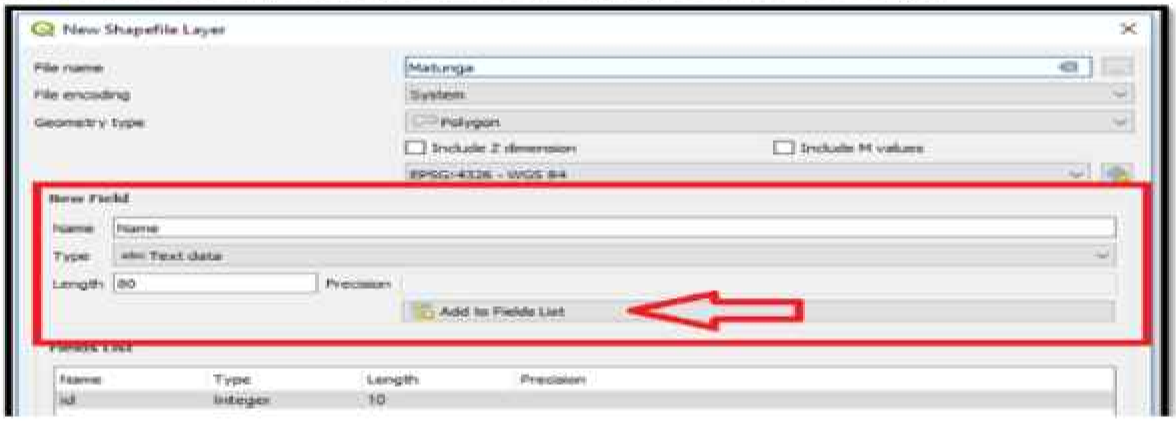
- **Field Panel**
    - Add the **Attribute** you want to show. (**Column Name** for Table)

    b. Specify **Type (DataType:**Text Data/Decimal Data/Whole Number/Date) of Attribute

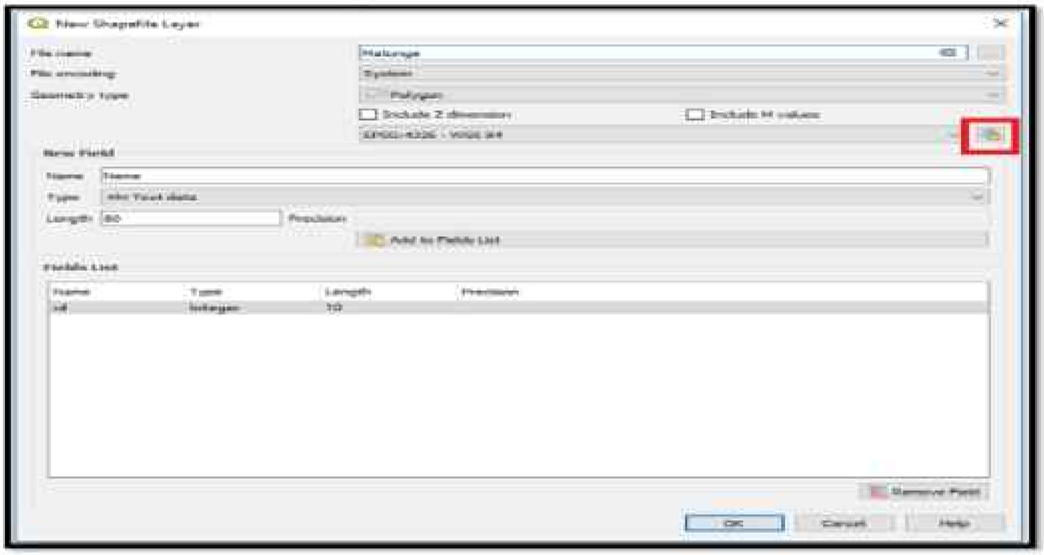
    c. Specify the **Length** of the Attribute. Specify **Precision** (If **Data Type** is **Decimal**)



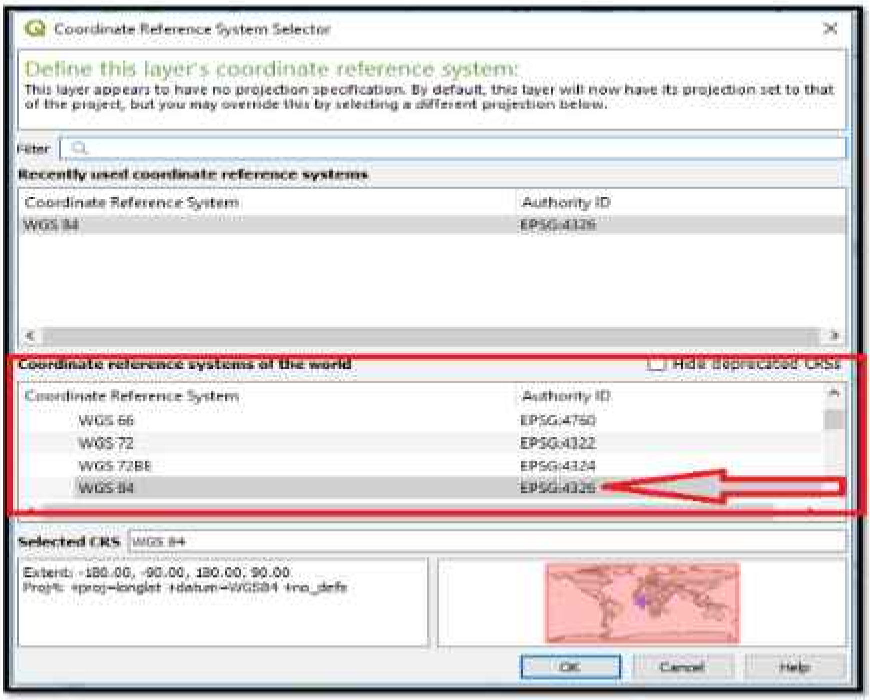
- Click on **Add to Field List** Button.
- You can add as many **fields (Column Name)** as you want for the layer.



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

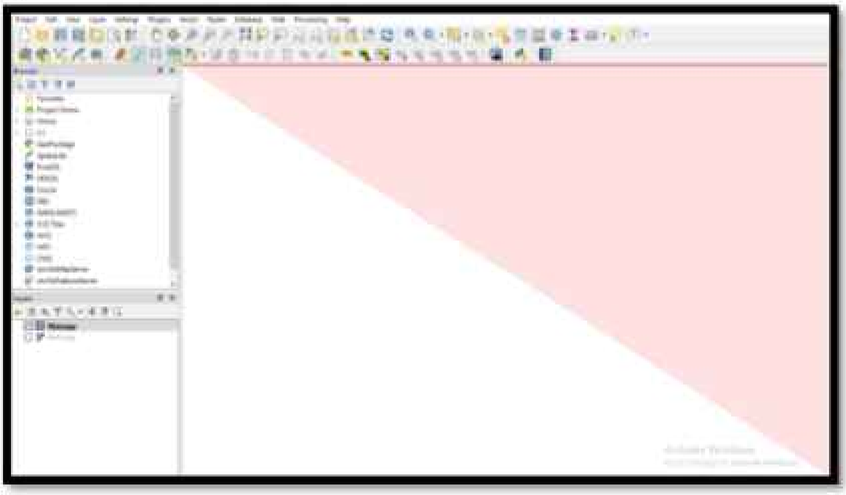


- The CRS dialog box will appear on screen. Click on the WGS84 option and it will be selected as follows. click on **OK**

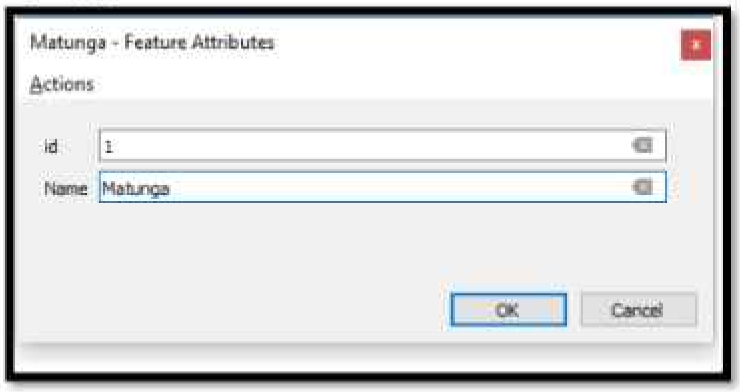


- Follow the steps to plot **Polygon features.**
- Select the **Polygon Feature(** In our case it is **Matunga** for **background)** from layer panel

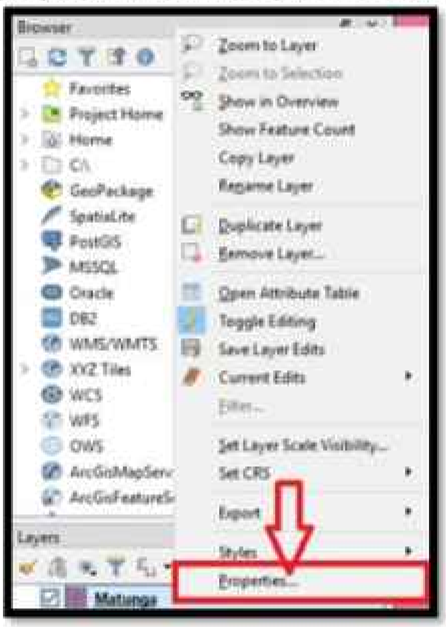
- Click **Toggle Editing Button**  → Click on **Add Polygon**  →Now place the cursor at the location where you want to place the polygon. for **polygon** layer **minimum 3 points** should be selected



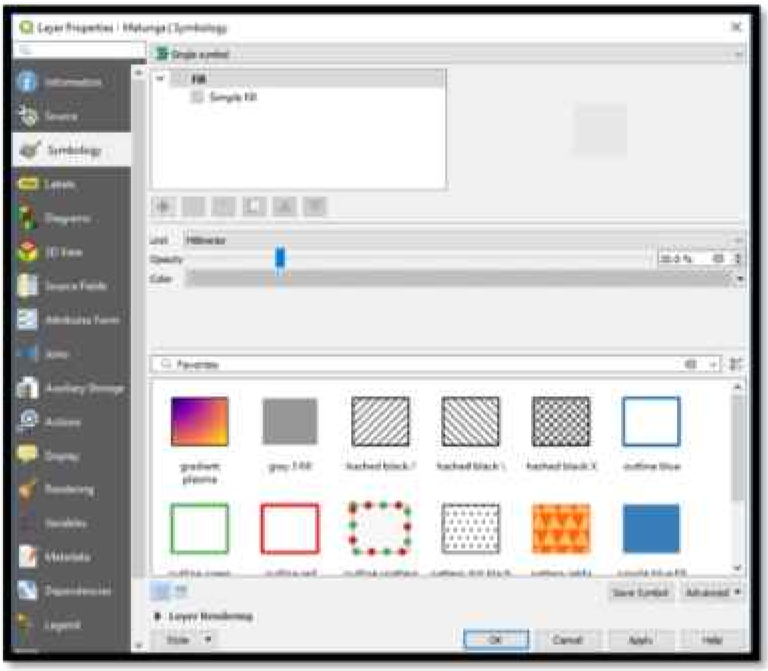
- Save the newly added polygon as follows.



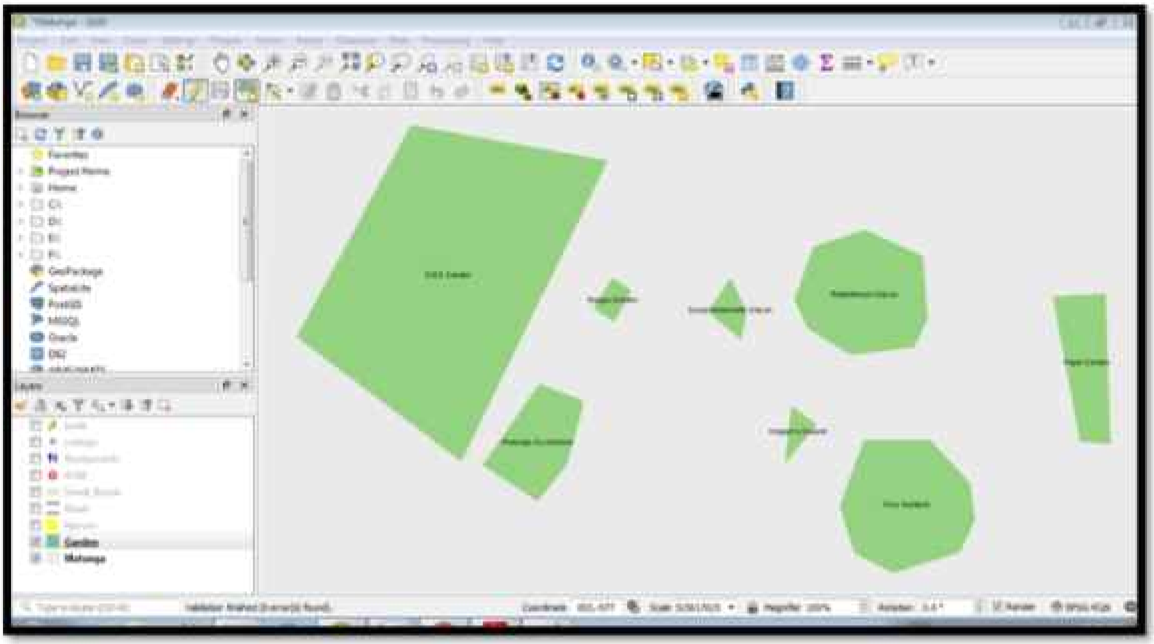
- Set **style** for polygon by using property window(**Right click** on Matunga Layer)



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



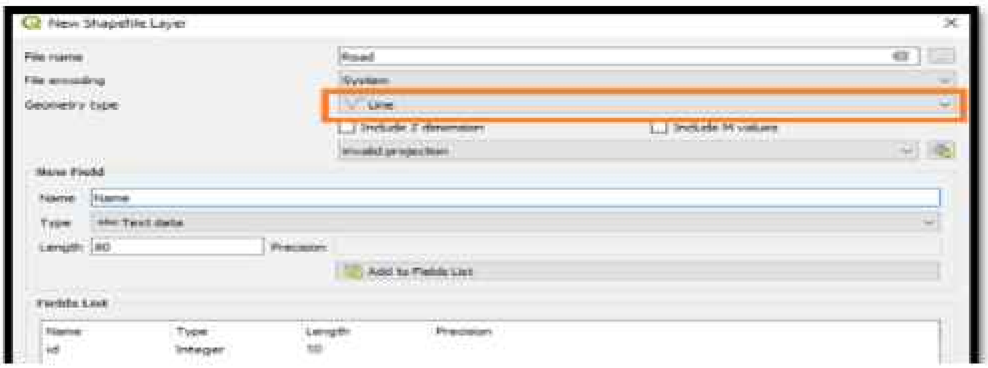
➤ Same way we can add one more polygon layer for Gardens.



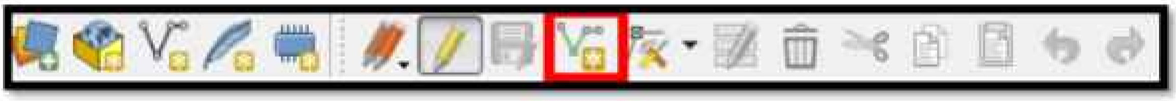
b) Creating Line vector layer

➤ Repeat the same steps as we have done for polygon layer.

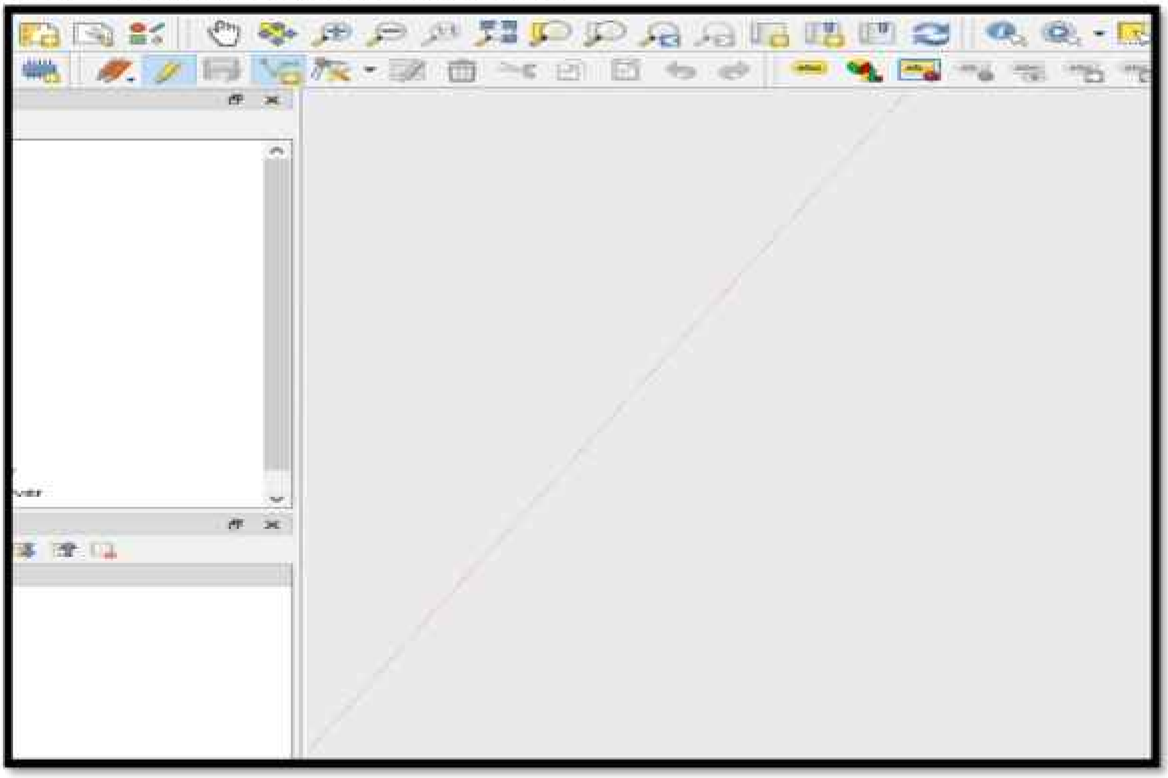
➤ Select geometry type Line.



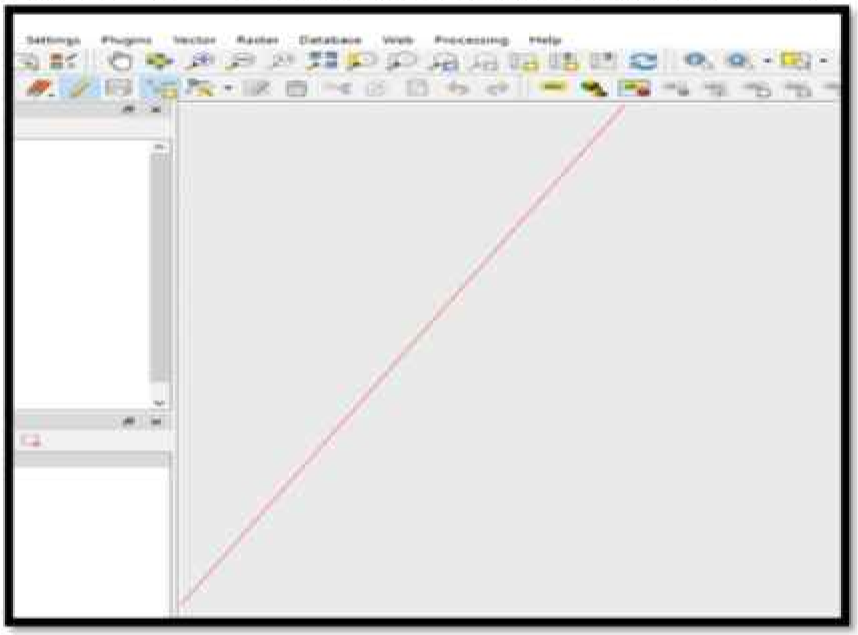
- **Road layer :**
    - To plot road **click** on **Add Line Feature**.



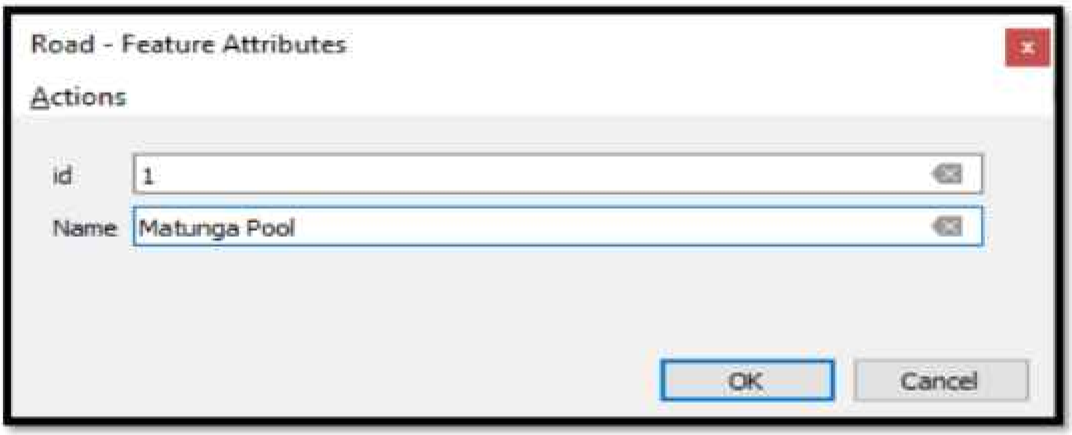
    - Click on the map where you want to draw line.



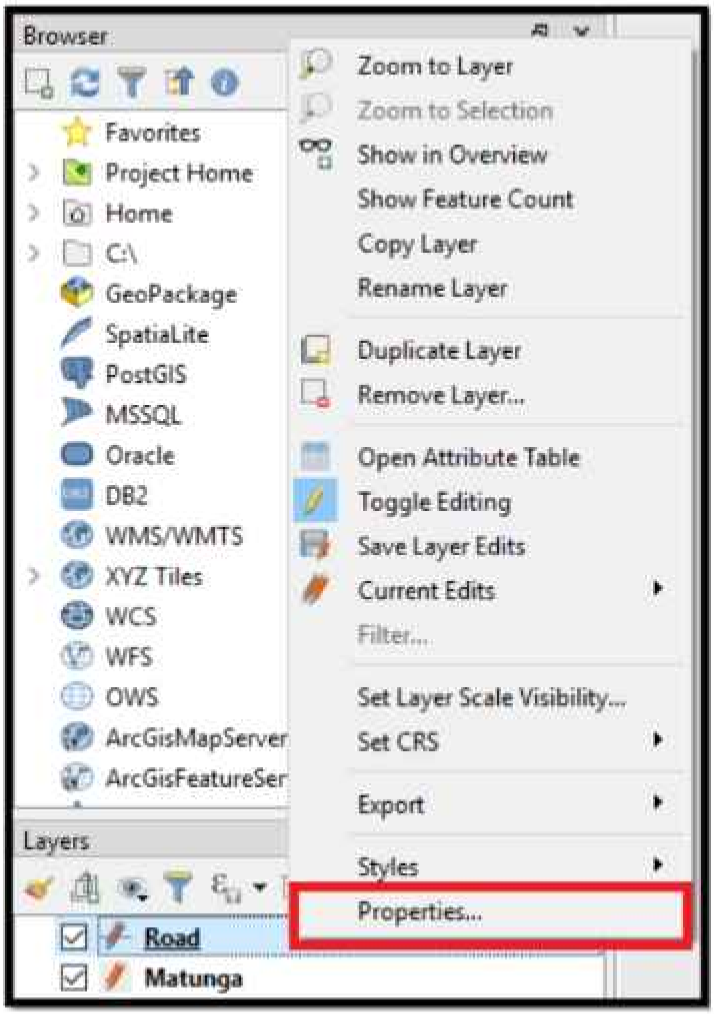
    - Once you are done then **right click** on map (**Dotted line** turn into **solid line**)

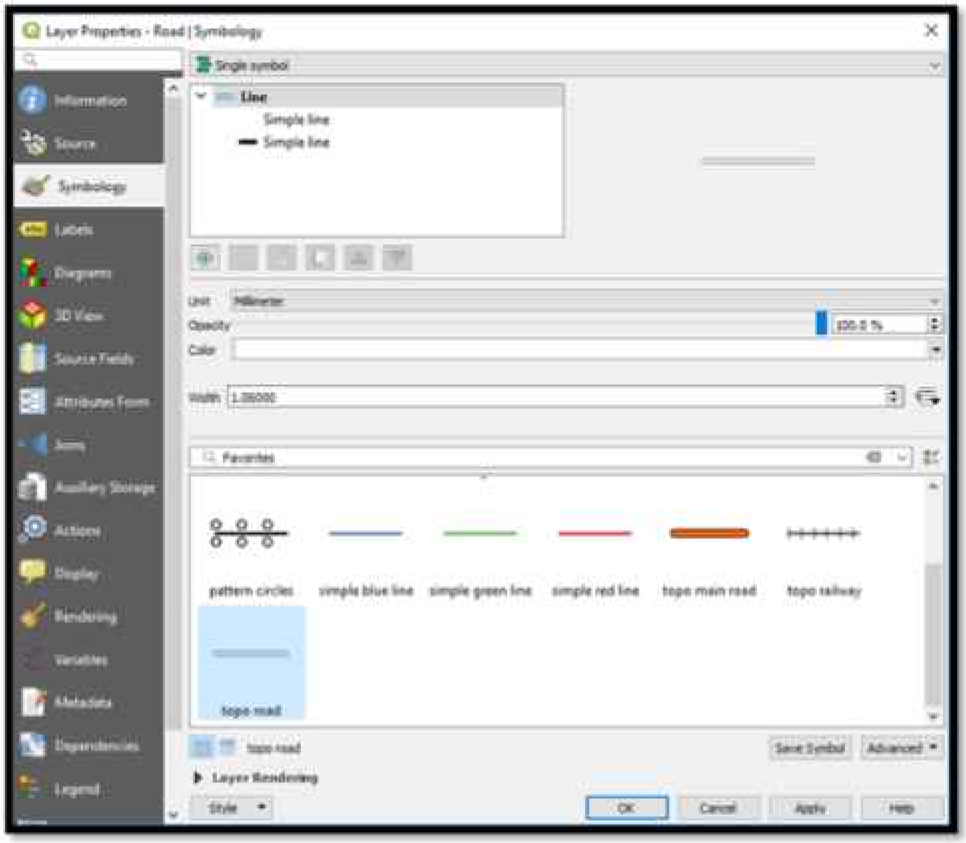


    - **save** your data

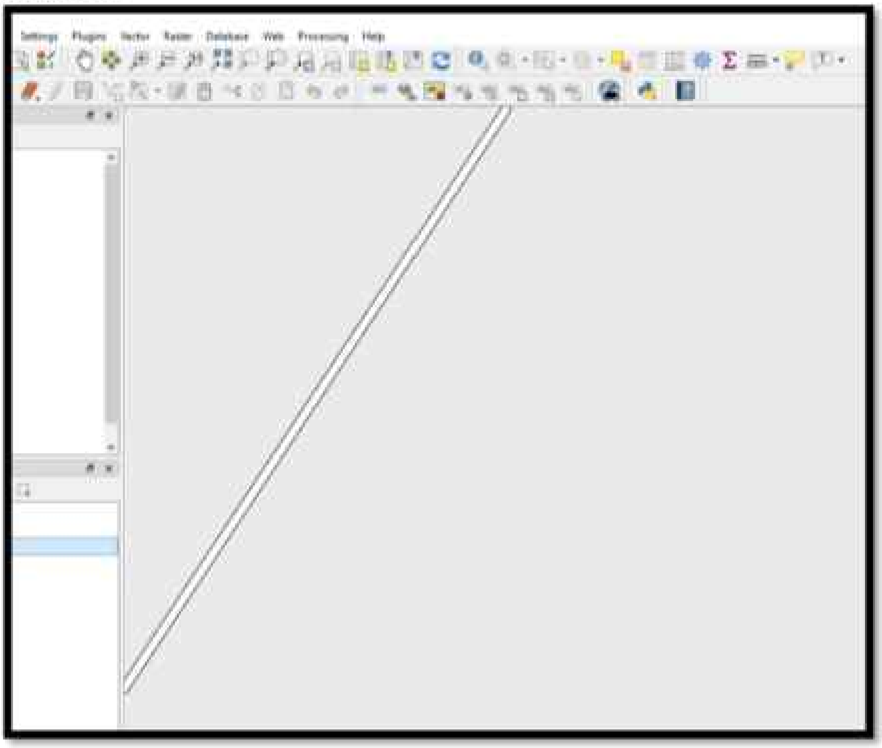


- set **style** for Roads in the same way as we have done for polygon

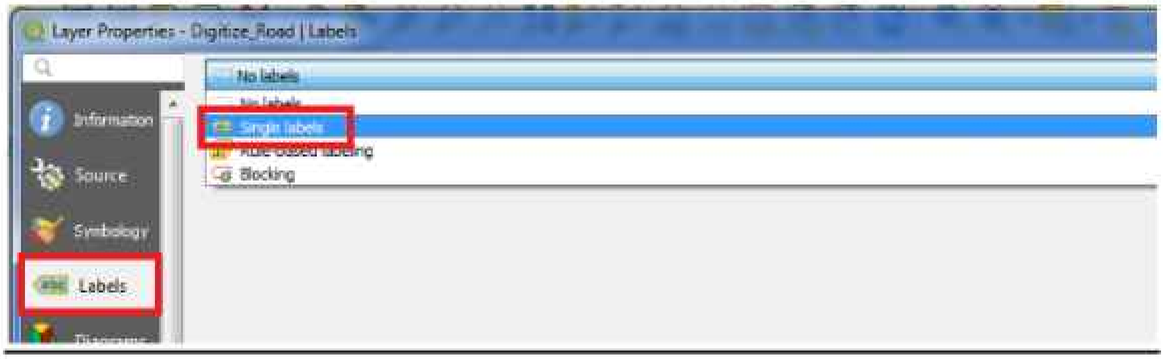




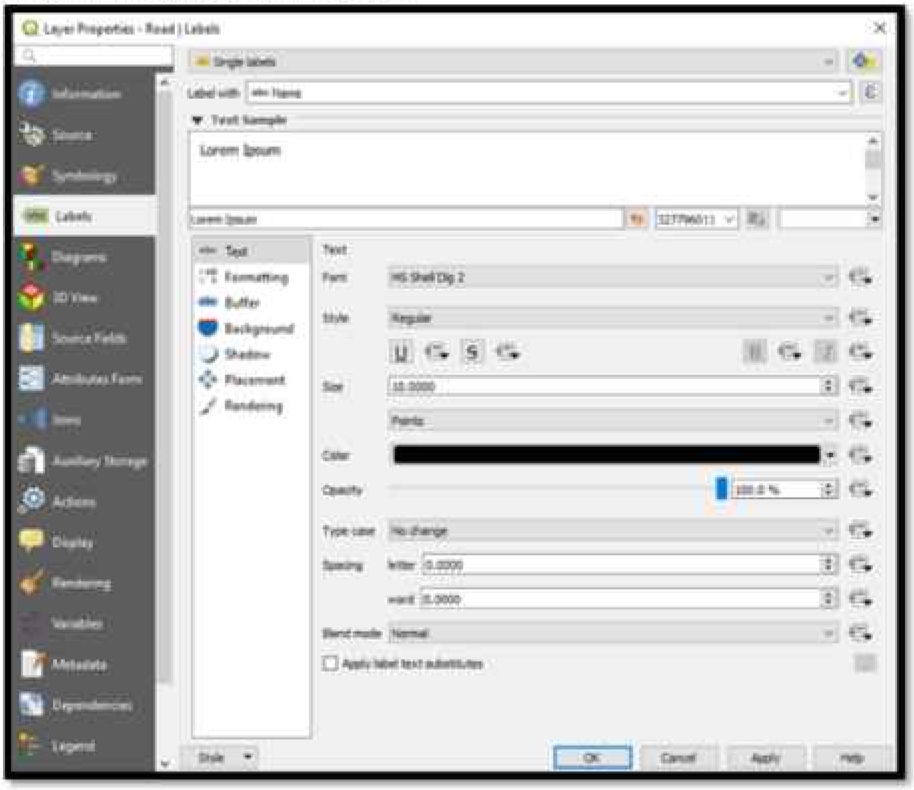
➢ Road will look as below



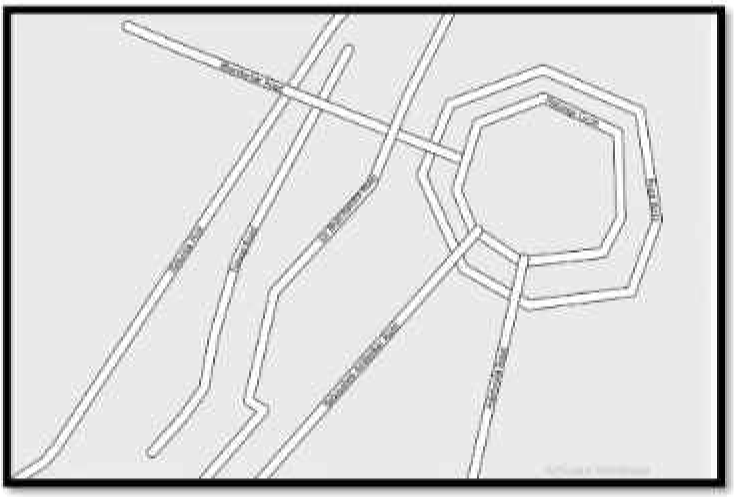
➢ To label your roads **Right click** on **Road layer** .Go to **properties** window then select label and set single **label property**



- Following window will appear on the screen

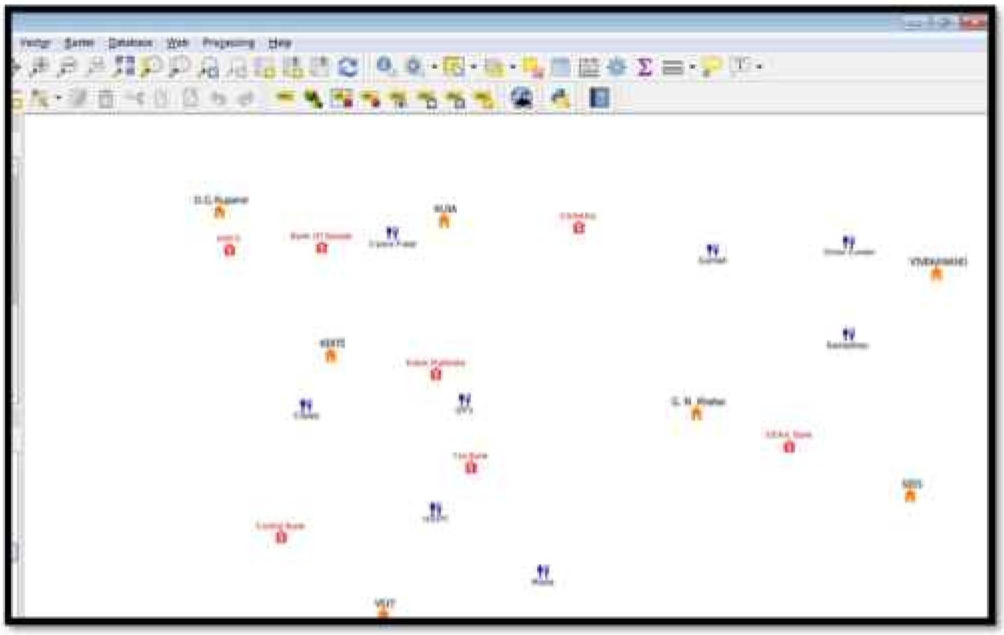


- Roads will look like these



C. Create Point vector layer

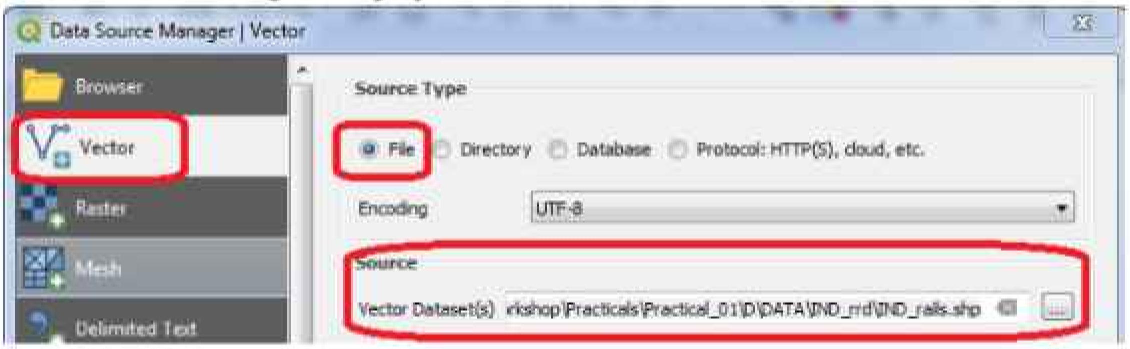
- Repeat same steps to add point layers as we have done in previous layers.(For ATM, Restaurants, Banks, Bus Stops etc)



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\D\DATA\IND_rrd\IND_rails.shp"
Press "ADD"

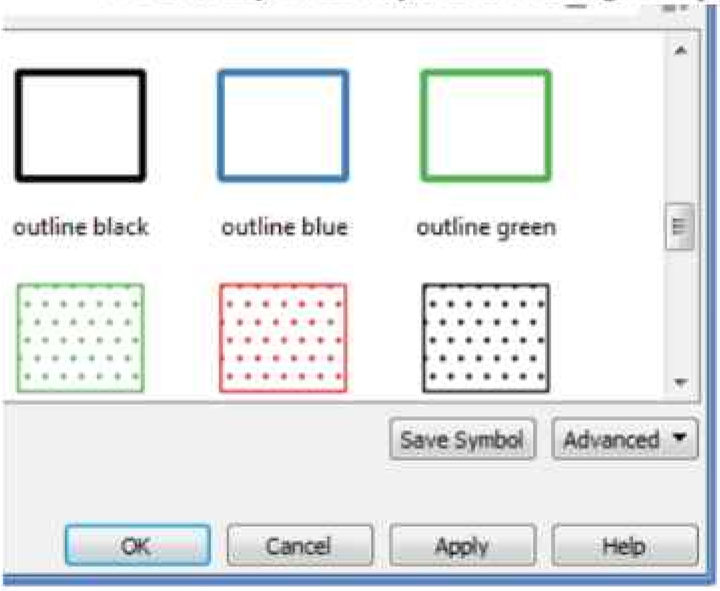
- Also add India Administrative Map

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

- Double Click on IND_adm0

Select 

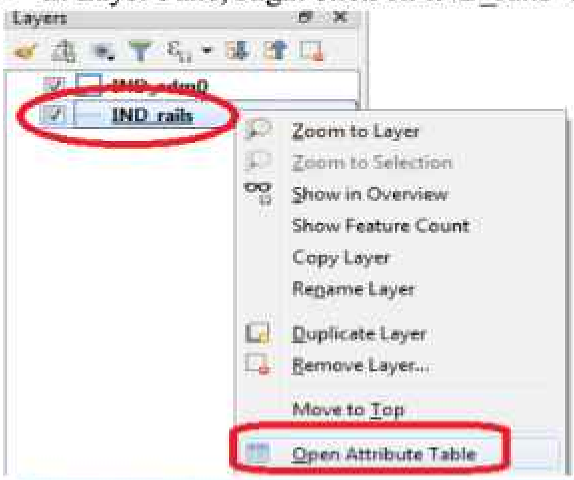
→ Select any outline style from below given options.

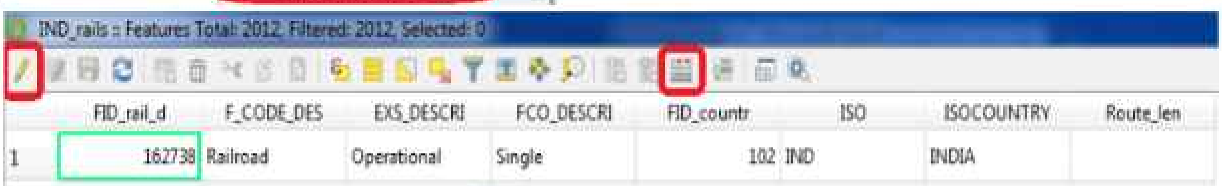


Press OK

- The display window will appear like

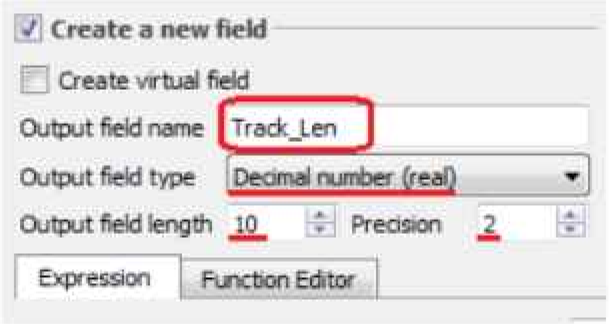
➤ In Layer Pane, Right click on IND_rails → Open Attribute Table



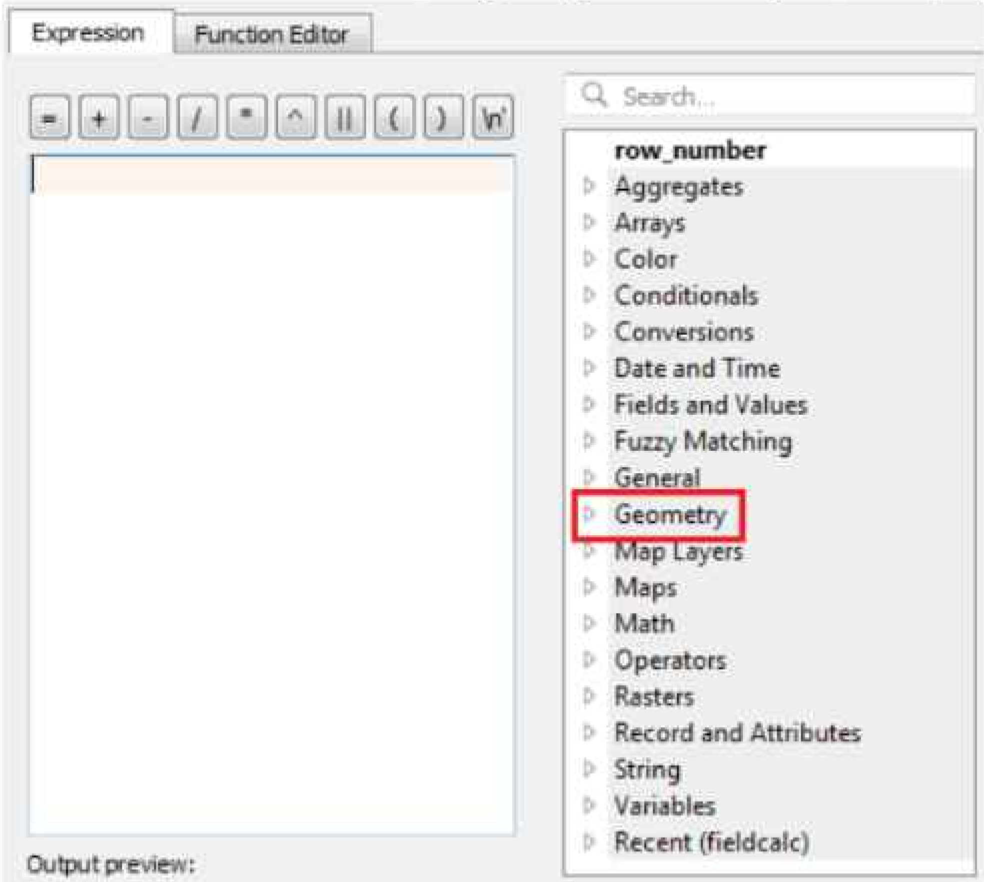


➤ Press Toggle Editing button using  button, on Attribute table window toolbar.

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



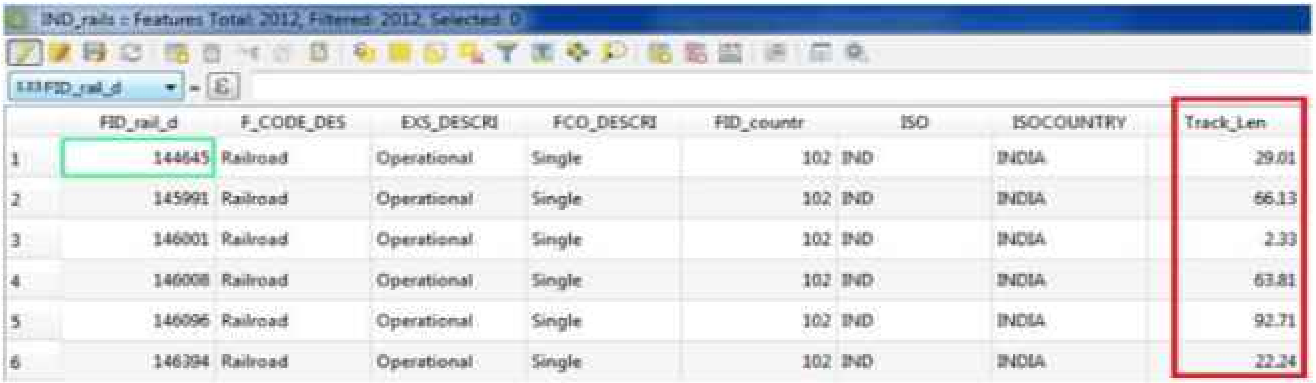
- From Function List search $length or go to Geometry → Select $length



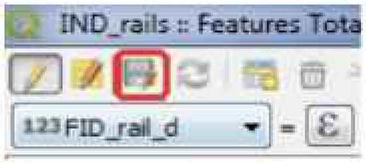
- Set expression as

Press “OK”

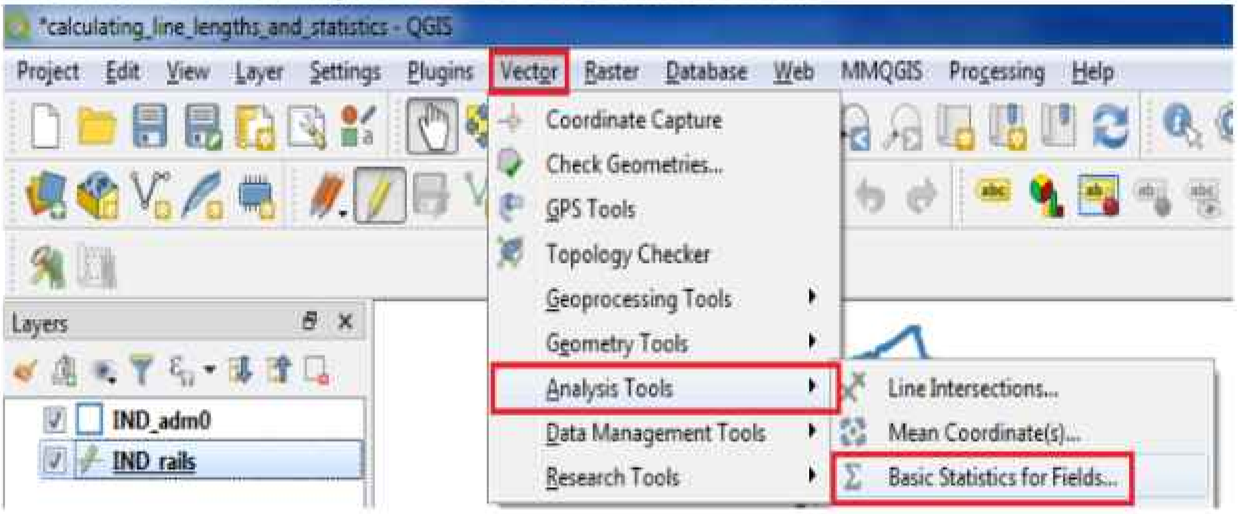
- A new column is added to the attribute table with value representing the length of track in KM.



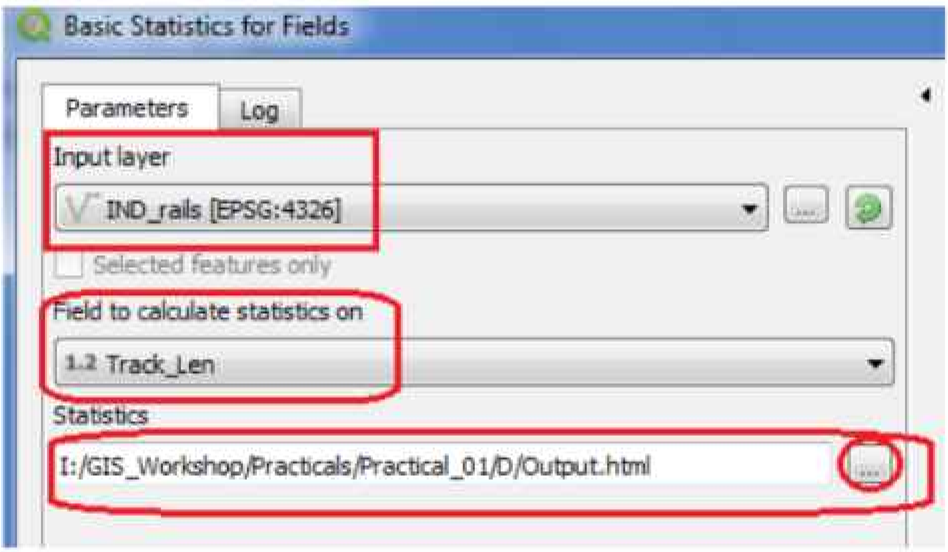
	FID_rail_d	F_CODE_DES	EXS_DESCRI	FCO_DESCRI	FID_countr	ISO	ISOCOUNTRY	Track_Len
1	144645	Railroad	Operational	Single	102	IND	INDIA	29.01
2	145991	Railroad	Operational	Single	102	IND	INDIA	66.13
3	146001	Railroad	Operational	Single	102	IND	INDIA	2.33
4	146008	Railroad	Operational	Single	102	IND	INDIA	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 Statics for Fields

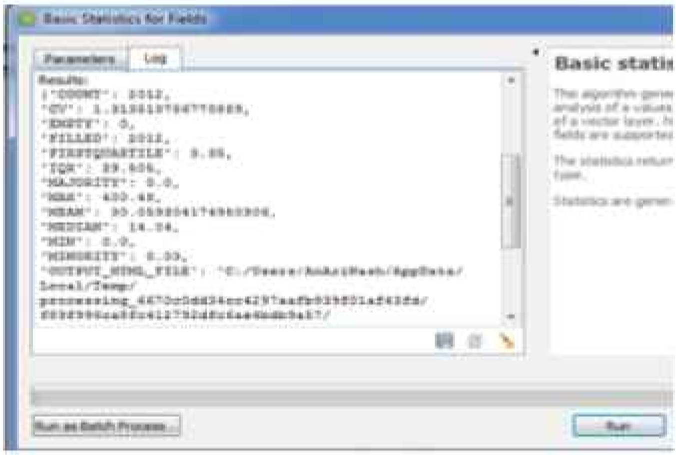


- Select IND_rails layer from input layer. And select Track_Len in "Field to Calculate statistics on"



- Press RUN

- The Result is



- Open the **"output.html"** file to get the field statistics.

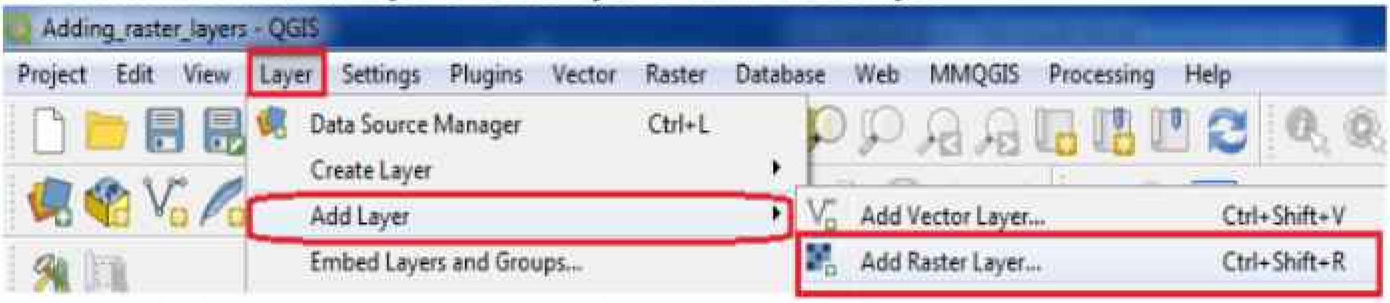
  Analyzed field: Track_Len
  Count: 2012
  Unique values: 1608
  NULL (missing) values: 0
  Minimum value: 0.0
  Maximum value: 400.48
  Range: 400.48
  Sum: 60479.320000000014
  Mean value: 30.059304174950306
  Median value: 14.04
  Standard deviation: 39.483220276624444
  Coefficient of Variation: 1.313510786770889
  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

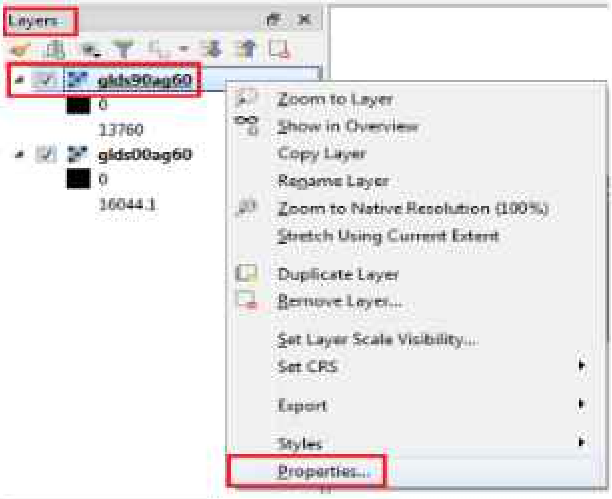


➢ Select Gridded Population of the World (GPW) v3 dataset from Columbia University, Population Density Grid for the entire globe in ASCII format and for the year 1990 and 2000.
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds90ag60.asc"
"\GIS_Workshop\Practicals\Practical_02\A\Data\gl_gpwv3_pdens_90_ascii_one\glds00ag60.asc"

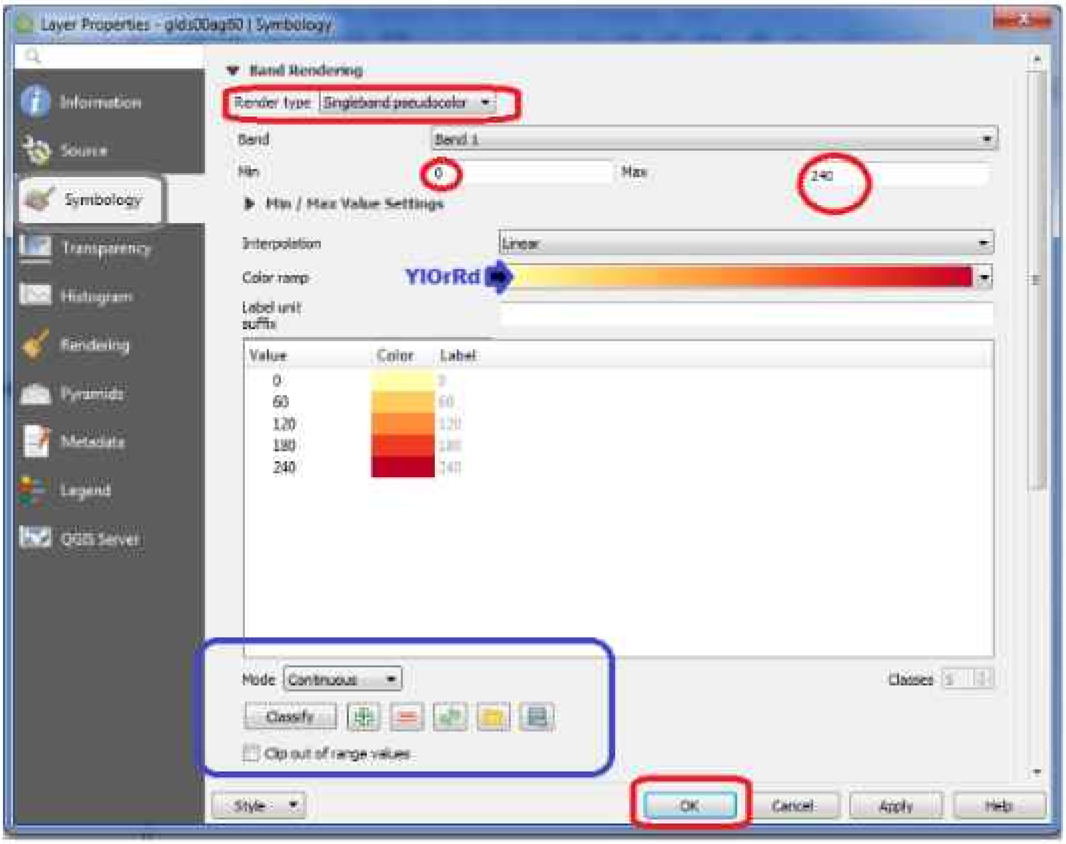
➢ Go to Project → Properties OR Press the Set CRS option on bottom right corner.
Select WGS 84 EPSG: 4326 and Press OK

b) Raster Styling and Analysis

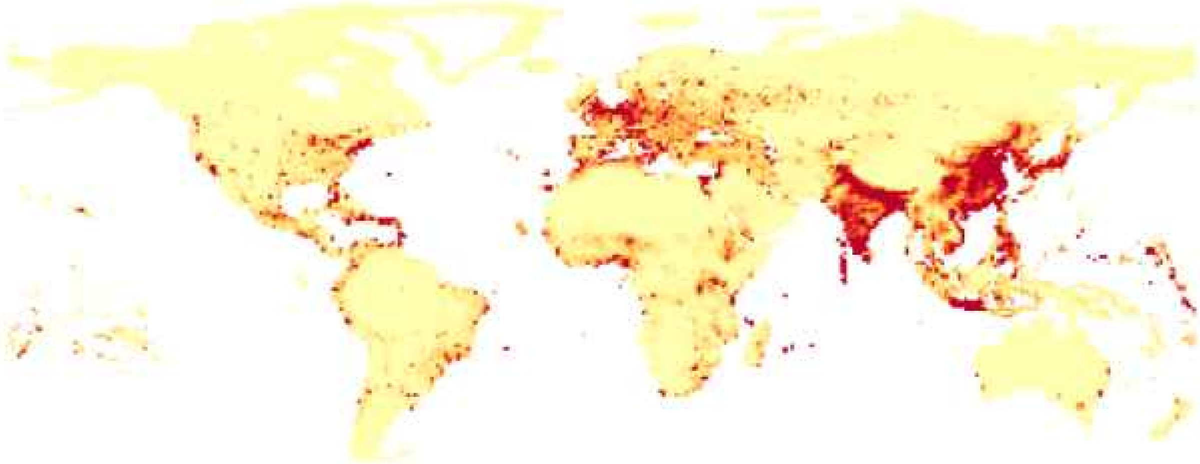
- To start with analysis of population data, convert the pixel from grayscale to Color.
- Select "glds90ag60.asc" Layer form layer Pane → select property OR double click on it.



