

National University of Battambang: Introduction to QGIS Worksheet

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Part 1: Familiarise yourself with the GitHub repository

The '[Next-Gen Agricultural Extension: Introduction to QGIS' GitHub Repository](https://github.com/lbannan/next-gen-qgis-workshop)¹ has been created to host and maintain all materials, information and resources from this workshop. Please read the information in the repository and download all required materials before the workshop.

Disclaimer: the data used in this workshop has been sourced from [Open Development Cambodia](#) and [World Bank](#). Although best efforts have been taken to use recent and relevant datasets, none of the data has been independently verified by the research team. Any conclusions, findings or analysis based on the examples used in this workshop are only for the purpose of learning how to use the QGIS software and should not be considered reliable for any decision making.

Part 2: Download software and materials

All required downloads can be found on the '[Next-Gen Agricultural Extension: Introduction to QGIS' GitHub Repository](https://github.com/lbannan/next-gen-qgis-workshop) under '[Downloads](#)'.

1. Download and install [QGIS Software](#)

Note: to avoid bugs in new releases, download the latest 'long term release'. This is currently [QGIS 3.28.14-Firenze](#).

¹ <https://github.com/lbannan/next-gen-qgis-workshop>

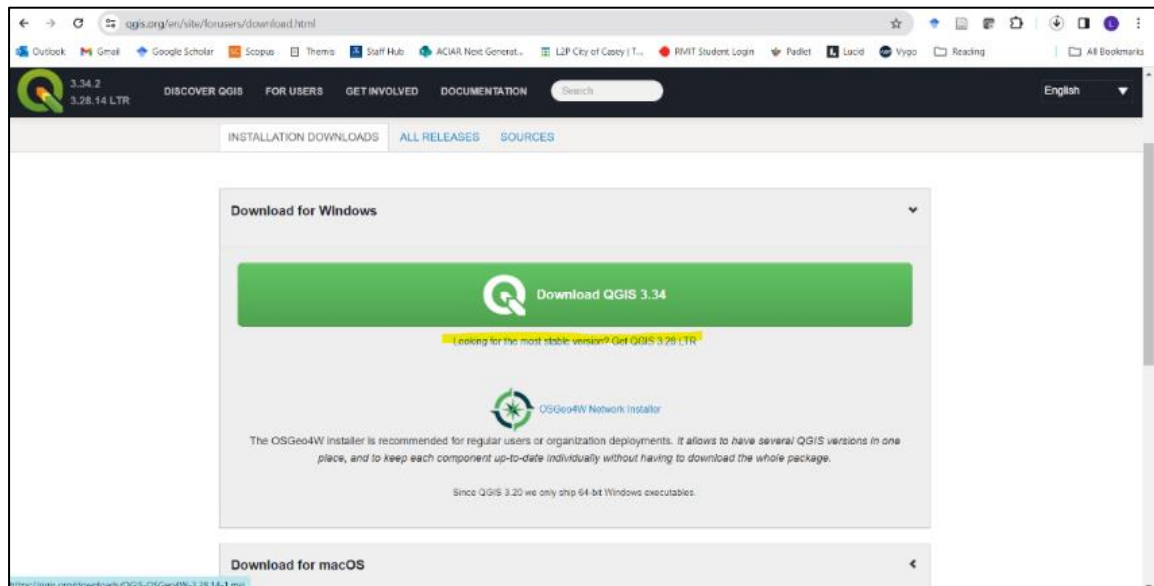


Figure 1: QGIS download page (see highlight for long term release)

2. Create a new folder on your computer to save all materials from this workshop in the same place.

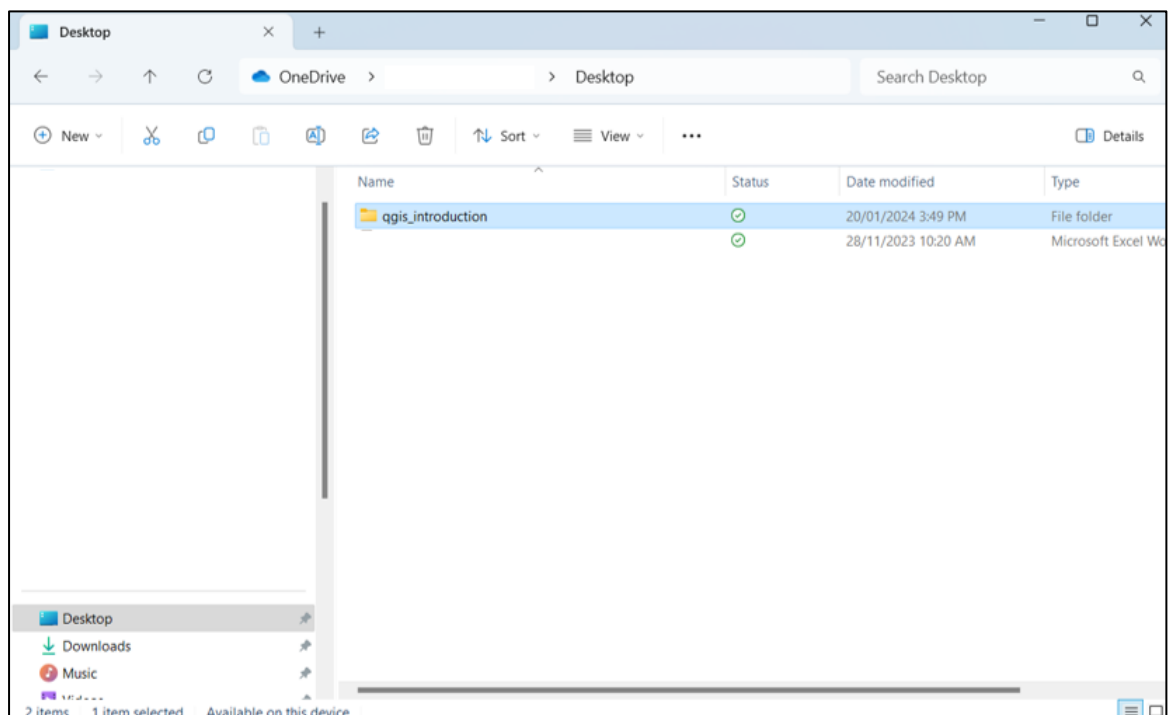


Figure 2: Create a new folder on your device to save all materials from this workshop

3. Download 'sample_data' folder which contains all spatial data to be used in the workshop from the [GitHub repository](#).
4. Read through the 'read_me.txt' files included in the sample data pack and familiarise yourself with the information in the dataset

Part 3: Introduction to QGIS interface

1. Open QGIS from your taskbar and start a 'New Empty Project'
2. Familiarise yourself with the basic QGIS interface, noting where you can find:
 - a. 'Browser'
 - b. 'Layers' panel
 - c. 'Select' tool
 - d. Project coordinate system (should be set to EPSG: 4326)
 - e. Processing toolbox
 - f. Toolbar

