QGIS TRAINING MANUAL FOR LOWER SECONDARY LEVEL SCHOOLS

Rwanda Education Board

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I. GETTING STARTED WITH QGIS

I.1 Definition of QGIS

QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps.

Usefull terminologies

- **Attribute** : a piece of data relating to a feature , example the name of a settlement or the population of a region
- **Attribute table** : a table showing the attribute values for all the features in a layer
- **Coordinate reference system**: CRS the sytem used to reference the X and Y coordinates of your data
- **Feature** : an individual object in your data,example a line ,point or polygone
- **Layer** : a set of data , usually of one type which can be turned on and off , moved above or below other layers, and styled/ labelled
- **Line** : vector data which has two ends which don't meet, possibly with intermadiate points, for example roads
- **Plugin** : an optional application which provides additional functionality to GIS
- **Point** : data comprising sets of individual X and Y coordinates , but not joined togetther , example village or hospiatl
- **Polygon** : data comprising one or more closed lines, forming shapes which can be filled , for example land masses, or provinces
- **Project** : a set of data , styles and print composers within QGIS used to make a map
- **Raster** : map data which is represented as an image , with pixel valuyes of between o and 255
- **Style** : rules used to represent data objects with colour , shapes, icons or charts according to the values of their attributes
- **Vector** : data which is represented as sets of coordinates , producing lines , points or polygones
- **Shape file**: A shapefile (.shp) is a vector data storage format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.
- **A layer file:** A layer file (.lyr) is a file that stores the path to a source dataset and other layer properties, including symbology.

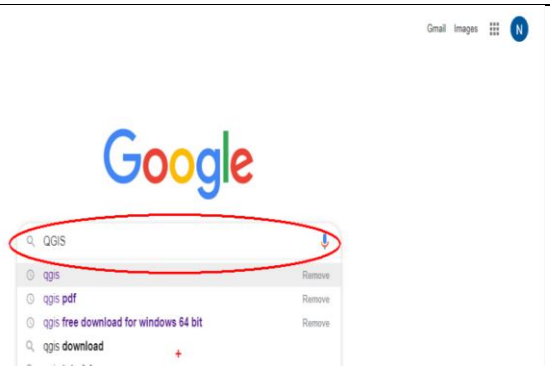
I.2 Difference between ArcGIS and QGIS

In this training manual we will be trained on QGIS but not ArcGIS as it is in the syllabus , Both these Software do almost the same work , but we have decided to use QGIS it is the one which is easy for teachers and students to find because it is free to download..

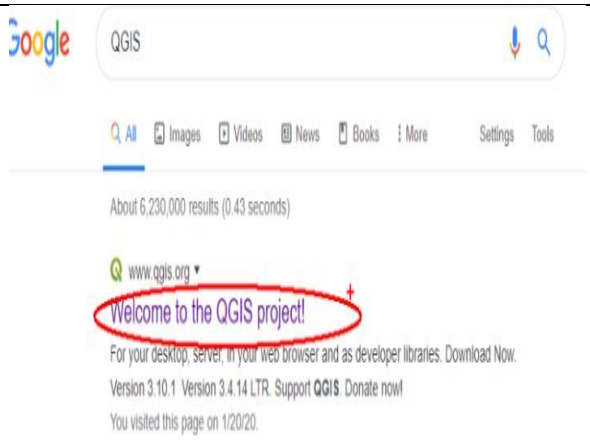
QGIS	ArcGIS
• It is open source Software. • It is freely available. • It can be installed on different operating Systems. • It is not licensed Software. • It is developed by all over the world Programmers.	• It is commercial Software. • It is not freely Available. • It can only be installed on window System. • It is single user Licensed software. • It is deployed in secure environment of Esri

I.3 Downloading and installing QGIS in a computer

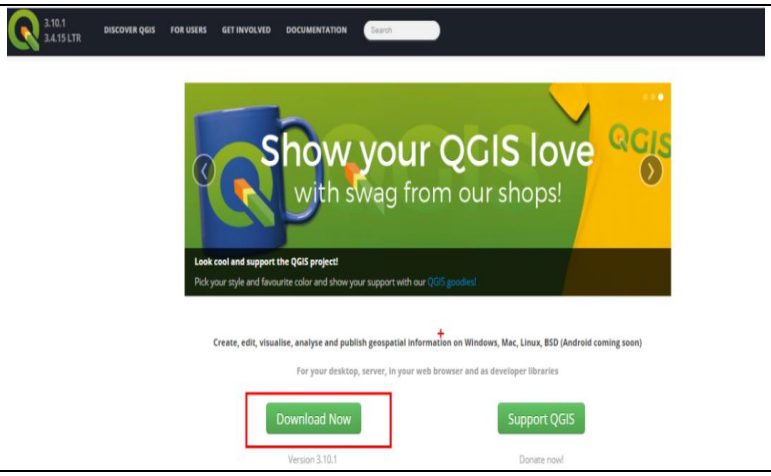
- Open your browser and type the word QGIS in google search engine

➢ Open your browser: Google chrome, internet explorer, Mozilla Firefox… ➢ Type the word **QGIS** ➢ **Press enter** .	

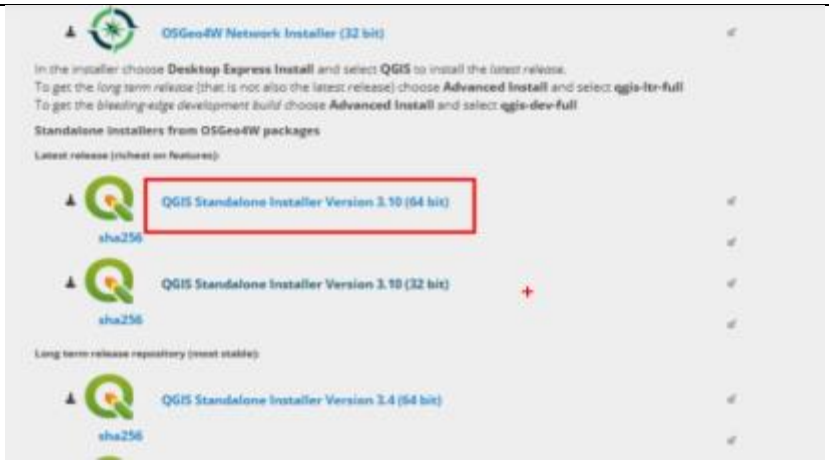
- Click on welcome to QGIS Project

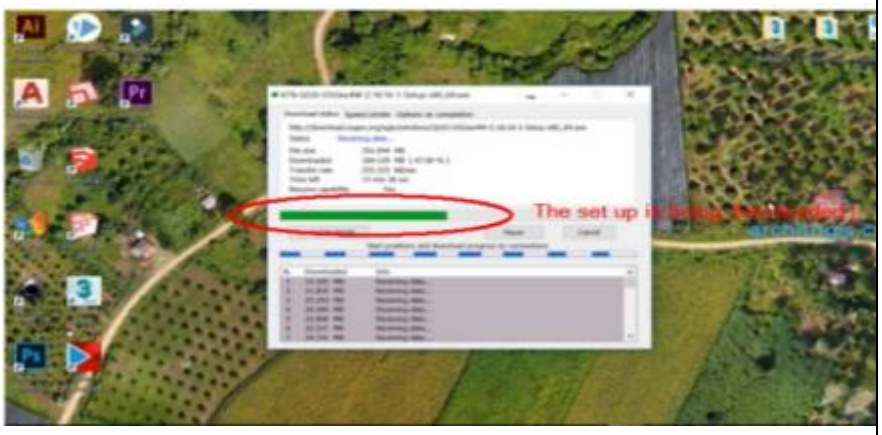
➢ The "**welcome to QGIS project!"** link will appear and then click on it	

- **Downloading the set up**

➢ The **download now** will appear and then you click on it for the next step	

- **Selecting the QGIS version compatible with your computer**

• There are different versions of QGIS , you will choose the one which is compatible with your Windows. • Some computers have Windows 32 bit other have windows 64 bit , for new QGIS users we recommend **the stand alone installer** .	

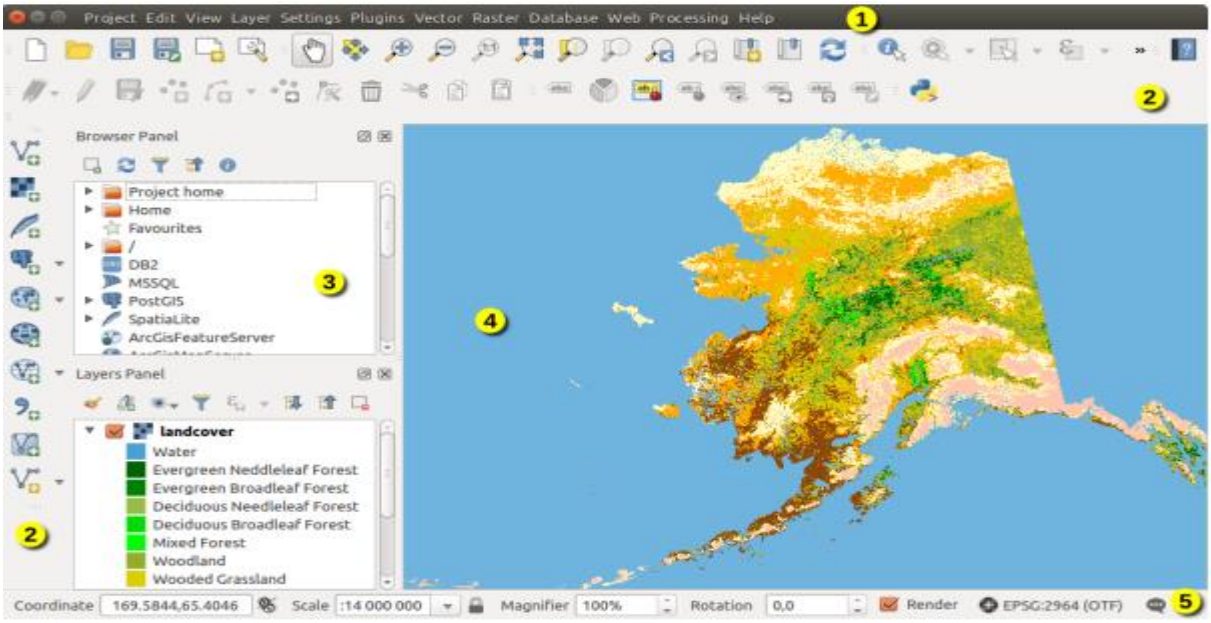
a. The set up will be automatically downloaded , this can take 4 to five minutes	 

- **Installing QGIS in a computer**

b. **Double click the downloaded set up** and then follow the steps.	

You can also **visit** the following link to install the set up" https://www.youtube.com/watch?v=5GmfCseIh3Y

I.4 QGIS Graphical User Interface (GUI)



The QGIS GUI is divided into five components:

(1) Menu bar
(2) Toolbars
(3) Panels
(4) Map view
(5) Status bar

I.4.1 Menu bar

The Menu bar provides access to various QGIS functions using a standard hierarchical menu.

I.4.1.1 Project

Menu Option	Shortcut
New	Ctrl+N
Open	Ctrl+O
New from template →	
Open Recent →	
Save	Ctrl+S
Save As...	Ctrl+Shift+S
Save as Image...	
DXF Export...	
DWG/DXF Import...	
Project Properties...	Ctrl+Shift+P
New Print Composer	Ctrl+P
Composer manager...	
Print Composers →	
Exit QGIS	Ctrl+Q

I.4.1.2 Edit

Menu Option	Shortcut
Undo	Ctrl+Z
Redo	Ctrl+Shift+Z
Cut Features	Ctrl+X
Copy Features	Ctrl+C
Paste Features	Ctrl+V
Paste features as →	
Add Feature	Ctrl+.
Add Circular String	
Add Circular String by Radius	
Move Feature(s)	
Delete Selected	
Modify Attributes of Selected Features	
Rotate Feature(s)	
Simplify Feature	

I.4.1.3 View

Menu Option	Shortcut
Pan Map	
Pan Map to Selection	
Zoom In	Ctrl+Alt++
Zoom Out	Ctrl+Alt+-
Select →	
Identify Features	Ctrl+Shift+I
Measure →	
Statistical Summary	
Zoom Full	Ctrl+Shift+F
Zoom To Layer	
Zoom To Selection	Ctrl+J
Zoom Last	
Zoom Next	
Zoom To Native Resolution	
Decorations →	
Preview mode →	
Map Tips	
New Bookmark...	Ctrl+B
Show Bookmarks	Ctrl+Shift+B
Refresh	F5
Panels →	
Toolbars →	
Toggle Full Screen Mode	F11

I.4.1.4 Layer

Menu Option	Shortcut
Data Source Manager	Ctrl+L
Create Layer →	
Add Layer →	
Embed Layers and Groups...	
Add from Layer Definition File...	
Copy Style	
Paste Style	
Copy Layer	
Paste Layer/Group	
Open Attribute Table	F6
Toggle Editing	
Save Layer Edits	
Current Edits →	
Save As...	
Save As Layer Definition File...	
Remove Layer/Group	Ctrl+D
Duplicate Layer(s)	
Set Scale Visibility of Layer(s)	
Set CRS of Layer(s)	Ctrl+Shift+C
Set Project CRS from Layer	
Layer Properties...	
Filter...	Ctrl+F
Labeling	
Show in Overview	
Show All in Overview	
Hide All from Overview	

I.4.1.5 Settings

Menu Option
User Profiles →
 *Style Manager...*
 *Custom Projections...*
 *Keyboard Shortcuts...*
 *Interface Customization...*
 *Options...*

I.4.1.6 Plugins

Menu Option	Shortcut
 *Manage and Install Plugins...*	
 *Python Console*	Ctrl+Alt+P

I.4.1.7 Vector

Menu Option	Shortcut
 *Coordinate Capture*	
 *Check Geometries...*	
 *GPS Tools*	
 *Topology Checker*	
Geoprocessing Tools →	Alt+O+G
Geometry Tools →	Alt+O+E
Analysis Tools →	Alt+O+A
Data Management Tools →	Alt+O+D
Research Tools →	Alt+O+R

I.4.1.8 Raster

Menu Option	Toolbar
Raster calculator. . .	
Align Raster. . .	
Analysis →	
Projection →	
Miscellaneous →	
Extraction →	
Conversion →	
Georeferencer	*Raster*

I.4.1.9 Database

Menu Option	Toolbar
DB Manager	*Database*
eVis →	*Database*
Offline Editing →	*Database*

I.4.1.10 Web

Menu Option	Toolbar
MetaSearch	*Web*

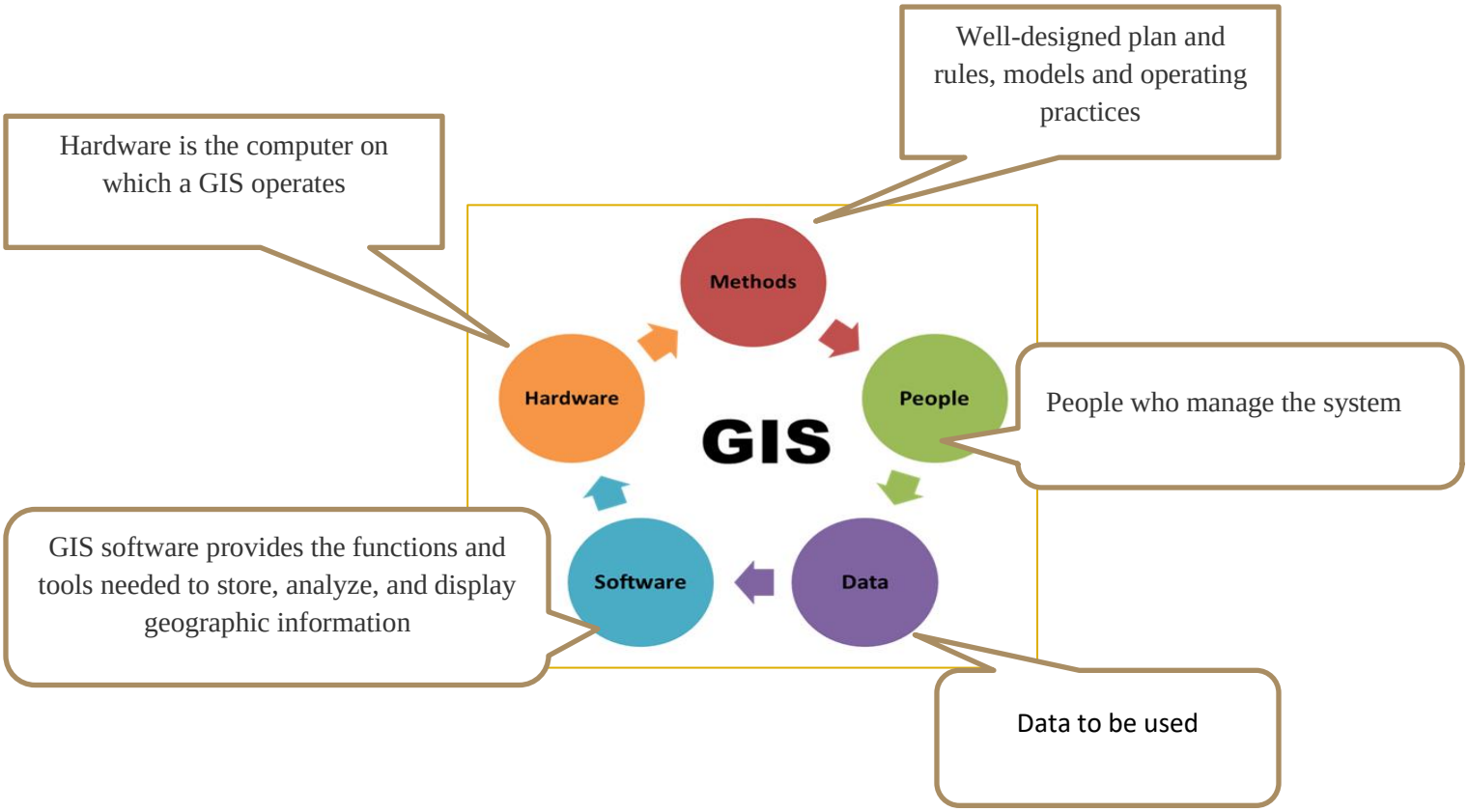
I.4.1.11 Mesh

Menu Option
Mesh Calculator

I.4.1.12 Help

Menu Option	Shortcut	Toolbar
Help Contents	`F1`	*Help*
API Documentation		
Report an Issue		
Need commercial support?		
QGIS Home Page	`Ctrl+H`	
Check QGIS Version		
About		
QGIS Sponsors		

I.5 GIS components



I.6 GIS data types

I.6.1 Vector data

Vector data is not made up of a grid of pixels. Instead, vector graphics are comprised of vertices and paths.

The three basic symbol types for vector data are points, lines and polygons (areas). Because cartographers use these symbols to represent real-world features in maps, they often have to decide based on the level of detail in the map. These are images such as streets, rivers, railway lines, lakes, city blocks, and any other features that can be drawn on a map.

I.6.2 Raster Data

Raster Data: These are items, usually images that are composed of pixels. The images may be extracts of satellite images, scanned maps, aerial photographs, or any object that shows pixels when enlarged.

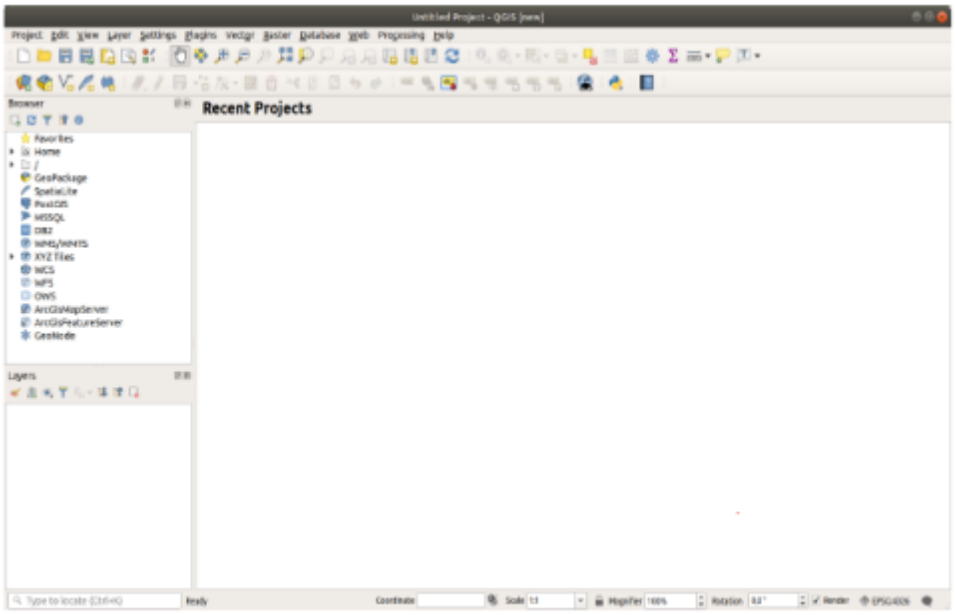
1.7 Data to be used in this training manual

The **sample data** that accompanies this resource is freely available and comes from the following source:
https://www.healthpolicyproject.com/geoHealth/resources/Workbook_Exercises_and_Data.zip
Download the prepared dataset and unzip the file. All the necessary data are provided in the **Workbook_Exercises_and_Data folder**.

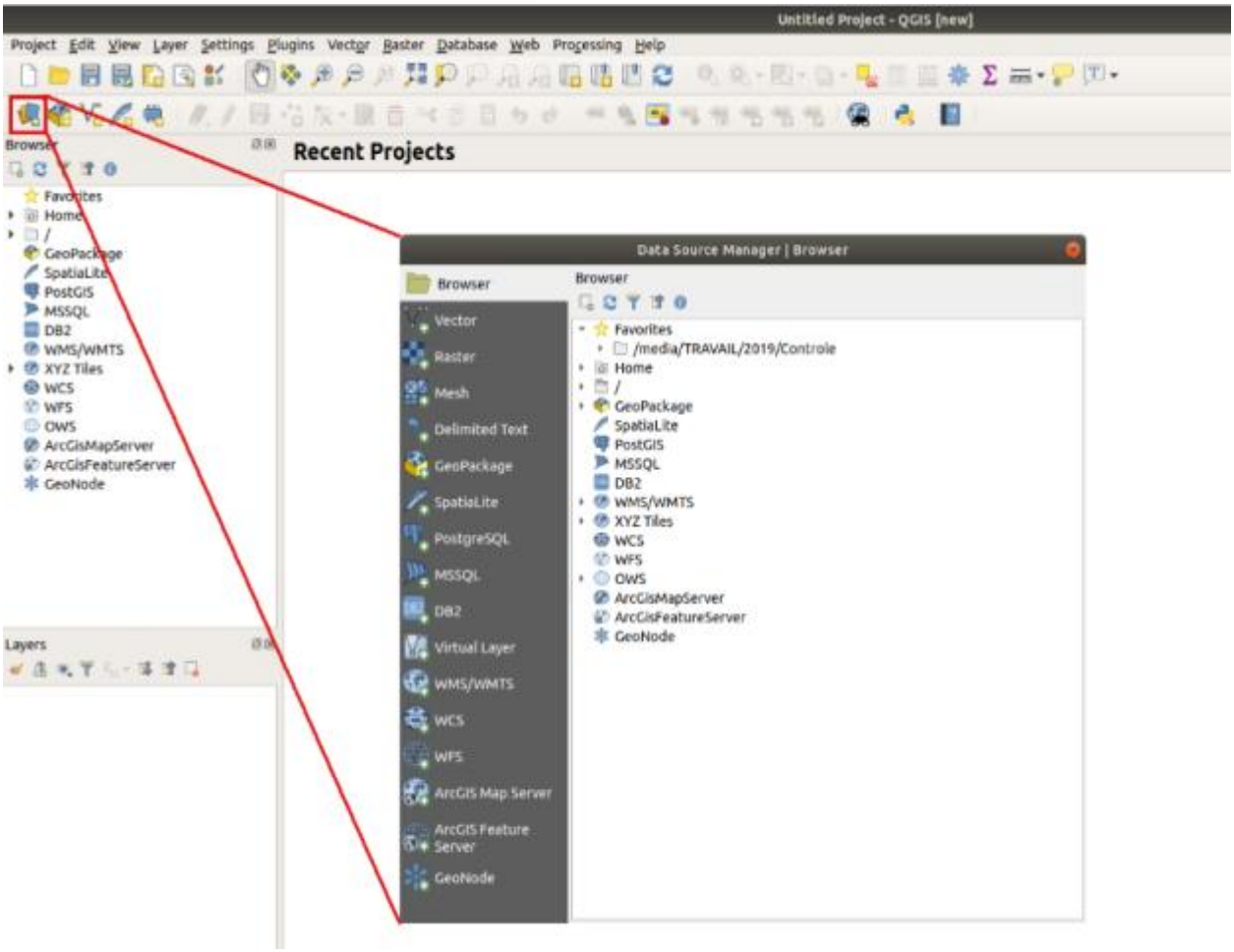
1.8 Adding your first layer

A layer can be Districts, Sectors , Provinces Etc ,To add your first layer you will do the following:

- Open QGIS. You will have a new, blank map.