- Select 

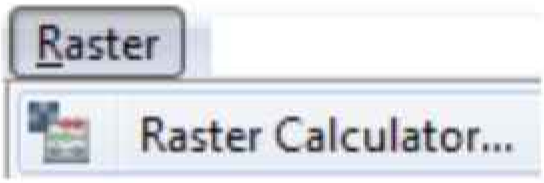


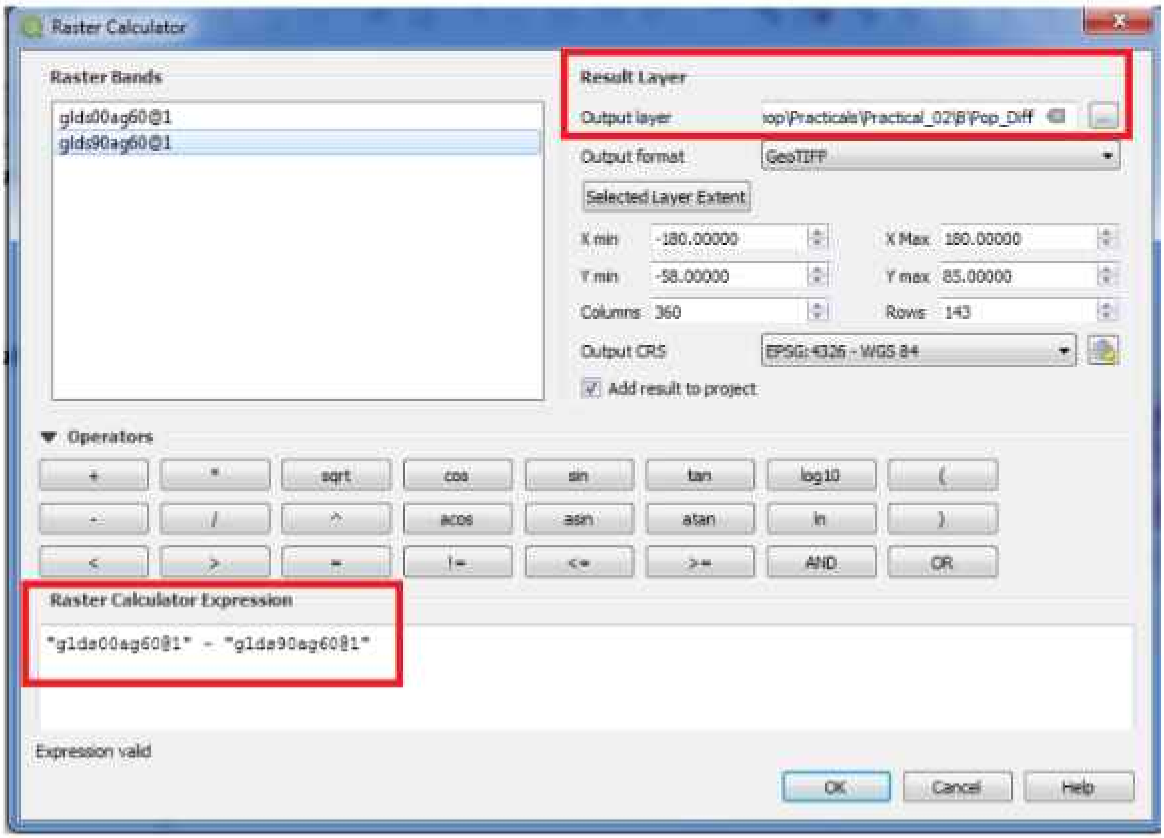
- Press "APPLY"
- Repeat the same for "glds00ag60.asc" Layer



Layer output after applying style.

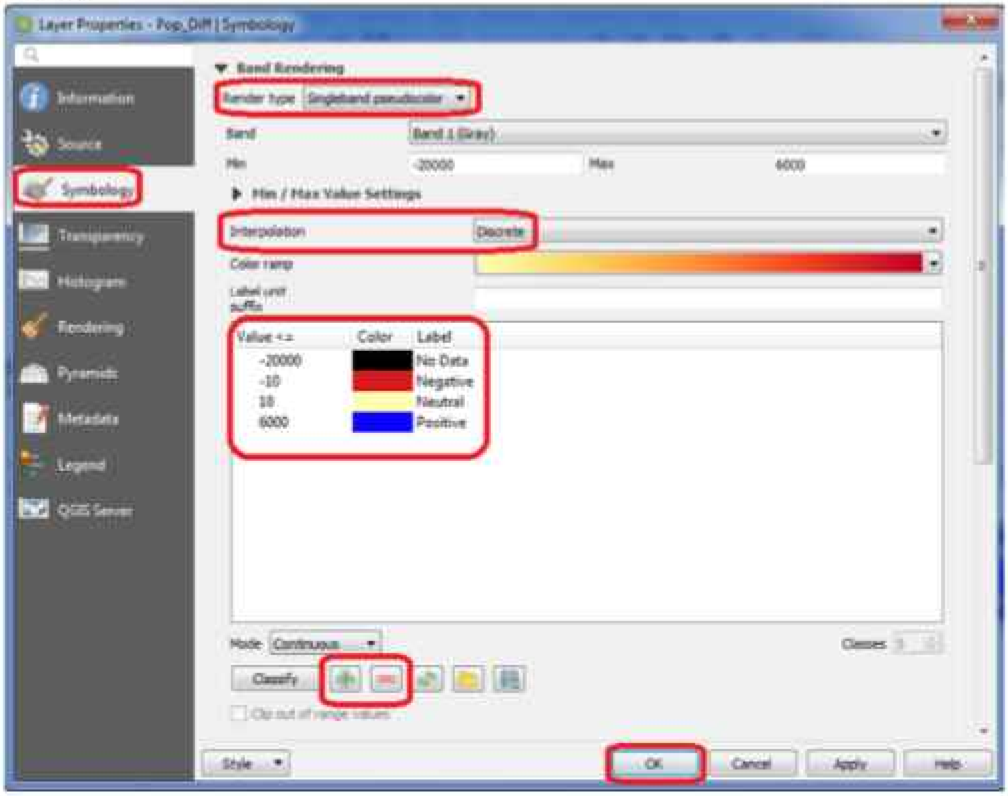
- ➢ The objective this experiment is to analyze raster data, as an example we will find areas with largest population change between 1990 and 2000, by calculating the difference between each pixel values.
- ➢ Go to Raster → Raster Calculator

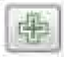


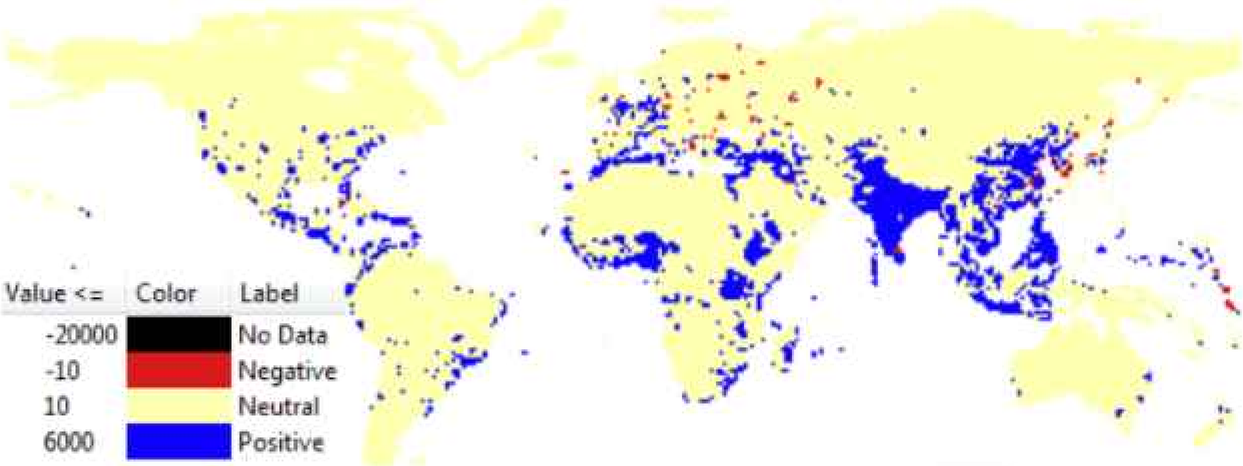


- ➢ Put the expression "glds00ag60@1" - "glds90ag60@1"
- ➢ Select the output file location & name and Press OK.

- 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

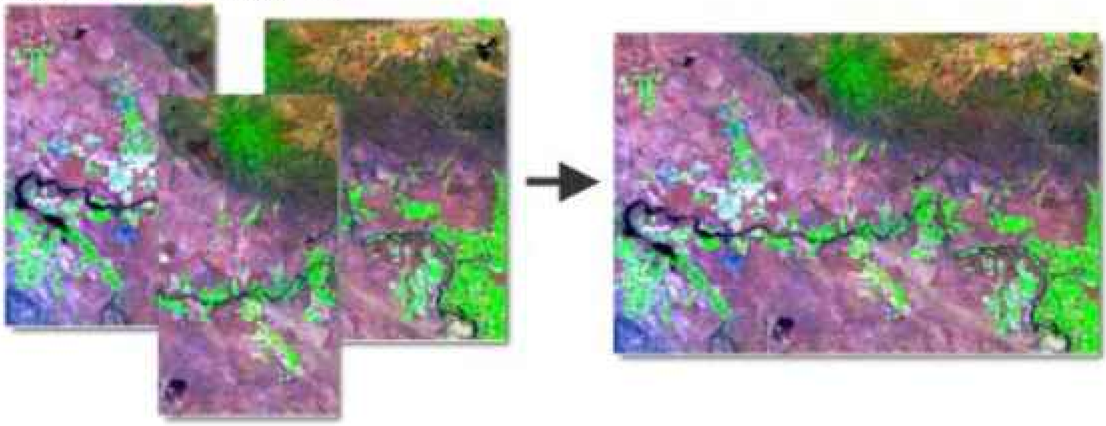


- Explore an area of your choice and check the raster band value using  to verify the classification rule.
- The red pixel shows negative changes and blue shows positive changes.

c) Raster Mosaicking and Clipping

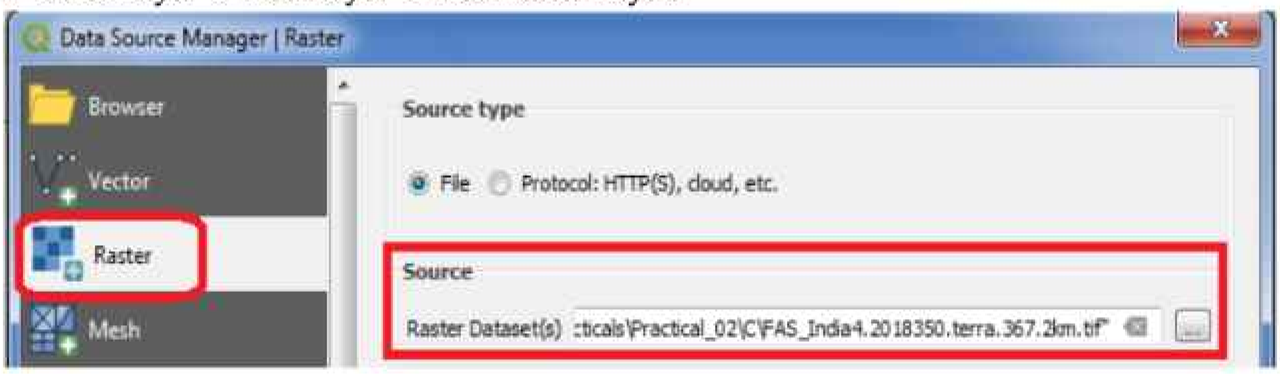
A **mosaic** is a combination or merge of two or more images.
In GIS, a single raster dataset can be created from multiple raster datasets by mosaicking them together.

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

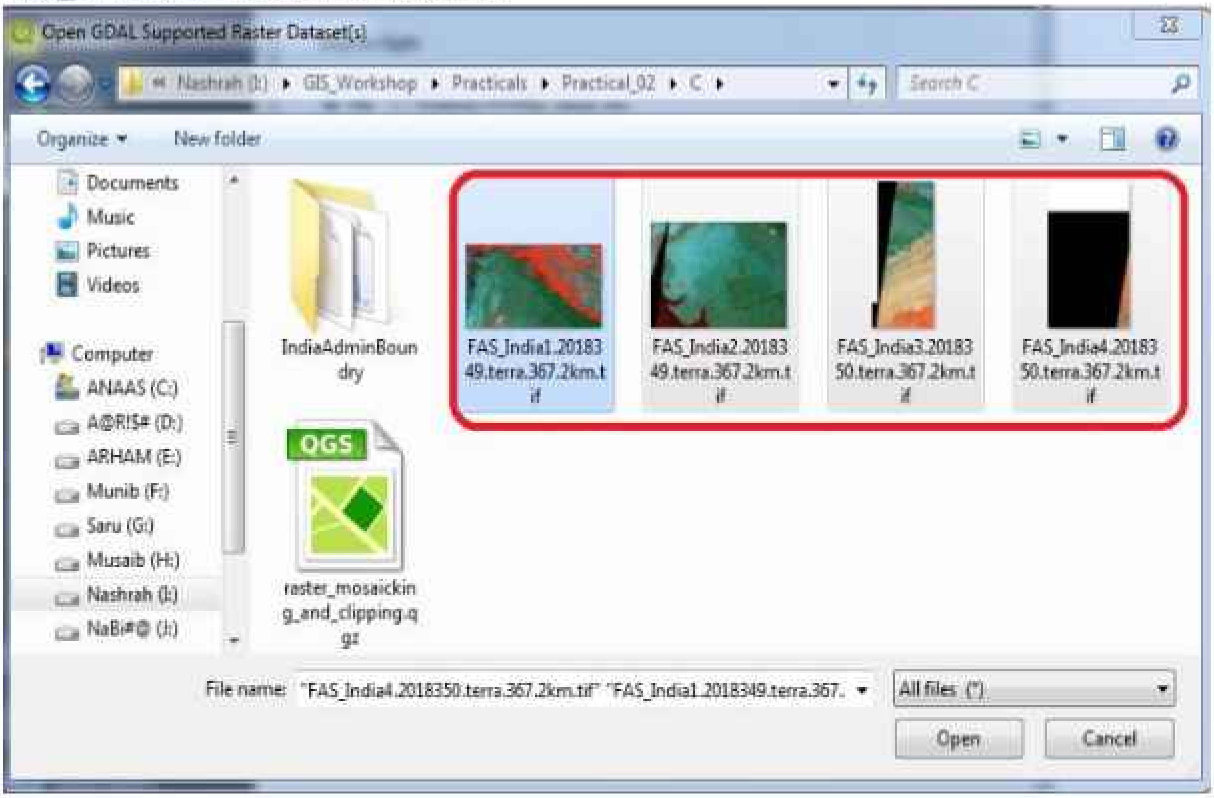


These overlapping areas can be handled in several ways; for example, you can choose to only keep raster data from the first or last dataset, you can blend the overlapping cell values using a weight-based algorithm, you can take the mean of the overlapping cell values, or you can take the minimum or maximum 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.

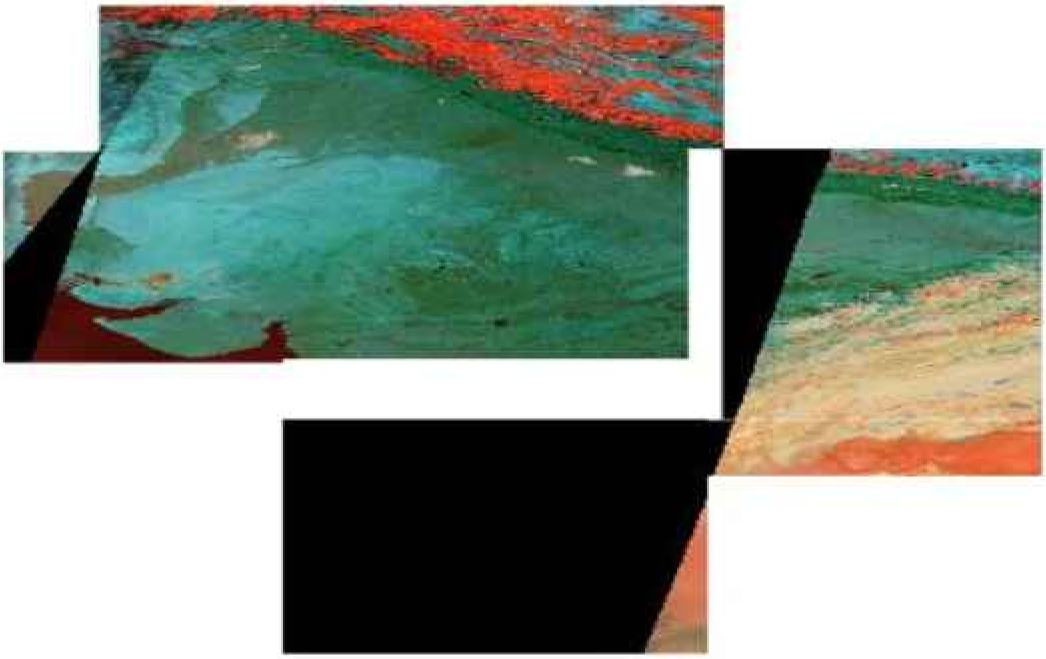
- Go to Layer → Add Layer → Add Raster Layer.



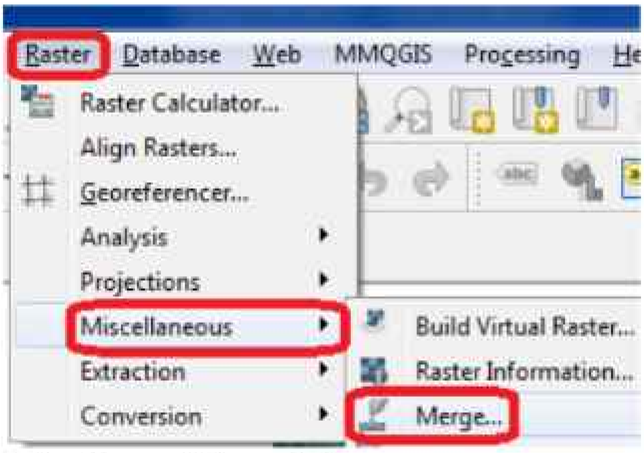
- Select the following "**.tif**" raster images for India from data folder.
  FAS_India1.2018349.terra.367.2km.tif
  FAS_India2.2018349.terra.367.2km.tif
  FAS_India3.2018349.terra.367.2km.tif
  FAS_India4.2018349.terra.367.2km.tif



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

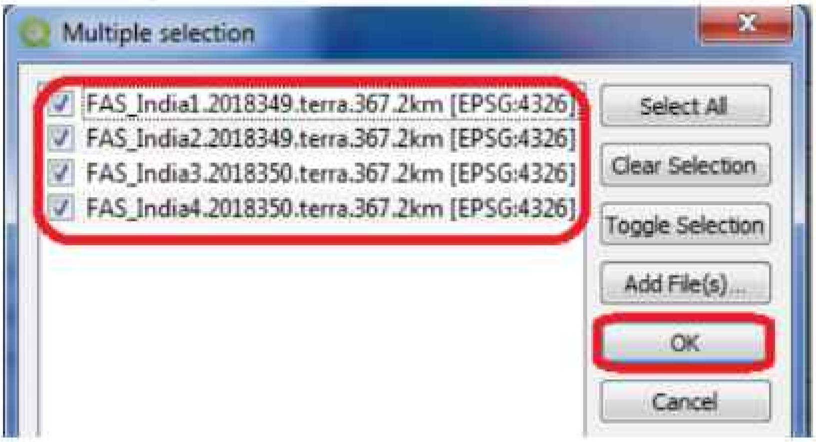


- Go to Raster → Miscellaneous → Merge

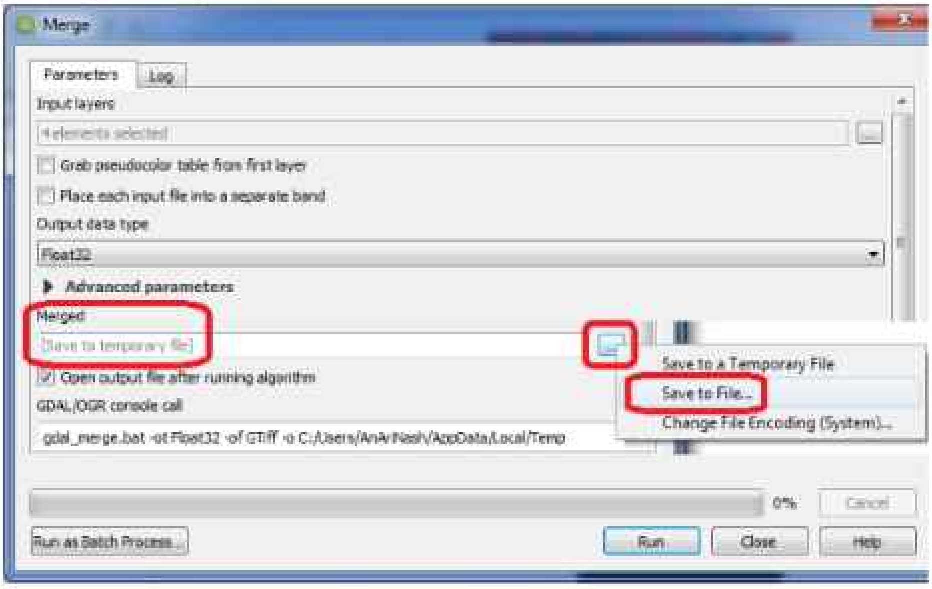


- In the Merge dialog window

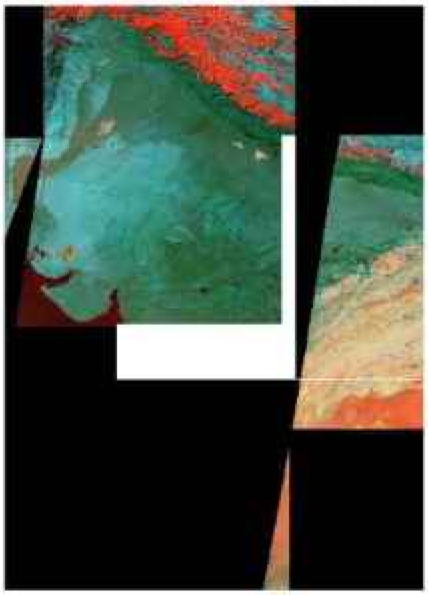
- Select all layers and Press OK.



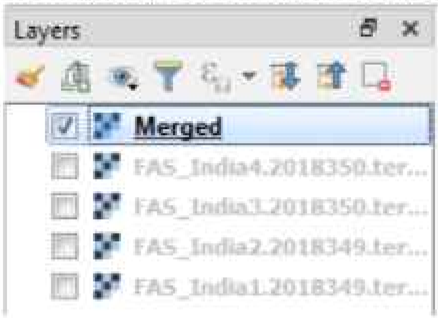
- In Merge dialog window select a file name and location to save merged images.



- 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.

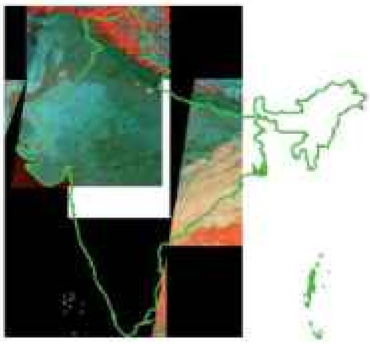


- You can now deselect individual layers from layer pane and only keep the merged raster file.

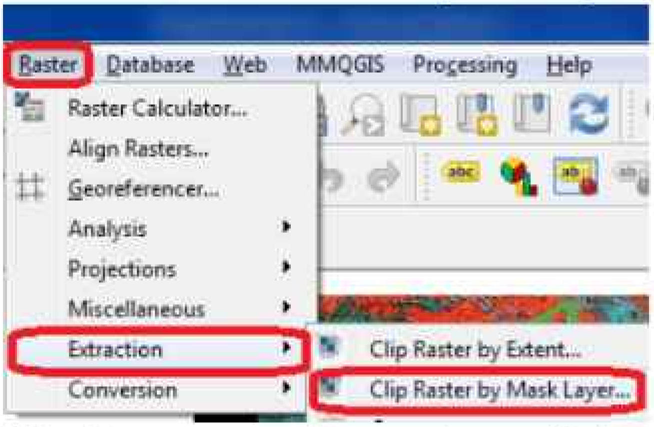


- Go to Layer→ Add Vector Layer → Select \GIS_Workshop\Practicals\Practical_02\C\IndiaAdminBoundry\IND_adm0.shp file.
- From layer properties → select  → select any one of the following

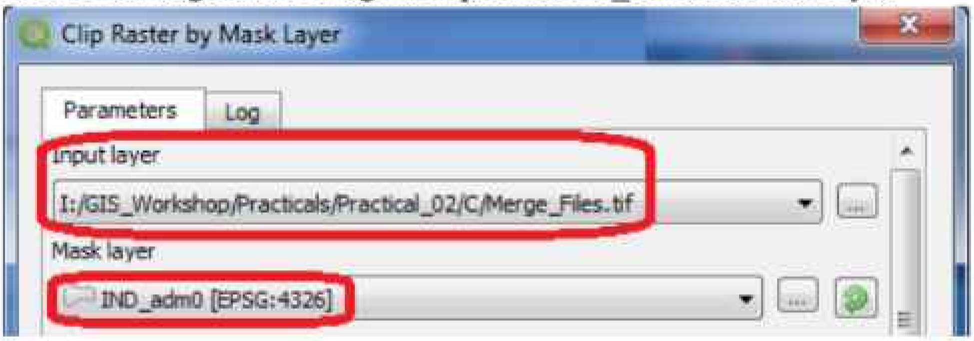
- The result will be



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

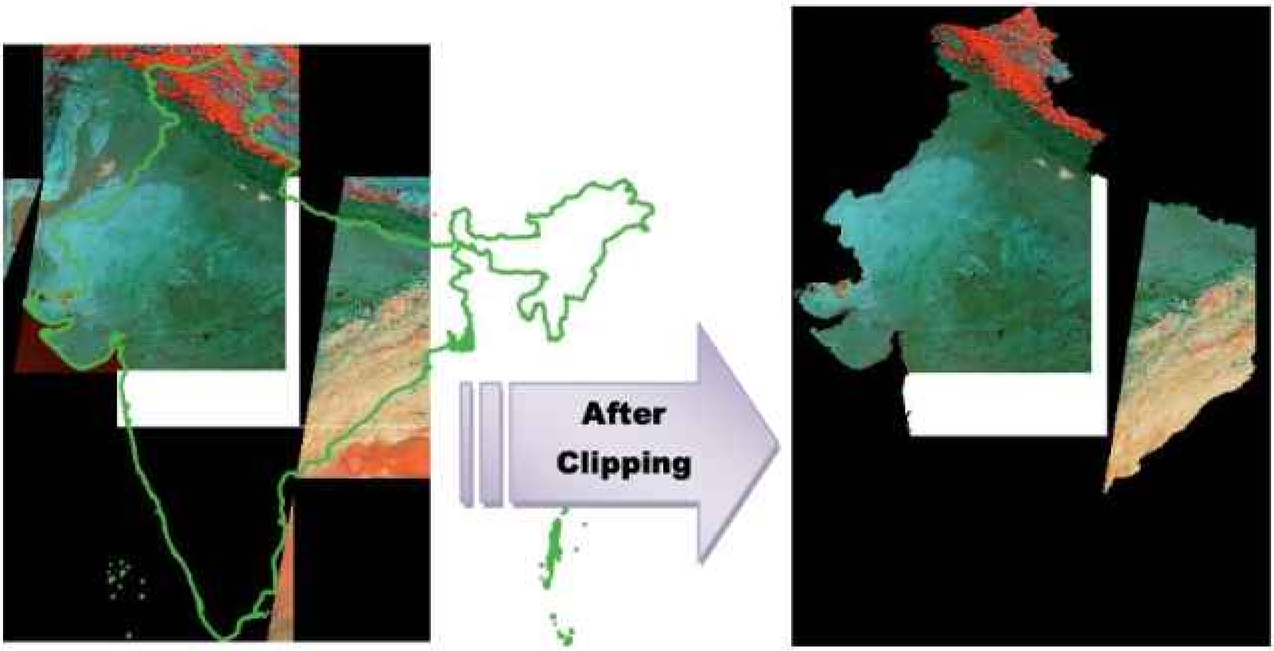


➢ Select the merge raster image as input and Ind_adm0 as mask layer.



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

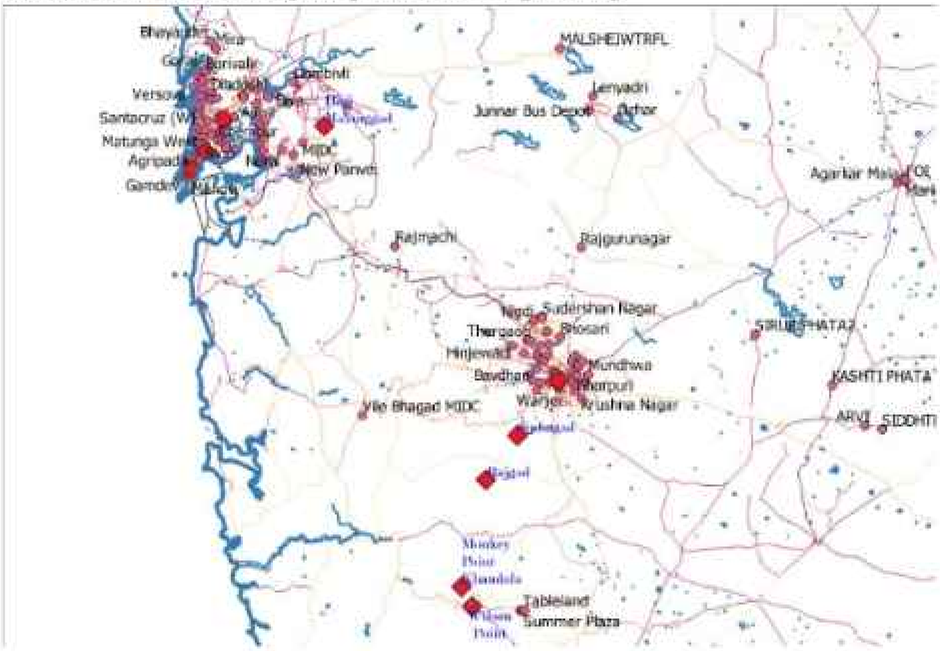
➢ Press RUN.



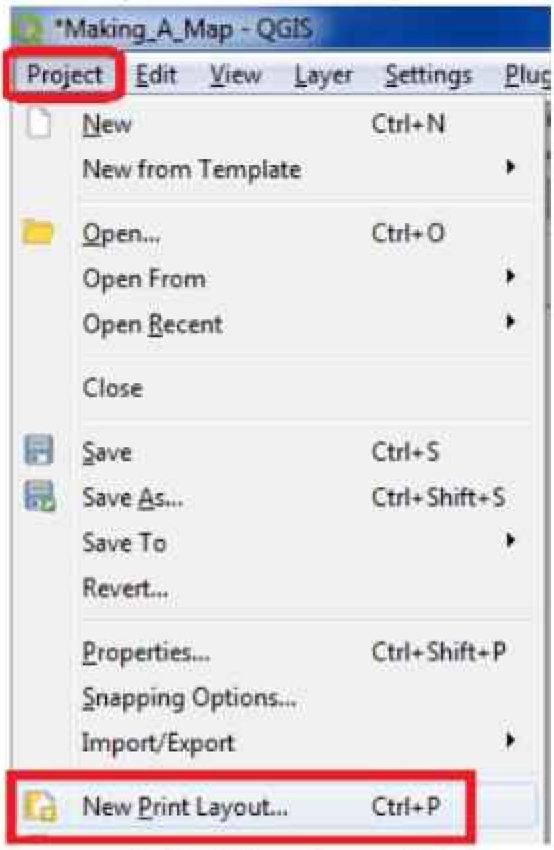
PRACTICAL - 3

a) Making a Map

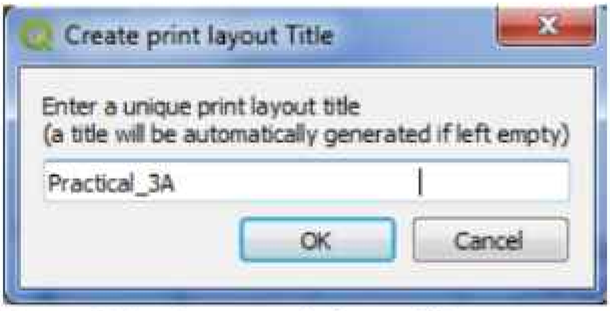
- Create a new Thematic Map or open and existing one
- Consider the following map as an example map



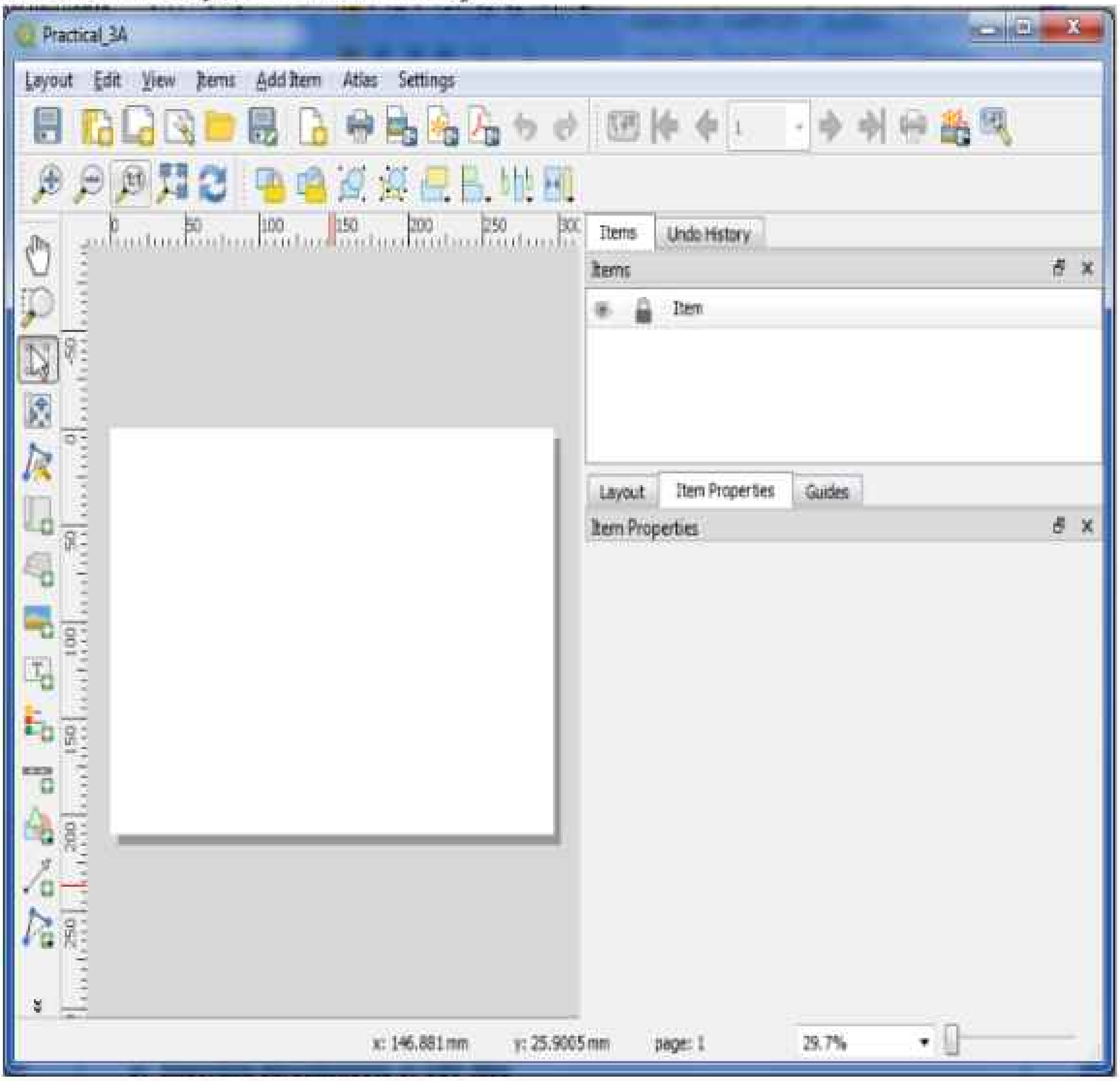
- Go to Project → New PrintLayout



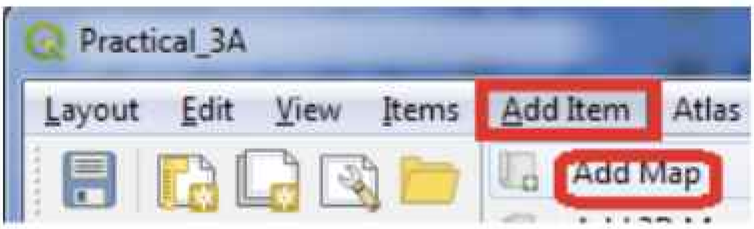
- Insert a suitable title and press “OK”.

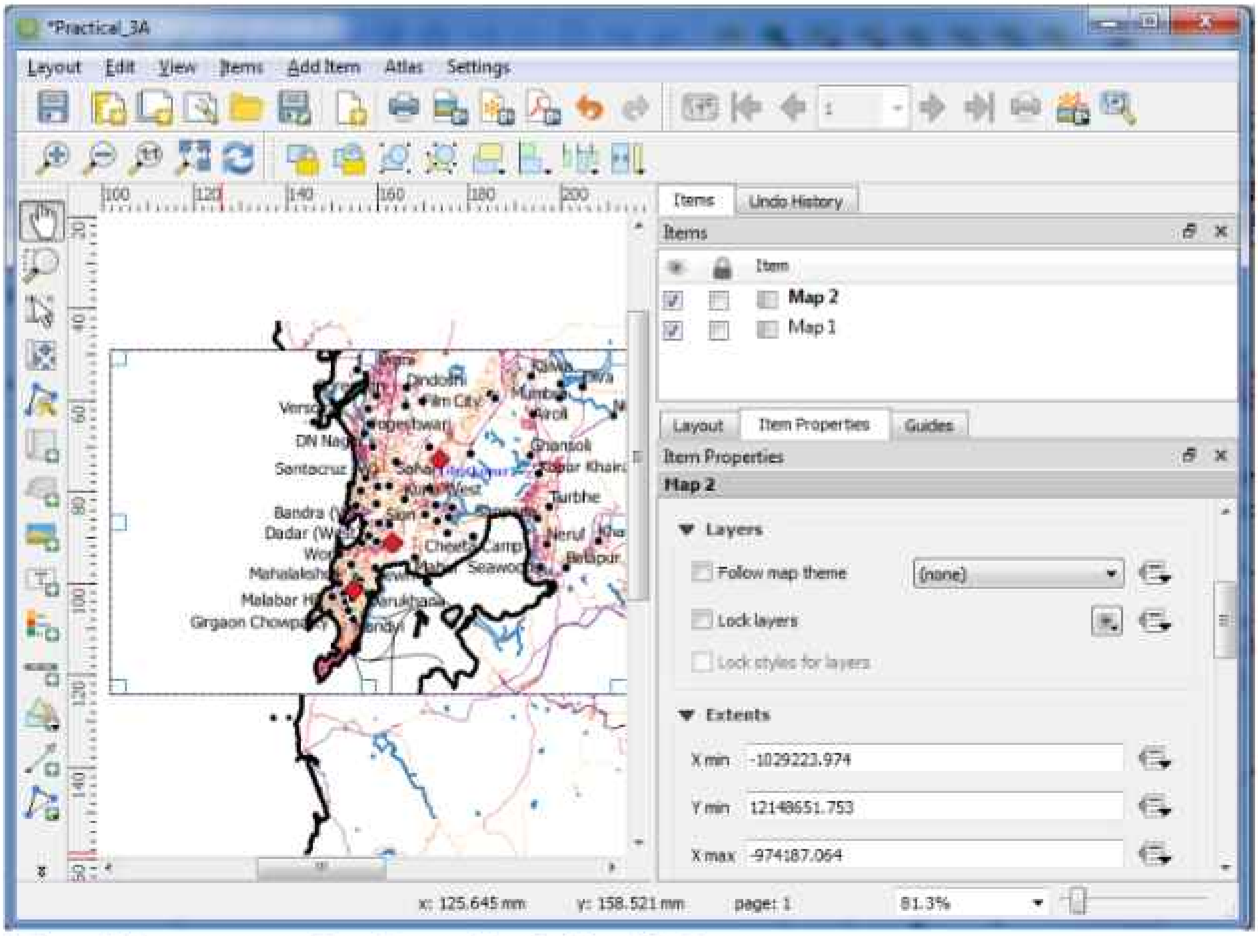


➢ A new Print Layout window will open

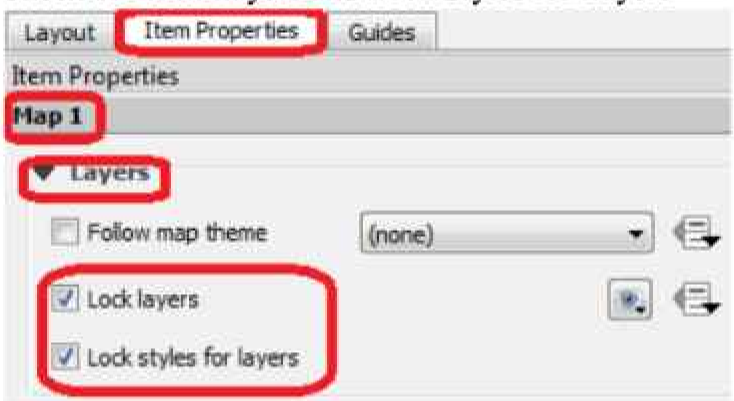


➢ Select Add Item → Add Map



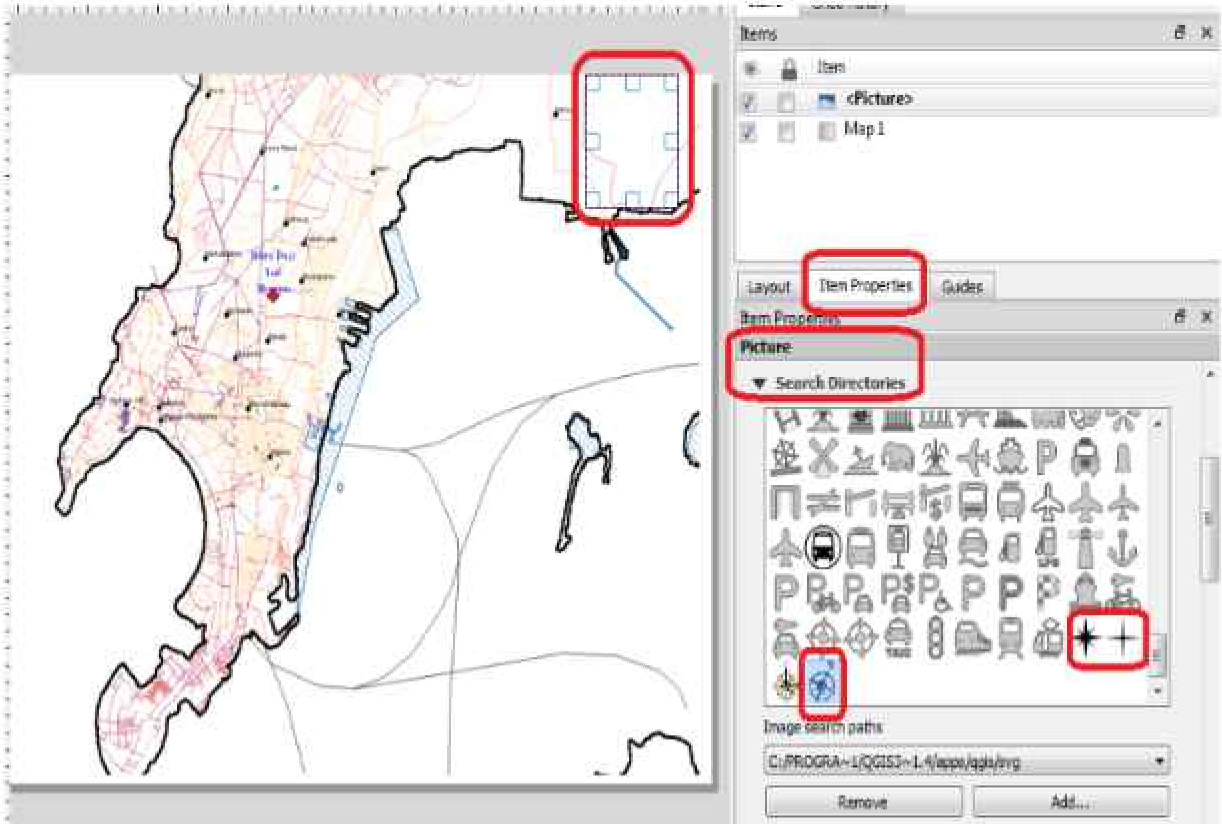


- After adding map go to ItemProperties → Map1→ Layers
  Check on Lock Layers and Lock Styles for Layers



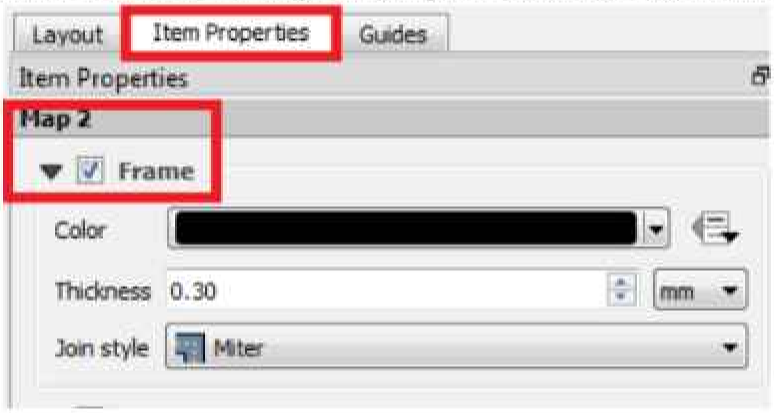
This will ensure that if any change in layers or change their styles, the Print Layout view will not change.

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

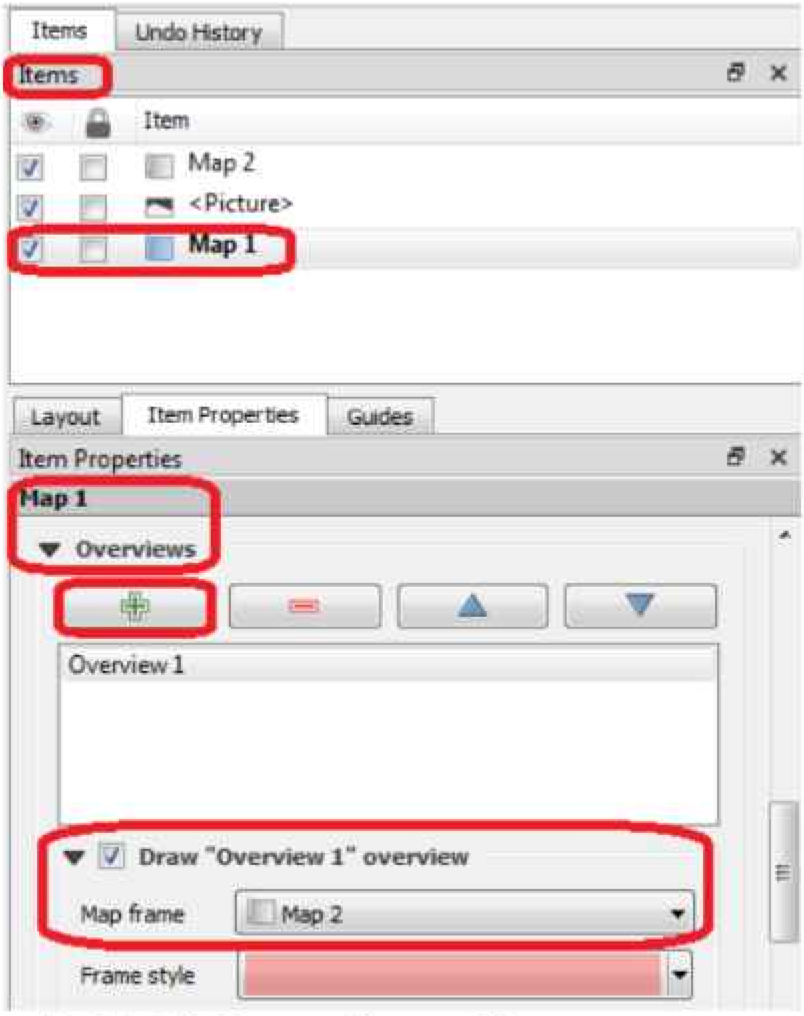


- Also adjust Image Rotation to its appropriate value.
- Item Properties → Image Rotation

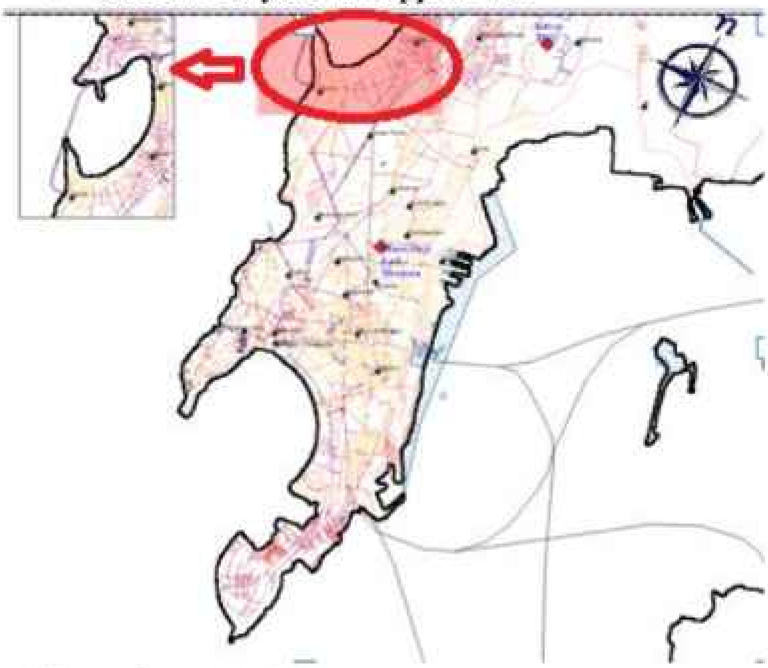
- Add an inset Using Add Item → Add Picture → Select an area to be highlighted on main Map.
- Set a frame for Inset by enabling the check box for Frame.



- 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).

