



First training material on basic Quantum Geographic Information System (QGIS)



Bangladesh Forest Department
20 – 21 September 2016

UN-REDD
PROGRAMME



The UN-REDD Programme, implemented by FAO, UNDP and UNEP, has two components: (i) assisting in developing countries to prepare and implement national REDD strategies and mechanisms; (ii) supporting the development of normative solutions and standardized approaches based on sound science for a REDD instrument linked with the UNFCCC. The programme helps empower countries to manage their REDD processes and will facilitate access to financial and technical assistance tailored to the specific needs of the countries.

The application of UNDP, UNEP and FAO rights-based and participatory approaches will also help ensure the rights of indigenous and forest-dwelling people are protected and the active involvement of local communities and relevant stakeholders and institutions in the design and implementation of REDD plans.

The programme is implemented through the UN Joint Programmes modalities, enabling rapid initiation of programme implementation and channelling of funds for REDD efforts, building on the in-country presence of UN agencies as a crucial support structure for countries. The UN-REDD Programme encourage coordinated and collaborative UN support to countries, thus maximizing efficiencies and effectiveness of the organizations' collective input, consistent with the "One UN" approach advocated by UN members.

The UN-REDD Bangladesh National Program is implemented by the Bangladesh Forest Department under the leadership of Ministry of Environment and Forests. United Nations Development Program (UNDP) and Food and Agriculture Organization (FAO) are the two implementing partners.

Contacts

Rakibul Hassan Mukul

Project Director
UN-REDD Bangladesh National Programme
Bangladesh Forest Department
Email: pd-unredd@bforest.gov.bd

Matieu Henry

Chief Technical Advisor
Food & Agriculture Organization of the United Nations
Email: matieu.henry@fao.org

Suggested Citation: **Costello, L., Akhter, M. & Hoque, A.** 2016. First Training Material on Basic Quantum Geographic Information System (QGIS). 20-21 September 2016, Dhaka, Bangladesh Forest Department, Food and Agriculture Organization of the United Nations.

Disclaimer

This report is designed to reflect the activities and progress related to UNJP/BGD/057/UNJ UN-REDD Bangladesh National Programme. It does not reflect the official position of the supporting international agencies including FAO and UNDP and should not be used for official purposes. Should readers find any errors in the document or would like to provide comments for improving the quality they are encouraged to contact one of above contacts.

EXECUTIVE SUMMARY

The training will follow a structured and sequential method on the basis of the needs and the training methodology will be fully interactive and hands on which will have advantages like:

- Hands-on training methods are effective for training in new procedures and new equipment.
- They are immediately applicable to trainees' jobs.
- They allow trainers to immediately determine whether a trainee has learned the new skill or procedure.

To import GPS data from a file that is not a GPX file, you use the tool ***Import other file*** in the GPS Tools dialog. Here you select the file that you want to import (and the file type), which feature type you want to import from it, where you want to store the converted GPX file and what the name of the new layer should be. Note that not all GPS data formats will support all three feature types, so for many formats you will only be able to choose between one or two types. Total 21 participants (16 male and 5 female) attended the training.

Contents

1. BACKGROUND.....	4
2. GETTING ACQUAINTED WITH GIS.....	5
2.1. WHAT'S GIS	5
2.2 Usefulness of GIS	5
2.3 A Short History of GIS.....	6
2.4 QGIS: What and Why?	6
2.5 QGIS Interface.....	8
3. LOADING AND INTEGRATING DIFFERENT FORMATS OF DATA WITH QGIS	10
3.1. GPS to QGIS.....	10
3.2. Loading Vector data (shapefile)	12
3.3. Load Google Maps ,Bing Maps and OpenStreetMaps :	13
3.4 Creating KML layer in Google Map and Loading in QGIS:.....	14
3.5 Loading CSV File from excel and Modification of attribute table	16
3.6 Joining attribute table.....	18
3.7 Loading GPX File from excel and Using field calculator	21
4. CREATE MAP	23
4.1 Key Options of Geospatial Data Representations.....	23
4.1.1. <i>Layer Order and Transparency</i>	23
4.1.2. <i>Symbology and Label</i>	25
4.2. Map/Print Composer	28
4.3. Export Maps.....	34
APPENDIX 1 : LIST OF PARTICIPANTS.....	35

1. BACKGROUND

The first national forest inventory for Bangladesh was implemented in the year 2005 with the support from FAO. The inventory was conducted using a systematic sampling design, based on measurement of 299 plots distributed across the entire country. Based on the existing national forest assessment data and additional accessible field inventory and model data, the aim of this training is to provide support on data management and analysis, quality control and assurance.

QGIS (previously known as Quantum GIS) is a community driven free and open-source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis. Similar to other software GIS systems, QGIS allows users to create maps with many layers using different map projections. Maps can be assembled in different formats and for different uses. QGIS allows maps to be composed of raster or vector layers. Different kinds of raster images are supported, and the software can georeference images. QGIS has a small file size compared to commercial GIS's and requires less RAM and processing power; hence it can be used on older hardware or running simultaneously with other applications where CPU power may be limited. QGIS supports dxf, shapefiles, coverages, and personal geodatabases. MapInfo, PostGIS, and a number of other formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.

A number of public and private organizations have adopted QGIS. Innovative use of QGIS plugins such as Open Street Map (OSM) may also provide efficiencies for the inventory process. OSM's functionality that provides geo-referenced printed maps that can be marked in the field and then uploaded and digitised may be useful for monumenting permanent sample inventory plots and assist in the archiving process.

Objective

- Identify baseline capacity of GIS capacity external to RIMS
- Increase sustainability of GIS capacity at FD by targeting participants outside of RIMS
- Increase capacity on basic GIS operations

Proposed Methodology

The training will follow a structured and sequential method on the basis of the needs and the training methodology will be fully interactive and hands on which will have advantages like:

- Hands-on training methods are effective for training in new procedures and new equipment.
- They are immediately applicable to trainees' jobs.
- They allow trainers to immediately determine whether a trainee has learned the new skill or procedure.

2. GETTING ACQUAINTED WITH GIS

2.1. WHAT'S GIS

The acronym GIS refers to Geographic Information Systems - a tool that allows geographers and analysts to visualize data in several different ways in order to see patterns and relationships in a given area or subject. These patterns generally appear on maps but they can also be found on globes or in reports and charts. GIS is a computer based tools for mapping and analyzing features and events on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps.

In a GIS, you connect data with geography. You understand what belongs where. Because you don't fully understand your data until you see how it relates to other things.

It's REALLY hard to visualize the locations of latitudes and longitudes coordinates from a spreadsheet.

name	latitude	longitude	pop_min	pop_max
Seattle	47.570002	-122.339985	569369	3074000
New York	40.749979	-73.980017	8008278	19040000
Miami	25.787611	-80.224106	382894	5585000
Los Angeles	33.989978	-118.179981	3694820	12500000
Dallas	32.820024	-96.840017	1211704	4798000

Attribute table

But when you add these positions on a map, it's like magic to the reader.



Latitude and Longitude on a Map

Everyone knows that maps make geographic information easier to understand. However, at present, maps are not only confined to help visualize some complex or boring charts rather it has more profound influence and benefits to almost every sector of our life.

2.2 Usefulness of GIS

GIS is a very powerful decision-making tool that has a massive range of applications, whatever your business – resource management, logistics, planning, transport, surveying, demographic studies, epidemiology and environment, to name but a few.

With GIS, you can analyse topographic, environmental, demographic and land use data to help you with your business decisions and project management.

Uses of GIS range from indigenous people, communities, research institutions, environmental scientists, health organisations, land use planners, businesses, and government agencies at all levels. Some examples include:

- Resource mapping
- Hydrological Analysis
- Remote sensing applications
- Public Participation GIS
- Road networking
- Rout planning
- Wastewater and storm water systems
- Waste management

2.3 A Short History of GIS

The first truly operational GIS appeared in Ottawa, Ontario in 1962 and was developed by Roger Tomlinson of Canada's Department of Forestry and Rural Development in an effort to use map overlays for analysis of various areas in Canada. This early version was called CGIS.

The more modern version of GIS used today emerged in the 1980s when ESRI (Environmental Systems Research Institute) and CARIS (Computer Aided Resource Information System) created a commercial version of the software that incorporated the methods of CGIS, but also included newer "second generation" techniques. Since then it has undergone a number of technological updates, making it an efficient mapping and informational tool.

With the acknowledgement of the importance of data and its power, gradually people have learnt the necessity to open GIS for general people without the complications of licensing and purchasing the GIS software and with this view, emerges the concept of QGIS in 2002.

2.4 QGIS: What and Why?

QGIS acronym refers to Quantum GIS is a cross-platform free and open-source desktop geographic information system (GIS) application that provides data viewing, editing, and analysis. Similar to other software GIS systems, QGIS allows users to create maps with many layers using different map projections. Maps can be assembled in different formats and for different uses. QGIS allows maps to be composed of raster or vector layers. Typical for this kind of software, the vector data is stored as either point, line, or polygon-feature. Different kinds of raster images are supported, and the software can georeference images.

Here are five strong reasons why QGIS offers as a much acceptable option in field of GIS:

QGIS is Free

QGIS is FOSS which stands for Free and Open Source Software. Anybody with an Internet connection can visit one of the download sites and retrieve a copy of the GIS software. There is no cost the to user and the source code is available under the terms of the GNU General Public License(GPL). Downloading the software only cost to you your time.

QGIS is Cross Platform

On a Mac, PC, or Linux machine? It doesn't matter. There is a QGIS installation package available for all three operating systems. There is also a build for Android for those users wanting to get QGIS up and running on a compatible tablet. Unfortunately, the licensing policy for iOS and therefore its incompatibility with GPL means no iPad versions will be available anytime soon. The cross platform availability of QGIS opens it up to a wider range of potential users than many of the commercial versions currently on the market. QGIS' growing popularity can, in part, be attributed to the lack of comprehensive Mac-based GIS software applications. For Mac users who don't want to have to run a PC only GIS software application on a virtual machine, QGIS is becoming a very acceptable alternative.

The Use of Open Source GIS is Growing

While it certainly hasn't reached the widespread level of Esri's ArcGIS platform, QGIS is growing in its use as a viable alternative to commercial GIS. The QGIS organization publishes case studies that highlight the practical application of the GIS software on its site which includes the decision by the Swiss Canton of Solothurn to use QGIS instead of Esri products in 2006 to fulfill the geospatial needs involved in serving its 250,000 citizens. How many users of QGIS out there is hard to pinpoint but Gary Sherman, the founding developer of QGIS, performed some analysis on worldwide QGIS users by geocoding the I.P. addresses where QGIS was downloaded. From that analysis, Sherman estimated in December of 2011 that there were at least 100,000 users globally of Quantum GIS.

Plenty of QGIS Support and Tutorials

If you're worried that you'll be left on your own to slog through figuring out QGIS, know that QGIS has a thriving user based support. There is a growing and active volunteer developer base that works on fixing bugs and extending the functionality of QGIS. Nathan W. created an interesting video visualizing the growth of QGIS based on commit history logs.

Peer support for issues about using QGIS can be answered by tagging questions with QGIS on the GIS Stack Exchange section. The QGIS site has a "How do I do that in QGIS?" with introductory tutorials covering working with raster and vector data, spatial analysis, and cartography. The Free and Open Source GIS Ramblings blog run by Anita Graser is an excellent source for QGIS tips and tutorials.

The *Getting Started with QGIS* article has further pointers to resources for learning QGIS

2.5 QGIS Interface

To launch QGIS, click: **Start -> All Programs -> QGIS -> QGIS Desktop**. QGIS normally adds the version number after “QGIS”, which is currently 2.16.2. The main windows of QGIS can be divided into three regions shown in Figure 1.

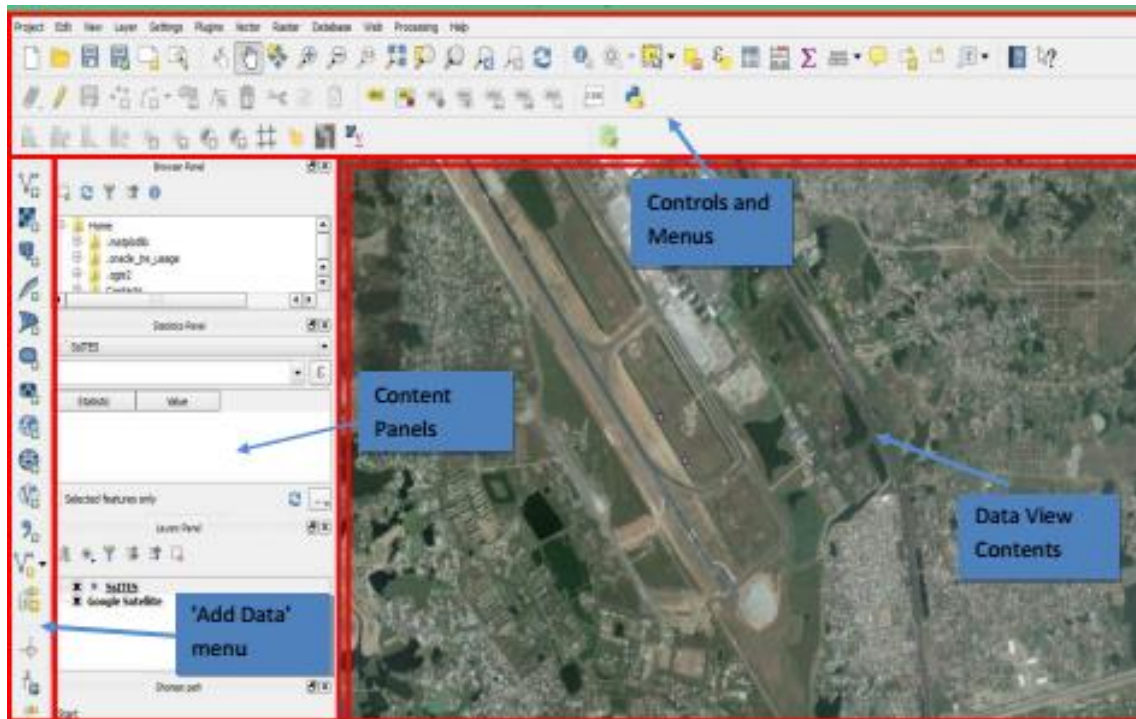


Figure 1. The Main Window of QGIS showing Regions

Frequently-used File Formats in QGIS:

Feature Data: Feature data are usually organized as points, lines, and polygons in vector format.

Shapefile: The most commonly used geospatial data format. Although it appears to be one file in ArcMap, shapefile includes **multiple files** with the same file name, but different extensions. *.shp, *.dbf, and *.shx are must-have.