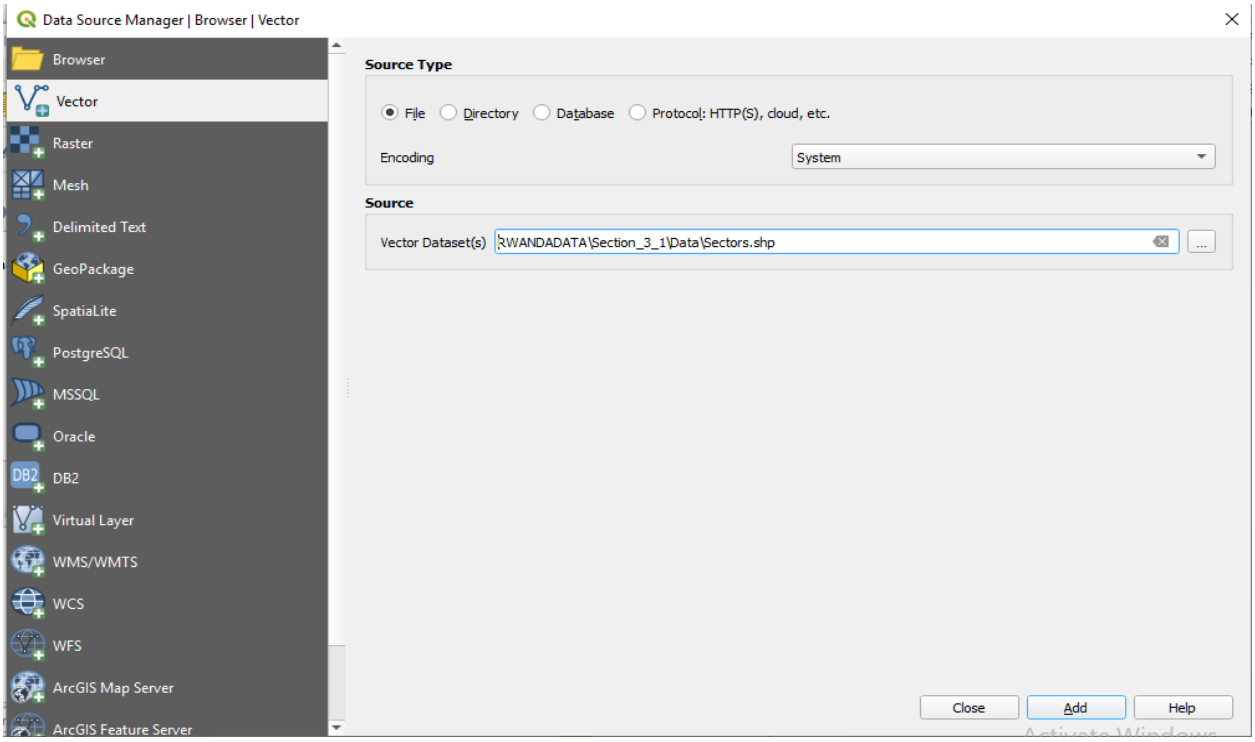


- **click the**  **Open Data Source Manager button**

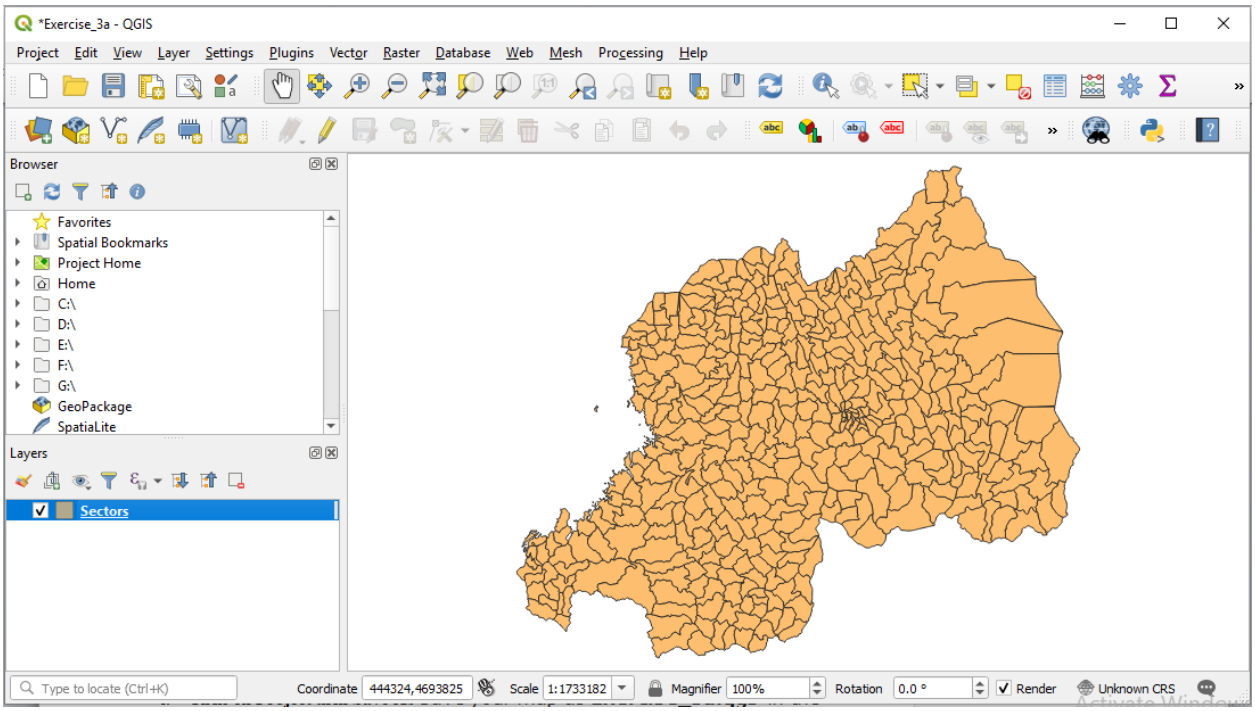


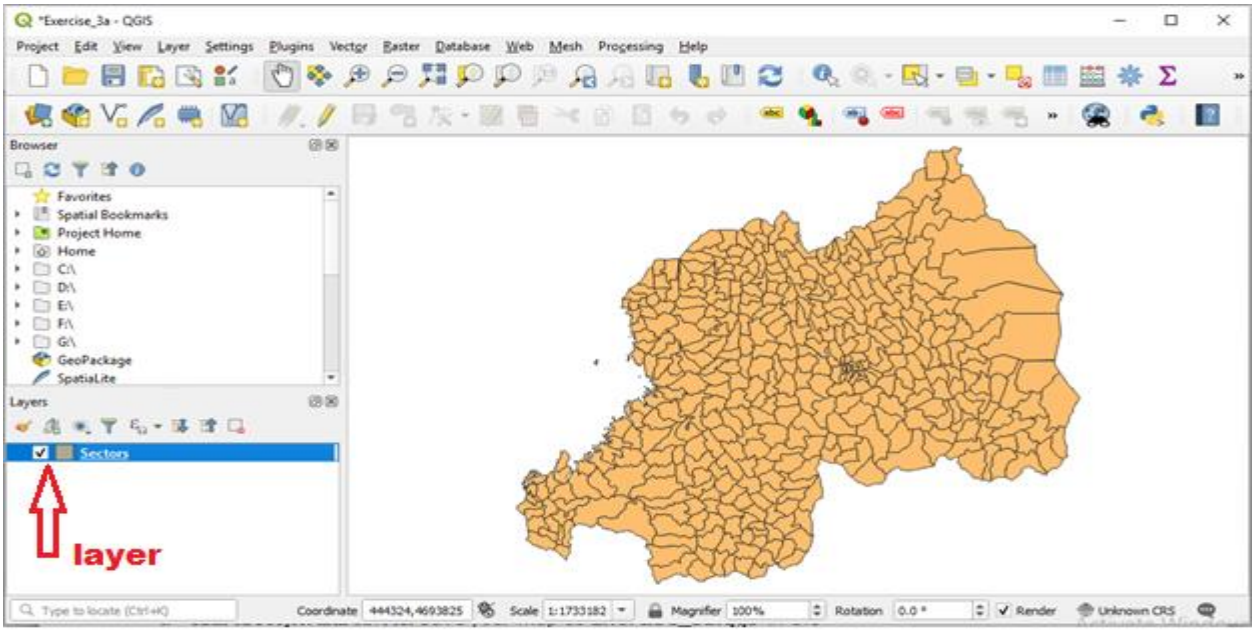
- **Load the Sectors.shp vector dataset:**

a. Click on **layer menu**
b. **add layer >add vector layer** or open **data source manager**
c. Click on the **Vector tab**
d. Enable the **File** source type
e. Press the **…** button next to **Vector Dataset(s)**
f. Select the **Workbook_Exercises_and_Data\Section_3_1\Data/ Sectors.shp**file in your training directory.
g. Click **Open**.



h. Click **Add**. Then **Close**.



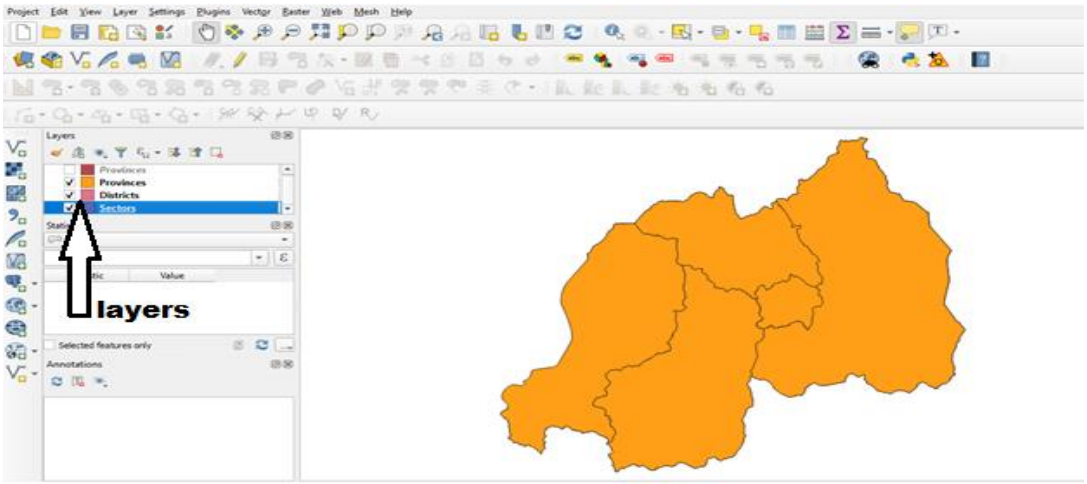


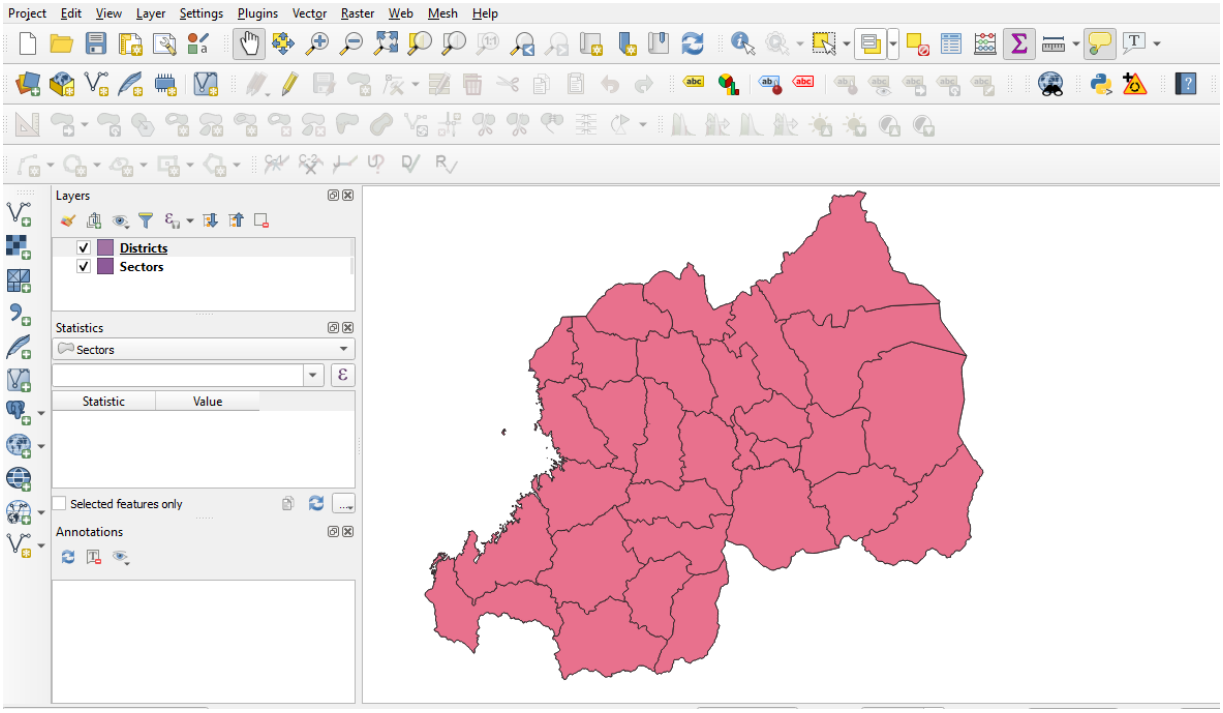
The sectors layer is now there

i. Click on **Project** then **Save As** Save your map as **Exercise_3a.qgs** in the **Workbook_Exercises_and_Data \Section_3_1** folder

EXERCISE 1 : Repeat the steps above to add Districts.shp and Provinces.shp layers from the same folder (Workbook_Exercises_and_Data \Section_3_1\Data) to the map.

Result:





II. CREATING A BASIC MAP

II.1 Working with Vector Data

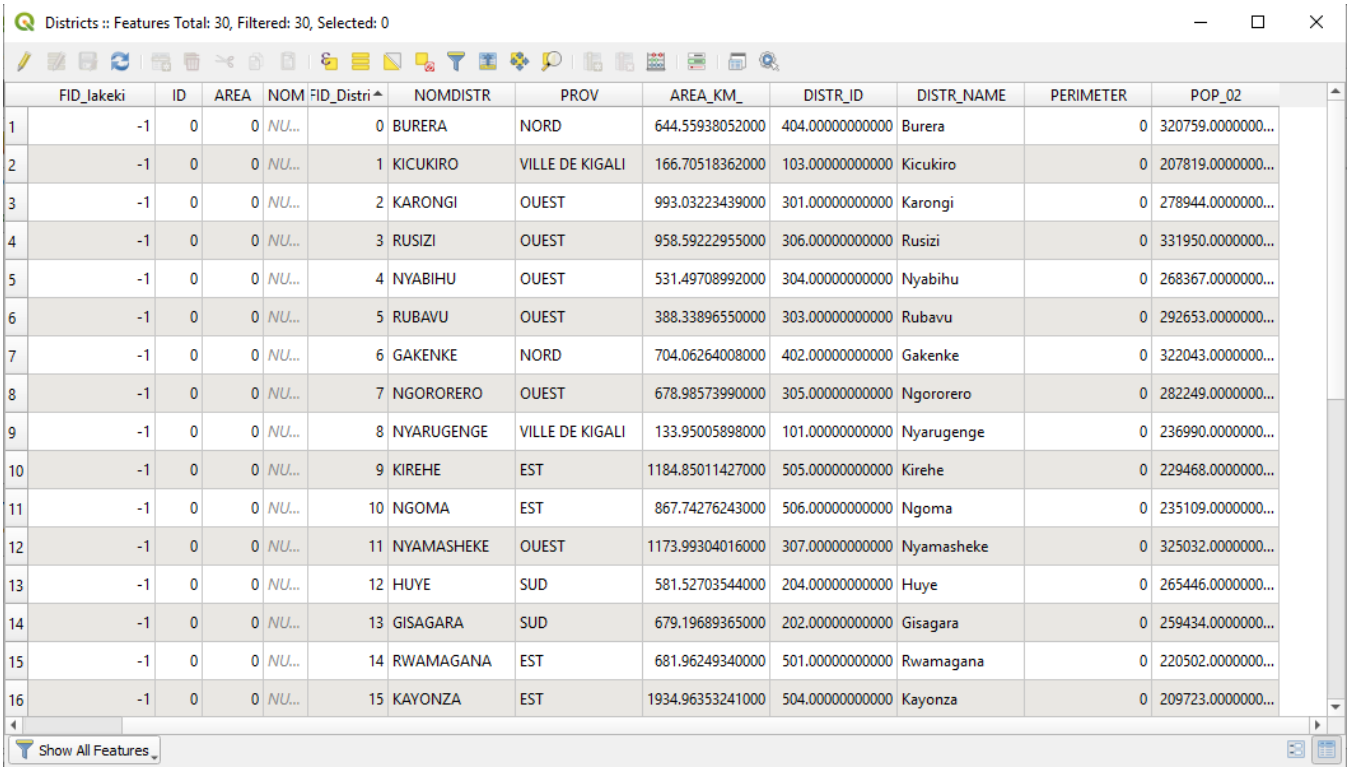
The vector model represents the location and shape of geographic features using points, lines and polygons while their other properties are included as attributes (often presented as a table in QGIS).

II.1.1 Viewing Layer Attributes

It's important to know that the data you will be working with does not only represent **where** objects are in space, but also tells you **what** those objects are.
To see all the available data in the **districts layer**,

- click the  button or
- right click the **districts layer** and
- choose **Open Attribute Table**

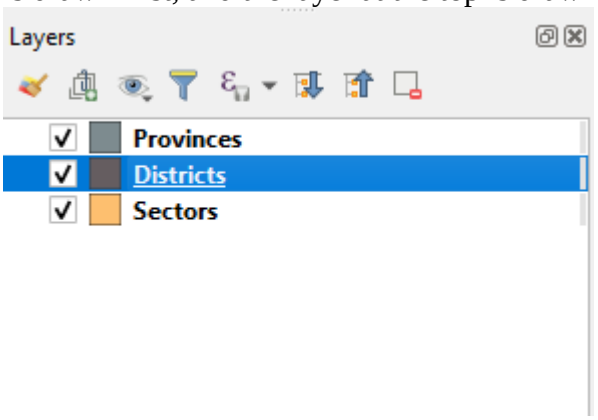
It will show you a table with more data about the Districts layer.



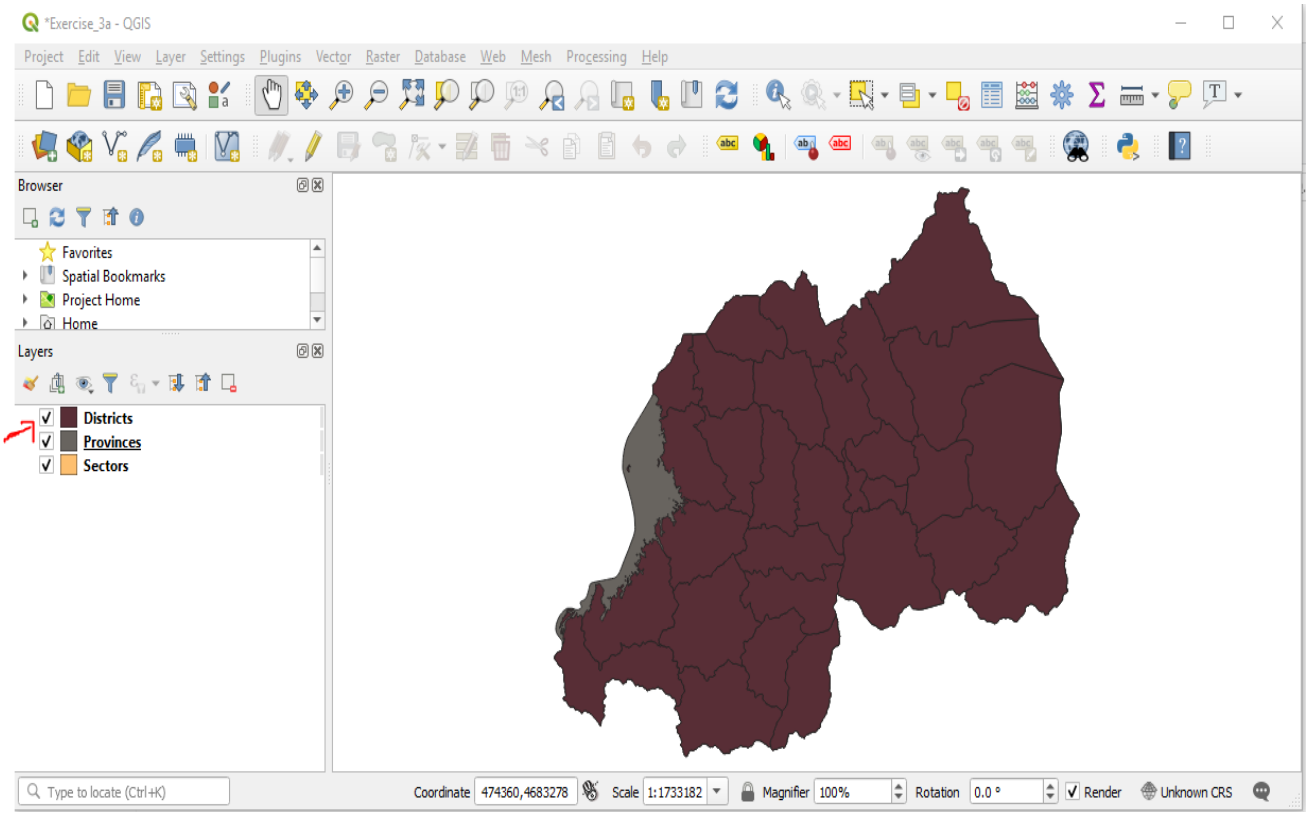
	FID_lakeki	ID	AREA	NOM	FID_Distri	NOMDISTR	PROV	AREA_KM_	DISTR_ID	DISTR_NAME	PERIMETER	POP_02
1	-1	0	0	NU...	0	BURERA	NORD	644.55938052000	404.00000000000	Burera	0	320759.0000000...
2	-1	0	0	NU...	1	KICUKIRO	VILLE DE KIGALI	166.70518362000	103.00000000000	Kicukiro	0	207819.0000000...
3	-1	0	0	NU...	2	KARONGI	OUEST	993.03223439000	301.00000000000	Karongi	0	278944.0000000...
4	-1	0	0	NU...	3	RUSIZI	OUEST	958.59222955000	306.00000000000	Rusizi	0	331950.0000000...
5	-1	0	0	NU...	4	NYABIHU	OUEST	531.49708992000	304.00000000000	Nyabihu	0	268367.0000000...
6	-1	0	0	NU...	5	RUBAVU	OUEST	388.33896550000	303.00000000000	Rubavu	0	292653.0000000...
7	-1	0	0	NU...	6	GAKENKE	NORD	704.06264008000	402.00000000000	Gakenke	0	322043.0000000...
8	-1	0	0	NU...	7	NGORORERO	OUEST	678.98573990000	305.00000000000	Ngororero	0	282249.0000000...
9	-1	0	0	NU...	8	NYARUGENGE	VILLE DE KIGALI	133.95005898000	101.00000000000	Nyarugenge	0	236990.0000000...
10	-1	0	0	NU...	9	KIREHE	EST	1184.85011427000	505.00000000000	Kirehe	0	229468.0000000...
11	-1	0	0	NU...	10	NGOMA	EST	867.74276243000	506.00000000000	Ngoma	0	235109.0000000...
12	-1	0	0	NU...	11	NYAMASHEKE	OUEST	1173.99304016000	307.00000000000	Nyamasheke	0	325032.0000000...
13	-1	0	0	NU...	12	HUYE	SUD	581.52703544000	204.00000000000	Huye	0	265446.0000000...
14	-1	0	0	NU...	13	GISAGARA	SUD	679.19689365000	202.00000000000	Gisagara	0	259434.0000000...
15	-1	0	0	NU...	14	RWAMAGANA	EST	681.96249340000	501.00000000000	Rwamagana	0	220502.0000000...
16	-1	0	0	NU...	15	KAYONZA	EST	1934.96353241000	504.00000000000	Kayonza	0	209723.0000000...

