

GF-TADs Foot and Mouth Disease Risk Assessment Training Workshop

19 - 21 September 2023 Johannesburg, South Africa



Introduction to qGIS and disease mapping

Outline

- Part 1: Introduction to QGIS
- Part 2: Importing and Manipulating Data
- Part 3: Making a Choropleth Map
- Part 4: Layouts for Publication
- Part 5: Summary and Q&A

What is QGIS?

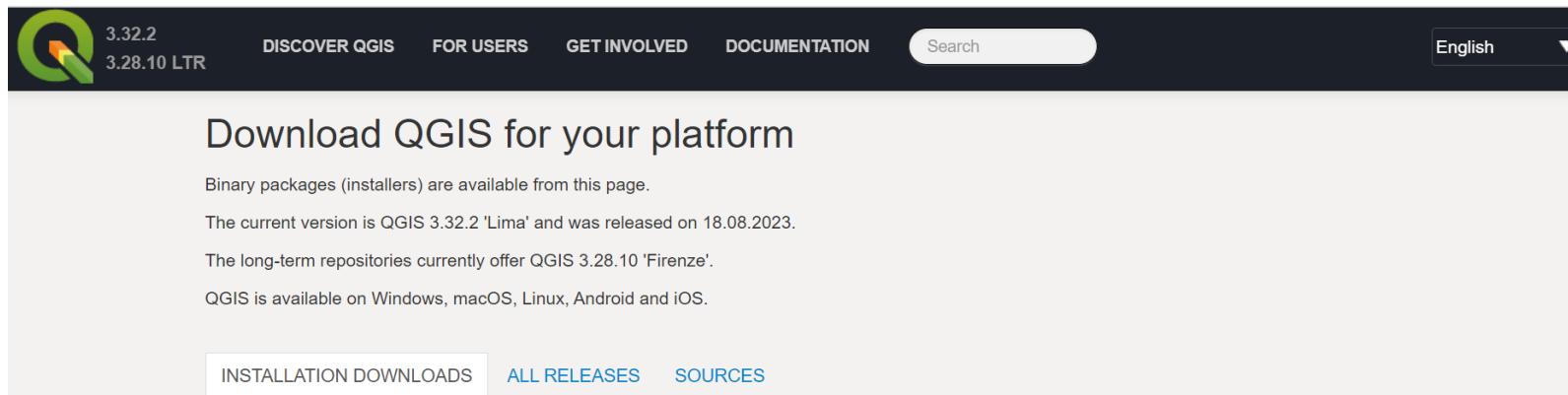
- Open-source Geographic Information System (GIS) software
- Collecting, storing, analyzing, and visualizing geospatial data
- Key features
 - **Data Handling**
 - shapefiles, GeoJSON, KML, PostGIS
 - raster data formats like GeoTIFF
 - **Symbology and Styling**
 - **Analysis Tools**
 - e.g. buffer, clipping, intersection, and network analysis
 - **Plugins**

QGIS - Typical Uses

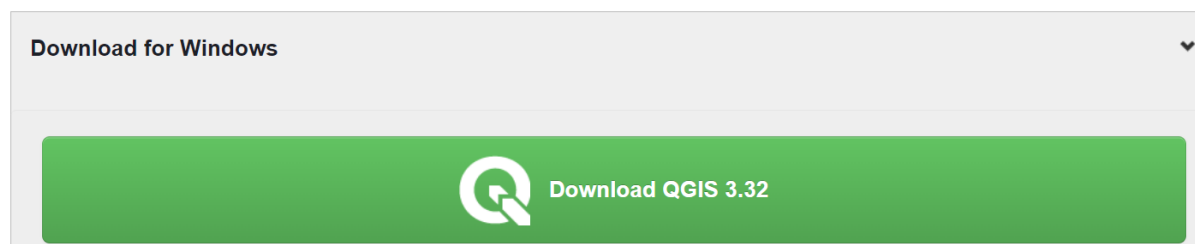
- **Mapping**
- **Spatial Analysis**
 - Analyze spatial relationships, conduct site suitability analysis, calculate distances
- **Data Conversion**
 - Convert geospatial data between different formats
- **Database Integration**
- **Remote Sensing**
- **Data Visualization**

Installing QGIS

- <https://qgis.org/en/site/forusers/download.html>
- Standard/express installation fine for most users