Personal Geodatabase: These files are based on Microsoft Access (*.mdb). From user perspective, all kinds of geodatabase are the same, which include multiple layers (different geospatial data) in one geodatabase.

MapInfo files: The following three are legendary geospatial file formats. MapInfo is the first desktop GIS software for Windows. Its files (*.tab) are widely used.

ArcInfo: ArcInfo is the previous generation of ArcGIS. Its file (*.e00) are supported in QGIS as well.

Google Earth: *.kml and *.kmz (zipped KML) are Google Earth file formats, which are popular in Location-Based Service now. Many websites support kml and kmz files.

GML and GeoJSON: Open source geospatial data standard, which is also popular in online applications.

GPS: The track of GPS records can be imported into QGIS as *.gpx files. This function is very useful in surveying.

CSV: *.csv files stands for comma separated value, which can be regarded as a legendary spreadsheet file format.

Raster Data: Raster data uses grid to represent a region with values as a “field”. Images explicitly have the parameter of resolution. Typical raster data is:

GeoTIFF: They have the file extension of *.tif. The key difference between normal TIFF file and GeoTIFF is that GeoTIFF has projection information. Hence, normal TIFF files cannot be correctly added to the desired location.


GeoJPEG: Similar to GeoTIFF, but they have *.jpg extension.


Usage: Raster data can be air photos, satellite images, elevation data (DEM). But raster data tends to be huge and slow to load.


3. LOADING AND INTEGRATING DIFFERENT FORMATS OF DATA WITH QGIS

3.1. GPS to QGIS

There are dozens of different file formats for storing GPS data. The format that QGIS uses is called GPX (GPS eXchange format), which is a standard interchange format that can contain any number of waypoints, routes and tracks in the same file.

To load a GPX file you first need to load the plugin. **Plugins** ▸  **Plugin Manager...** opens the Plugin

Manager Dialog. Activate the  **GPS Tools** checkbox. When this plugin is loaded two buttons with a small handheld GPS device will show up in the toolbar:

-  Create new GPX Layer
-  GPS Tools

For working with GPS data we provide an example GPX file using which the following steps have to be performed-


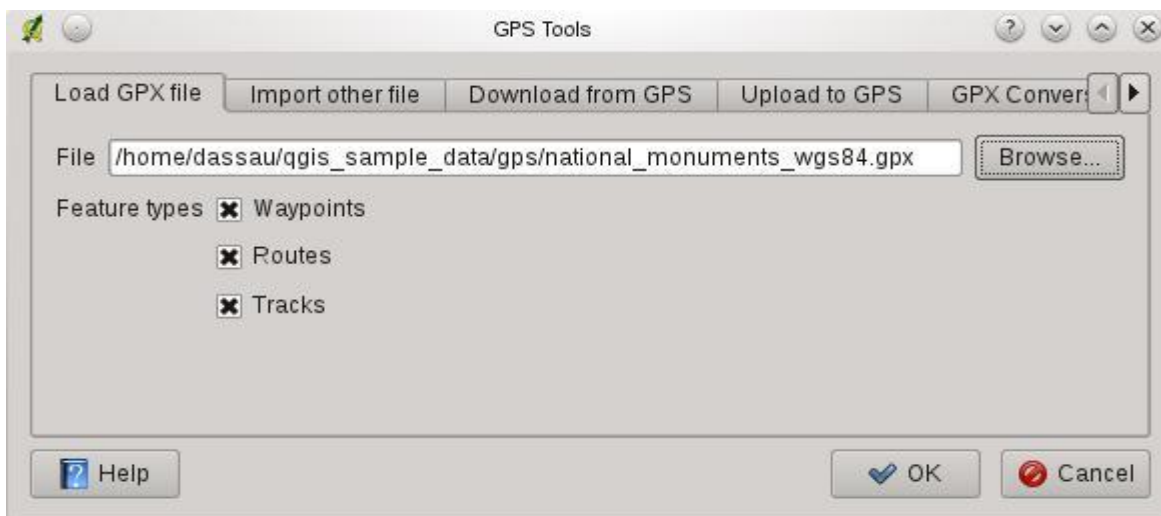
1. Select **Vector** ▸ **GPS** ▸ **GPS Tools** or click the  **GPS Tools** icon in the toolbar and open the **Load GPX file** tab (see [figure GPS 1](#)).
2. Browse to the folder `qgis_sample_data/gps/`, select the GPX file `national_monuments.gpx` and click **[Open]**.

Figure GPS 1:



The *GPS Tools* dialog window

Use the **[Browse...]** button to select the GPX file, then use the checkboxes to select the feature types you want to load from that GPX file. Each feature type will be loaded in a separate layer when you click **[OK]**. The file `national_monuments.gpx` only includes waypoints.

Note

GPS units allow to store data in different coordinate systems. When downloading a GPX file (from your GPS unit or a web site) and then loading it in QGIS, be sure that the data stored in the GPX file uses WGS84 (latitude/longitude). QGIS expects this and it is the official GPX specification.


GPSTabel

Since QGIS uses GPX files you need a way to convert other GPS file formats to GPX. This can be done for many formats using the free program GPSTabel, which is available at <http://www.gpsbabel.org>. This program can also transfer GPS data between your computer and a GPS device. QGIS uses GPSTabel to do these things, so it is recommended that you install it. However, if you just want to load GPS data from GPX files you will not need it. Version 1.2.3 of GPSTabel is known to work with QGIS, but you should be able to use later versions without any problems.

Importing GPS data

To import GPS data from a file that is not a GPX file, you use the tool **Import other file** in the GPS Tools dialog. Here you select the file that you want to import (and the file type), which feature type you want to import from it, where you want to store the converted GPX file and what the name of the new layer should be. Note that not all GPS data formats will support all three feature types, so for many formats you will only be able to choose between one or two types.

3.2. Loading Vector data (shapefile)

Click the **Add Vector Layer**  button to add geospatial data (Figure 2), which opens a window (Figure 3)

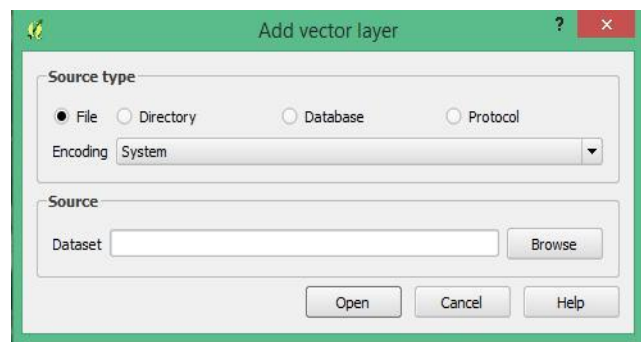
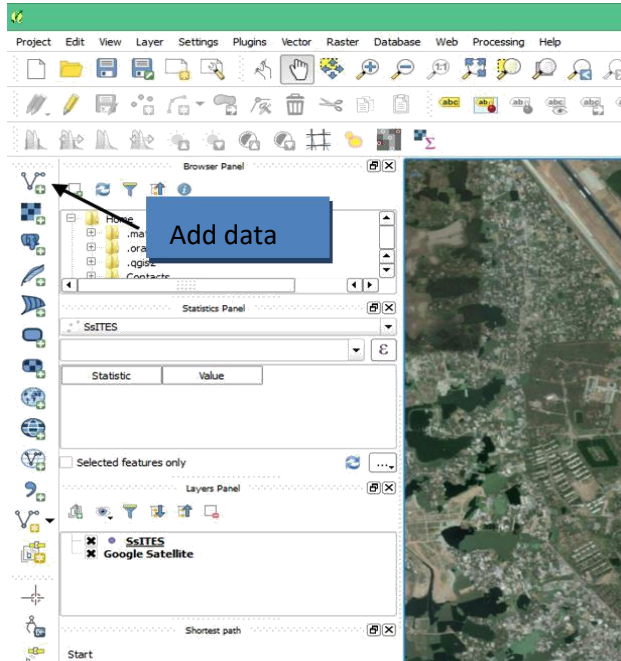


Figure 2. The Main Window : Add Vector Layer button Figure 3. The Pop-up Window to "Add Vector Layer"

Then you can browse to the file you want to work with by clicking the **Browse** button just like any other file explorer dialogs in Windows. You can open multiple files at one time by holding the **Ctrl** or **Shift** button when you are clicking the mouse button to make selections. The by-default file filter is *.shp file (Figure 4). But there are many other choices, such as *.kml (Google Earth) and *.csv, much broader than ArcGIS.

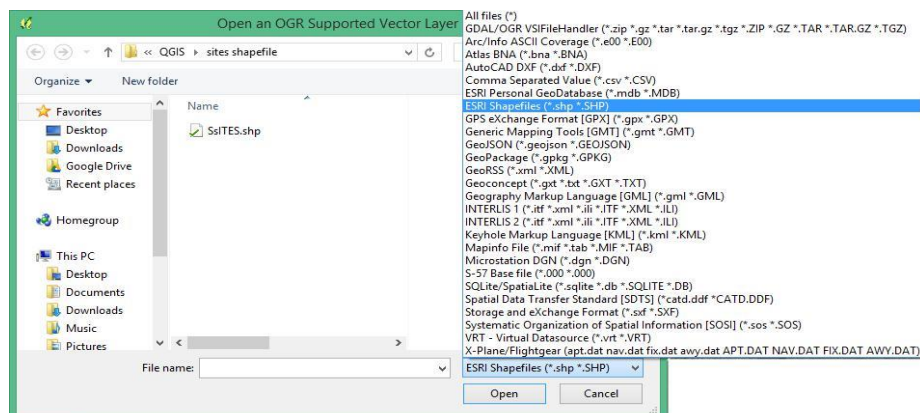


Figure 4. The File Open Dialog with File Filters

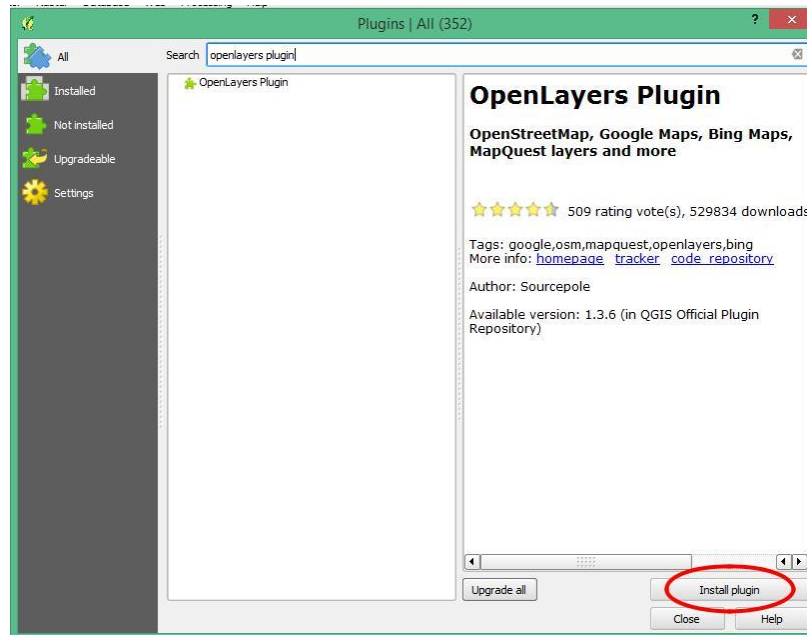
For example, you can browse *Khulna_Div.shp* file from *pov_khl* folder that was provided in Practice Data folder as your sample dataset.

3.3. Load Google Maps ,Bing Maps and OpenStreetMaps :

QGIS provides the flexibility of using Google (or Yahoo) Satellite images or Bing aerial images as a background layer in your map. To do so, follow the steps below:

1. Install the OpenLayers Plugin into QGIS:

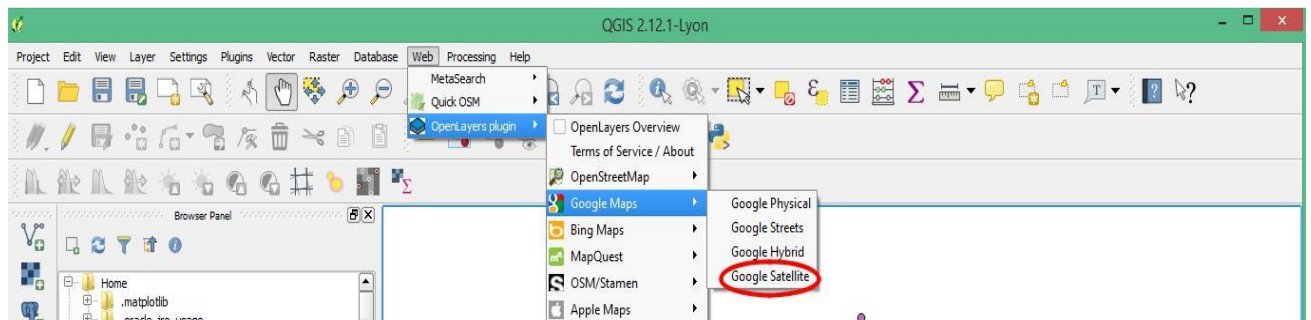
- a. Go to **Plugins -> Manage and Install Plugins**, which leads to a dialog.
- b. Type '**Openlayers Plugin**' in the search box



- c. Click on '**Install plugin**' and the '**Openlayers Plugin**' will be installed in your QGIS.

2. Add Google Satellite map as Background layer:

Go to the menu **Web -> Openlayers plugin ->Add Google Satellite MAP.**



3. Add Bing Aerial Map as Background layer:

Go to the menu **Web -> Openlayers plugin -> Bing maps-> Bing aerial.**

4. Add Openstreet Map as Background layer:

Go to the menu **Web -> Openlayers plugin -> OpenstreetMap-> OpenStreetMap**

3.4 Creating KML layer in Google Map and Loading in QGIS:

Google map or Google Earth makes use of KML or keyhole markup language, to display features, which actually stores geographic features in Vector format. You can create KML file from Google map for mapping and displaying the same by again uploading the same KML file on Google map or created KML file converted from Shapefile. Before creating KML file on Google map, you should have an Google account and should be logged in with that. So that once KML file created, you would be able to see it in My Places of Google map after wards. You can also look link for how to create KML file from Google earth. Steps are following:

- Open **Google map** and sign in with all in one Google account.
- Click on **Menu** (Left corner of search option)> **Your Places** > **Maps** > **Create Map** (At the Bottom) (A new window will open)
- Click on **Add layer** (A new untitled layer will open)> **Layer Option** (At the right corner with three dots) . You can rename , delete or see the table of the layer.