II.1.2 Reordering the Layers

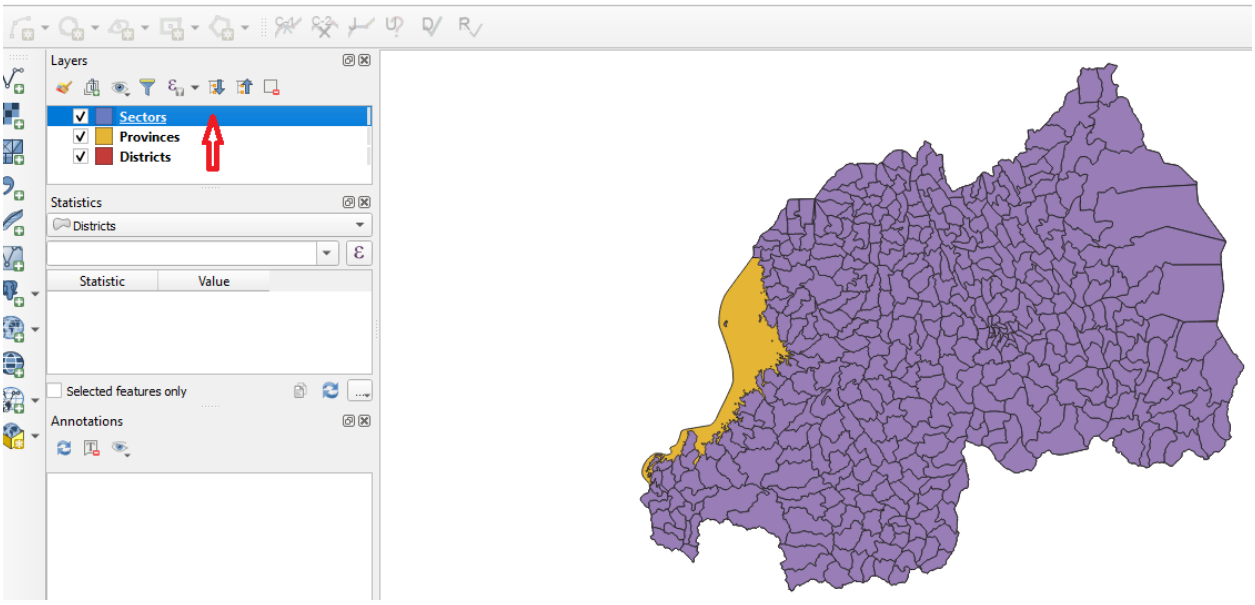
The layers in your Layers list are drawn on the map in a certain order. The layer at the bottom of the list is drawn first, and the layer at the top is drawn last.



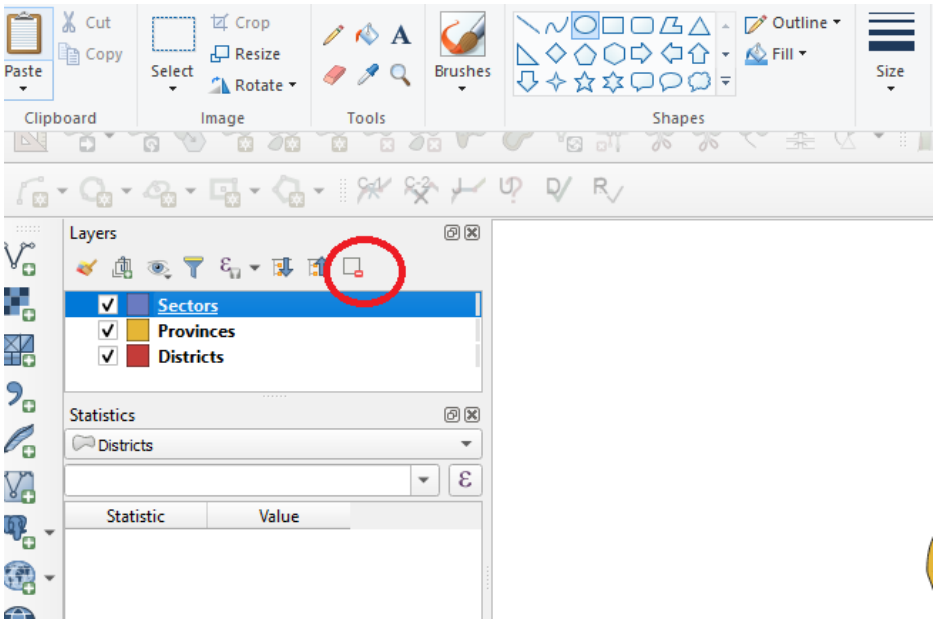
- **Click and drag on a layer** in the Layers list put **districts layer** on top of **provinces layer**.
- Reorder them to look like this:

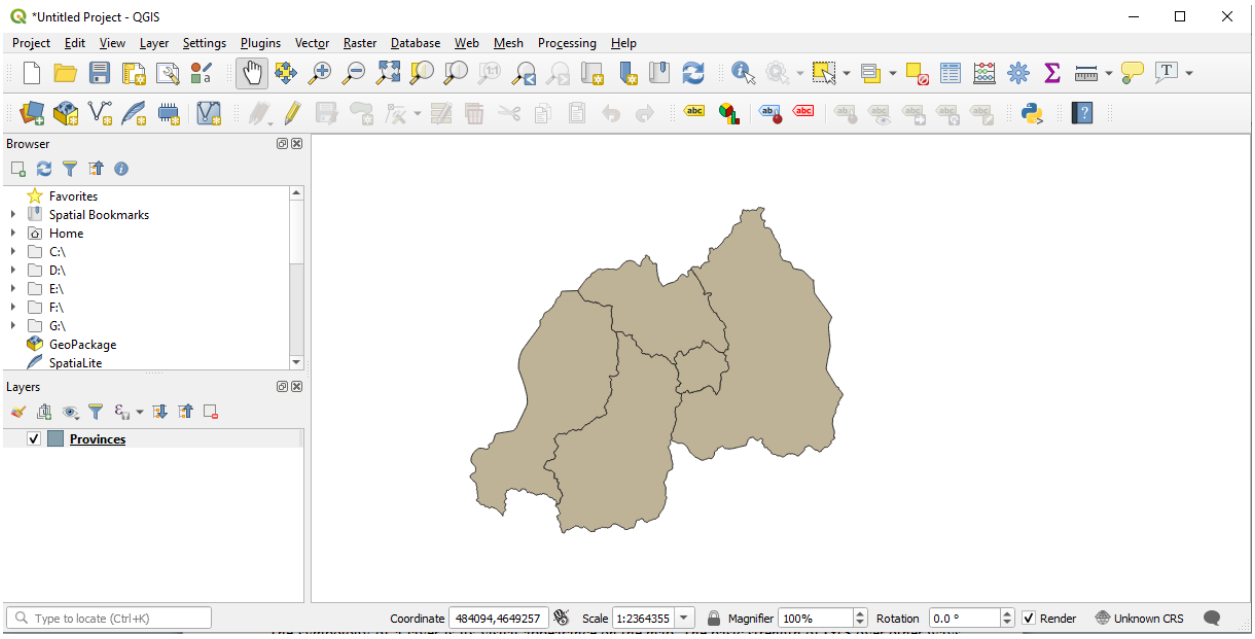


II.1.3 Removing the Layers



- **Select a layer** in the Layers list.
- Click on **Remove Layer icon**.





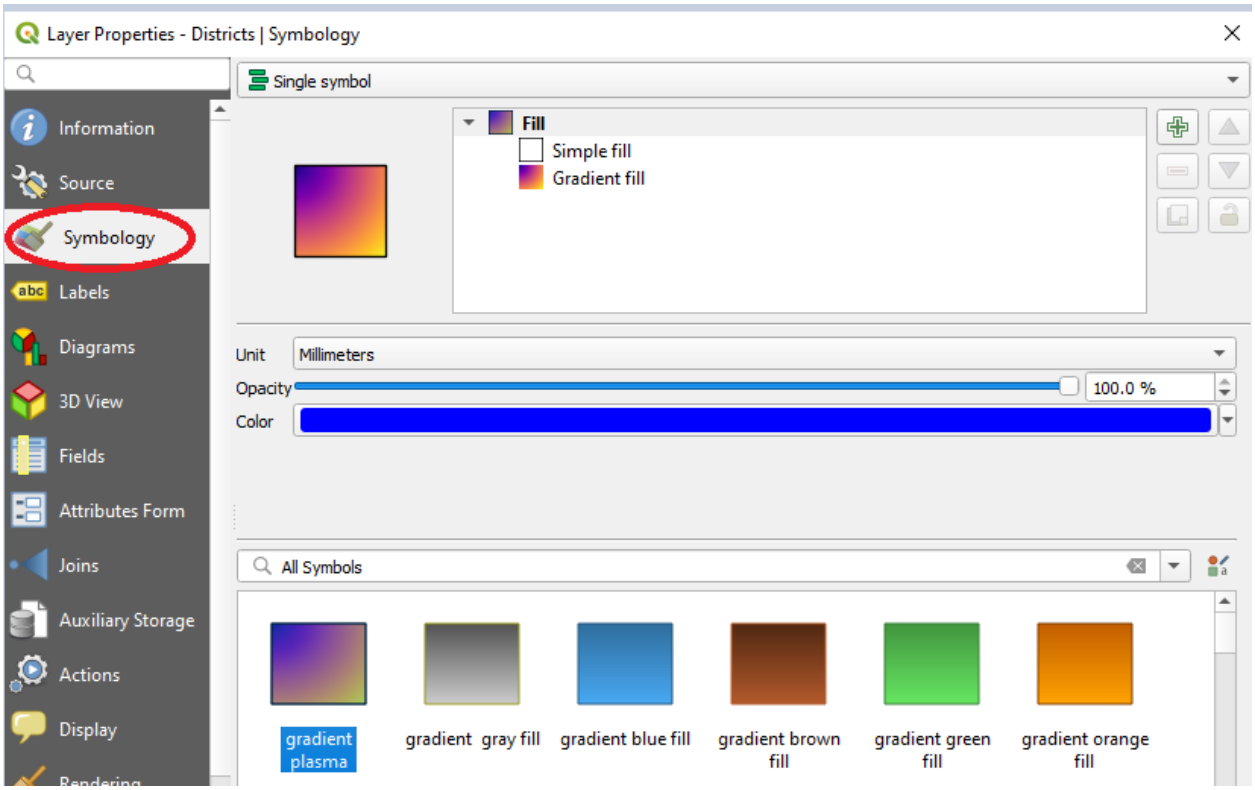
II.2 Symbology

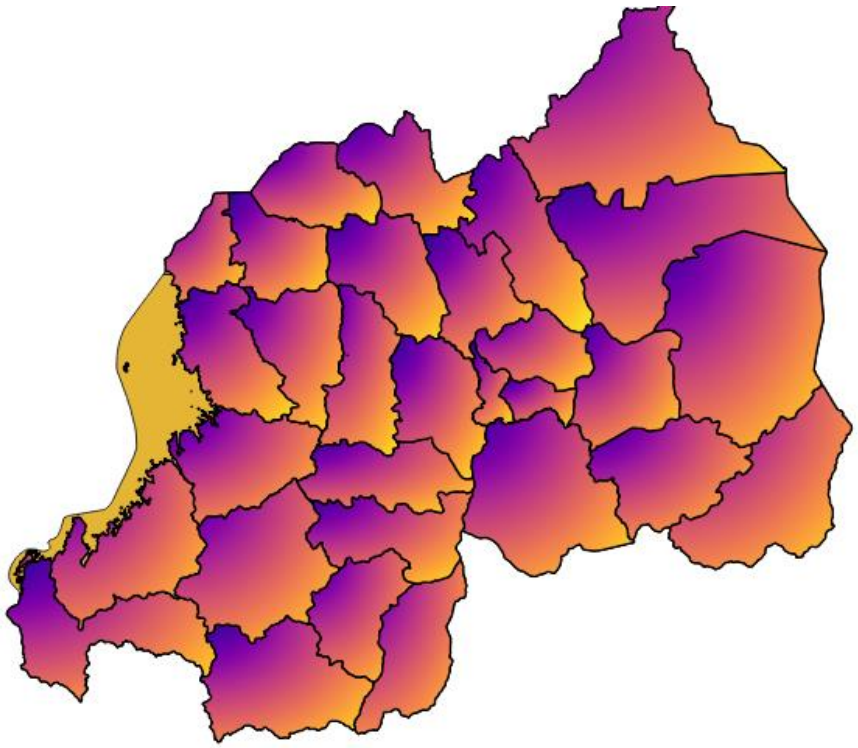
The symbology of a layer is its visual appearance on the map.

II.2.1 Changing Colors

To change a layer's color

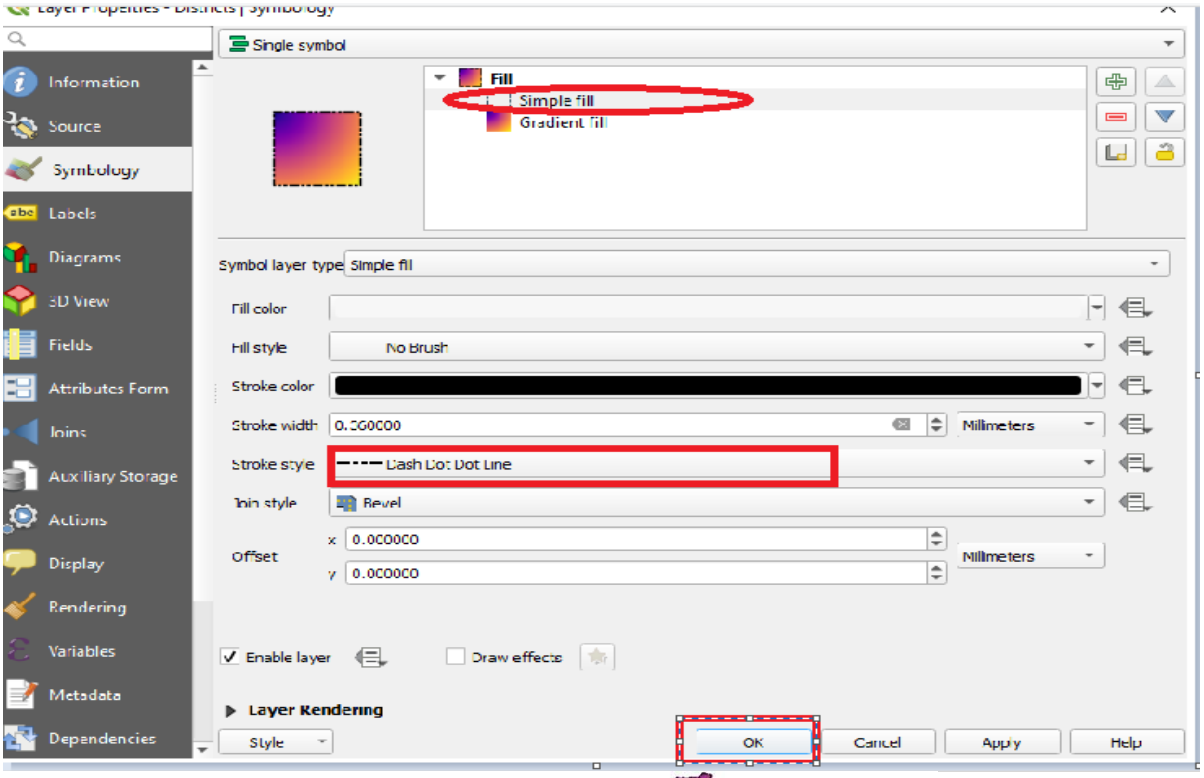
- Right-click on the **districts layer** in the layers list.
- Select the menu **item Properties** in the menu that appears.
- select the **Symbology**
- Click the **color** select button next to the Color label.
- Choose a color and click **OK**.

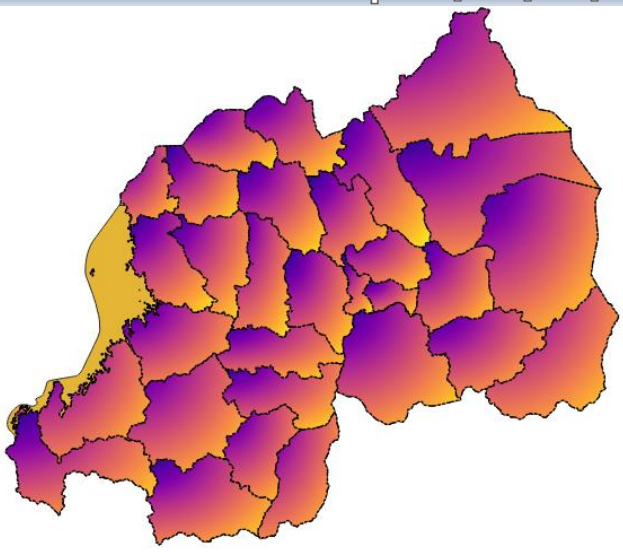

Layer Properties - Districts | Symbology
Information
Source
Symbology
Labels
Diagrams
3D View
Fields
Attributes Form
Joins
Auxiliary Storage
Actions
Display
Single symbol
Fill
Simple fill
Gradient fill
Unit
Millimeters
Opacity
100.0 %
Color
All Symbols
gradient plasma
gradient gray fill
gradient blue fill
gradient brown fill
gradient green fill
gradient orange fill



II.2.2 Changing Symbol Structure

- Open the **Layer Properties** window for the **districts** layer.
- Click **Symbology**
- Expand the **Fill dropdown** and select the **Simple fill** option.
- Click on the **Stroke style** dropdown. At the moment, it should be showing a **short line** and the **words Solid Line**.
- Change this to **dash dot dot line**
- Click **OK.**

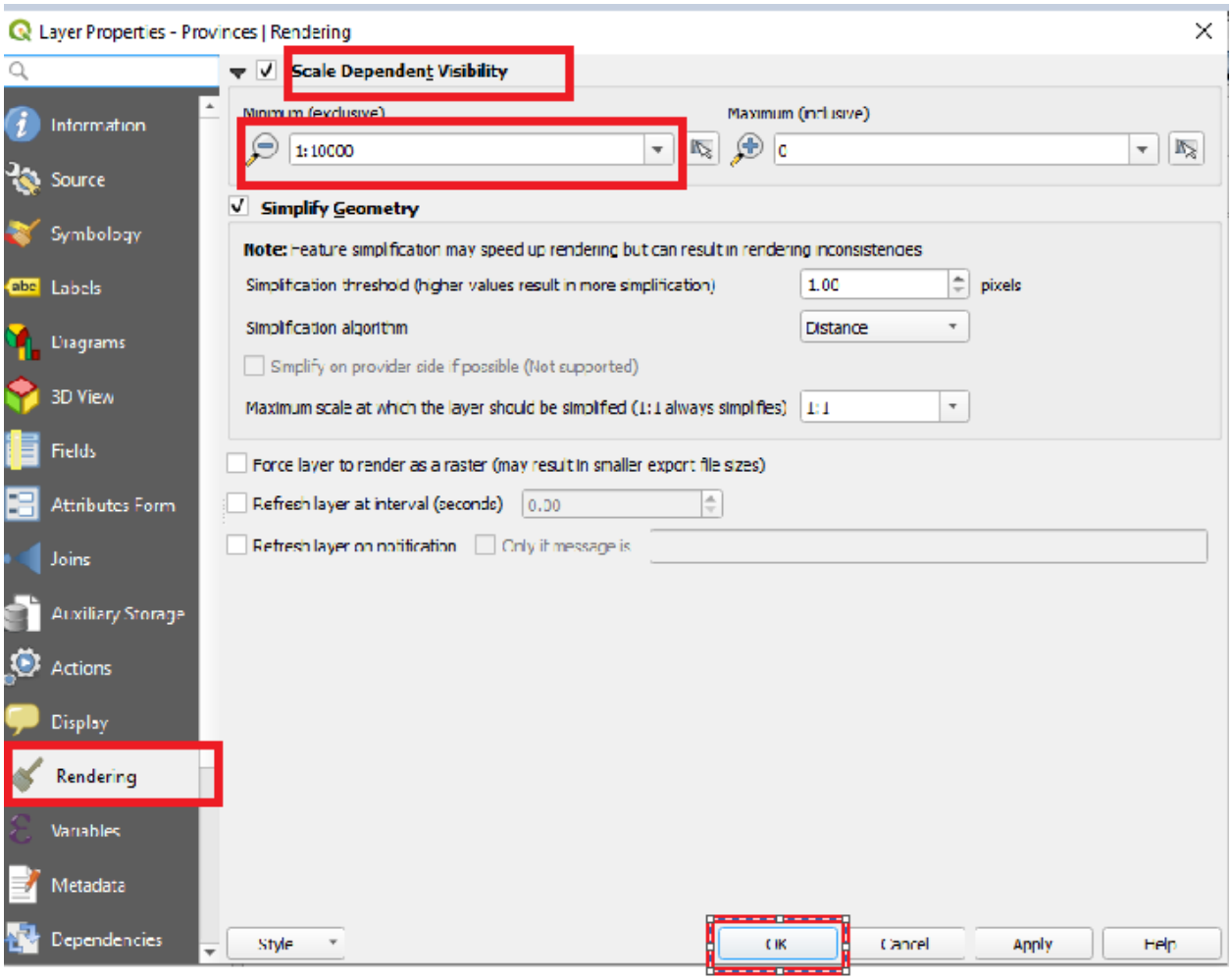


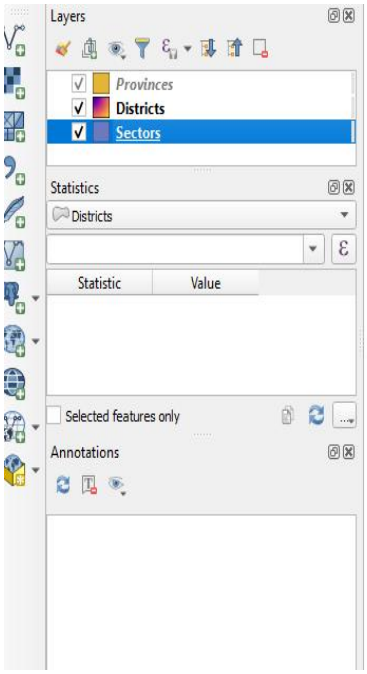


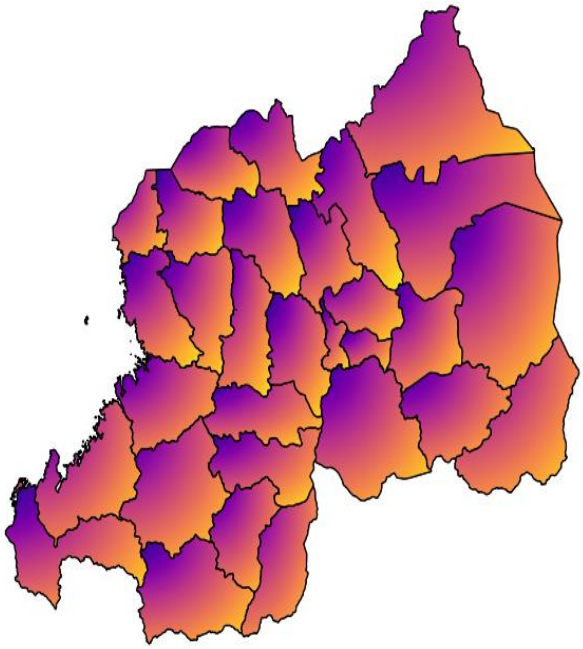
II.2.3 Scale-Based Visibility

Sometimes you will find that a layer is not suitable for a given scale. For example, a dataset of all the provinces may have low detail, and not be very accurate at sectors level
In our case, we may decide to hide the provinces from view at small scales.