Note: See below for Figure X which highlights the position of these features

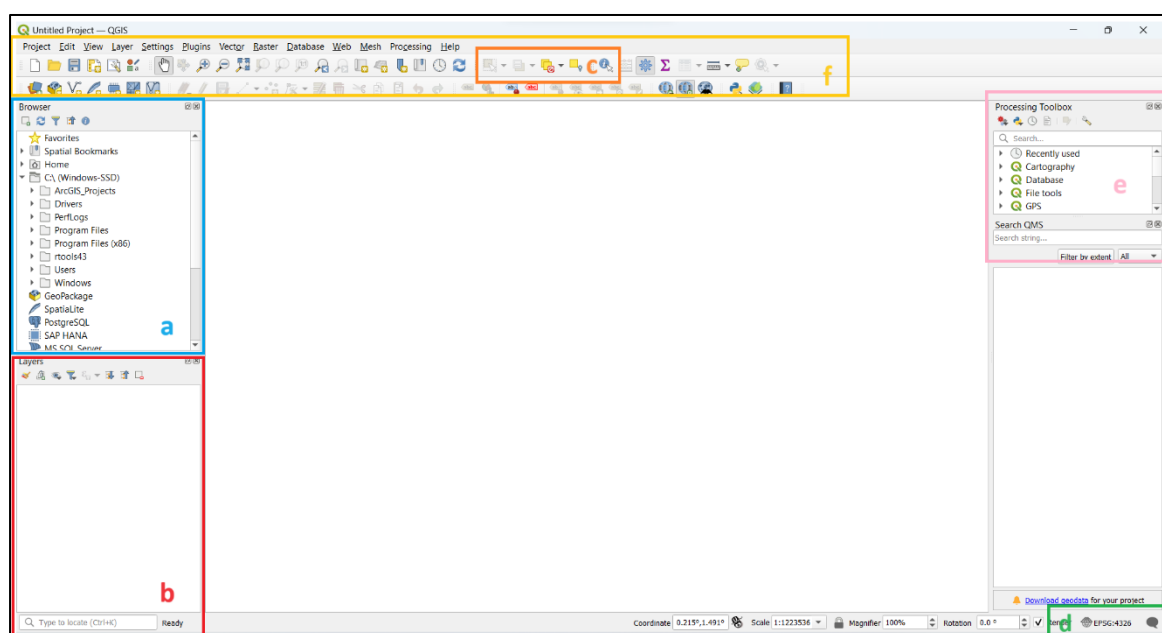


Figure 3: Labelled interface, highlighting features from step 2

3. Save project by navigating to: 'Project' > 'Save As' > 'qgis_introduction' in project folder > 'Save'

Part 4: Adding data to QGIS project

1. Open sample_data folder and navigate to worldbank-countries
 - a. Locate the file: 'WB_countries_Admin0_10m.shp'

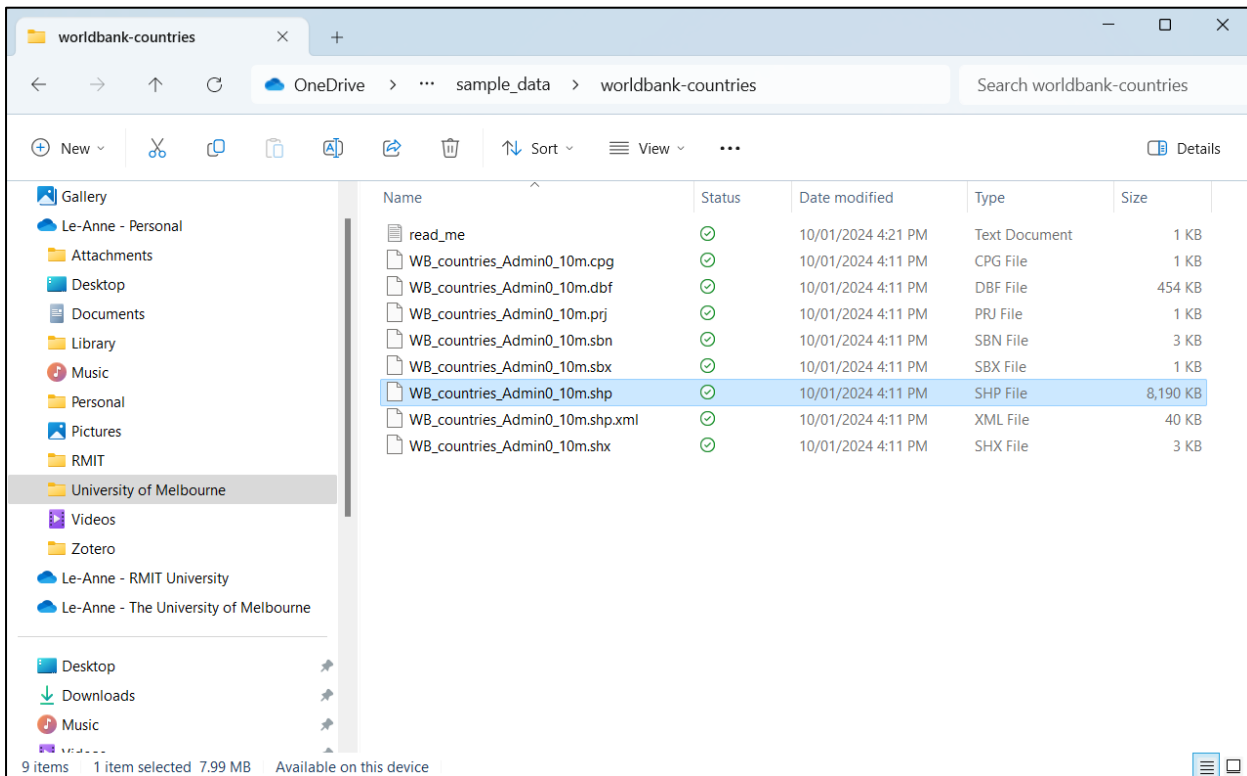


Figure 4: World map shapefile

2. Drag and drop this file into the main window of QGIS

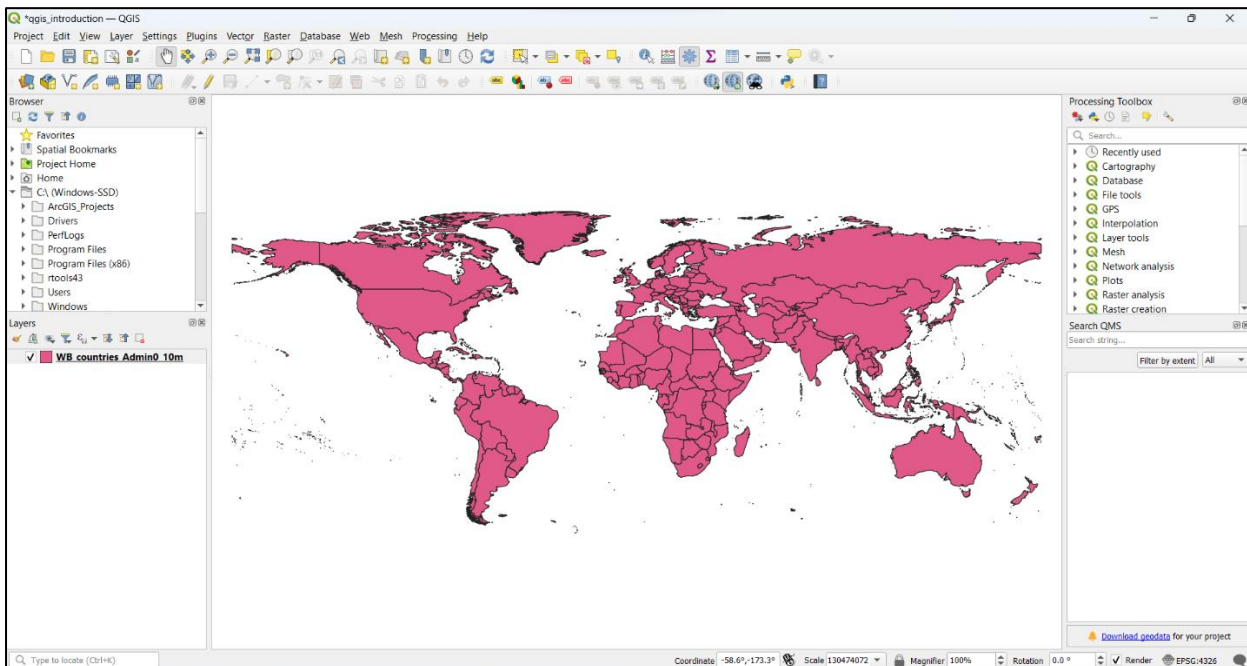
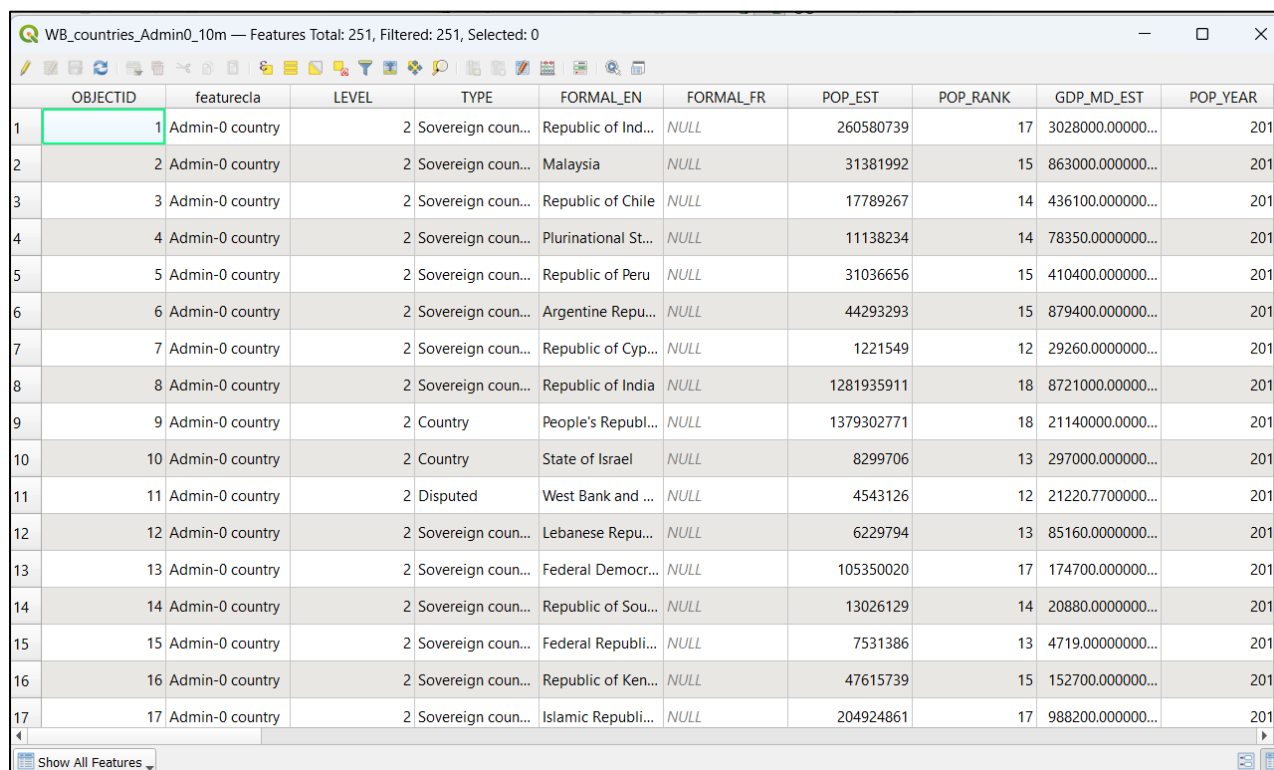


Figure 5: QGIS default display of World Bank country administrative boundaries dataset

3. Try panning around the frame and zoom in on Cambodia

4. Right click on the layer in the 'Layers' panel and select 'Open Attribute Table' for the world map layer



OBJECTID	featurecla	LEVEL	TYPE	FORMAL_EN	FORMAL_FR	POP_EST	POP_RANK	GDP_MD_EST	POP_YEAR
1	Admin-0 country	2	Sovereign coun...	Republic of Ind...	NULL	260580739	17	3028000.00000...	201
2	Admin-0 country	2	Sovereign coun...	Malaysia	NULL	31381992	15	863000.000000...	201
3	Admin-0 country	2	Sovereign coun...	Republic of Chile	NULL	17789267	14	436100.000000...	201
4	Admin-0 country	2	Sovereign coun...	Plurinational St...	NULL	11138234	14	78350.0000000...	201
5	Admin-0 country	2	Sovereign coun...	Republic of Peru	NULL	31036656	15	410400.000000...	201
6	Admin-0 country	2	Sovereign coun...	Argentine Repu...	NULL	44293293	15	879400.000000...	201
7	Admin-0 country	2	Sovereign coun...	Republic of Cyp...	NULL	1221549	12	29260.0000000...	201
8	Admin-0 country	2	Sovereign coun...	Republic of India	NULL	1281935911	18	8721000.00000...	201
9	Admin-0 country	2	Country	People's Republ...	NULL	1379302771	18	2114000.0000...	201
10	Admin-0 country	2	Country	State of Israel	NULL	8299706	13	297000.000000...	201
11	Admin-0 country	2	Disputed	West Bank and ...	NULL	4543126	12	21220.7700000...	201
12	Admin-0 country	2	Sovereign coun...	Lebanese Repu...	NULL	6229794	13	85160.0000000...	201
13	Admin-0 country	2	Sovereign coun...	Federal Democr...	NULL	105350020	17	174700.000000...	201
14	Admin-0 country	2	Sovereign coun...	Republic of Sou...	NULL	13026129	14	20880.0000000...	201
15	Admin-0 country	2	Sovereign coun...	Federal Republi...	NULL	7531386	13	4719.00000000...	201
16	Admin-0 country	2	Sovereign coun...	Republic of Ken...	NULL	47615739	15	152700.000000...	201
17	Admin-0 country	2	Sovereign coun...	Islamic Republi...	NULL	204924861	17	988200.000000...	201

Figure 6: World Bank shapefile attribute table

5. Using the attribute table, navigate to 'Cambodia' and find out:
 - a. What is the total population of Cambodia according to this World Bank data?
 - b. What is the GDP?
6. Select Cambodia, Vietnam, Thailand and Laos so that they are highlighted on the map

Notes:

- You can select multiple lines by holding 'control' on a Windows computer or 'command' on a Mac
- There is a button in the attributes table toolbar called 'move selection to top' which can be helpful for viewing your selections (see Figure 7)

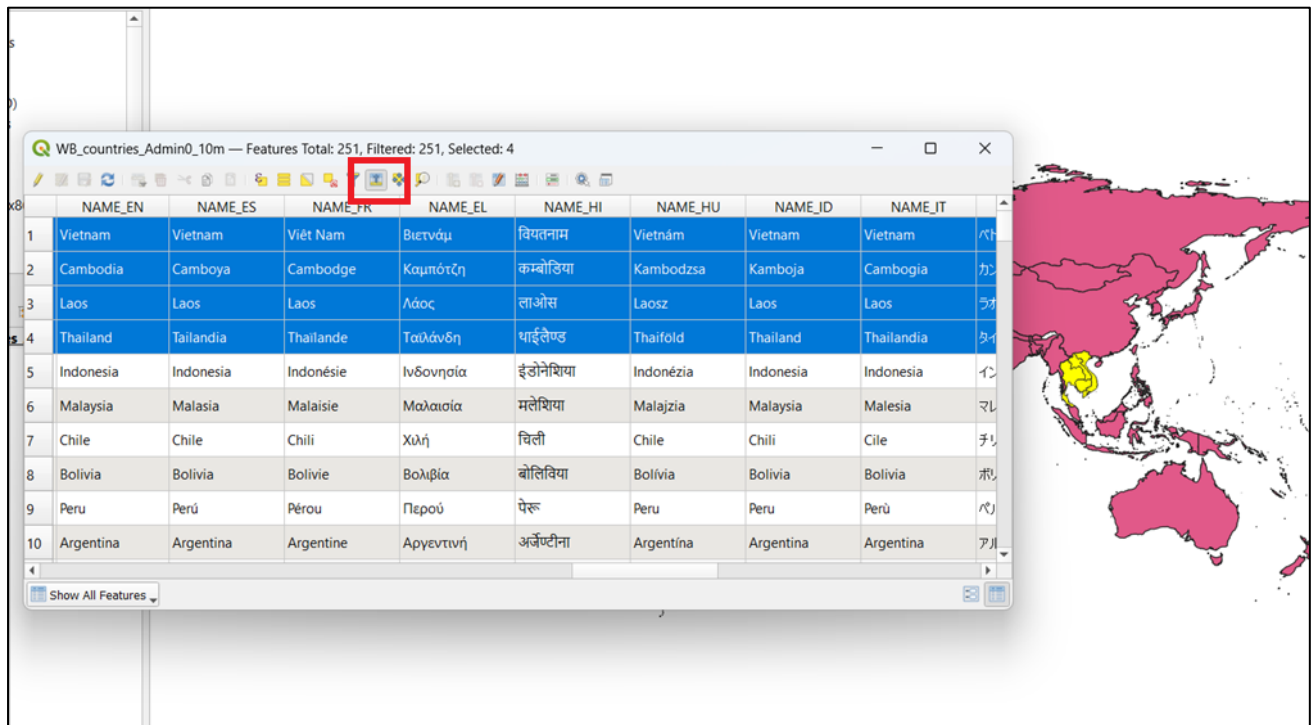


Figure 7: Cambodia and neighbouring countries selected in the attribute table and on the map

7. Close the attribute table (the four countries selected should remain highlighted in your project)

Part 5: Editing a layer in QGIS

1. Navigate to the 'Processing toolbox' on the top right corner and search for 'Extract selected features'
2. Input layer: WB_countries_Admin0_10m and then click 'Run'

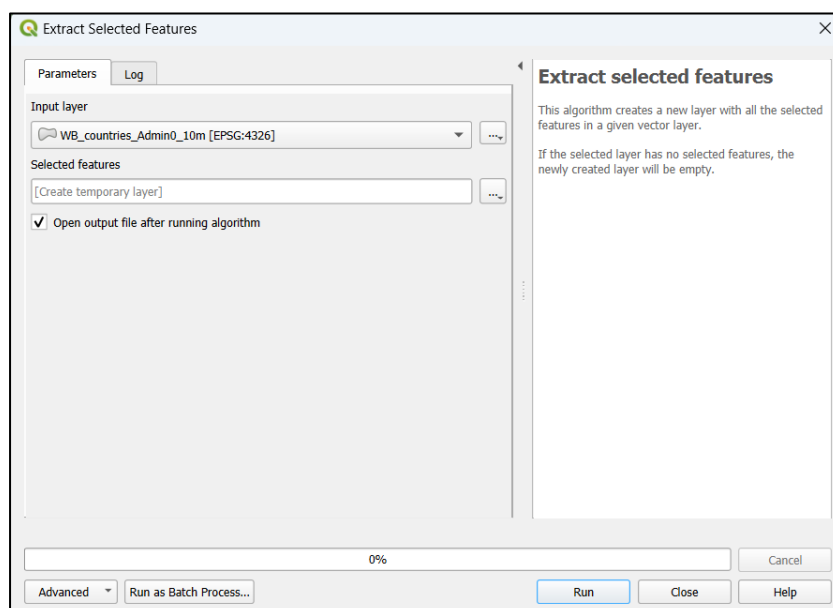


Figure 8: Extract Selected Features tool and correct inputs before pressing 'Run'

3. A new layer called 'Selected features' should now be visible in the 'Layers' panel
4. Hide 'WB_countries_Admin0_10m' by unticking the box next to the layer name
5. Right click 'Selected features' layer and click 'Zoom to Layer'
6. Only the new layer you have created should be visible and centred in the screen
7. Rename your new layer to 'selected_countries'