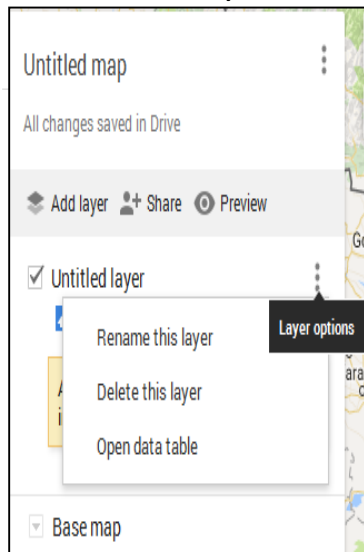


Figure 5: Layer Option

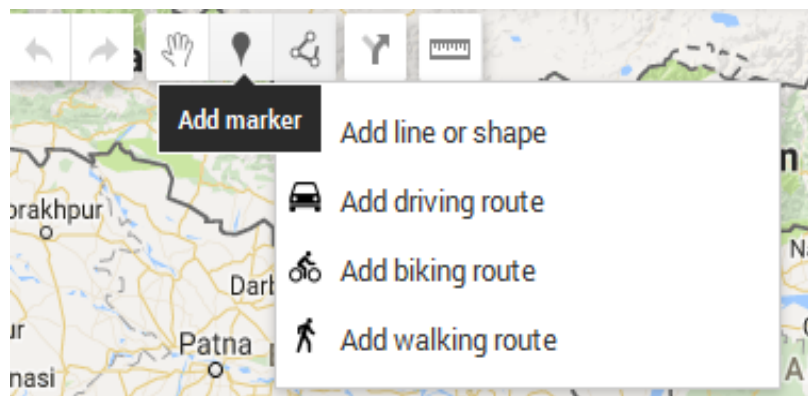


Figure 6: The Drawing Options

- In the map window there are some drawing options. If you keep your cursor on the options, it will show you the name. **Add marker** is used only to put any points on map and **Add line or shape** is used for drawing any polygon or line .Before drawing , search your area in search options.

Note that while you are drawing any polygon, it will be a confined area and the starting and ending point will be the same. While drawing any feature, please complete your desired drawing with double click at ending point.

- When you have completed drawing any feature(point, line or polygon), a pop-up window will open to write the name and description about it and you will also find the edit and style options below the pop-up window.

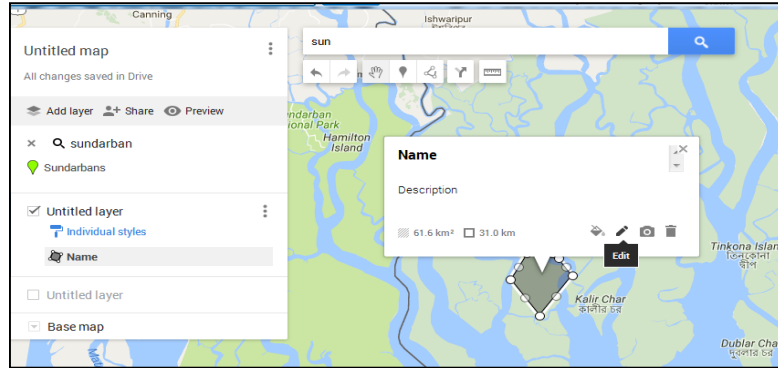


Figure 7: The pop-up window for feature details

- If you have completed drawing all the features under a layer, now it's time to export the layer as KML. From **Untitled map** at left top corner of the page, there are three dots as representing different options. Click on it and select **Export To KML**. A pop-up window will open and select the desired layer and download it. The layer has been saved as KML file.

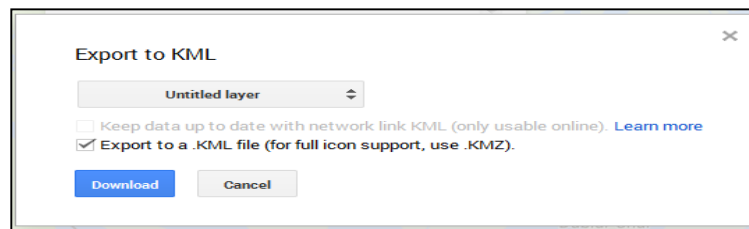


Figure8 : Pop-up window of Export to KML

- **Open QGIS desktop > Add Vector layer > Browse kml layer> Right click on kml layer > save it as a shapefile from Save as option**

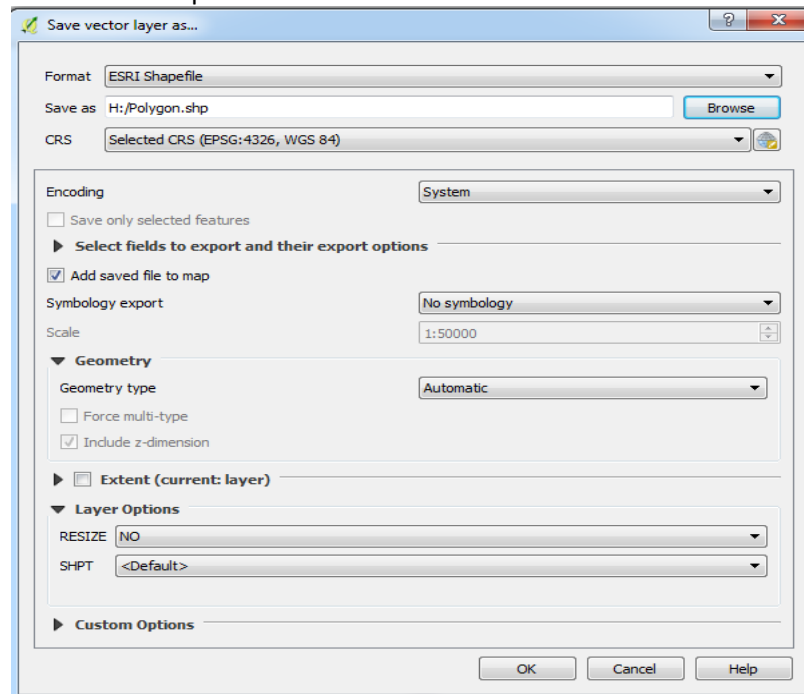


Figure 9: A pop-up window of save vector layer as option

3.5 Loading CSV File from excel and Modification of attribute table

A **CSV** is a comma separated values file, which allows data to be saved in a table structured format. CSV can be converted from an excel file and it is more necessary when we are using the data in QGIS. QGIS directly supports CSV file rather than an excel file. So, if you have an excel data to join, you must convert it into CSV file and then load into QGIS.

Conversion to CSV

- Open the Excel file in Microsoft Office Excel and save it as a new file
- Click on File> **Save As**> Select **CSV as Save as type**> **Save**

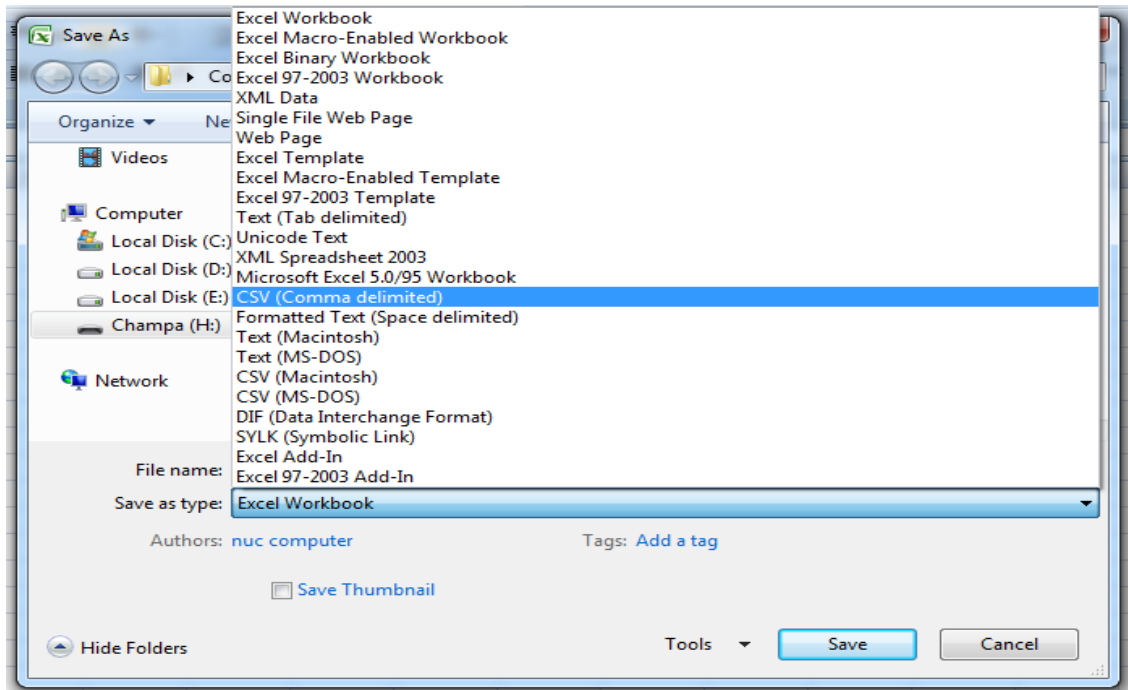


Figure 10: Pop-up window of Excel Save as type option

Loading CSV in QGIS

Now, the excel file has been converted into a CSV file and will be loaded into QGIS. Click on **Layer** on menubar > **Add Layer**> **Add Delimited Text Layer**. The point to be noted that there are two types of tabular data: one contains geographic data (x, y coordinates) and another contains descriptive data having in details information.

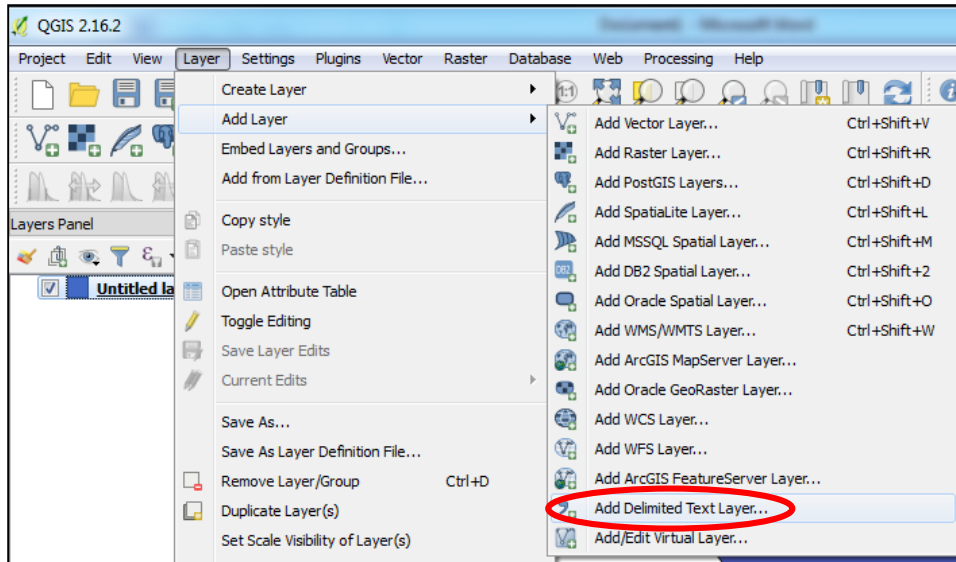


Figure 11: Pop-up window showing to Layer option

In case of geographic data, the file format will be CSV and geometry definition will be Point coordinates which will create a point layer in layer panel. Then you must save your layer as shapefile from **Save as** option by right clicking on the layer.

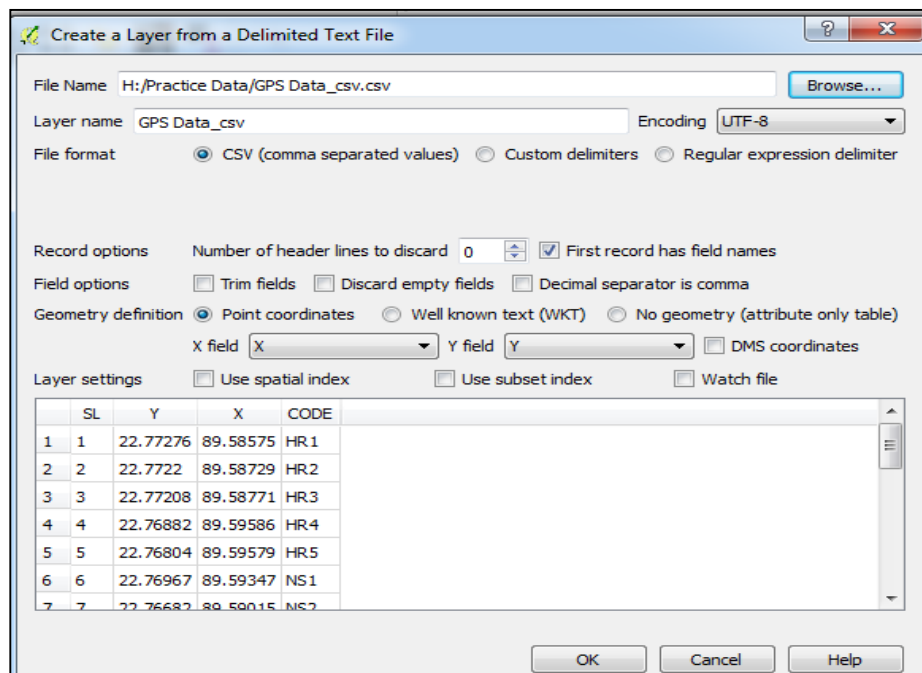


Figure 12: CSV browsing in case of geographic data

In case of descriptive data, file format will remain same as CSV but there be **NO geometry** in **Geometry definition** option but one thing to note down that this time data won't create any shapefile unlike geographic data as it is a descriptive file having no geometric points.