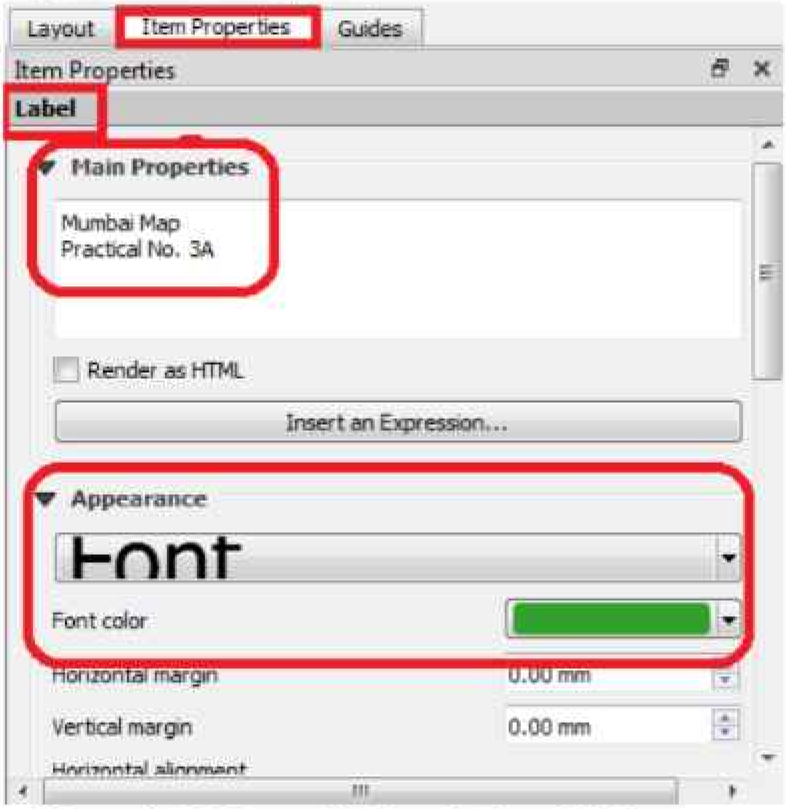


- The Print Layout will appear like



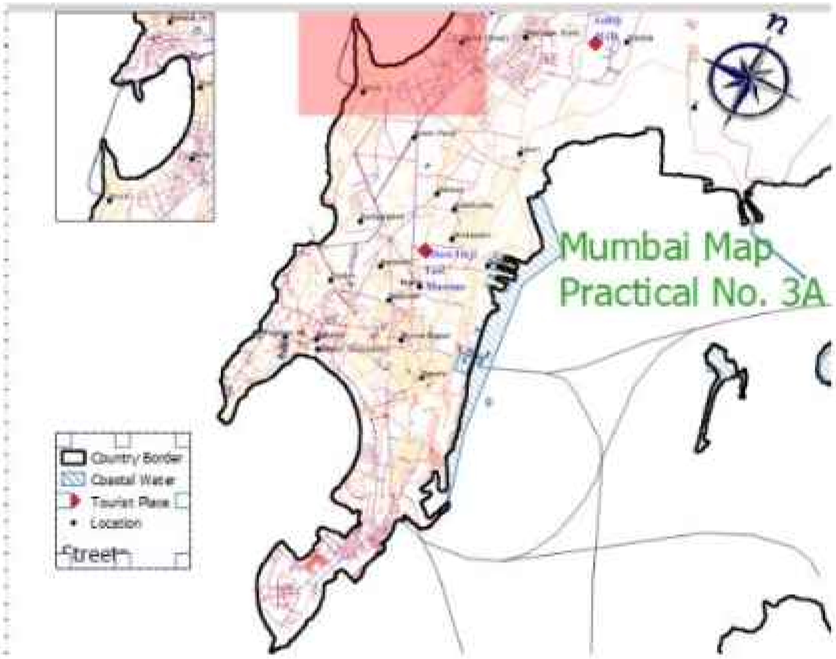
- Add Item → Add Label

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

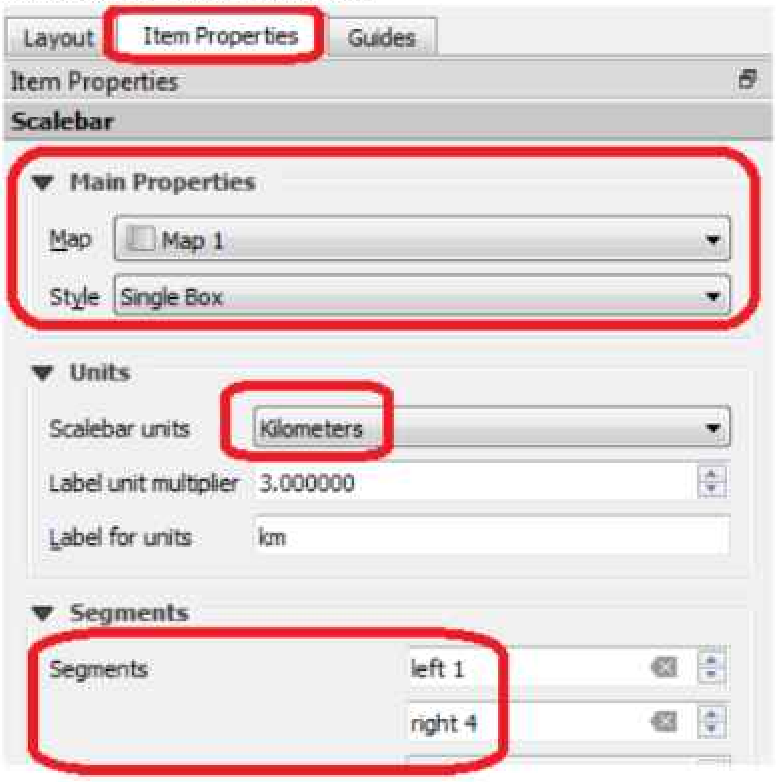


- Add Item → Add Legend→ Place the legend indicator at appropriate location.
- Uncheck auto update and use suitable legend indicator label.

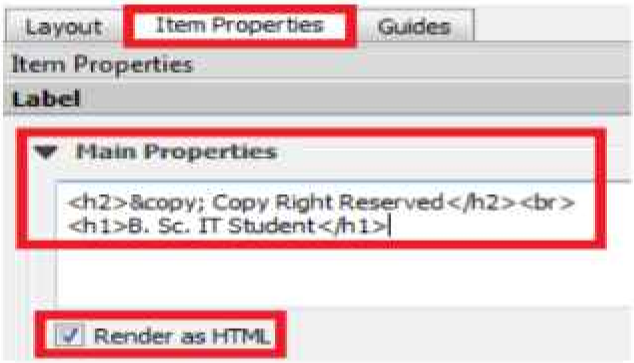
➢ The Print Layout will appear



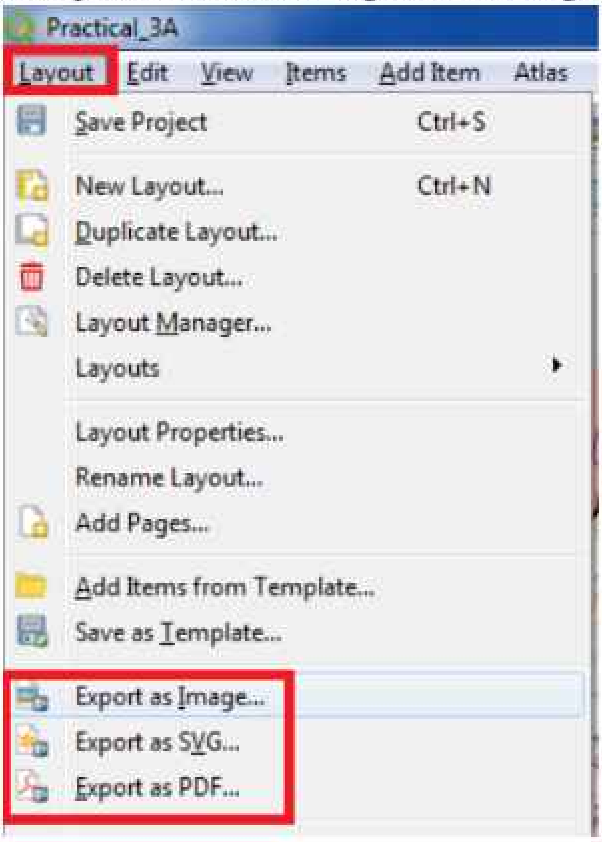
➢ Add Item → Add Scale Bar



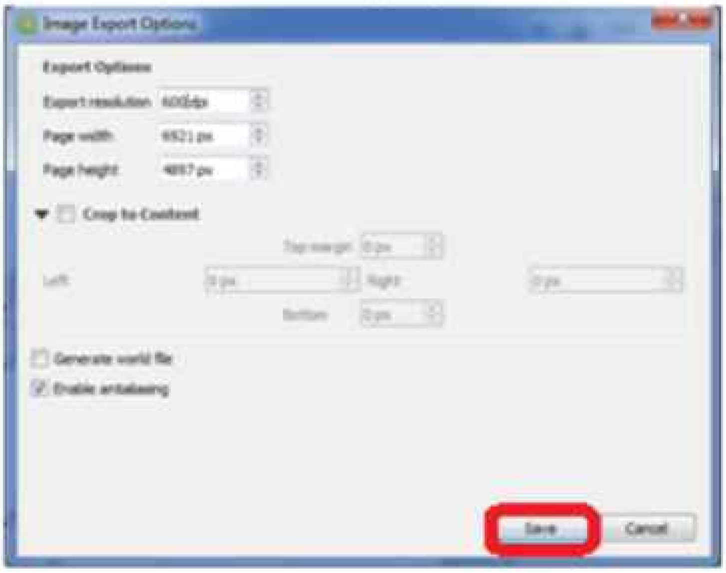
➢ Add Item → Add Label→Add a Label using HTML rendering



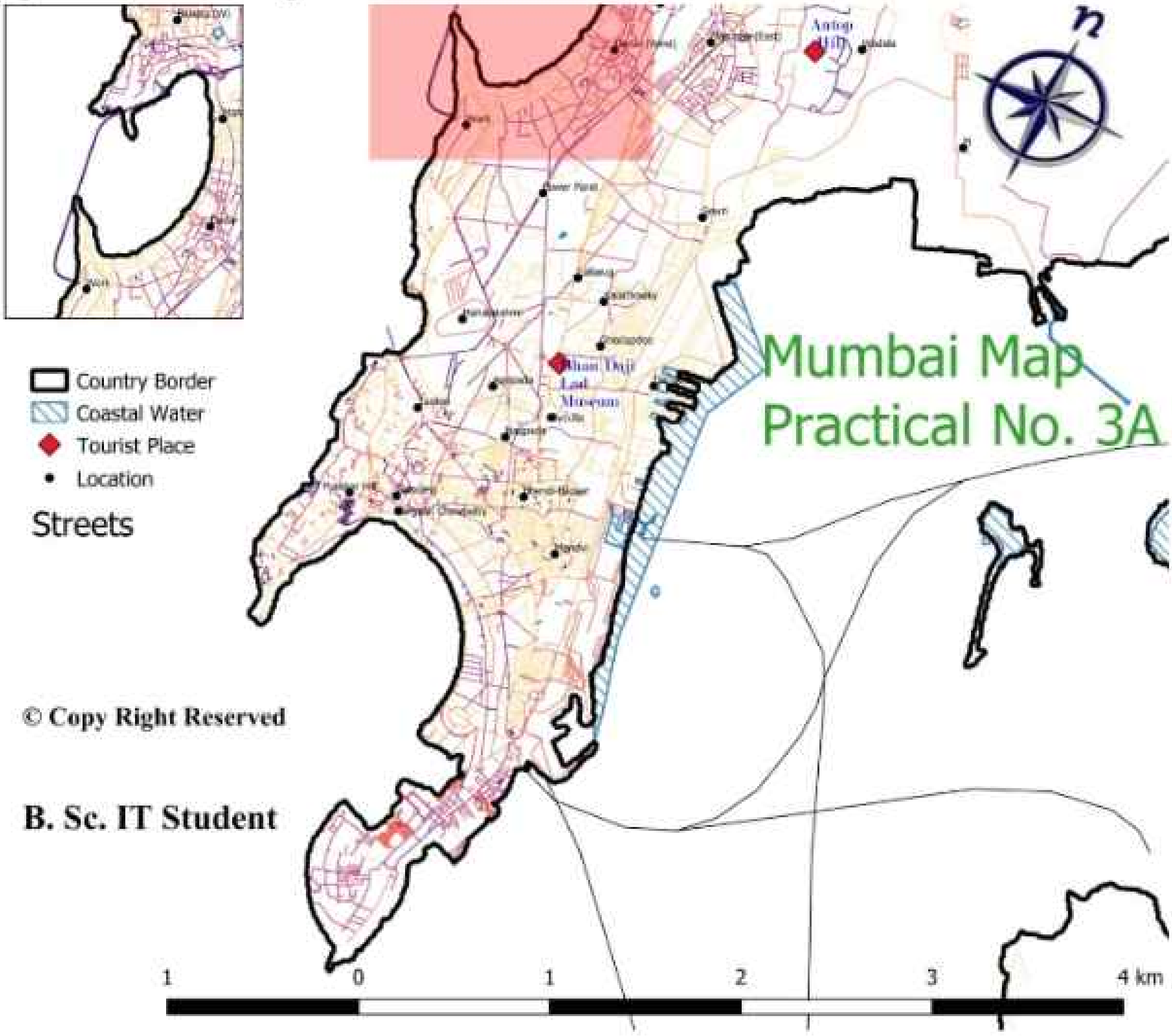
➢ A Map can be saved in Image or PDF using Layout → Export as Image / Export as PDF



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



➢ Open the PDF or Image from location.

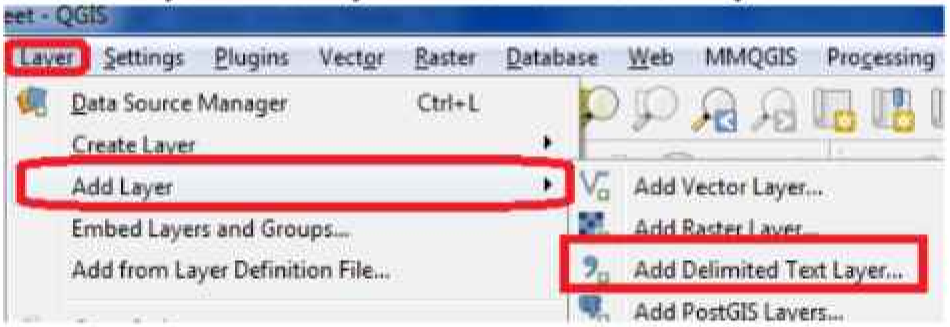


b) Importing Spreadsheets or CSV files

➢ 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.

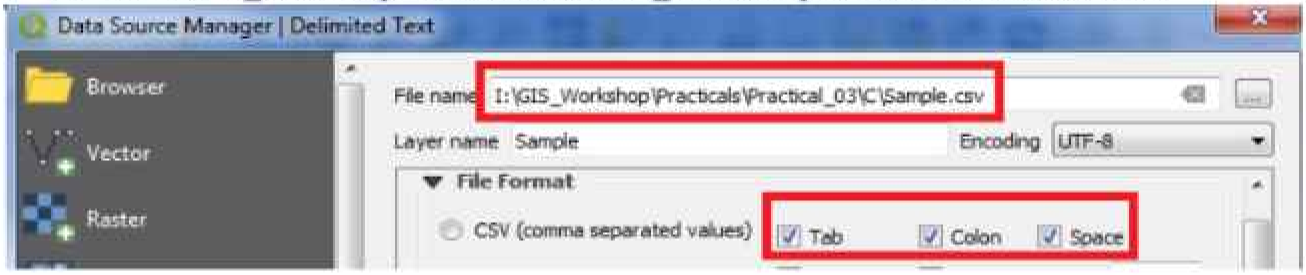
➢ Sample file for Earthquake data will be used in this practical.

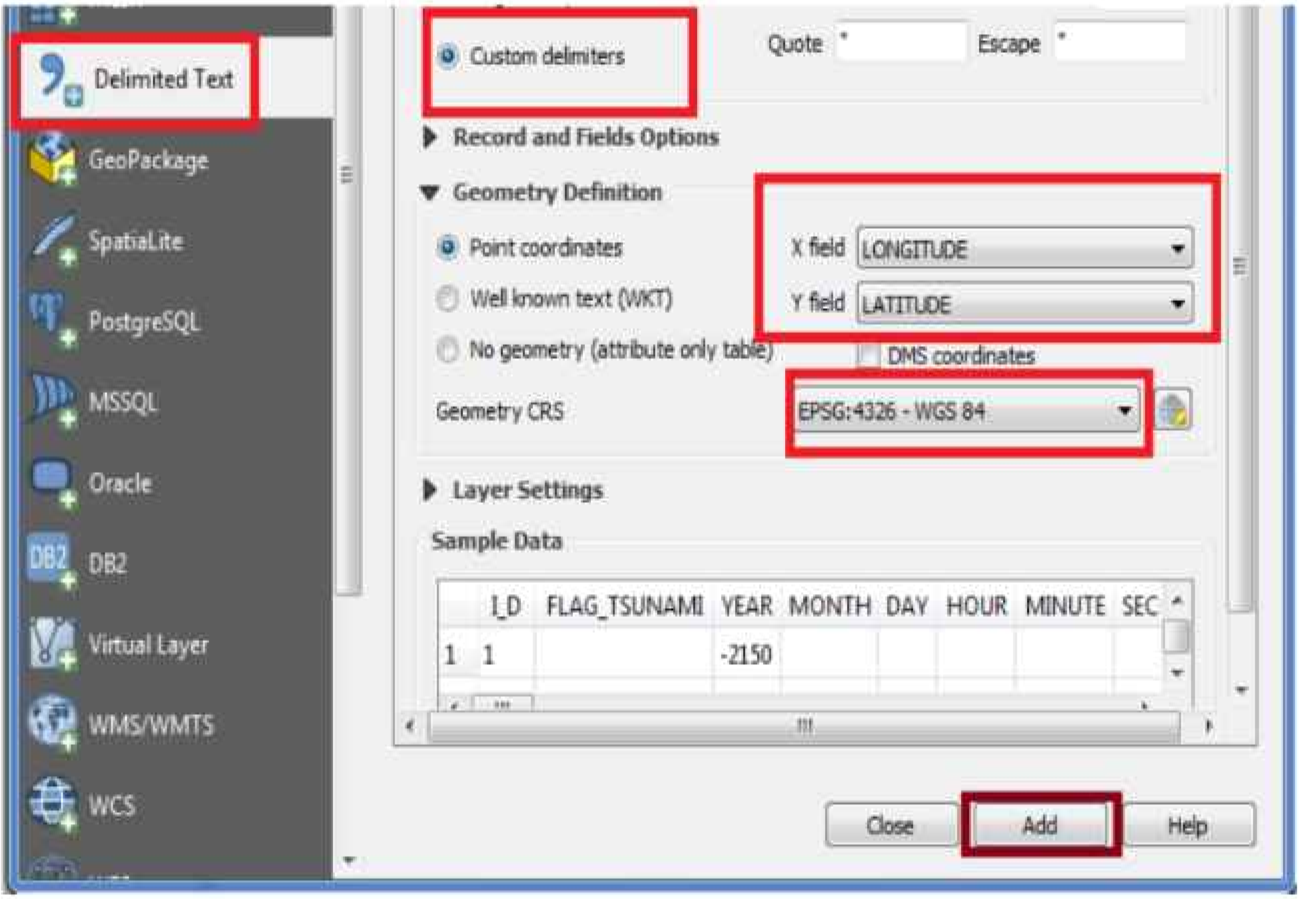
➢ Go to Layer → Add Layer → Add Delimited text Layer



➢ Data Source Manager | Delimited Text window will appear

➢ Select the \GIS_Workshop\Practicals\Practical_03\C\Sample.csv file from data folder.

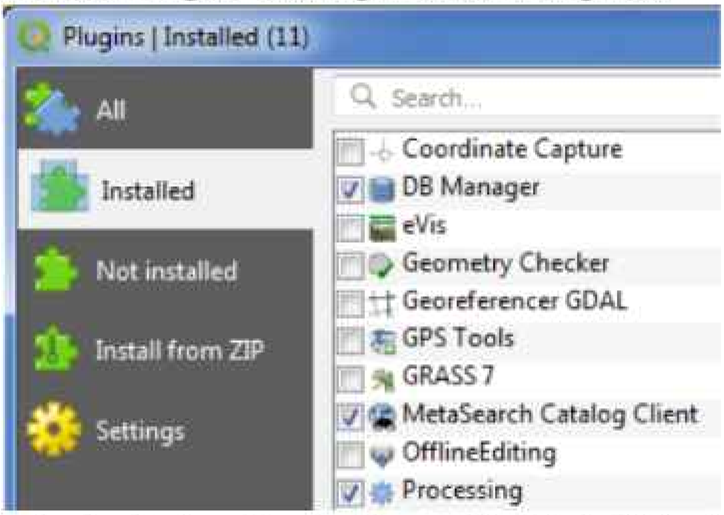




- Press ADD and close the window.
- Output:

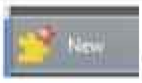
c) Using Plugins

- 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

or

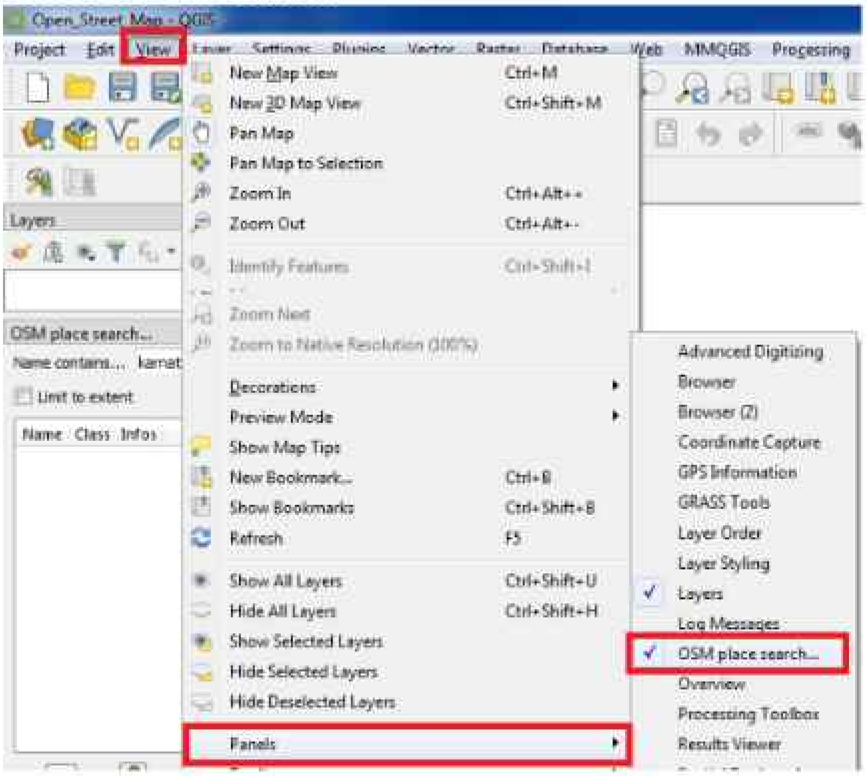
- A 

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

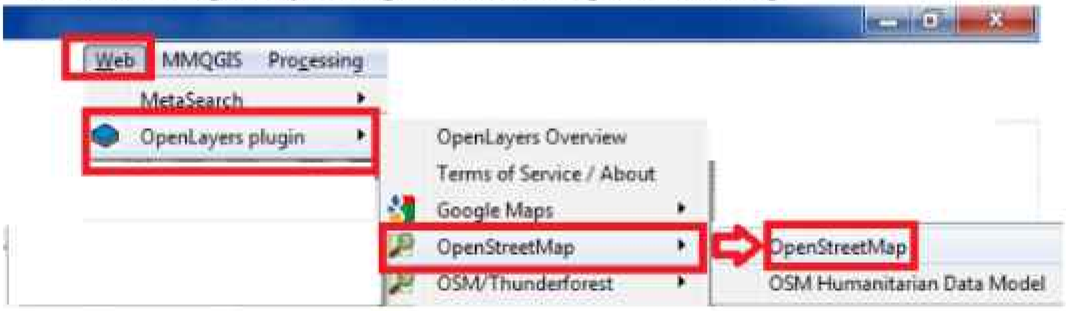
d) Searching and Downloading OpenStreetMap Data

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.

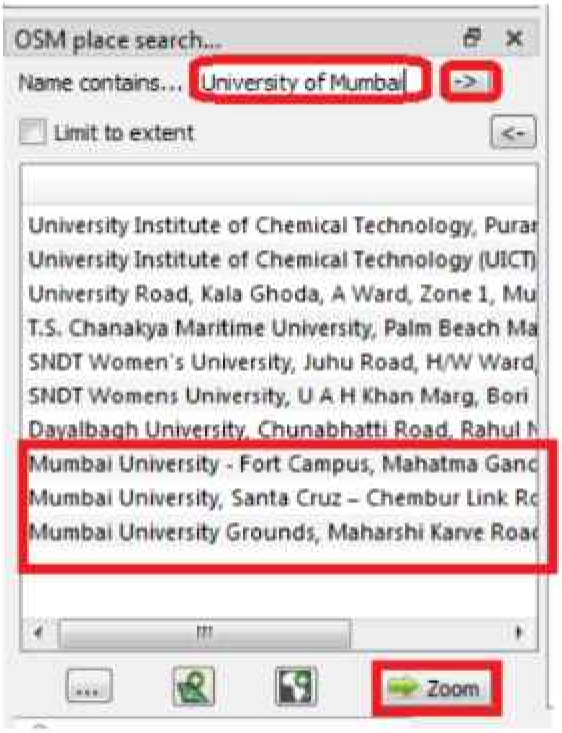
- Add "**Open Layer"** and "**OSM Search"** Plugin from Not Installed option from Plugin Manager Dialog Box.
- The **OSM Place Search** plugin will install itself as a *Panel* in QGIS, if not go to View → Panels → select OSM Place Search.



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

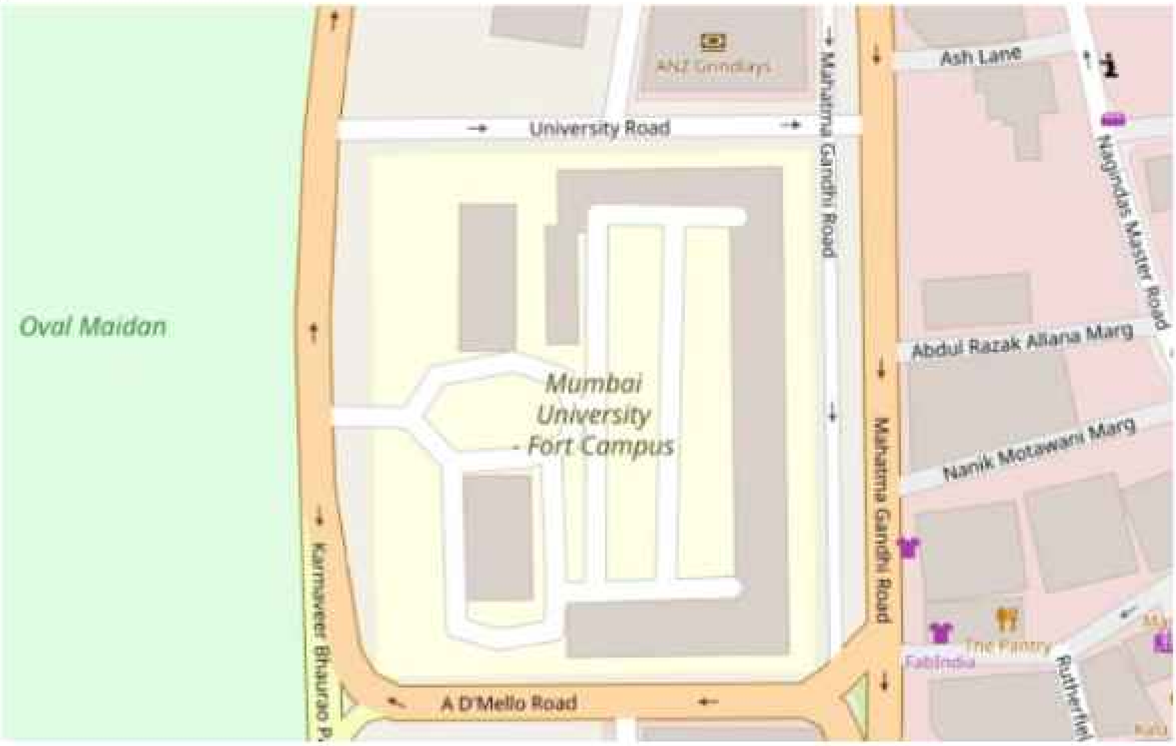


- A World map will appear on screen.
- If an error occurs in loading maps, go to project properties → CRS →



- 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 

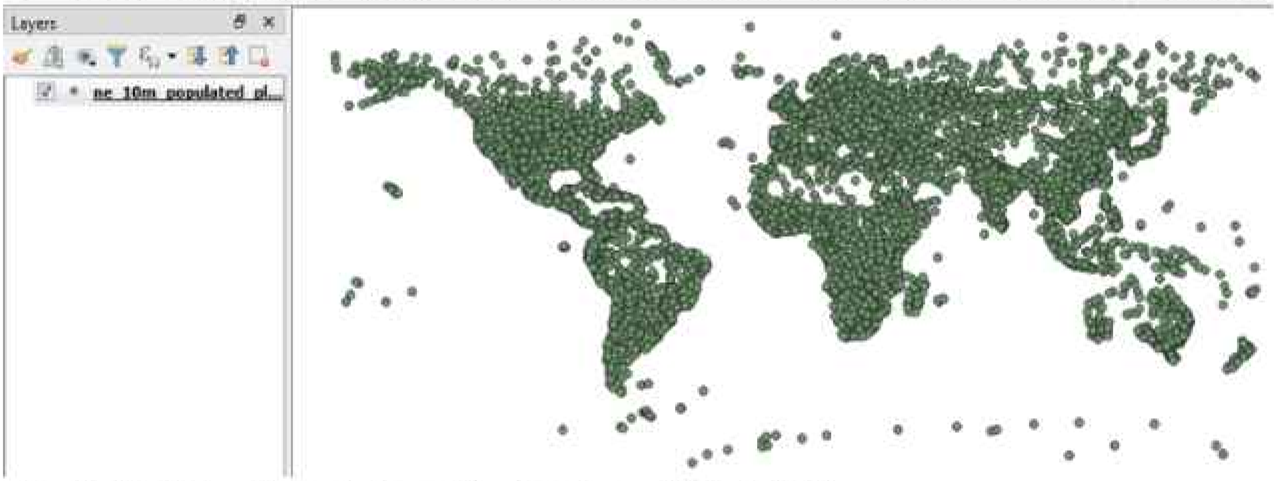
Output:



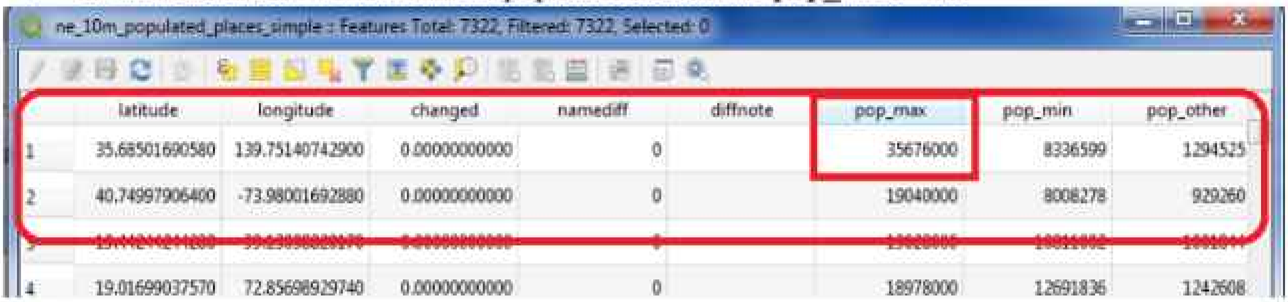
PRACTICAL - 4

A. Working with attributes

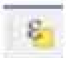
- ➢ Start a new project.
- ➢ Go to Layer → Add Layer → Add Vector Layer
- ➢ Select "\GIS_Workshop\Practicals\Practical_04\A\Data\ne_10m_populated_places_simple.zip"

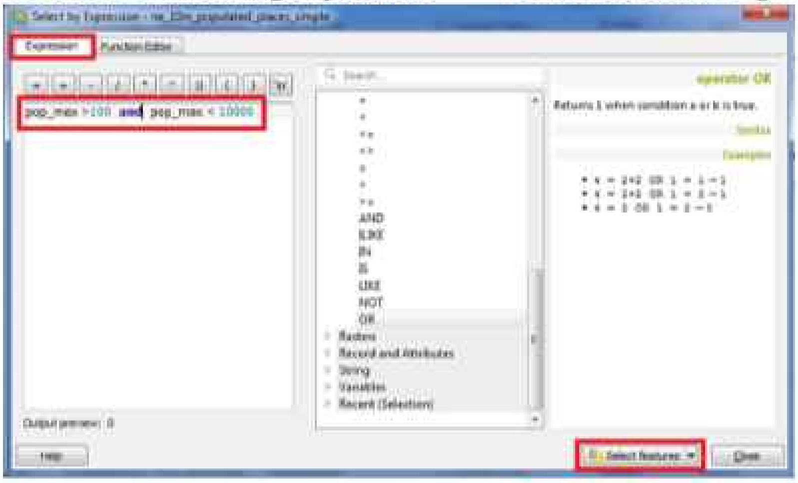


- ➢ Right click on Layer in Layer Panel → Open Attribute Table.
- ➢ Explore various attributes and their values in the Attribute table.
- ➢ To find the Place with maximum population click on "**pop_max**" file


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

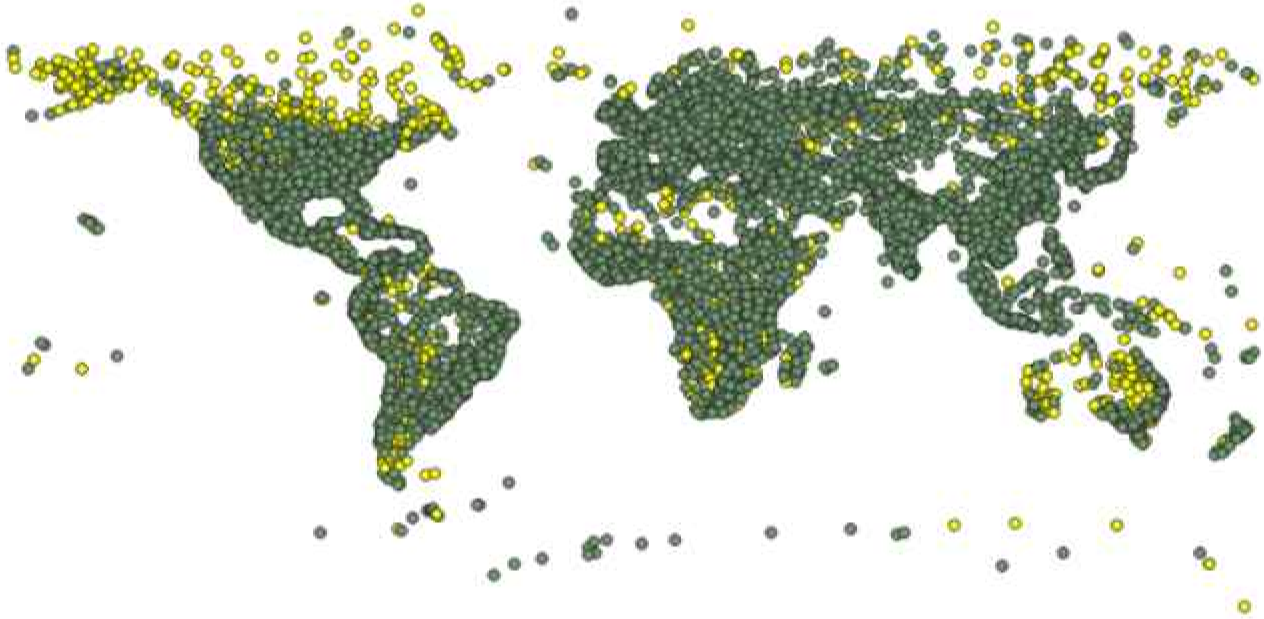
	latitude	longitude	changed	namediff	diffnote	pop_max	pop_min	pop_other
1	35.68501690580	139.75140742900	0.00000000000	0		35676000	8336599	1294525
2	40.74997906400	-73.98001692880	0.00000000000	0		19040000	8008278	929260
3	[illegible]	[illegible]	[illegible]	0		[illegible]	[illegible]	[illegible]
4	19.01699037570	72.85698929740	0.00000000000	0		18978000	12691836	1242608

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



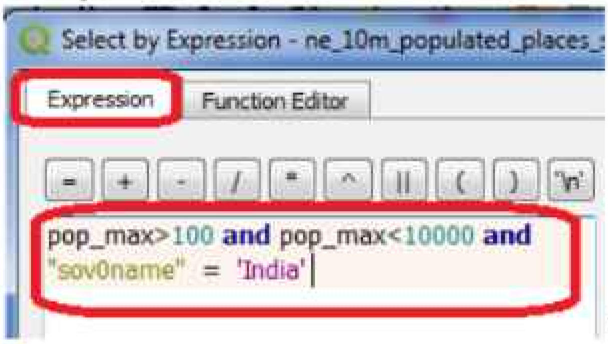
- ➢ Enter pop_max>100 and pop_max<10000 and click  button to get all the places with population between 100 and 10000.

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

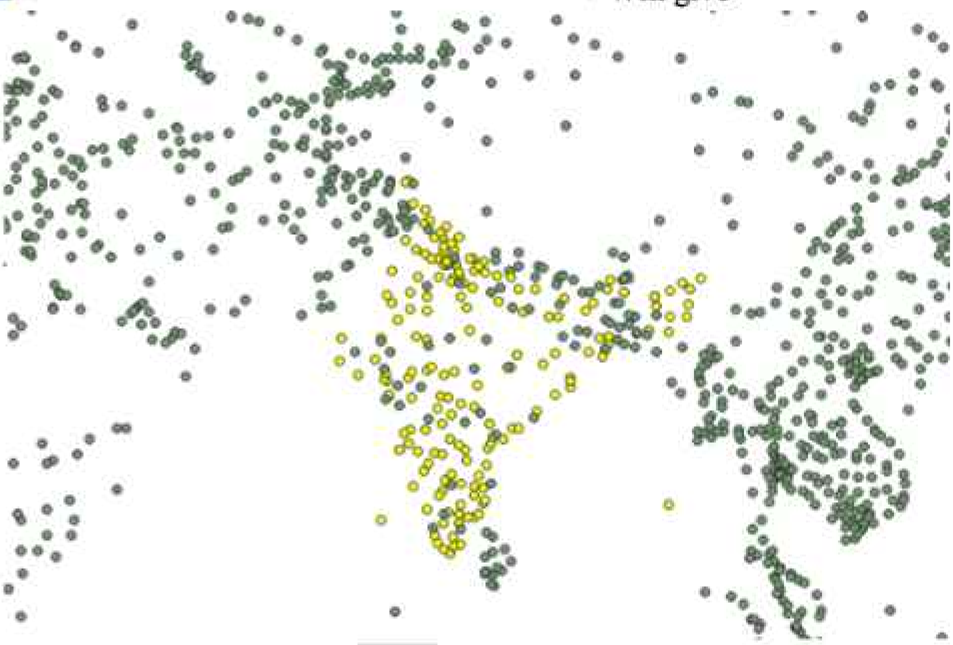


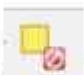
➢ Different queries can be performed using the dataset.

➢ Try this



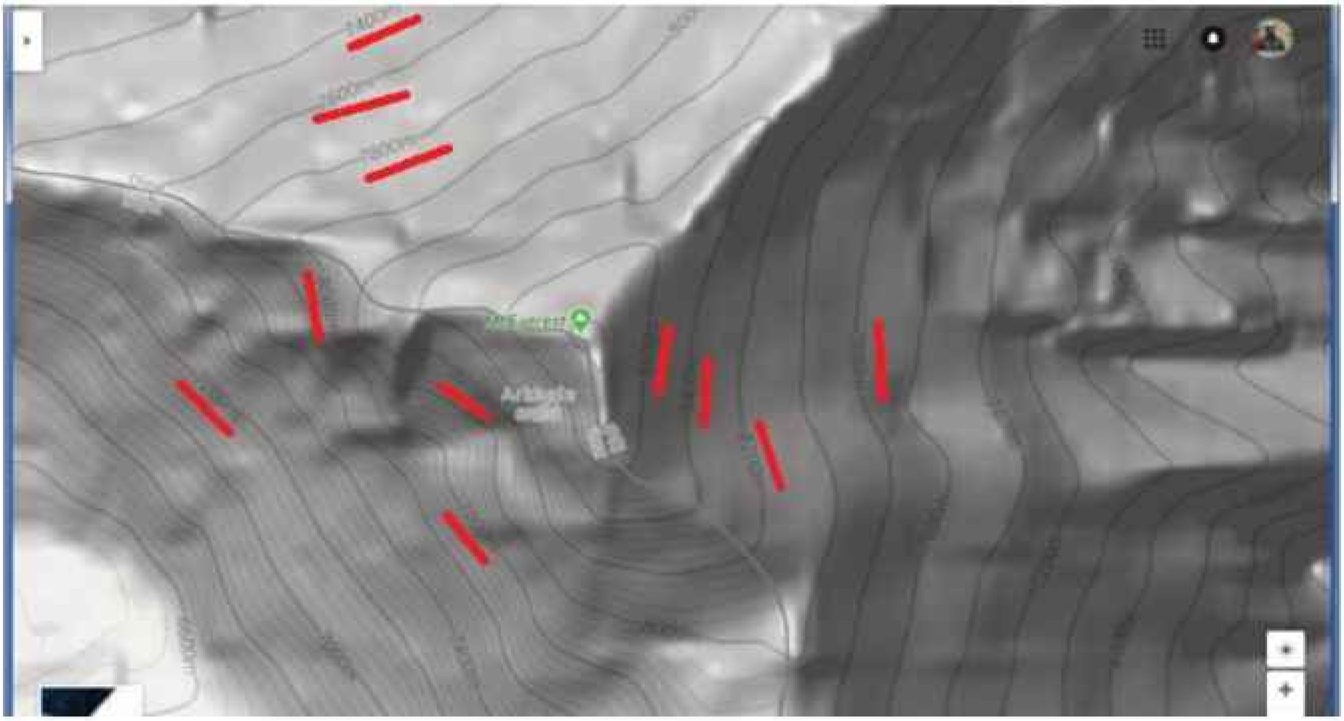
Will give



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

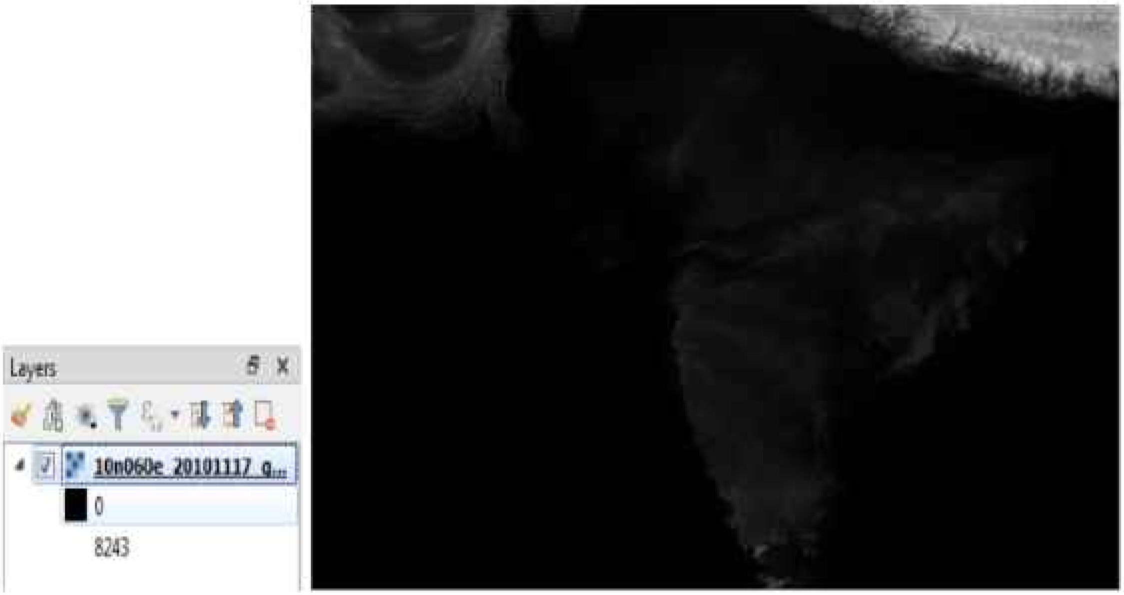
b) Terrain Data and Hill shade analysis

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.

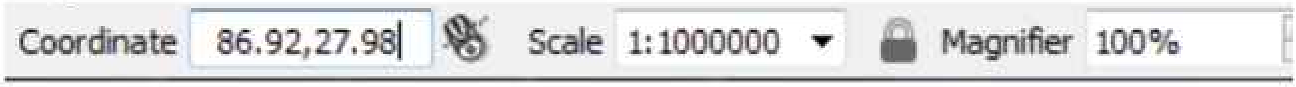


https://www.google.com/maps/@27.9857765,86.9285378,14.75z/data=!5m1!1e4?hl=en-US

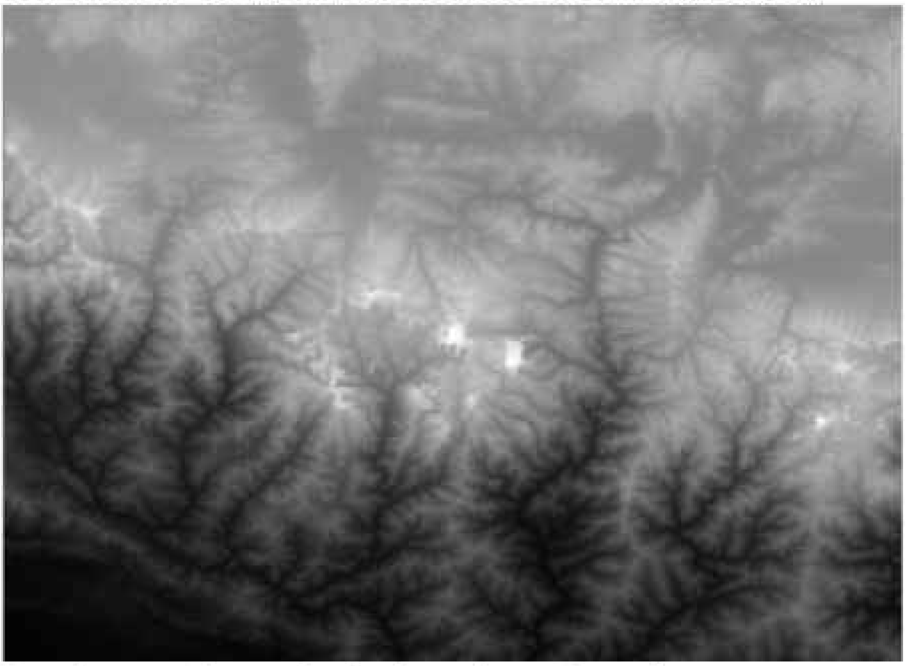
- Go to Layer → Add Raster Layer → select "10n060e_20101117_gmted_mea300.tif", from Data folder



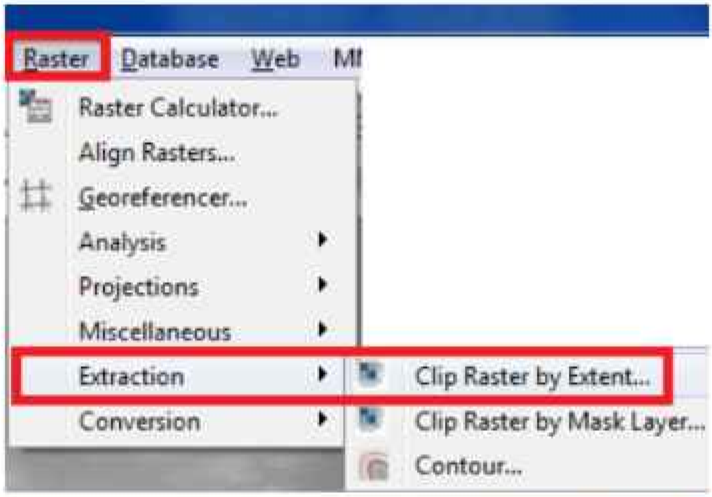
- The Lower altitude regions are shown using dark color and higher using light shade as seen on top region containing Himalaya and Mt Everest.
- Mt. Everest - is located at the coordinates 27.9881° N, 86.9253° E.
- Enter 86.92, 27.98 in the coordinate field, Scale 900000 and Magnifier 100% at the bottom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

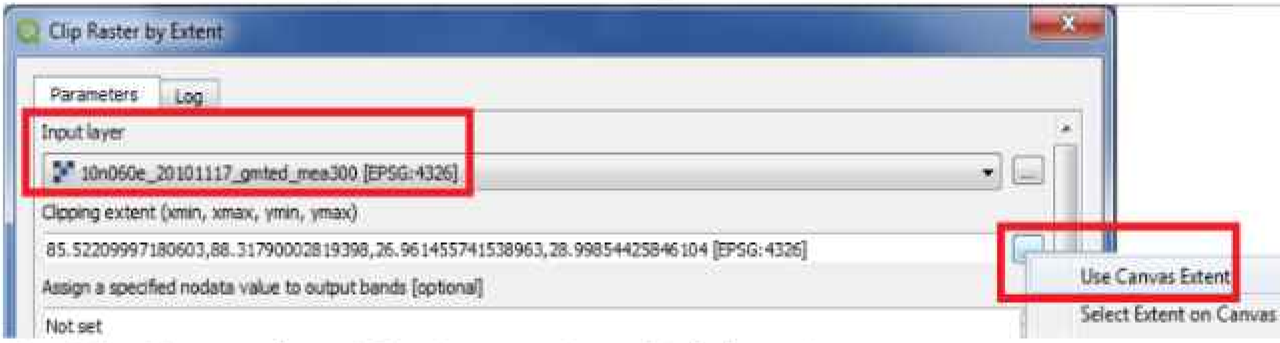


- Press enter the view port will be centered on Himalaya Region.



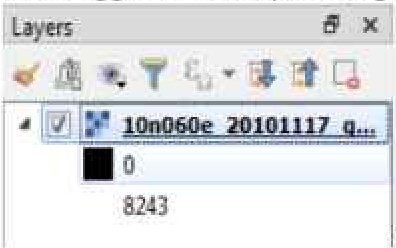
- Crop the raster layer only for the region under study.
- Go to Raster → Extraction→ Clip Raster by Extent



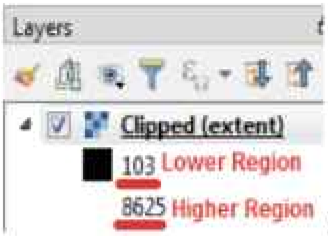


- Select the raster layer *(if project contains multiple layers)*.
- Select the clipping area by selecting the option **Use Canvas Extends** if the visible part of map is to be selected or manually select an area on canvas by using **Select Extent on Canvas**.
- Select the location and file name for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

- Press RUN.
- Deselect the original layer and keep the clipped one.
- The Clipped raster layer is representing altitude are from 103 Meters.

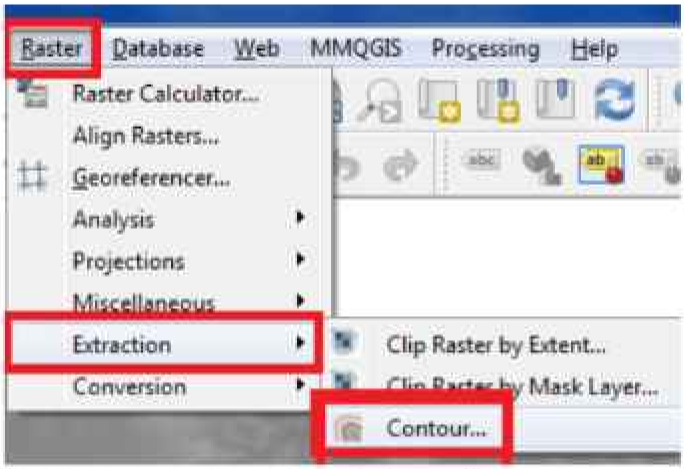


Original Raster

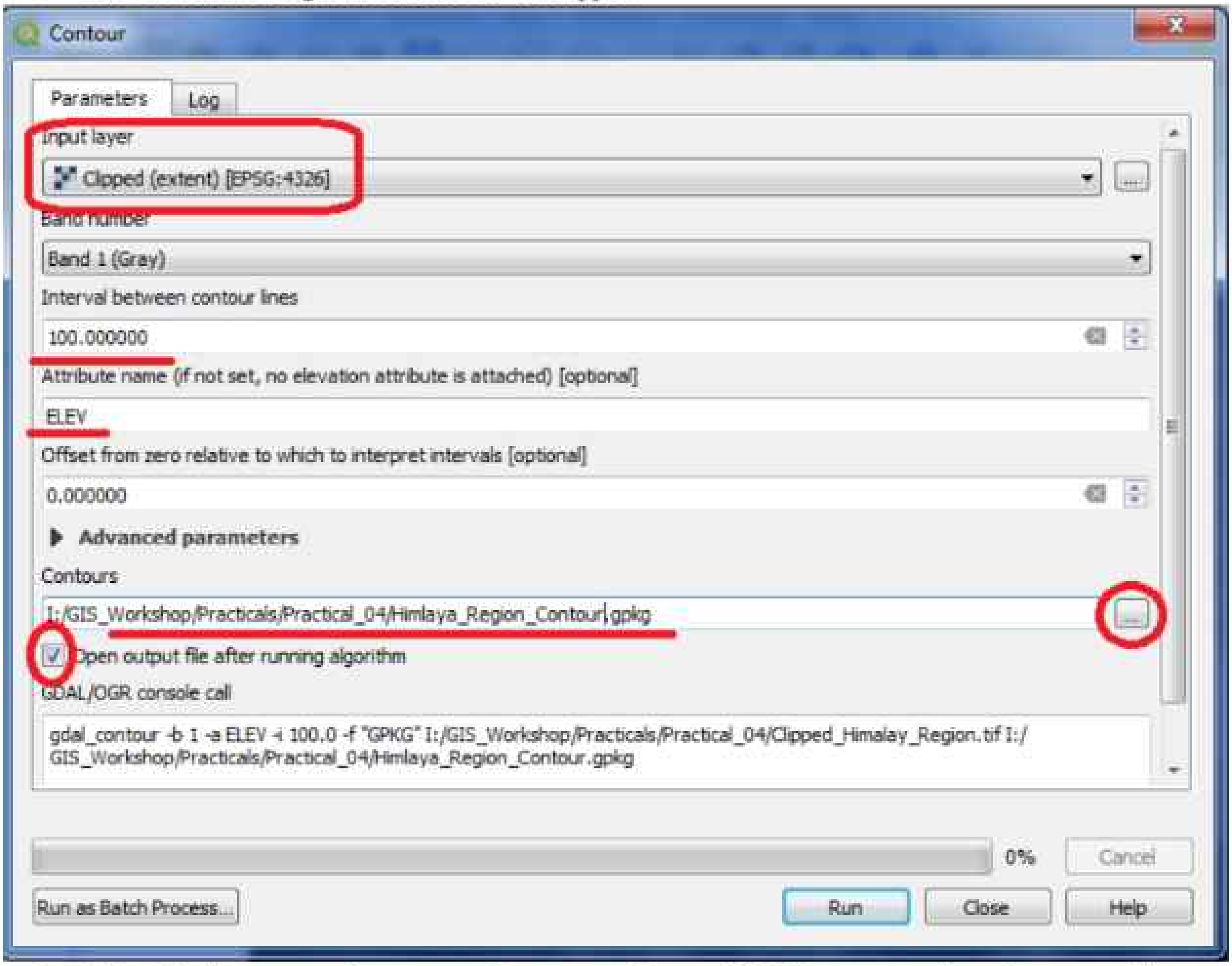


Clipped Raster

- 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

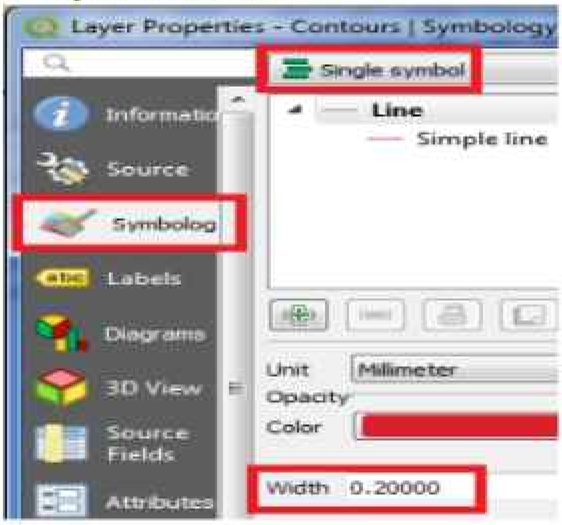


- The Contour configuration window will appear

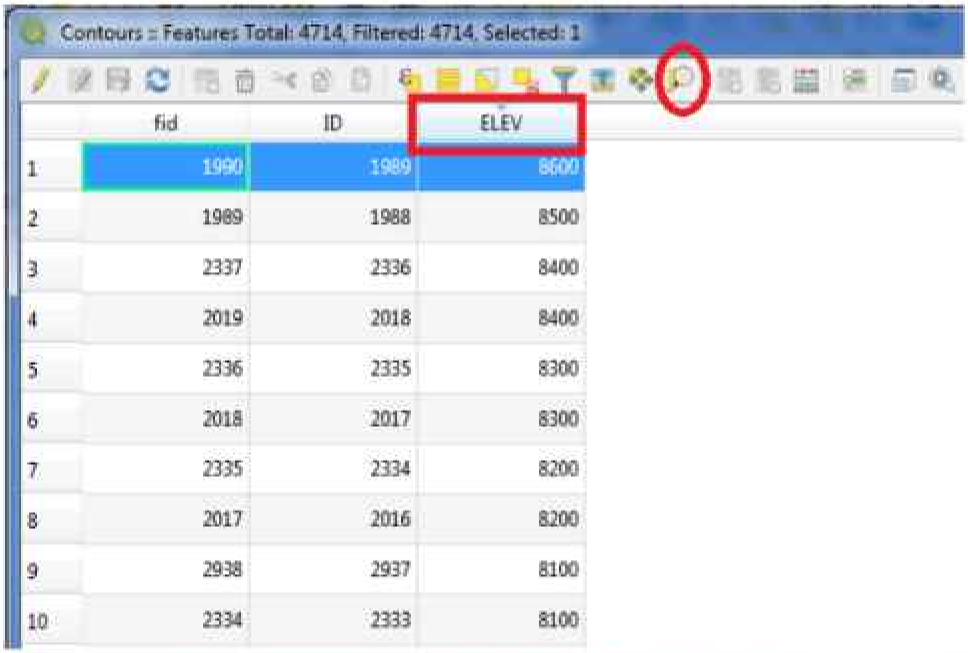


- Select the input raster layer name. Set contour interval 100.00 meters, select the output file name & location and check the option to add output file to project after processing.
- Press "RUN".
- The contour layer will appear like this

➢ Label the layer using "ELEV" field and set appropriate symbols for line.