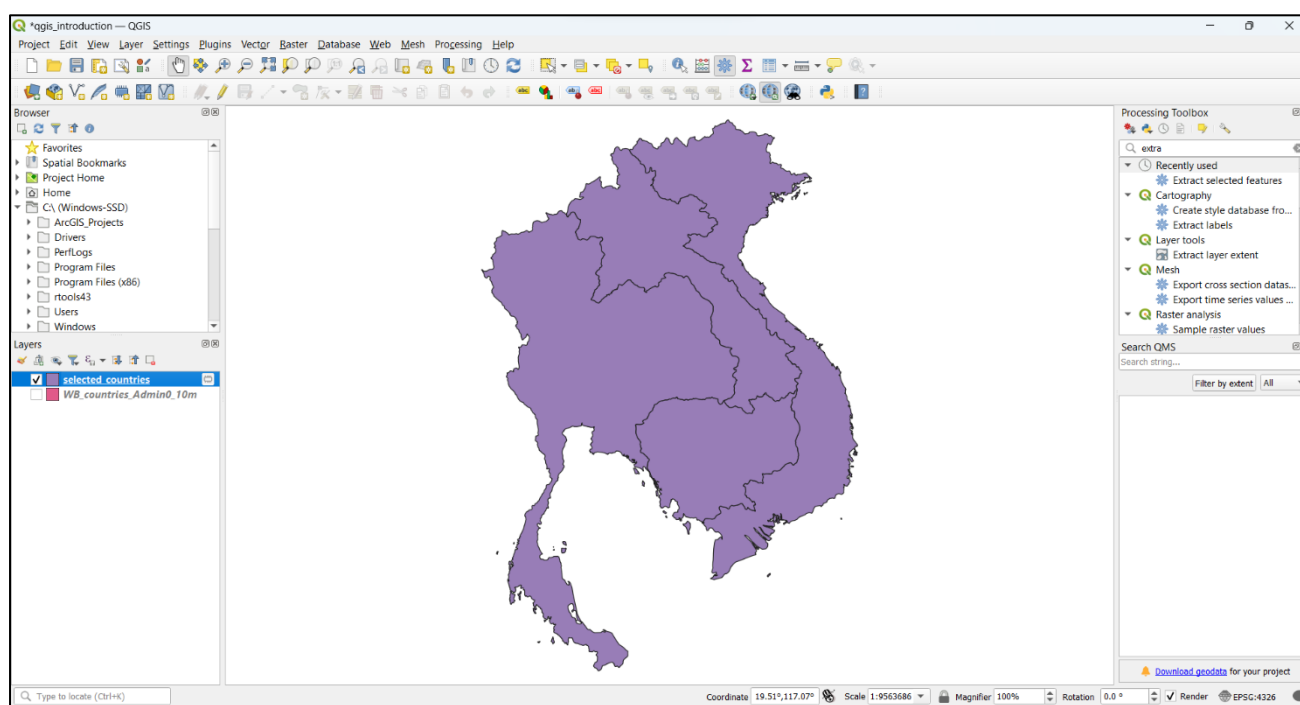


Figure 9: Extracted layer including only Cambodia, Vietnam, Laos and Thailand

8. Right click 'selected_countries' layer and press 'Properties'
 - a. Toggle to 'Labels'
 - b. Change 'No labels' to 'Single labels'
 - c. Select 'NAME_EN' from the value field
 - d. Press 'Ok'

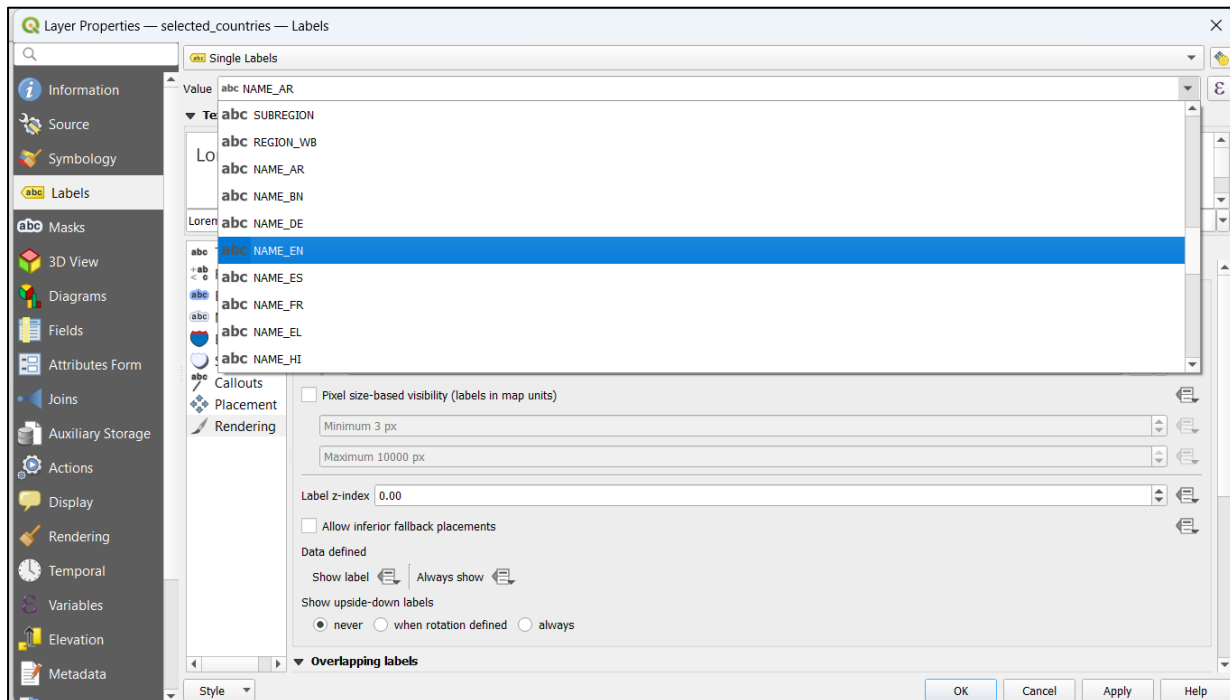


Figure 10: Selection for adding country name labels

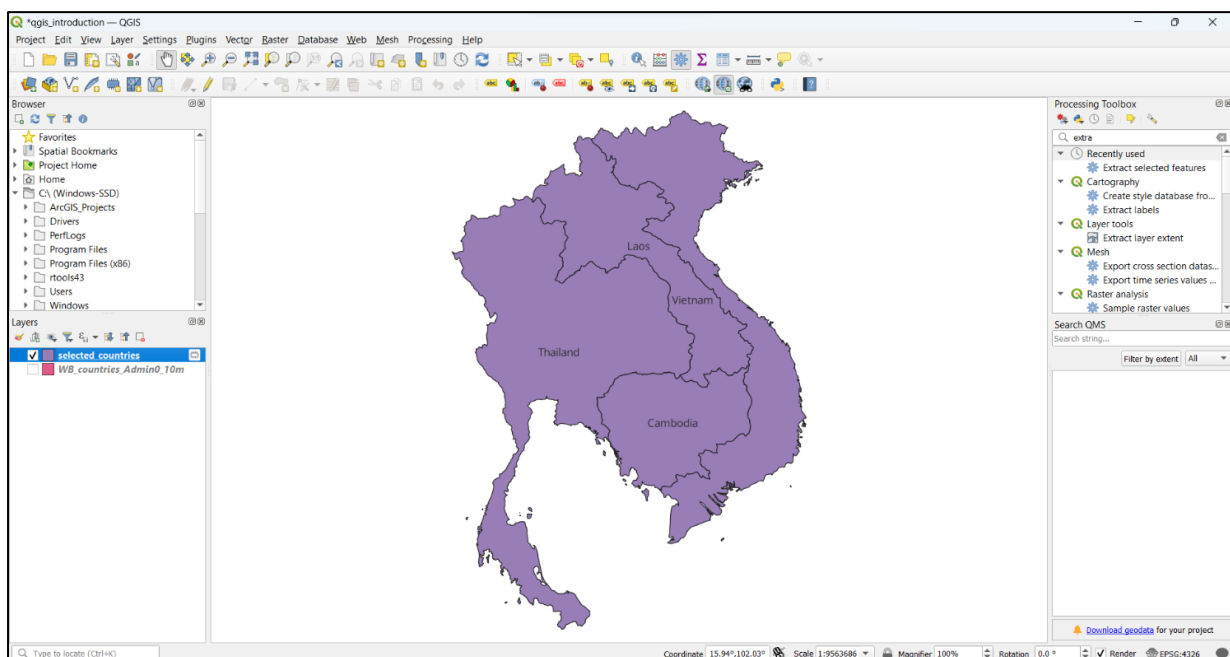


Figure 11: Surrounding countries with labels

9. Save your project

Part 6: Saving a layer in QGIS

When you create new layers using geoprocessing tools, they are not automatically saved as a new file. To save a layer as a new shapefile follow these steps.

1. Right click 'selected_countries'
2. Select 'Make Permanent'
3. Click on the '...' in the pop up to navigate to project folder
4. Save the file as an ESRI Shapefile, named 'selected_countries'
5. Leave encoding set to UTF-8
6. Press 'Ok'

Note: You should always save spatial data with the shortest possible file names, avoid using spaces and avoid using a number as the first character

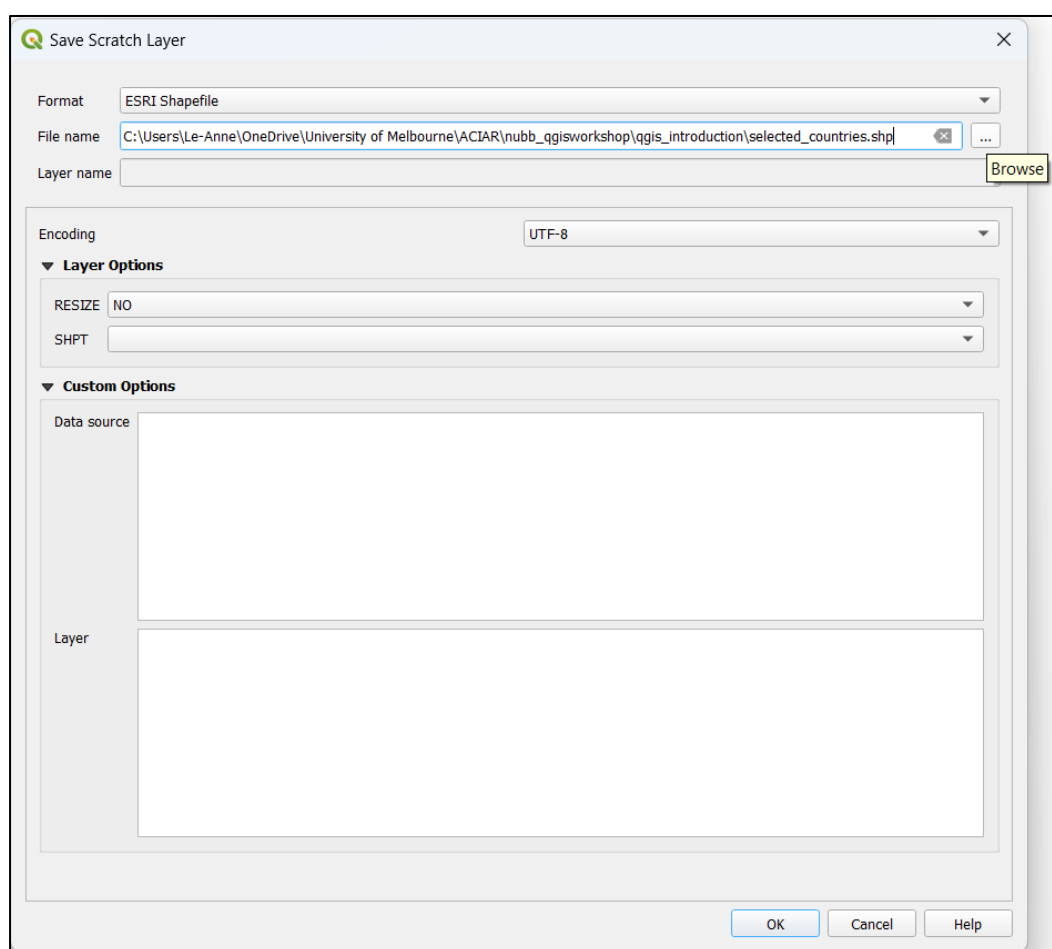


Figure 12: Make a temporary (scratch) layer permanent

7. Save project and hide selected_countries layer from view by unticking it in the layers pane

Part 6: Case study

Case study: an NGO has approached your organisation for information. They have funding to build a new school and would like you to provide some potential areas which may benefit from the project. Use GIS to identify areas for their consideration.

Discussion: How would you approach this without using GIS? What information would you use or steps would you take? Based on your prior experience, which province do you expect would most benefit from a project such as this?

Literacy Rates: Graduated symbology

1. Open the folder 'literacy-rates-2008' in the 'sample_data' folder
2. Add 'literacy-rates.shp' to the project by dragging it into the 'Layers' panel
3. Right click on the layer in QGIS and 'Open Attribute Table'

Discussion: What do you think each of these values represent? Check the read_me.txt file to confirm you are correct.