- Open the **Layer Properties**
- Activate the **Rendering** tab.
- clicking on the checkbox labeled **Scale dependent visibility**:
- Change the **Minimum value to 1:10000**
- Click **ok**







III. Classifying Vector Data

Classifying vector data allows you to assign different symbols to features depending on their attributes. This allows someone who uses the map to easily see the attributes of various features.

III.1 Attribute Data

The whole strength of QGIS is that all the objects that are visible on the map also have attributes. Maps in a QGIS aren't just pictures. They represent not only objects in locations, but also information about those objects.

III.2 The Label Tool

Labels can be added to a map to show any information about an object..

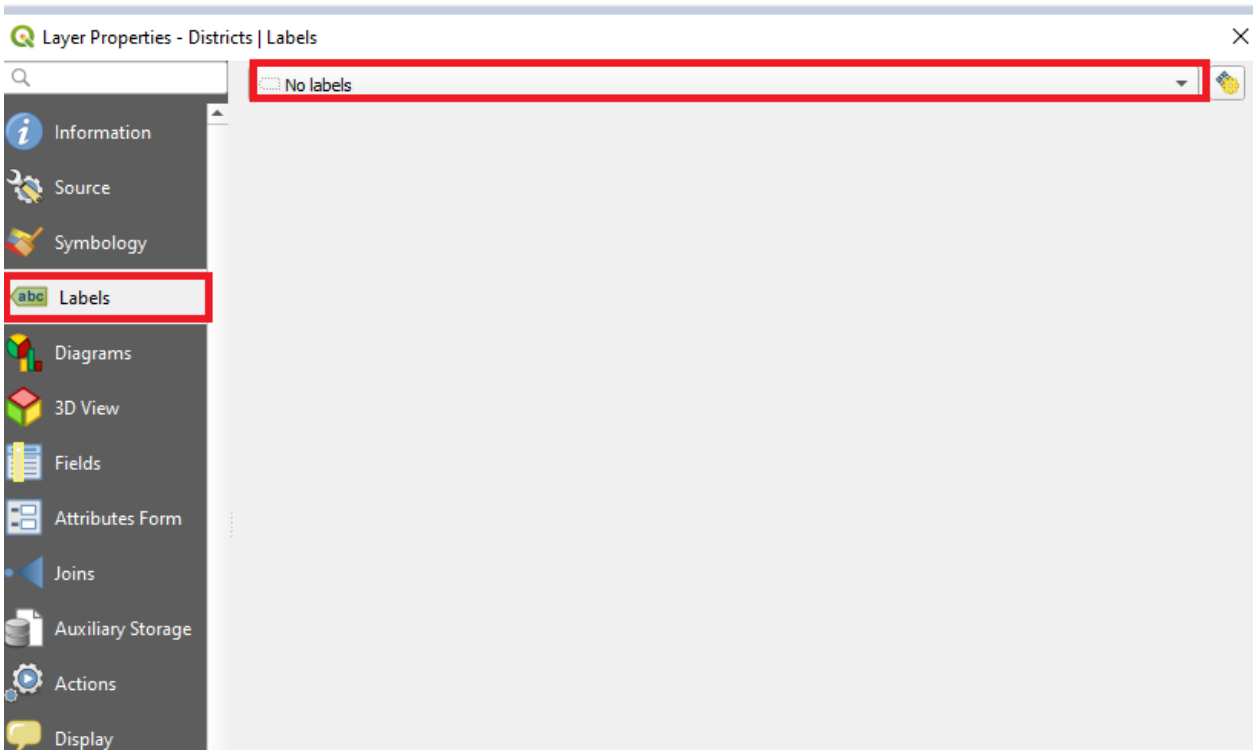
III.2.1 Using Labels

Before being able to access the Label tool, you will need to ensure that it has been activated.

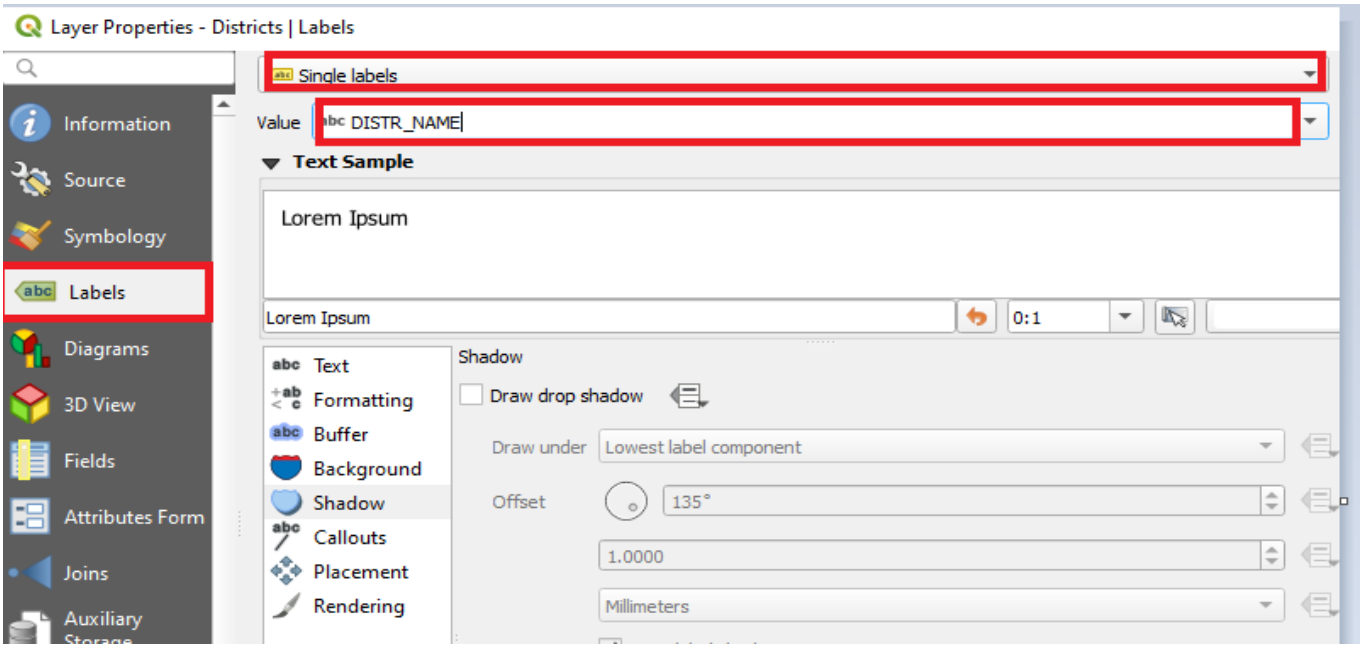
- Go to the menu item **View→ Toolbars**.
- Ensure that the Label item has a check mark next to it
- Click on the **districts layer** in the Layers panel
- Click on the following toolbar button: 

or rigth click **districts layer** then **properties** click 

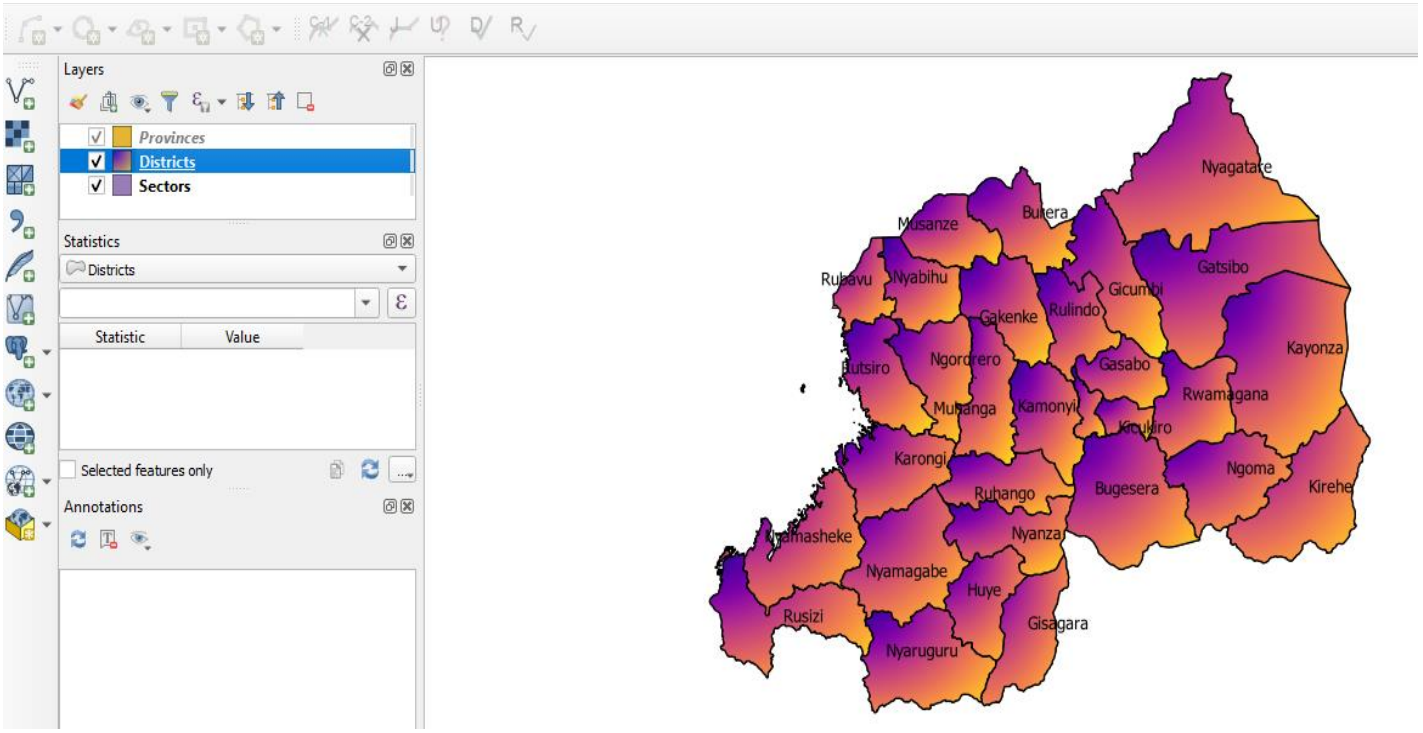
- Change **No labels** to **Single Labels**



- Click on **value**
- Select **DISTR_NAME** from the list

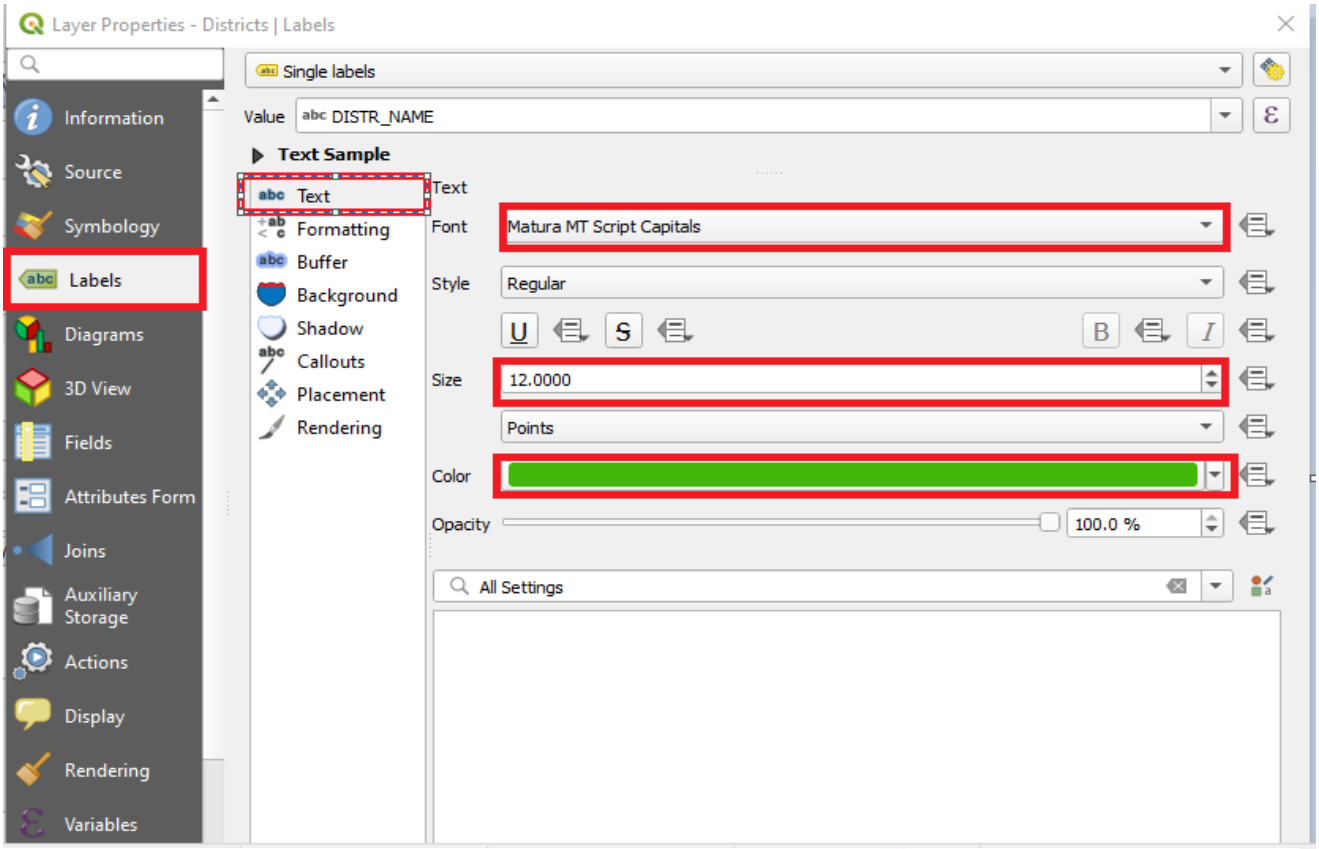


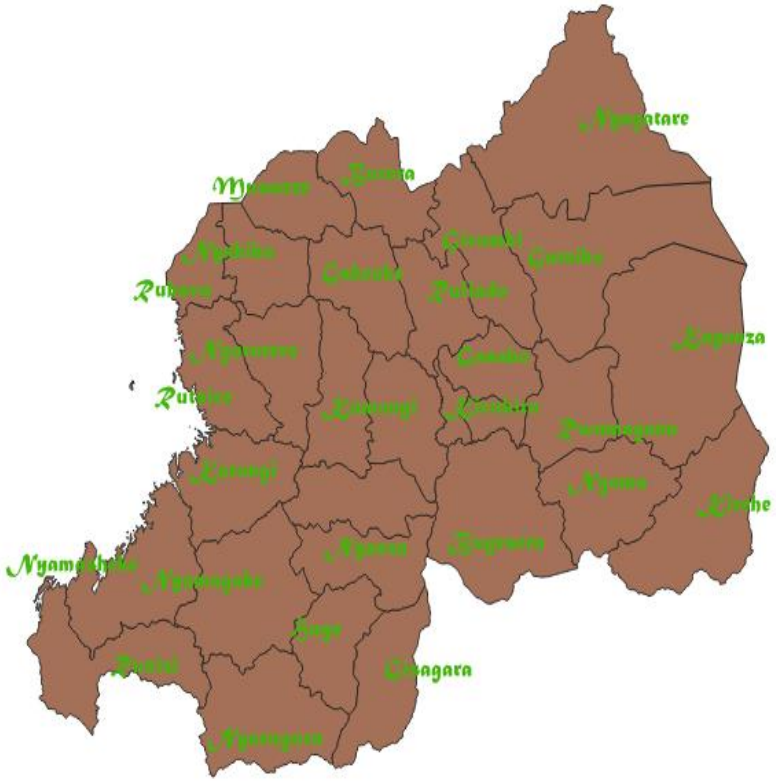
- Click **Apply** and then **ok**.



III.2.2 Changing Label Options

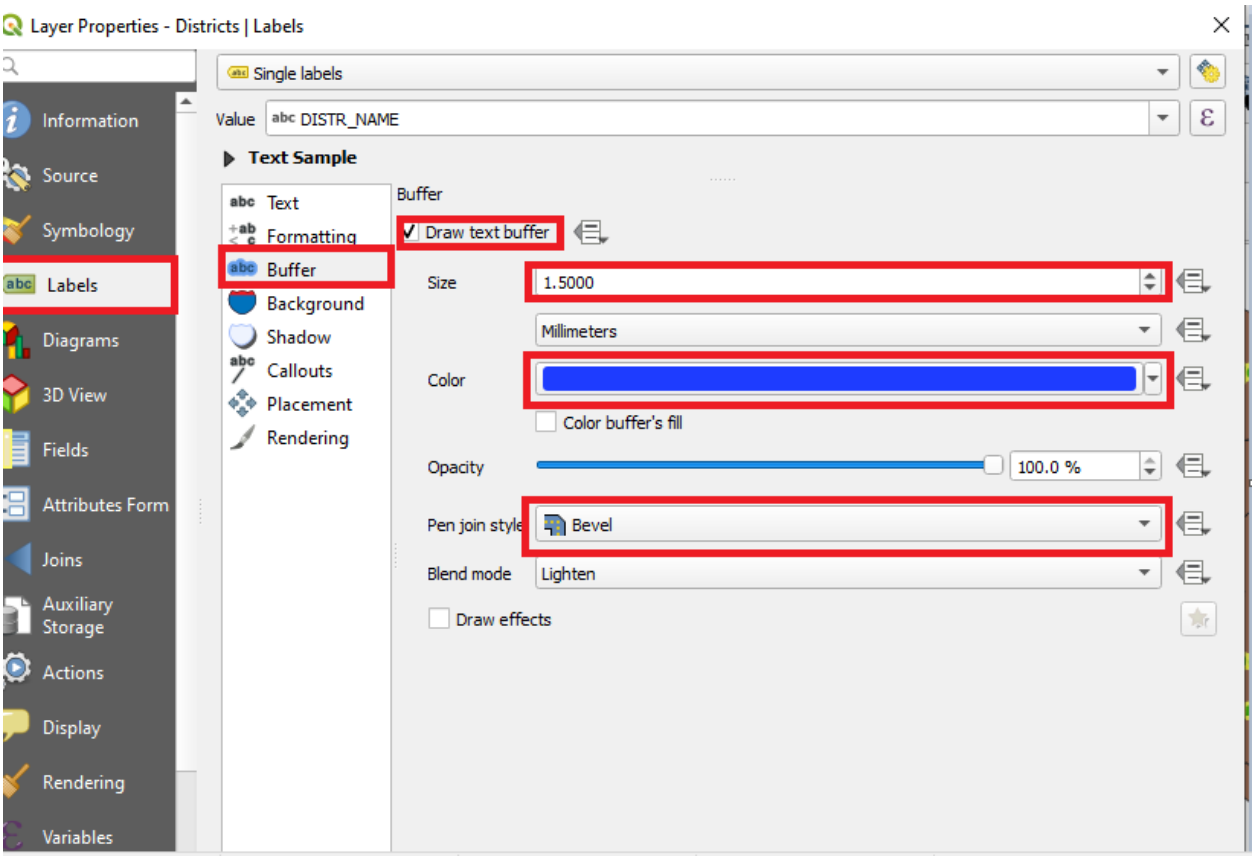
- **Rigth clicking on layer** you want to formatting
- Click on **properties** then **Click labels** .
- Make sure **Text** is selected in the left-hand options list, and then updates the text formatting

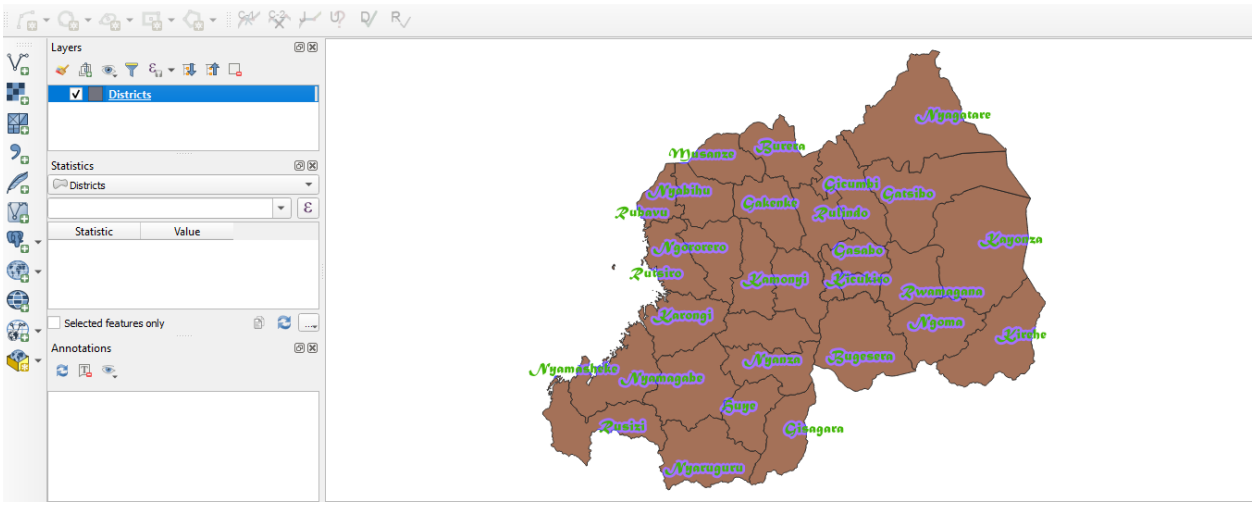

Layer Properties - Districts | Labels
Single labels
Value
DISTR_NAME
Text Sample
Information
Source
Symbology
Labels
Diagrams
3D View
Fields
Attributes Form
Joins
Auxiliary Storage
Actions
Display
Rendering
Variables
Text
Formatting
Buffer
Background
Shadow
Callouts
Placement
Rendering
Text
Font
Matura MT Script Capitals
Style
Regular
Size
12.0000
Points
Color
Opacity
100.0 %
All Settings