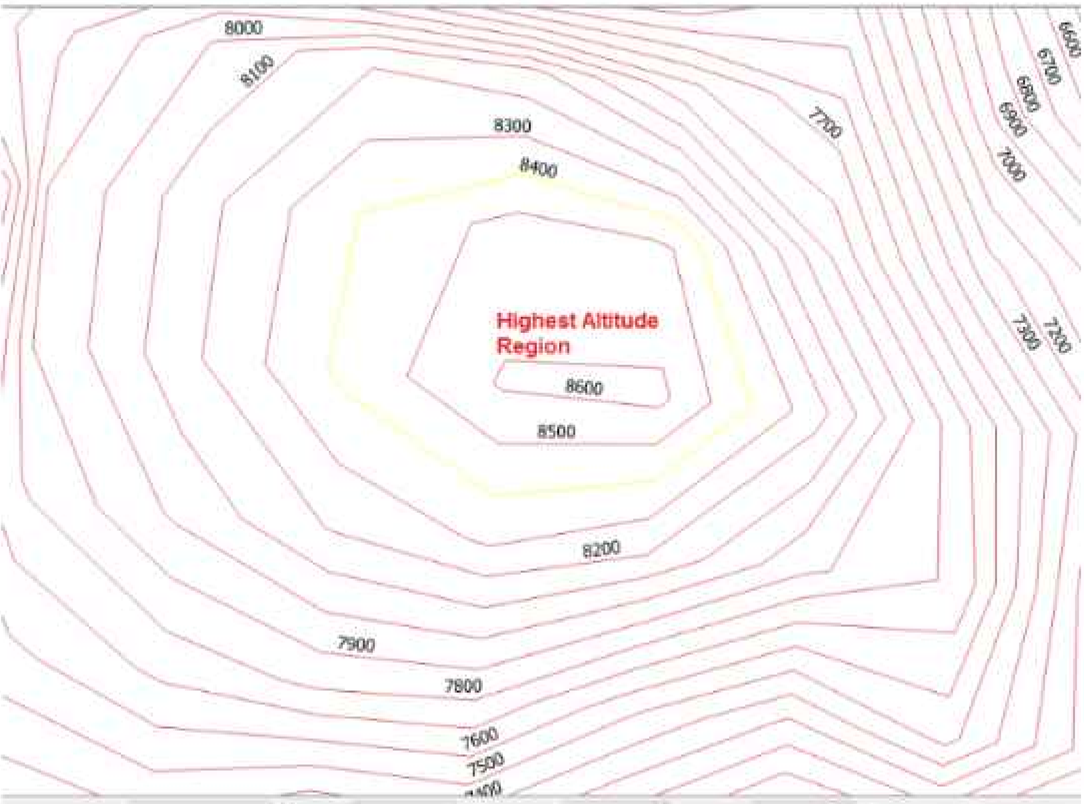


➢ In the Layer panel right click on Contour Raster Layer and select "**Open Attribute table**",
➢ Arrange the table in descending order based on the value of "ELEV" column.
➢



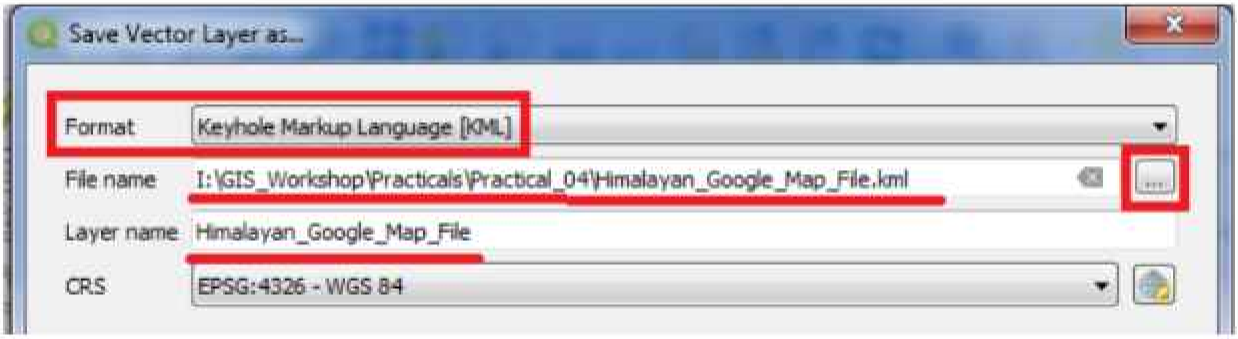
Contours :: Features Total: 4714, Filtered: 4714, Selected: 1

	fid	ID	ELEV
1	1990	1989	8600
2	1989	1988	8500
3	2337	2336	8400
4	2019	2018	8400
5	2336	2335	8300
6	2018	2017	8300
7	2335	2334	8200
8	2017	2016	8200
9	2938	2937	8100
10	2334	2333	8100



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

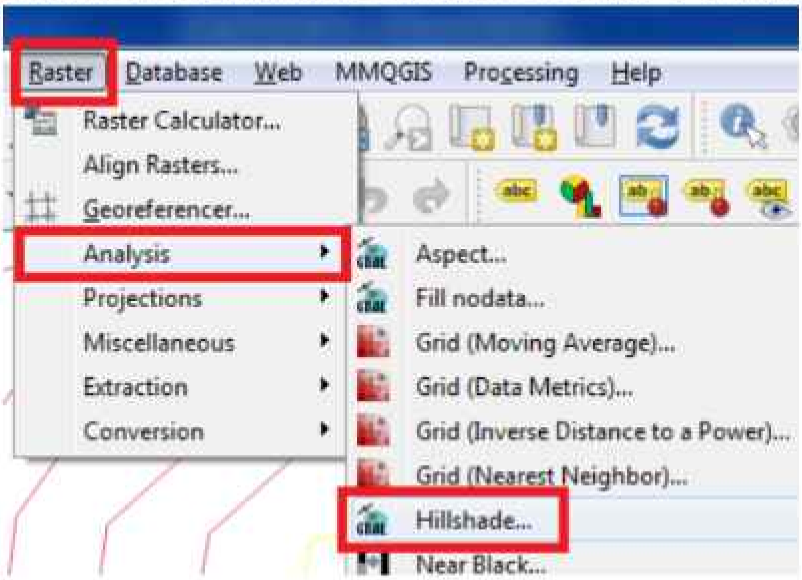
- To verify the above contour files using Google Map
- Make a copy of Contour Layer, Go to Layer →Save As
- Select file format as "Keyhole Markup Language", set file name, location and Layer Name.
- Also set CRS to WGS 84 EPSG:4326



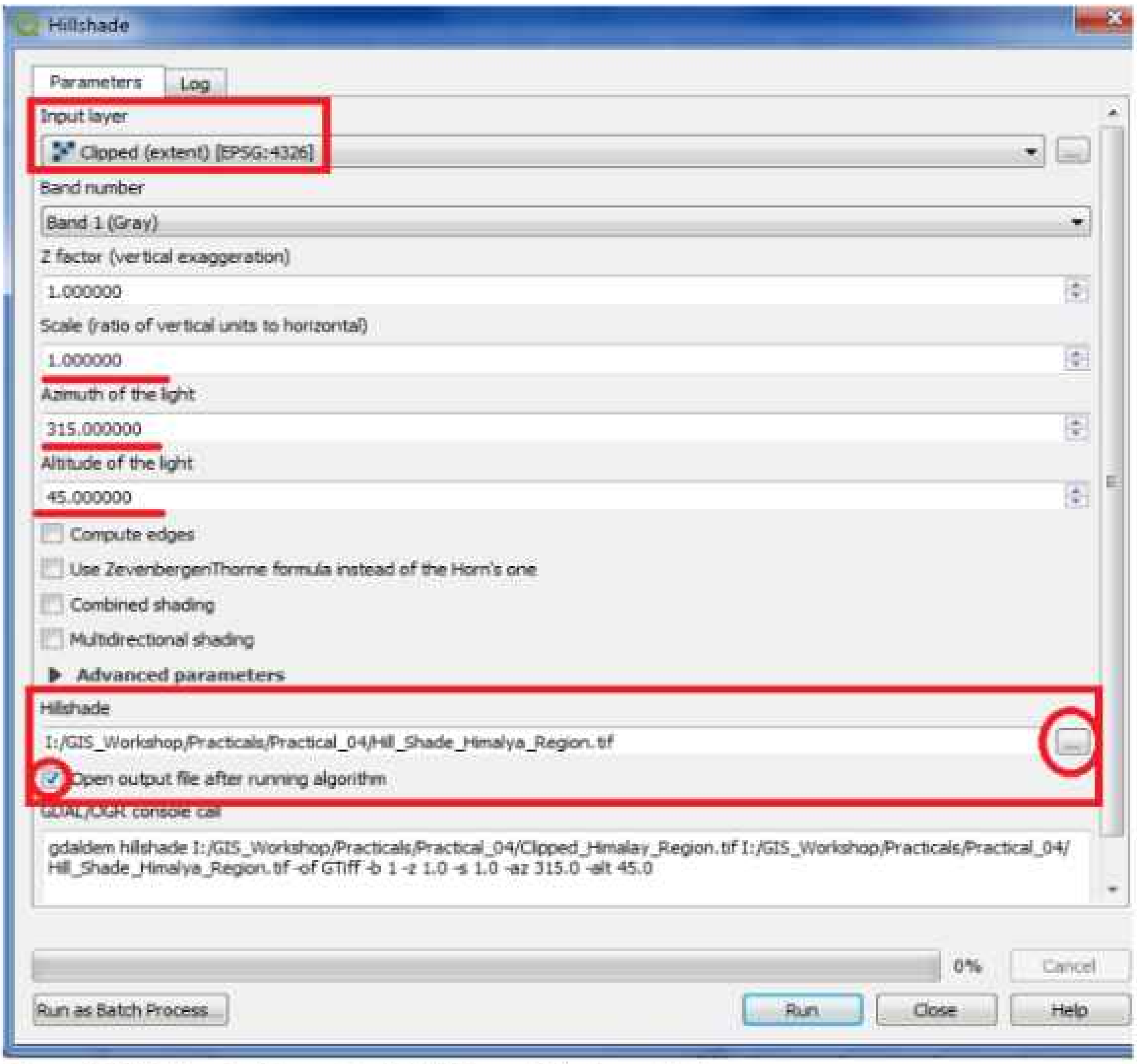
- Go to the stored location on Hard Disk and open the "Himalayan_Google_Map_File.kml" with Google Map.\

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.

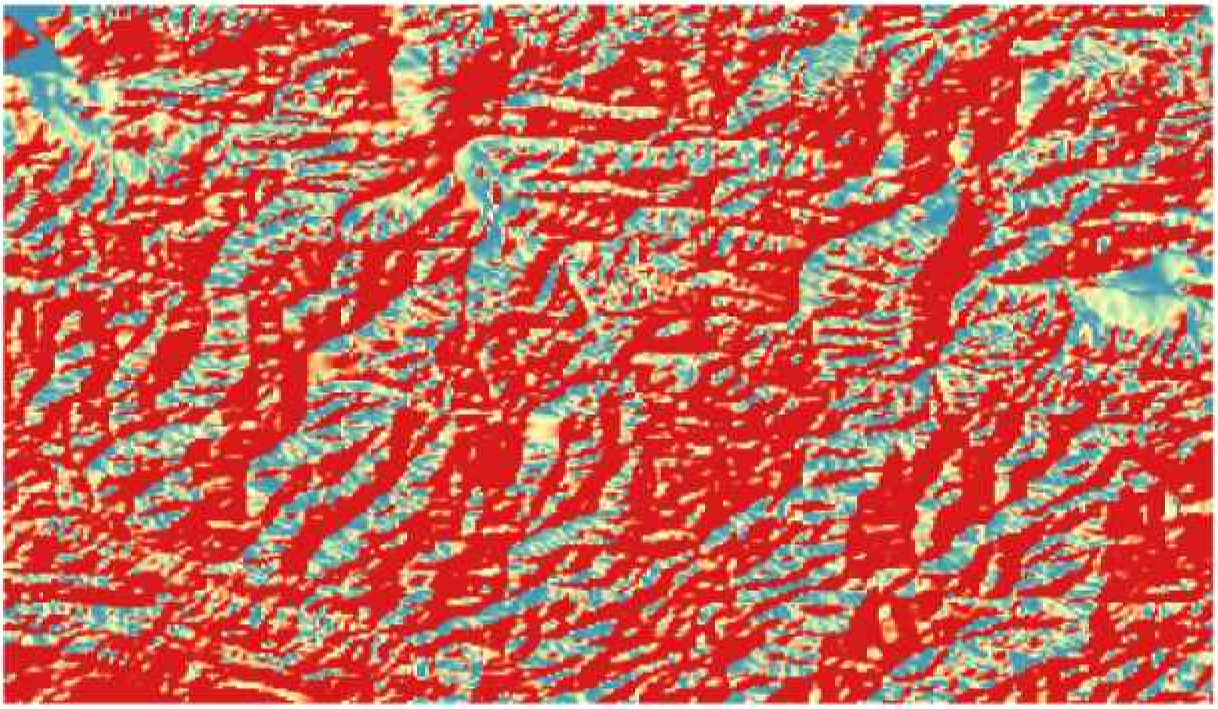
- For Hill Shade surface analysis
- Go to Plugin → Install Georeferencer GADL.
- After successful installation of plugin Go to Raster → Analysis → Hill Shade



- 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.

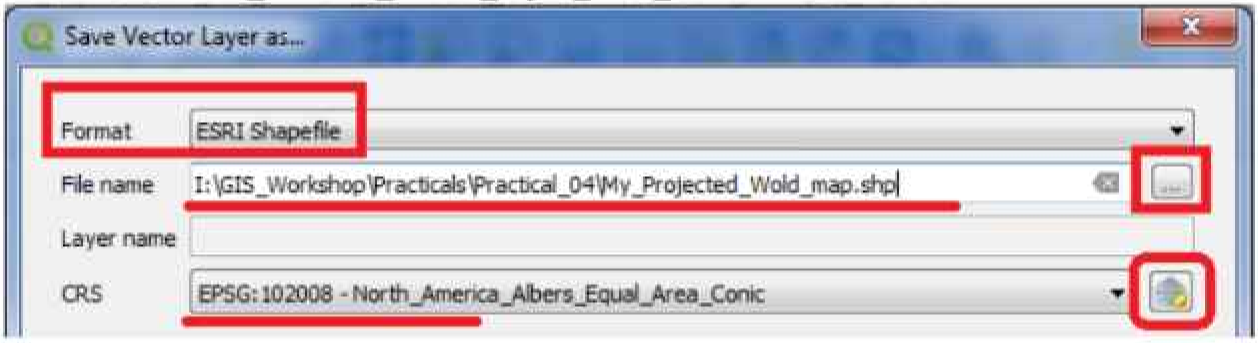


PRACTICAL - 5

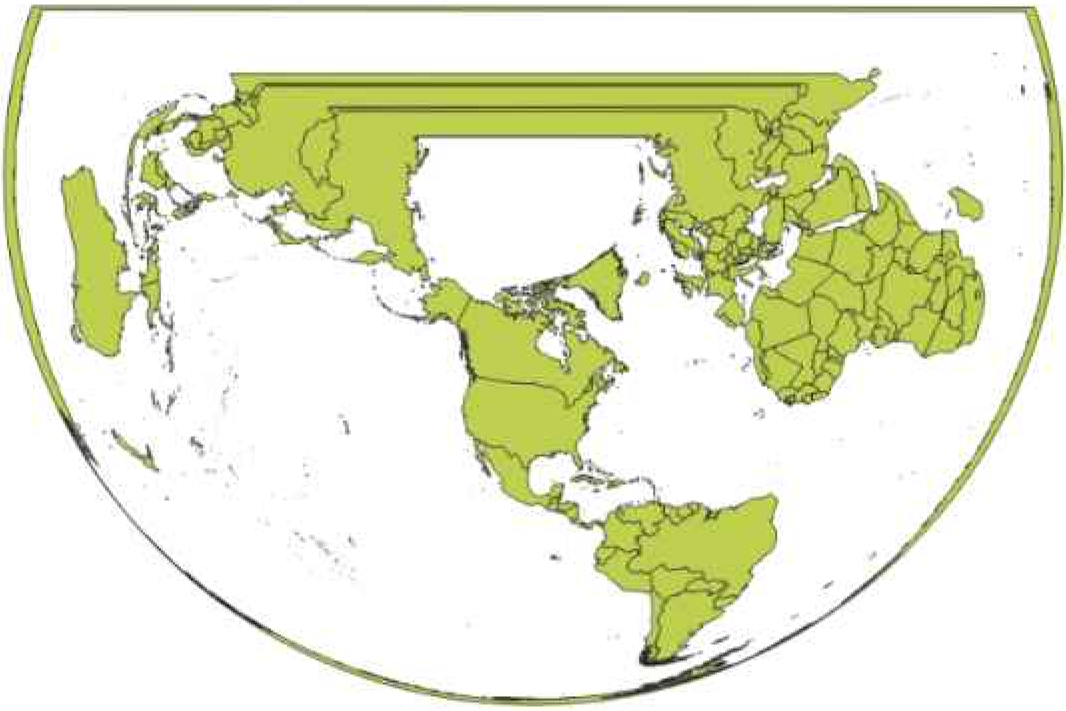
Working with Projections and WMS Data

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



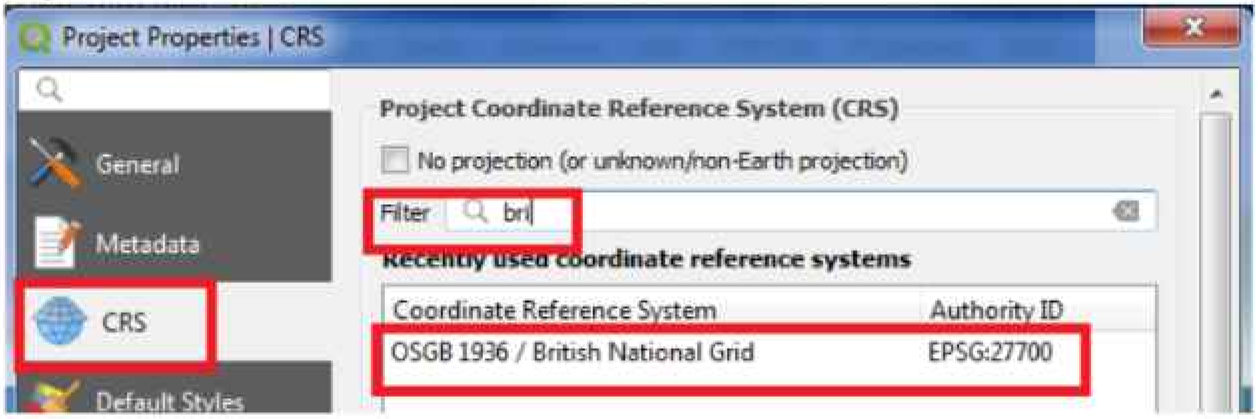
- Press "OK".
- Deselect the original Image and keep the projected layer visible.



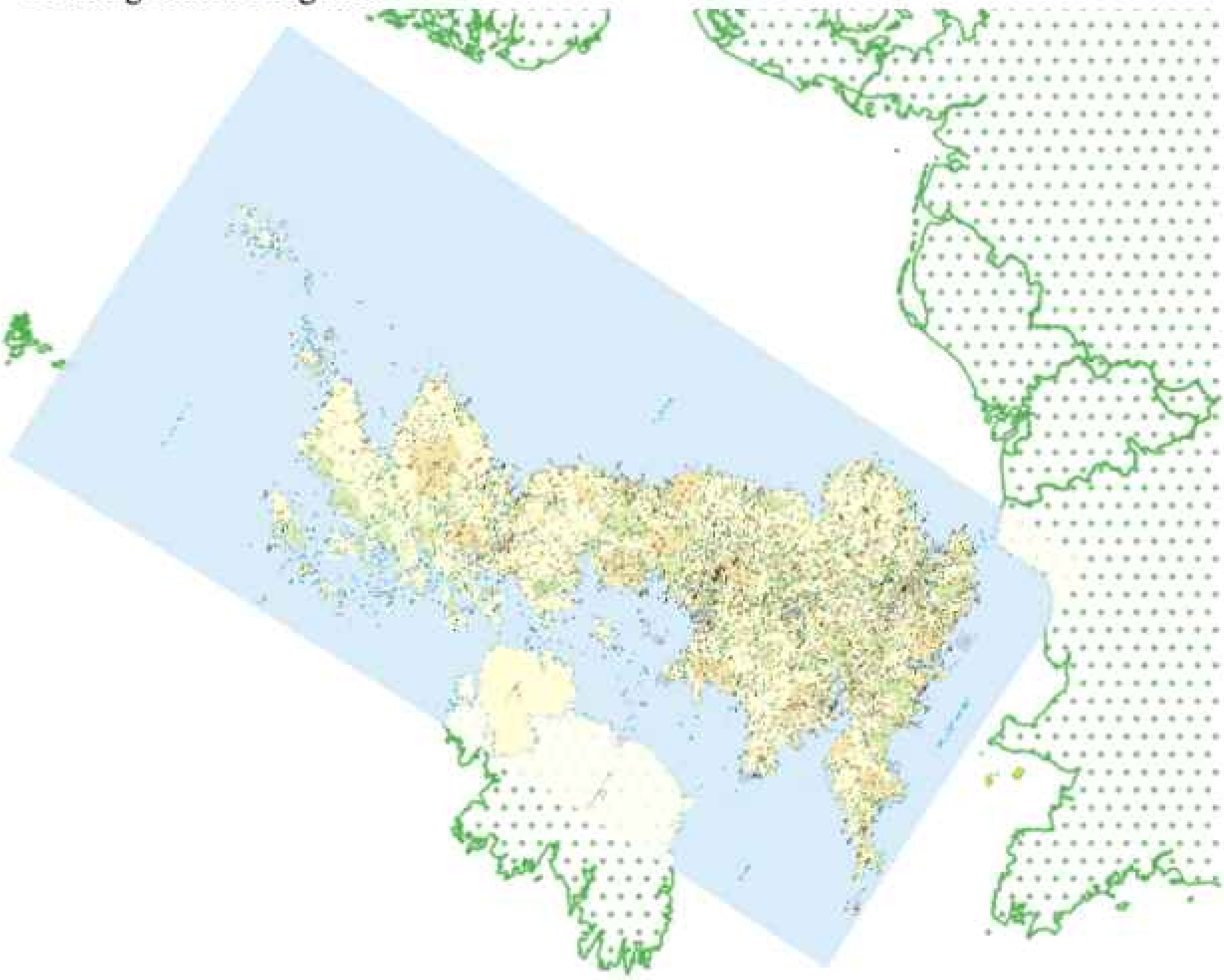
- Select Layer → Add Layer → Add Raster Layer → Select MiniScale_(standard)_R17.tif from Location

"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

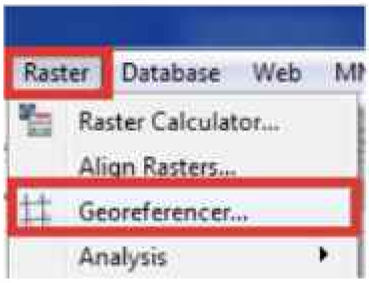
- **Georeferencing**

  A. Georeferencing Topo Sheets and Scanned Maps

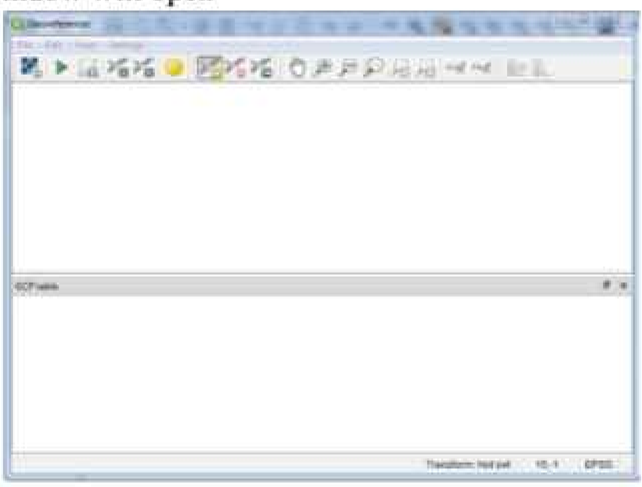
  - Start a new project
  - Go to Layers → Add Layer → Add vector Layer
  - Select GIS_Workshop\Manual\Prac06\IND_adm0.shp
  - Zoom in to Mumbai region in the layer.

  - Go to Plugins→ Manage and Install Plugins
  - Ensure that 

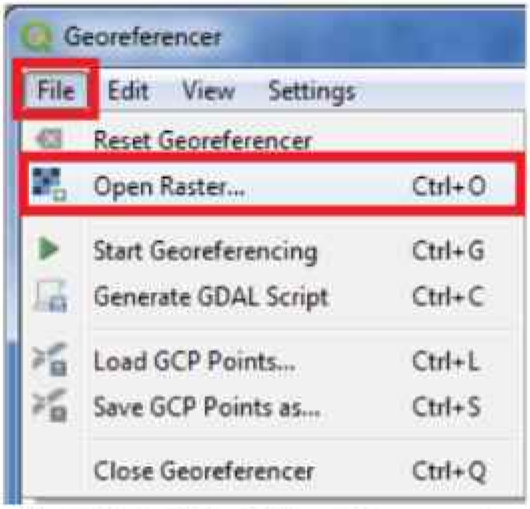
is checked, if not install Georeferencer GDAL plugin.
  - Go to Raster → Georefrencer



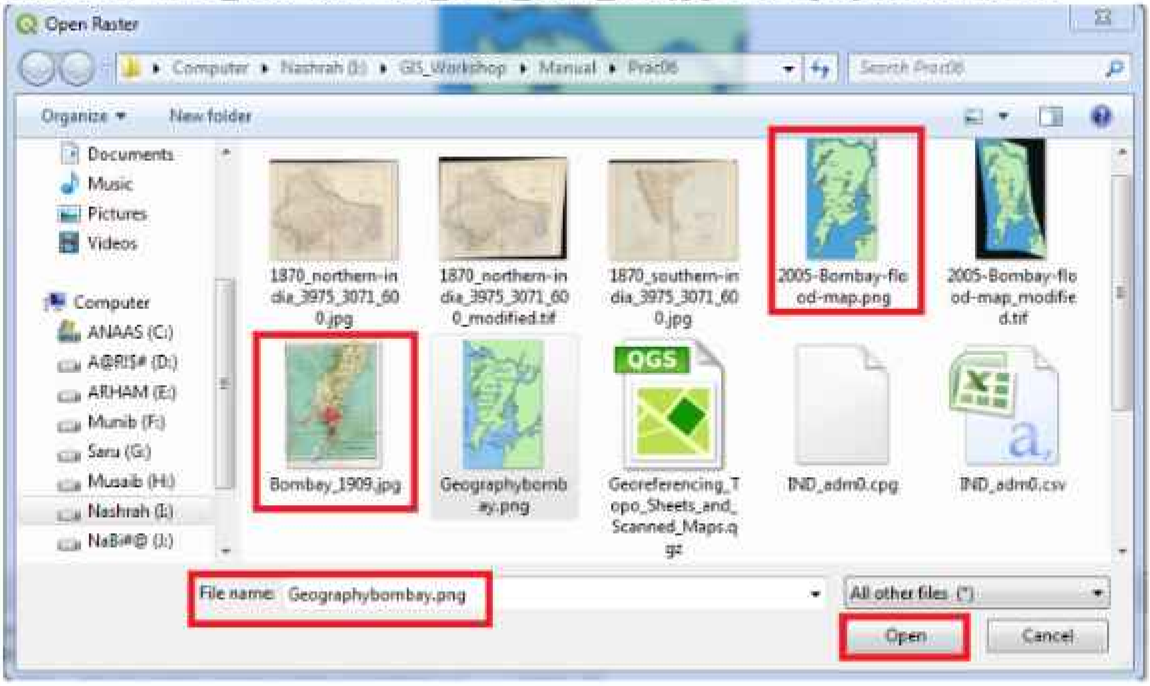
  - A new Georeferencer window will open



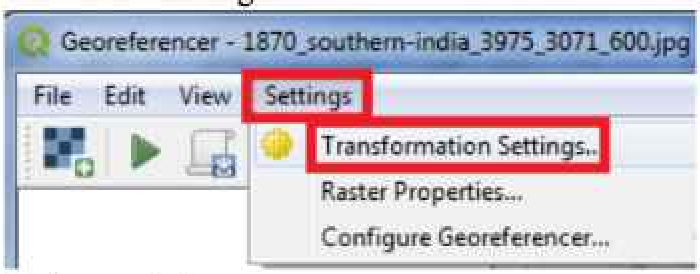
  - File → Open Raster



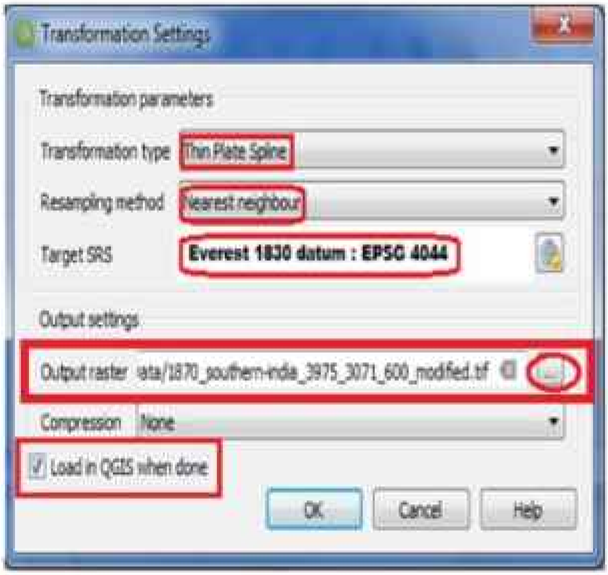
➢ Select file "1870_southern-india_3975_3071_600.jpg" from project data folder



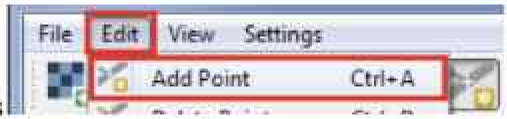
➢ Go to Settings →Transformation Settings



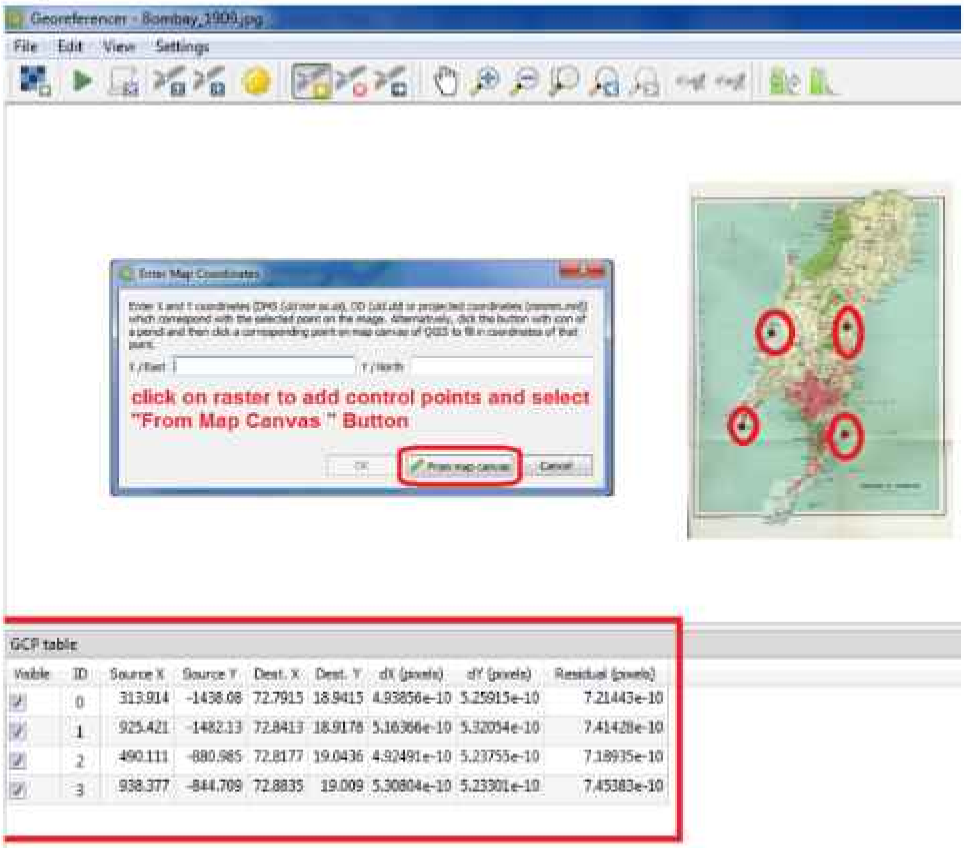
➢ In the Transformation Settings window



- 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".

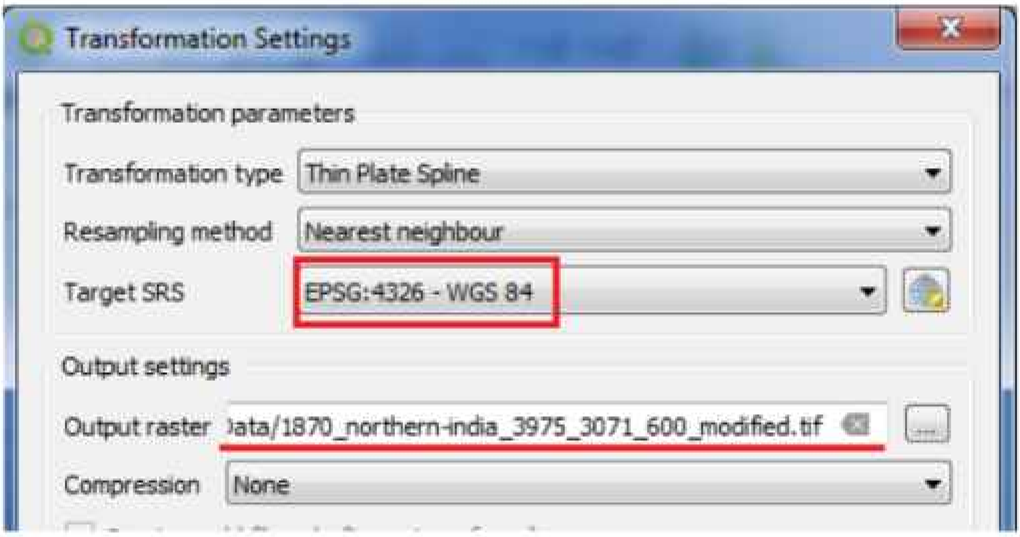


➢ In Georeferencer window Go to Edit → Add Points



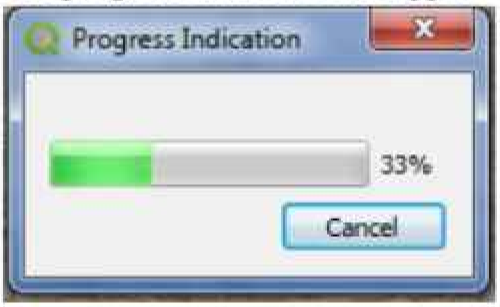
➢ Select the set of control points.

➢ Go to, Setting → transformation settings.

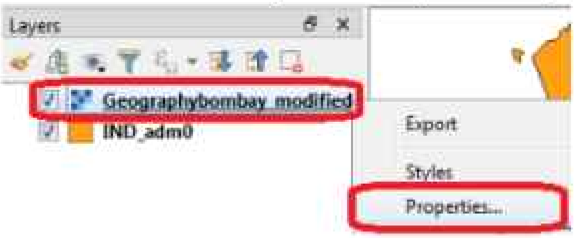


- Press "RUN"
- In Georeferencing window go to → File → Start Georeferencing

- The progress indicator will appear

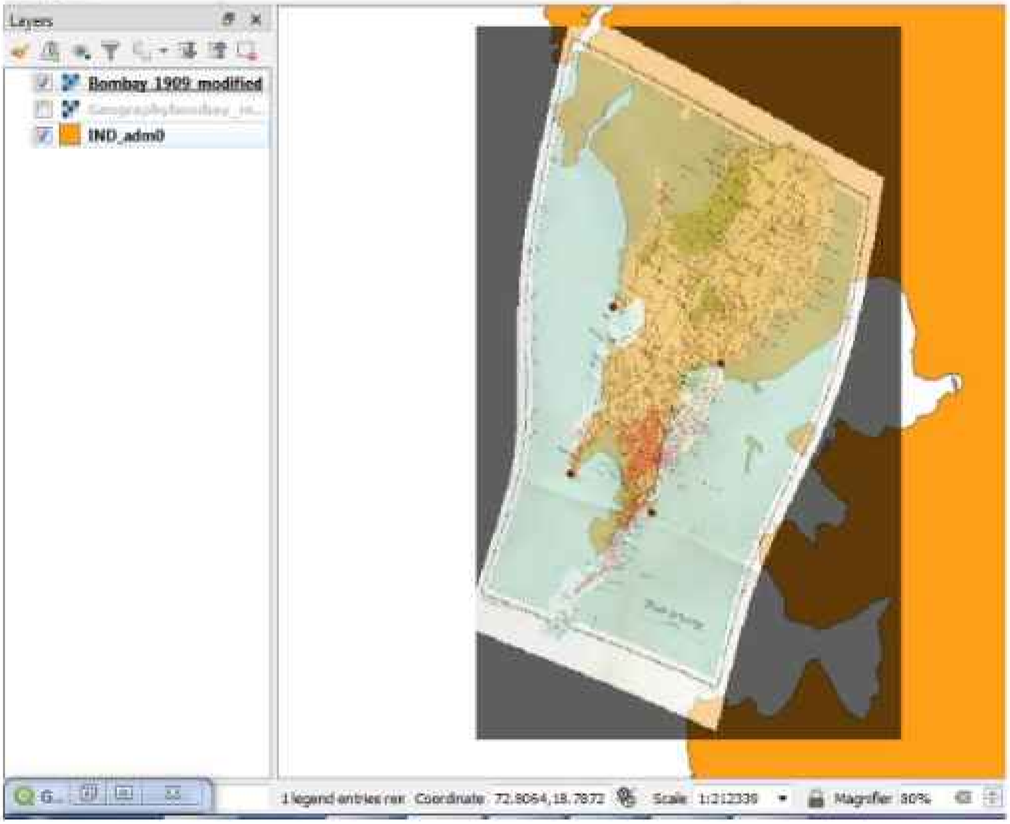


- The canvas area will now have the scanned map of Mumbai referenced with control points.
- Select the newly added layer in Layer Panel Right click and go to property.



- Set Transparency level of raster layer to appropriate level.

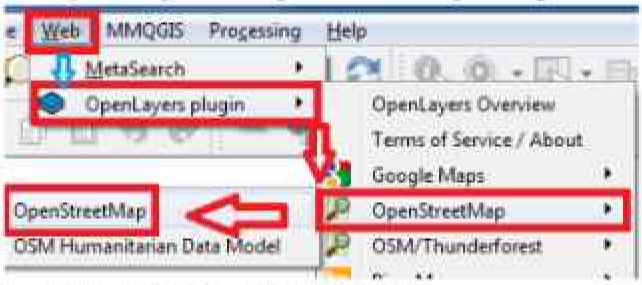
Output:



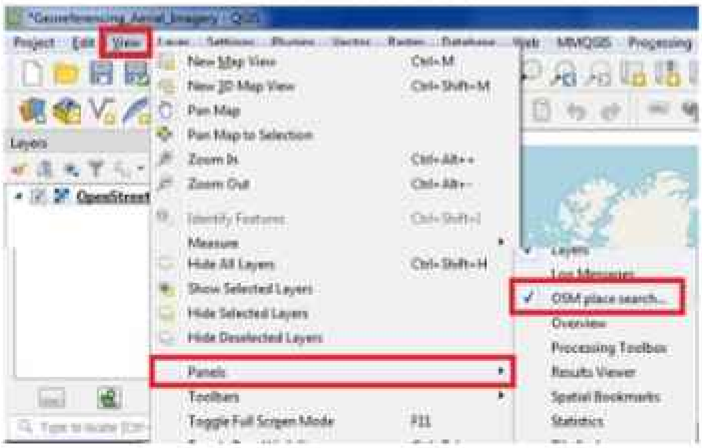
➢ The Scanned Image map coincides with the existing map.

B. Georeferencing Aerial Imagery

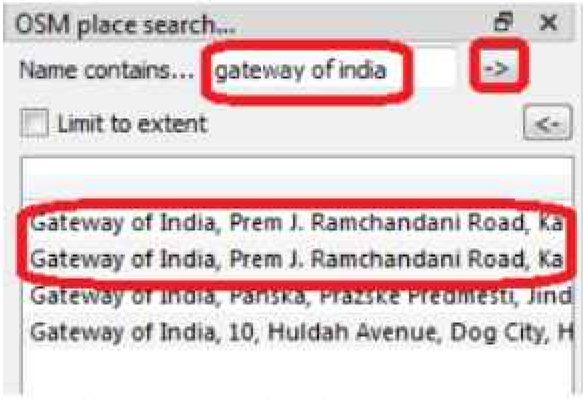
- Install plugin OpenStreetMap
- Go to Web Menu → OpenLayerPlugin → OpenStreetMap→ OpenStreetMap



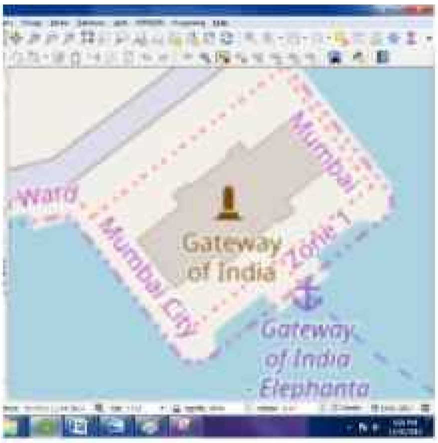
- Go to Project → Properties → Set CRS to EPSG 3857
- Go to View → Panels → select OSM Place search



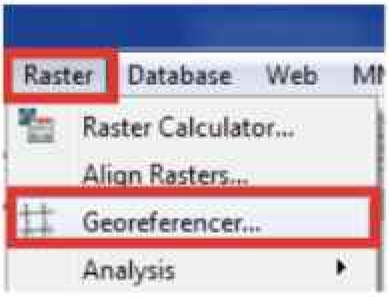
- The Gateway of India, Mumbai is located at 18.92°N 72.83°E
- Search Gateway of India in OSM Search Panel



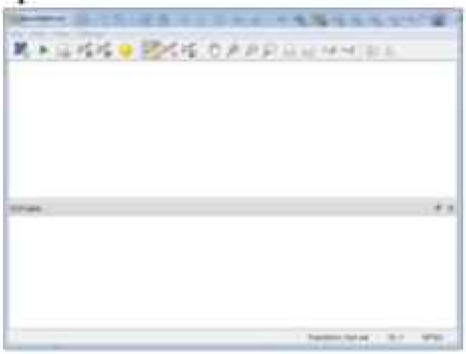
- Zoom in to appropriate level.
- The map will appear like this



- ➢ Go to Raster → Georefrencer

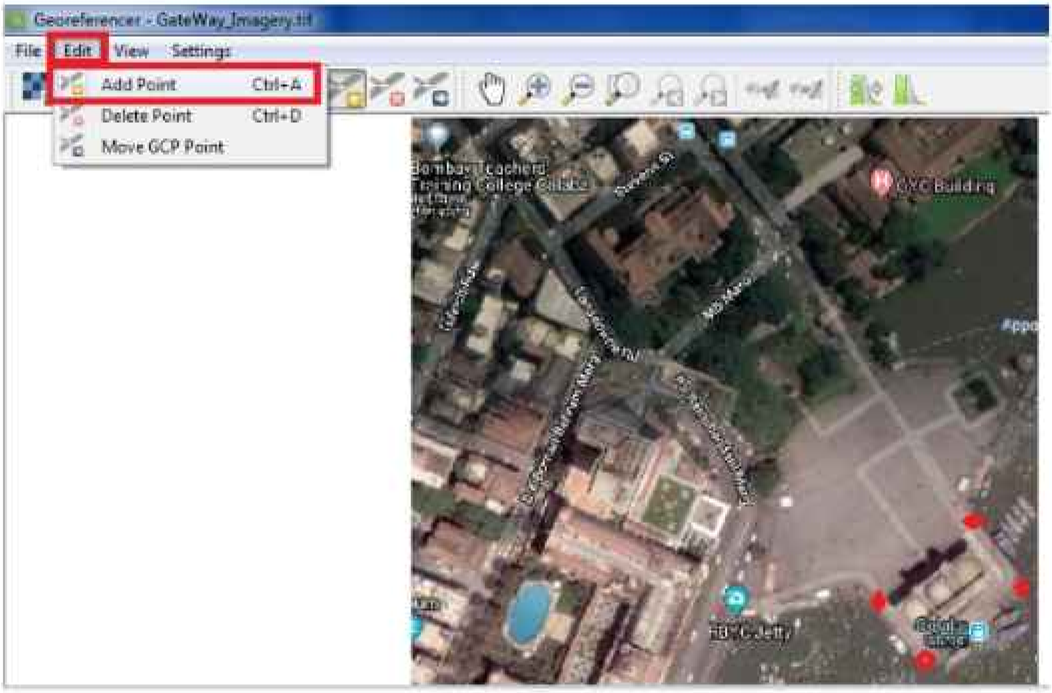


- ➢ A new Georeferencer window will open



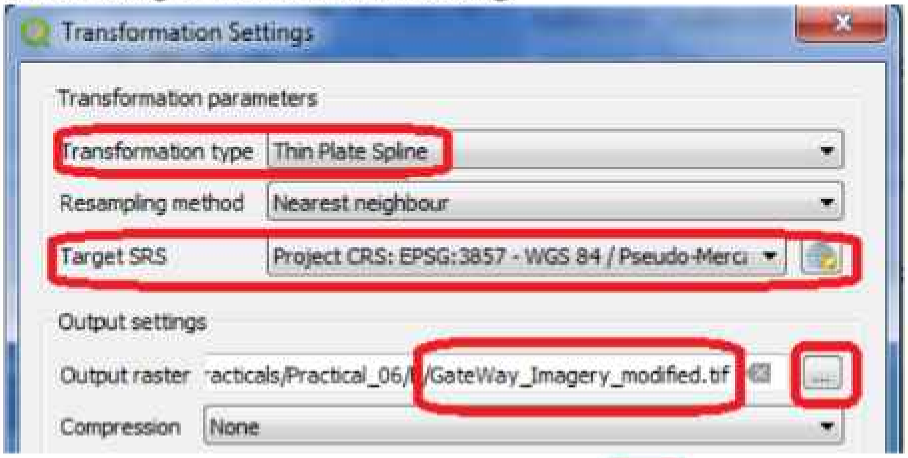
- ➢ File → Open Raster

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

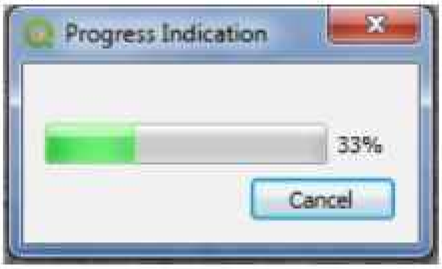


- Go to Edit → Add Point
- Select control points from map (Indicated in red color).

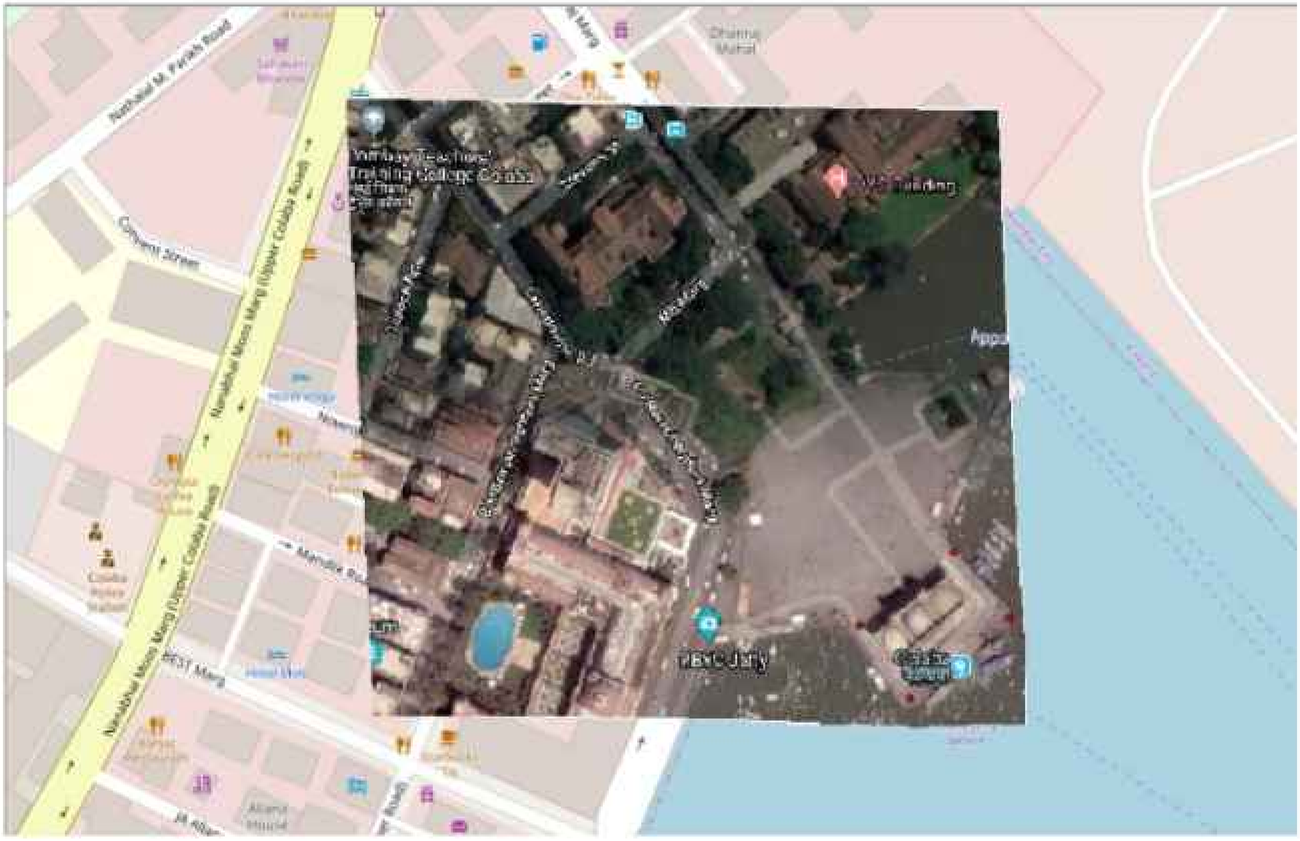
- Go to Setting → Transformation Setting



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



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

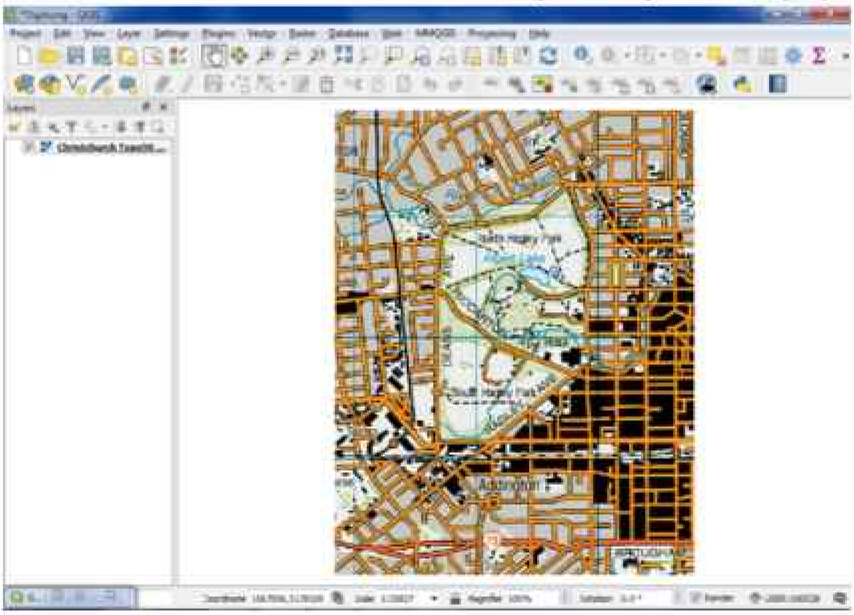


C. Digitizing Map Data

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 diferent types of spatial (point, line, polygon) as well as non-spatial layers. This makes is much easier to move it around instead of a bunch of shapefiles.