4. Close attribute table and open 'Properties' for the layer
5. Navigate to 'Symbology'
 - a. Change 'Single Symbol' to 'Graduated'
 - b. Change 'Value' to 'T_LIT15' which represents total literacy of people >15 years old by province
 - c. Open 'color ramp' drop down menu and select 'Blues and 'Invert color ramp'
 - d. Change 'Mode' to 'Natural Breaks (Jenks)'
 - e. Click 'Classify'
 - f. Decrease precision to 0 to remove decimal values from legend
 - g. Press 'Ok' to view changes

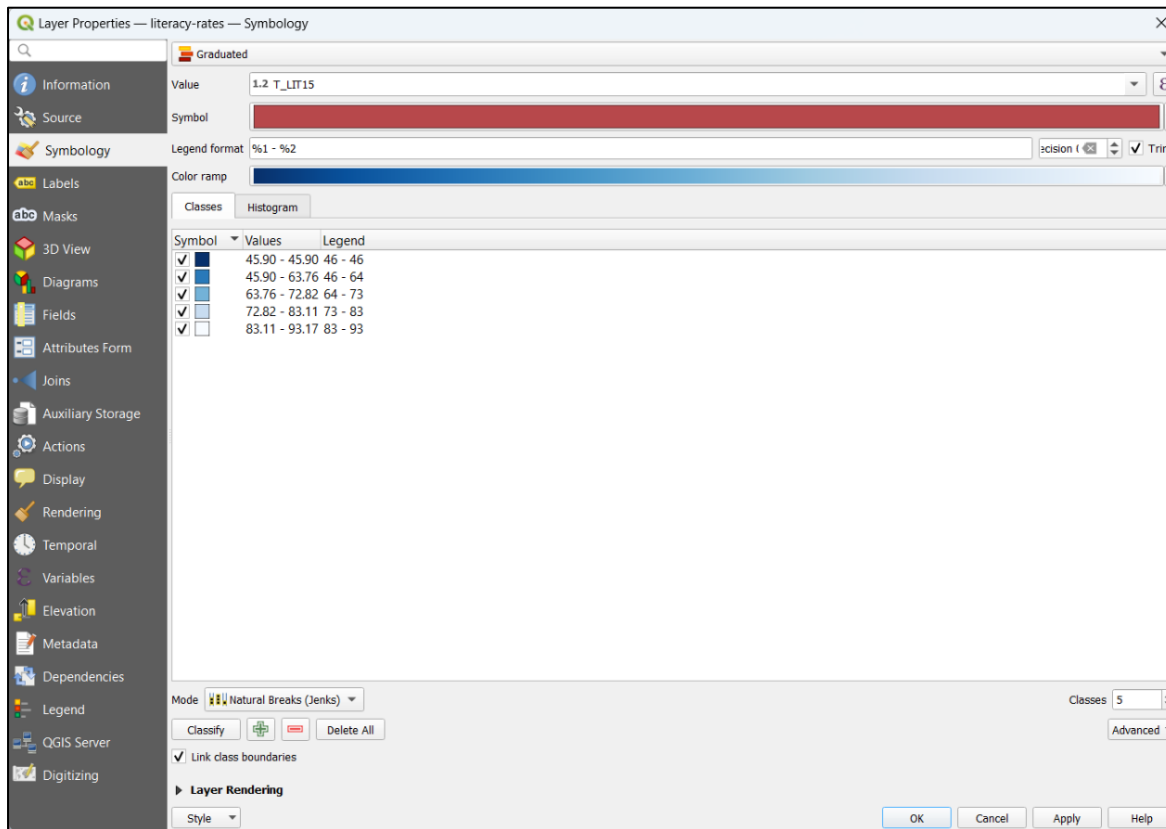


Figure 13: Symbology pane with correct selections for literacy-rates layer

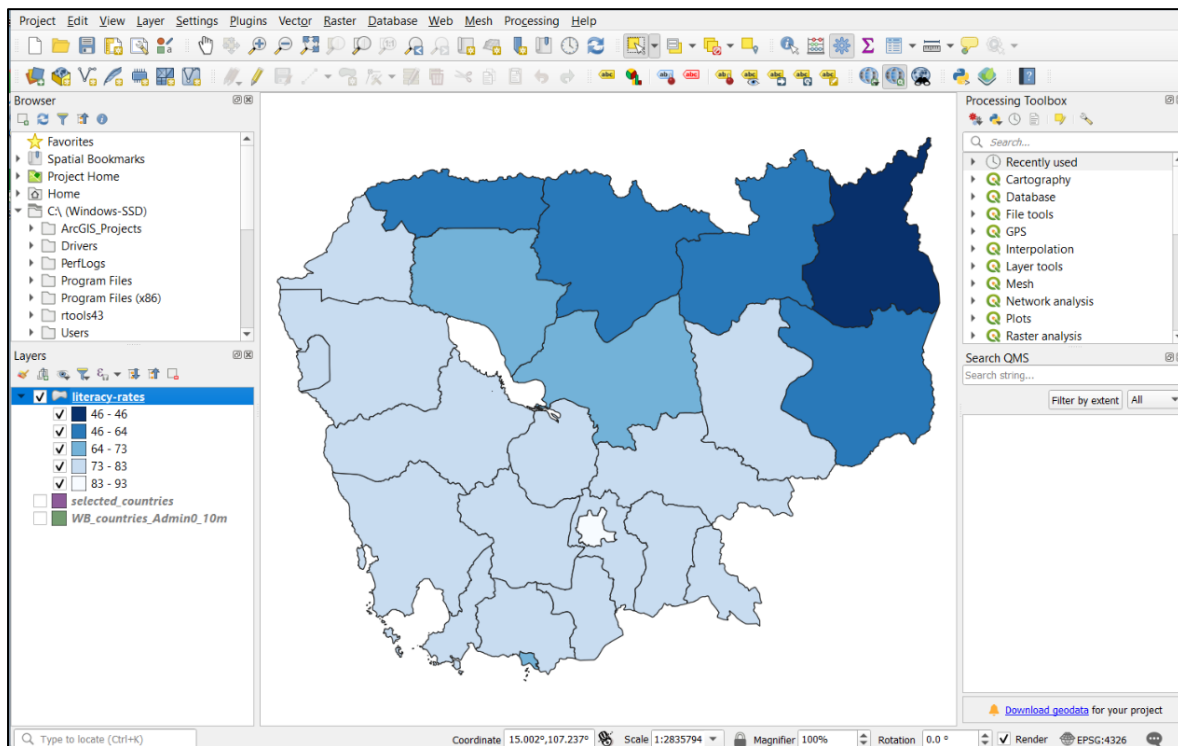


Figure 14: Literacy-rates layer after applying graduated symbology

6. Open the attribute table and sort 'T_LIT15' in ascending order
7. Click on the row with the lowest total literacy level and note the province name and figures
8. View your selection on the map by closing or minimising the attribute table

Discussion: According to this data, which province has the lowest literacy rates in the country? What about the highest?

9. Deselect all features using the deselect button in the toolbar
10. Save your project
11. Deselect the 'literacy-rates' layer for a blank canvas

This is a good start for our analysis, we now know which provinces are likely to benefit from funding for a new school.

Existing schools: Categorised symbology

This shapefile contains point data on schools in Cambodia. Check the attribute table to find out what other information it holds.

1. Navigate to 'school-locations' folder in the 'sample_data'
2. Add the 'school_of_cambodia.shp' to the QGIS project by dragging it into the 'Layers' pane
3. Right click the layer and press 'Properties'
4. Navigate to the 'Symbology' tab and adjust the following selections:
 - a. Change 'Single Symbol' to 'Categorised'
 - b. Change 'Value' to 'SCHOOL_TYP'
 - c. Change 'Color ramp' to 'Reds'
 - d. Press 'Classify' to populate values
 - e. Delete any unnecessary values using the red 'minus/delete' button
 - f. Press 'Ok' to view changes

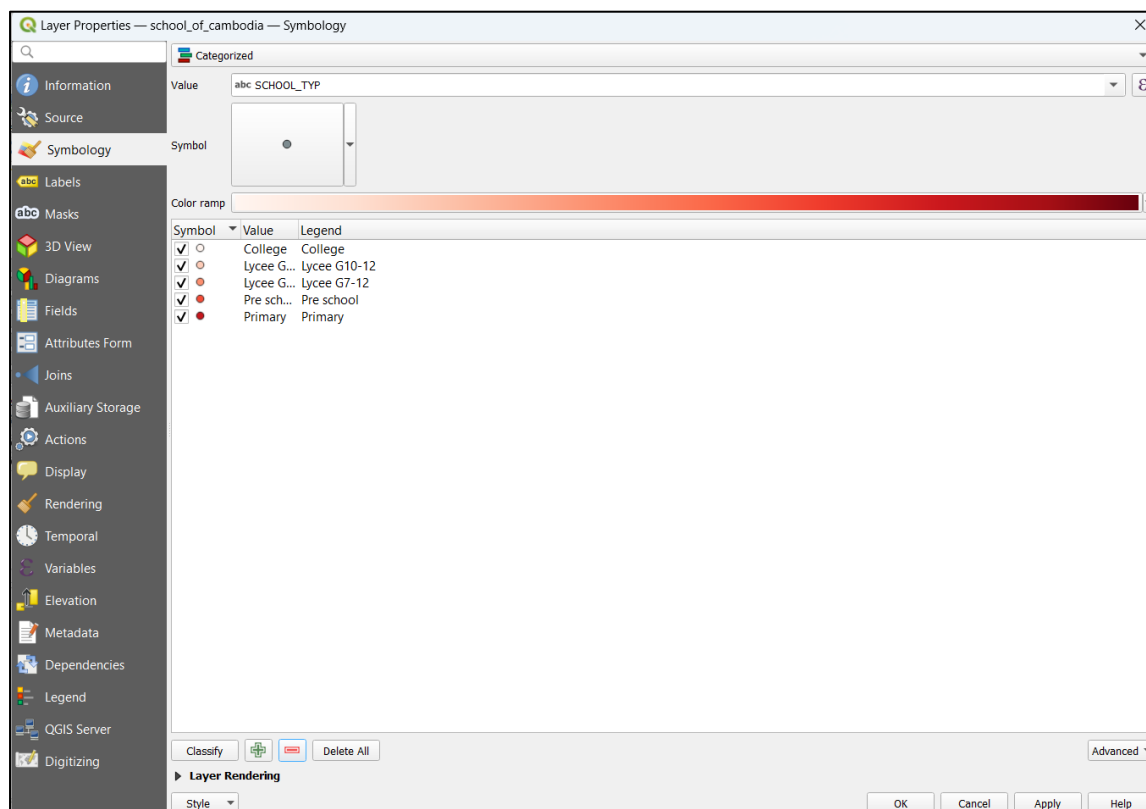


Figure 15: Correct selections for applying categorised symbology to school_of_cambodia layer

5. Save your project
6. Tick the 'literacy-rates' layer so that it is visible in your project
7. Zoom into Ratanak Kiri province and consider the following:
 - What do you notice when you select and deselect the different types of school in the legend?
 - How does this relate to the literacy rates from the other data set?
 - Based on this information, what type of school appears to be most needed in the region?
8. Deselect 'Pre school' and 'Primary'
9. Right click on the literacy-rates layer and click 'Zoom to layer'
 - How does this region compare to the rest of Cambodia?

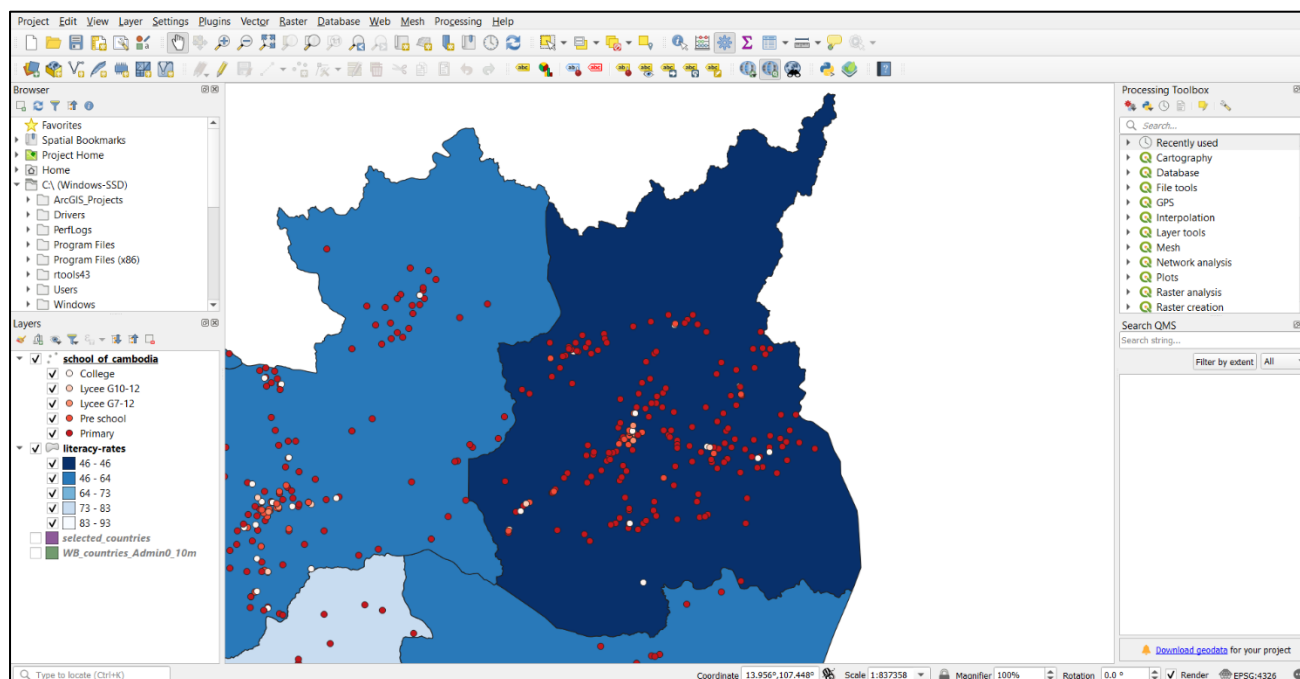


Figure 16: Ratanak Kiri Province with literacy-rates and school_of_cambodia layers enabled

10. Deselect the school_of_cambodia layer so that only the literacy-rates layer is visible

Distance from villages to upper secondary schools: Identifying spatial relationships

This shapefile contains information on the distance from villages to the nearest upper secondary school.