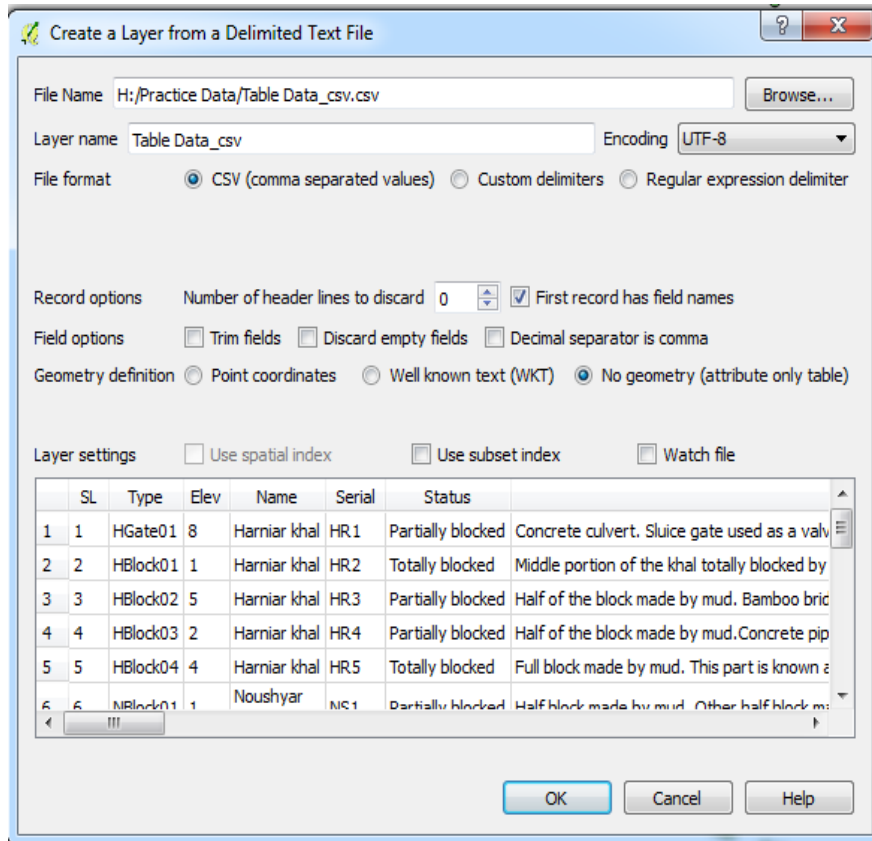


Figure 13: CSV browsing in case of descriptive data

3.6 Joining attribute table

If we have both geographic and descriptive data both for any specific location, we will generate a point shapefile from GPS data and there must be some common attributes like Serial number in both file on basis we can join both data. As the point layer is a shapefile, its attribute table will expand after joining the description of the points. Besides, we can also join any tabular data with any shapefile with a condition of common columns in both. Steps are following:

- Right click on shapefile> **Properties** > **Joins**
- Click on plus sign (+) at the left bottom to add the the table
- **Join layer** will be the tabular descriptive data
- **Join Field** and **Target field** are the ncommon attributes we need to select
- Click on **Choose which fields are joined** and selecte the attributes according to requirements
- Then **Ok** > in next window **Apply**> **Ok**.

Now Open the attribute table of shapefile by right clicking and you will see the added columns in layer. But now, if we remove this layer now and then browse again you won't find the added field anymore as it wasn't saved when u added. So, whenever you are joining any data, just save it as another shapefile from **Save as** option and after that as much as you remove, you will find the the data u added as same.

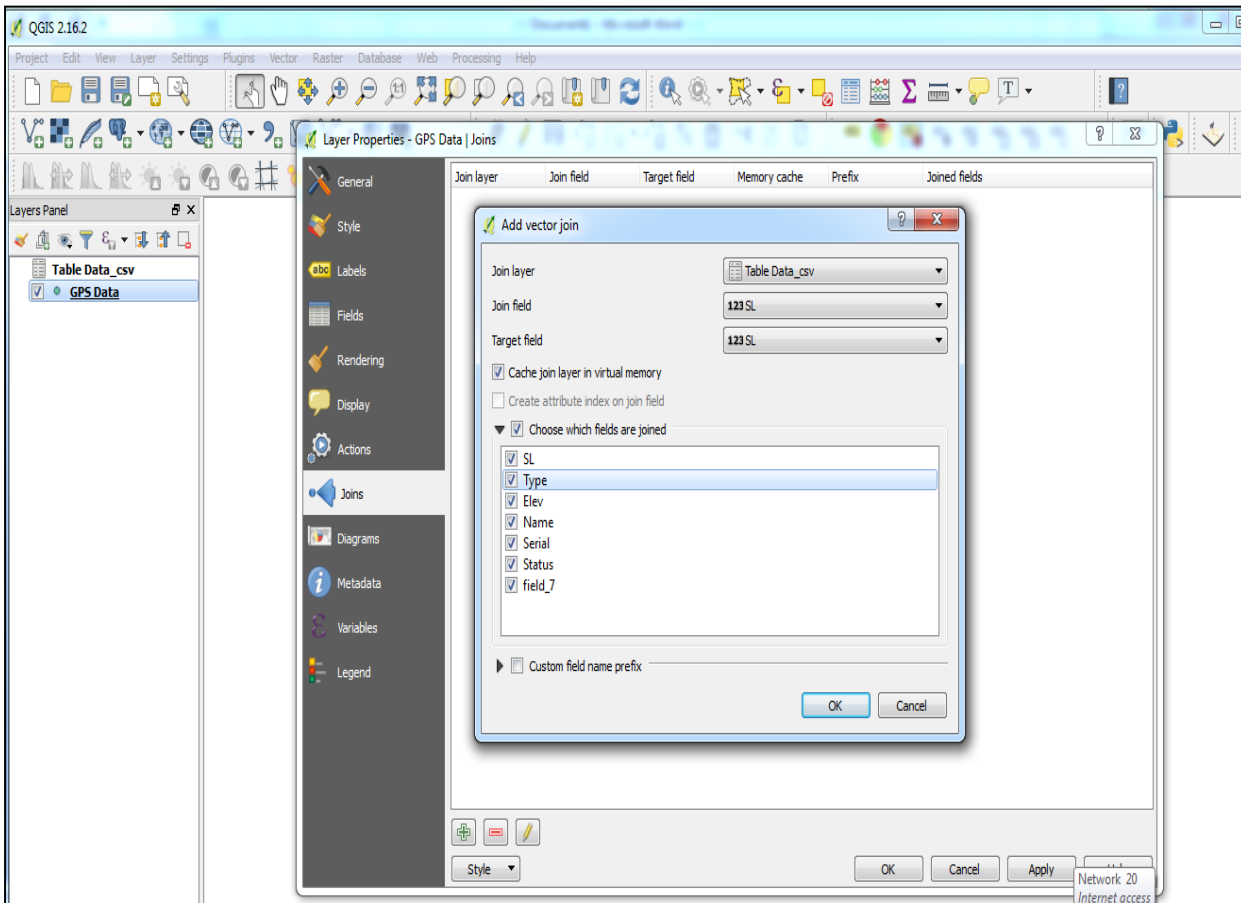


Figure 14: Pop-up window showing the join options

Editing in attribute table

As data input is very very manual, so it's not ever surprising if we find any typing mistake in attribute table. Then we need to make it correct or change anywhere if needed to use a correct data and from this point of view, editing is one of the most important part in attribute table modification. To edit, open the attribute table of the layer and click on the very first option, **Toggle editing mode** in toolbar. Now the editing mode is active and you can delete or change any text or number or calculate any field or create any new field or add any new feature.



Extracting selected attributes from table

While we are having huge dataset like any divisional map or any soil/forest map for a large area or any district map etc. having in detailed information and we want to work on a specific area or any specific attributes, we need to extract the data from the large dataset. The selection depends on the attributes we want to make an analysis over.

- Open the attribute table and click on **Select/ filter feature using from** (The view will be changed)
- Then **Column preview > select** the column in which desired attributes are existing
- Click on the attributes by pressing shift button you want to extract at left side (The selected attributes will also be selected in map canvas)
- Now right click on layer and save it as a new shapefile from **Save as** option. Now the new shapefile contains the selected attributes only.

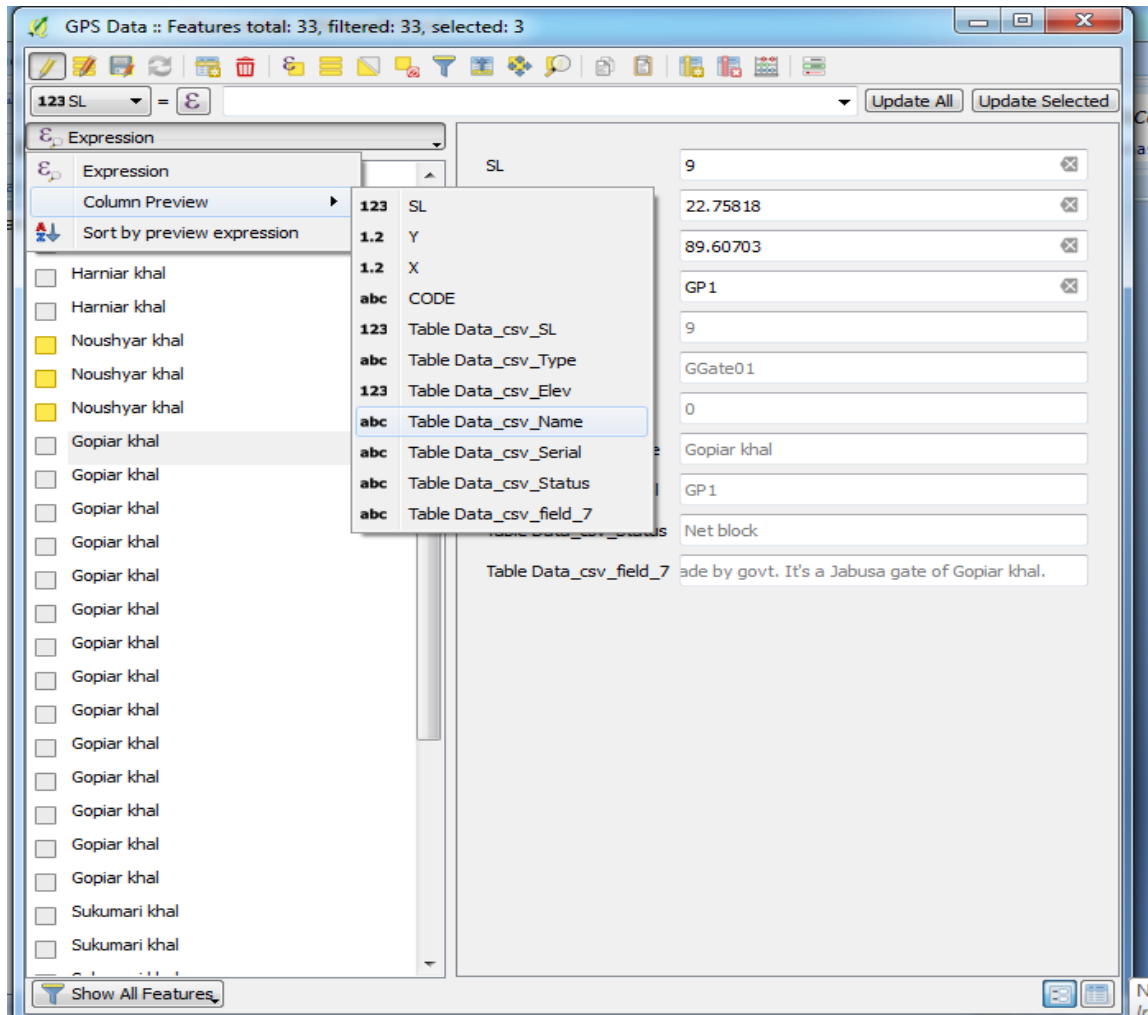


Figure 15: Pop-up window showing the select by attributes option

Extracting attribute table as an excel file

- Install the XY Tools into QGIS:
- Go to **Plugins -> Manage and Install Plugins**, which leads to a dialog.
- Type in the search box
- Click on **'Install plugin'** and the **XyTools** will be installed in your QGIS
- Select the layer in layer panel first and then click on **Vector > XY Tools> Save Attribute table as an excel file**
- Select the required fields and click on **ok**.

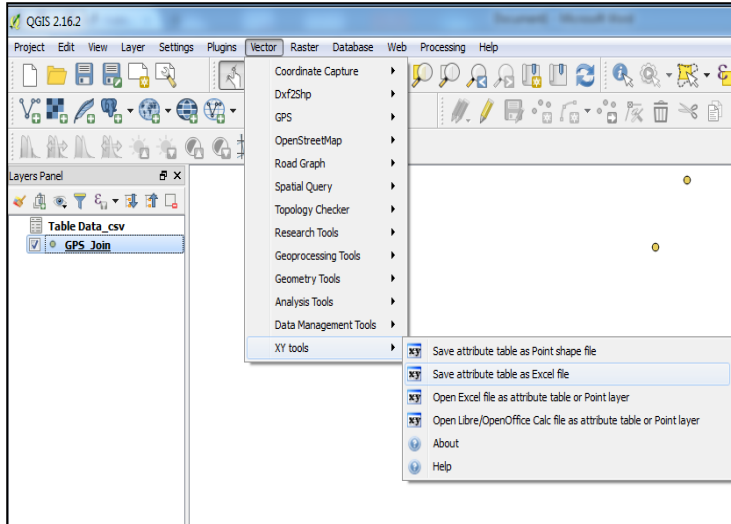


Figure 16: XY Tools option

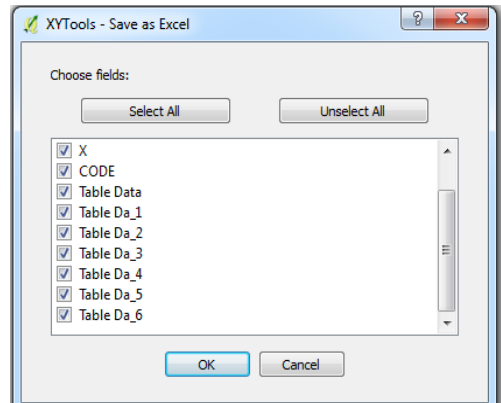


Figure 17: save as Excel option

3.7 Loading GPX File from excel and Using field calculator

GPX stands for GPS exchange Format that c

- Click on ADD Vector layer > Browse GPX file format using data type keeping GPX
- Select all the Layer

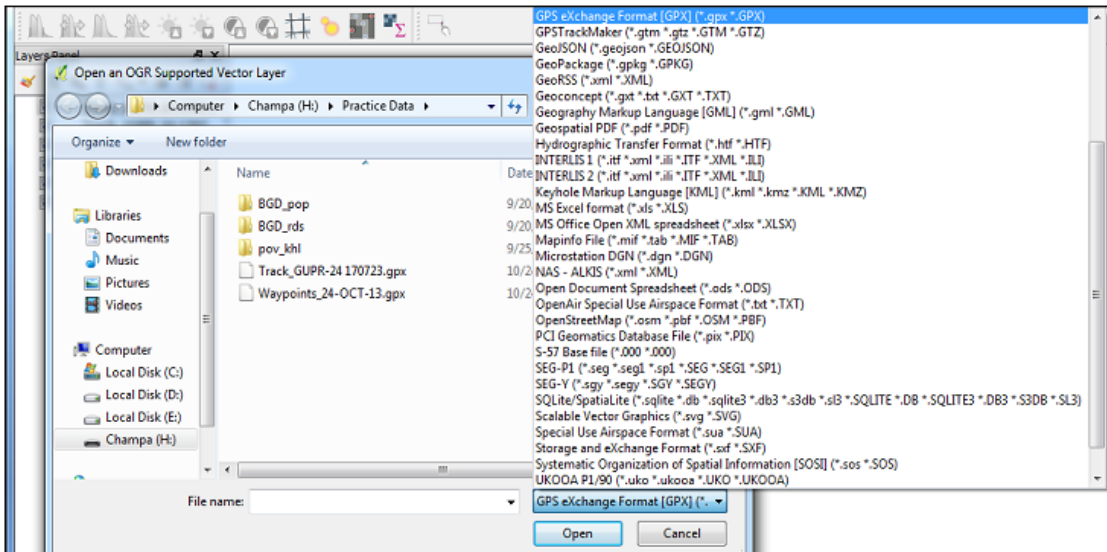


Figure 18: GPX Data Format

- Open Attribute table to check the data it contains. Waypoints , trackpoints have points in shapefile. Now we will calculate X and Y coordinates using Field calculator.