III.2.3 **The problem of the labels overlapping / the Buffer option.**

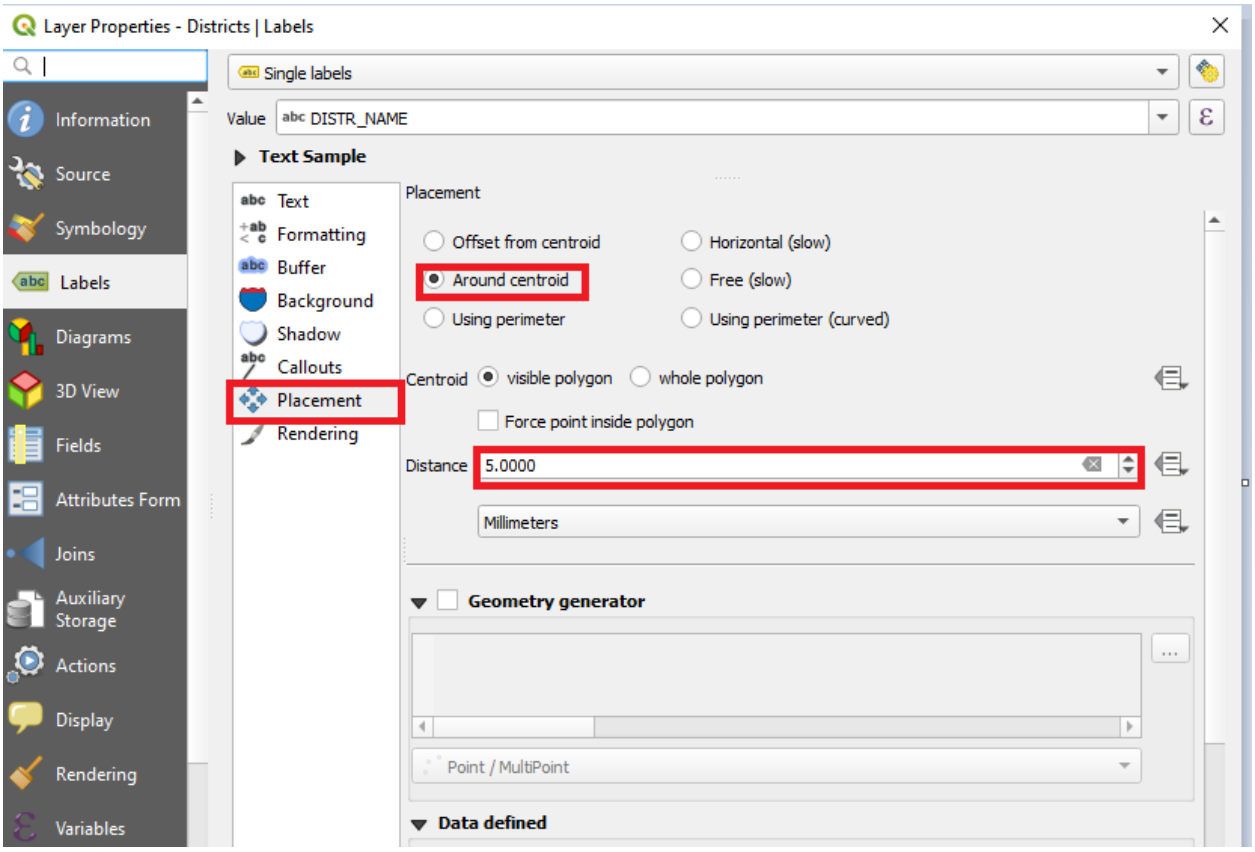
- Open the Label tool dialog.
- Select **Buffer** from the left-hand options list.
- Select the checkbox next to **Draw text buffer**, then choose options to match those shown here
- Click **Apply** then **Ok**

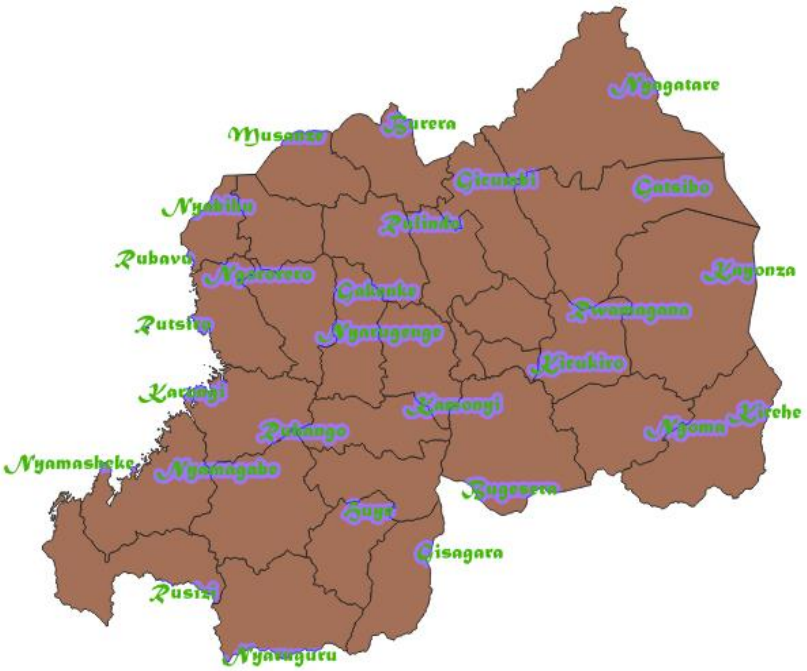




III.2.4 Address the positioning of the labels in relation to their point markers.

- In the **Label tool** dialog, go to the **Placement tab**.
- Change the value of **Distance to 5mm** and make sure that **around point** is selected
- **Click Apply** then **Ok**



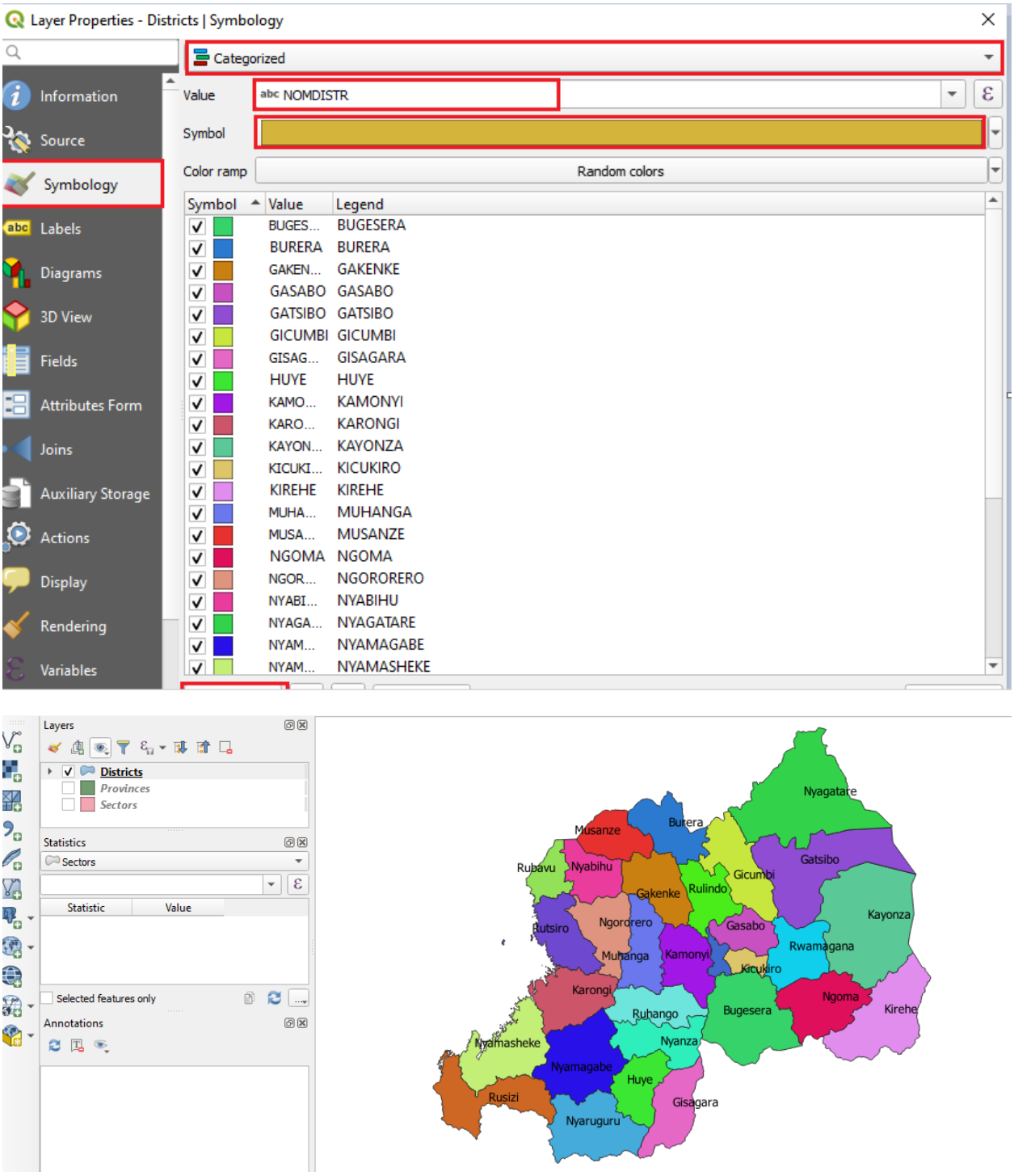


III.3 Classification

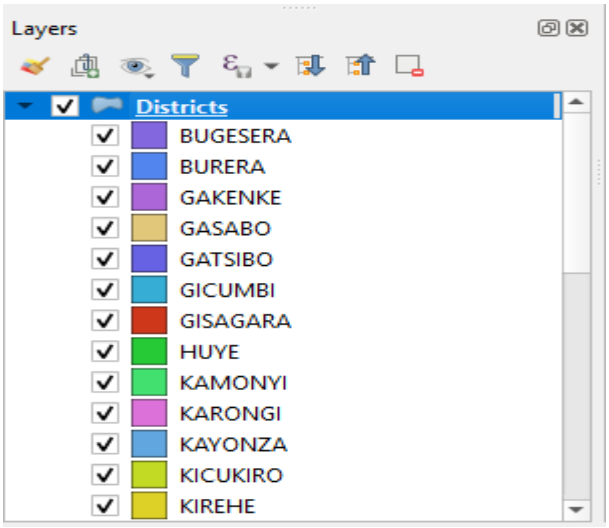
Labels are a good way to communicate information such as the names of individual places, but they can't be used for everything. For example, let's say that someone wants to know what each landuse area is used for.

III.3.1 Classifying Nominal Data

- **Uncheck sectors layer** then **select districts layer**
- Open the **Layer Properties** dialog.
- Go to the **Symbology tab**.
- Click on **Single Symbol** and change it to **Categorized**
- change the Column or value to **NOMDISTR** and the Color ramp to Random colors.
- Click on **Classify**
- Click **Apply** and Then **OK**.



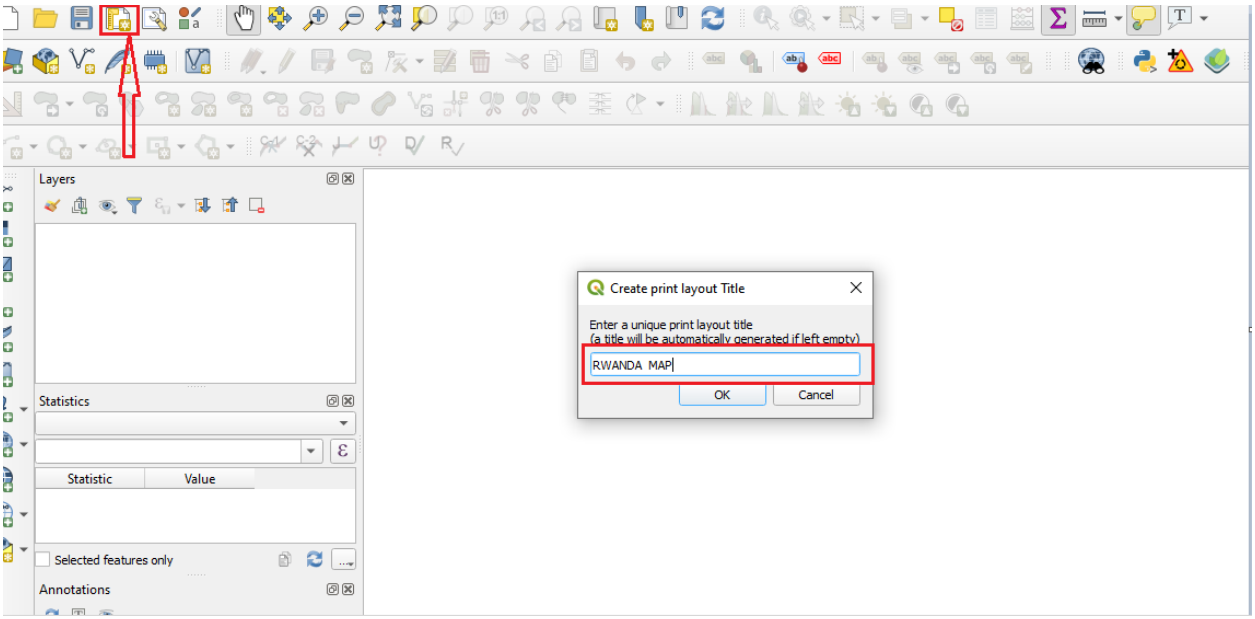
- Click the arrow before then districts layer in the Layer list, you'll see the categories explained:

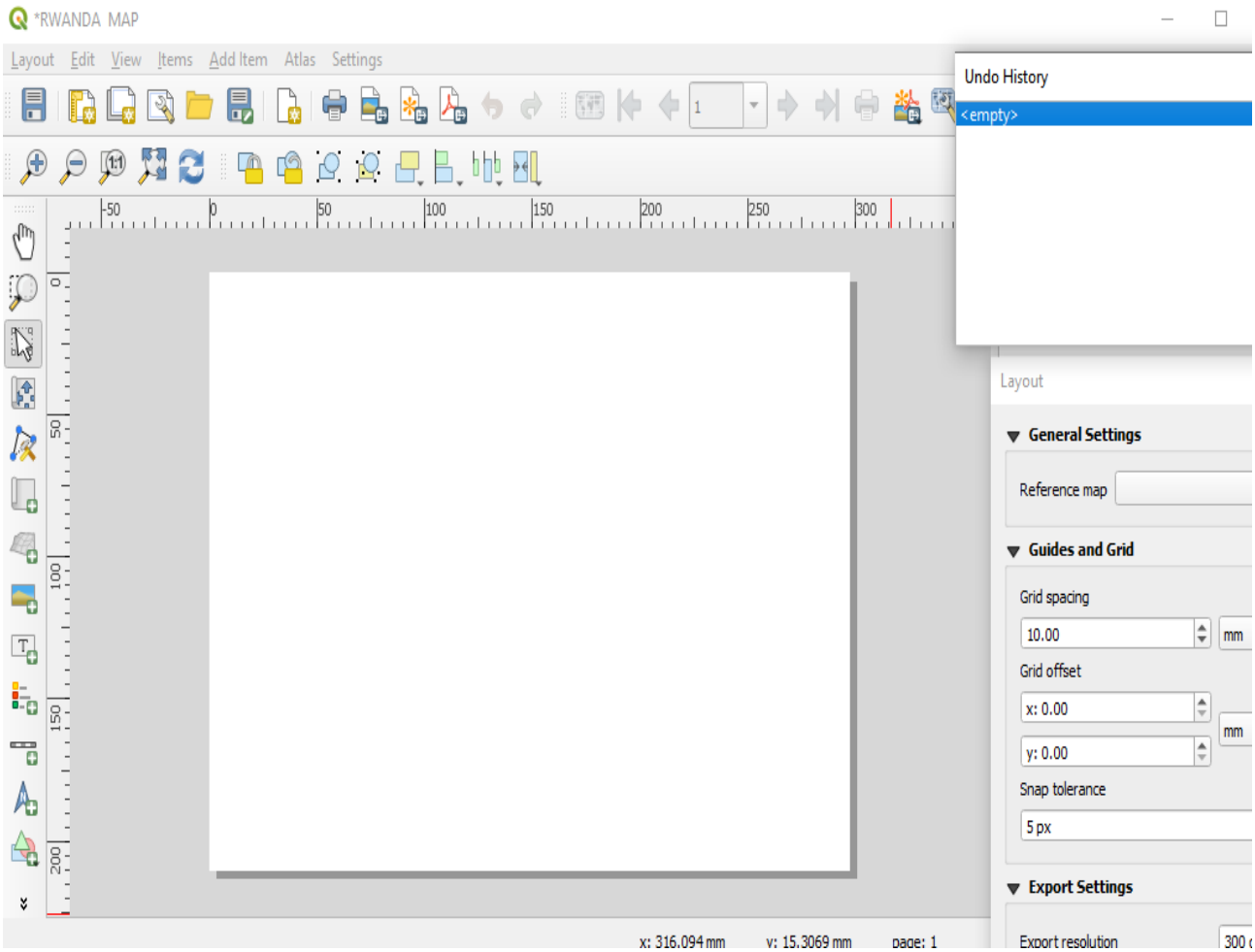


IV. CREATING MAPS

IV.1 Using Print Layout

- Click on the Project / New Print Layout.
- Add title.
- Click **OK**.

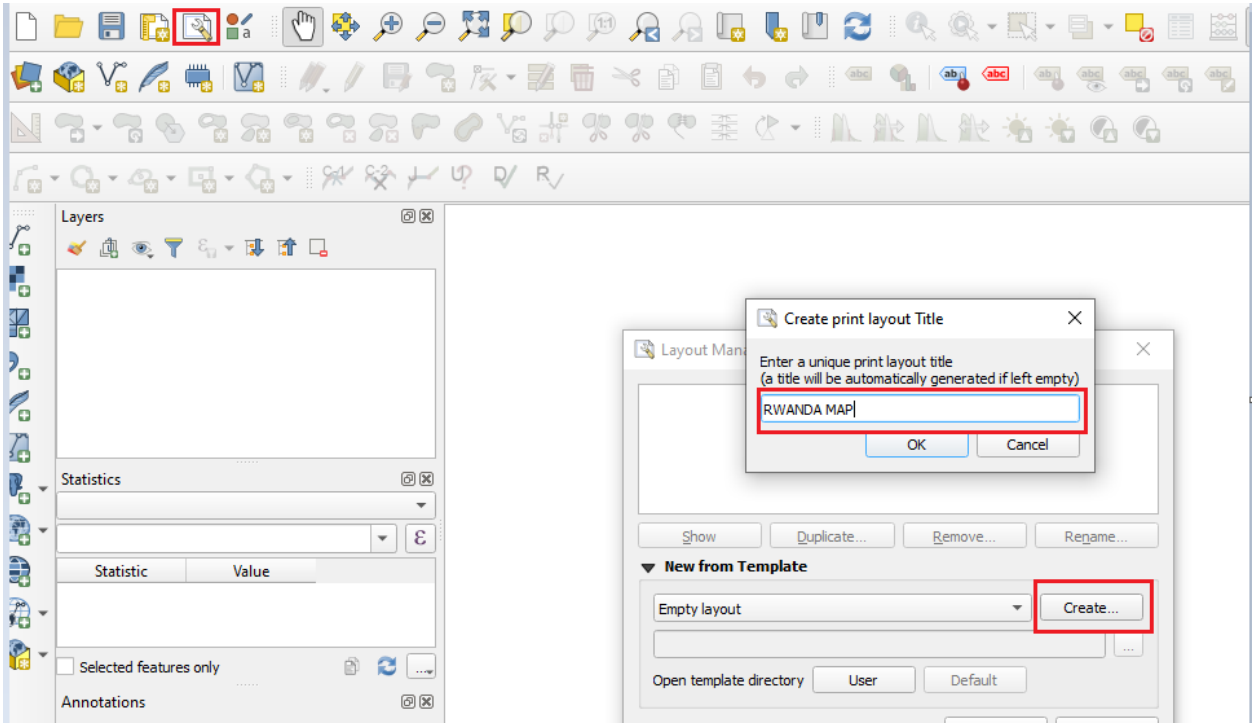


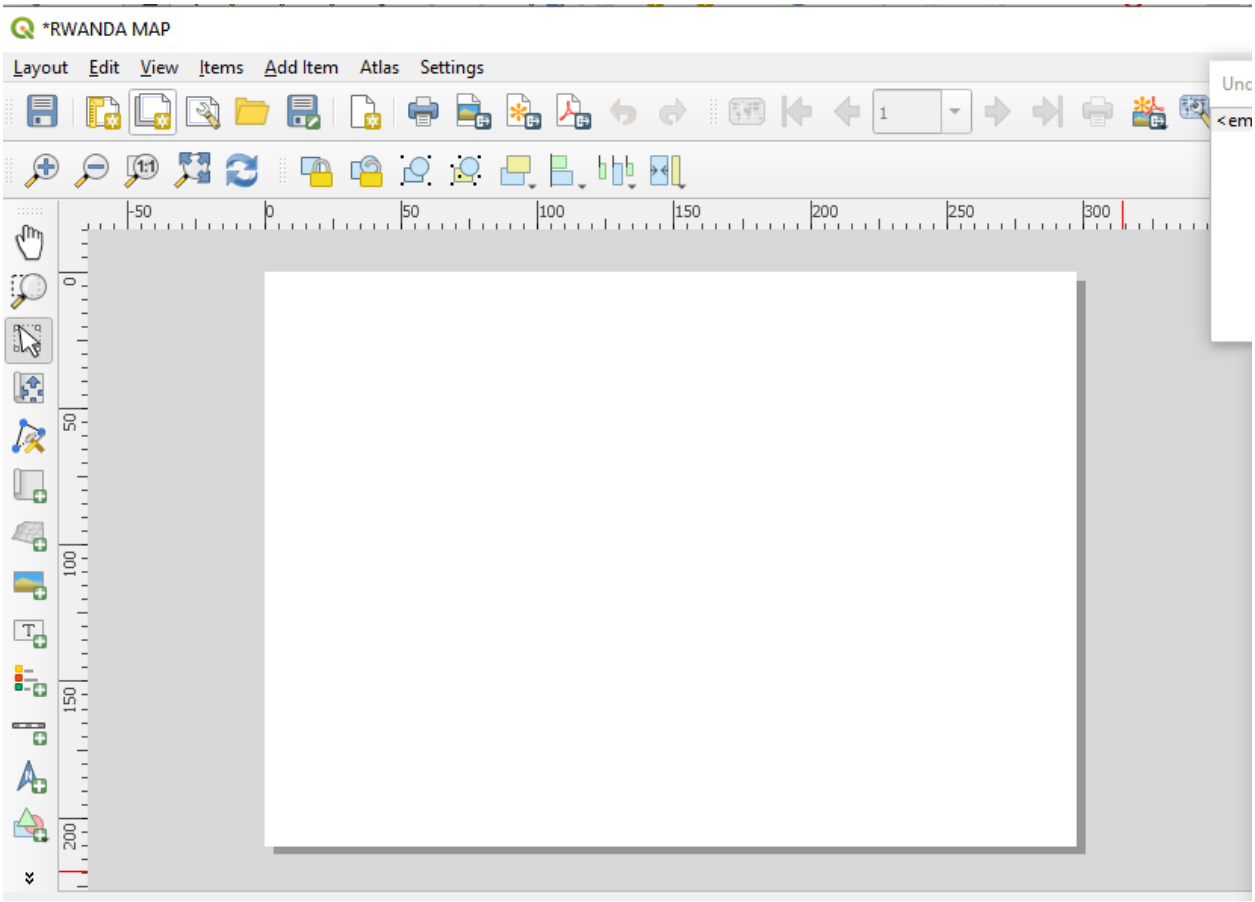

*RWANDA MAP
Layout Edit View Items Add Item Atlas Settings
Undo History
<empty>
Layout
General Settings
Reference map
Guides and Grid
Grid spacing
10.00
mm
Grid offset
x: 0.00
y: 0.00
mm
Snap tolerance
5 px
Export Settings
Export resolution
x: 316.094 mm
y: 15.3069 mm
page: 1

IV.1.1 The Layout Manager

QGIS allows you to create multiple maps using the same map file. For this reason, it has a tool called the **Layout Manager**.