Check the attribute table to find out what other information it holds.

1. Navigate to 'distance-to-upper-sec-schools' folder in the 'sample_data'
2. Add the 'DUSS.shp' to the QGIS project by dragging it into the 'Layers' pane
3. Right click on the DUSS layer and navigate to the symbology tab*
 - a. Change 'Single symbol' to 'Graduated'
 - b. Change 'Value' to 'dist_kms'
 - c. Change 'Color ramp' to 'Greens'
 - d. Change 'Mode' to 'Equal Interval'
 - e. Change 'Classes' to '4'
 - f. Manually adjust the 'Values' column so that the intervals are:

Values	Legend
0.00 – 20.00	0 – 20
20.00 – 30.00	20 - 30
30.00 – 40.00	30 – 40
40.00 – 80.02	40 – 80

- g. Click 'OK'

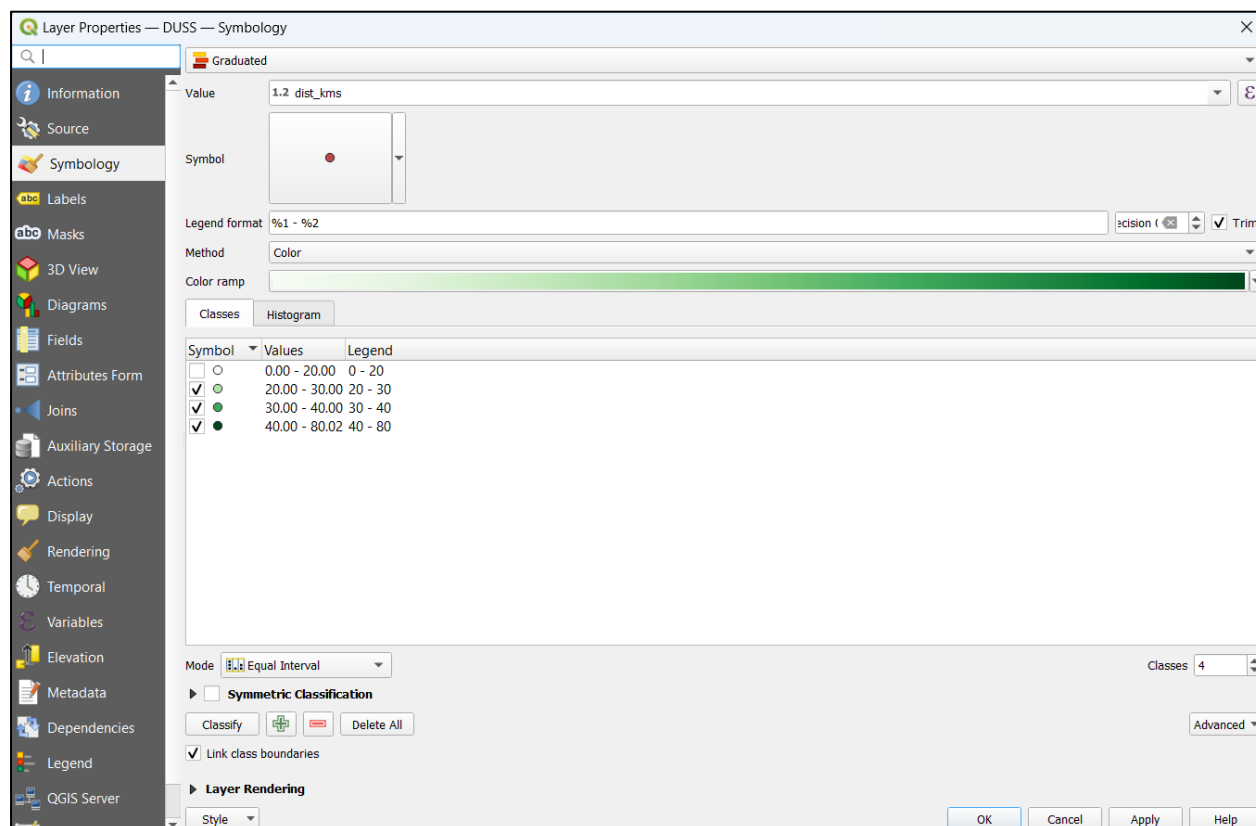


Figure 17: Correct selections to apply graduated symbology to distance from villages to upper secondary schools (DUSS) layer

4. Zoom into Ratanak Kiri Province and view the school_of_cambodia layer alongside the DUSS layer
 - a. View only 'Lycee G7-12' and 'Lycee G10-12' by unselecting all other categories in the school_of_cambodia layer

Discussion: Can you see the relationship between the 'DUSS' layer and the 'school_of_cambodia' layer that the symbology reveals?

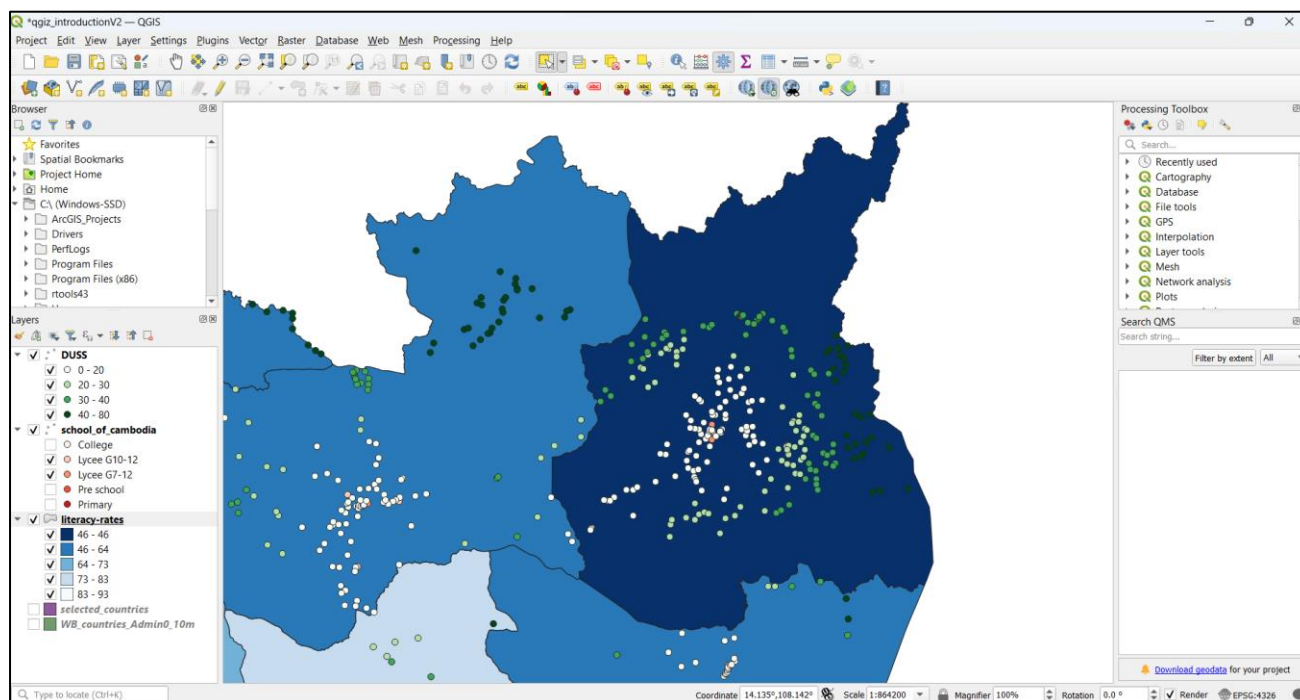


Figure 18: Villages and their distance from nearest upper secondary schools displayed alongside upper secondary school locations

5. According to the requirements of the NGO, villages >30km are considered villages of interest for this project, deselect all villages from the DUSS layer that are <30km from an upper secondary school (G7-12).

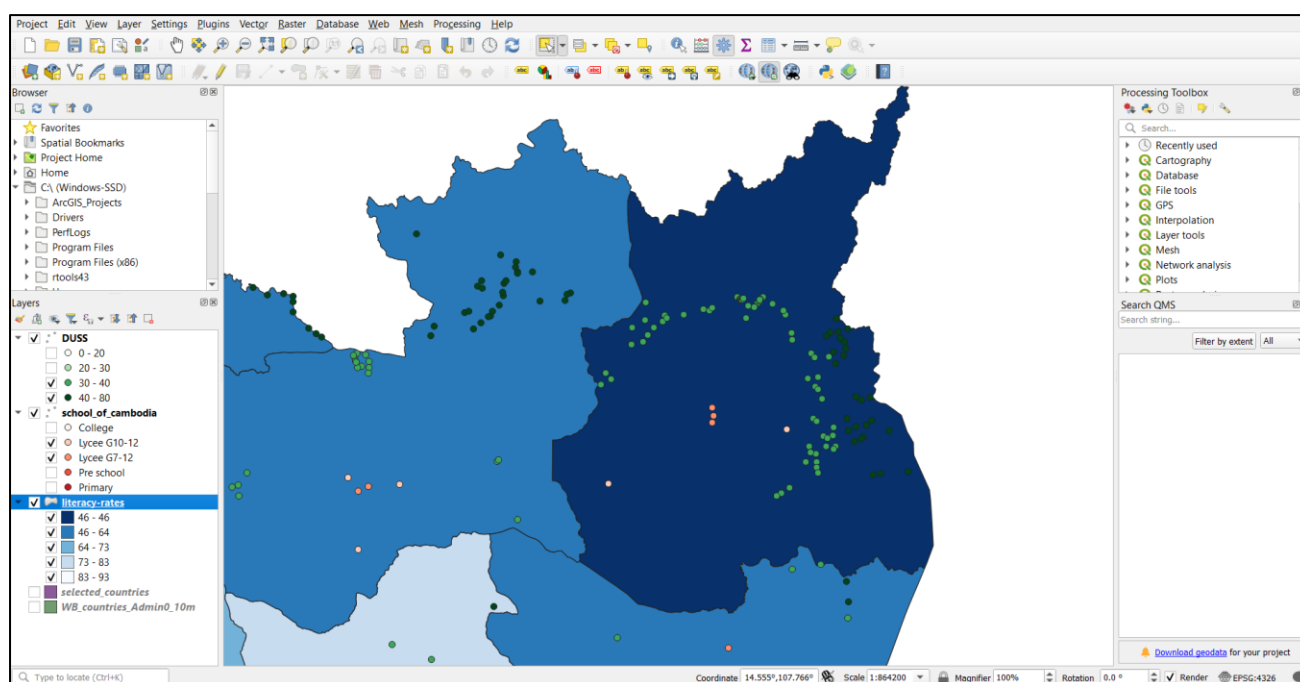


Figure 19: Villages >30km from the nearest upper secondary school alongside school locations

- Well done! You have used GIS to identify 93 villages in the Ratanak Kiri province who may benefit from the funding being offered by the NGO. Use the attribute table and the select tool to find out a few of the names of the villages.

Communes: Point in polygon analysis

This shapefile contains polygons that represent administrative boundaries for communes in Cambodia.

Case study: The NGO is happy with your identification of villages in the Ratanak Kiri Province but says that they do not have time to visit all of them. They have asked you to produce a map which shows the two communes with the most villages >30km from their nearest school.