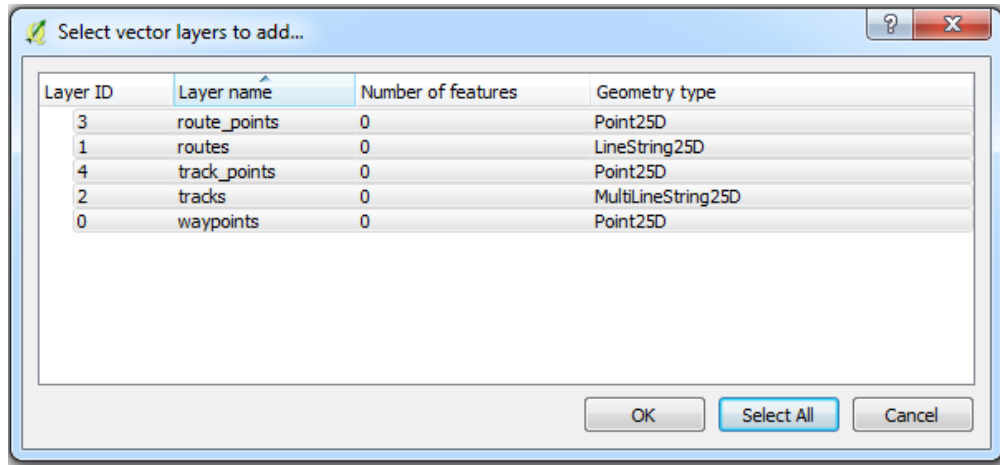
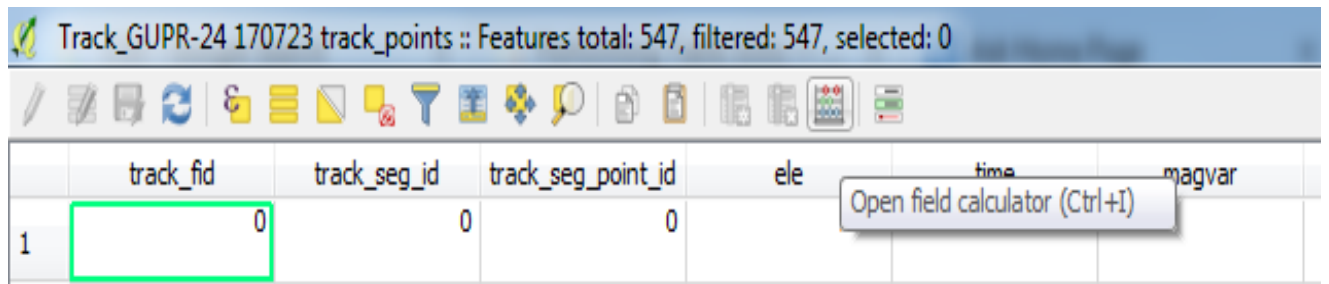


Figure 19: Pop-up window of Vector layer to add

- The point layer we want to add X and Y coordinates , need to open it's attribute table
- Click on **Open field calculator**



- Type field name , Field type, field length, precision and expression and Click on ok

Note that we are calculating latitude select \$y and double click on it to activate and while calculating longitude select \$X and double click on it. The field type will be decimal degree as it is coordinate.

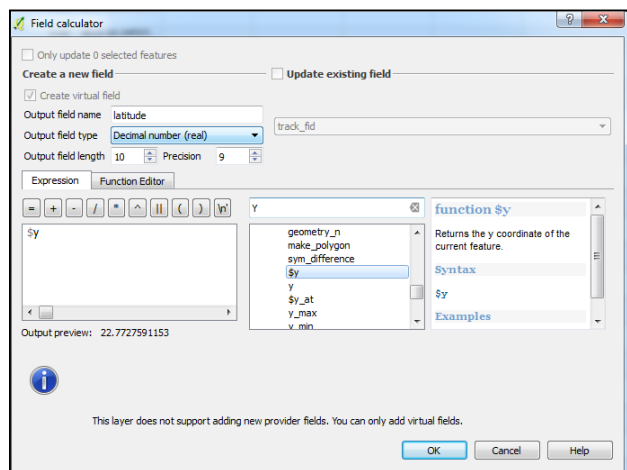


Figure 20:Pop-up window of Field calculator

4. CREATE MAP

4.1 Key Options of Geospatial Data Representations

Main options of changing geospatial data representations include layer order, layer transparency, symbology, label, and annotation. Apart from the first one (layer order) and last one (annotations), all the rest are located in the pop-up window (Figure 21) when you right-click the layer you want to modify and select **property** (Figure 21). They are under either the **style** or **labels** tab.

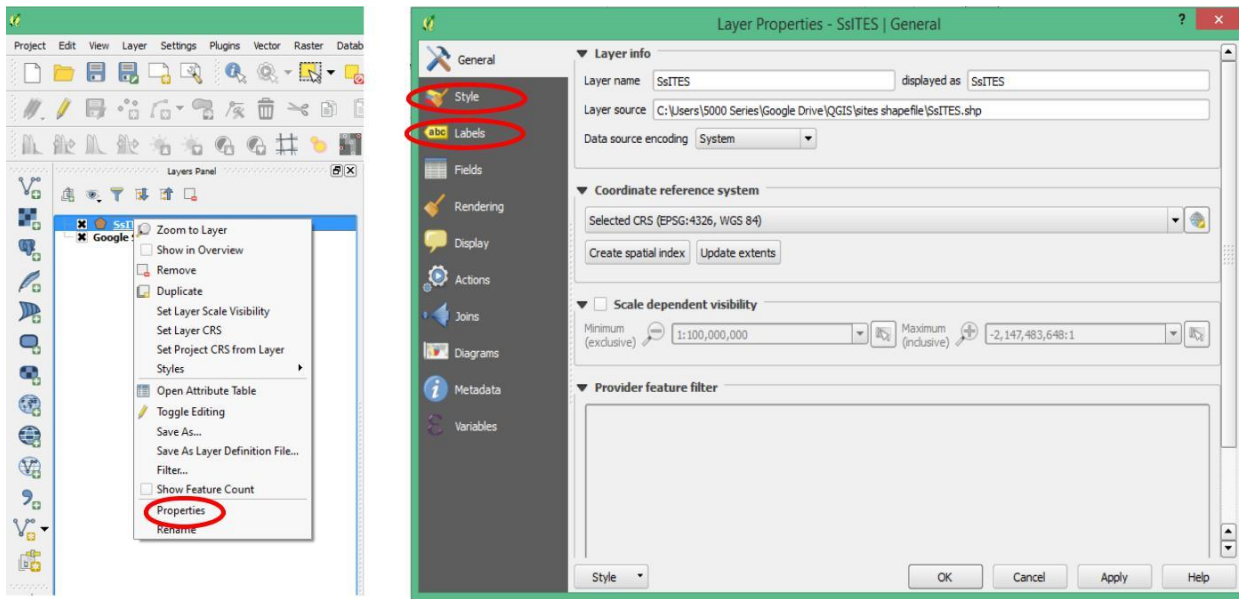


Figure21. The Pop-up Window of a Layer's Property and the Property Window

All options will be introduced as subsections in the following.

4.1.1. Layer Order and Transparency

QGIS displays geospatial data according to the order in the table of contents: the bottom layer will be drawn on the screen first and covered by upper layer. Hence, the layer on the top in the table of contents will be displayed as the top layer in the map. Unlike ArcMap, QGIS will not order layers automatically.

When a feature layer (point, line or polygon) is put under a polygon-feature layer, the feature one is covered and invisible. You can change layer visibility by switching the checkboxes left to the layer name in table of contents (Figure 23). And the display order can be changed by simply dragging the layer toward or away from the top.

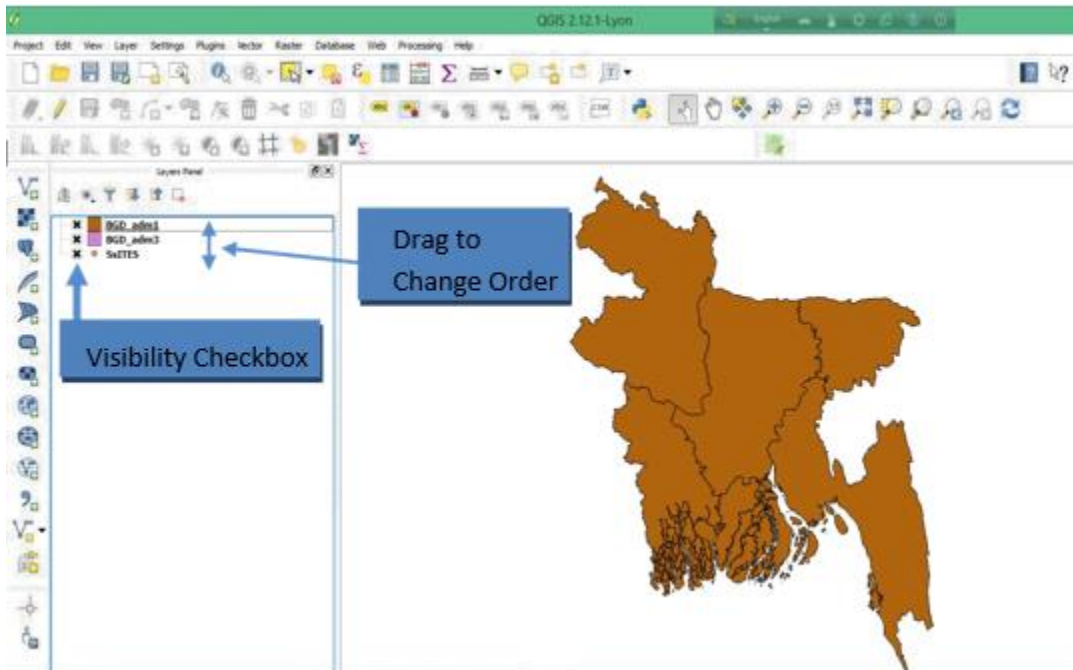


Figure 23 . Layer Visibility and Order Control

When a polygon layer, such as buildings or parcels, is added over an image, the content on image under the building is often invisible. But sometimes users like to only show the parcel's boundary and keep the image displayed. In this case, layer transparency and hollow symbology can help. To do so, right-click on the polygon layer and select Properties first (Figure 8). Then switch to the tab Symbology and click on the symbol itself (Figure 24). You can make polygons hollow by changing Fill options from solid to none. Alternatively, you can change the Transparency ratio as well.

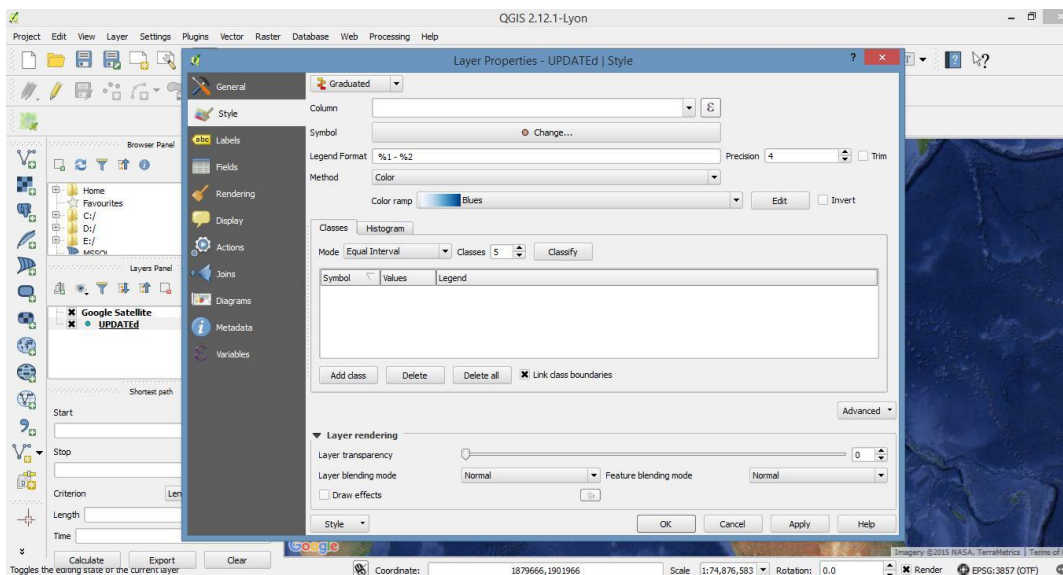


Figure 24: Properties of Style

4.1.2. Symbology and Label

Symbology or Style is critical in making maps, which are classified into four Legend type in QGIS (on the top of Figure). Due to its complexity, these four categories and their normal usages will be briefly introduced in the note region with further reading. We will only focus on symbol customization and classification symbols, which are mostly used. Unlike ArcMap, QGIS does not hold a large library of professional symbols. In fact, only point-feature layers can have different symbols (Figure 25), while line and polygon layers can only change line and fill options.

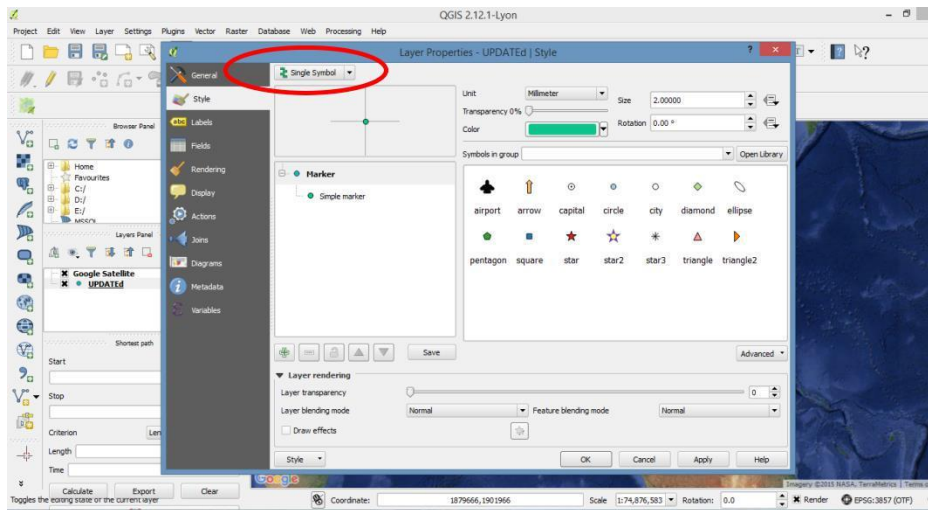


Figure 25: The Symbology or Style Customization Window

We can also categorized data depending on the categories in the Style option of Properties of a selected feature.