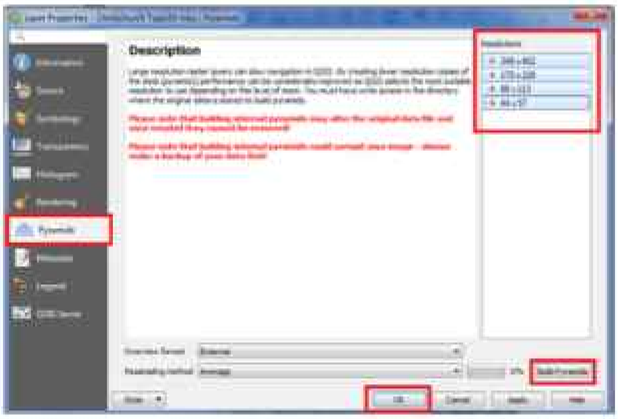
Digitizing Map Data

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

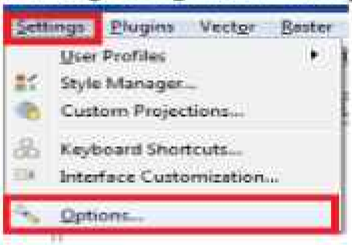


- QGIS offers a simple solution to make raster load much faster by using **Image Pyramids**.
- Right-click the Christchurch Topo50 map.tif layer and select Properties.

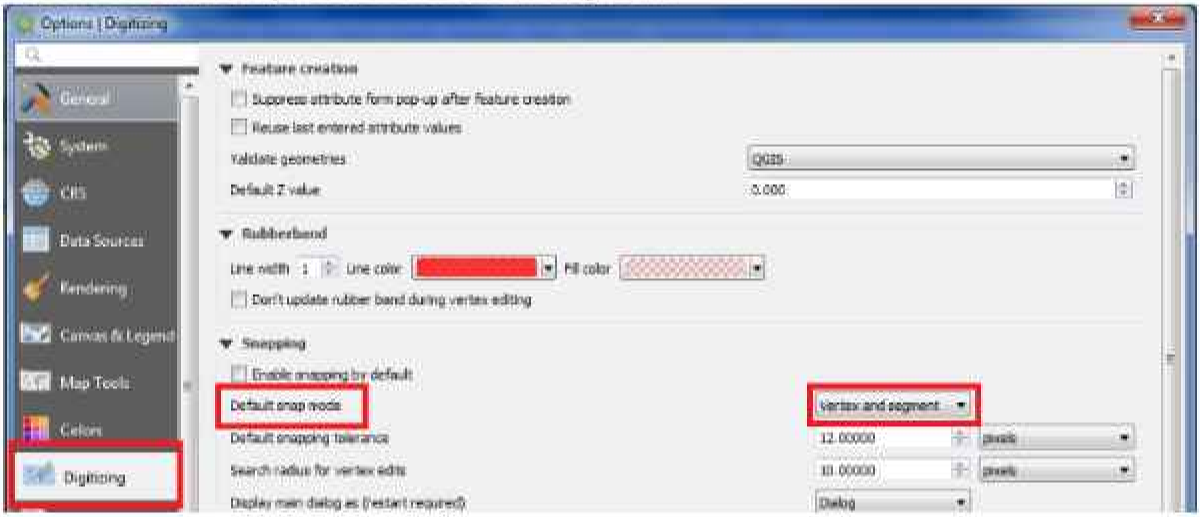
- Choose the Pyramids tab. Hold the Ctrl key and select all the resolutions offered in the Resolutions panel.



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



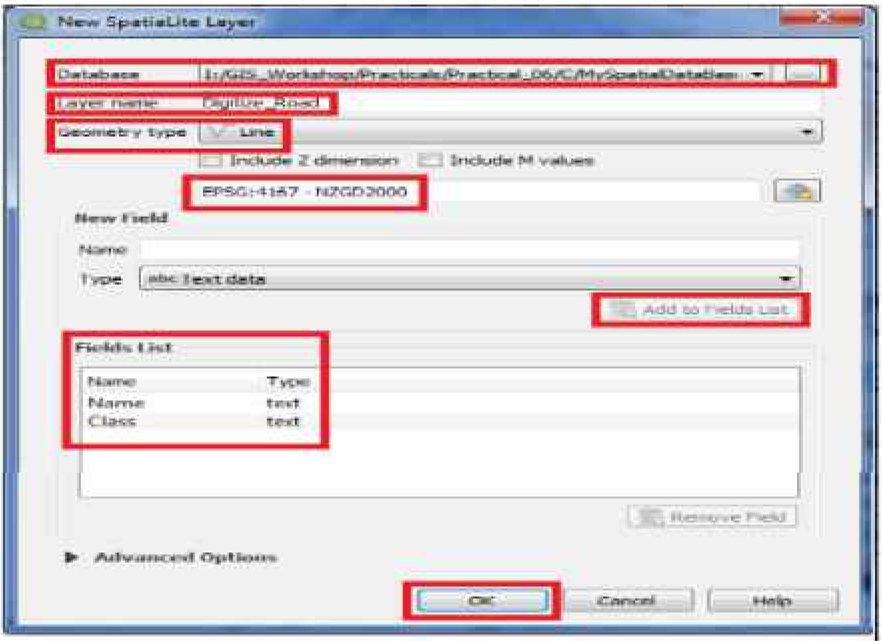
- Set the Default snap mode to vertex and segment.



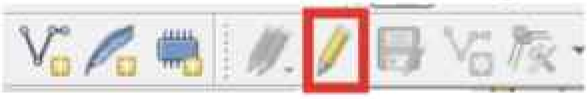
- Press OK.

- 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



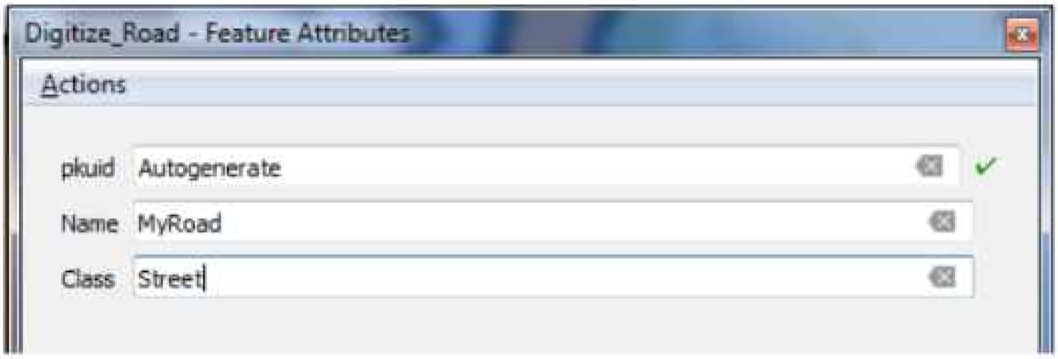
- ➢ Add "Name" and "Class" fields using "Add to Fields List".



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

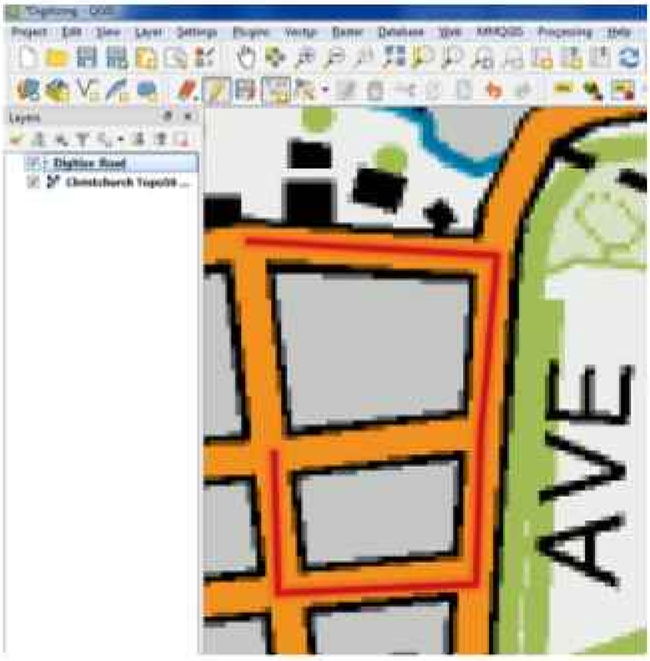
- ➢ Click the 

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.

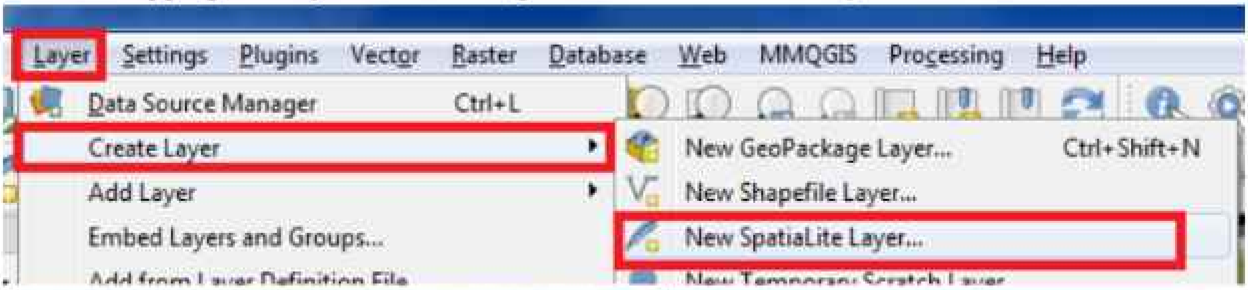


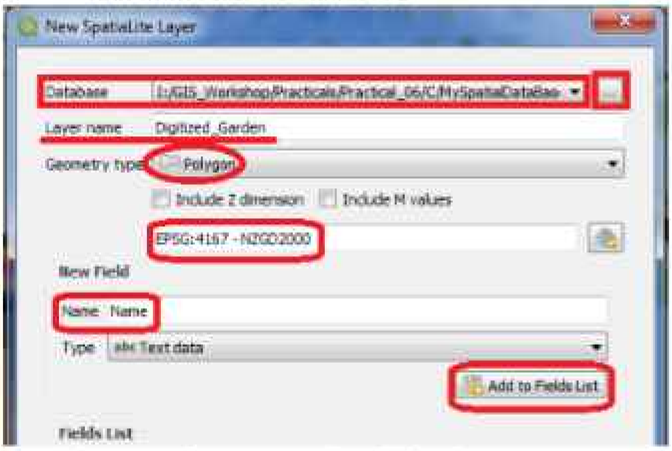
- ➢ On Layer Panel Right Click on Digitze_Road, Select the Style tab in the Layer Properties dialog.

Result

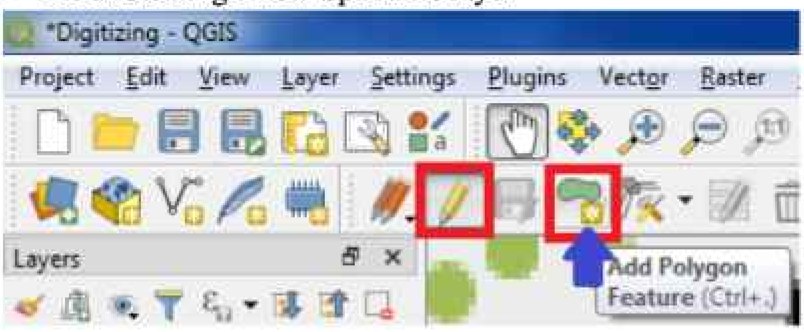


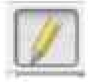
➢ Select appropriate style to see the digitized road feature clearly.



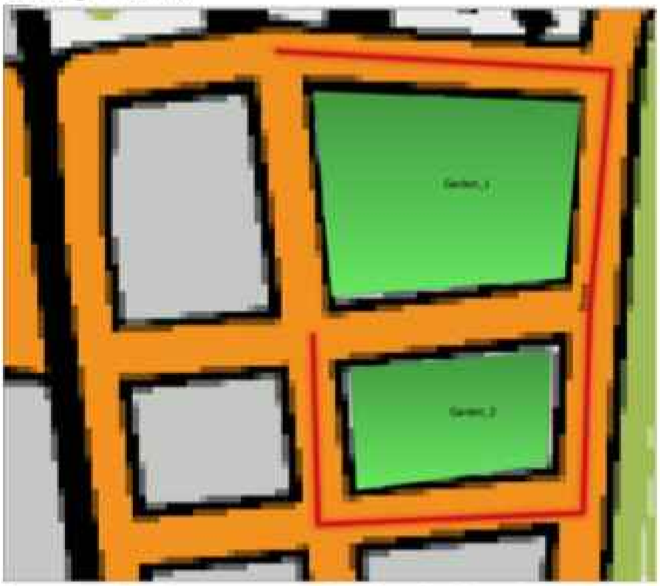


➢ After creating a new Spatialite layer



- 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



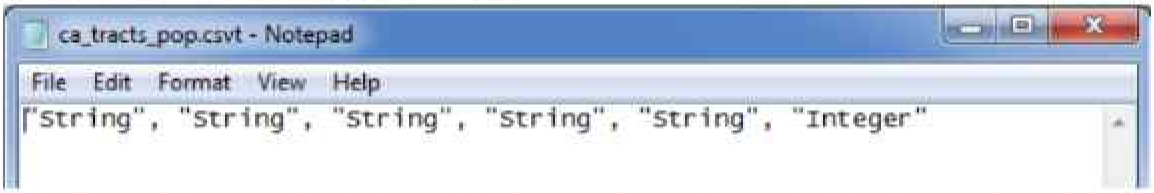
- Using the above procedure a point feature can also be digitized.
- The digitizing task is now complete. You can play with the styling and labeling options in layer properties to create a nice looking map from the data you created.

PRACTICAL - 7

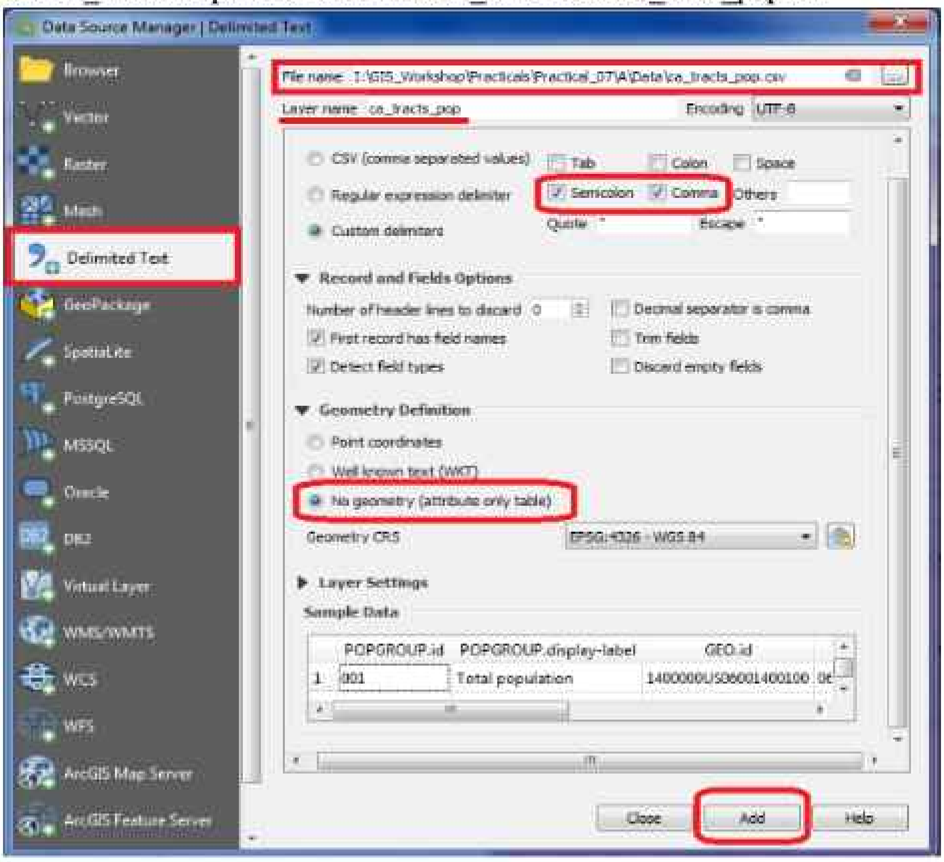
Managing Data Tables and Saptial data Sets:

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.



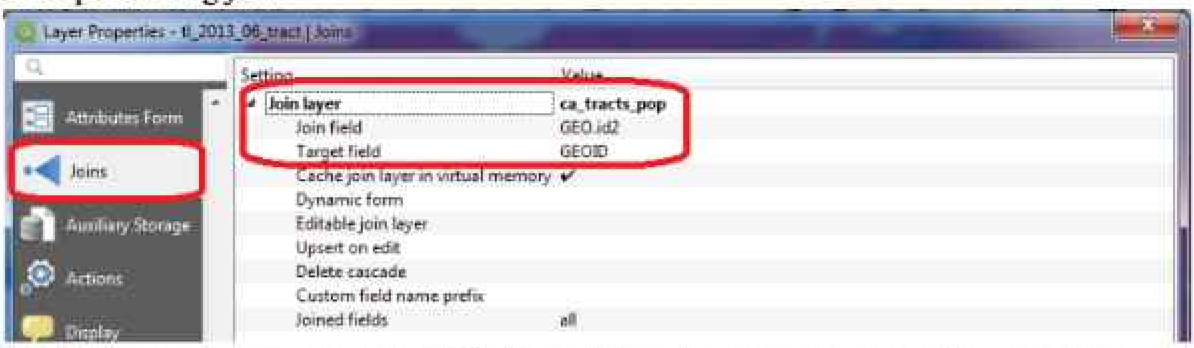
- This file will have only 1 row specifying data types for each column. Save this file as ca_tracts_pop.csvt in the same directory as the original *.csv* file.
- Go to Layer → Add Layer → Add Delimited Text Layer
  And add I:\GIS_Workshop\Practicals\Practical_07\A\Data\ca_tacts_pop.csv"



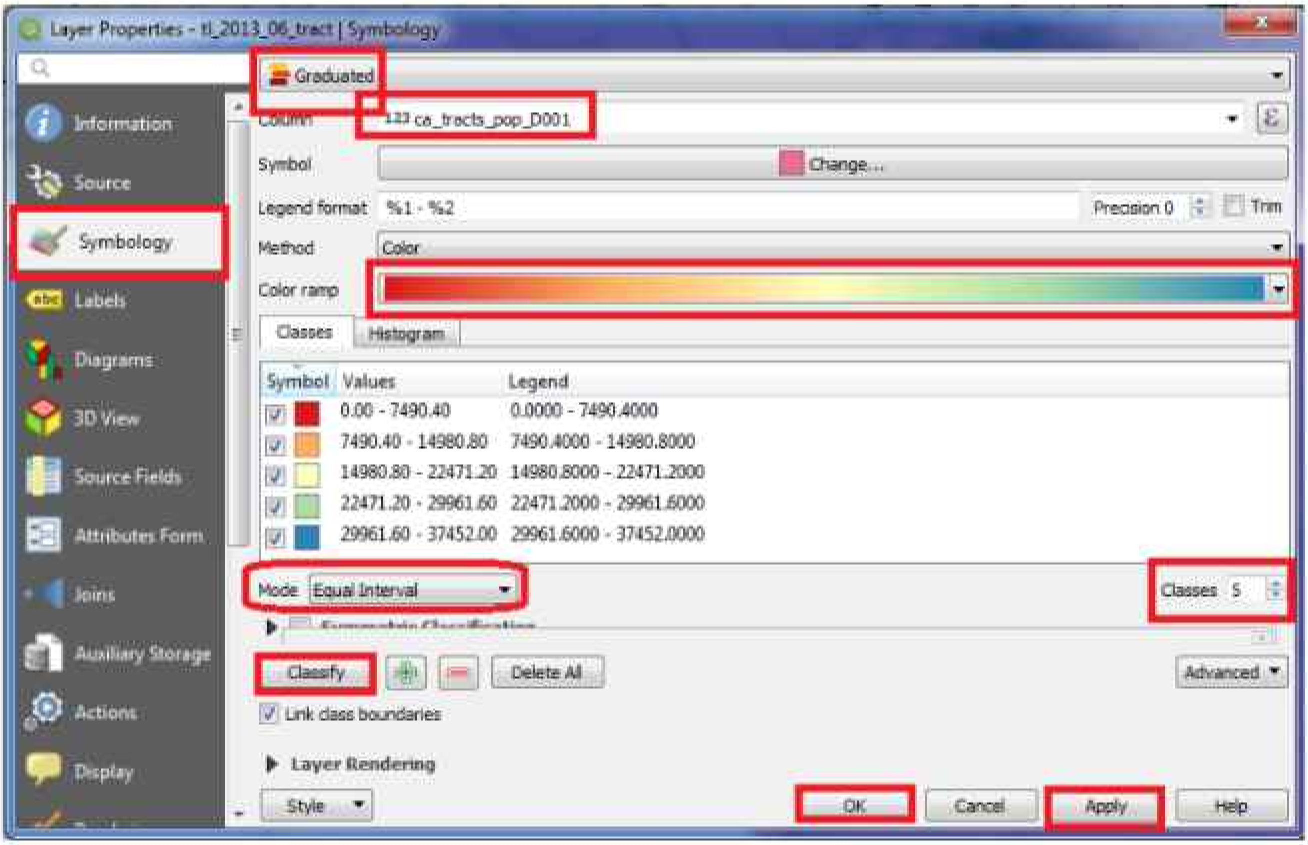
- In the layer panel, Right click on "tl_2013_06_tract", layer and select Properties

- 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.

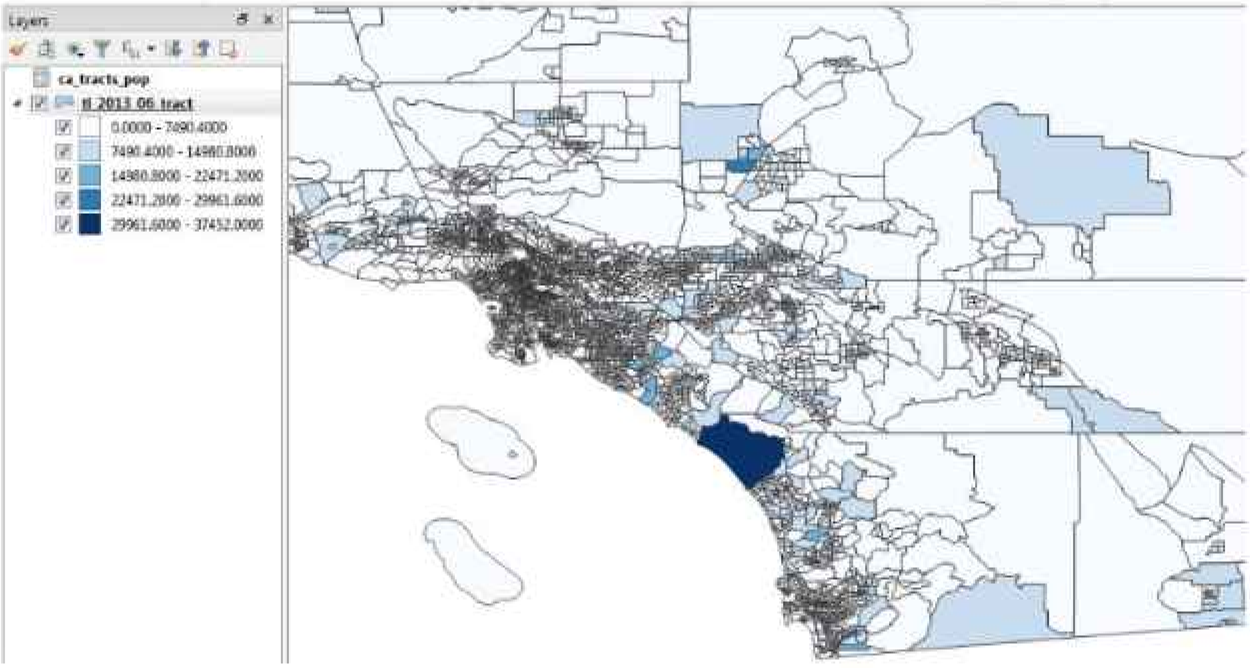
- After performing join



- 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.

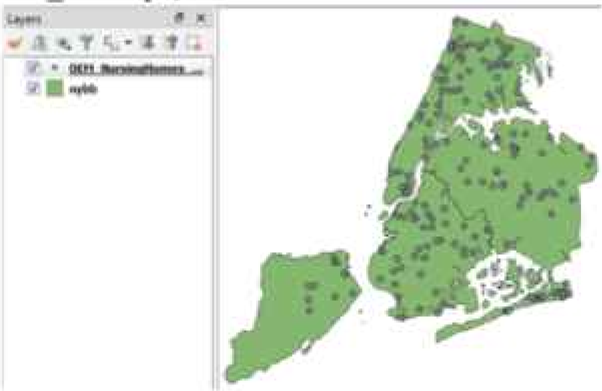


➤ A detailed and accurate population map of California can be seen as the result. Same technique can be used to create maps based on variety of census data.



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.

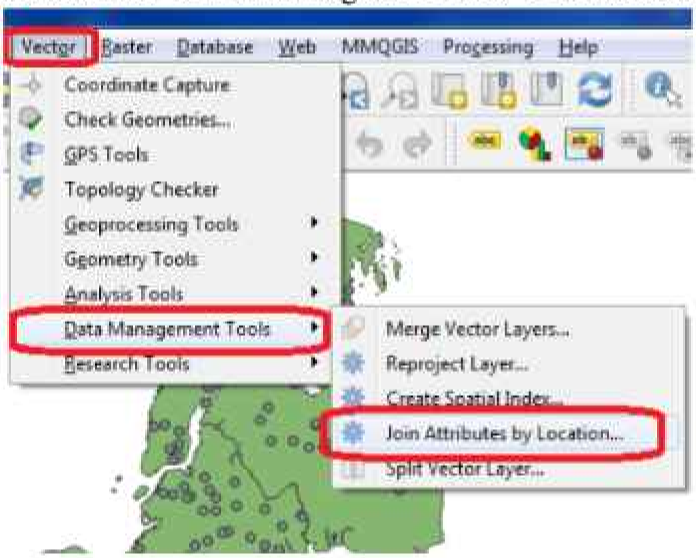


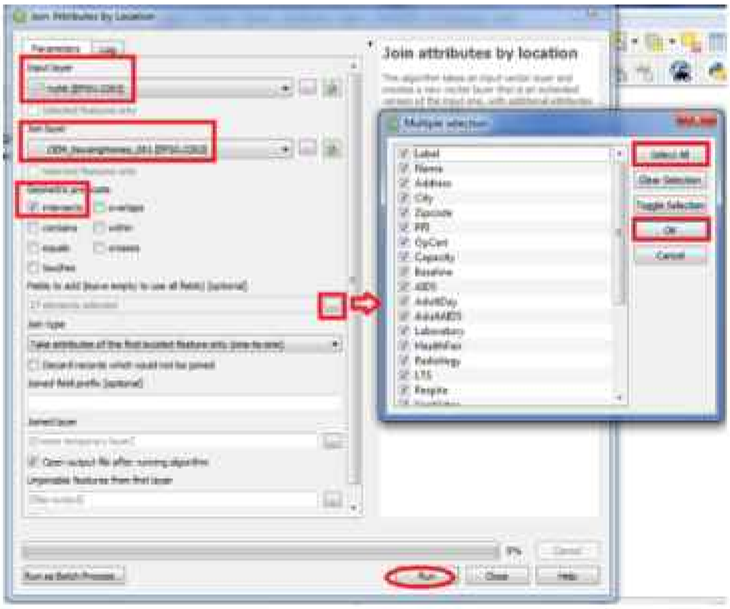
- Go to attribute table and observe the data.
- Table before performing Join

OEM_NursingHomes_001 :: Features Total: 177, Filtered: 177, Selected: 0

	Address	City	Zipcode	PFI	OpCert	Capacity
1	66 VAN CORTL...	BRONX	10463	1217.00000000000	7000307.000000...	264
2	2505 GRAND AVE	BRONX	10468	1244.00000000000	7000337.000000...	46
3	2401 LACONIA ...	BRONX	10469	1245.00000000000	7000338.000000...	200
4	3200 BAYCHES...	BRONX	10475	1242.00000000000	7000356.000000...	236
5	700 WHITE PLA...	BRONX	10473	856.00000000000	7000361.000000...	240
6	3400 CANNON ...	BRONX	10463	1234.00000000000	7000374.000000...	400
7	612 ALLERTON ...	BRONX	10467	1218.00000000000	7000308.000000...	520
8	666 KAPPOCK S...	BRONX	10463	1233.00000000000	7000385.000000...	200
9	3518 BAINBRID...	BRONX	10467	1227.00000000000	7000319.000000...	200
10	801 CO-OP CIT...	BRONX	10475	1260.00000000000	7000389.000000...	480
11	2266 CROPSEY ...	BROOKLYN	11214	1364.00000000000	7001303.000000...	271
12	2865 BRIGHTO...	BROOKLYN	11235	1399.00000000000	7001342.000000...	320

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

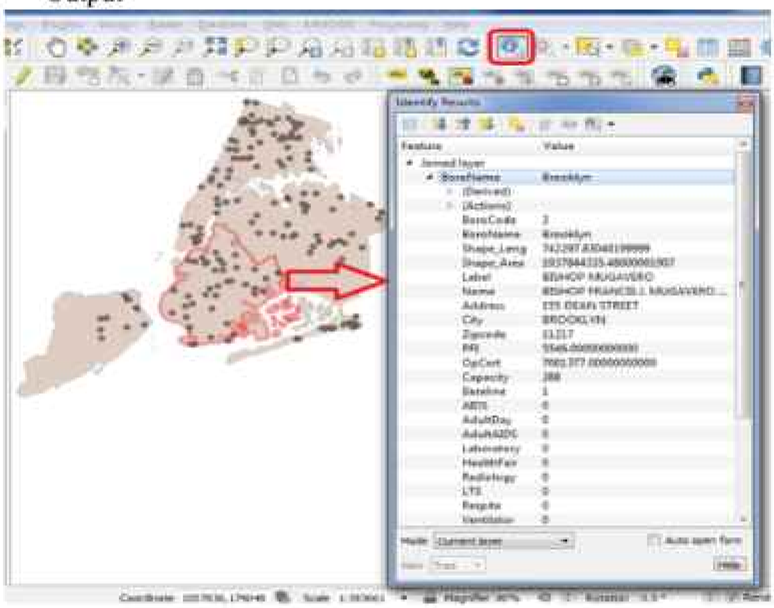




- Attribute table after join

City	Zipcode	PFI	OpCert	Capacity
ASTORIA	11102	6384.00000000000	7003405.000000...	280
BROOKLYN	11217	5546.00000000000	7001377.000000...	288
BRONX	10472	1251.00000000000	7000381.000000...	200
STATEN ISLAND	10304	1755.00000000000	7004310.000000...	300
NEW YORK	10003	4807.00000000000	7002351.000000...	28

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



PRACTICAL - 8

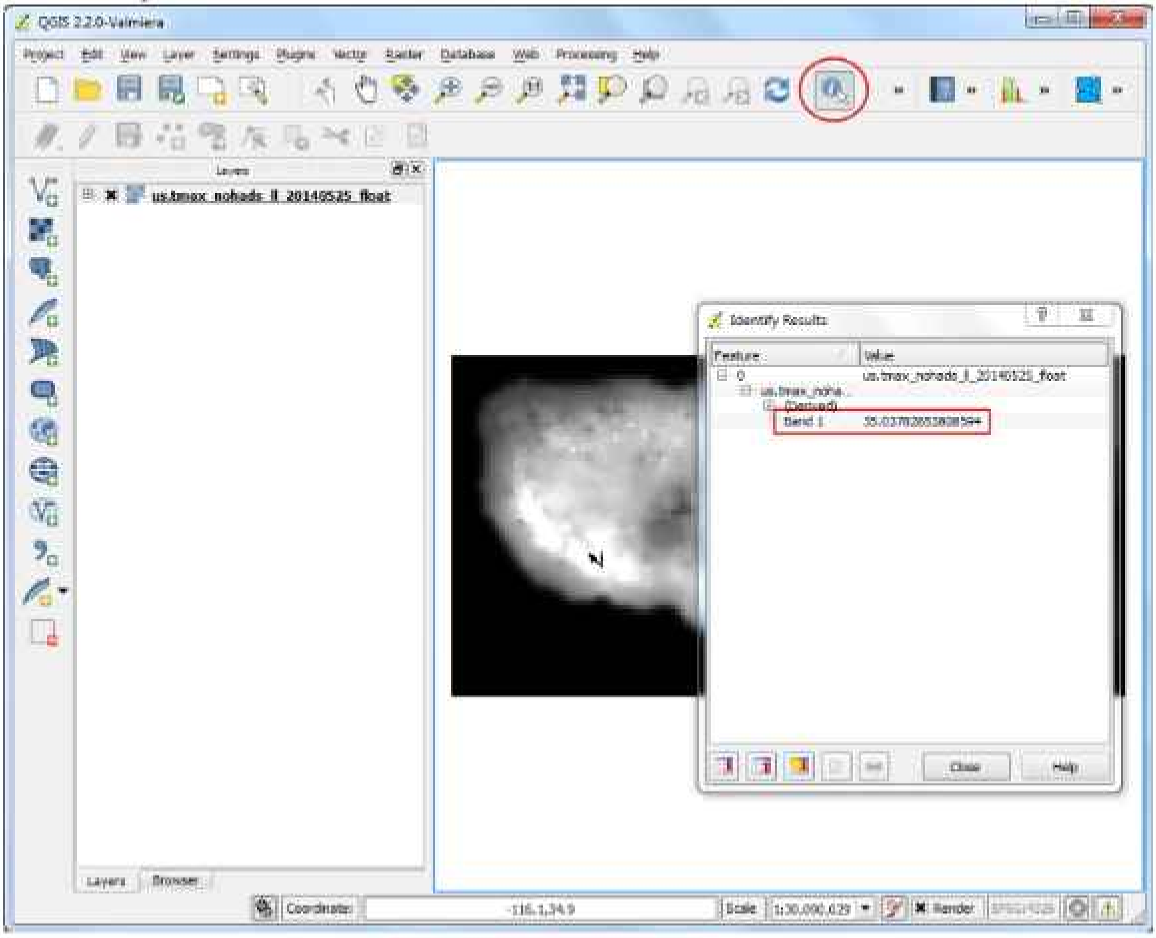
B) Sampling Raster Data using Points or Polygons

Many scientific and environmental datasets come as gridded rasters. Elevation data (DEM) is also distributed as raster files. In these raster files, the parameter that is being represented is encoded as the pixel values of the raster. Often, one needs to extract the pixel values at certain locations or aggregate them over some area. This functionality is available in QGIS via two plugins - Point SamplingTool and Zonal Statistics plugin.

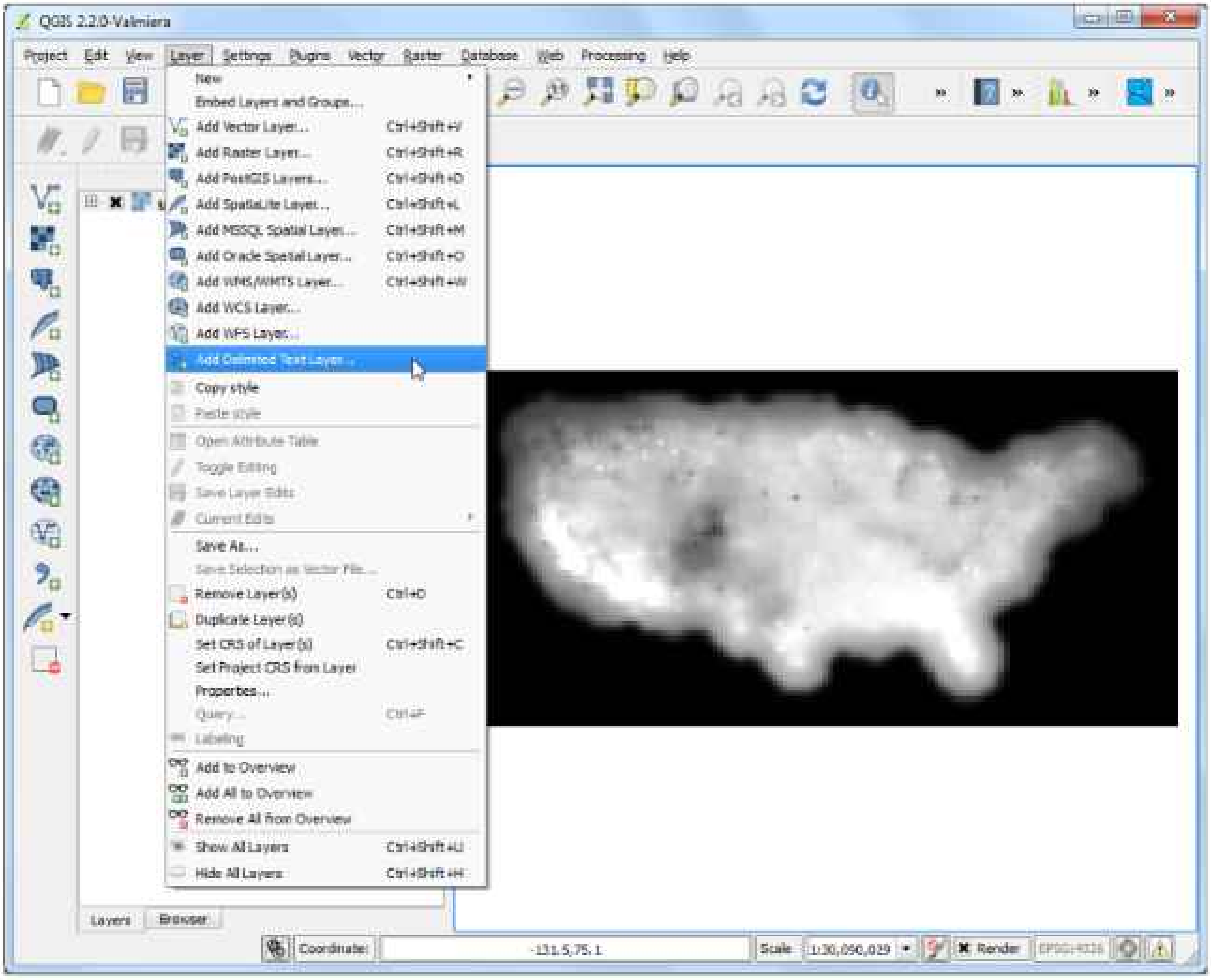
Procedure

1. Go to Layer ☐Add Raster Layer and browse to the downloaded us.tmax_nohads_ll_{YYYYMMDD}_float.tif file and click Open.

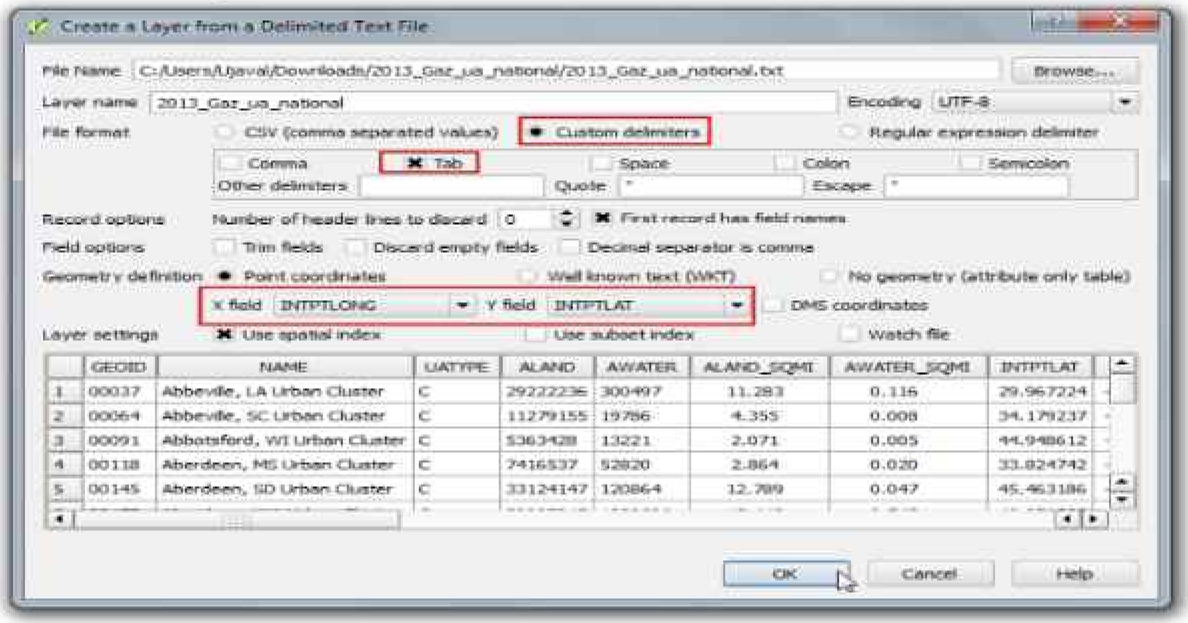
2. Once the layer is loaded, select the Identify tool and click anywhere on the layer. You will see the temperature value in celsius as the value or Band 1 at that location.



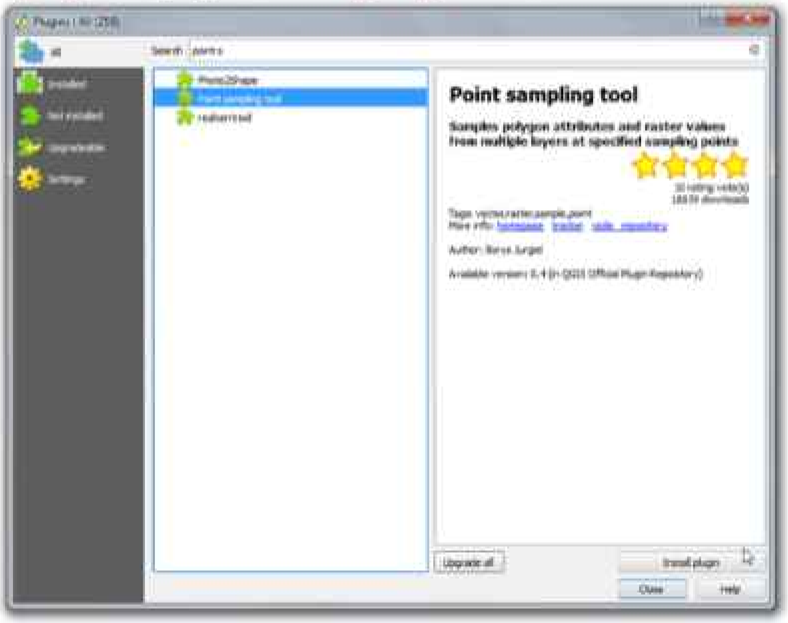
3. Now unzip the downloaded 2013_Gaz_ua_national.zip file and extract the 2013_Gaz_ua_national.txt file on your disk. Go to Layer ☐Add Delimited Text Layer.



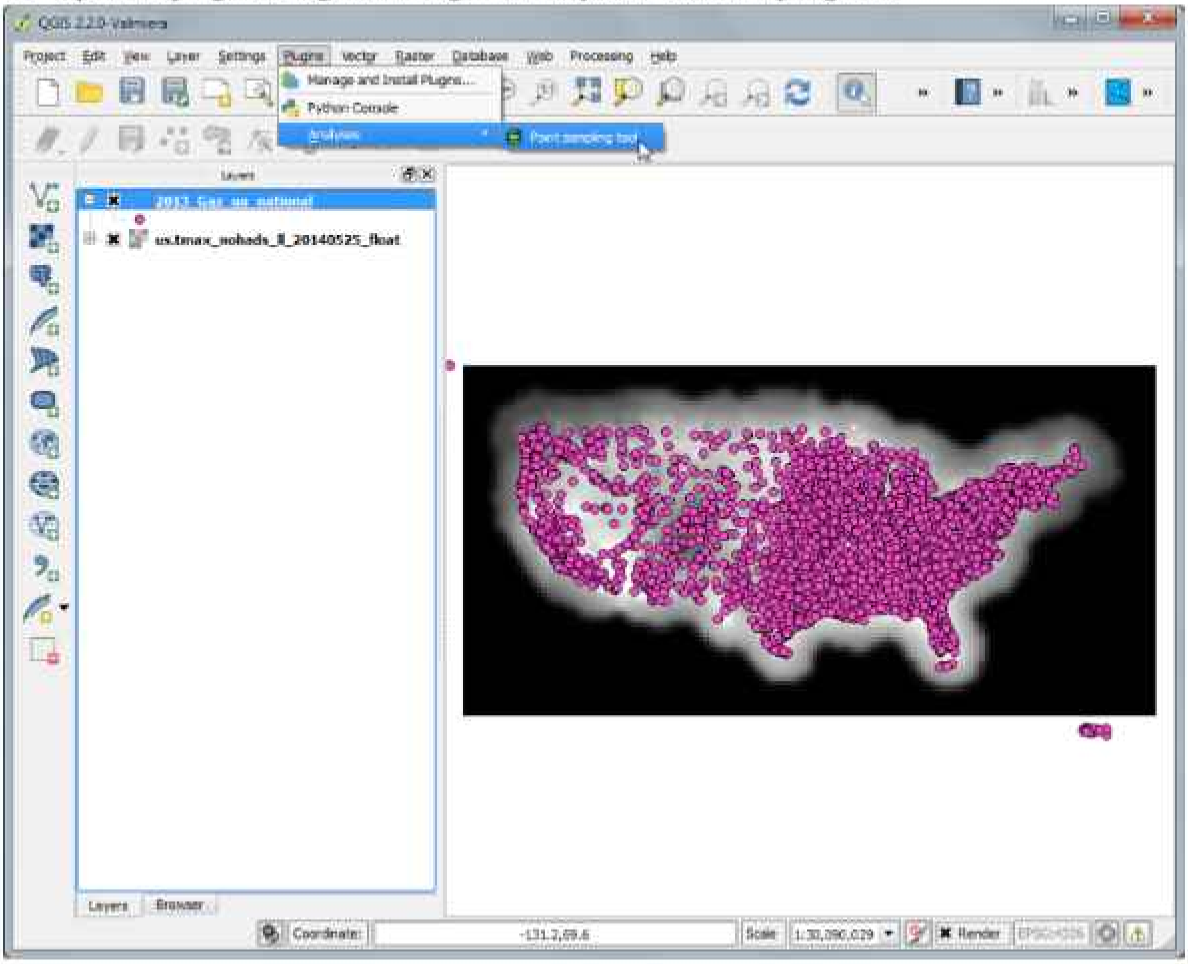
4. In the Create a Layer from Delimited Text File dialog, click Browse and open 2013_Gaz_ua_national.txt. Choose Tab under Custom delimiters. The point coordinates are in Latitude and Longitude, so select INTPTLONG as X field and INTPTLAT as Y field. Check the Use spatial index box and click OK.



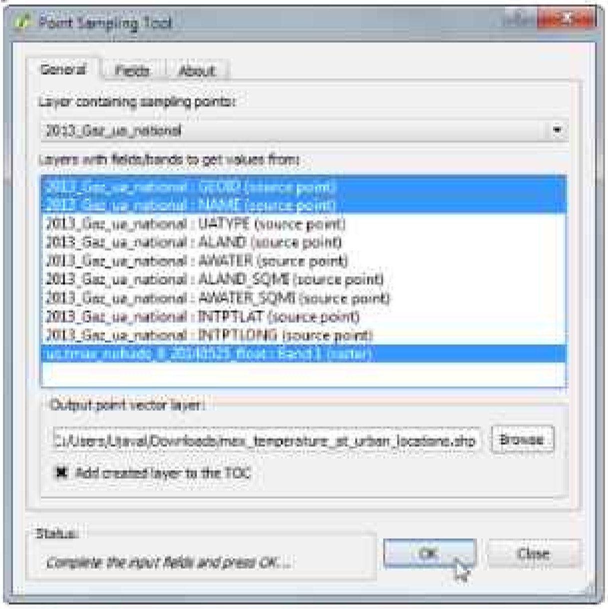
5. Now we are ready to extract the temperature values from the raster layer. Install the Point Sampling Tool plugin. See *Using Plugins* for details on how to install plugins.



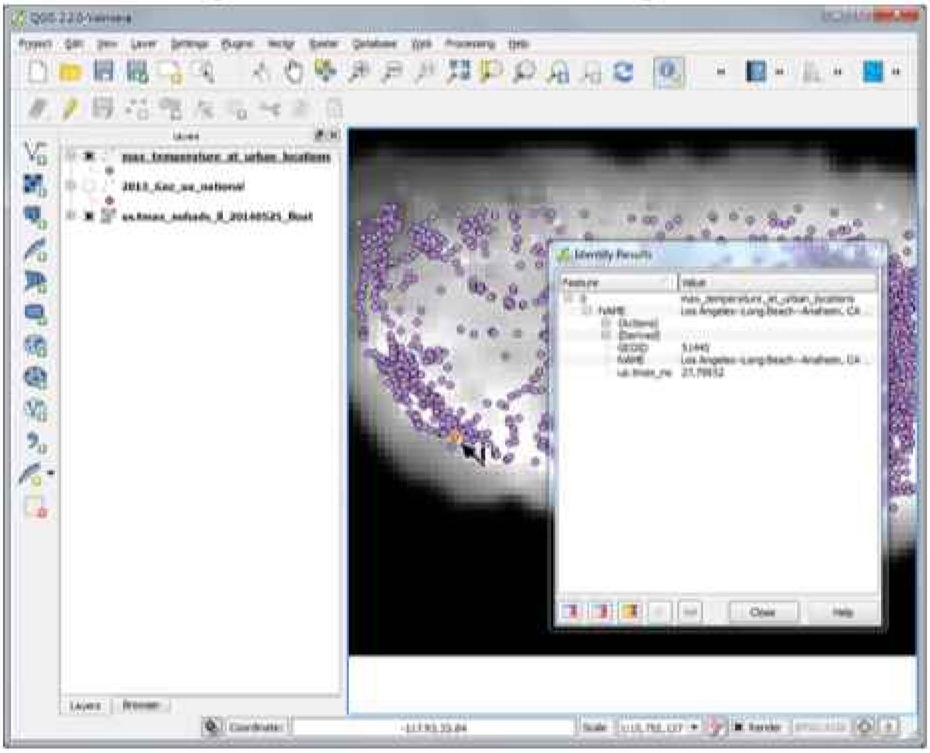
6. Open the plugin dialog from Plugins □Analyses □Point sampling tool.



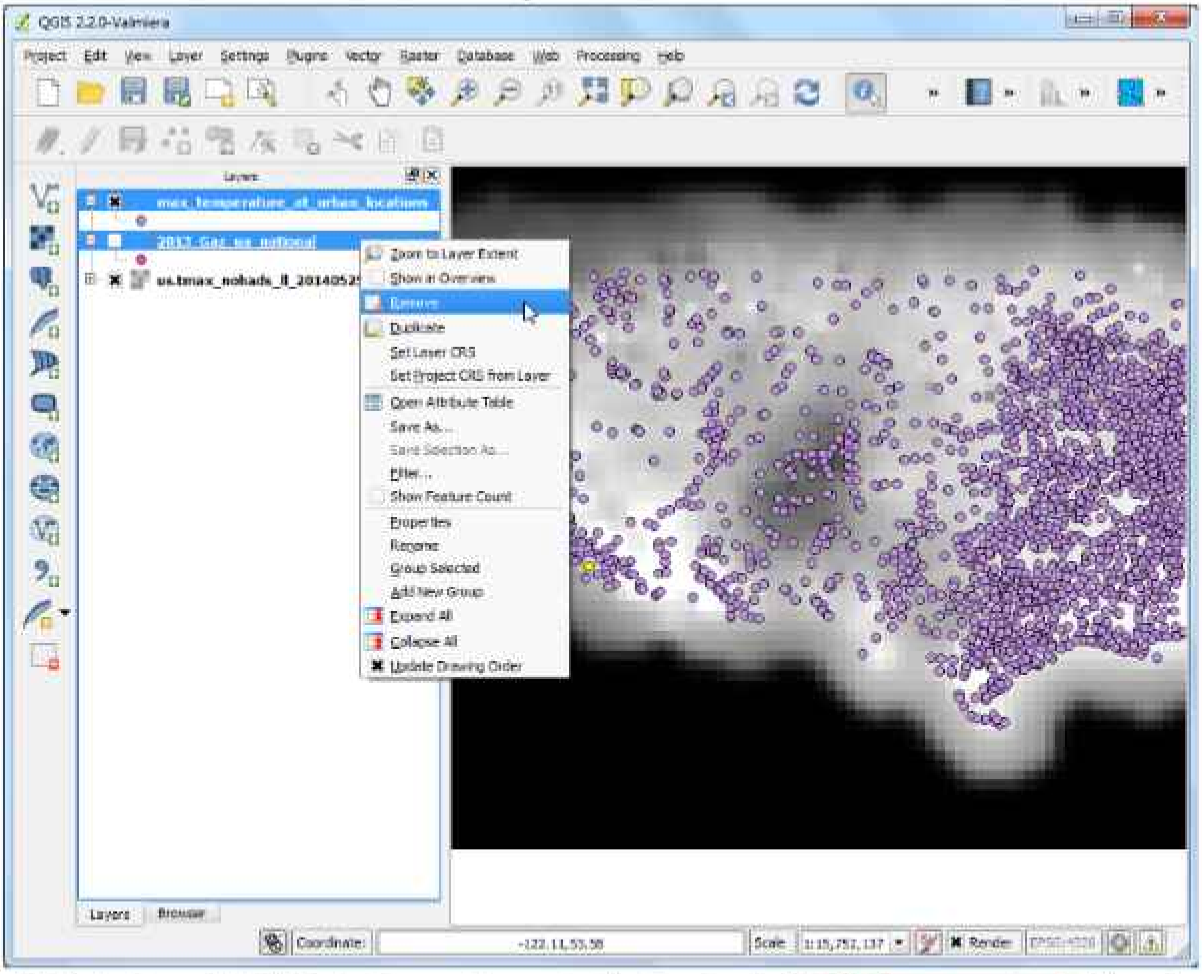
7. In the Point Sampling Tool dialog, select 2013_Gaz_ua_national as the Layer containing sampling points. We must explicitely pick the fields from the input layer that we want in the output layer. Choose GEOID and NAME fields from the2013_Gaz_ua_national layer. We can sample values from multiple raster band at once, but since our raster has only 1 band, choose the us.tmax_nohads_ll_{YYYYMMDD}_float: Band 1. Name the output vector layer as max_temparature_at_urban_locations.shp. Click the OK to start the sampling process. Click Close once the process finishes.



8. You will see a new layer max_temparature_at_urban_locations loaded in QGIS. Use the Identify tool to click on any point to see the attributes. You will see the us.tmax_no field - which contains the raster pixel value at the location of the point.