- Drag the communes_cambodia.shp into the project
- Drag the commune layer underneath the DUSS layer and note the relationship between communes and villages
- Deselect the communes_cambodia layer in the 'Layers' pane so that it is no longer visible
- Highlight the DUSS layer by clicking on its name in the Layers pane
- Use the select tool to highlight all villages in Ratanak Kiri Province that are >30km from the nearest secondary school

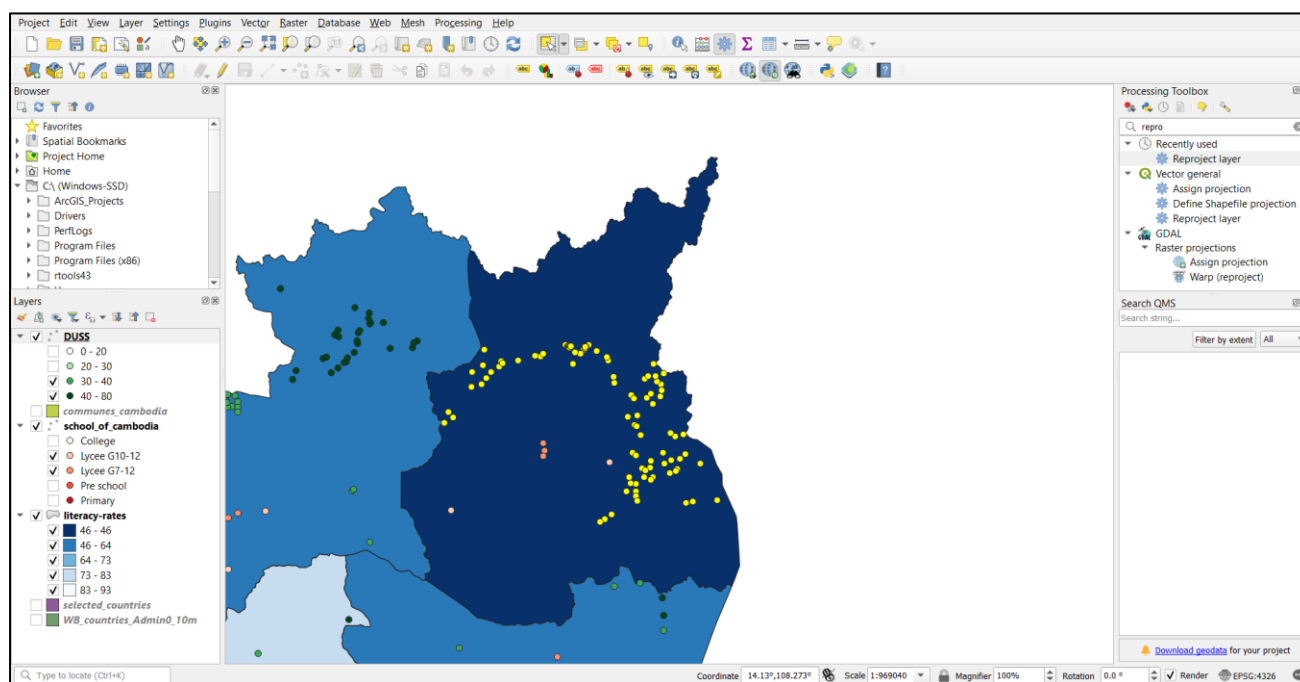


Figure 20: Villages (yellow) in the Ratanak Kiri province after using the select tool

- Use the 'Extract Selected Features' tool in the Processing Toolbox to create a new layer with only these villages (see Figure 21) for correct inputs

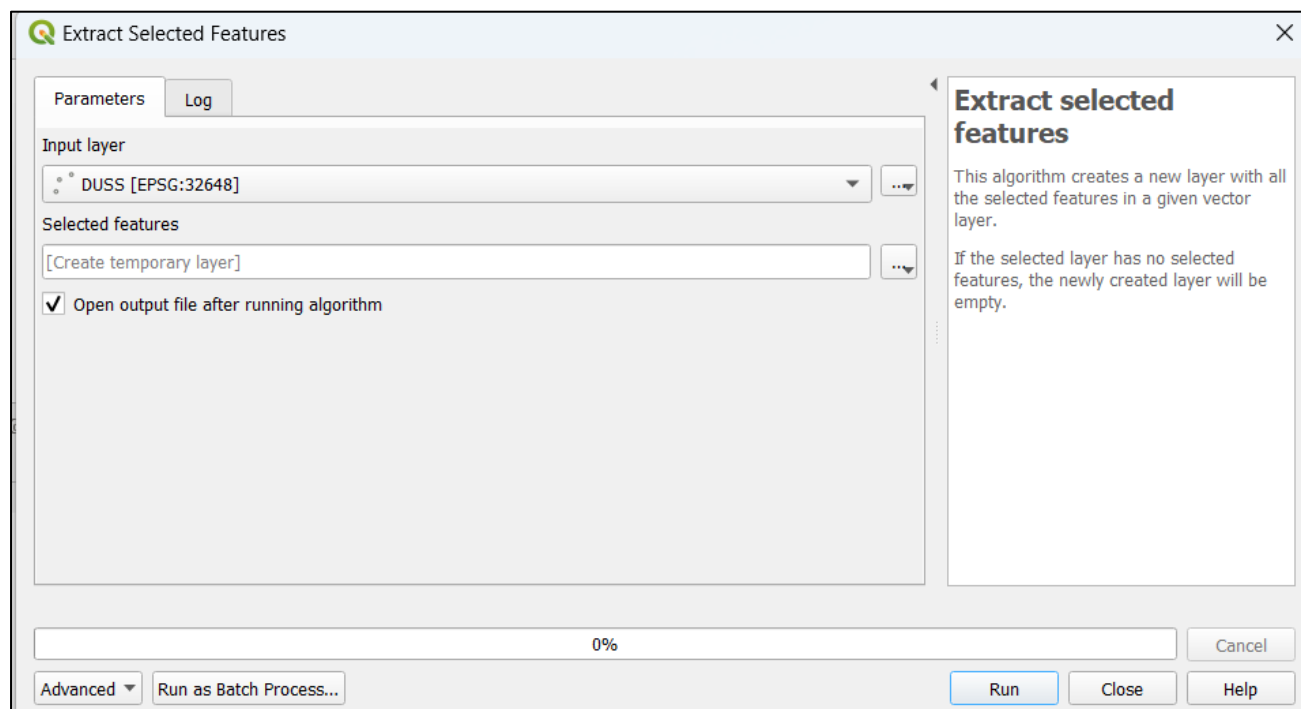


Figure 21: Extract Selected Features tool to create a new layer including selected villages in Ratanak Kiri province

7. Save your project
8. Rename the new 'Selected features' layer 'villages_thirty'
9. Right click on the Layer and click 'Make permanent'
10. Press the three dots to browse to your project folder
11. Save the file as 'villages_thirty' (see Figure 22)

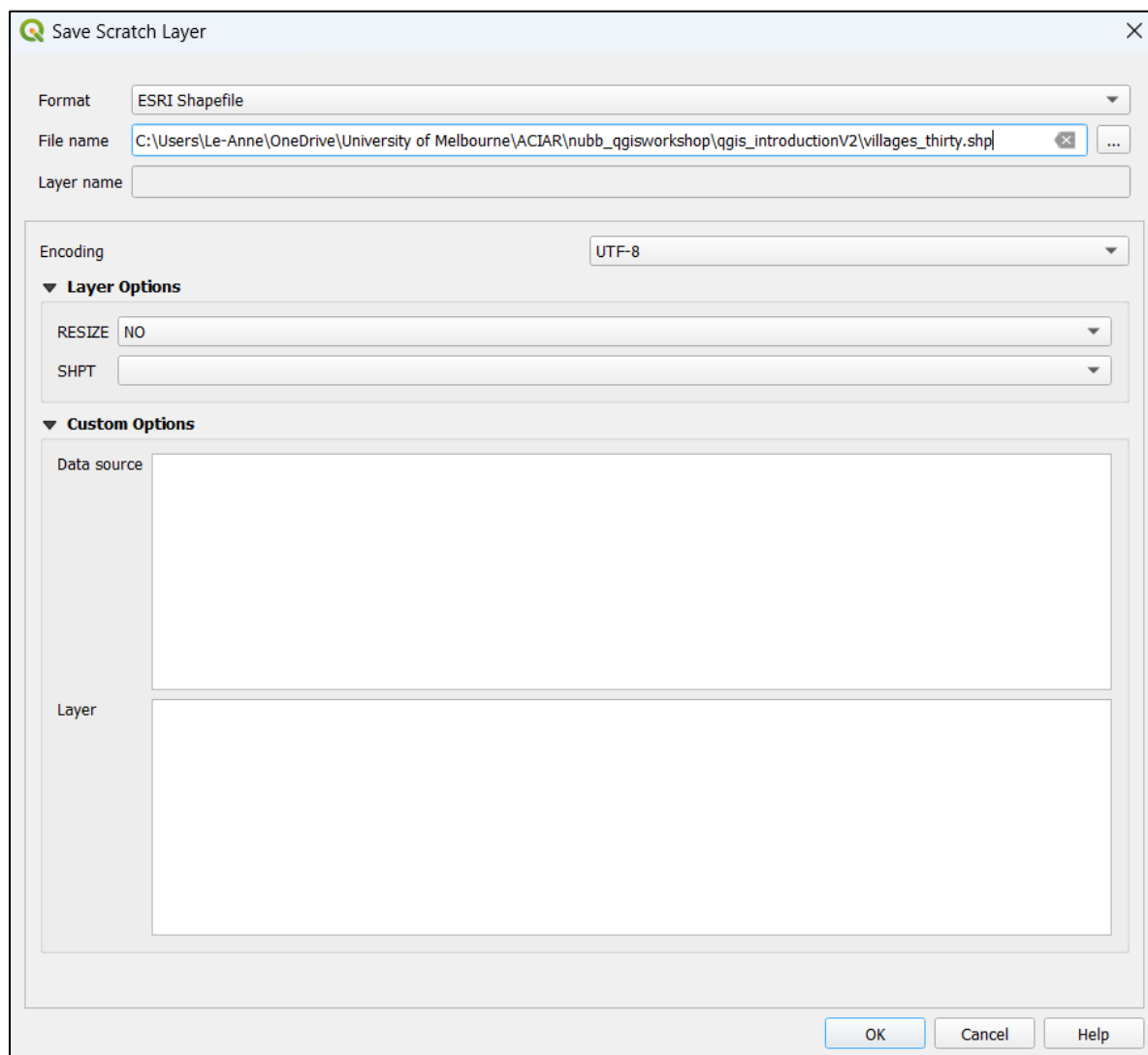
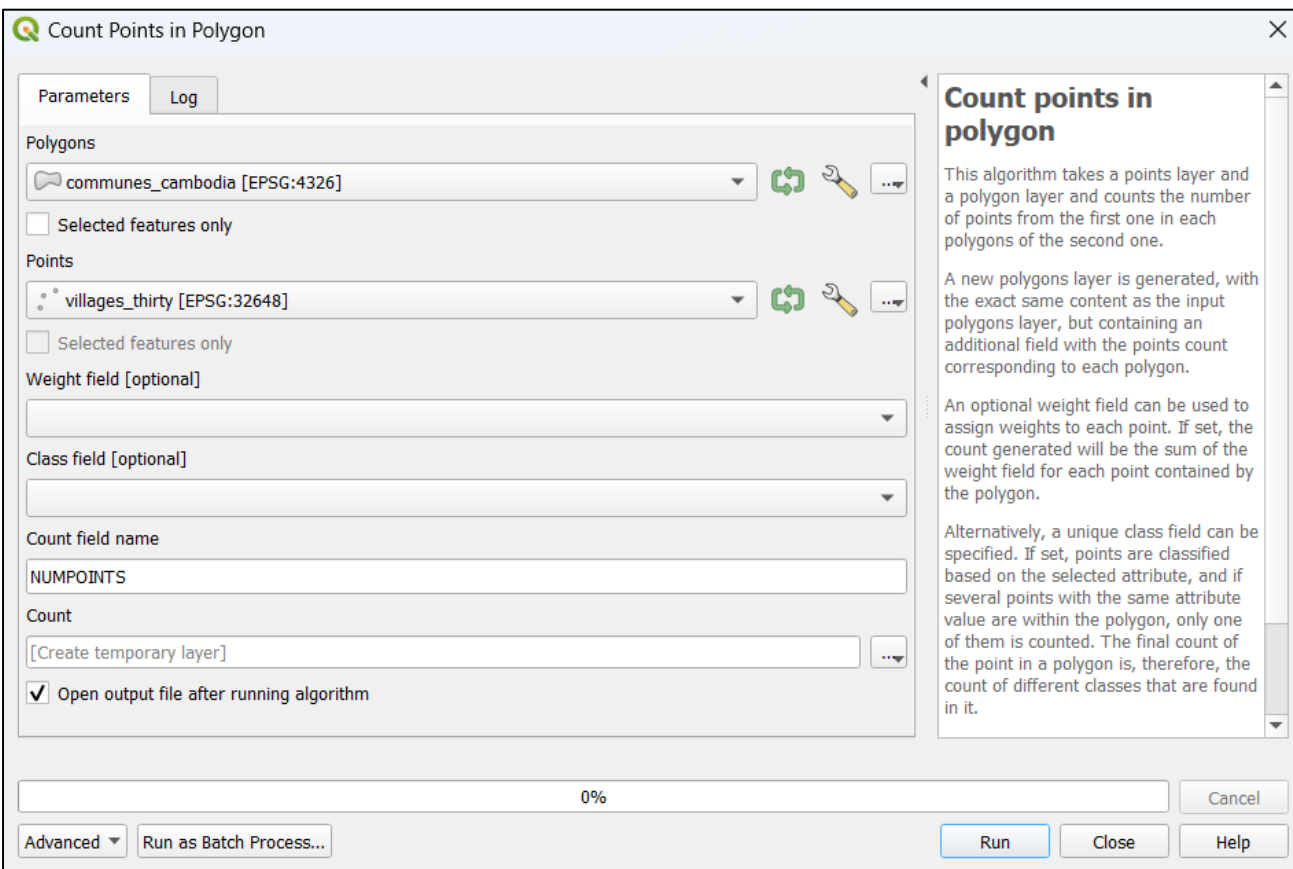


Figure 22: Make 'villages_thirty' layer permanent by saving it in your project folder

12. Press 'OK'
13. Search the 'Processing Toolbox' for the 'Count points in polygon' Vector tool
 - a. Select 'communes_cambodia' as the 'Polygons' layer
 - b. Select 'villages_thirty' as the 'Points' layer
14. Press 'OK'



Count points in polygon

This algorithm takes a points layer and a polygon layer and counts the number of points from the first one in each polygons of the second one.

A new polygons layer is generated, with the exact same content as the input polygons layer, but containing an additional field with the points count corresponding to each polygon.

An optional weight field can be used to assign weights to each point. If set, the count generated will be the sum of the weight field for each point contained by the polygon.