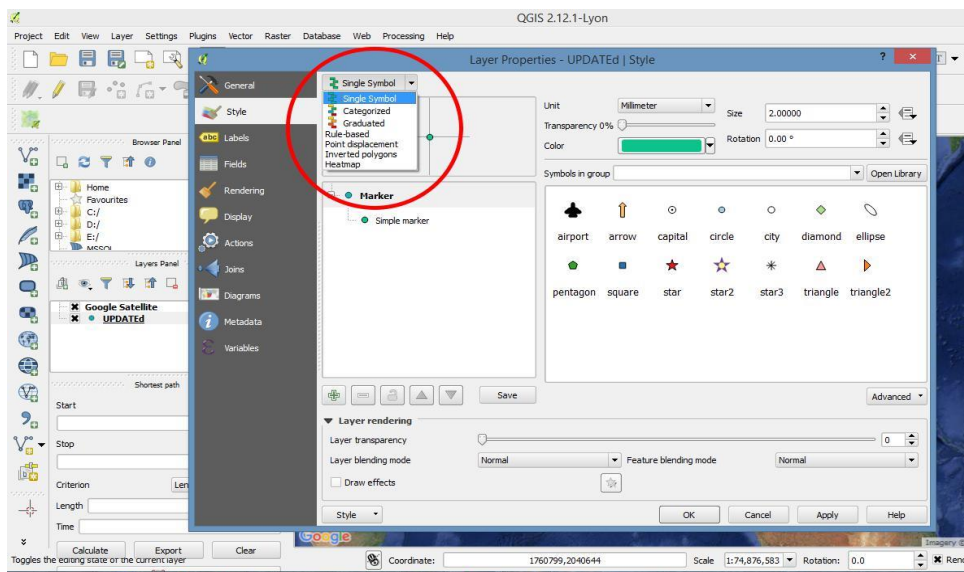


Figure 26: Categorization in Style option

Note that you can still customize individual symbols for each category (size, shape, etc) by double clicking the corresponding class on either the left pane or the line in Style window (Figure). The labels are an important feature of a map.

By marking some property up on the map, for instance the name of the marked location, labels can make your map more useful, informative, and visually appealing. To add labels to your map, right-click on the layer that you want to add marks on and select Properties (Figure 27 & 28). Then follow the steps below:

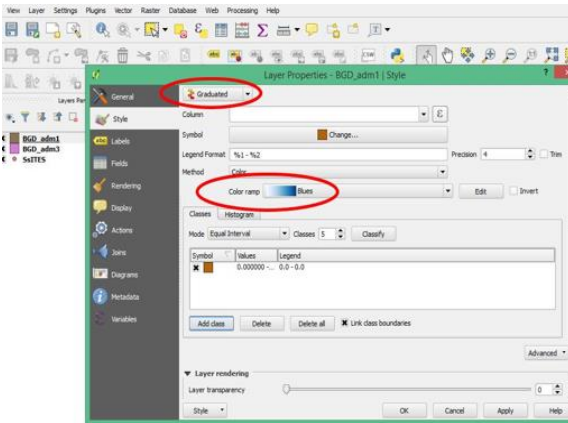


Figure 27: Example of Style

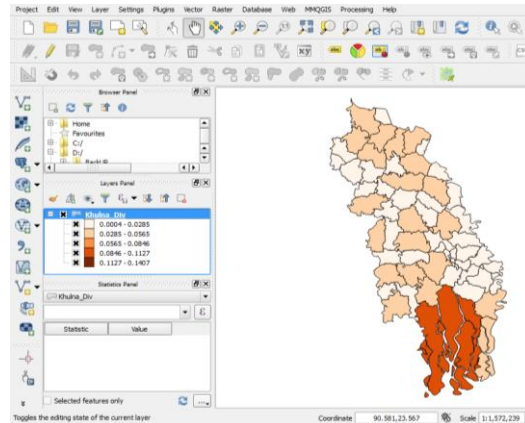


Figure 28: Selecting Graduated properties

1. Select the Labels tab and check on (off by default) "Display labels".
2. Choose the attribute you want to display on the map in the dropdown of Field Containing label (Figure 14).
3. Change Font, so that it is clearly shown on the map.
4. You can click on the Apply button to see the effect until it is satisfactory. Then click OK to save your setting and exit.
5. (Optional) If you think the added labels are not distinct on the map background, you can make a buffer background around the texts.

Graduated Map- To present variation of data within a region a graduated map can be developed by right clicking on the layer and select **Properties-> Style->** then select the options as the picture below. The class interval and the class breaks can be customized by clicking on them.

Labels : To show the labels on any feature on the map we have to follow the process like right clicking on the layer and select **Properties-> Labels->** then select the steps as the picture below (Figure 29 and 30). You have to define the Label with by selecting the column in attribute table you want to show on the map.

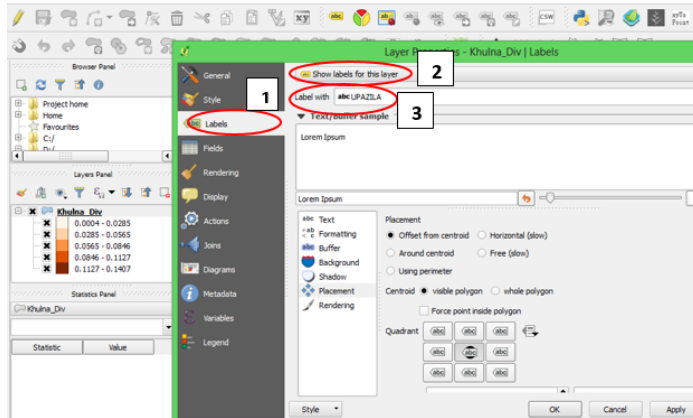


Figure 29: Showing labels on the map

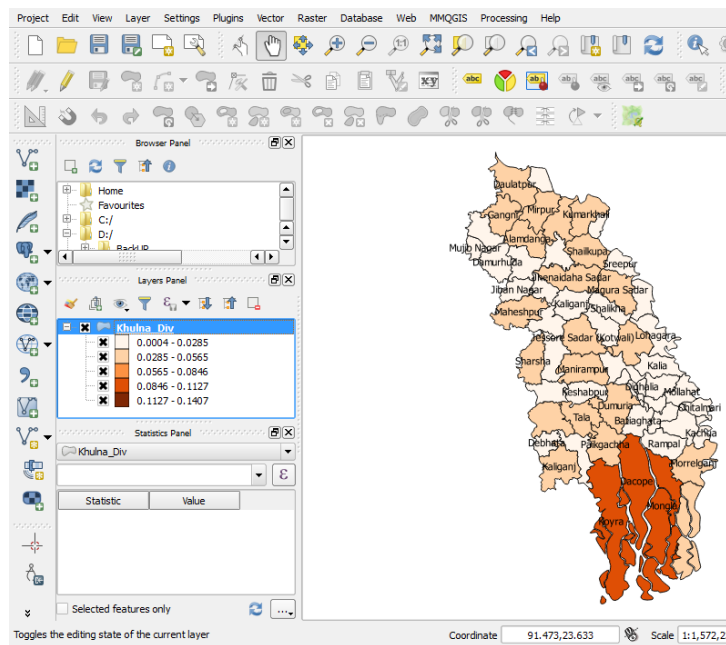


Figure 30: Graduated Map with labels

4.2. Map/Print Composer

When the geospatial data and its representations are satisfactory, you can add other map components in another window via Project-> New Print Composer (Figure 31). You can manage multiple composers via **File -> Composer** Title box will pop up. Entering the Title a new window will pop up.

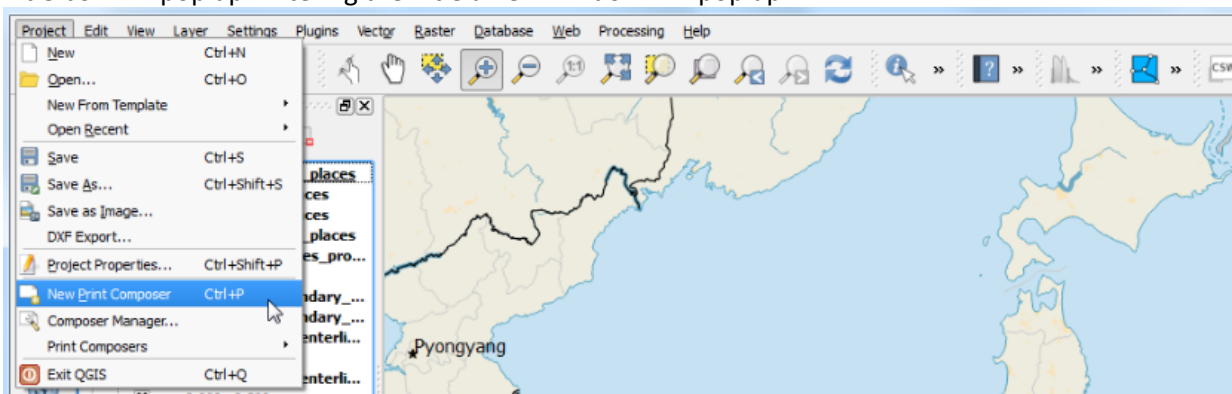


Figure 31: New Print Composer in Project menu

Key components of publishing a map include:

- The title of the map;
- The scale of the map;
- The North Arrow (Orientation);
- The Legend (how to interpret the map);
- (Optional) The reference (where you obtain the data)
- Date of preparation and map preparing authority

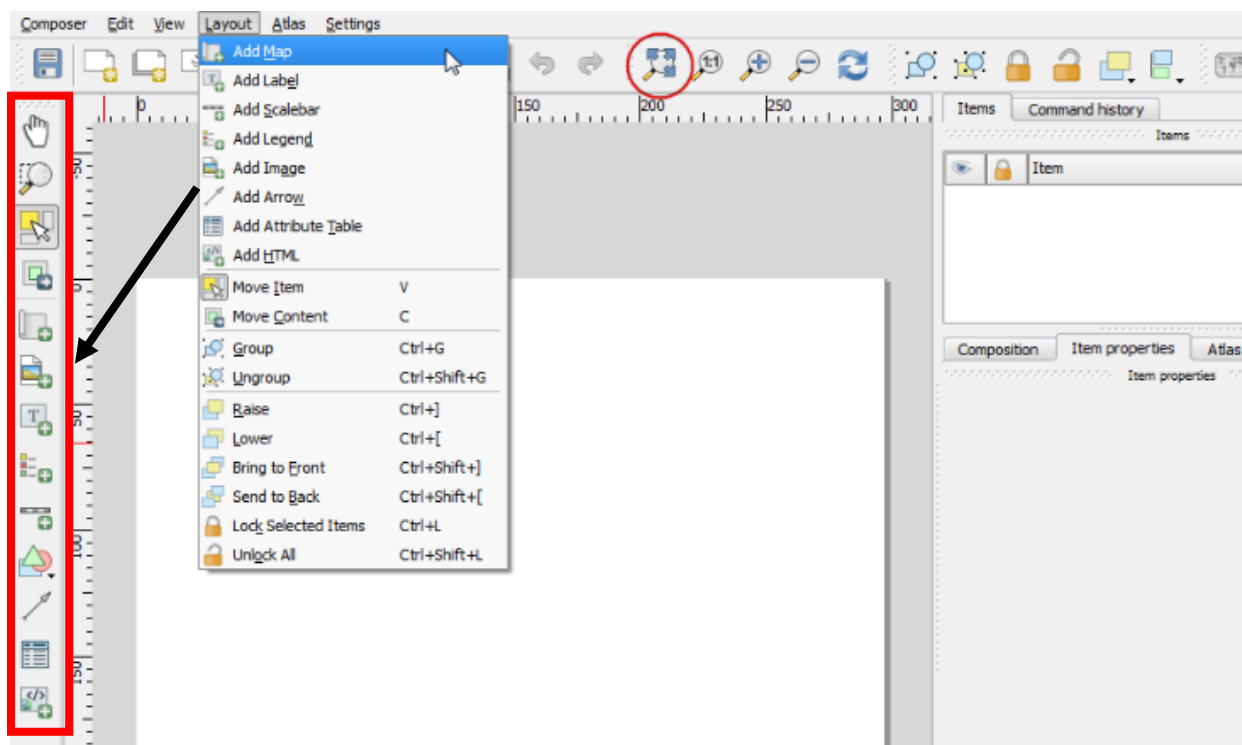


Figure 32: Map Composer

The main part, map, can be added by clicking in **Layout>Add Map**, and then drag a rectangle on the paper to define display area and extent.

Map titles can be added as a text box by clicking and then click on the spot where you want to place the title at. Please note that, in print composer, you can customize the properties of all components by switching to the ITEM tab. So, for instance, if you want to change the font of the title, click the title first (so that it is selected) and change to the ITEM tab. There is a button called Font where you can find all properties there.

Add scale bar is also intuitive: click on and then click where you want to add it. You can change Unit label and Style. The scale bar style can be numeric, i.e. 1:5,000,000, or different bar/line forms. All options are intuitive and can be tested by changing it back and forth.

North Arrow can be added as an arrow. The options of a north arrow in QGIS are very limited. Legend can be added in the same way as others (click on).

QGIS has better organization of legend properties than ArcMap. The major options are located under Legend items. You can fine tune in Item Options.

Now we can start to assemble our map.

- **Go to Project > New Print Composer.**
- You will be prompted to enter a title for the composer. You can leave it empty and click Ok.

Note

Leaving the composer name empty will assign a default name such as **Composer 1**.

In the Print Composer window, click on Zoom full to display the full extent of the Layout. Now we would have to bring the map view that we see in the QGIS Canvas to the composer. You can add the items by choosing from **Layer** tab or the **Layer Panel** at left of the canvas (Figure 33).

- Go to Layout > Add Map
- Once the Add Map button is active, hold the left mouse button and drag a rectangle where you want to insert the map.

You will see that the rectangle window will be rendered with the map from the main QGIS canvas. The rendered map may not be covering the full extent of our interest area.