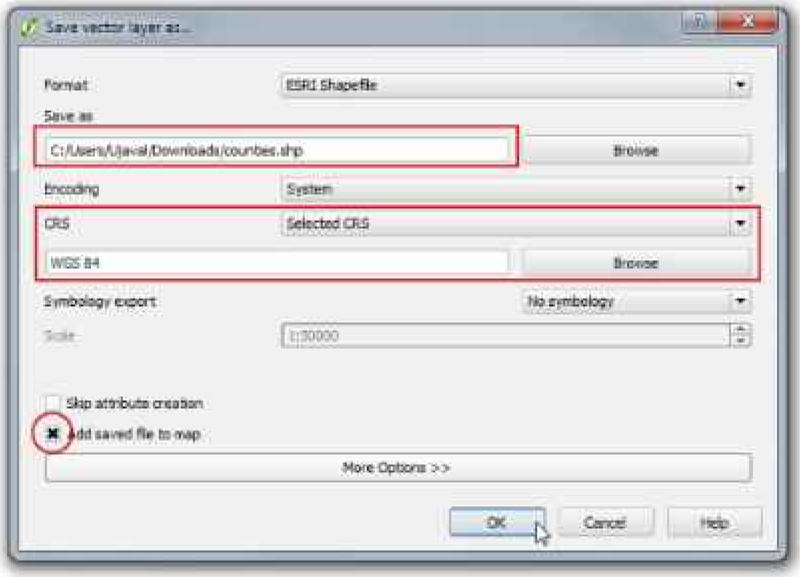


9. First part of our analysis is over. Let’s remove the unnecessary layers. Hold the Shift key and select max_temparature_at_urban_locations and 2013_Gaz_ua_national layers. Right-click and select Remove to remove them from QGIS TOC.

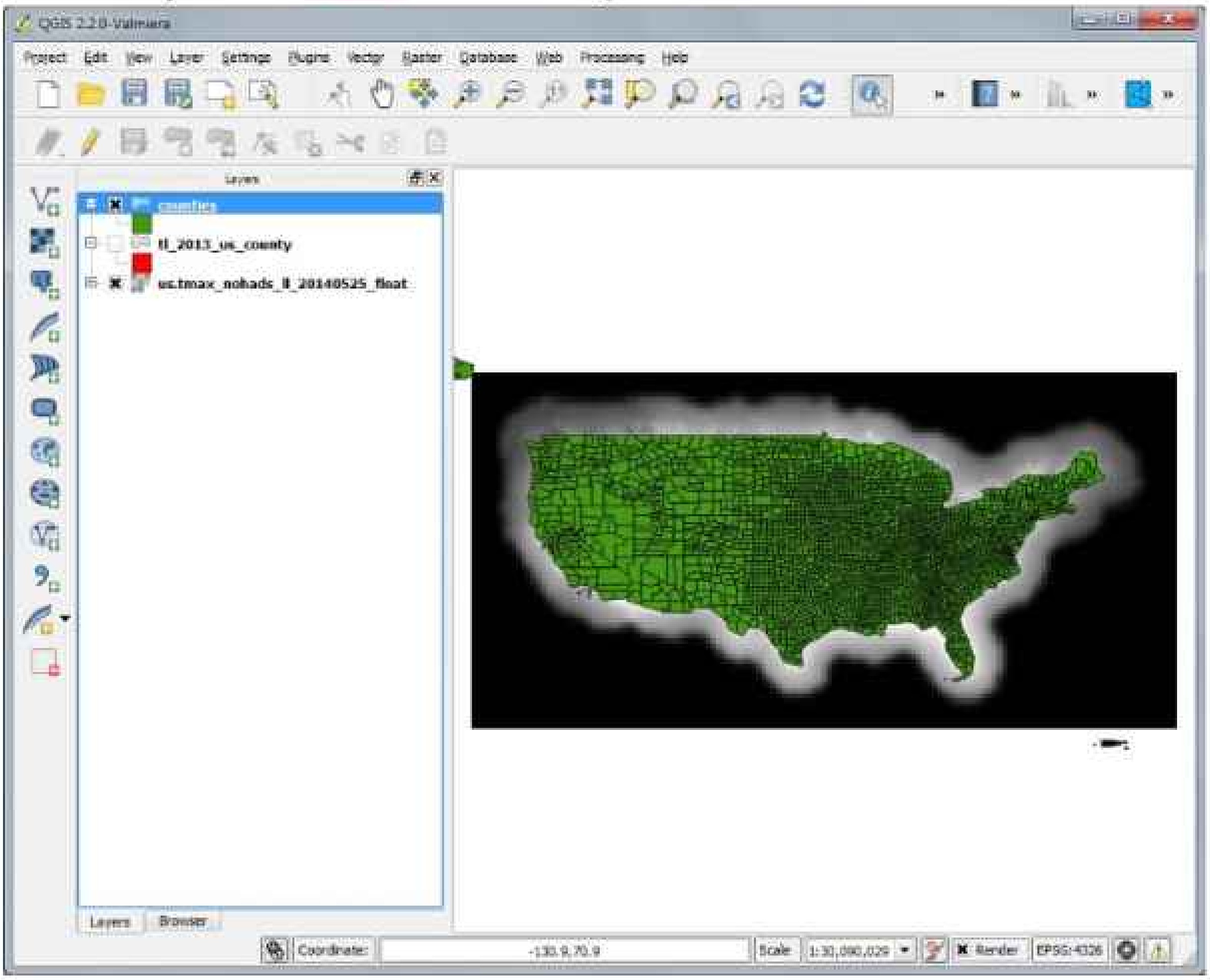


10. Go to Layer ☐Add Vector Layer. Browse to the downloaded tl_2013_us_county.zip file and click Open. Select thetl_2013_us_county.shp as the layer and click OK.
11. The tl_2013_us_county will be added to QGIS. This layer is in EPSG:4269 NAD83 projection. This doesn’t match the projection of the raster layer. We will re-project this layer to EPSG:4326 WGS84 projection.
12. Right-click the tl_2013_us_county layer and select Save As...

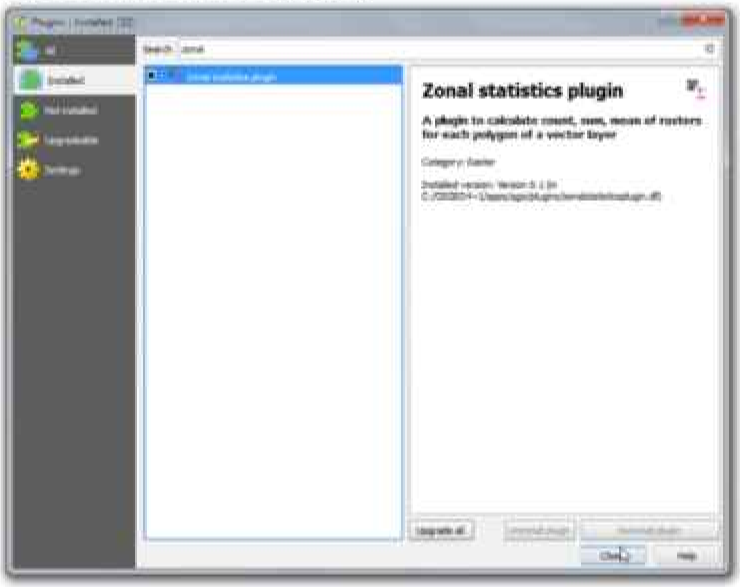
13. In the Save Vector layer as.. dialog, click Browse and name the output file as counties.shp. Choose Selected CRS from the CRS dropdown menu. Click Browse and select WGS 84 as the CRS. Check the Add saved file to map and click OK.



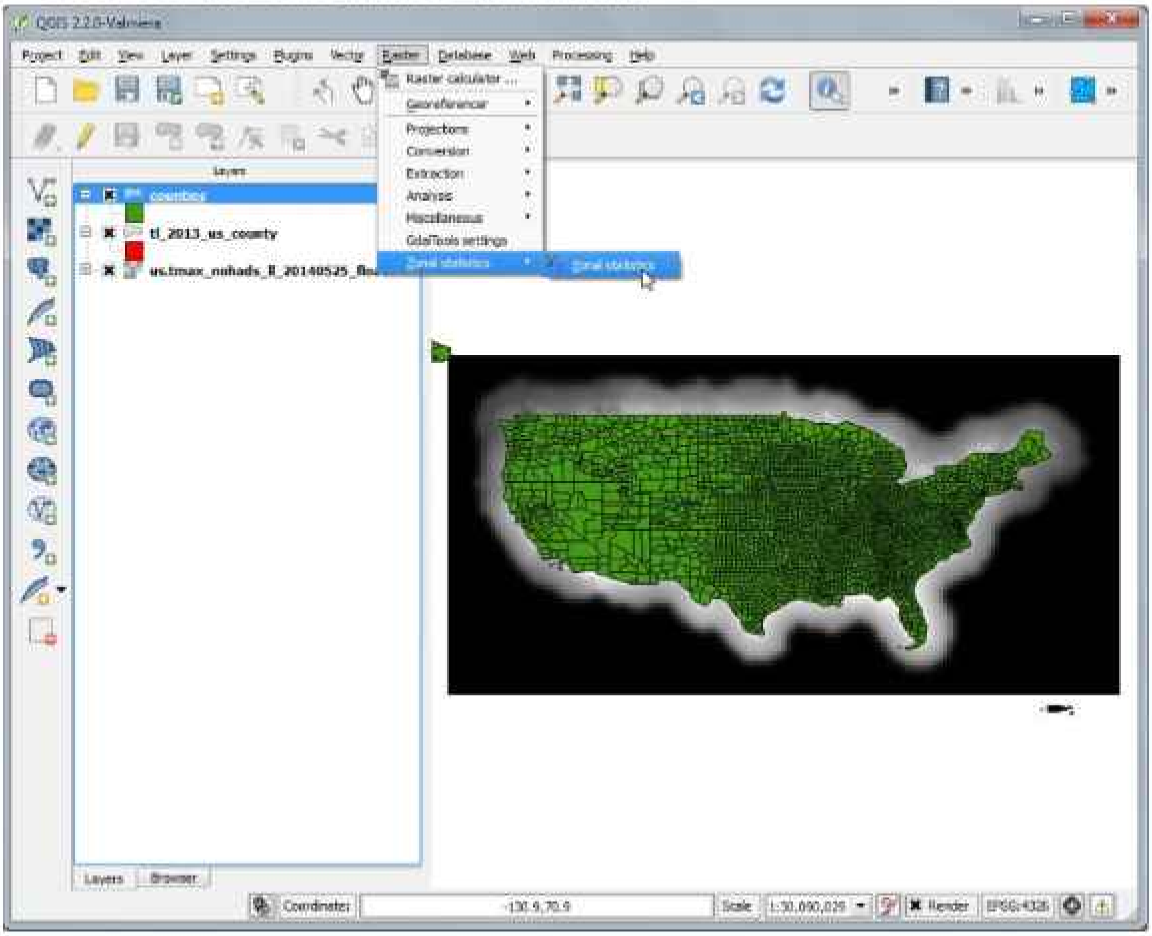
14. A new layer named counties will be add to QGIS.



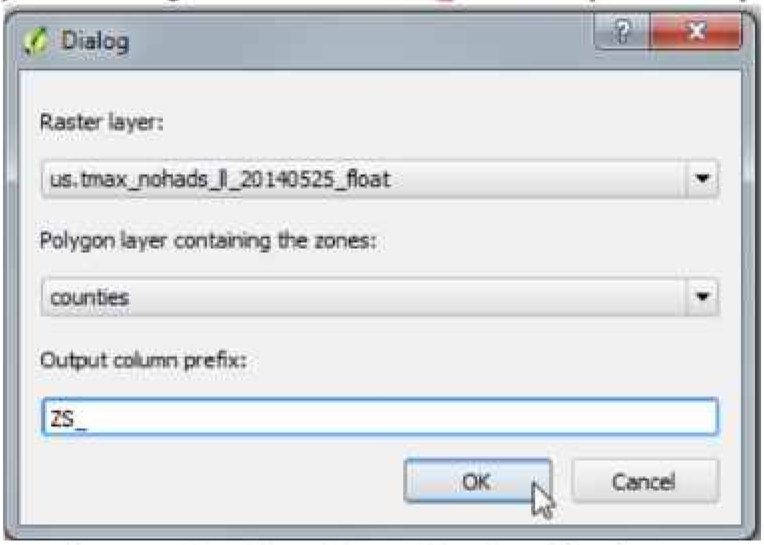
15. Enable the Zonal Statistics Plugins. This is a core plugin so it is already installed. See *Using Plugins* to know to how enable core plugins.



16. Go to Raster Zonal statistics Zonal statistics.

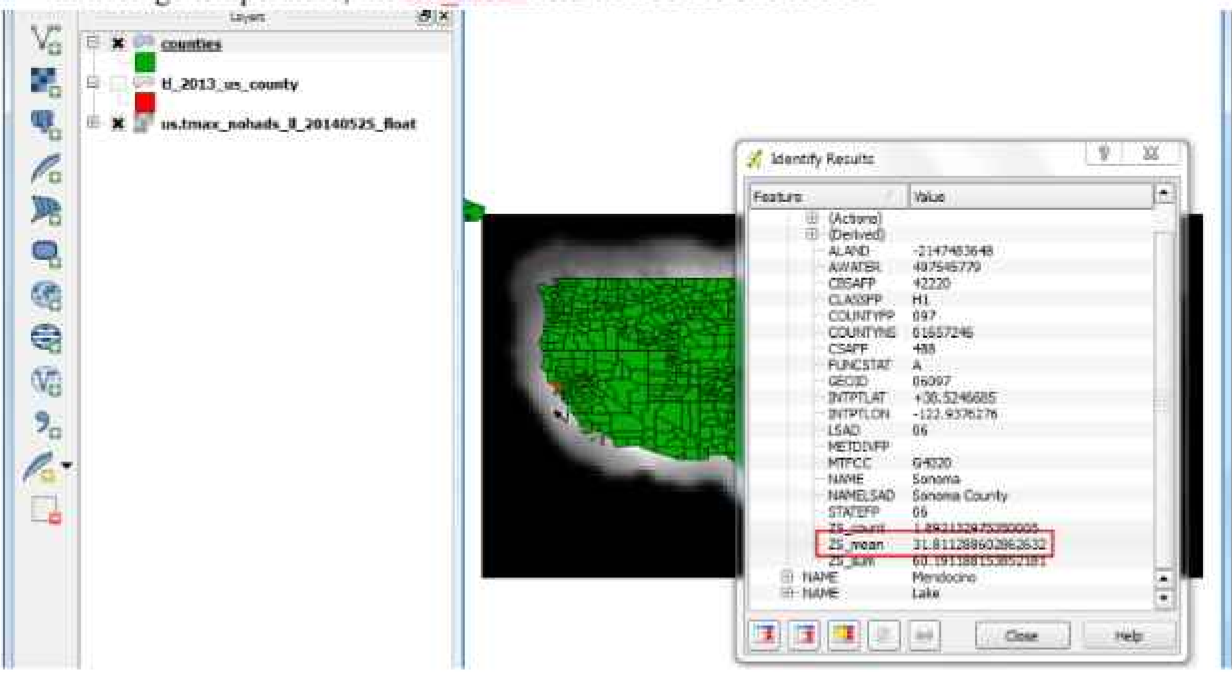


17. Select us.tmax_nohads_ll_{YYYYMMDD}_float as the Raster layer and counties as the Polygon layer containing the zones. Enter ZS_ as the Output column prefix. Click OK.

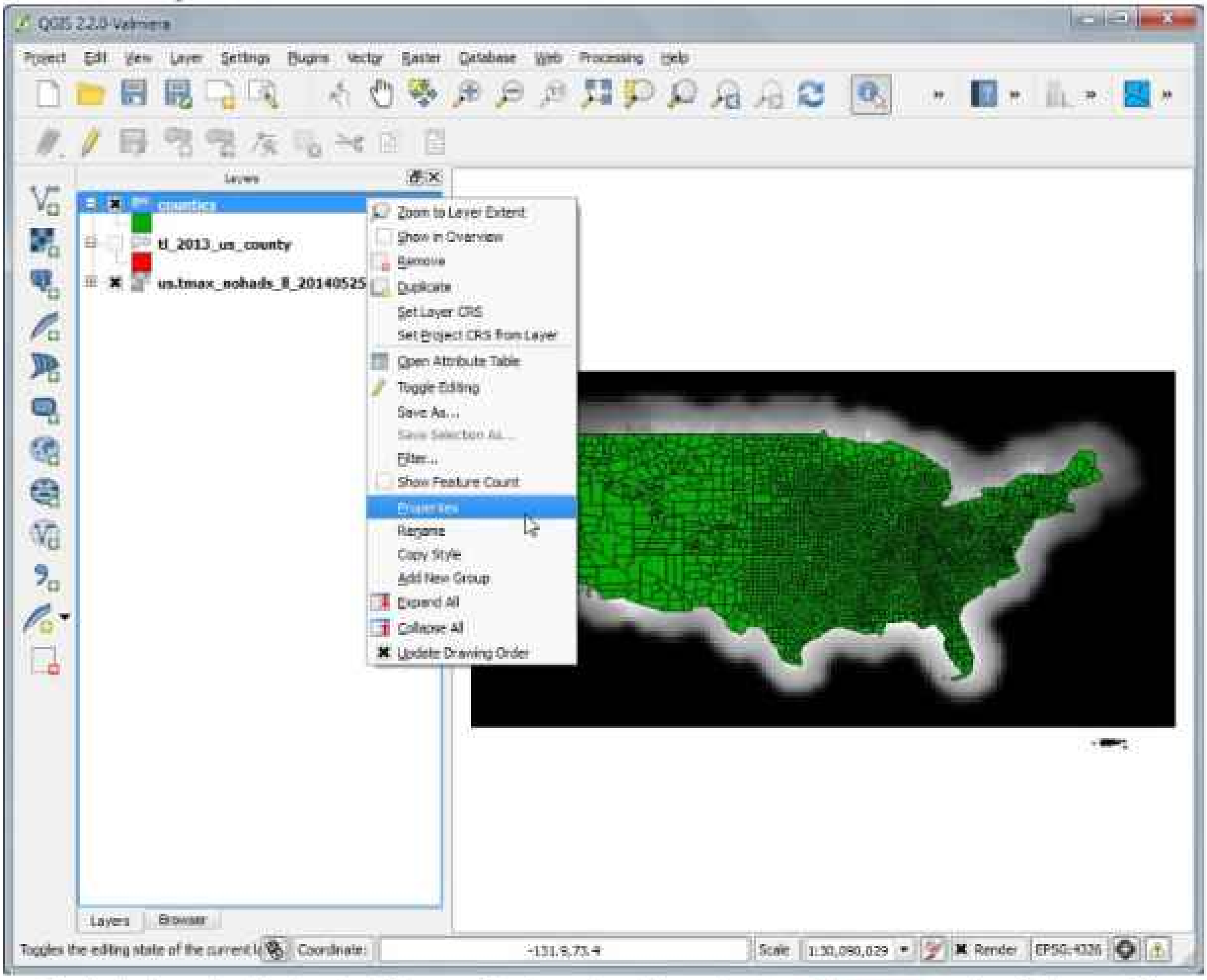


18. The analysis may take some time depending on the size of the dataset.

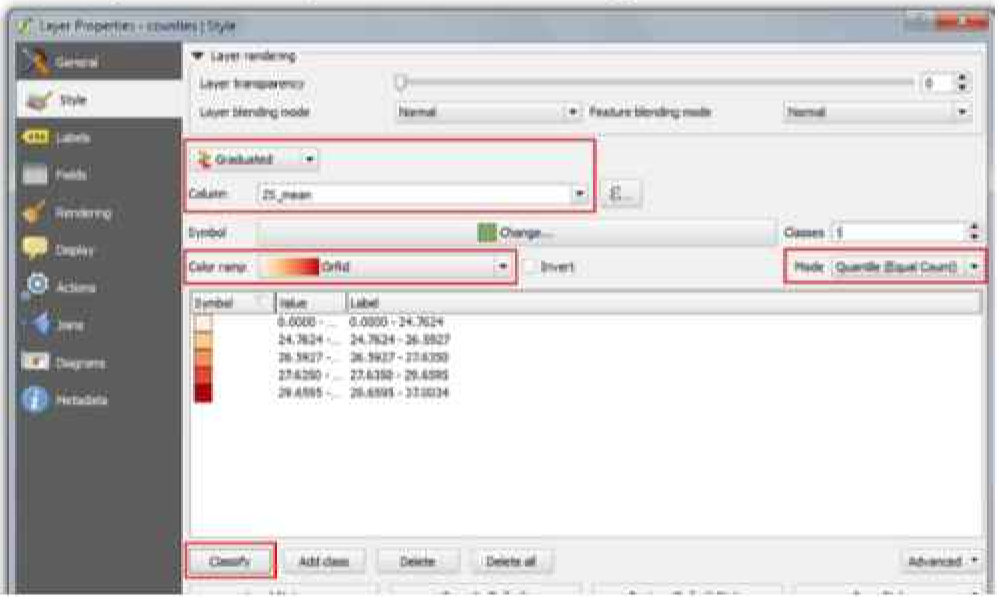
19. Once the processing finishes, select the counties layer. Use the Identify tool and click on any county polygon. You will see three new attributes added to the layer: ZS_count, ZS_mean and ZS_sum. These attributes contain the count of raster pixels, mean of raster pixel values and sum of raster pixel values respectively. Since we are interested in average temperature, the ZS_meanfield will be the one to use.



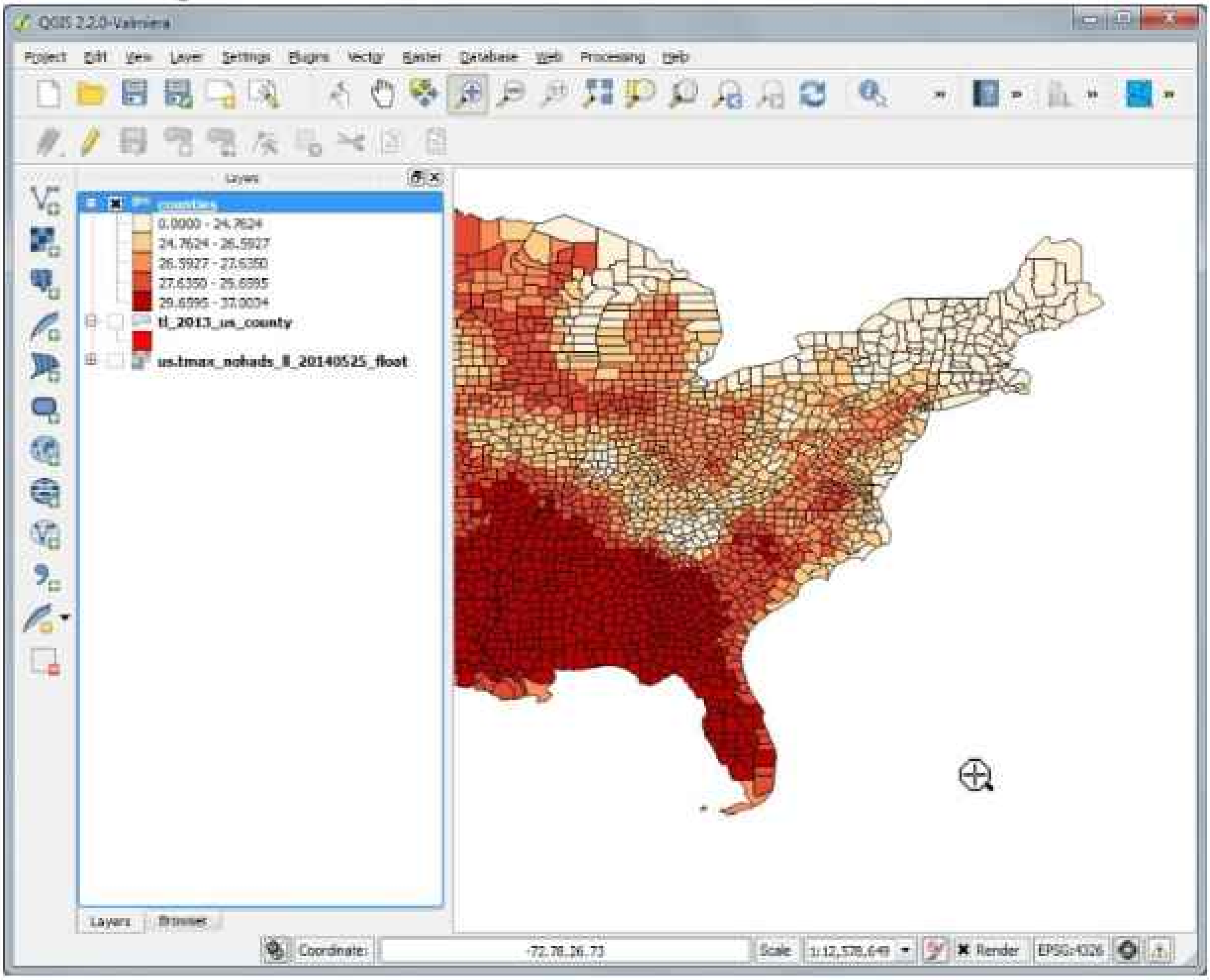
20. Let's style this layer to create a temperature map. Right-click the counties layer and select Properties.



21. Switch to the Style tab. Choose Graduated style and select ZS_mean as the Column. Choose a Color Ramp and Mode of your chose. Click Classify to create the classes. Click OK.



22. You will see the county polygons styled using average maximum temperature extracted from the raster grid.



Practical 9

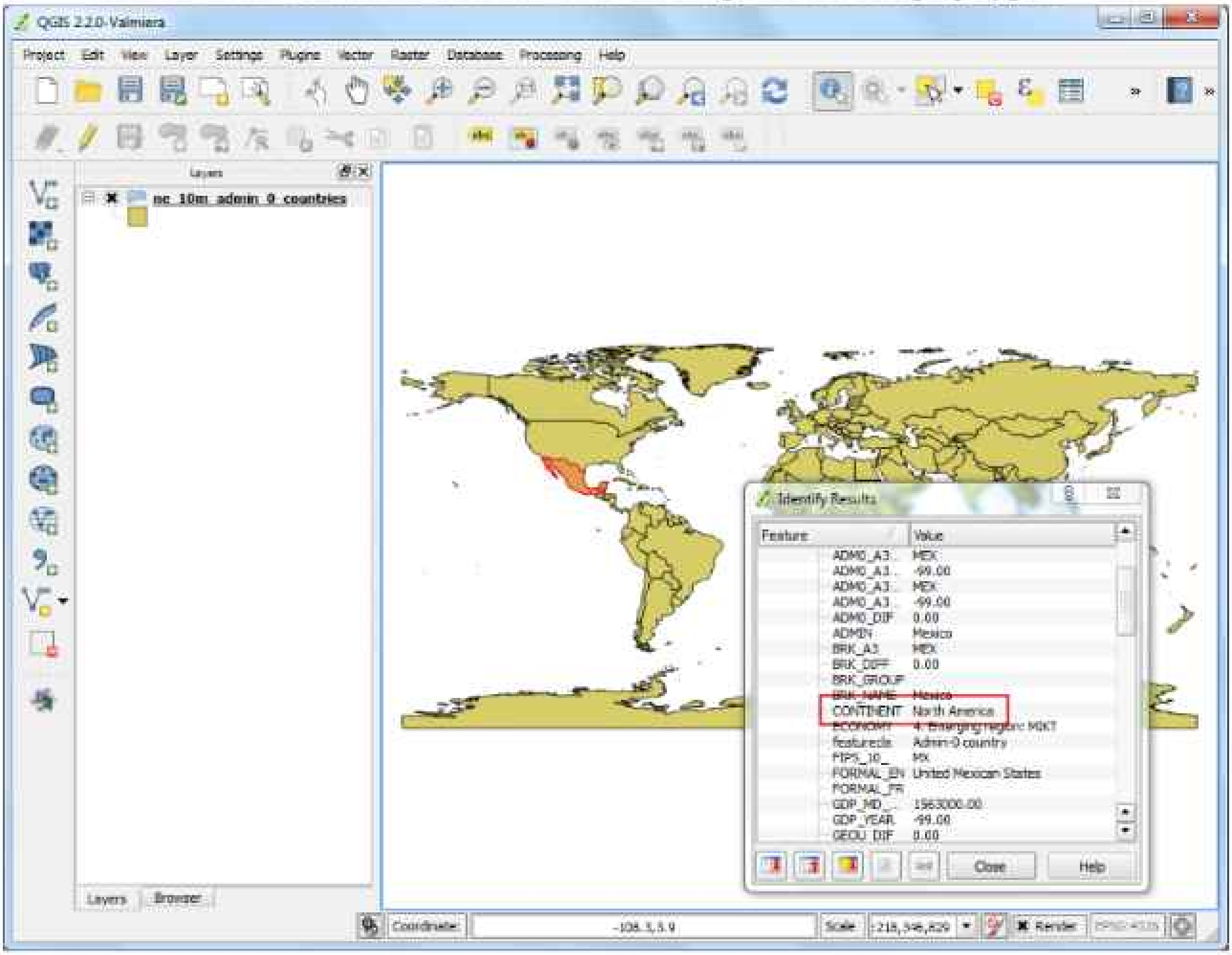
Advance GIS Operations 2:

a) **Batch Processing using Processing Framework**
b) **Automating Complex Workflows using Processing Modeler**
c) **Automating Map Creation withPrint Composer Atlas**

(a) Batch Processing using Processing Framework

Procedure

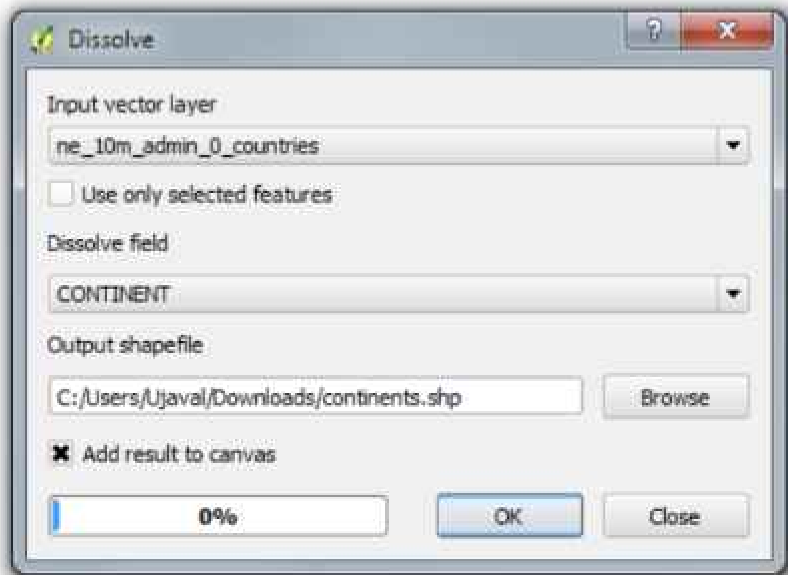
1. Go to Layer ‣ Add Vector Layer.
2. Browse to the downloaded Admin 0 Countries shapefile ne_10m_admin_0_countries.shp and click Open.
3. As our task is to clip the global layers to the boundary of Africa, we need to first prepare a layer containg a polygon for the entire continent. The countries layer has an attribute called **CONTINENT**. We can use a geoprocessing concept called *Dissolve* to merge all countries that have the same continent value and merge them to a single polygon.



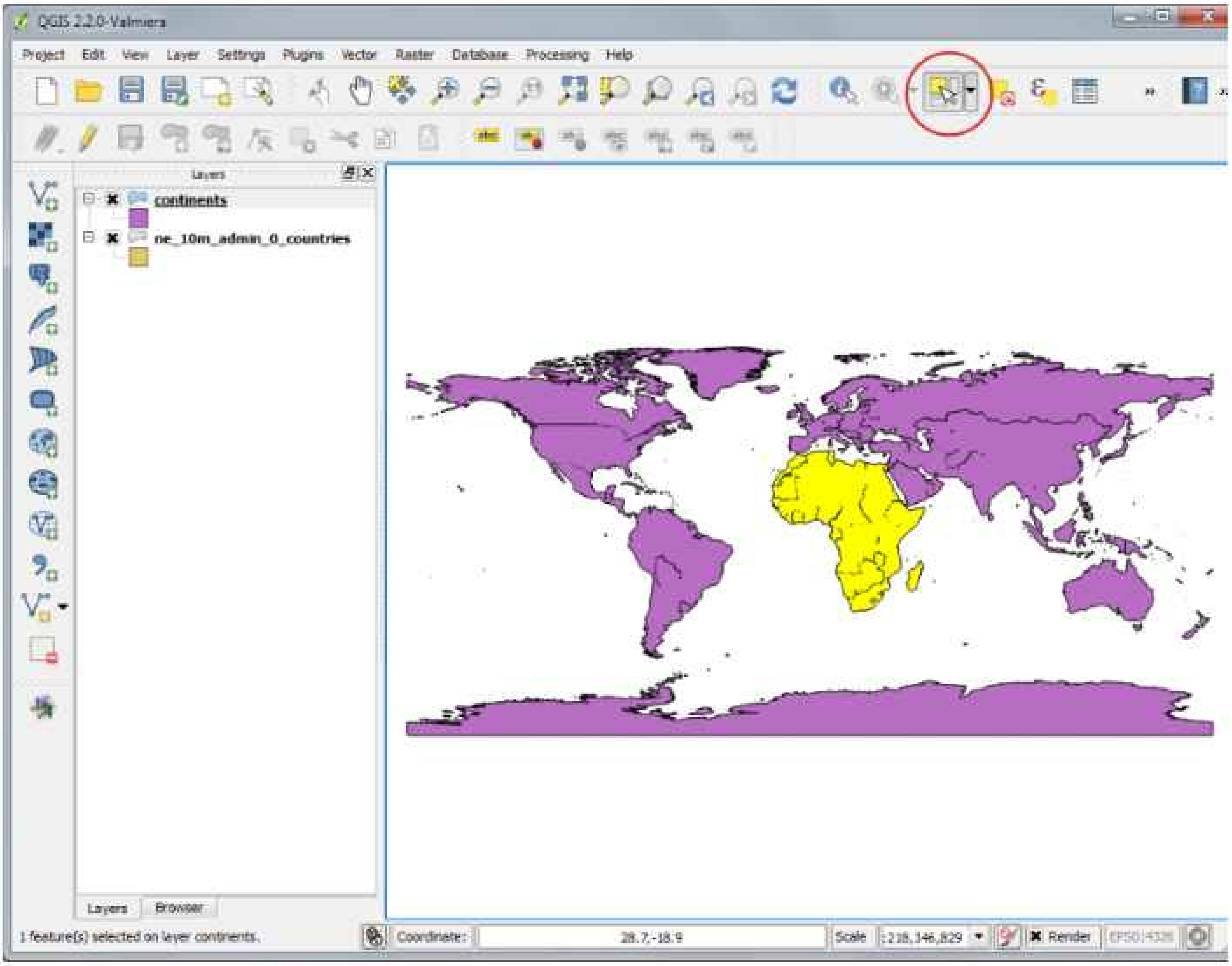
4. Open the Dissolve tool from Vector ‣ Geoprocessing Tools ‣ Dissolve.

5. Select ne_10m_admin_0_countries as the Input vector layer. The Dissolve field would be CONTINENT. Name the output file as continents.shp and check the box next to Add result to convas.

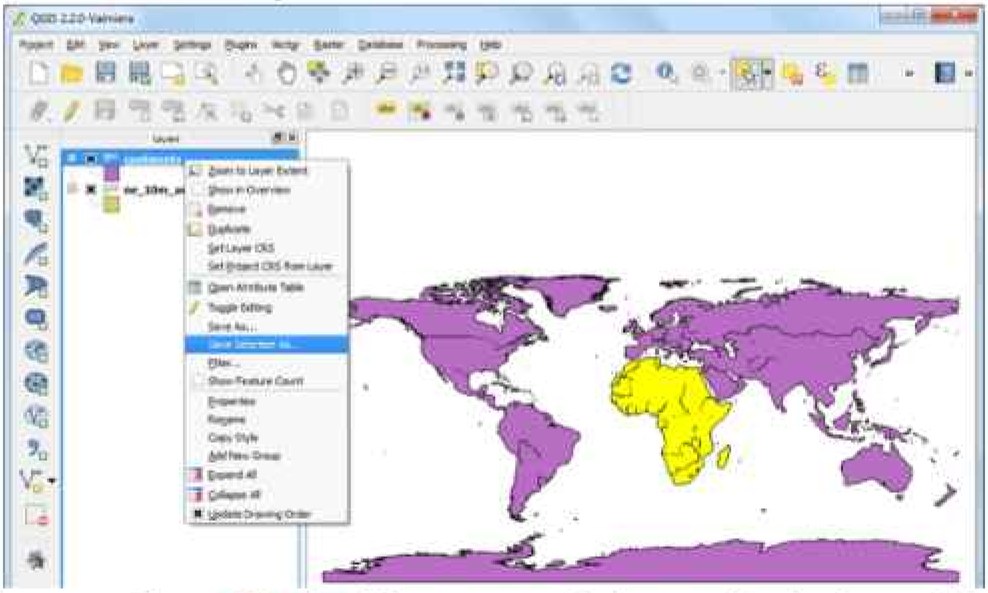
Note
If you want to merge **ALL** polygons regardless of their attributes, you can select – Dissolve All – as the Dissolve field. This will combine all polygons in the layer and give you a single aggregate polygon



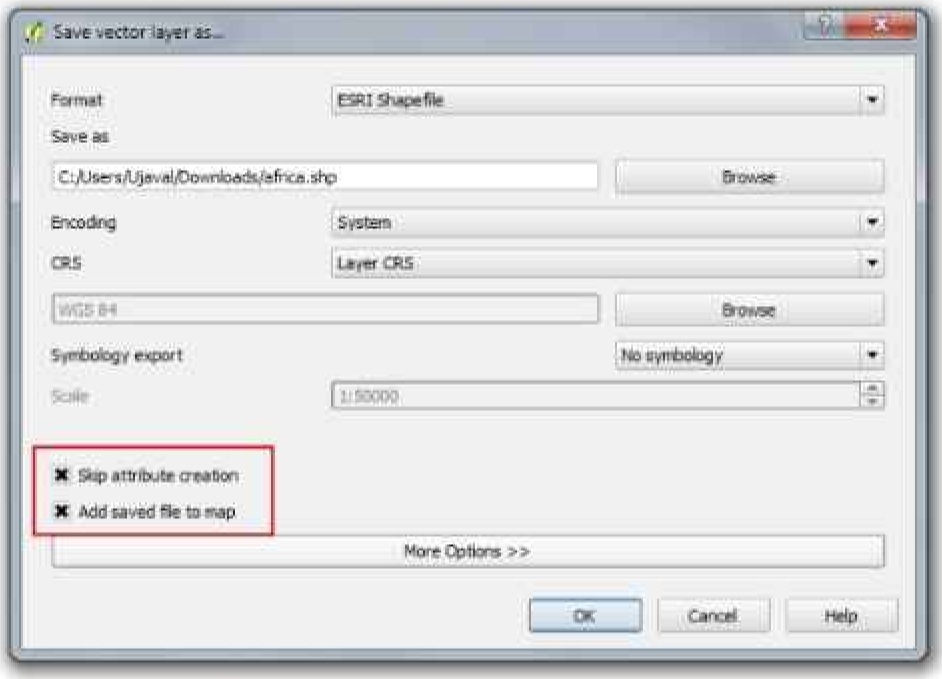
6. The dissolve processing may take a while. Once the process finishes, you will see the new continent layer added to QGIS. Use the Select Single Feature tool from the toolbar and click on Africa to select the polygon representing the continent.



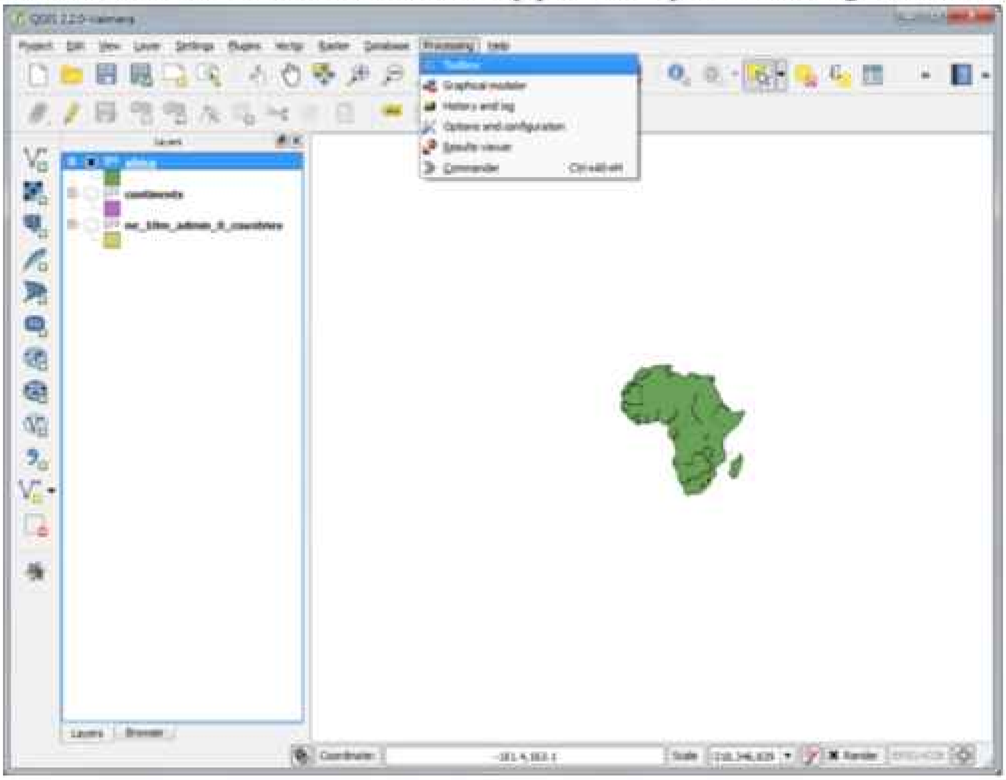
7. Right-click the continents layer and select Save Selection As....



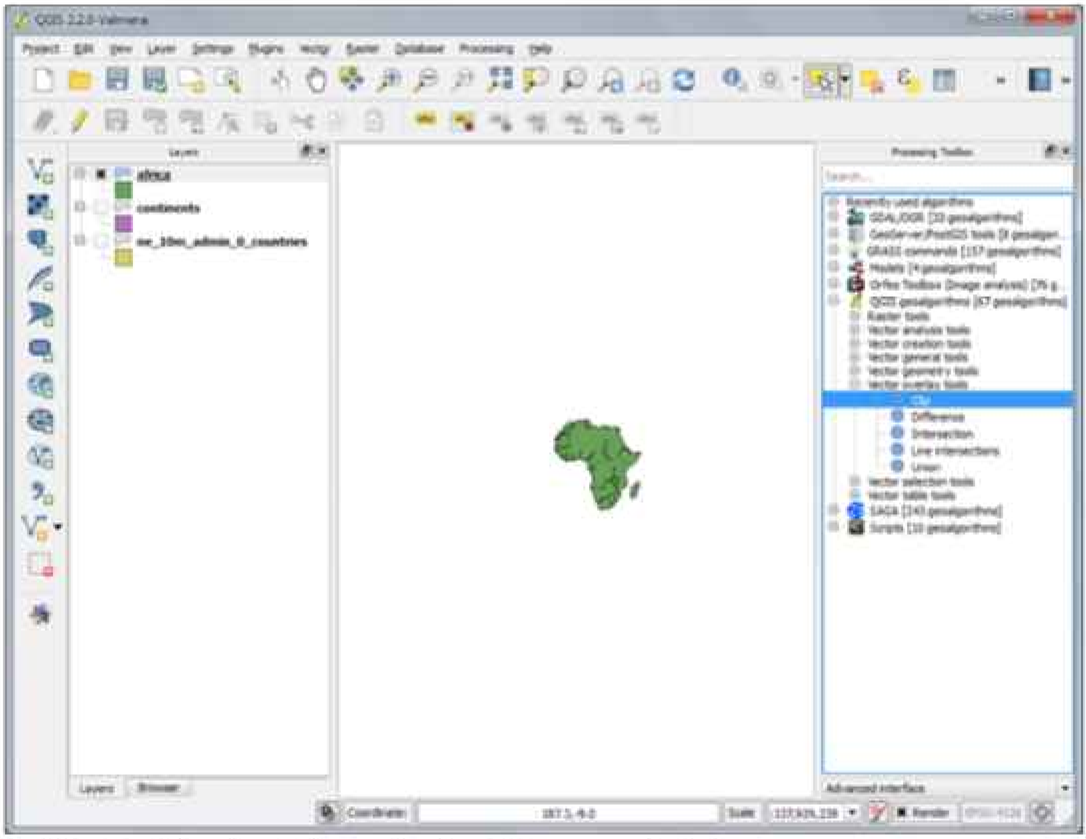
8. Name the output file as africa.shp. Since we are only interested in the shape of the continent and not any attributes, you may check the Skip attribute creation. Make sure the Add saved file to map box is checked and click OK.



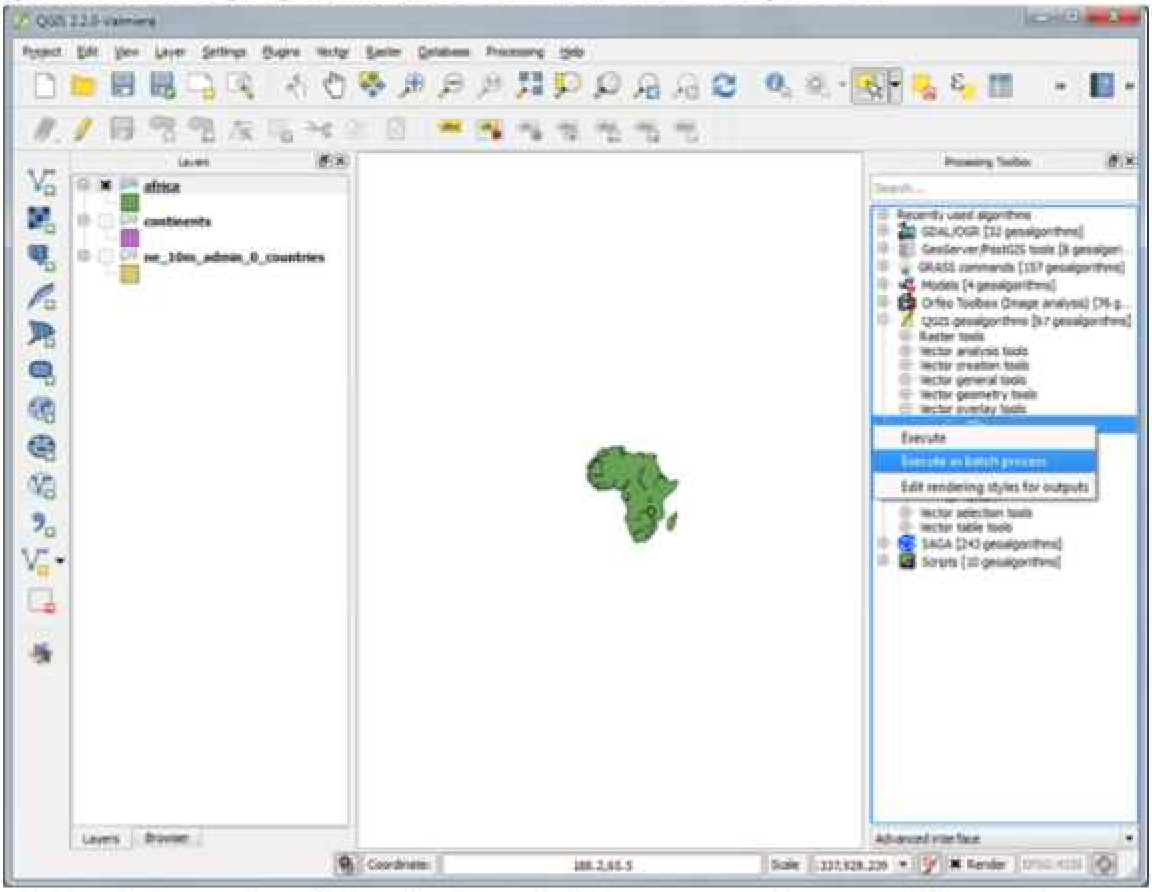
9. Now you will have the africa layer loaded in QGIS containing a single polygon for the entire continent. Now, it's time to start our batch clip process. Open Processing ‣ Toolbox.



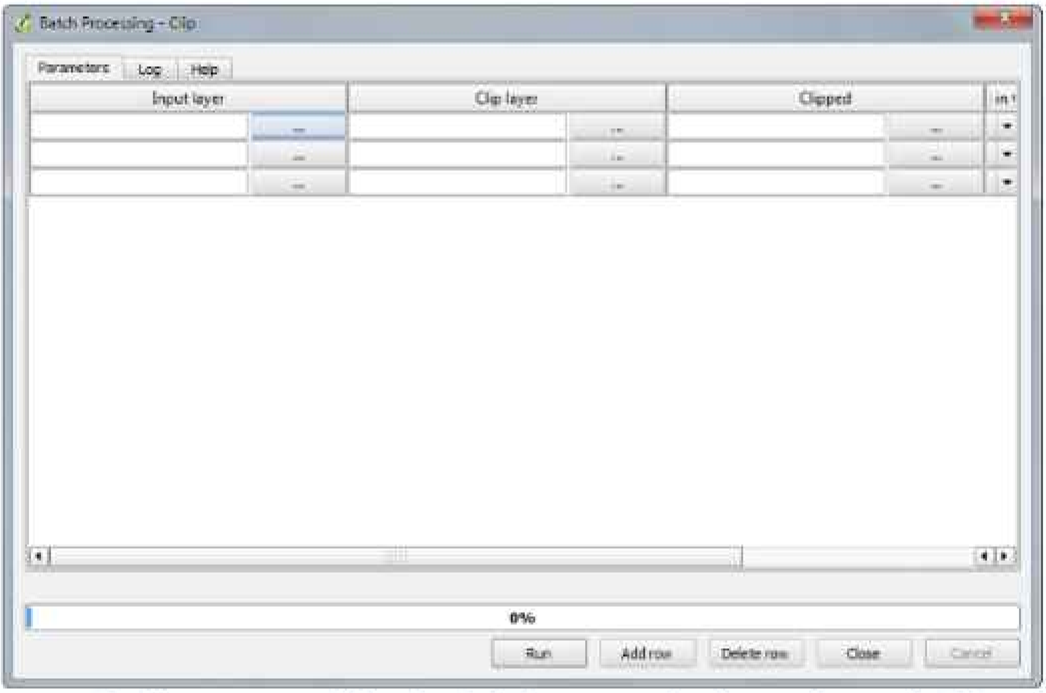
10. Browse all available algorithms and find the Clip tool from QGIS geoalgorithms ‣ Vector overlay tools ‣ Clip. You may also use the Search box to easily find the algorithm as well.



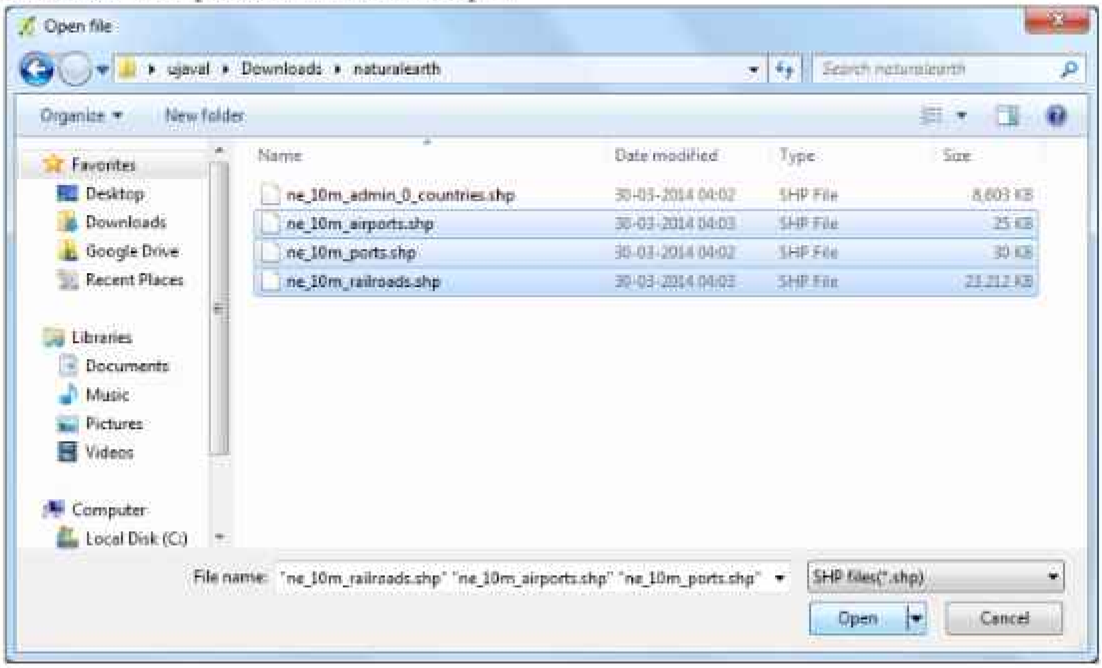
11. Right-click the Clip algorithm and select Execure as batch process.



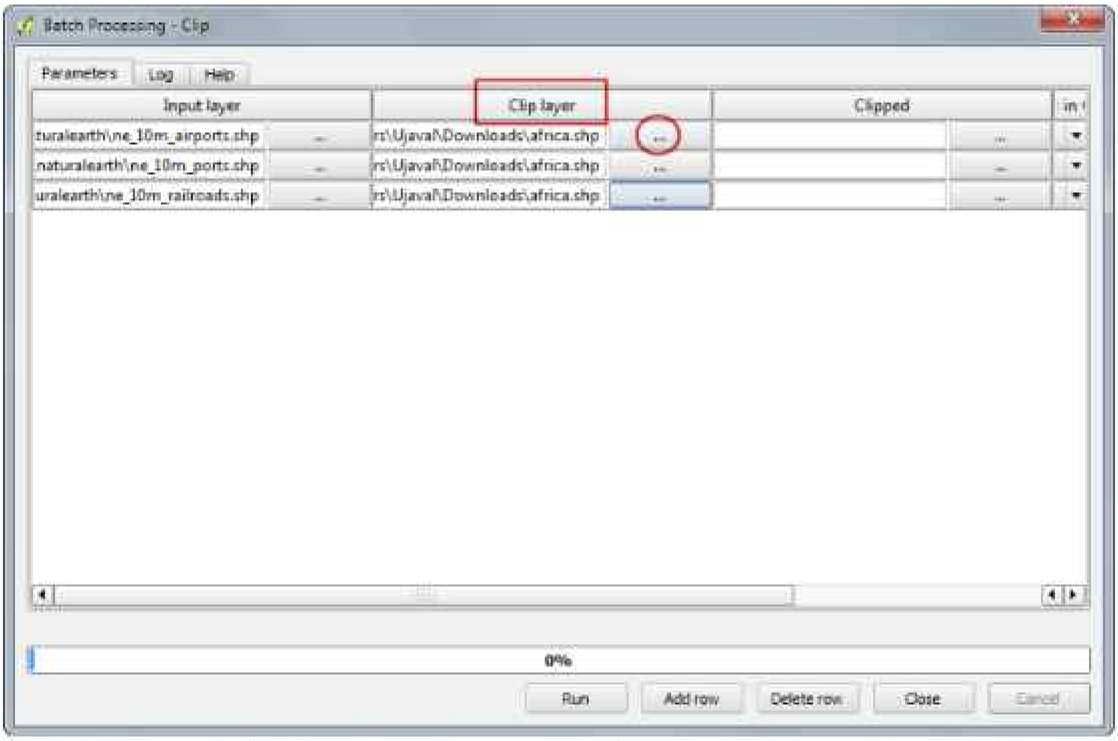
12. In the Batch Processing dialog, the first tab is Parameters where we define out inputs. Click the ... next to the first row in the Input layer column.