Alternatively, a unique class field can be specified. If set, points are classified based on the selected attribute, and if several points with the same attribute value are within the polygon, only one of them is counted. The final count of the point in a polygon is, therefore, the count of different classes that are found in it.

Figure 23: Correct inputs for 'Count Points in Polygon' tool

15. A new layer called 'Count' will appear in the Layers pane
16. View the attribute table and note which communes have the most 'NUMPOINTS'
17. Click the column name to sort in ascending order, note the two communes with the most amount of villages – Ta Vaeng Kraom (14) and Nhang (14)
18. Close the attribute table
19. Right click on the layer and go to 'Properties'
20. Navigate to the 'Symbology' tab
 - a. Change 'Single symbol' to 'Categorised'
 - b. Choose 'NUMPOINTS' for 'Value'
 - c. Click 'Classify'
 - d. Delete all classifications except '14'
 - e. Change the 'Symbol' colour to orange

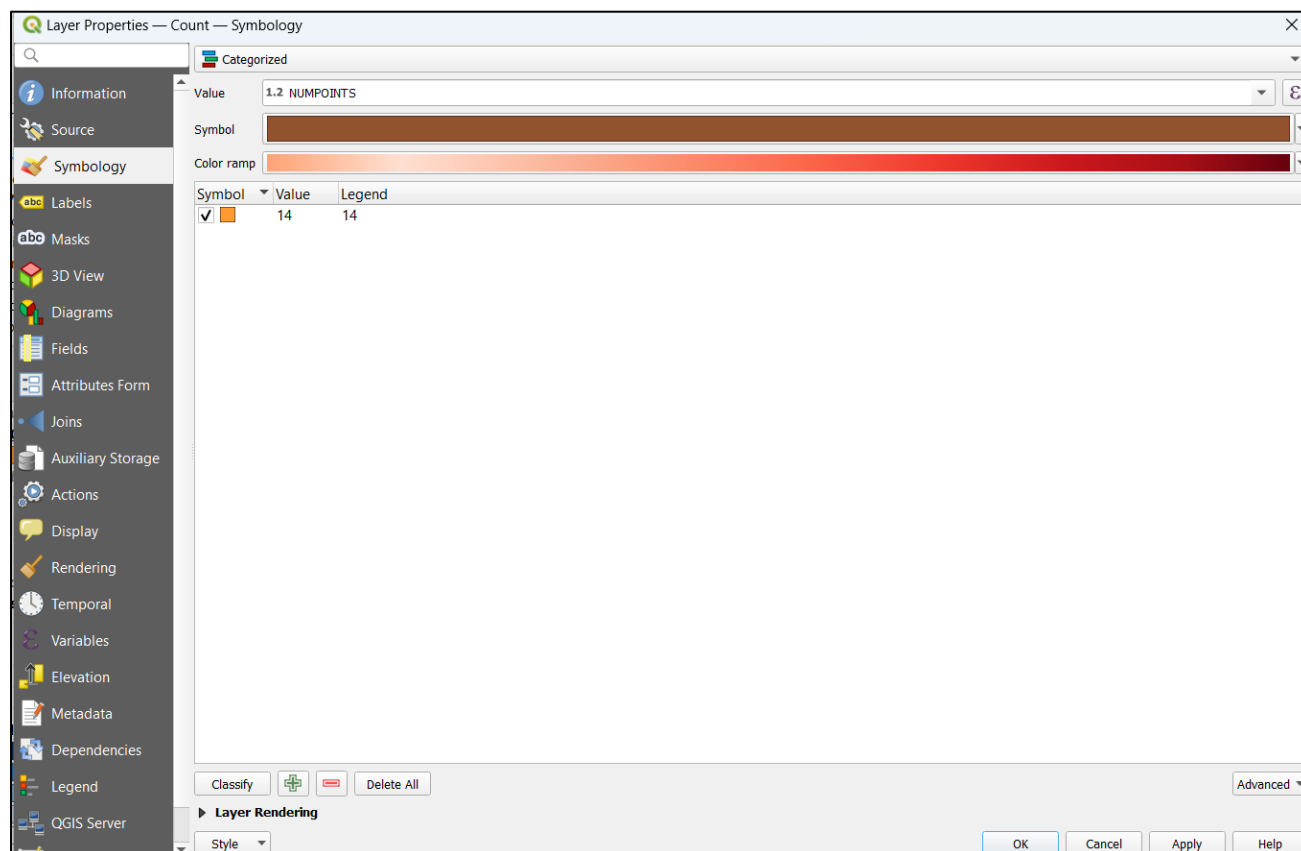


Figure 24: Correct selections to apply symbology to priority communes in the Ratanak Kiri Province

21. Navigate to 'Labels' tab in the Count layer
 - a. Select 'Single Labels' from the dropdown menu
 - b. Select 'COM_NAME' for 'Value'
 - c. Navigate to 'Buffer' tab
 - i. Select 'Draw text buffer'
 - ii. Set size to '0.8500' 'Millimetres'

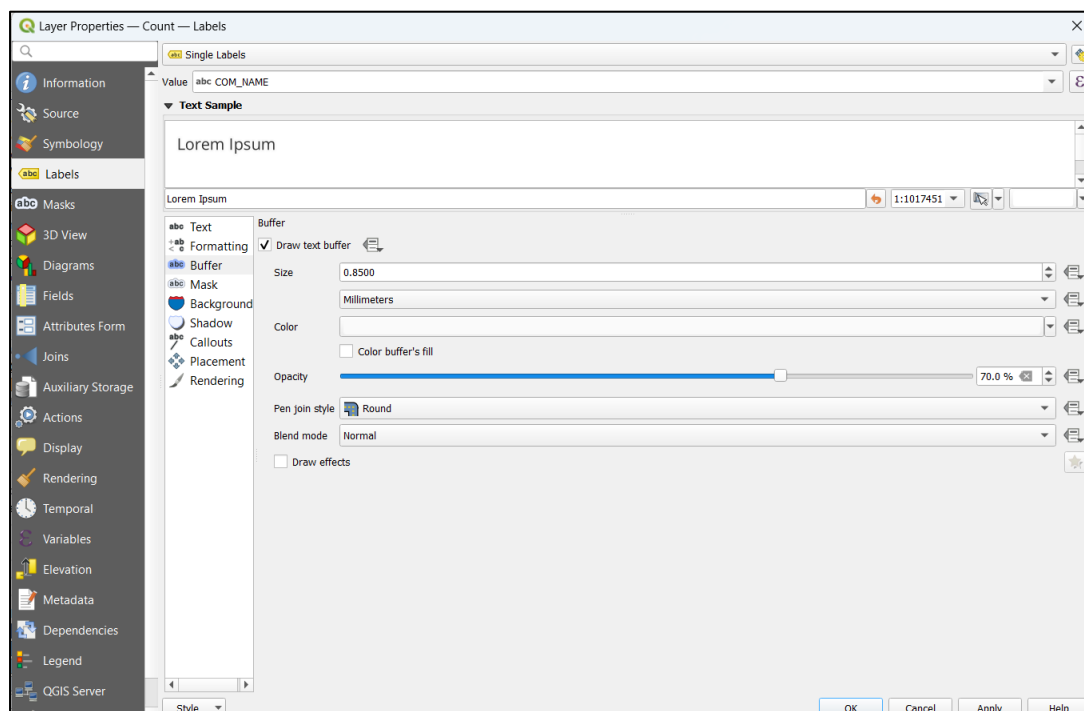


Figure 25: Correct selections to apply symbology to priority communes in the Ratanak Kiri Province

- d. Navigate to 'Placement' tab (see Figure 26)
 - i. Select 'Offset from Centroid' for 'Mode' and adjust placement to centre-left
- e. Press 'OK'

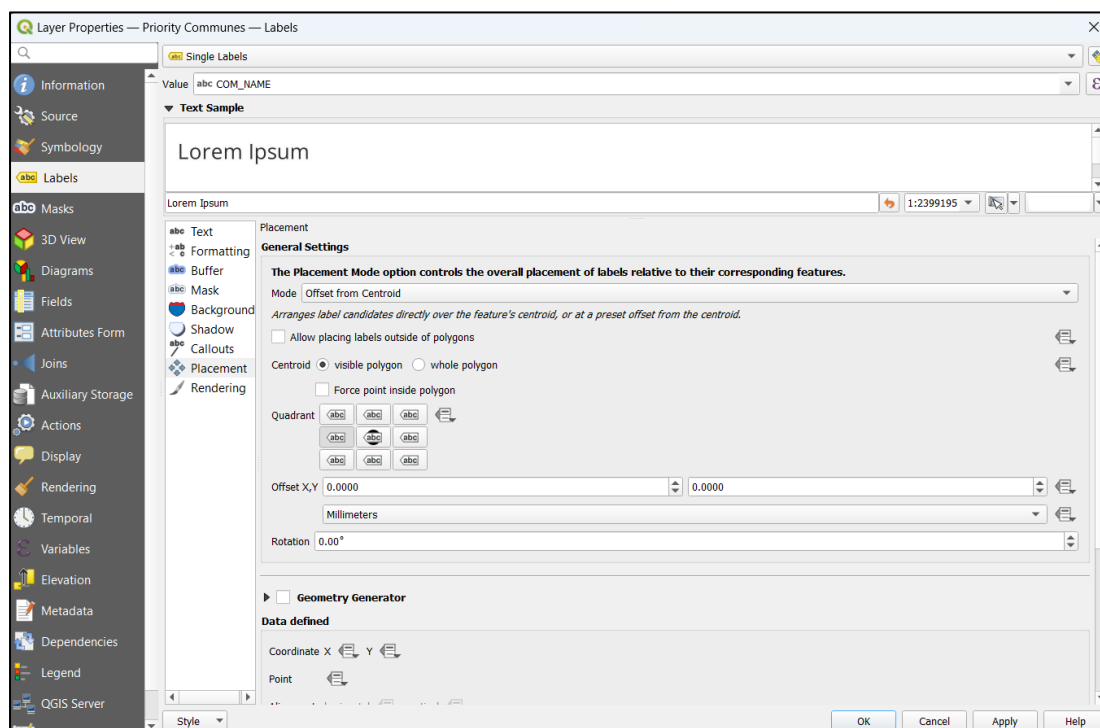


Figure 26: Correct selections to apply symbology to priority communes in the Ratanak Kiri Province

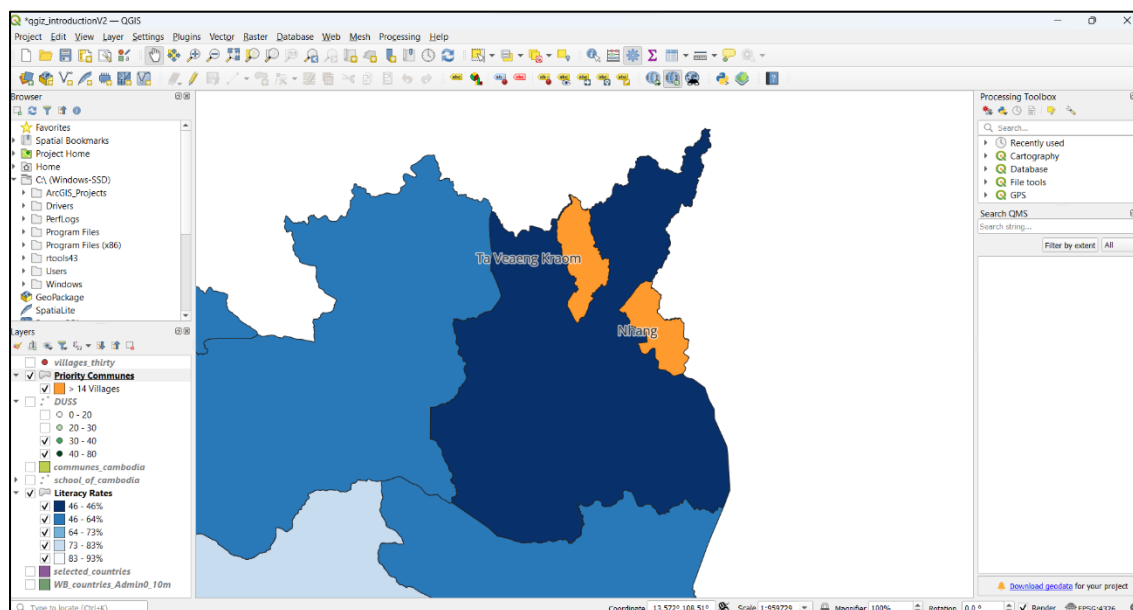


Figure 27: Project view after adjusting labels and symbology

22. Right click on 'Count' layer and rename to priority_communes
23. Right click on 'priority_communes' layer and click 'Make permanent'
24. Click on three dots to browse to project folder, save new shapefile (see Figure 28)
25. Leave encoding as UTF-8

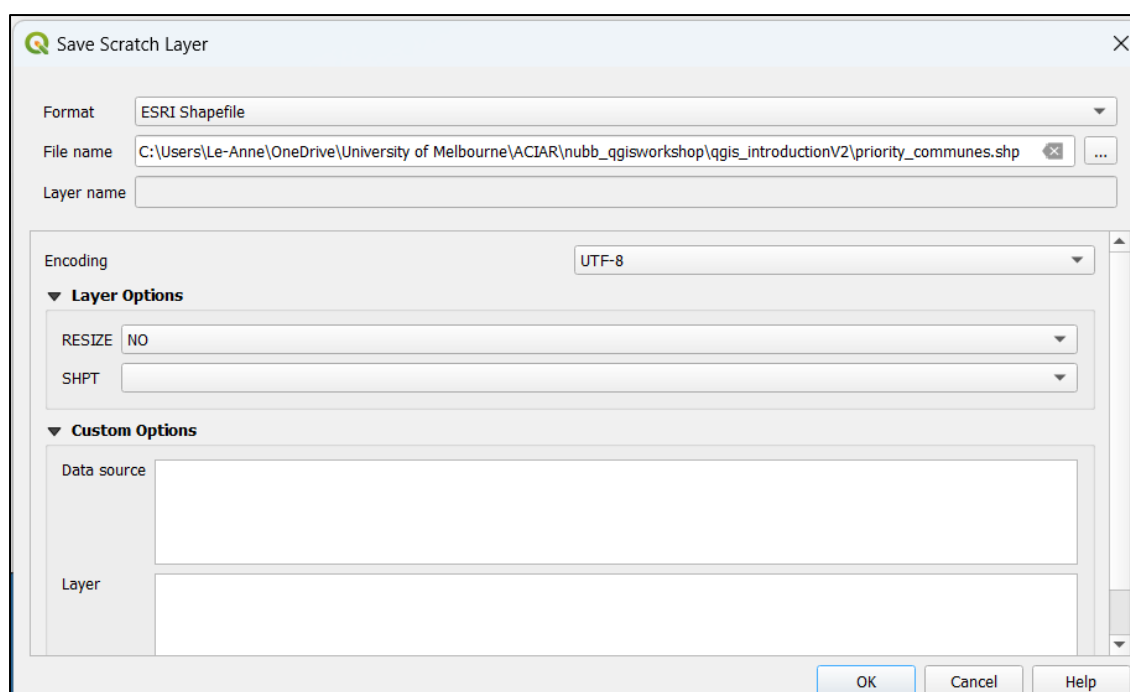


Figure 28: Make priority_communes layer permanent by saving as a new shape file

26. Press 'OK'

Creating a map for distribution

Now that you have identified the two communes with the highest need for a new school with your given data, you are ready to create a map to give to the decision makers to support your evidence.