- Select Layout > Move item content to pan the map in the window and center it in the composer.

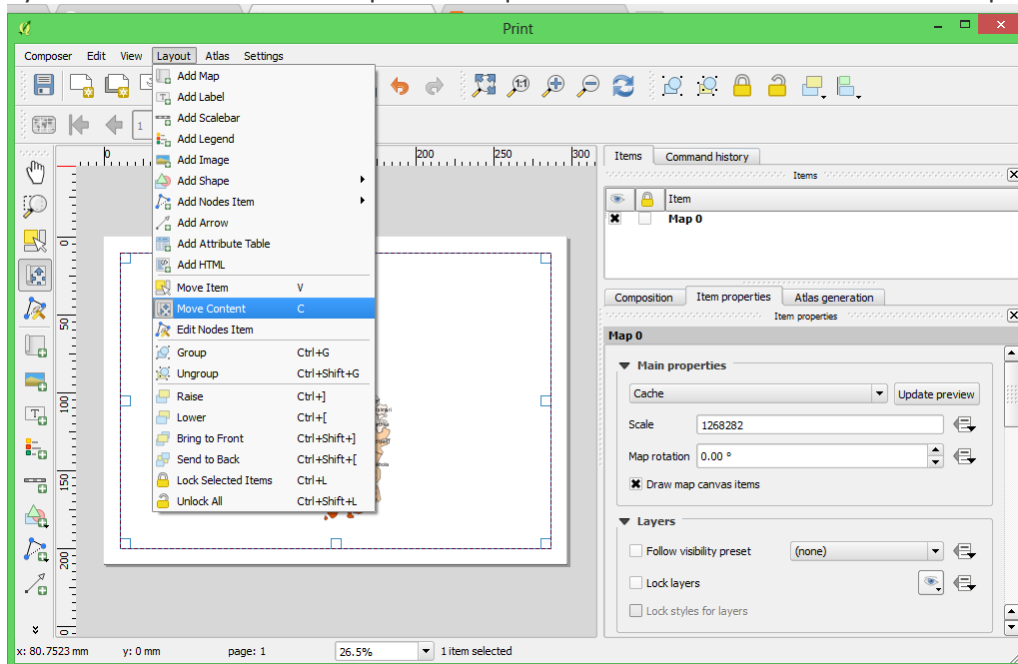
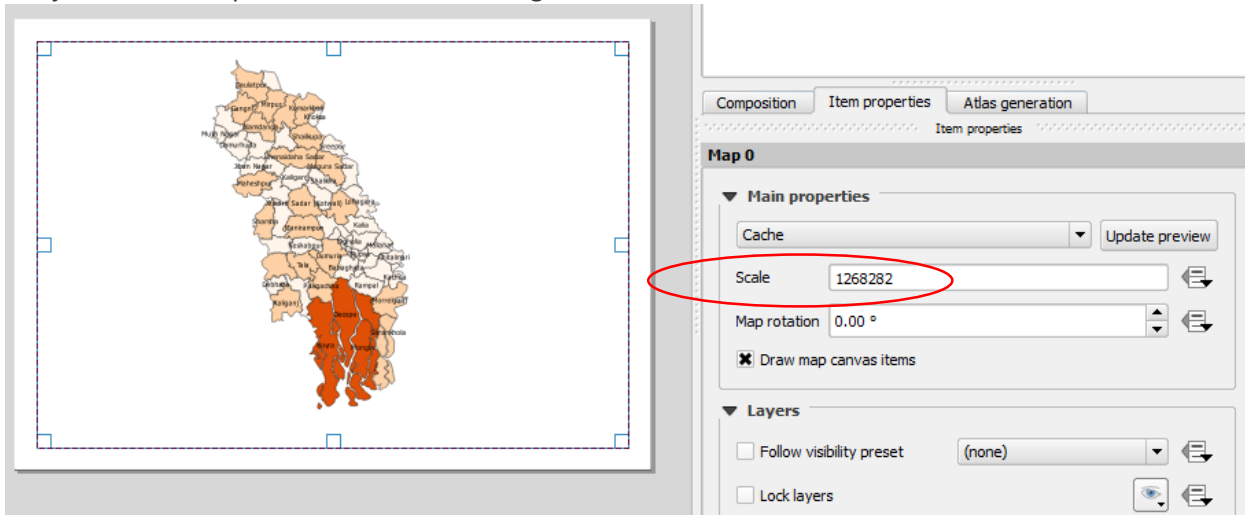
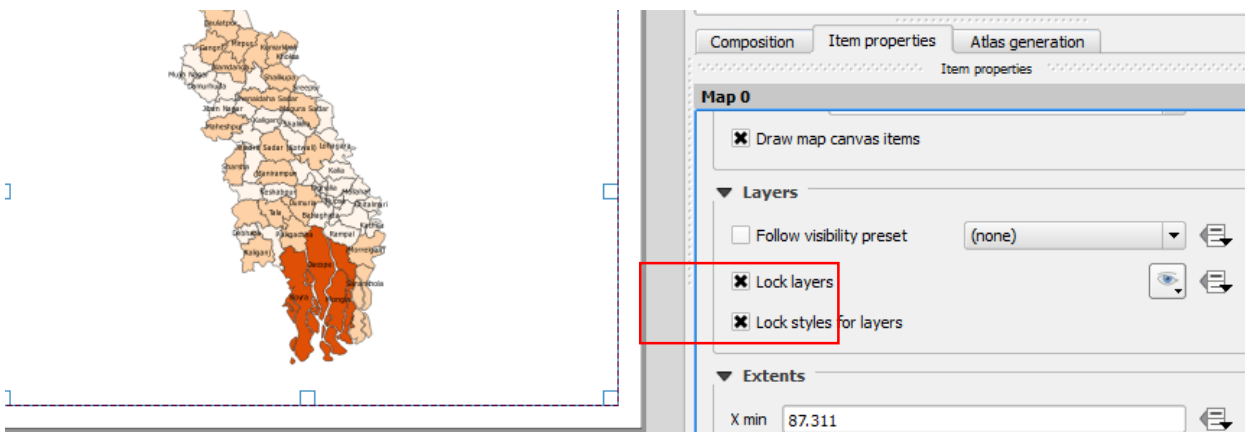


Figure 33: Layer Tab and Layer Panel

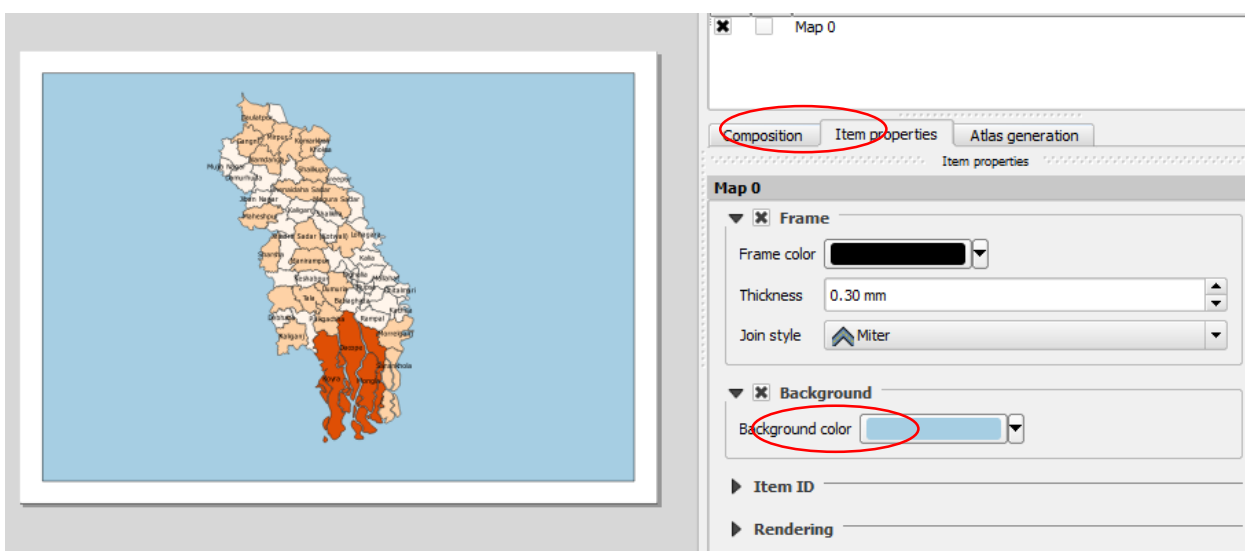
- Let us adjust the zoom level for the given map. Click on the Item Properties tab and change the scale value adjusted the composer view as shown in figures below.



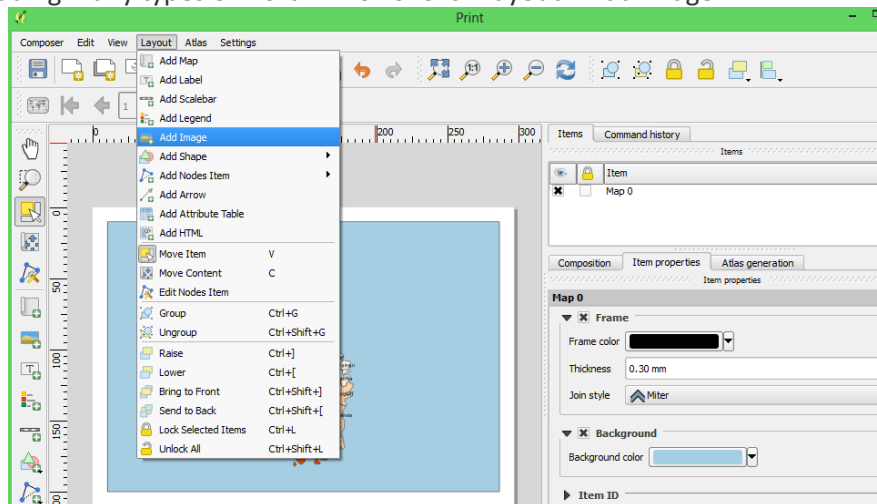
- Now we will add a map inset that shows a zoomed in view for the Tokyo area. Before we make any changes to the layers in the main QGIS window, check the Lock layers for map item and Lock layer styles for map item boxes. This will ensure that if we turn off some layers or change their styles, this view will not change.



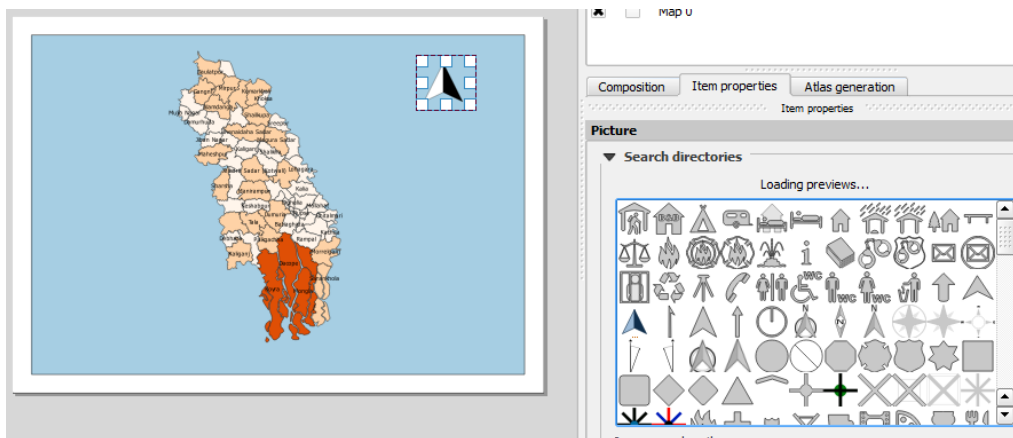
- We can change the frame of the map using the Frame properties from Item Properties panel at right side (see the figure below).



- Now we will add a North Arrow to the map. The Print Composer comes with a nice collection of map-related images - including many types of North Arrows. Click Layout > Add Image.



- Holding your left mouse button, draw a rectangle on the top-right corner of the map canvas. On the right-hand panel, click on the Item Properties tab and expand the Search directories section and select the North Arrow image of your liking as figure below



- Now that we have the map inset ready, we will add a grid and zebra border to the main map. Select the **Map 0** object from the Items panel. In the Item properties tab, scroll down to the Grids section. Click the Add a new grid button.

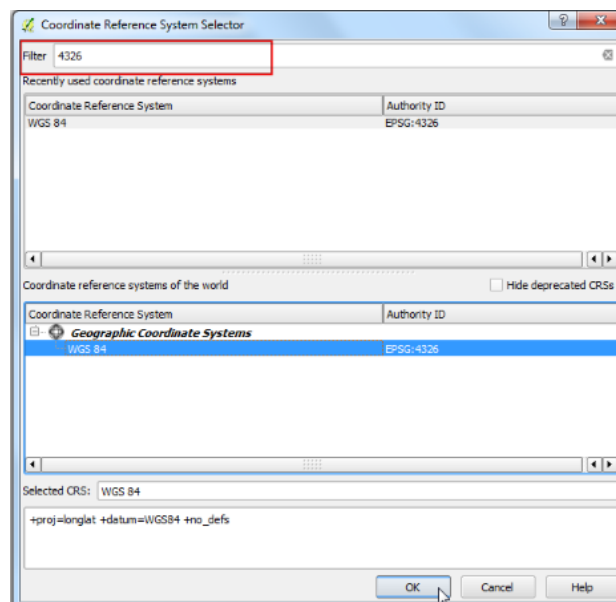


Figure : To change the CSR

- By default, the grid lines use the same units and projections as the currently selected map projections. However, it is more common and useful to display grid lines in degrees. We can select a different CRS for the grid. Click on the change... button next to CRS.
- In the Coordinate Reference System Selector dialog, enter 4326 in the Filter box. From the results, select the WGS84 EPSG:4326 as the CRS. Click OK.