- Click on the **Project / Layout Manager**
- Click the **Create button** and give the new layout the name.
- Give name and Click **OK.**

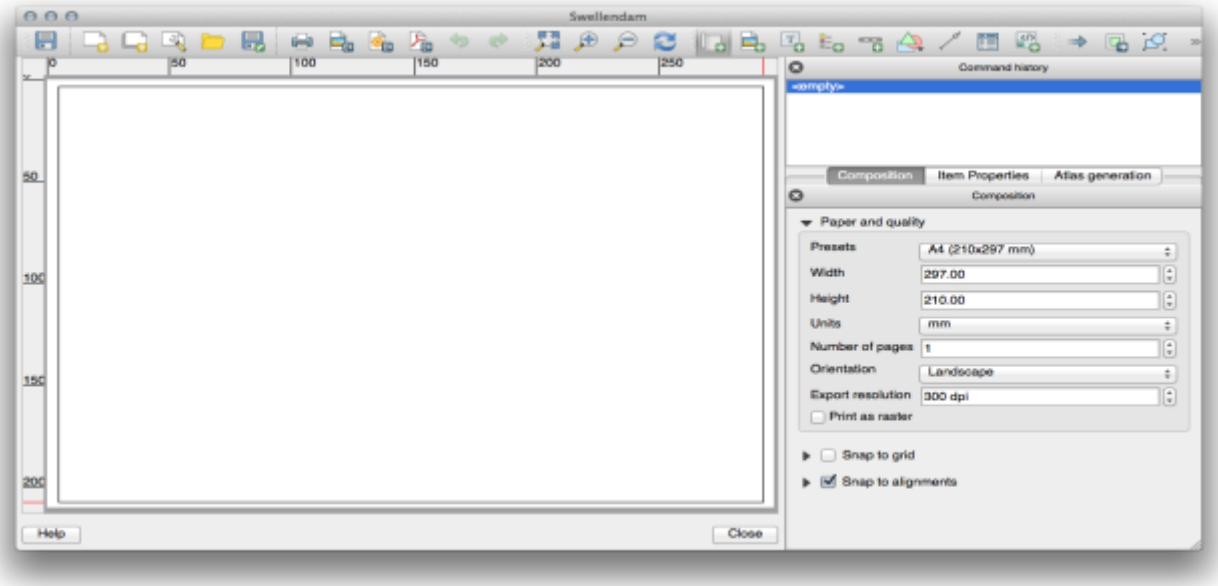




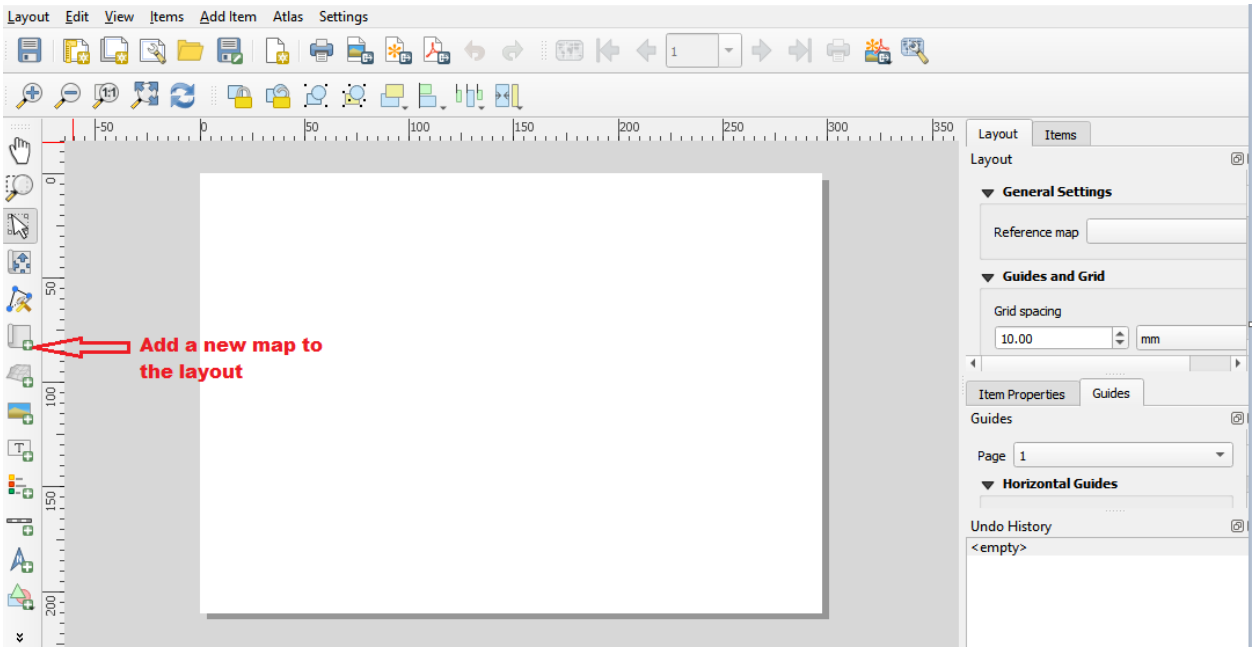
IV.1.2 Basic Map Composition

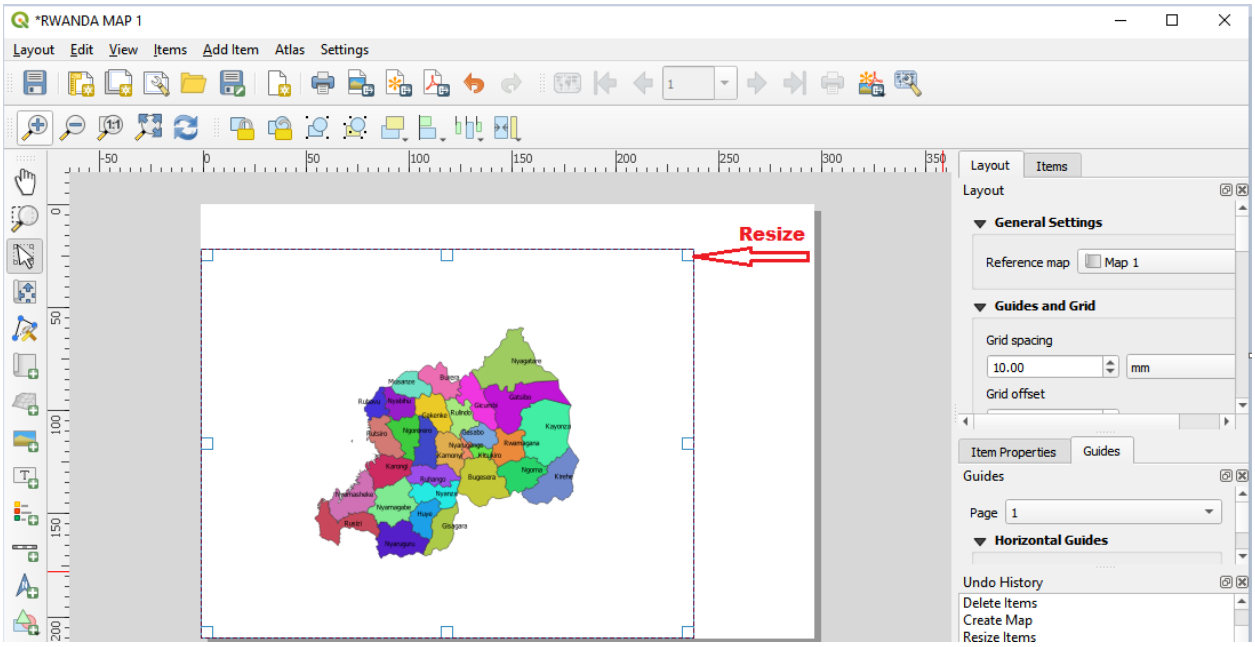
In the **Print Layout** window, check that the values under layout panel or **Composition ▸ Paper and Quality** are set to the following:

- **Size:** A4 (210x297mm)
- **Orientation:** Landscape
- **Quality:** 300dpi



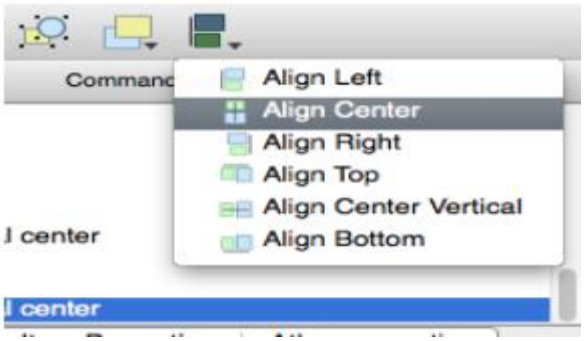
- Click on the **Add New Map** button: 
- **Click and drag a box** on the blank page:
- Move the map by **clicking and dragging it around**
- Resize it by clicking and dragging the boxes in the corners





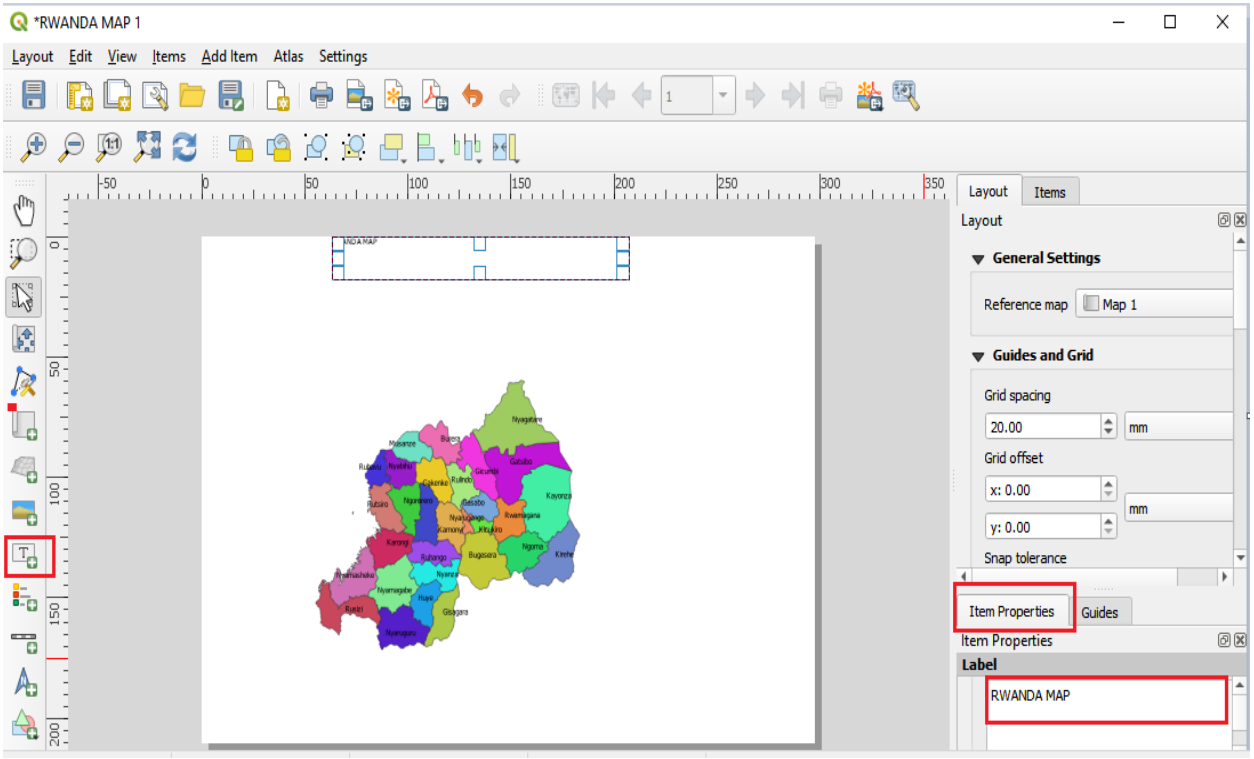
IV.1.3 Adding a Title

- Click on this button 
- Click on the page, above the map, and a label will appear at the top of the map.
- Resize it and place it in the top center of the page. It can be resized and moved in the same way that you resized and moved the map.
- Click the map to select it
- Hold in Shift on your keyboard and click on the label so that both the map and the label are selected.
- Look for the Align button  and click on the dropdown arrow next to it to reveal the positioning options and click Align center:



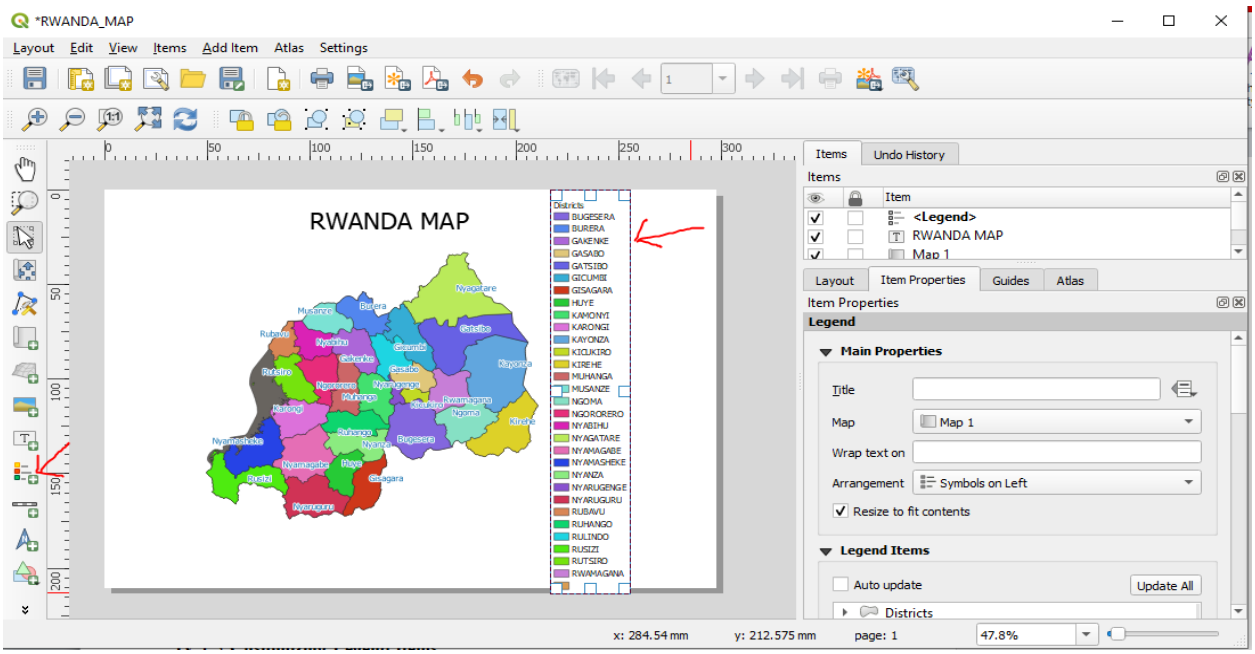
- Right-click on both the map and the label.
- Select the label by clicking on it.
- Click on the **Item Properties** tab in the side panel of the Layout window.

- Change the text of the **label** to "**RWANDA MAP":**
- Use this interface to set the **font and alignment** options



IV.1.4 Adding a Legend

- Click on this button: 
- Click on the page to place the legend, and move it to where you want it:

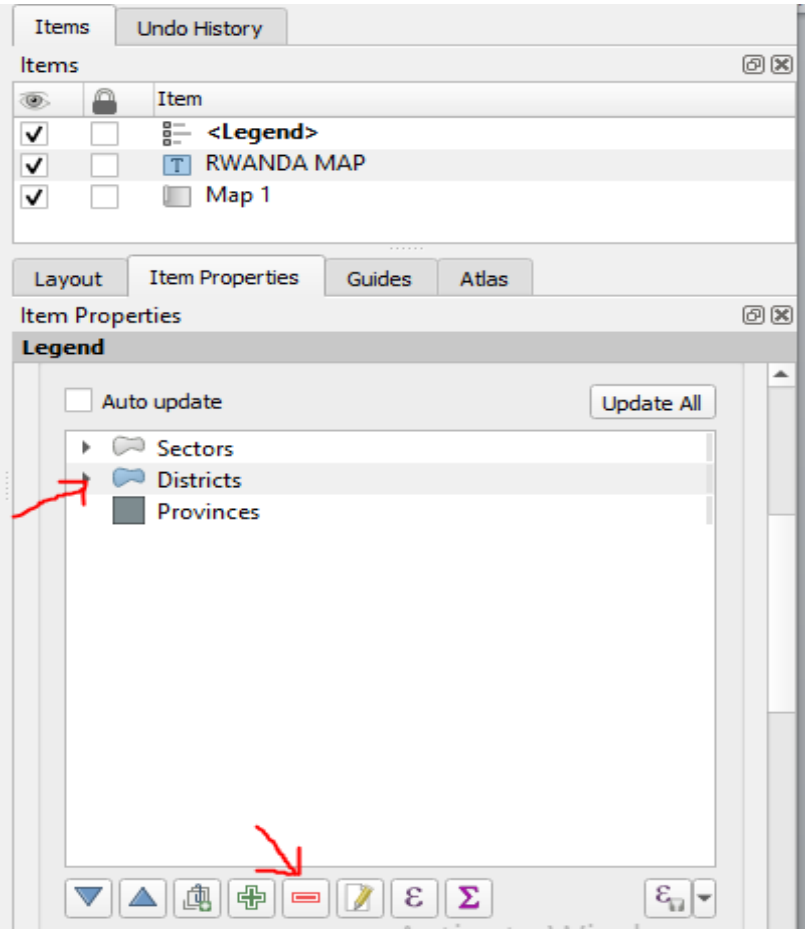


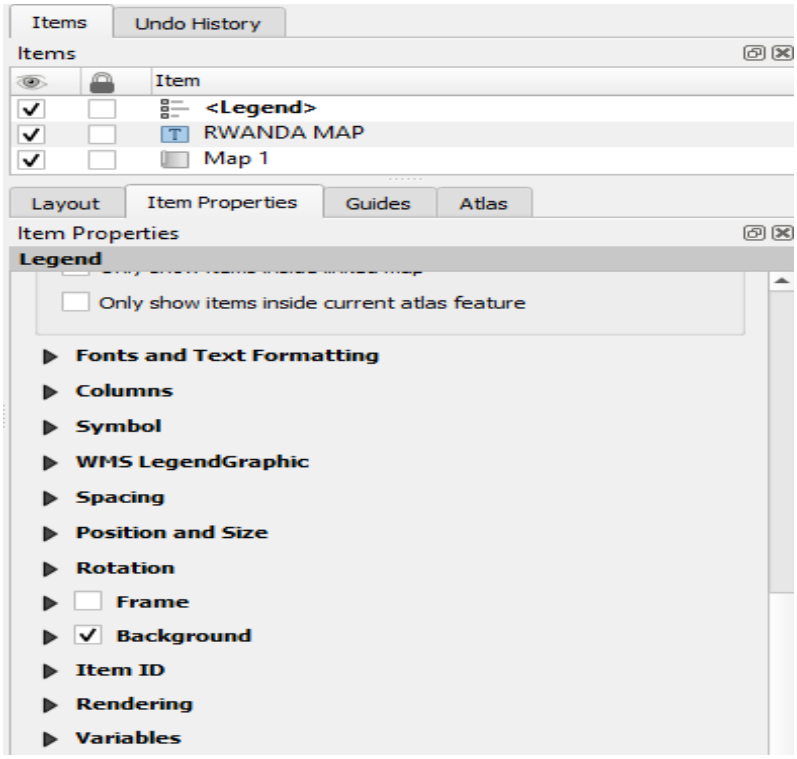
IV.1.5 Customizing Legend Items

- In the **Item Properties tab**, you'll find the **Legend items panel**.
- Select the provinces and districts entry.
- Delete them from the legend by **clicking the minus** button 

You can also rename items

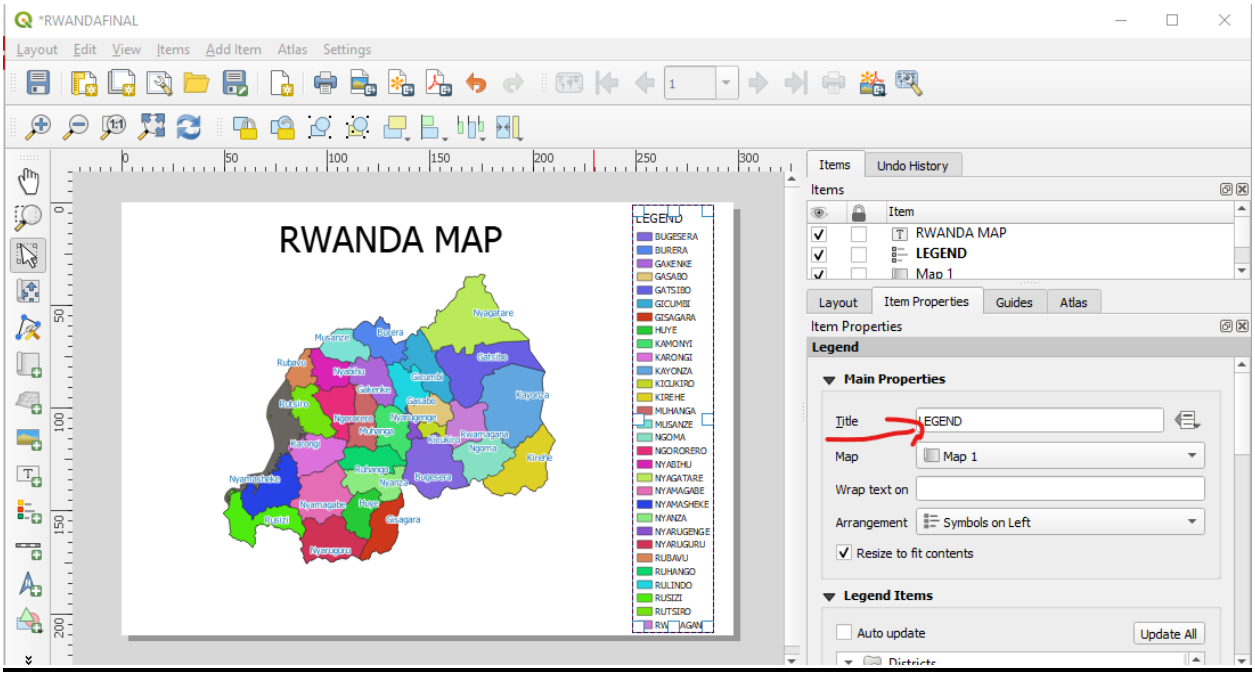
- Select a layer from the same list.
- Click the Edit button: 
- Rename the layers to sector, district province.
- Remove sector and provinces on the legend. You can also reorder the items and change other many font of legend on your map:



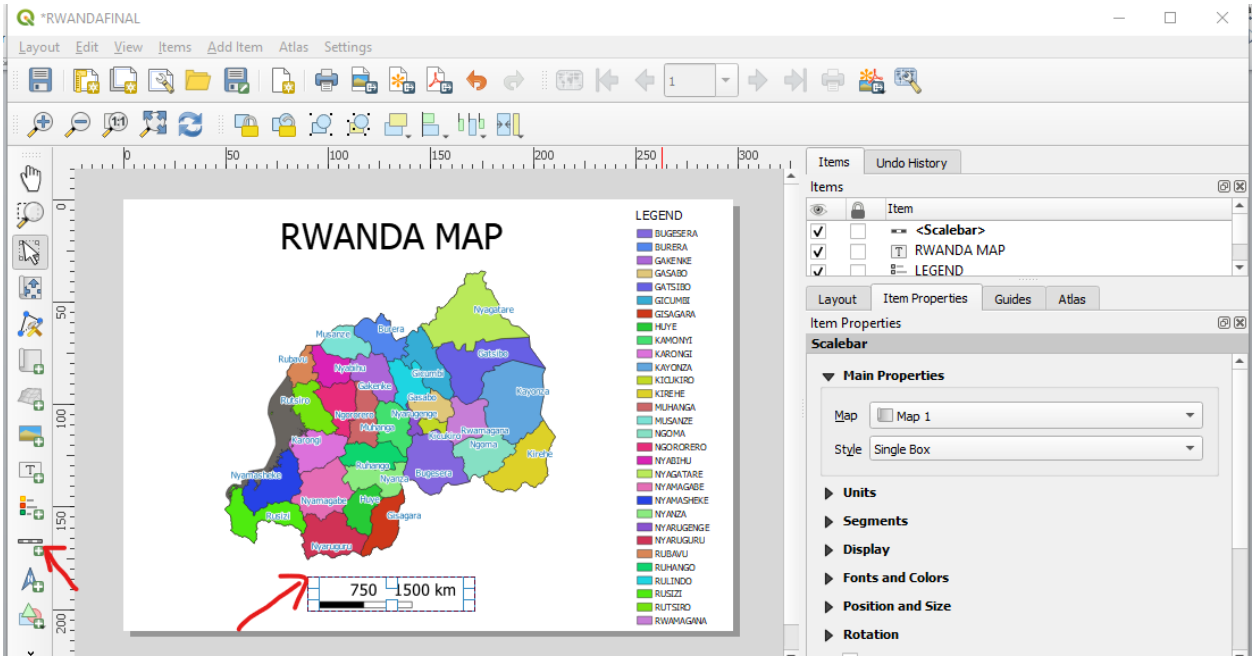


IV.1.5 Rename Legend

- In the **Item Properties tab**, you'll find the **Legend items panel**.
- Find **Title** type **name**.