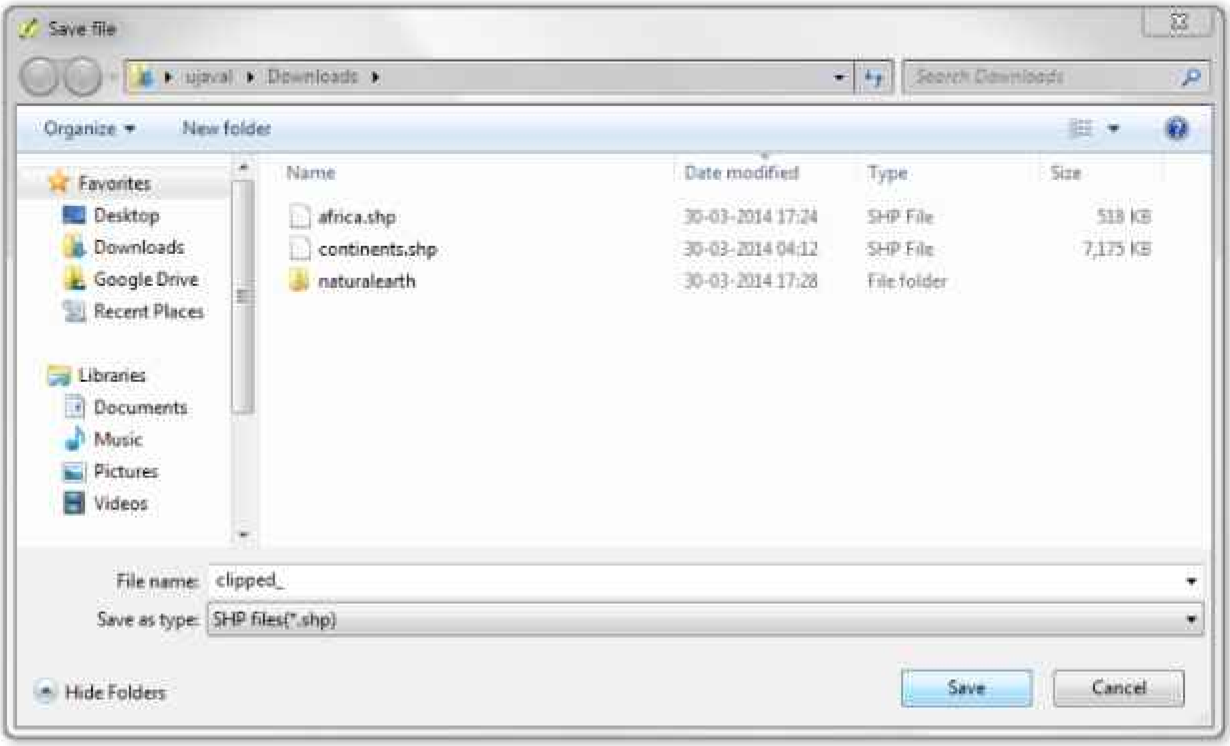
13. Browse to the directory containing the global transportation layers that you had downloaded. Hold the Ctrl key and select all the layers that you want to clip. You may also use Shift or Ctrl-A to make multiple selection. Click Open.



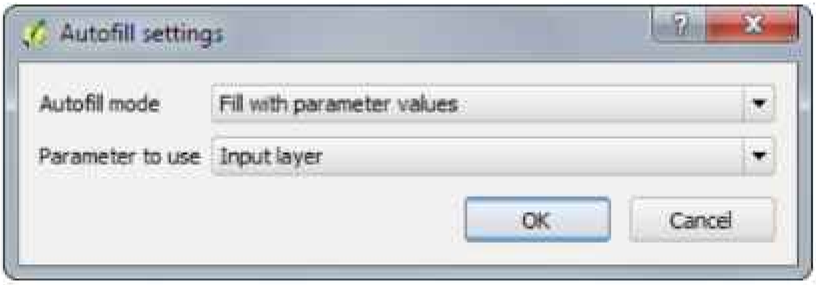
14. You will notice that the Input layer columns will be auto-populated with all layers you had selected. You may use Add row button to add more rows and define more inputs. Next, we need to select the layer containing the boundary to clip our input layers. Click the ... button for the first row and add the africa.shp Clip layer. Since the clip layer is the same for all our inputs, you can double-click the column header Clip layer and the same layer will be auto-filled for all the rows. Next, we need to define our outputs. Click the ... buton next to the first row in the Clipped column.



15. Browse the the directory where you want your output layers. Type the filename as clipped_ and click Save.

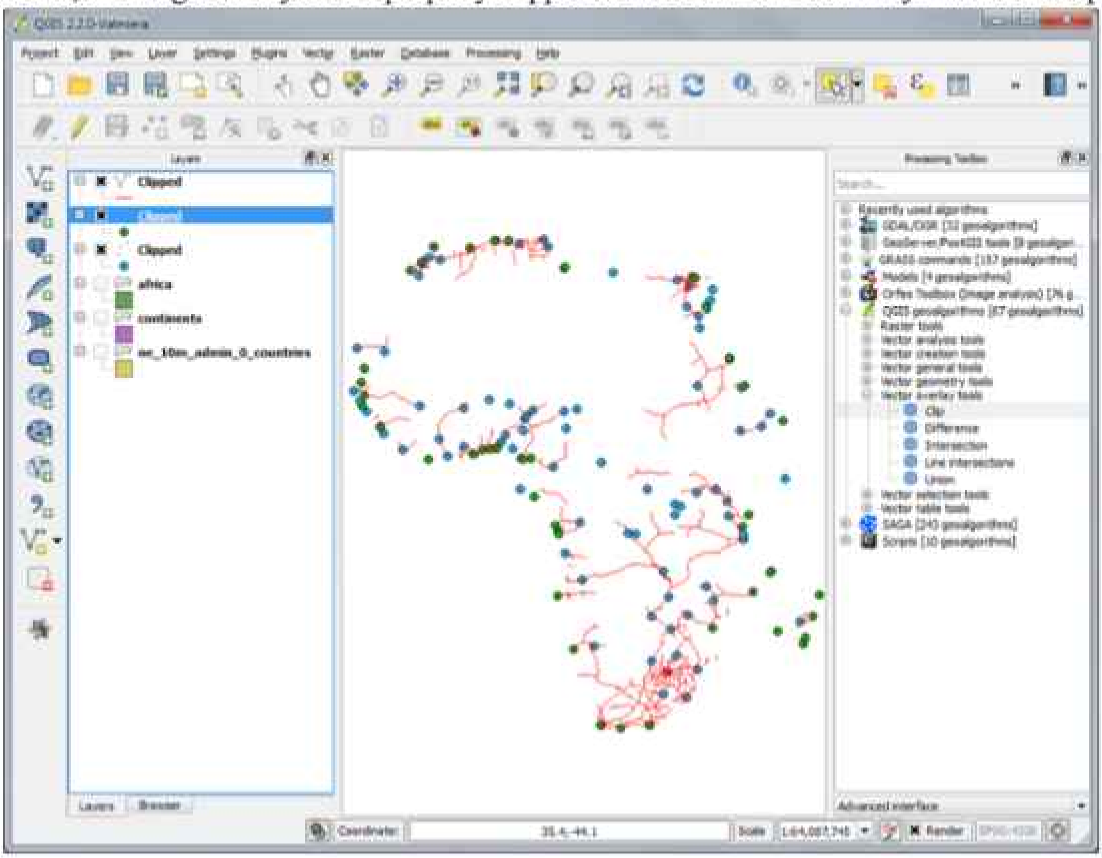


16. You will see a new Autofill settings dialog pop up. Select Fill with parameter values as the Autofill mode. Select Parameter to useas Input layer. This setting will add the input file name to the output along with the specified output_ filename. This is important to ensure all the output files have unique names and they do not overwrite each other.



17. Now we are ready to start the batch procesing. Click Run.

18. The clip algorithm will run for each of the inputs and create output files are we have specified. Once the batch process finishes, you will see the layers added to QGIS canvas. As you will notice, all the global layers are properly clipped to the continent boundary that we had specified.



PRACTICAL - 10

A. Validating map data.

AIM: To validate Map data using Excel and QGIS.

Software Used: QGIS Desktop 3.4.2 and Microsoft Excel 2013.

Datasets Used: The following datasets are used

1. Kenya_epidemiological_data.xls
2. Kenya_epidemiological_dict.xls

Shape Files used: Kenya admin.

Theory

The aim of this practical is to focus on the validation steps that should be performed during data cleaning. These include three types of checks:

1. Structural checks: e.g. unique ID, duplicates, format
2. Validation of plausibility - possible range of values e.g. min/max expected age
3. Logical checks - inconsistencies in answers e.g. occupation/age

The practical will be conducted using Microsoft Excel and QGIS software. The practical will be performed in the following stages

1. **Developing a data cleaning plan**
2. **Performing Structural data checks**
3. **Verifying the plausibility of data**
4. **Performing Logical data checks**
5. **Verifying coordinates of mapping data**
6. **Preparing data for mapping.**

Procedure

The following steps we need to perform in the Stage I of developing a data cleaning plan

1. Open the "Kenya_epidemiological_data.xls" in Microsoft Excel. Additionally open the corresponding dictionary "Kenya_epidemiological_dict.xls", which contains a description of all variables and information about their coding.
2. You should make note of the number of entries in your database, as you will need to keep track of any changes e.g. when you remove duplicates at a later stage.

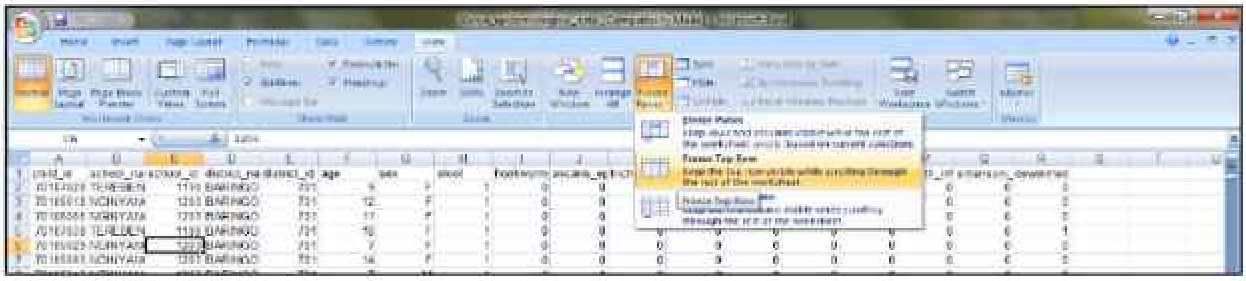
The following steps we need to perform in the Stage II of performing Structural Data checks

A. Format of the Database
B. Removing Duplicates
C. Coding of variables

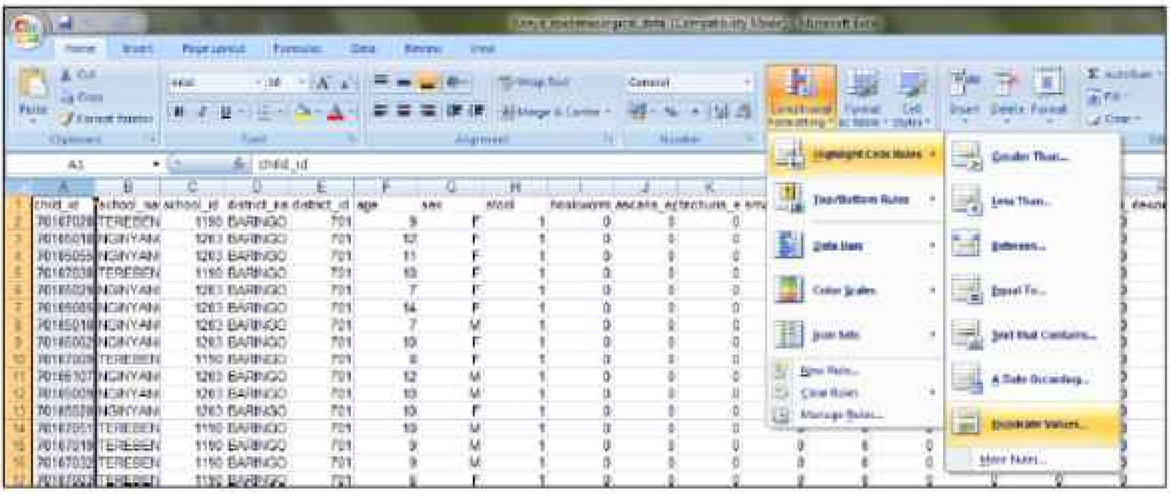
2A Format of the database

Open *Kenya_epidemiological_data.xls in excel.*

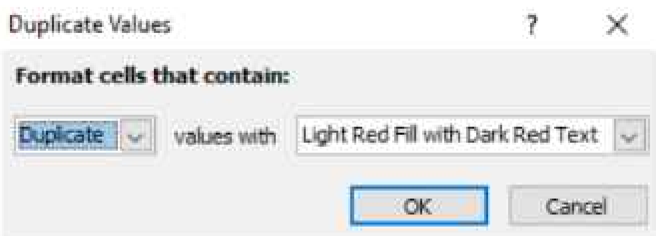
*Go to the **View** tab, click **Freeze Panes** and choose **Freeze Top Row**.*



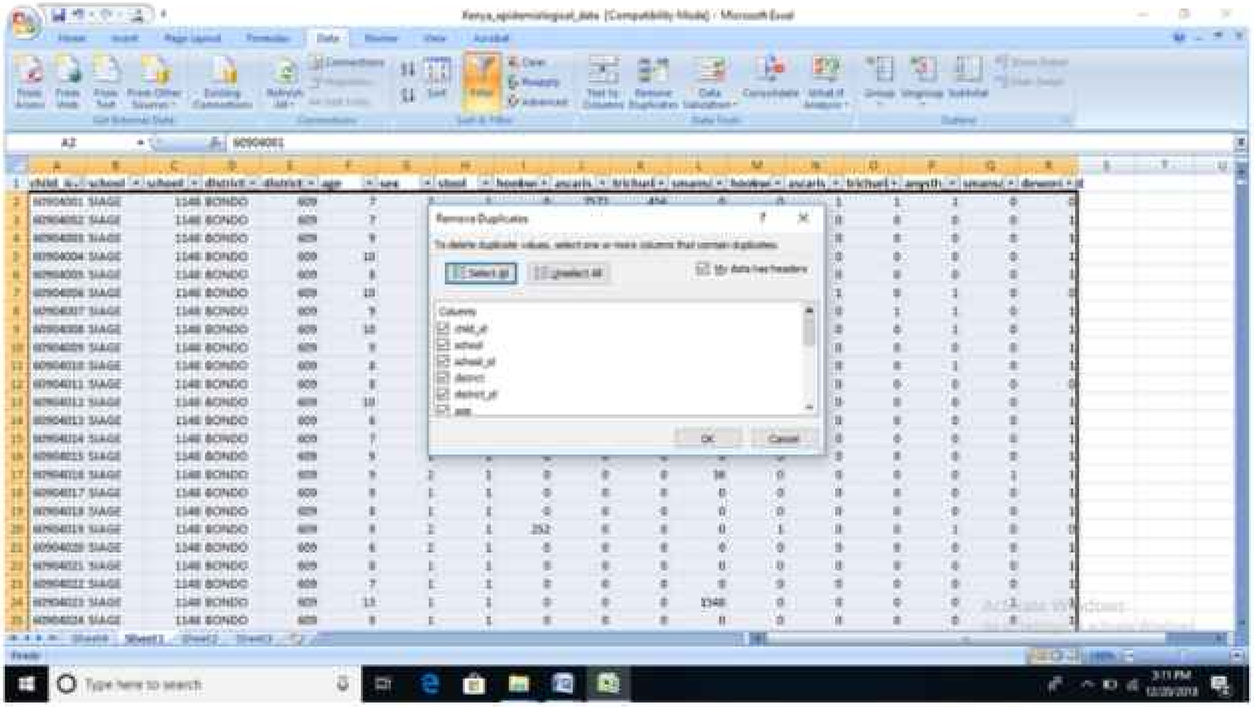
select the entire "child_id" column(first column),
Under Home Tab, click on ***Conditional formatting >Highlight Cell Rules>*** *Select* ***Duplicate values***



Now select the first combo box and select ***Duplicate*** *and select* ***Light red fill with Dark red text*** *in the next combo box as shown in figure*



2B Removing Duplicates
Select all the columns of existing worksheet
Now go to Data Tab and select Remove Duplicates



2C Coding of variables

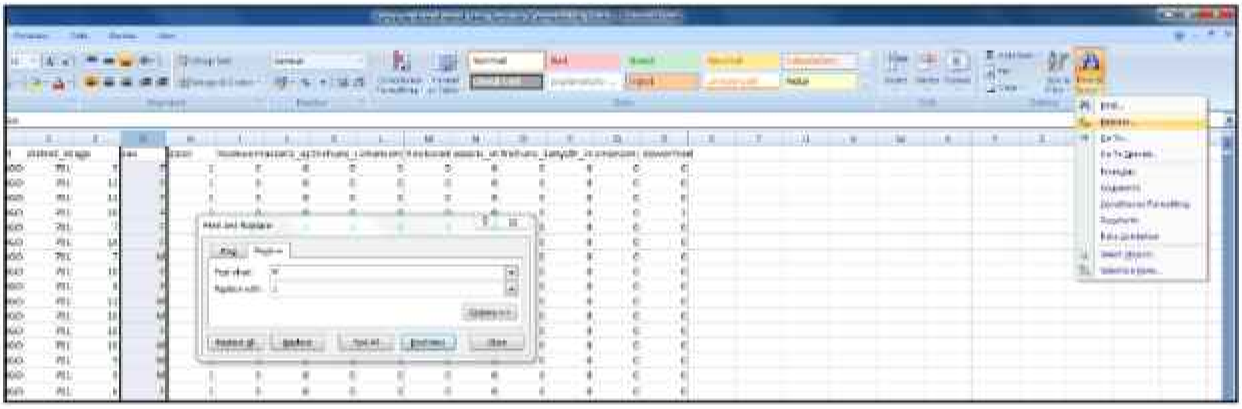
In the current worksheet, select the sex column.

Now type Ctrl+F and use Replace Function and Replace as follows

M-1

F-2

Please keep track of how many values are getting replace.



Step 3 Verifying the plausibility of data

In this step, we perform two basic operations

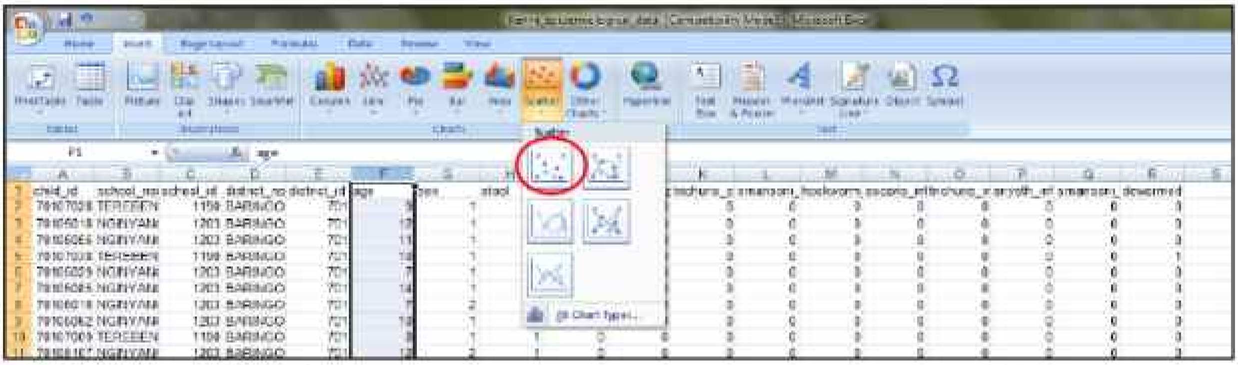
A. Coding of variables

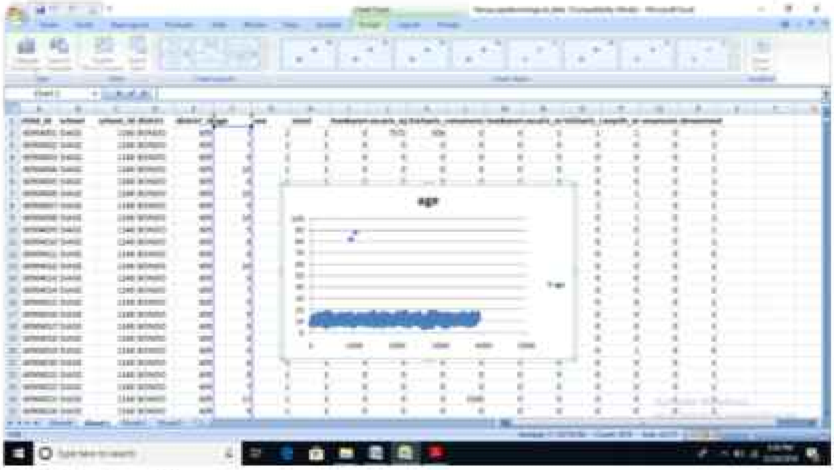
B. Using a filter to detect outliners

3A Coding of variables

Select the age column in the existing worksheet.

Now go to Insert tab and select Scatter. You will set chart as shown below

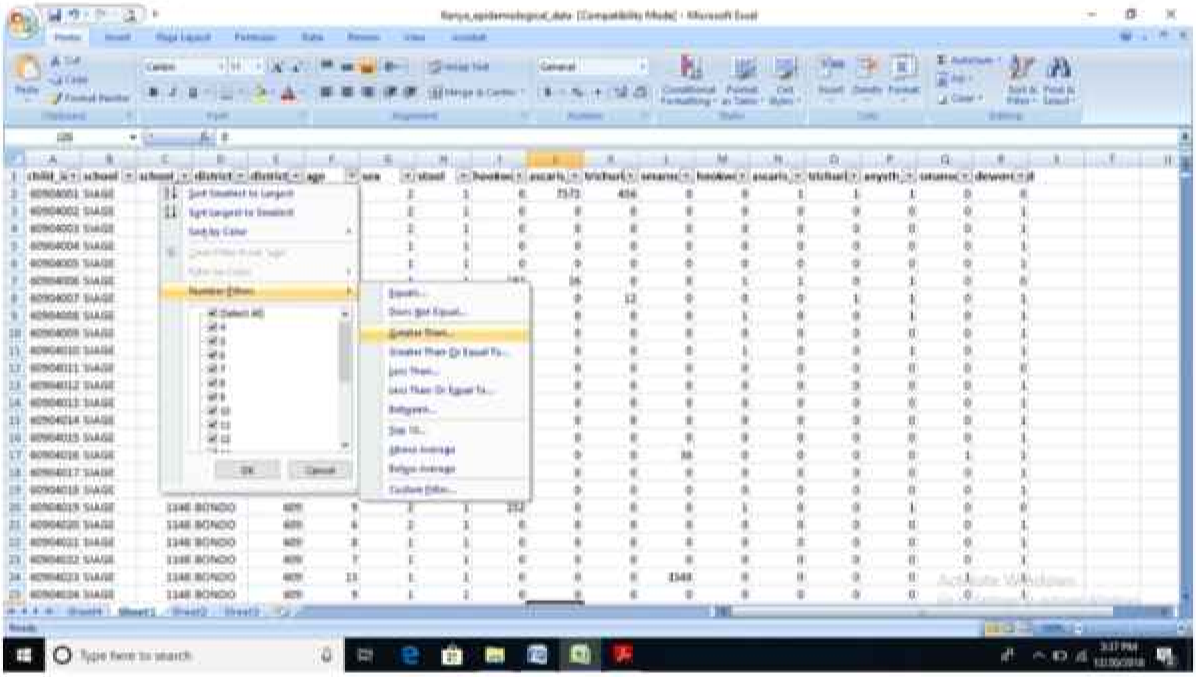


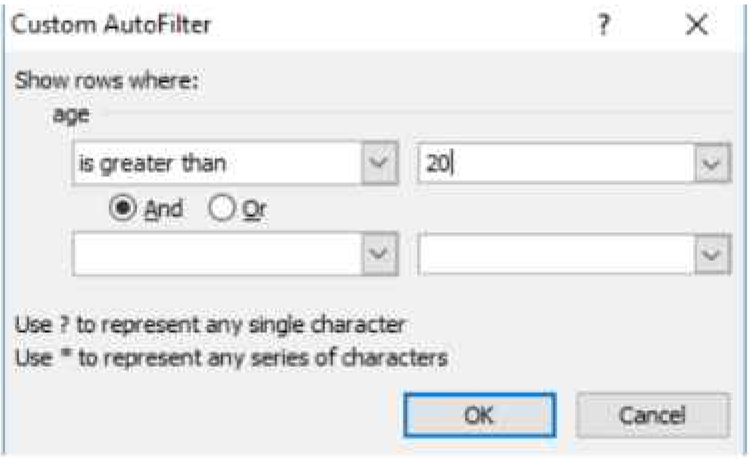


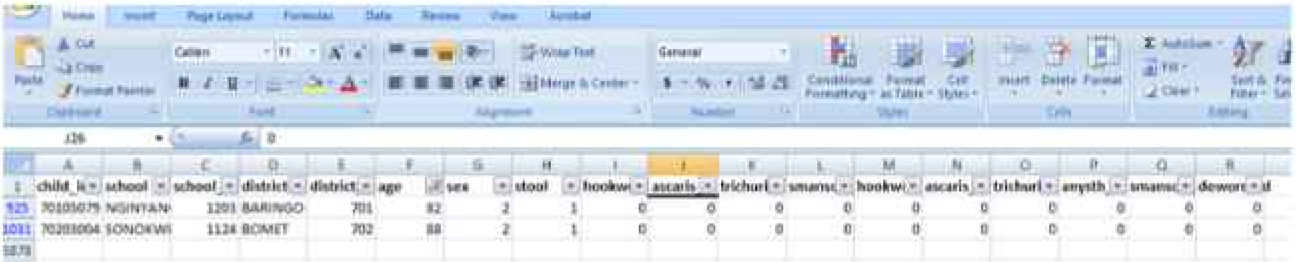
3B Using a filter to detect outliners

First go to the Home Tab>Sort and Filter>Filter. Click and apply the filter to all the columns of the worksheet.

Now click on age filter and click on Number Filter> Greater Than option and type the value 20 in greater than field.







Step 4: Logical Data checks

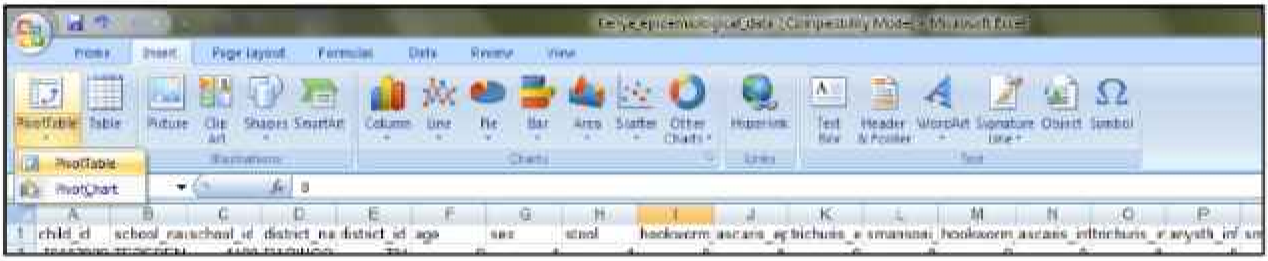
In this step, we perform two basic operations

A. Cross Tabulations

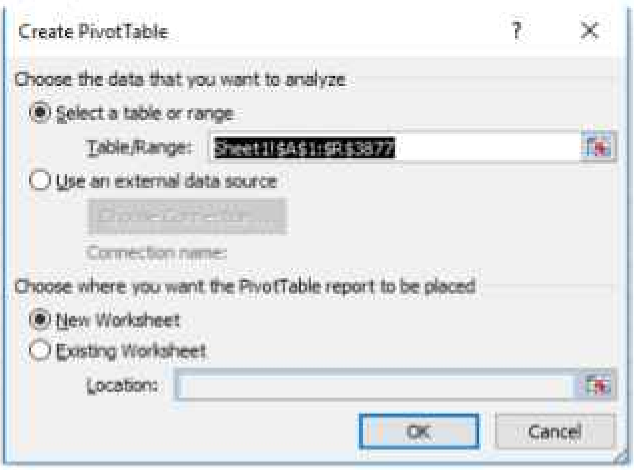
B. Formulas

A. Cross Tabulations

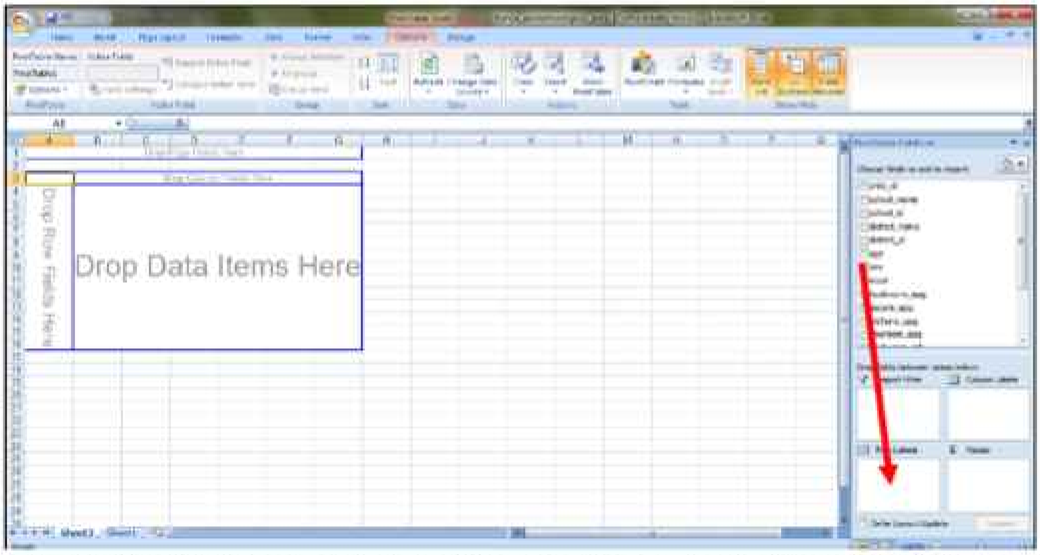
Open the existing worksheet. Now go to Insert Tab and select Pivot table function.



Select New Worksheet and click OK



An empty table is inserted in a new sheet and a window will open on the right hand side named PIVOT TABLE FIELD LIST.



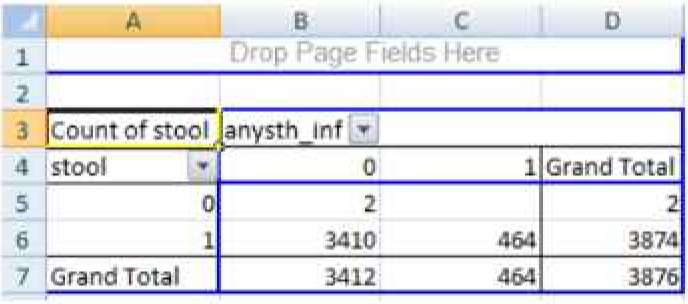
From the PivotTable Field List, drag the "stool" item and drop it into the "Row Label" field as show above.

Similarly, Click on *anysth_inf* and draw it into the "Column labels" and "Σ Values" field.

To include the count of observations in the table you might need to change the value field settings to count.

Click on the combo box Sum of stools and Click on Value Field Settings.

Change the value in Summarize value filed by to Count and click OK. Table is updated with count values as shown below



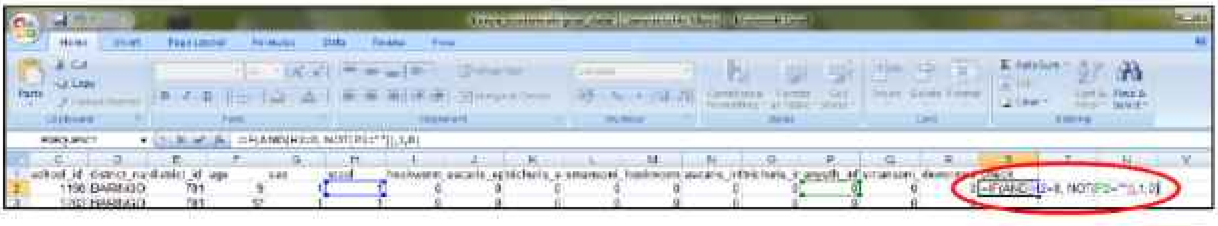
	A	B	C	D
1	Drop Page Fields Here			
2				
3	Count of stool	anysth_inf		
4	stool	0	1	Grand Total
5	0	2		2
6	1	3410	464	3874
7	Grand Total	3412	464	3876

4B Formulas

Open the existing worksheet

Create a new column with the variable called check

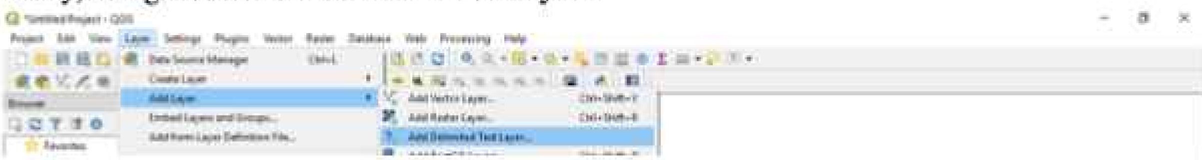
Type the following formula in S2 column of worksheet =IF(AND(H2=0, NOT(P2="")),1,0)



Now copy the formula to all other cells (ensure that the formula is copied to all rows in your dataset)
Now use the filter to show only entries with a check value of 1.

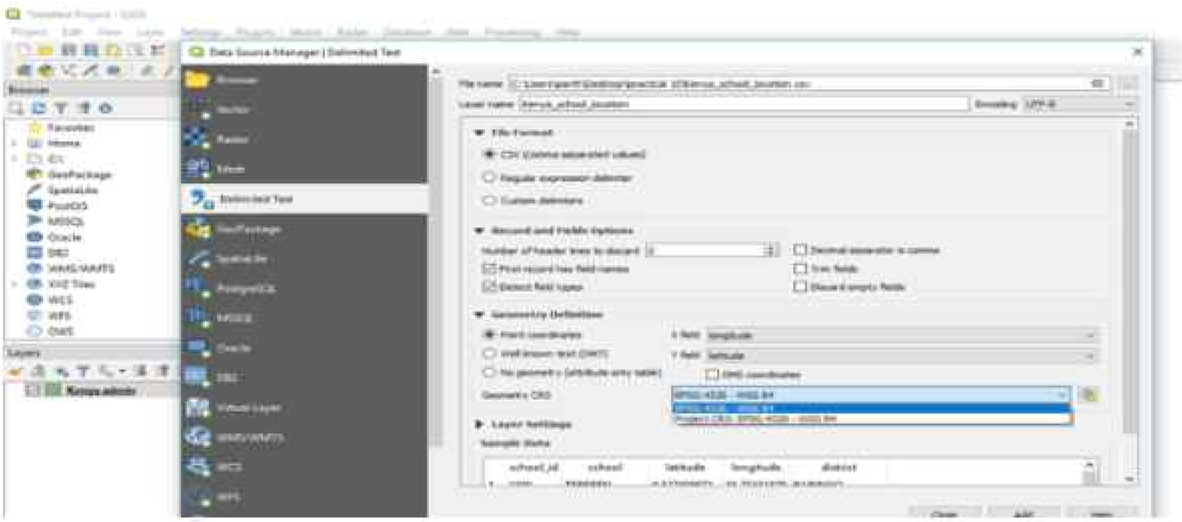
Step 5: Verifying the coordinates of mapping data
Create a New Project in QGIS Desktop 3.4.2.
Let's add the files!
Navigate to **Add Vector Layer** and add file: **Kenya_admin.shp**

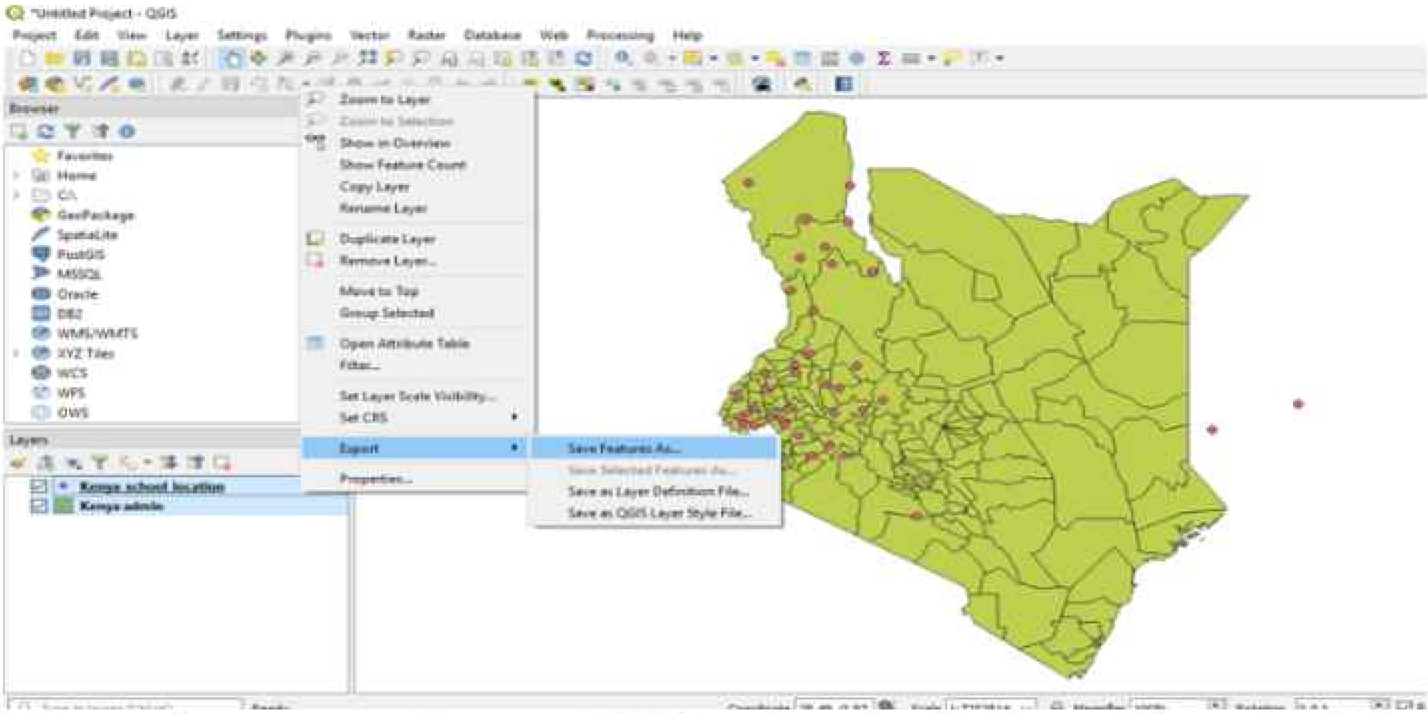
Similarly, navigate to **Add Delimited Text Layer.**



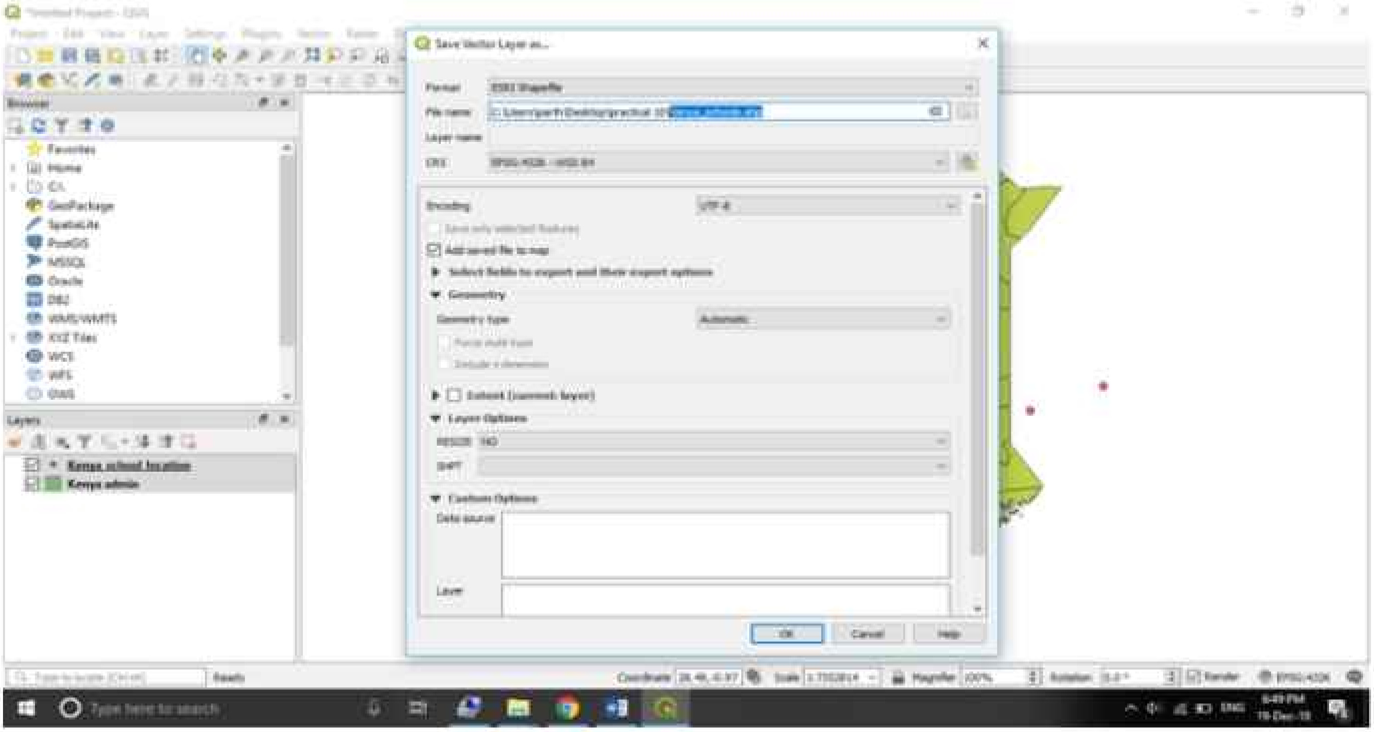
Here we have to add file: **Kenya_school_location.csv**. In **the Geometry Definition section**, there is a field called **Geometry CRS**, in that we have to select **WGS84** as coordinate system.

As you can see 2 points are not on the map.
To examine this, we need to save these layers as a Shapefile, to do that select both the layers **Kenya_school_location** and **Kenya admin**, then right click on them and choose **Save Features As…**

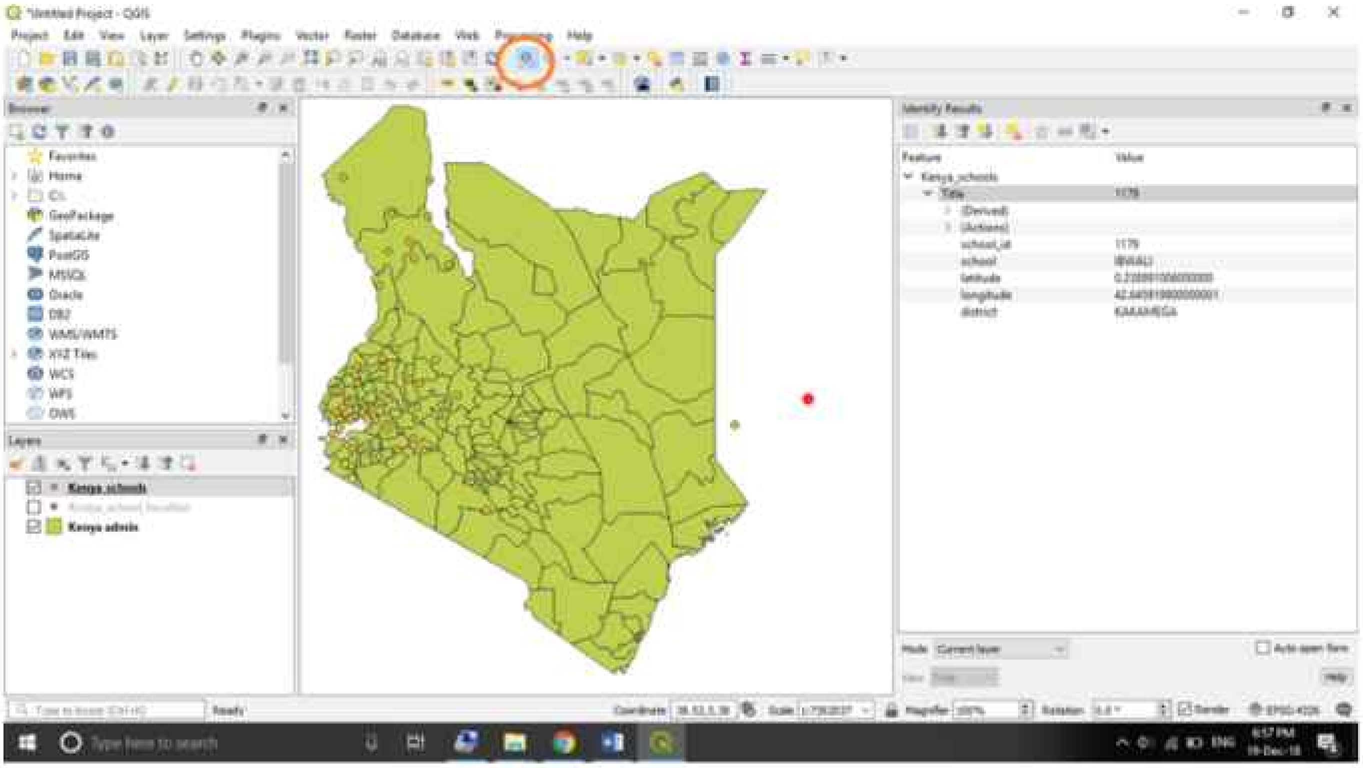




In the menu that comes up, set **Format** as **ESRI Shapefile** and put **File Name** as **Kenya_schools.shp**
After this is done you can uncheck the Kenya_school_location in the layers section.

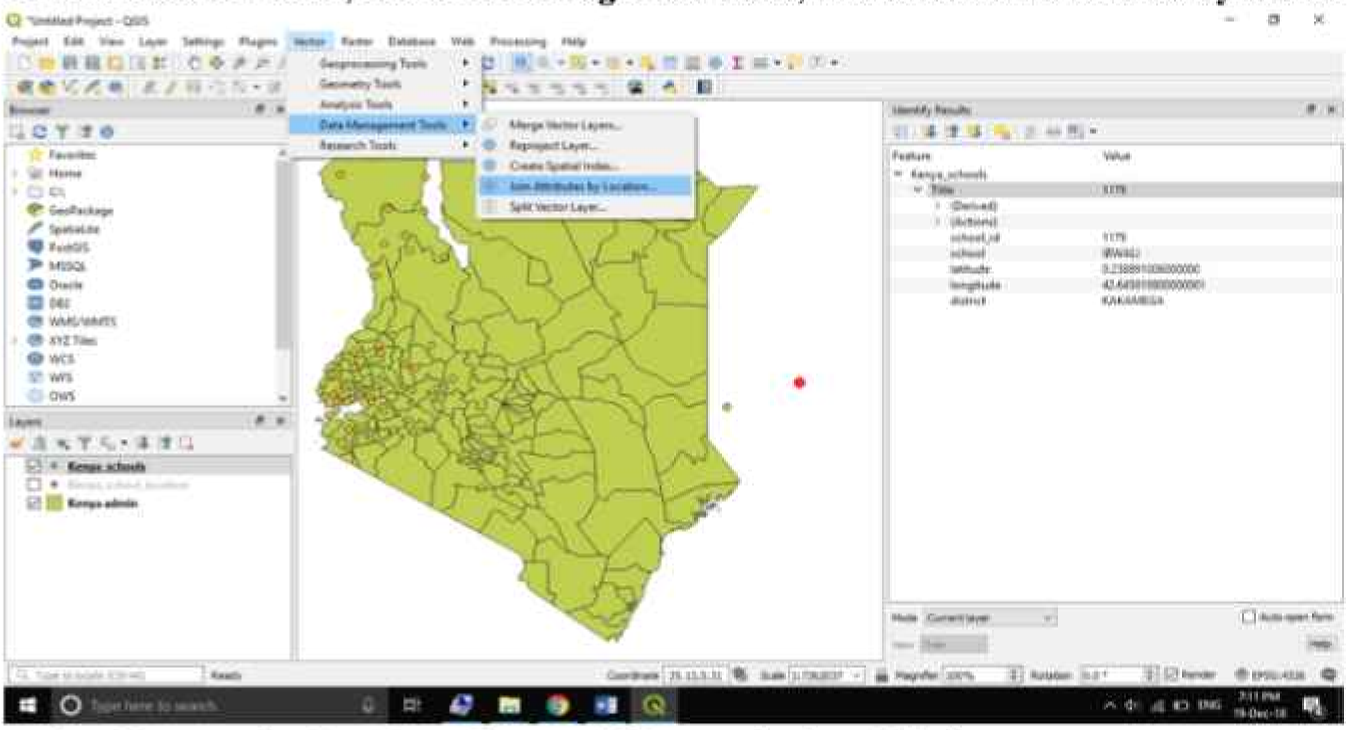


Let's try and get the details of these 2 points that are not on the map, select the **Kenya_schools** layer, click on the **Identify Features Tool** button and then click on the points outside of Kenya to get their details.

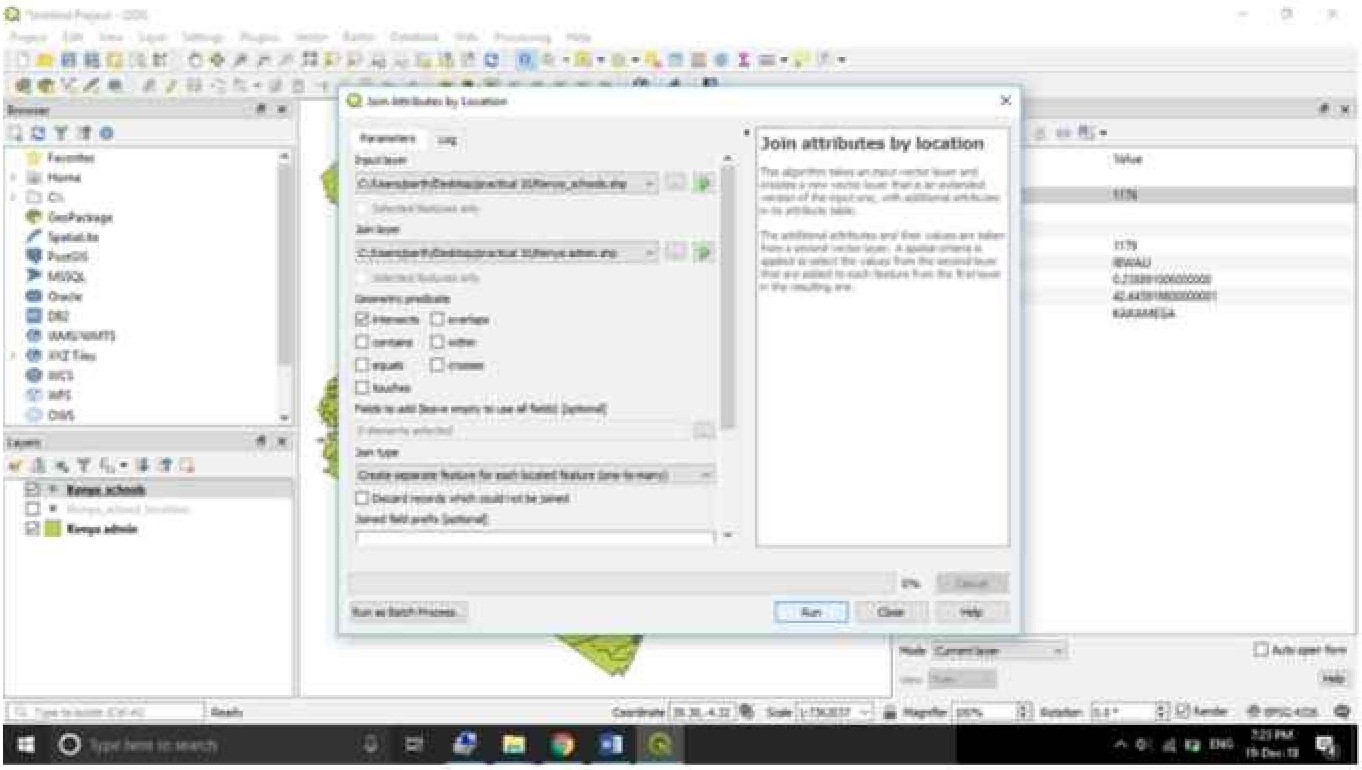


Now we want to add the district information to the map. Therefore, we will join information based on the geographical localization.