1. Click on 'Project' and select 'New Print Layout'
2. A pop up will appear asking you to name the Print Layout, insert 'site_selection'
3. Zoom into the blank canvas so that it is an appropriate size
4. Select 'Add map' from the left side bar and draw a square where you would like your map to go.

Notes:

- Only selected layers that are visible in your project will be included in the Map Layout
- You can adjust layers in your project and press 'refresh' on your Map Layout to update your
- All items will display in the drawing order listed under 'Items' to the right of the screen

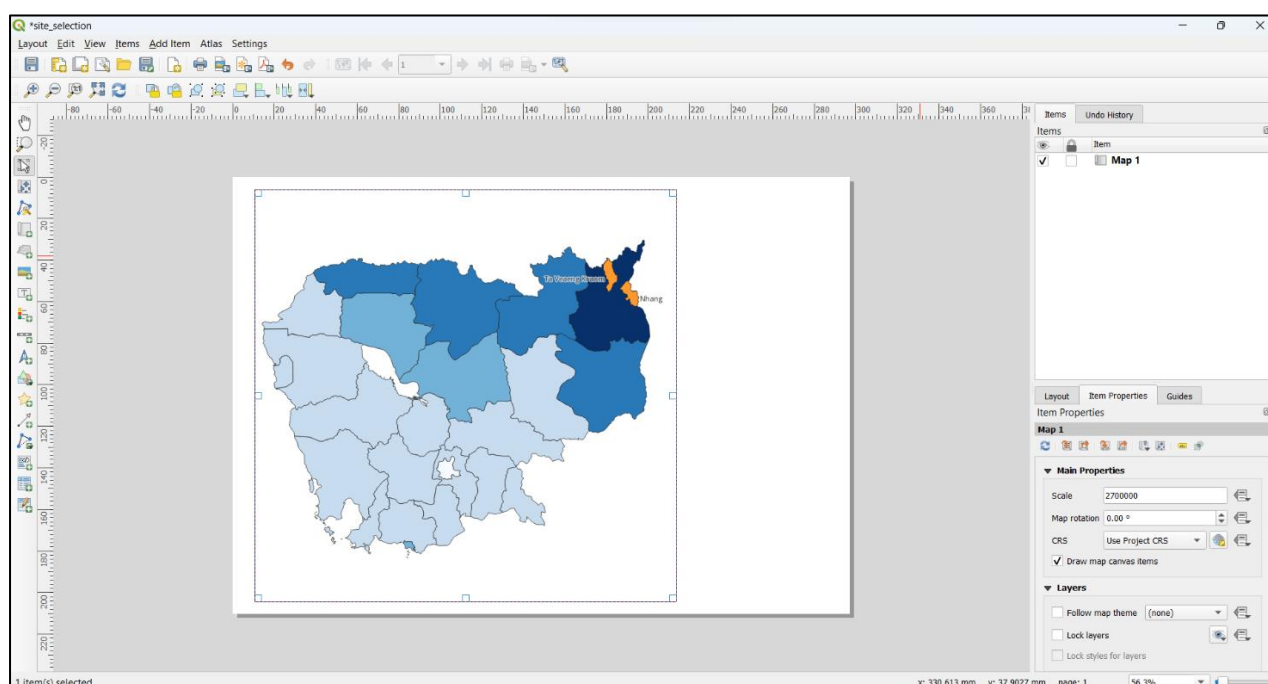


Figure 29: Map Layout view with map added

5. Click on Item Properties and set Scale to 2700000
6. Add map features using the options on the left of the screen such as:
 - a. Border (Shapes > Rectangle)
 - b. North arrow
 - c. Scale bar
 - d. Legend (ensure that you tick 'Only show items inside linked map')
 - e. Title

Note: There are many variations of Map Layouts and ways to adjust them, see this [Youtube video](https://youtu.be/LFJGLaH4Tvg?si=ViWKXyesuLofgkwY)² for a quick overview on some useful features.

² <https://youtu.be/LFJGLaH4Tvg?si=ViWKXyesuLofgkwY>

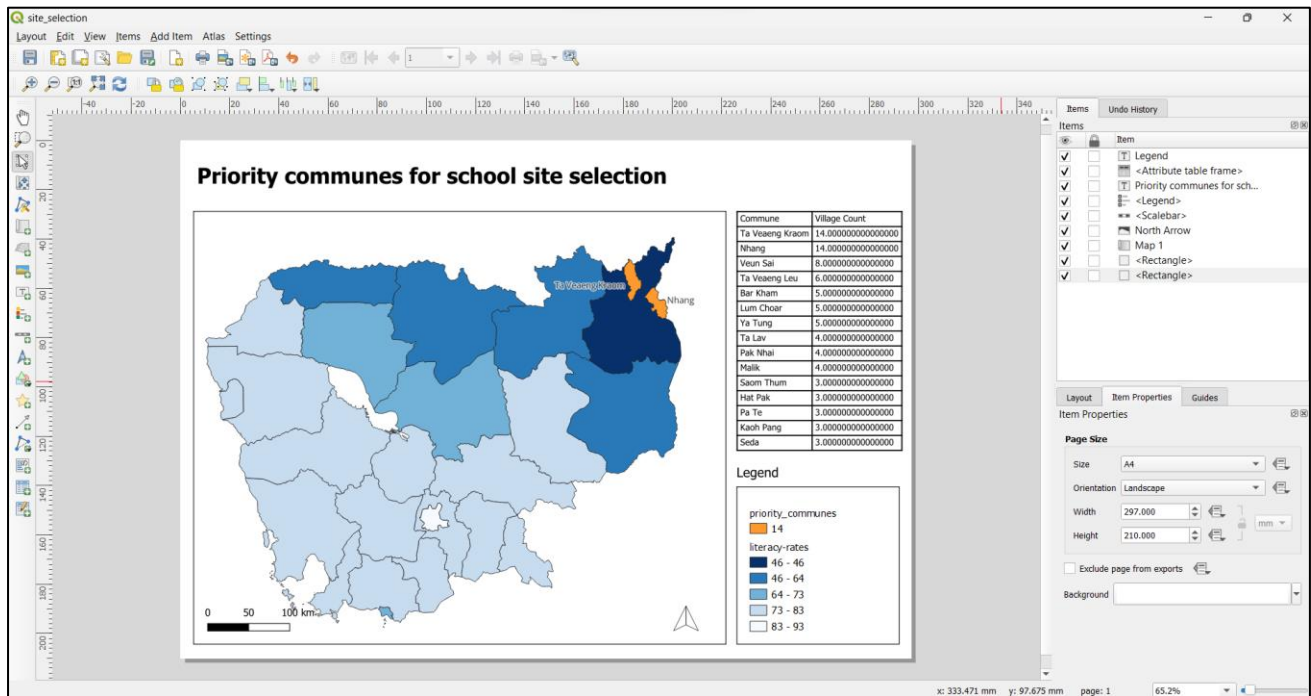
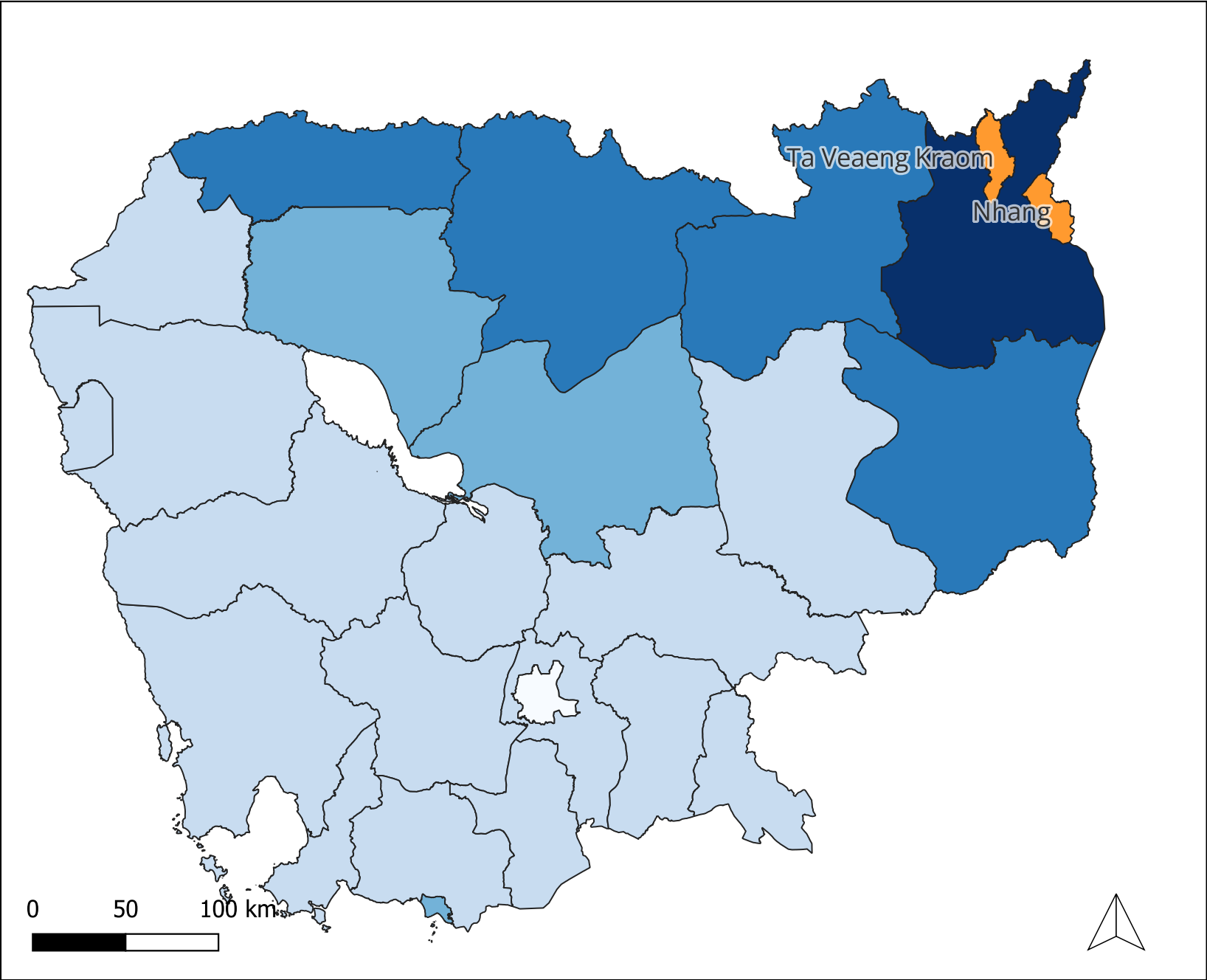


Figure 30: An example of a print layout ready for distribution

- Once you are happy with the way that your print layout looks, navigate to the top toolbar
- Select 'Export to PDF'
- Browse to folder where you want to save the PDF
- Keep all default options in the pop up and press 'Save'
- Navigate to folder on your desktop and admire your new map

Priority communes for school site selection



Commune	Village Count
Ta Veang Kraom	14.000000000000000
Nhang	14.000000000000000
Veun Sai	8.000000000000000
Ta Veang Leu	6.000000000000000
Bar Kham	5.000000000000000
Lum Choar	5.000000000000000
Ya Tung	5.000000000000000
Ta Lav	4.000000000000000
Pak Nhai	4.000000000000000
Malik	4.000000000000000
Saom Thum	3.000000000000000
Hat Pak	3.000000000000000
Pa Te	3.000000000000000
Kaoh Pang	3.000000000000000
Seda	3.000000000000000

Legend