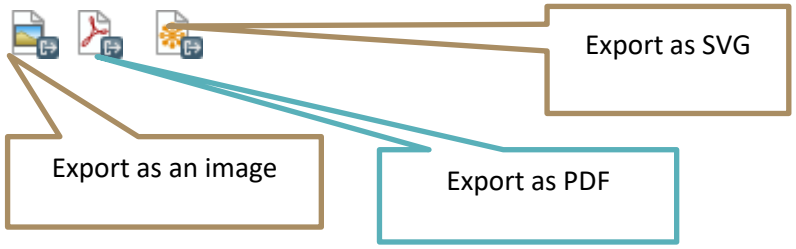


Add scale on map

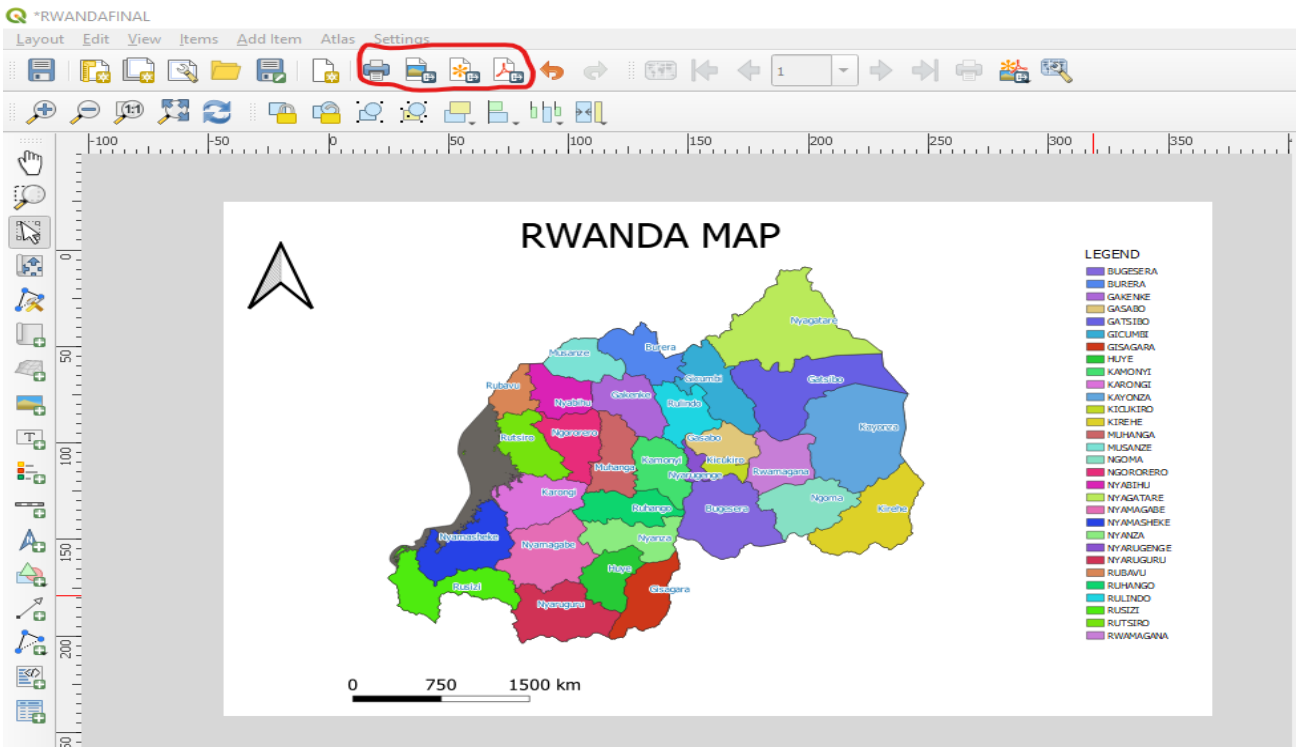


IV.1.6 Exporting Your Map

You'll see the export buttons near the top left corner of the **Layout** window:



These buttons allow you to export the map page to a file.



If you're sending the map to a cartographer (who may want to edit the map for publication), it's best to export as an SVG. SVG stands for "Scalable Vector Graphic"

If you need to send the map to a client, it's most common to use a PDF, because it's easier to set up printing options for a PDF.
For our purposes, we're going to use PDF.

- Click the **Export as PDF** button: 
- Choose a save location and a file name as usual.
- Click **Save**

V. Convert Excel file to .csv and load them in QGIS

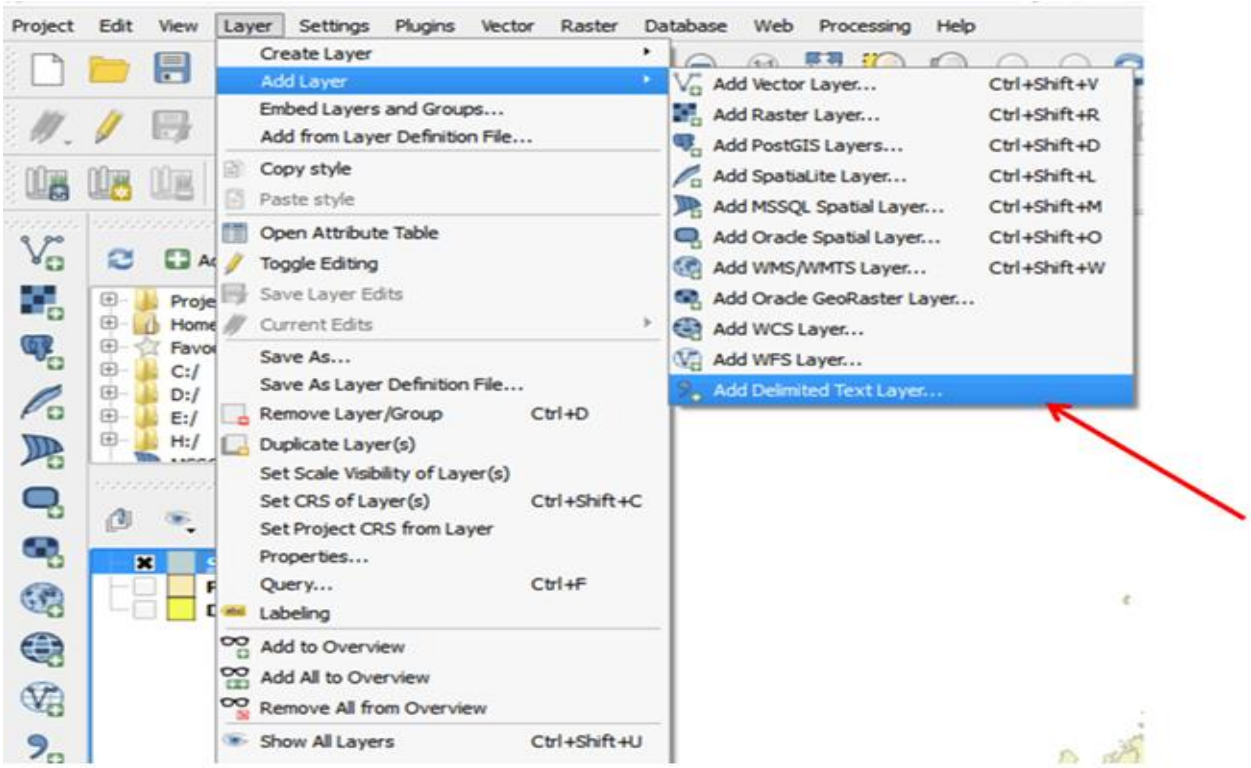
V.1 Convert excel file to CSV

- Browse to your **exercise data** folder.
- Open **ANC_HIV_2013_2014.xlsx**.
- Click on **File**
- Click on Save **As**. Save the new file as **District_EC3.csv**.
- Change the Save As type from Excel Workbook to CSV by clicking on the **down arrow** and selecting **CSV(Comma Delimited)**.
- Navigate to My Exercises\Data and save the file in the folder.

- Click **yes** on the next dialog box, which confirms you want to use the CSV format.
- Close the file and exit Excel.

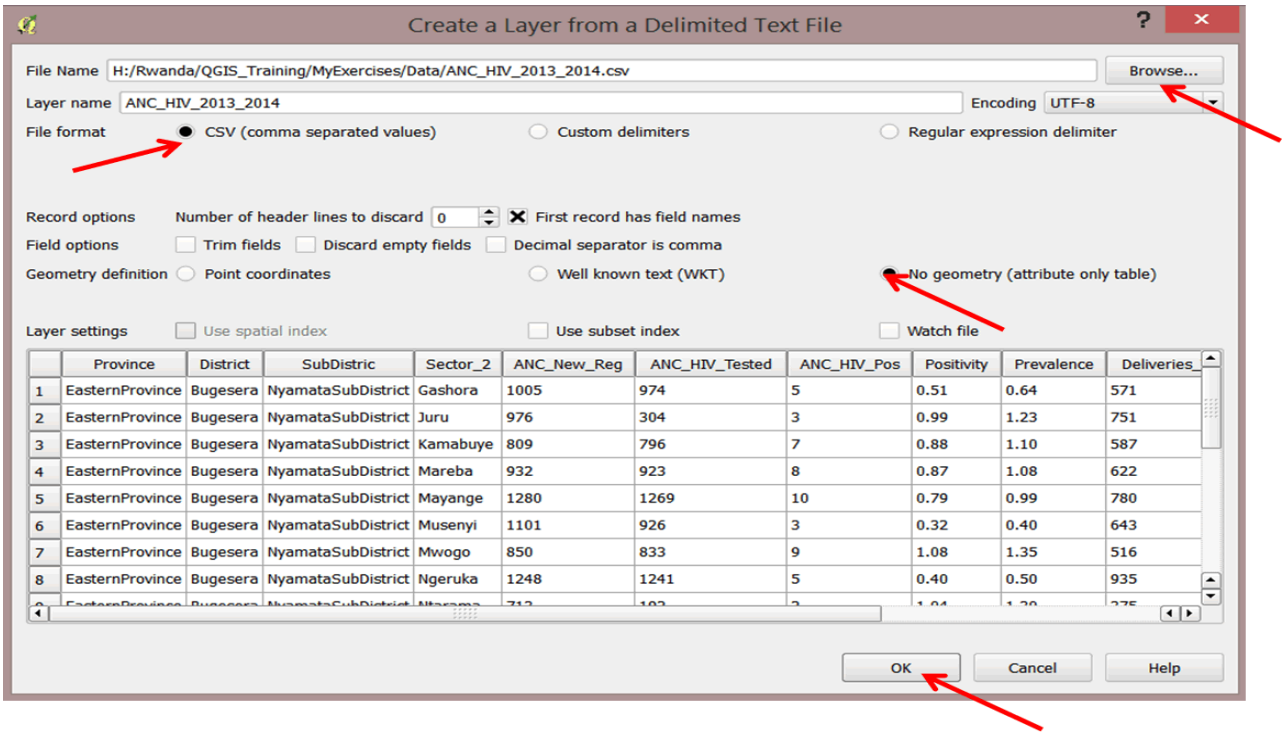
V.2 Load CSV files in QGIS

- Click on **Layer** on the main menu.
- Click on **Add Layer**
- Add Delimited Text Layer



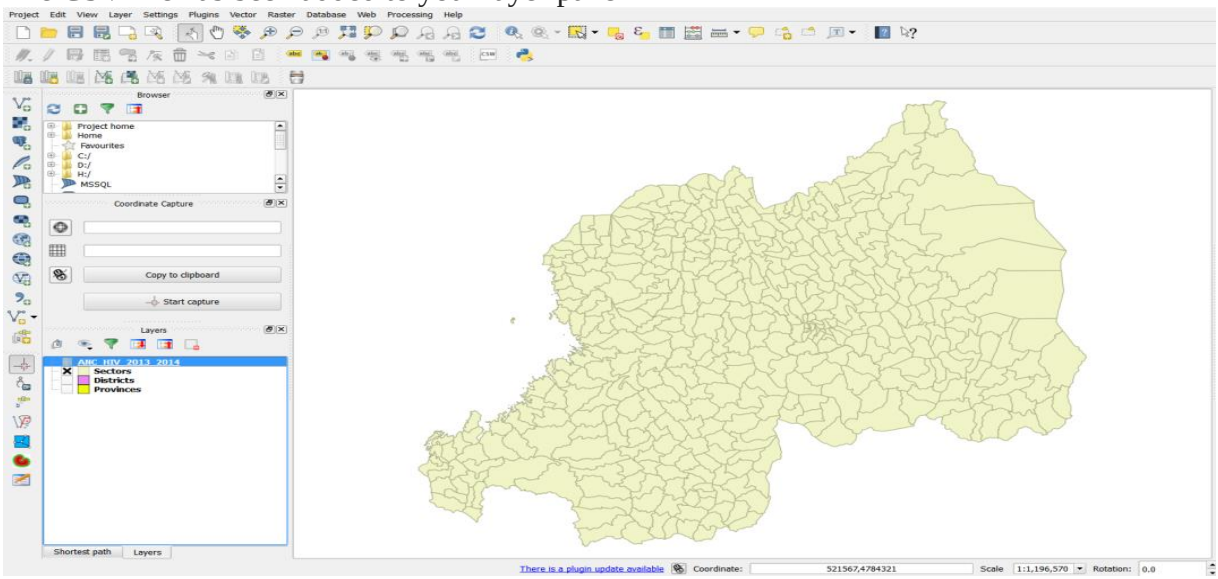
- Browse to MyExercises
- Select the CSV file you just saved: **District_EC3.csv**
- Select **CSV**
- No geometry (attribute only table).

- Click **Ok**.



	Province	District	SubDistric	Sector_2	ANC_New_Reg	ANC_HIV_Tested	ANC_HIV_Pos	Positivity	Prevalence	Deliveries_
1	EasternProvince	Bugesera	NyamataSubDistrict	Gashora	1005	974	5	0.51	0.64	571
2	EasternProvince	Bugesera	NyamataSubDistrict	Juru	976	304	3	0.99	1.23	751
3	EasternProvince	Bugesera	NyamataSubDistrict	Kamabuye	809	796	7	0.88	1.10	587
4	EasternProvince	Bugesera	NyamataSubDistrict	Mareba	932	923	8	0.87	1.08	622
5	EasternProvince	Bugesera	NyamataSubDistrict	Mayange	1280	1269	10	0.79	0.99	780
6	EasternProvince	Bugesera	NyamataSubDistrict	Musenyi	1101	926	3	0.32	0.40	643
7	EasternProvince	Bugesera	NyamataSubDistrict	Mwogo	850	833	9	1.08	1.35	516
8	EasternProvince	Bugesera	NyamataSubDistrict	Ngeruka	1248	1241	5	0.40	0.50	935

- The CSV file has been added to your layer panel



- Right-click **ANC_HIV_2013** and open the attribute table to familiarize you with the data.
- Close the attribute table.

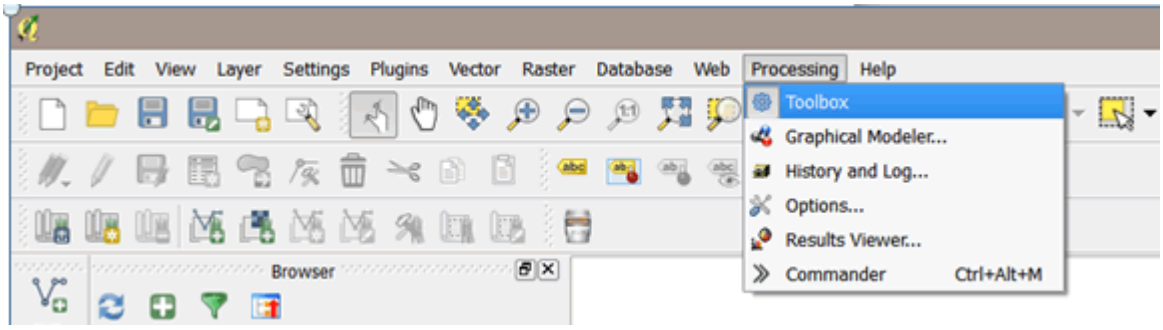
V.3 Link non-geographic data with geographic data

In order to map the data, we must link it to the Eastern Cape district boundaries. We will use the advanced table tools in QGIS to join these data; this is often referred to as 'a **join**'. Once we complete the join, we can save resulting output as a new shapefile.

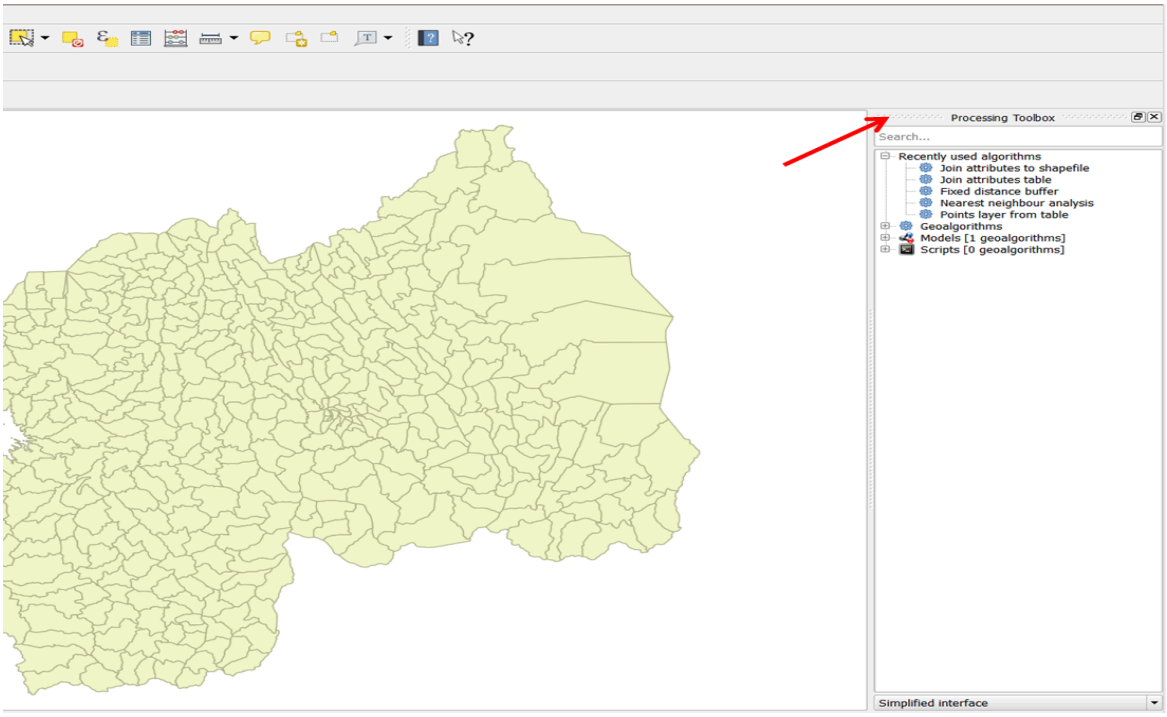
V.3.1 Load QGIS Processing Toolbox

The QGIS Processing Toolbox is used to run various algorithms for different purposes. The table tools can be found in the Processing Toolbox. We will access the tools and run the Join Attribute Tables algorithm.

Step 1: On the main menu, select **Processing** > **Toolbox**.

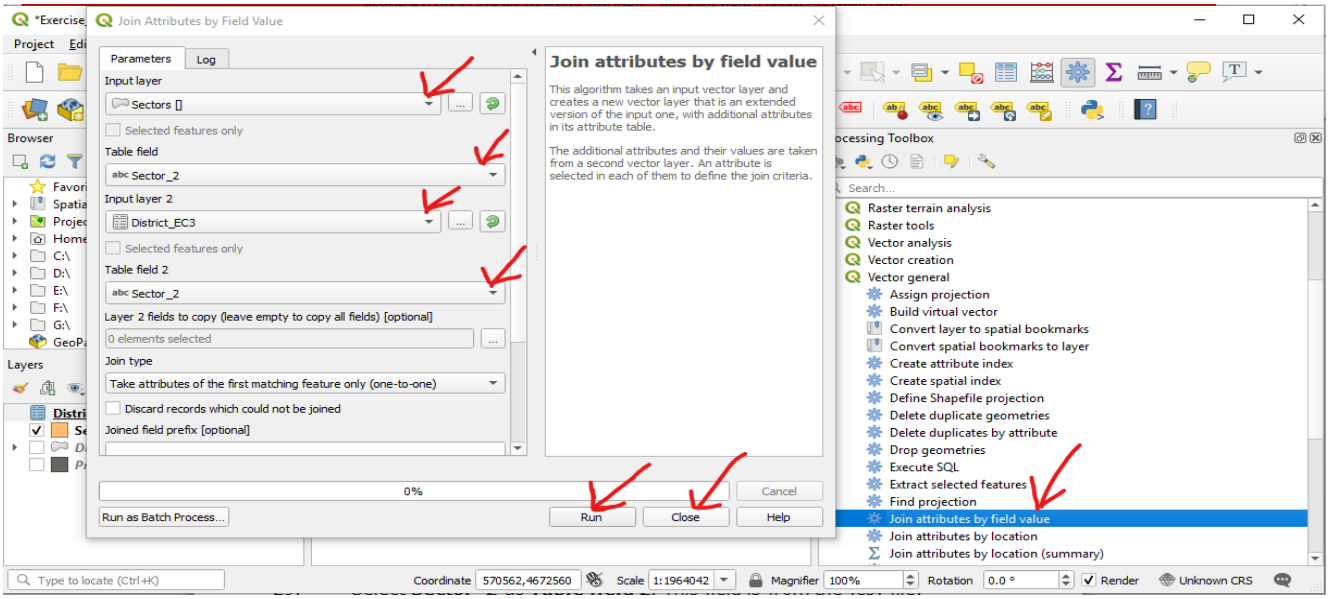


Step 2: The Processing Toolbox automatically snaps to your right panel.