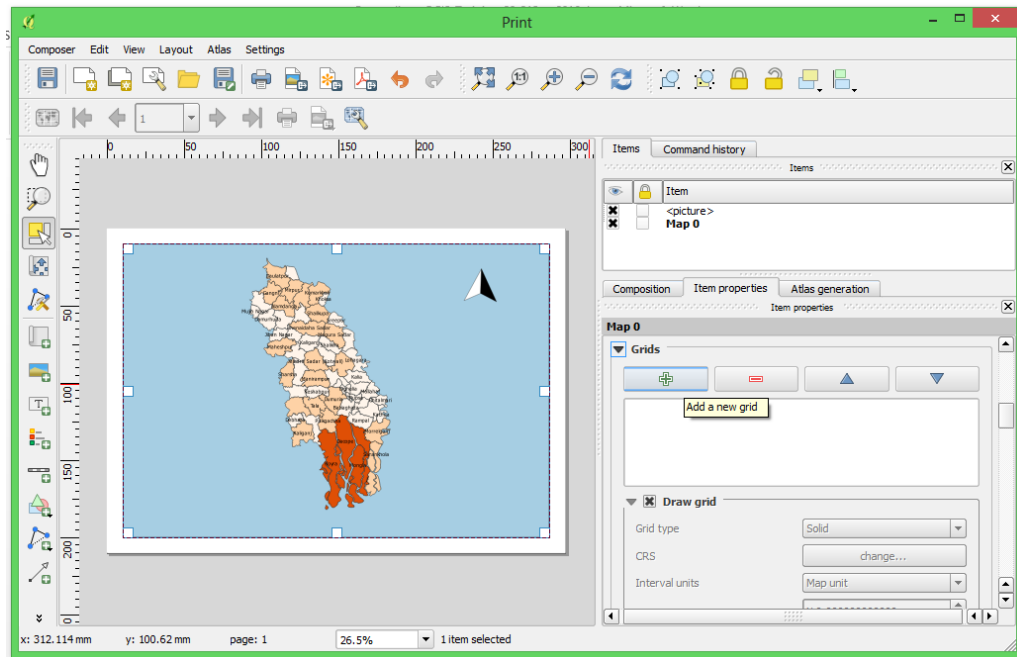
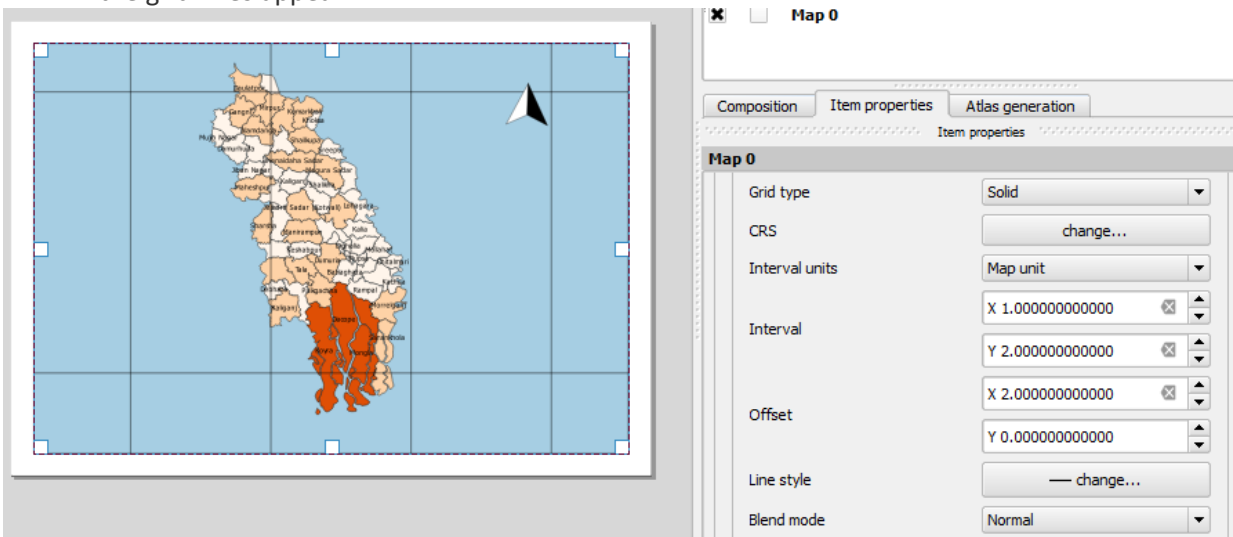
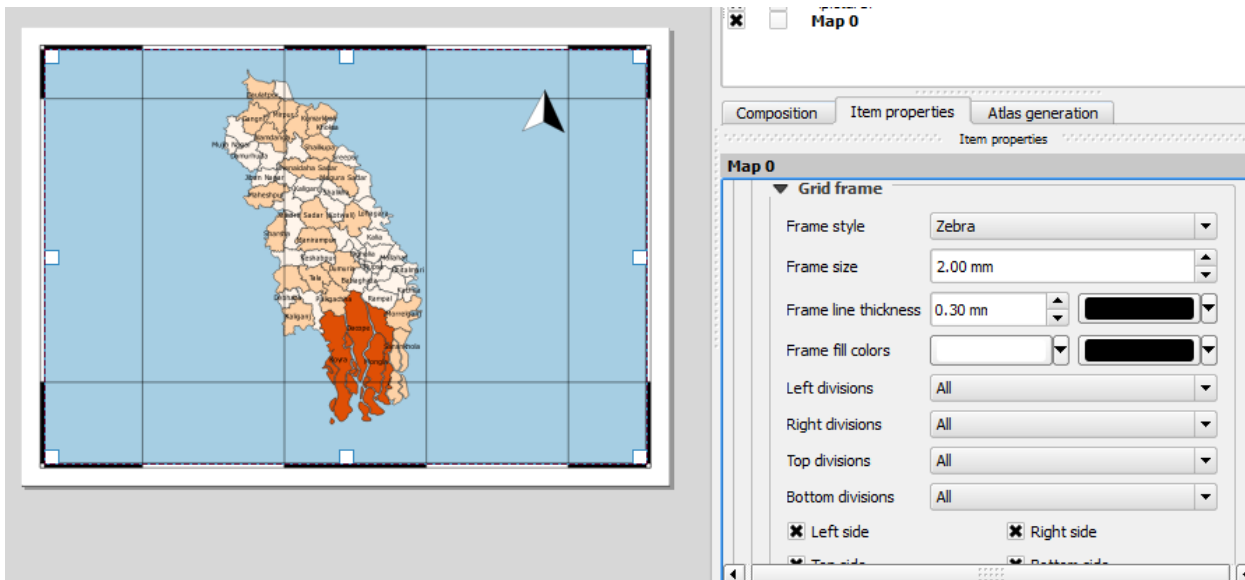


Figure: Add new grid

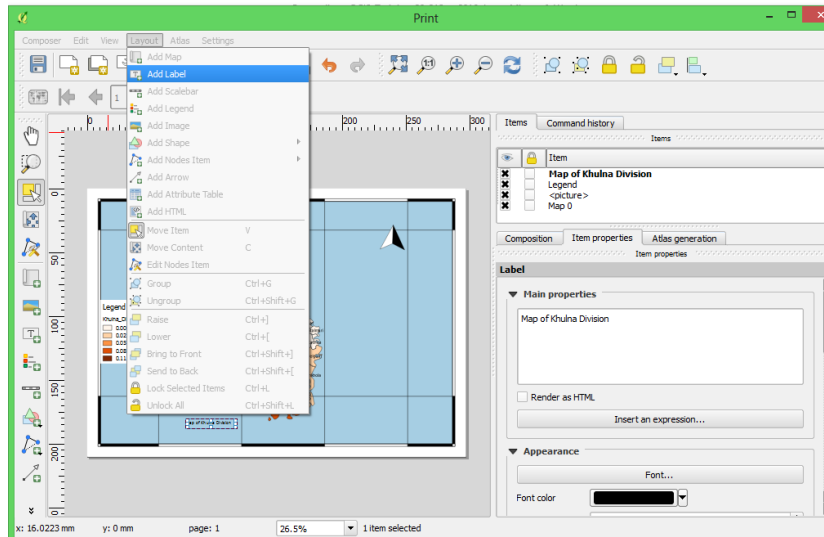
- Select the Interval values as 5 degrees in both X and Y direction. You can adjust the Offset to change where the grid lines appear.



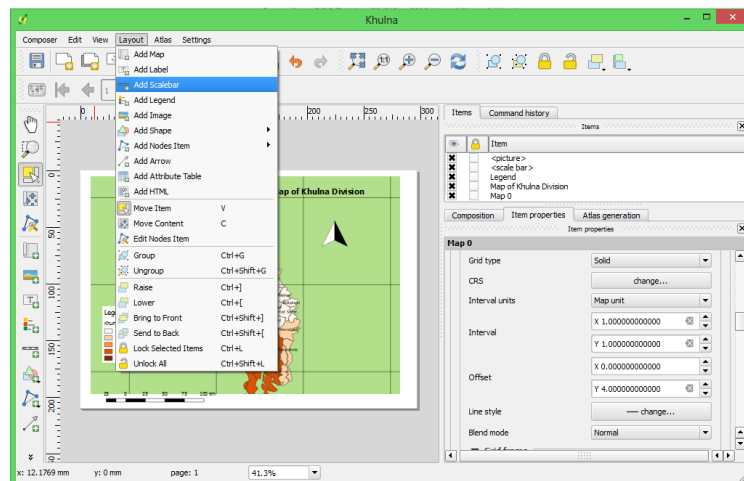
- We can change the Grid frame style from Grid frame panel, size, thickness etc as below.



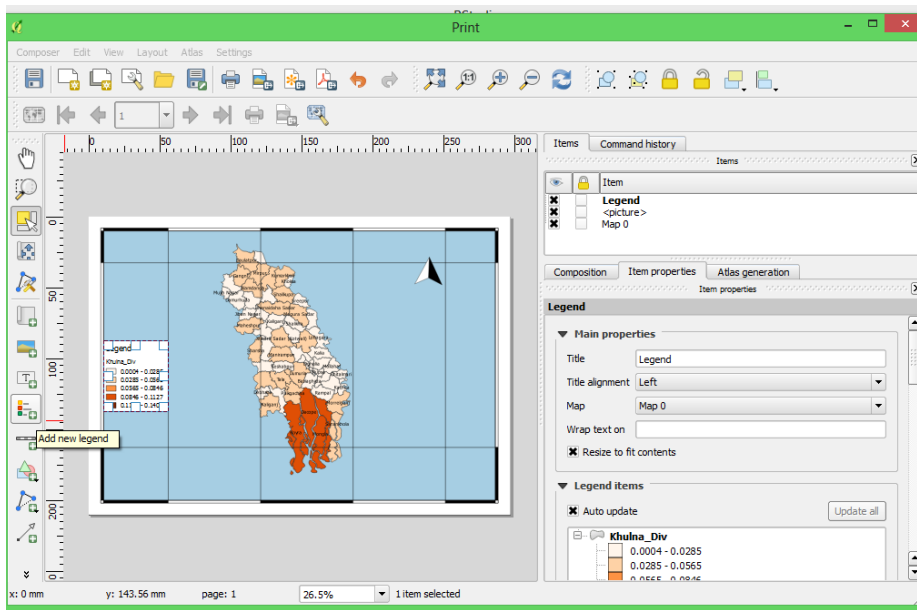
- It is time to label our map. Click on Layout ► Add Label.
- Click on the map and draw a box where the label should be. In the Item Properties tab, expand the Label section and enter the text as shown below.



- Click on the layout where you want the scalebar to appear. In the Item Properties tab, make sure you have chosen the correct map element for which to display the scalebar.
- Choose the Style that fit your requirement. In the Segments panel, you can adjust the number of segments and their size.

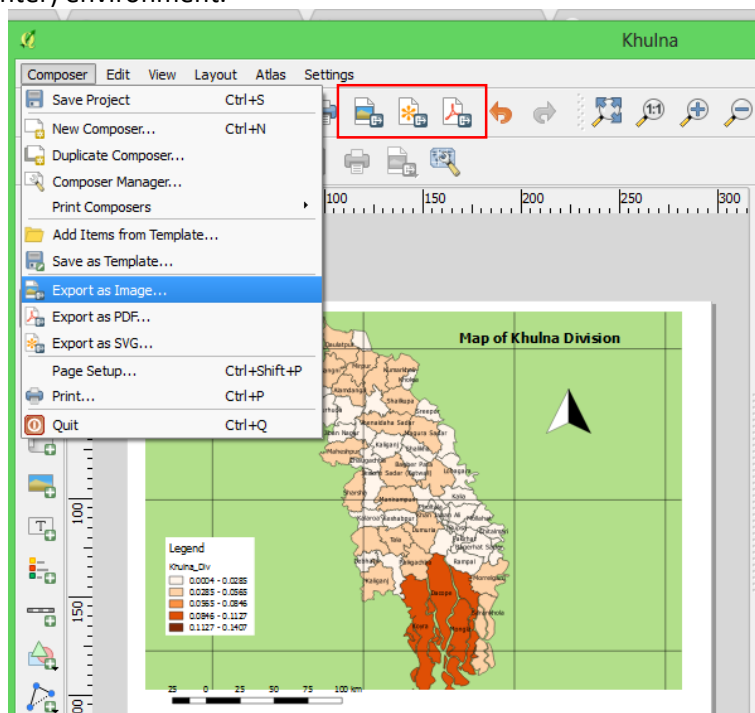


- Let's add the legend of the map by clicking add legend from Layer Tab and place the legend by click and dragging of left button of your mouse where you wish to place. Legend will be shown as available in the main QGIS data view as you displayed.



4.3. Export Maps

When you are satisfied with everything on the map and are ready to deliver, you can export your map as images, PDF, SVG, or print a hard copy. All options are under the File menu. You can specify the directory and file name of the map in this dialog. But, most importantly, you need to choose an appropriate file format by clicking on the Save as type dropdown. The most frequent-used formats are JPEG and PDF. JPEG is a popular graphic file format, which is easy to be inserted into word as a graph, while PDF is best used for sharing. The printed copy of PDF will be identical regardless of your computer (and printer) environment.



APPENDIX 1 : LIST OF PARTICIPANTS

Name	Email
Ajit Kumar Rudra	ajitrudra@yahoo.co.uk
Md. Mozaharul Islam	mazhar.raj@gmail.com
Shawkat Imran Arafat	shawkat.imran.arafat@gmail.com
Md. Anisur Rahman	anisur.boi@gmail.com
Md. Delowar Hossain	delowarhossain84@yahoo.com
Rokeya Begum	rupa_zaman@yahoo.com
K. M. Nazmul Islam	nazmul@ifescu.ac.bd
Anatoli Poultouchidou	anatoli.poultouchidou@fao.org
Abdullah-al-mamun	almamun.0022@gmail.com
Nikhil Chakma	nikhil.chakma@fao.org
Nandini Sarker	nandini.sarker@fao.org
Md. Saiful Islam Dewan	saiful.forester.bforest@gmail.com
Champa Rani Saha	champasaha21@gmail.com
Sharmin Akter	sharmin_tithy@yahoo.com
Abu Yousuf	yusufnaabe96@gmail.com
Rakibul Hasan Mukul	lalpiprey@gmail.com
Imran Ahmed	imranforest@live.com
Md. Shahir Kabir	sheikhshah00@gmail.com
Mohammad Sohal Rana	md_rana7777@yahoo.com
Khan Zarin Tasnim	Zarin.khan@fao.org
Ahasanul Hoque	hoque.ahasan@gmail