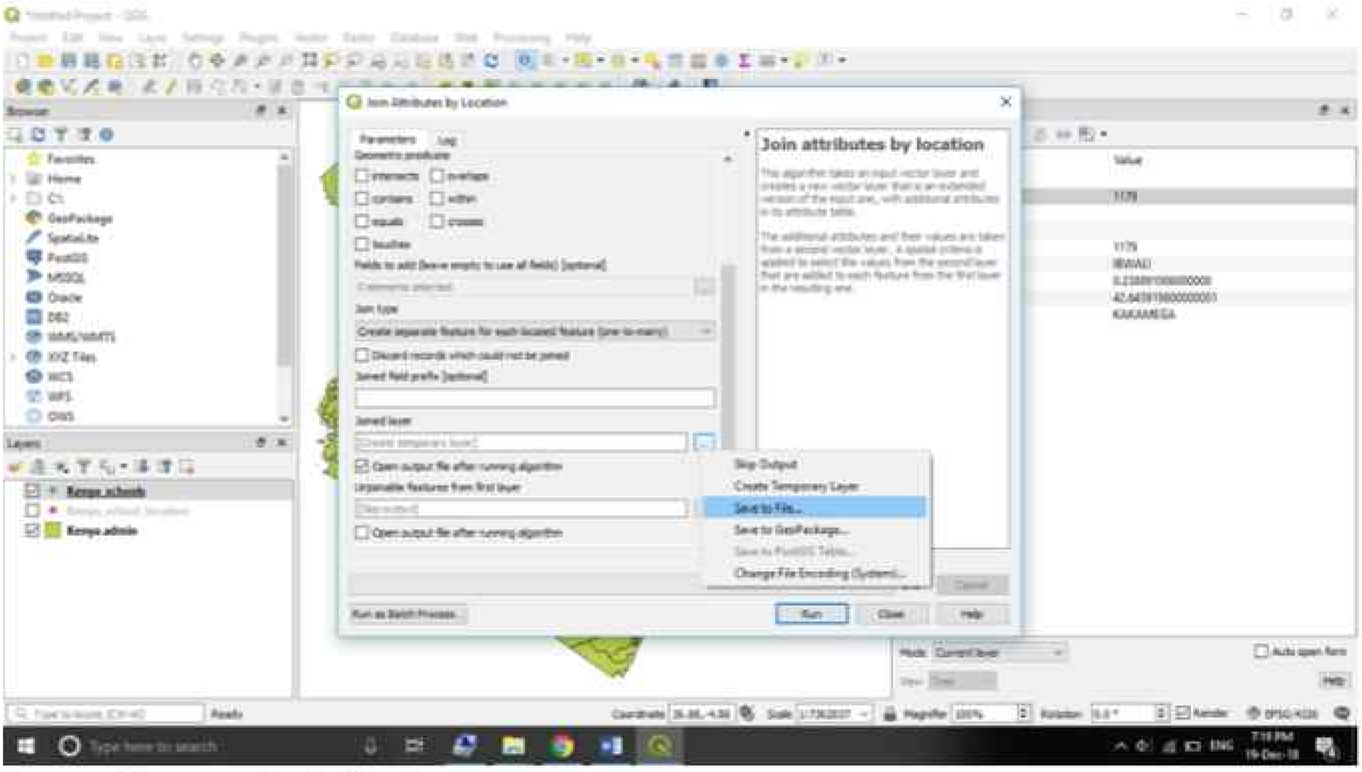
In the menu click on **Vector**, then **Data Management Tools**, then select **Join attributes by location.**



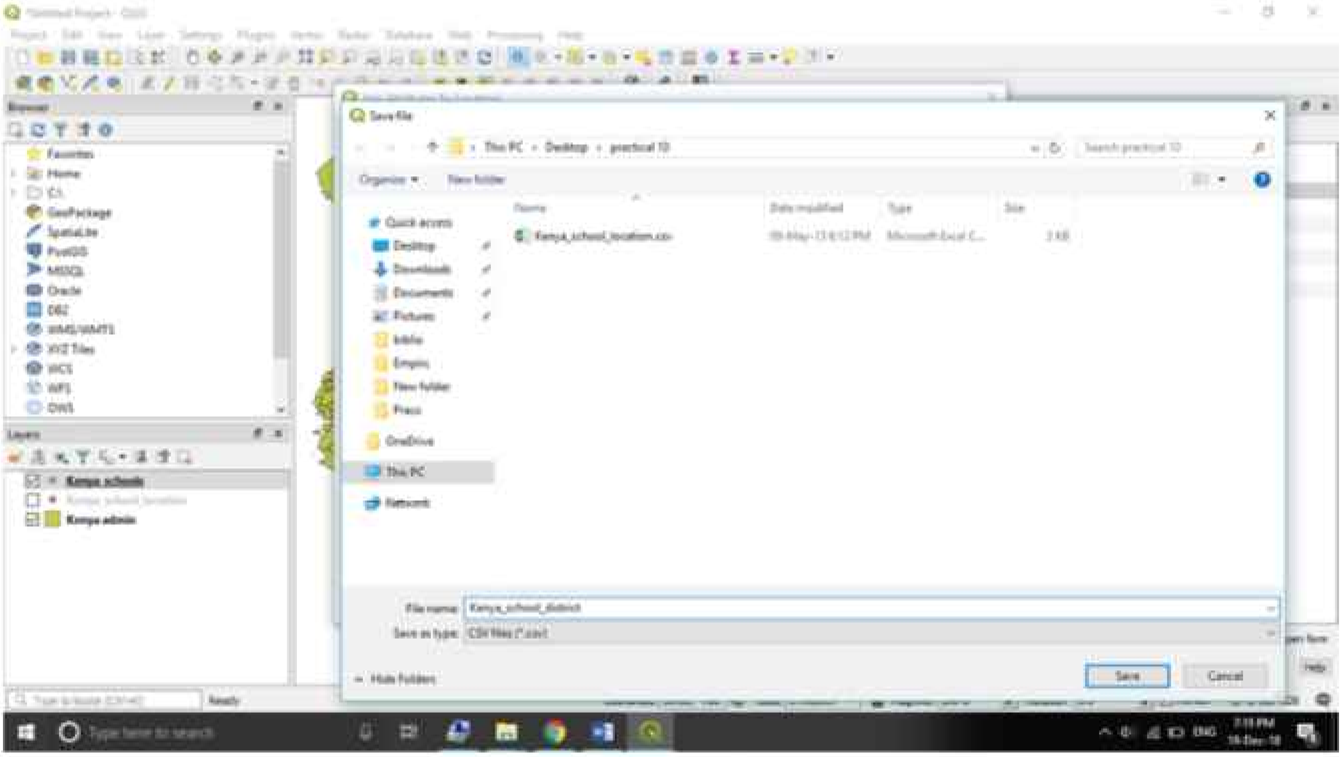
Then select **Kenya_schools** as **Input layer** and **Kenya_admin** as **Join layer**.



We also need to save the output so in **Joined Layer,** click "…"button to Browse location.



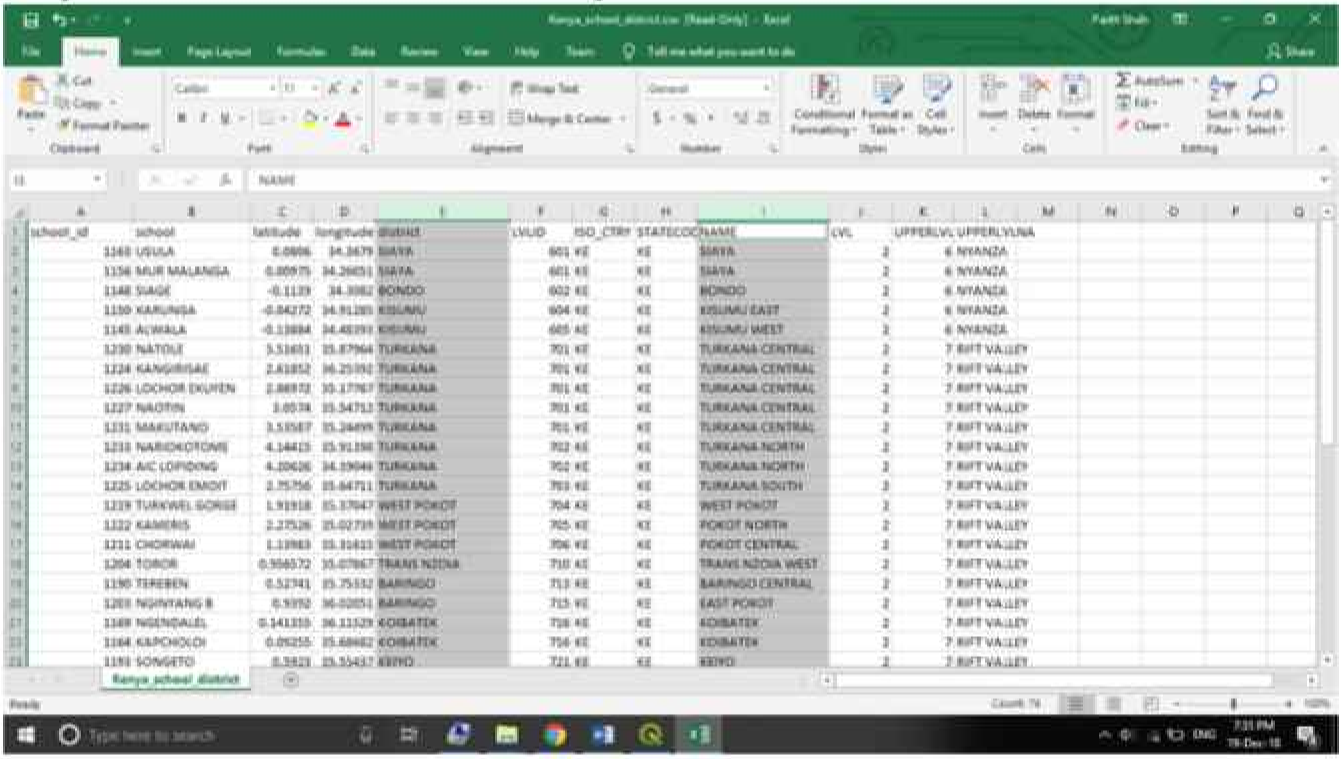
Save as **Kenya_school_district.csv**



And then click run.

After it is done…

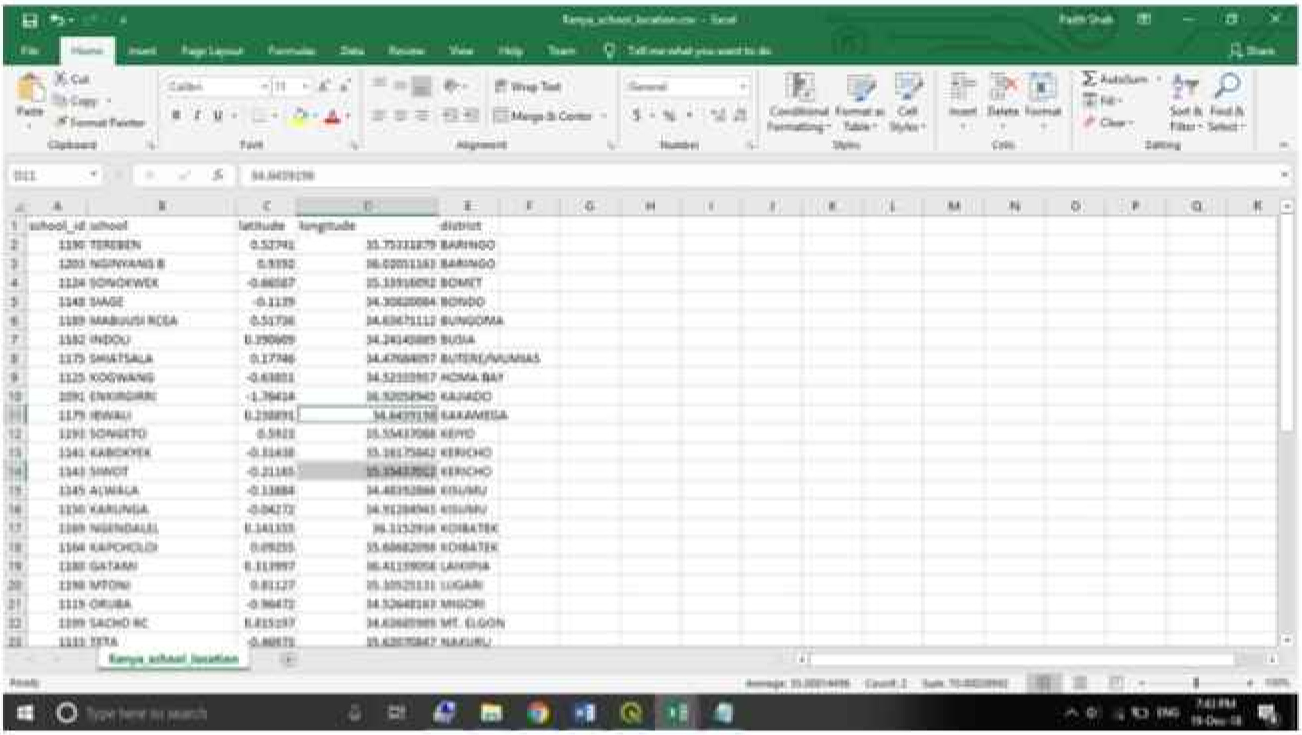
Navigate to the location of saved file **Kenya_school_district.csv**and open it, you should now be abl compare both **district** and **Name** for discrepancies.



We need to change the co-ordinate of those 2 points which were not on the map. So, open the file **Kenya_school_location.csv** and make the following changes, set:

IBWALI: Longitude 34.6459198

SIWOT: Longitude 35.35437012

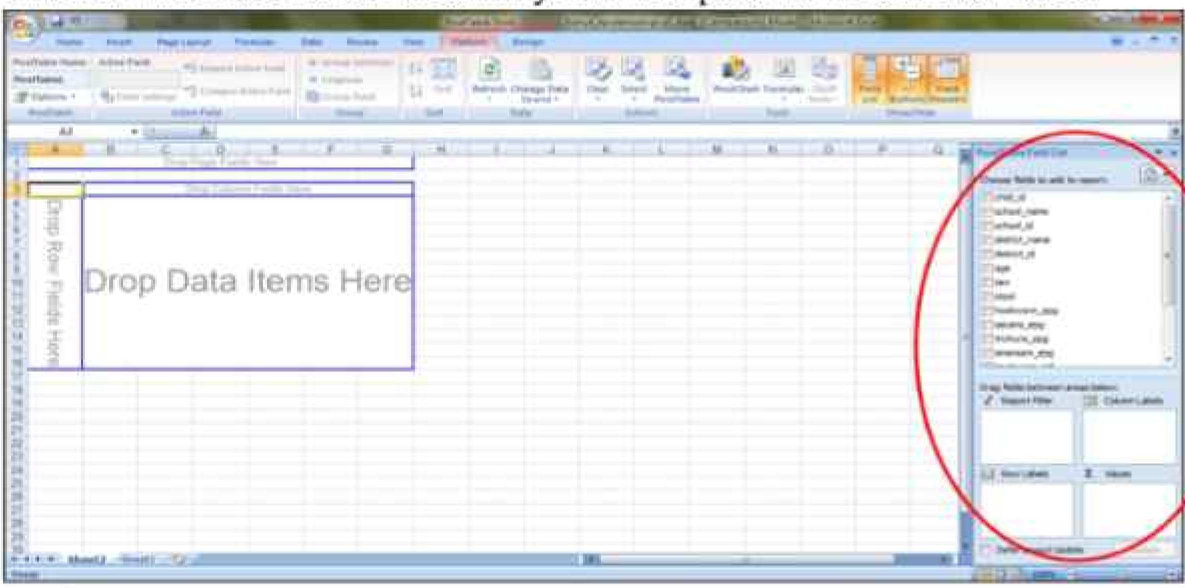


Save the file as: Kenya_school_location2.csv.

Step 6: Preparing data for mapping

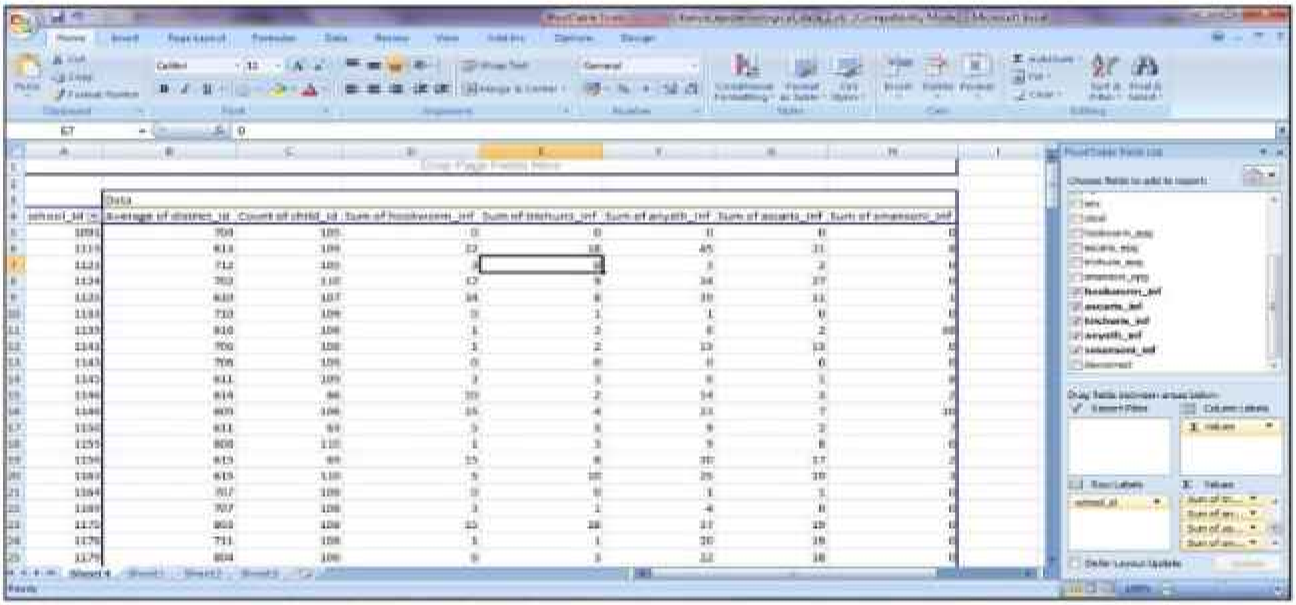
Open **Kenya_epidemiological_data_2.xls**, **select the entire sheet**, go to **Insert tab** to create new **Pivot Table.**

Tick New Worksheet to tell Excel that you want to place the table in a new sheet.



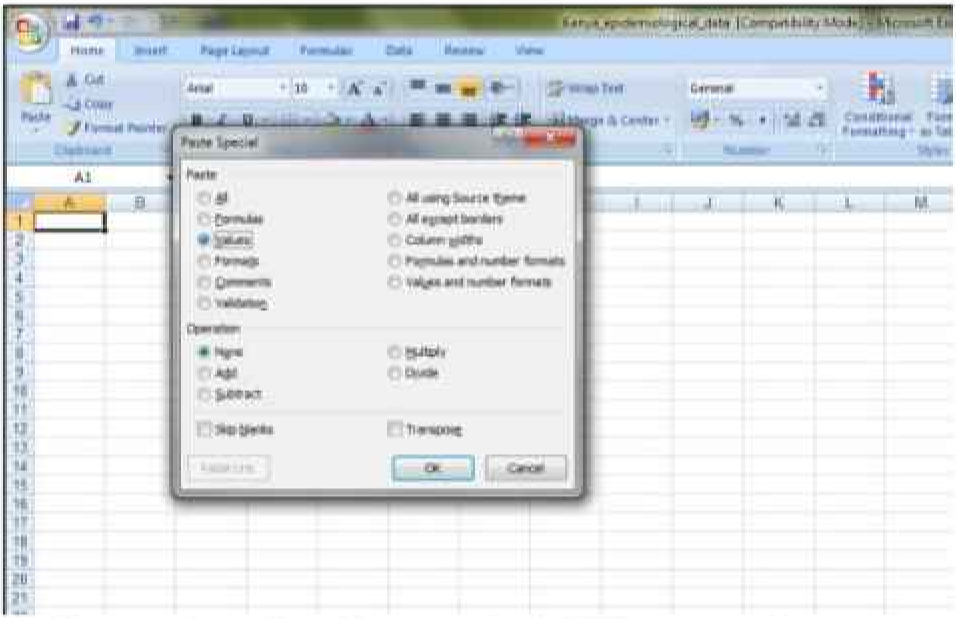
Now click on **school_id**todragand drop it in the **"Row labels"** field at the bottom.

Add **district_id** to**"Σ Values"**and click on it, a drop down list will open, click on **Value Field Settings**. Choose **Average** as type of calculation, because all children in the same school will have same district_id.

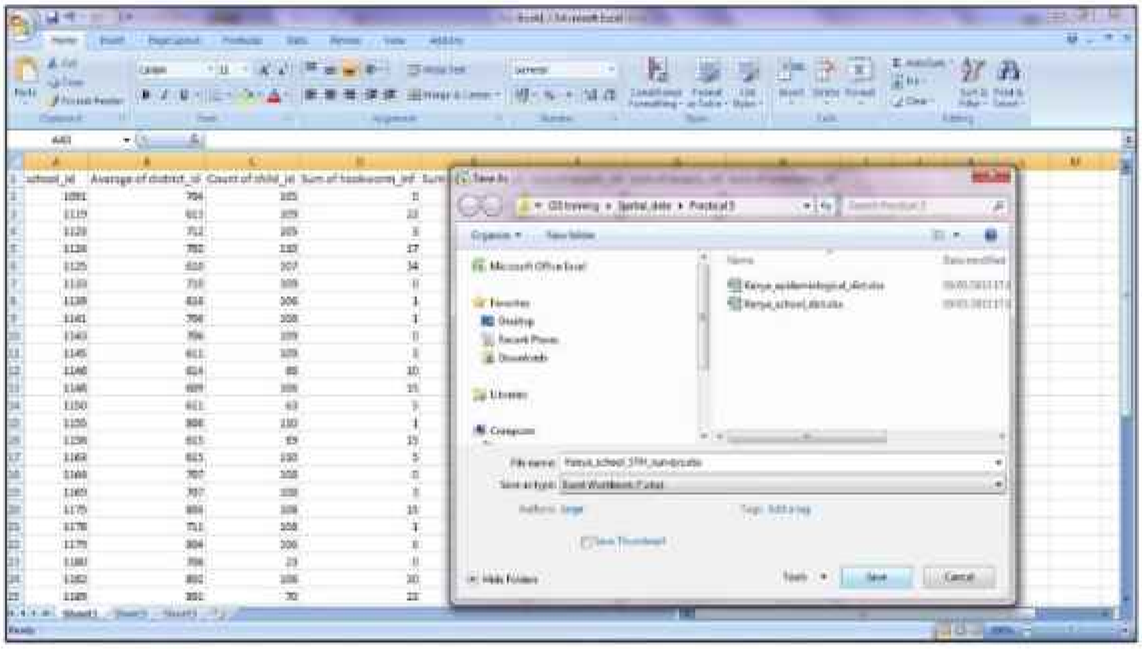


Now drag and drop**child_id** into the **"Σ Values"** field, click on **Value Field Settings** and choose **Count** to summarize the results. So, we come to know how many children per school are infected. Similarly, Drag and drop**anysth_inf** into the field, click on **Value Field Settings**and choose **Sum**. As, infected is 1 and not affected is 0, the sum will give us the total number of infected children.

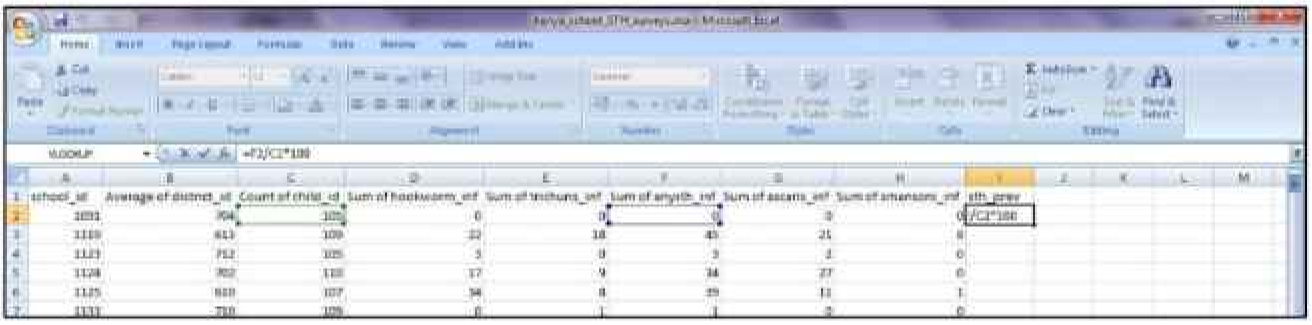
Now **copy the table**, open a new Excel file and paste the values into the new spreadsheet. Therefore, click Paste in the Home tab, then choose **Paste special** and paste only the **values.**
Remove the last row which has Grand Total and other values.



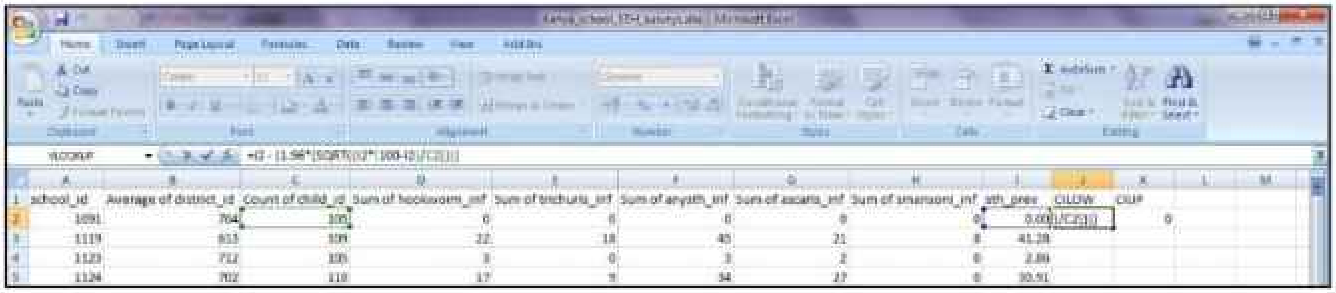
Save this new data table as **Kenya_school_STH_surveys.xlsx**

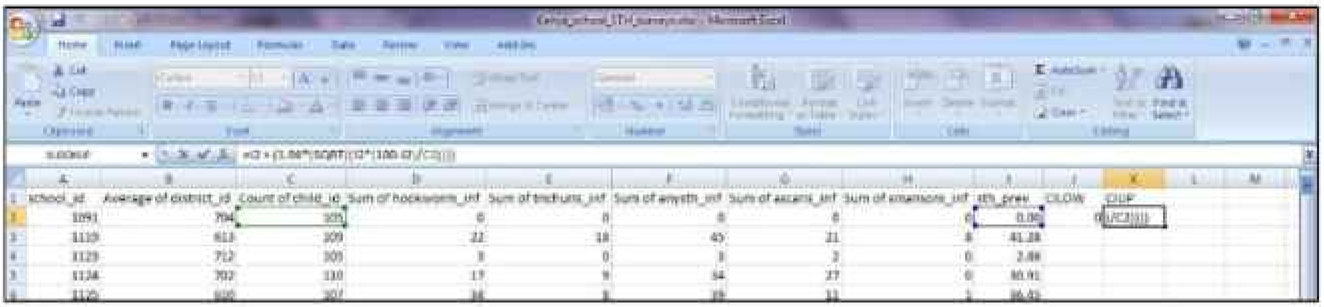


Now we need to know the total count of infected children, that is, the prevalence of STH.
So, w **ecreate a new column:sth_prev**in which we are going to be dividing the number of infected children by the number of children and multiplying by hundred to obtain a value in percent (%).
In the first cell under the heading type **=F2/C2*100** (this assumes that your number of children is in row C and the number of infected children in row F; you will need to **<u>adjust the column label accordingly</u>**); then copy the formula to the other cells in the column.



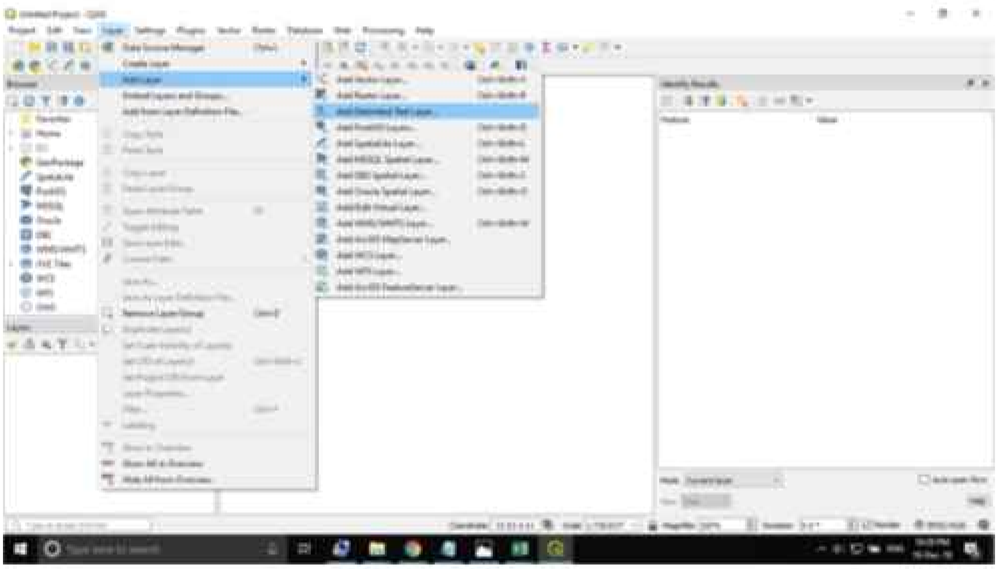
Additionally, you could calculate the 95% confidence interval (CI) of your prevalence.
You will have to create a new column called **"CIlow"** (lower confidence limit) and **"CIup"**(upper confidence limit)
You can calculate the limits by typing the formulas as follows and then copying to the other cells:
For CIlow: =I2 - (1.96*(SQRT((I2*(100-I2)/C2))))
For CIup: =I2 + (1.96*(SQRT((I2*(100-I2)/C2))))
Assuming I2 as **sth_prev** and C2 as **Count of child_id, <u>adjust accordingly.</u>**

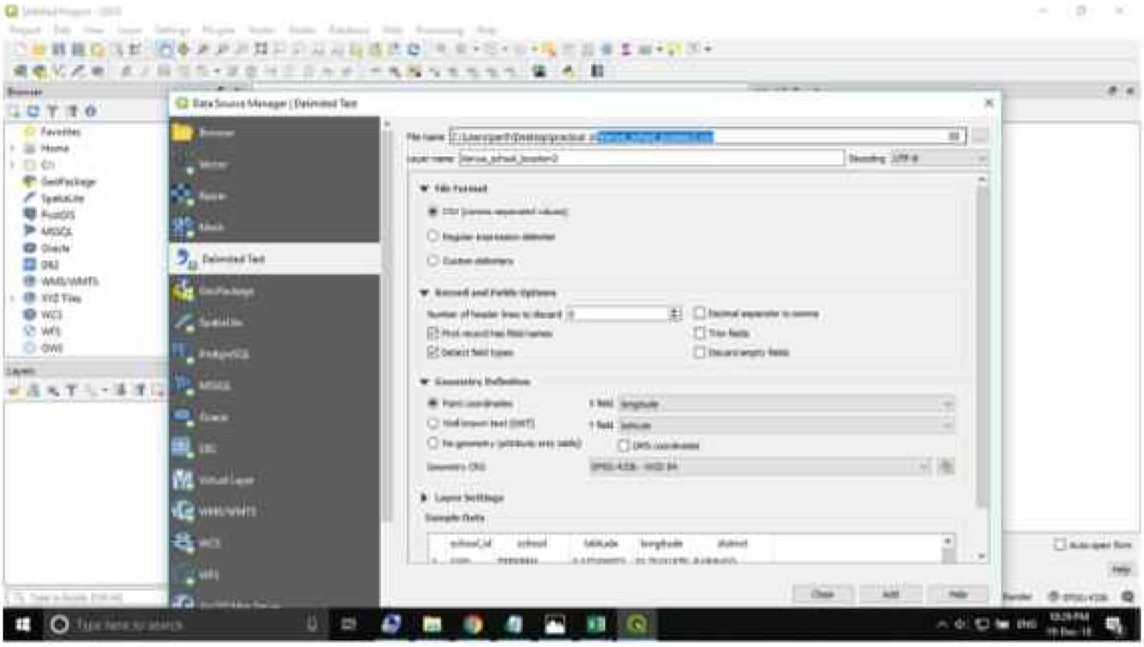




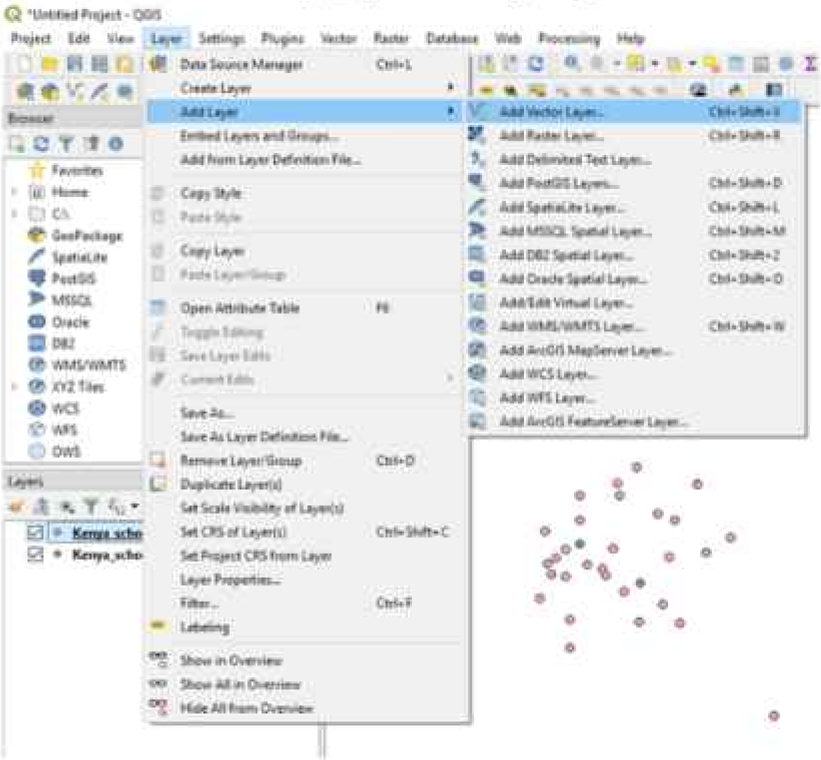
Save this file as **Kenya_epidemiological_school.csv**

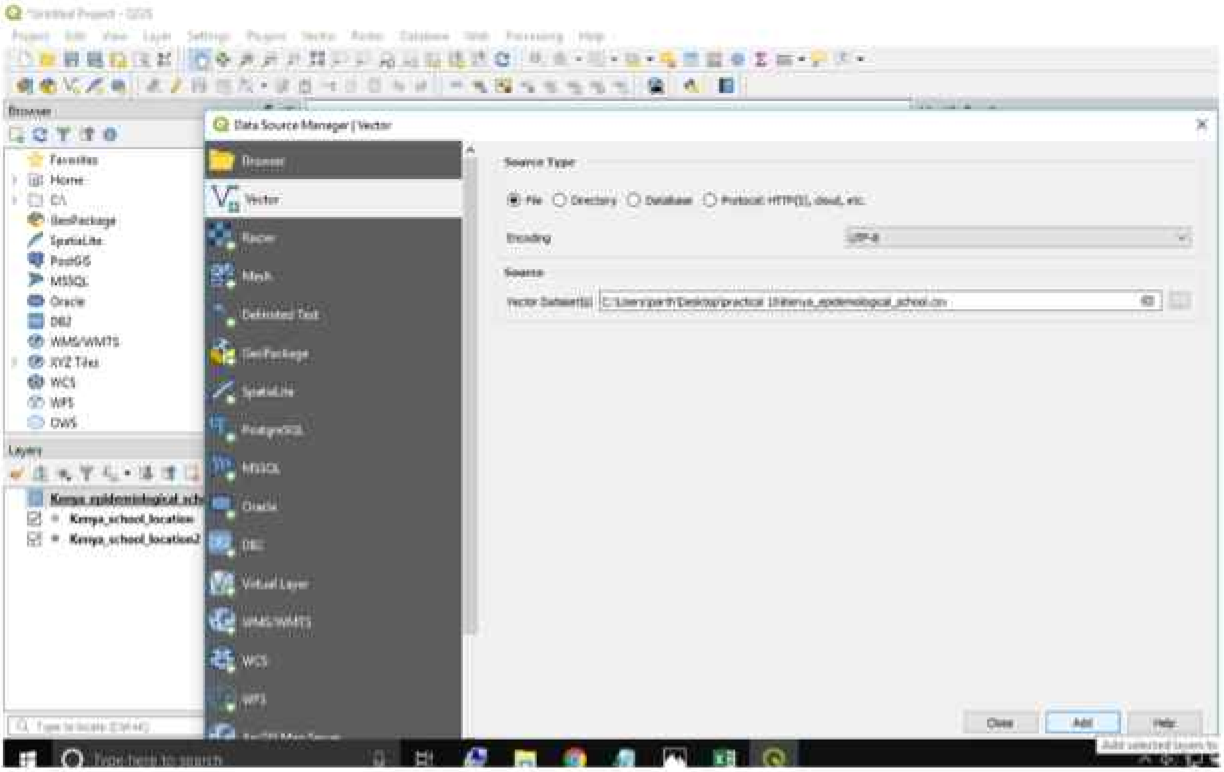
Now that all the datasets are ready, let's add them.
Open a new QGIS project.
First, add **Kenya_school_location2.csv** to the project. Click on **Add Delimited text** layer in the menu, and browse to select the file.





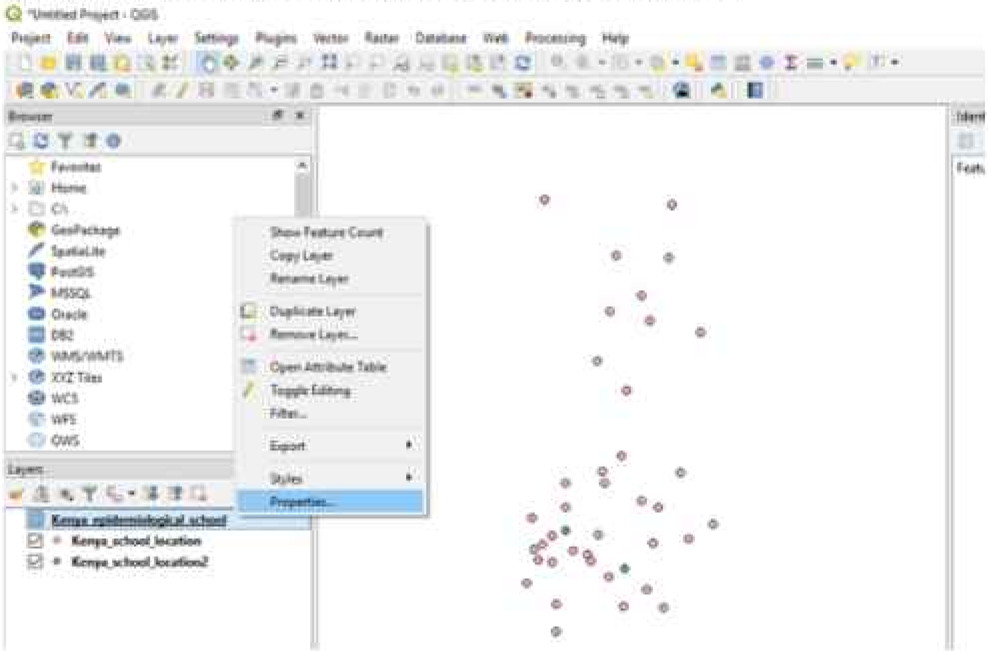
Similarly, **Add Vector Layer** and add **Kenya_ epidemiological_school.csv**



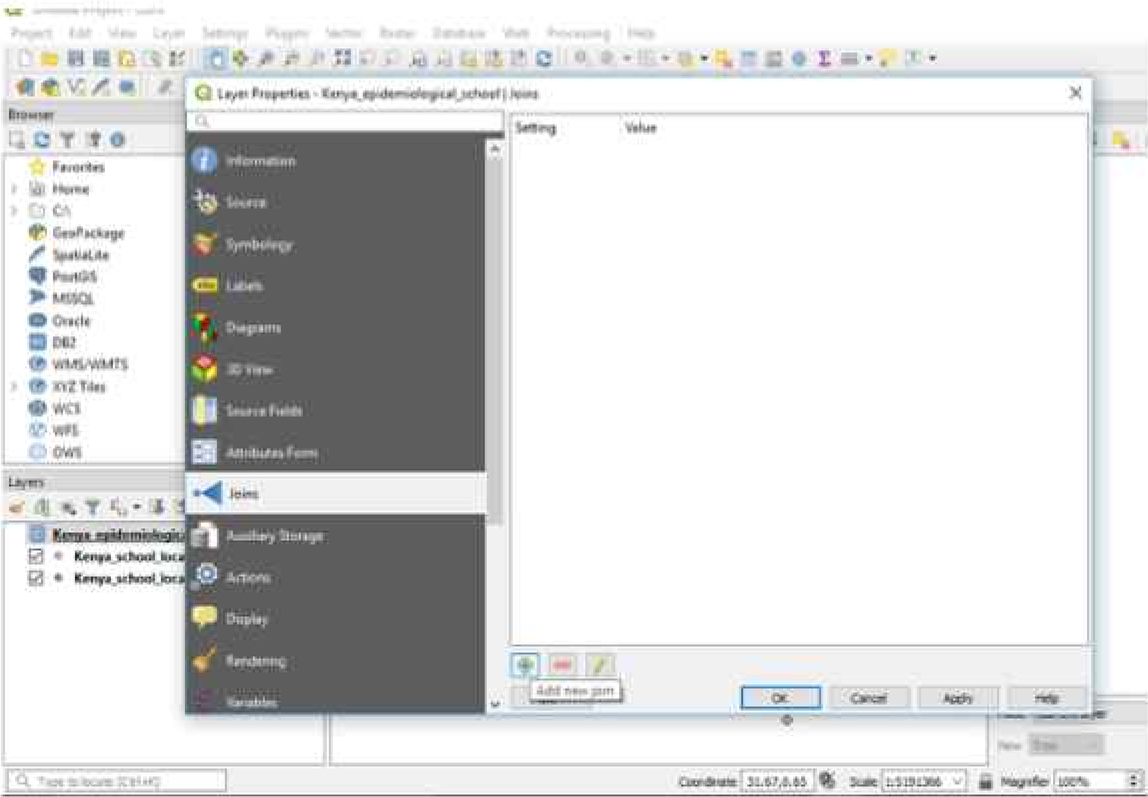


Now we'll join the data.

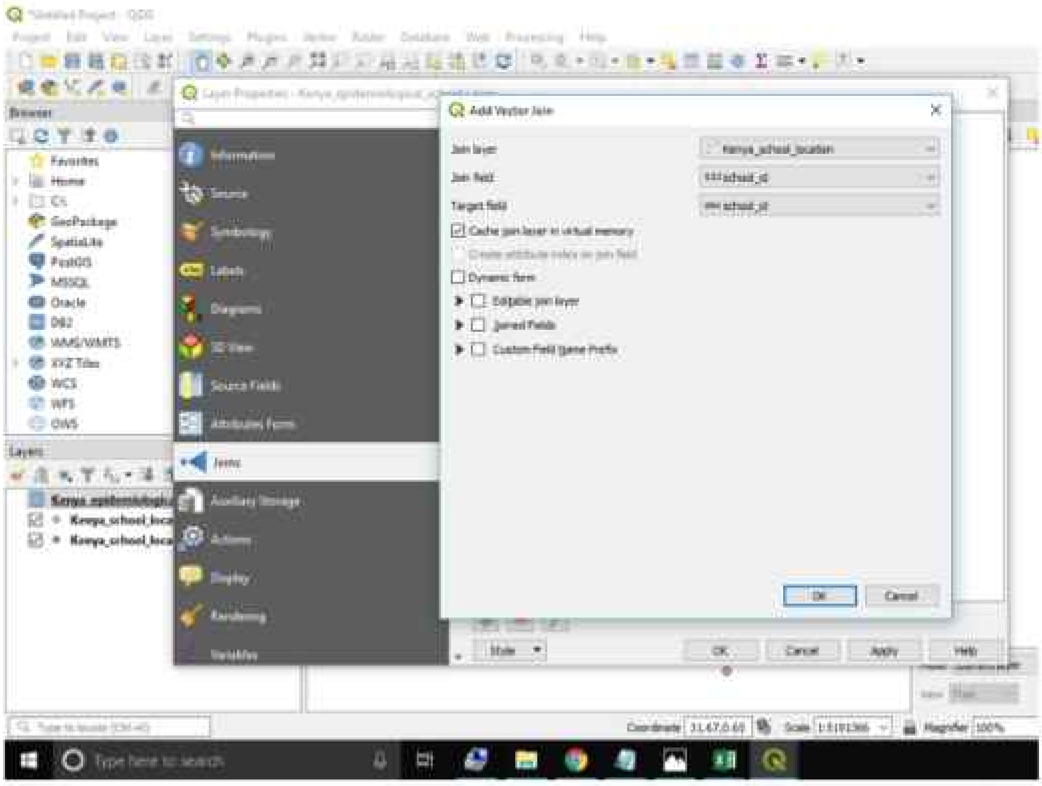
Right click on **Kenya _school_location2** layer and click on **Properties**



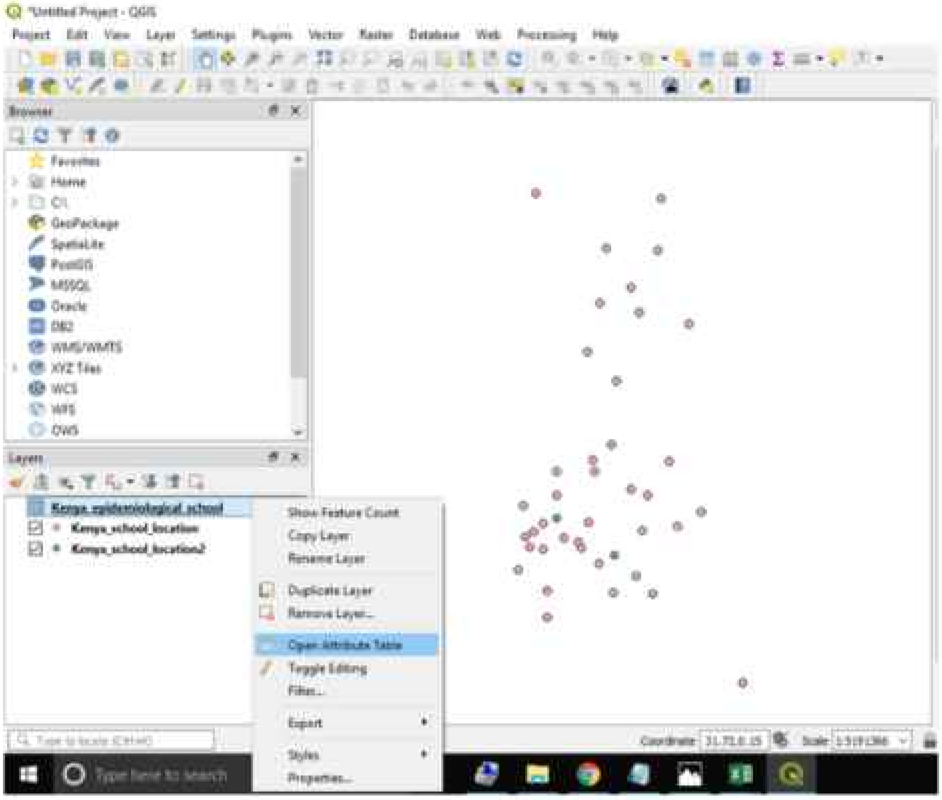
Go to the **Joins** section and click on the plus(+) button at the bottom



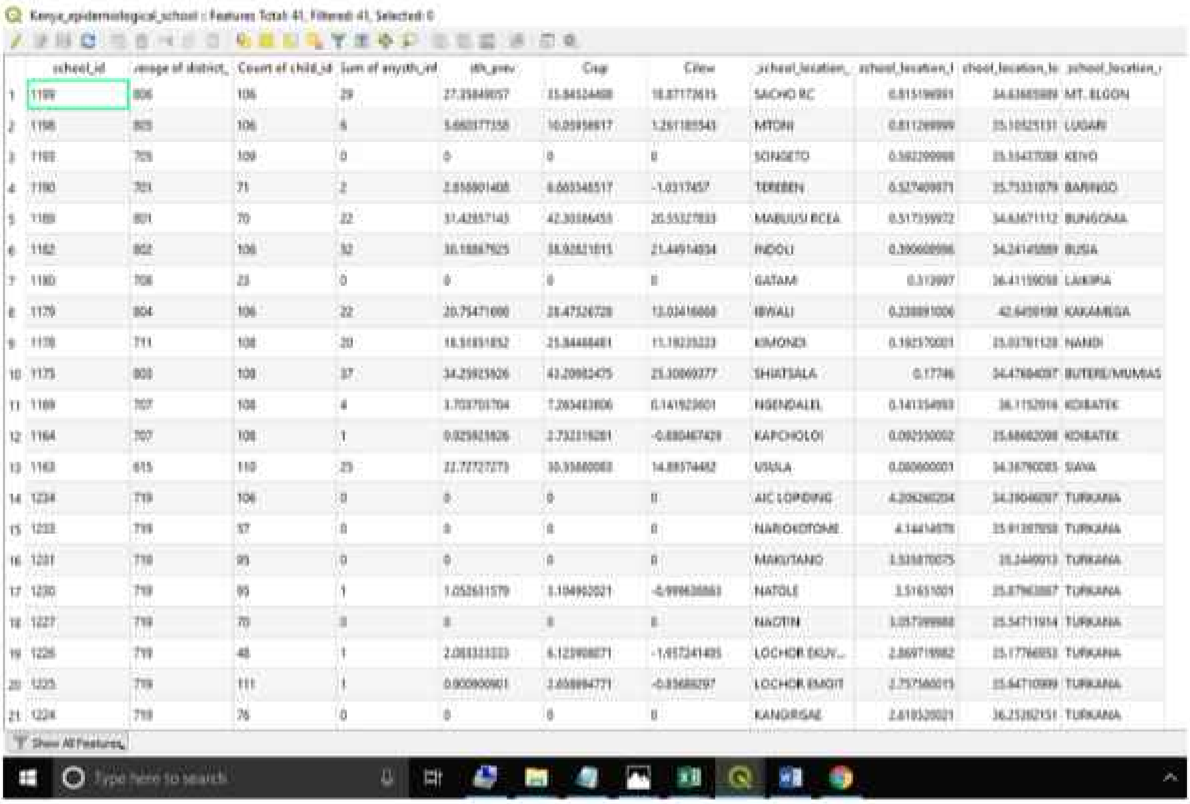
For "Join layer" choose**Kenya_epidemiological_school** and for"Join field" and "Target field" choose **school_id.** Then click on OK.



Right click on **Kenya_school_location2** layer and select **Open Attribute Table.**



You will see that the epidemiological variables are included.

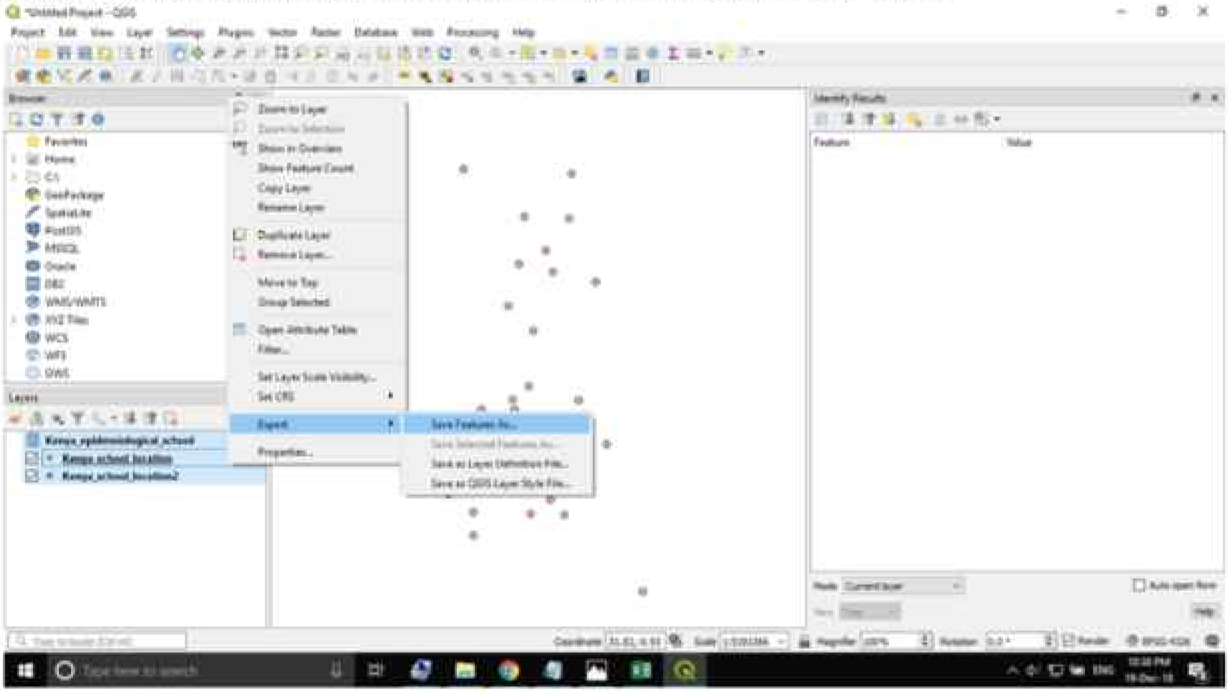

Kenya_epidemiological_school :: Features Total: 41, Filtered: 41, Selected: 0

	school_id	verage of district_	Count of child_id	Sum of any_sth_inf	sth_prev	CIup	CIlow	school_location_	school_location_l	chool_location_lo	school_location_
1	1199	806	106	29	27.35849057	35.84524488	18.87173615	SACHO RC	0.815196991	34.6365589	MT. ELGON
2	1198	805	106	6	5.660377358	10.05958917	1.261185543	MTONI	0.811269999	35.10525131	LUGARI
3	1193	705	109	0	0	0	0	SONGETO	0.582299988	35.5547088	KEIYO
4	1190	701	71	2	2.816901408	6.603346517	-1.0317457	TEREBEN	0.527409971	35.75331079	BARINGO
5	1188	801	70	22	31.42857143	42.30386455	20.55327833	MABUUSI RCEA	0.517359972	34.63671112	BUNGOMA
6	1182	802	106	32	30.18867925	38.92821815	21.44914834	INDOLI	0.390600996	34.24145889	BUSIA
7	1180	708	23	0	0	0	0	GATAM	0.313997	36.41159058	LAIKIPIA
8	1179	804	106	22	20.75471698	28.47326728	13.03416668	IBWALI	0.238891006	42.6459198	KAKAMEGA
9	1178	711	108	20	18.51851852	25.84448481	11.19235223	KIMONDI	0.192570001	35.03781128	NANDI
10	1175	803	108	37	34.25925926	43.20982475	25.30869377	SHIATSALA	0.17746	34.47684097	BUTERE/MUMIAS
11	1169	707	108	4	3.703703704	7.265483806	0.141923601	NGENDALEL	0.141354993	36.1152916	KOIBATEK
12	1164	707	108	1	0.925925926	2.732316281	-0.880467429	KAPCHOLOI	0.092550002	35.68682098	KOIBATEK
13	1163	615	110	25	22.72727273	30.35880083	14.89574462	USULA	0.060600001	34.36790085	SIAYA
14	1234	719	106	0	0	0	0	AIC LOPIDING	4.206260204	34.39046097	TURKANA
15	1233	719	57	0	0	0	0	NARIOKOTOME	4.1441497	35.91397858	TURKANA
16	1231	719	95	0	0	0	0	MAKUTANO	3.535870075	35.2449913	TURKANA
17	1230	719	95	1	1.052631579	3.104992021	-0.999638863	NATOLE	3.51651001	35.87963867	TURKANA
18	1227	719	70	0	0	0	0	NAOTIN	3.05739988	35.54711914	TURKANA
19	1226	719	48	1	2.083333333	6.123908071	-1.957241405	LOCHOR EKUY...	2.869719982	35.17766953	TURKANA
20	1225	719	111	1	0.900900901	2.658984771	-0.85680297	LOCHOR EMOIT	2.757580015	35.64710999	TURKANA
21	1224	719	76	0	0	0	0	KANGIRISAE	2.619520021	36.2320151	TURKANA

Show All Features

We are finally done, now we just have to save the files!!

Select all the layers, right-click on them and in Export select **Save Features As.**



Select **Format** as **ESRI Shapefile** and **File Name** as: **Kenya_school_epidata.shp**