Step 3: Expand **Vector general**.

From the listed table tools, double-click on the **Join Attribute by field value** tool to open it (see below).



Step 4: We will join the attributes **District_EC3** to the **sectors layer** and create a new shapefile.

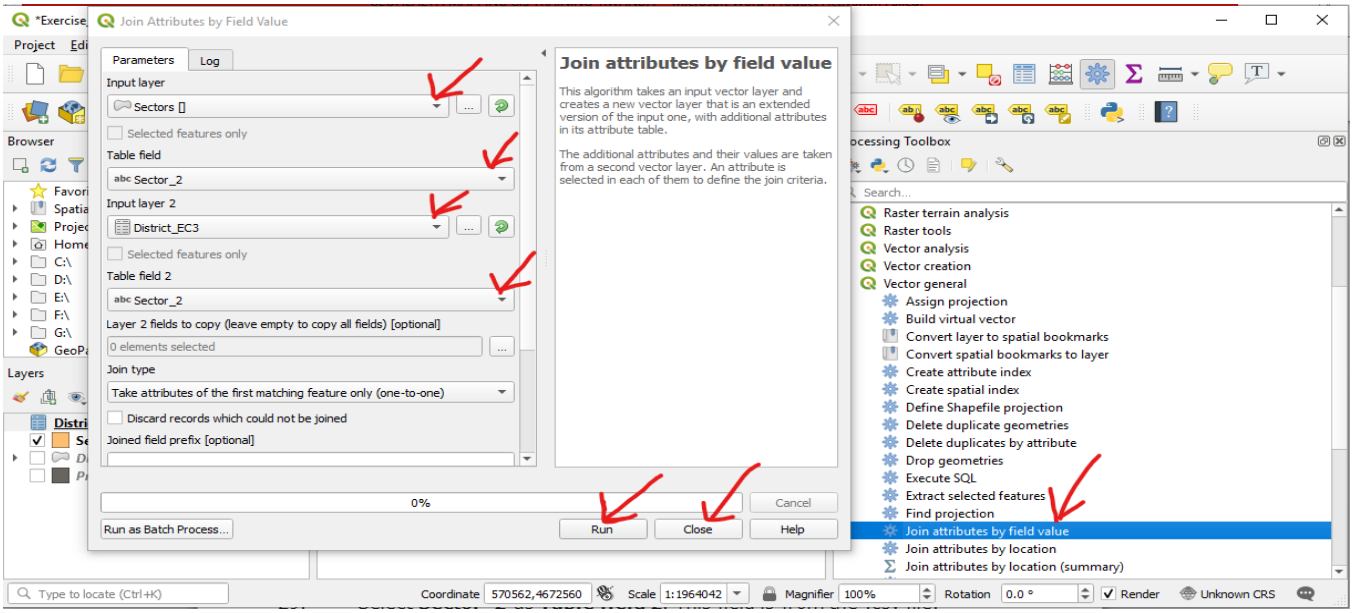
The **Input layer** in this case will be the **sectors layer** (the layer to which you will join attributes). The **Input layer** 2 will be **District_EC3** (the join table).

Select **Sectors** for **Input layer** and **District_EC3** as **Input layer 2**.

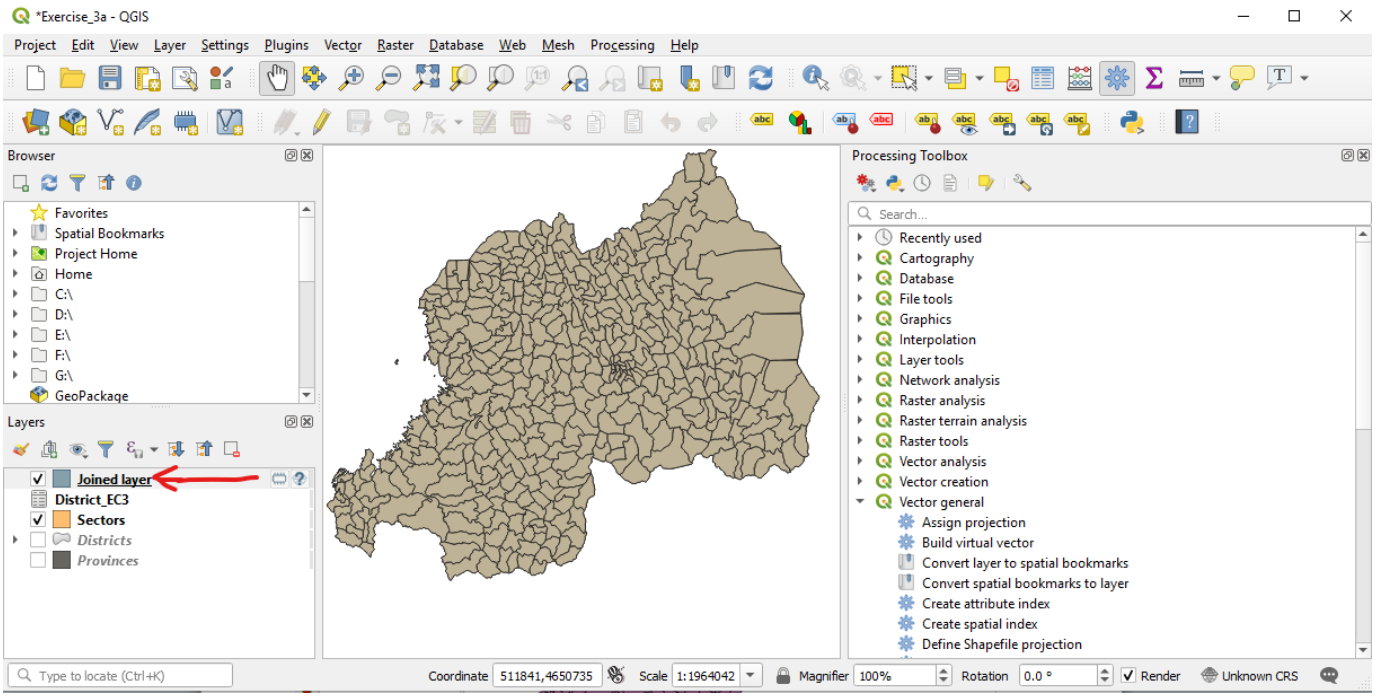
Select **Sector_2** as the **Table field**. This field is from the **sectors layer**.

Select **Sector_2** as **Table field 2**. This field is from the **District_EC3.csv** file.

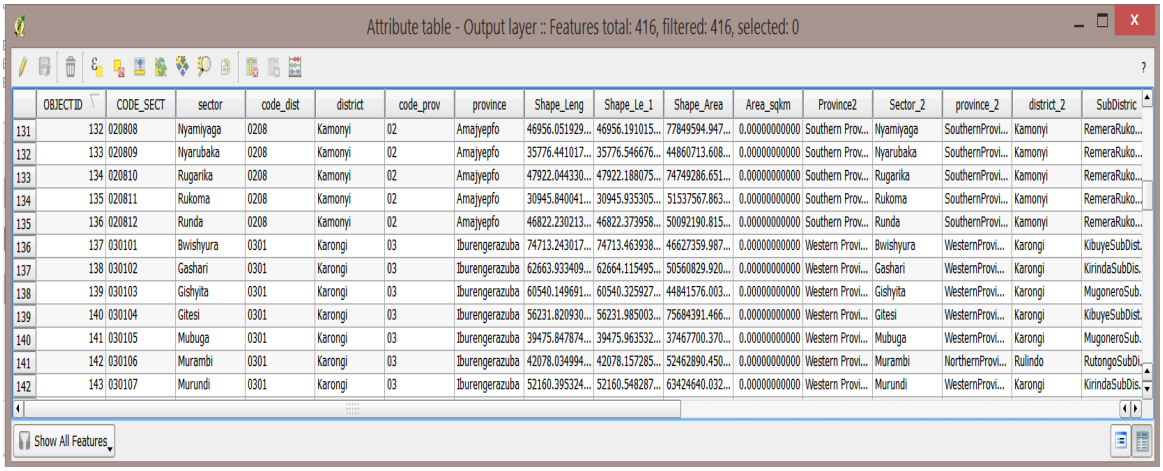
Step 5: Click on **Run** to run the tool then **Close**.



Step 6: Your layer has been added to your map document as **Joined Layer** (Output Layer in previous versions). Please note this is just an "alias" name.



Step 8: Open the Output layer attribute table, scroll right, and scroll through the data. The data has been joined to the sectors layer.



	OBJECTID	CODE_SECT	sector	code_dist	district	code_prov	province	Shape_Leng	Shape_Le_1	Shape_Area	Area_sqkm	Province2	Sector_2	province_2	district_2	SubDistric
131	132	020808	Nyamiyaga	0208	Kamonyi	02	Amajyepfo	46956.051929...	46956.191015...	77849594.947...	0.00000000000	Southern Prov...	Nyamiyaga	SouthernProvi...	Kamonyi	RemeraRuko...
132	133	020809	Nyarubaka	0208	Kamonyi	02	Amajyepfo	35776.441017...	35776.546676...	44860713.608...	0.00000000000	Southern Prov...	Nyarubaka	SouthernProvi...	Kamonyi	RemeraRuko...
133	134	020810	Rugarika	0208	Kamonyi	02	Amajyepfo	47922.044330...	47922.188075...	74749286.651...	0.00000000000	Southern Prov...	Rugarika	SouthernProvi...	Kamonyi	RemeraRuko...
134	135	020811	Rukoma	0208	Kamonyi	02	Amajyepfo	30945.840041...	30945.935305...	51537567.863...	0.00000000000	Southern Prov...	Rukoma	SouthernProvi...	Kamonyi	RemeraRuko...
135	136	020812	Runda	0208	Kamonyi	02	Amajyepfo	46822.230213...	46822.373958...	50092190.815...	0.00000000000	Southern Prov...	Runda	SouthernProvi...	Kamonyi	RemeraRuko...
136	137	030101	Bwishyura	0301	Karongi	03	Iburengerazuba	74713.243017...	74713.463938...	46627359.987...	0.00000000000	Western Provi...	Bwishyura	WesternProvi...	Karongi	KibuyeSubDist.
137	138	030102	Gashari	0301	Karongi	03	Iburengerazuba	62663.933409...	62664.115495...	50560829.920...	0.00000000000	Western Provi...	Gashari	WesternProvi...	Karongi	KirindaSubDis.
138	139	030103	Gishyita	0301	Karongi	03	Iburengerazuba	60540.149691...	60540.325927...	44841576.003...	0.00000000000	Western Provi...	Gishyita	WesternProvi...	Karongi	MugoneroSub.
139	140	030104	Gitesi	0301	Karongi	03	Iburengerazuba	56231.820930...	56231.985003...	75684391.466...	0.00000000000	Western Provi...	Gitesi	WesternProvi...	Karongi	KibuyeSubDist.
140	141	030105	Mubuga	0301	Karongi	03	Iburengerazuba	39475.847874...	39475.963532...	37467700.370...	0.00000000000	Western Provi...	Mubuga	WesternProvi...	Karongi	MugoneroSub.
141	142	030106	Murambi	0301	Karongi	03	Iburengerazuba	42078.034994...	42078.157285...	52462890.450...	0.00000000000	Western Provi...	Murambi	NorthernProvi...	Rulindo	RutongoSubDi...
142	143	030107	Murundi	0301	Karongi	03	Iburengerazuba	52160.395324...	52160.548287...	63424640.032...	0.00000000000	Western Provi...	Murundi	WesternProvi...	Karongi	KirindaSubDis.

Step 9: Close the attribute table.

Save your map as **Exercise_3a.qgs** in the **MyExercises folder**

- Click on **project**
- **Saves**

- File name **Exercise_3a**
- Save as type Select **.qgs**
- Click **save**

V.3.2 Create a choropleth map

Mapping the greatest and least values involves mapping features based on quantities. These quantities can relate to discrete data, continuous data, or data summarized by area.

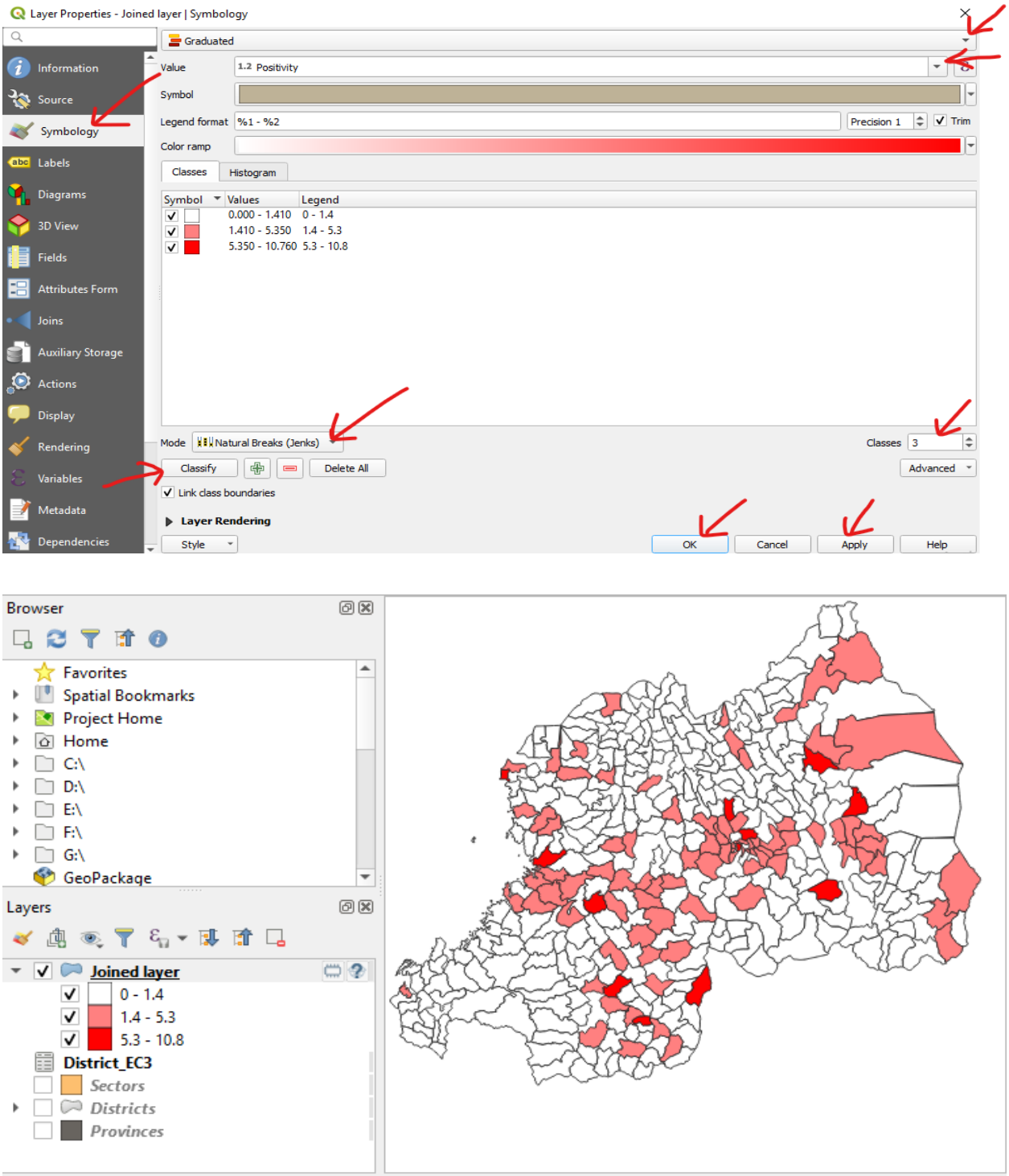
In our case, data is aggregated at sector administrative level. It can be mapped using classes to show variations in quantities across the districts.

Such maps are commonly referred to as **choropleth maps** or **area maps**.
Classes can be created manually or using standard classification schemes. The choice of scheme depends on data value distribution and the purpose of your map. Manual classification can be used to look for specific criteria or thresholds in your data, and when you understand the data well.

Commonly used standard classification schemes include:

- **Natural breaks (Jenks)**: creates classes based on natural groupings of data
- **Quantile:** each class contains an equal number of features
- **Equal Interval**: creates classes of equal intervals
- **Standard Deviation**: creates classes based on the extent to which values vary from the mean

    - Right-click on the **.csv** files and **removes** it from the map document.
    - **Turn off** the sectors layer by clicking on the box next to the layer name.
    - Double-click on **Output layer** to open the **properties dialog box.**
    - Click on **Style** in the left panel.
    - Select **Graduated** symbol from the pull down menu.
    - For the classification field (**Value**), select **Positivity**.
    - Change the **Classes** from **5 to 3** and select **Natural Breaks** as the classification **Mode**.
    - Select a **Color ramp**.
    - Click **Classify**,
    - Click **Apply** then **OK**. Refer to the graphic below.

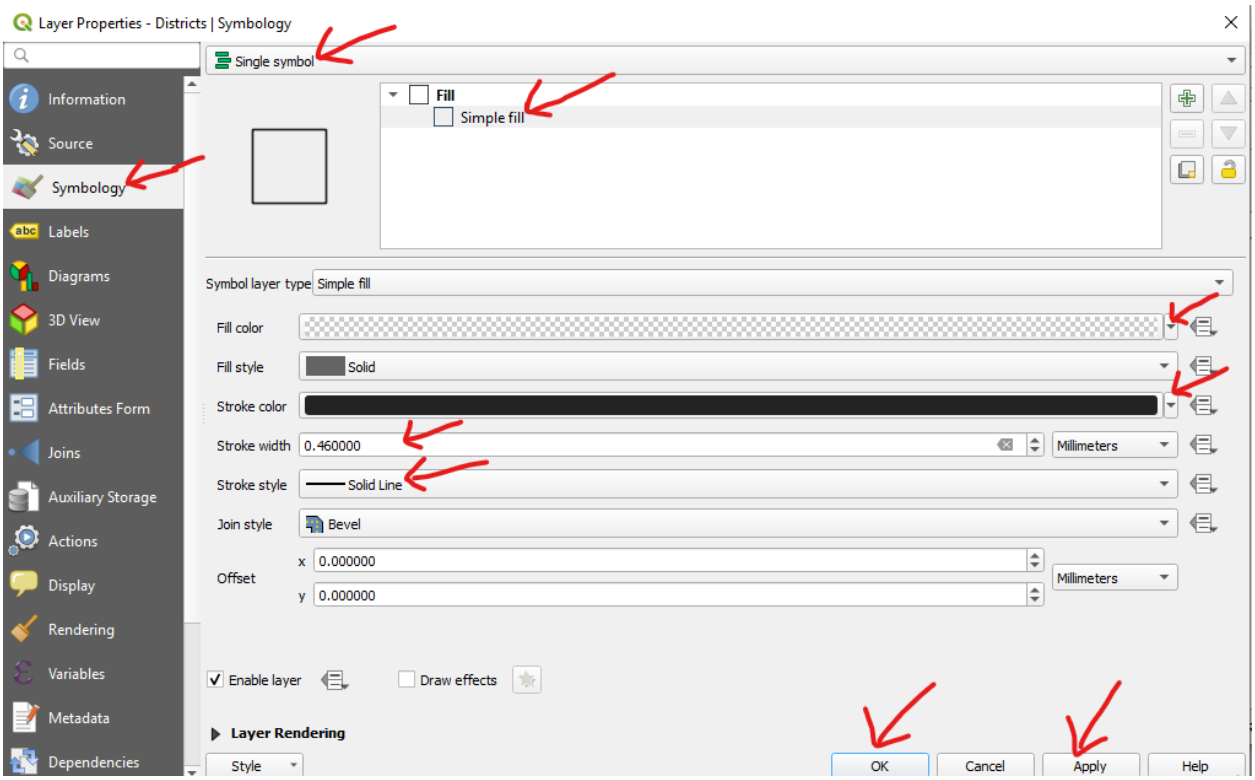


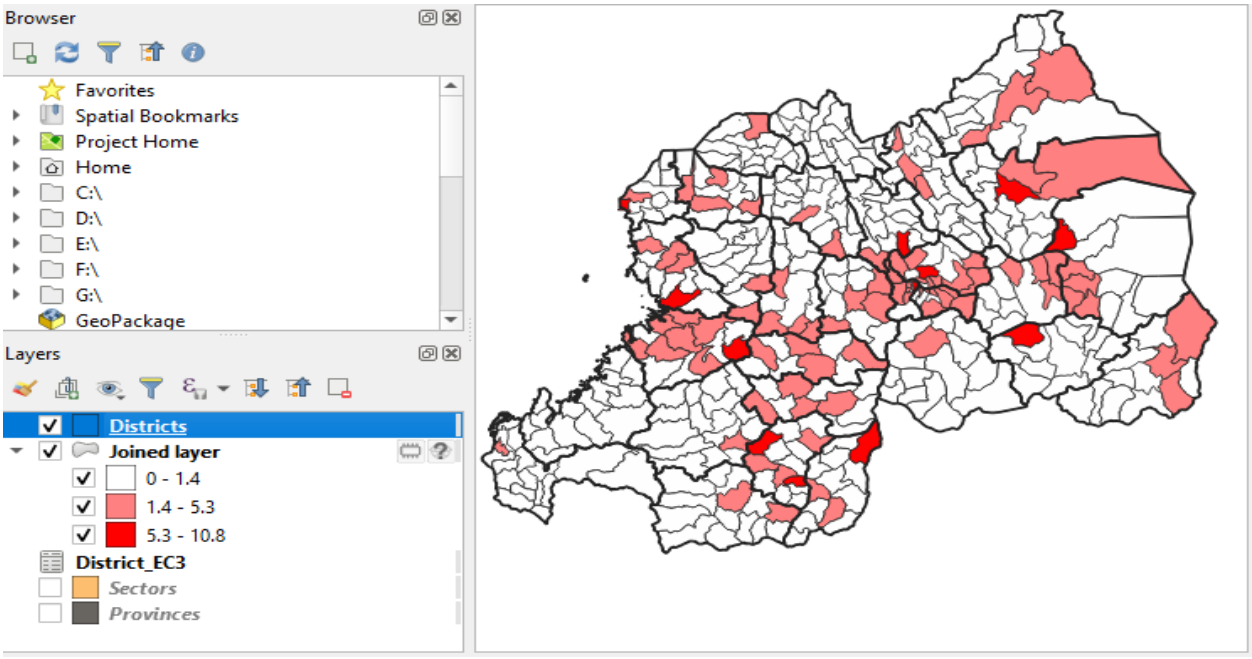
We would like to view data within a higher administrative level.

There are two administrative layers files in your layer panel, for districts and provinces.

- **Turn on** the Districts layer and drag it above the Output layer (the Output layer will no longer be visible). To make it visible, we will need to change the properties of the Districts layer.
- Double-click on the **Districts** layer to open the **Layer Properties** dialog box.

- Click on **Style** > **Simple fill**.
- Click on **Fill color** and select **Transparent fill**.
- Click on **Stroke style** to change to **solid line**.
- Select a **Stroke color black color**, or a color of your choice, and click **OK**.
- Change the **stroke width** to **0.50000**.
- Click **Apply** then **OK**.





VI. References

1. *https://docs.qgis.org/2.14/en/docs/index.html*
2. *https://docs.qgis.org/3.4/en/docs/training_manual/complete_analysis/index.html*
3. *https://www.healthpolicyproject.com/geoHealth/index.cfm*