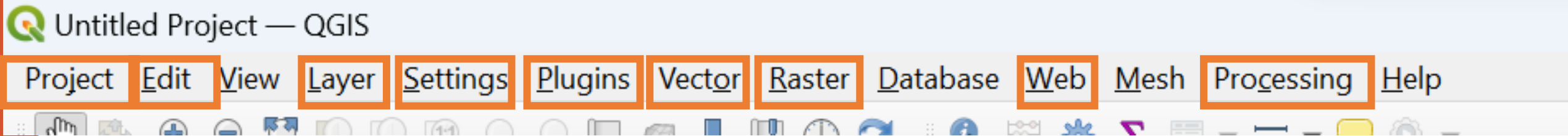


The screenshot shows the QGIS website's download page. At the top left, there is a QGIS logo and version information: 3.32.2 and 3.28.10 LTR. The navigation menu includes 'DISCOVER QGIS', 'FOR USERS', 'GET INVOLVED', and 'DOCUMENTATION', along with a search bar and a language dropdown set to 'English'. The main heading is 'Download QGIS for your platform'. Below this, it states: 'Binary packages (installers) are available from this page. The current version is QGIS 3.32.2 'Lima' and was released on 18.08.2023. The long-term repositories currently offer QGIS 3.28.10 'Firenze'. QGIS is available on Windows, macOS, Linux, Android and iOS.' At the bottom of the page, there are three tabs: 'INSTALLATION DOWNLOADS' (which is active), 'ALL RELEASES', and 'SOURCES'.



This block shows a specific download option for Windows. It features a grey header with the text 'Download for Windows' and a dropdown arrow. Below the header is a large green button with the QGIS logo and the text 'Download QGIS 3.32'.

QGIS Interface - Menu bar



- **Project:** Operations like creating a new project, opening an existing project, saving, and exporting.

- **Edit:** Tools for editing features and attributes.

- **View:** Options for controlling the view of the map canvas, such as zooming and panning.

- **Layer:** Options for adding, removing, and managing layers.

- **Settings:** General settings, project properties, and customization.

- **Plugins:** Access to QGIS plugins.

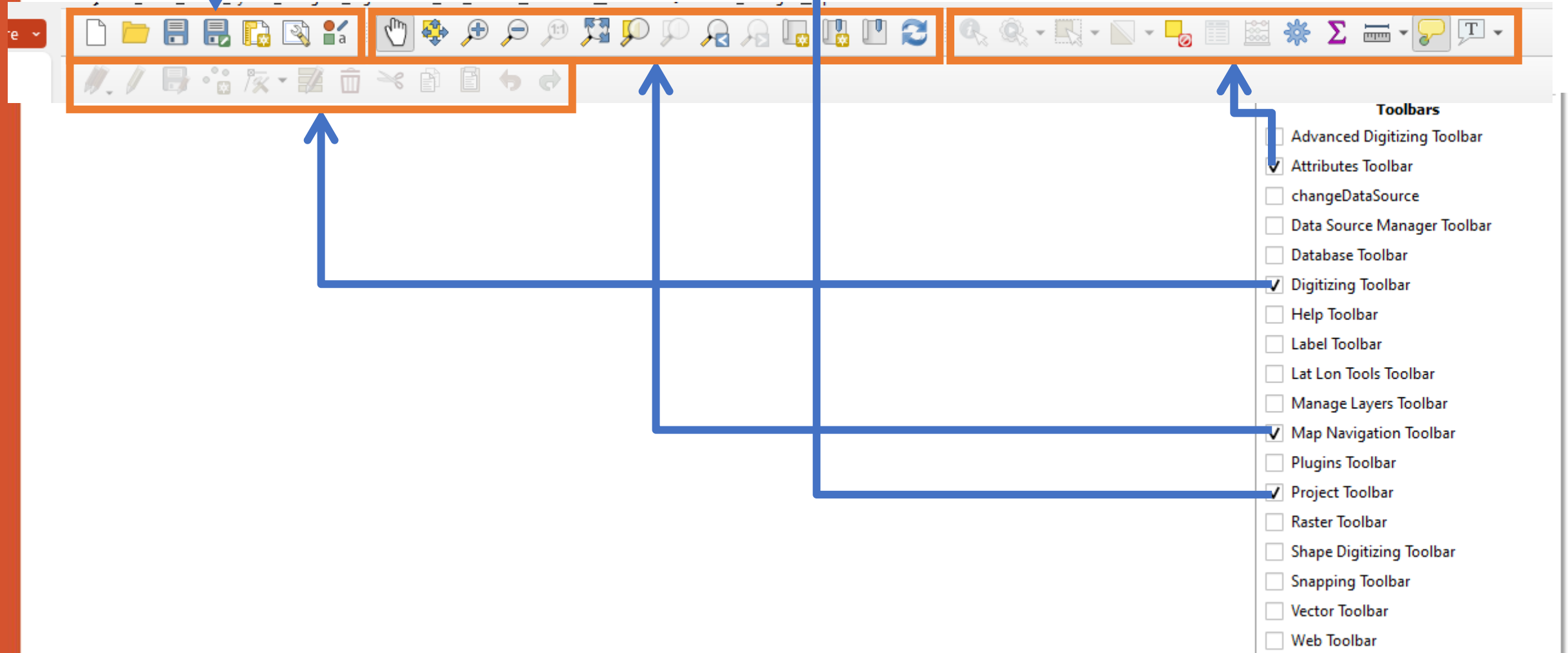
- **Raster:** Tools for raster data analysis and manipulation.

- **Vector:** Tools for vector data analysis and manipulation.

- **Web:** Tools for adding web maps and services.

- **Processing:** Opens the Processing Toolbox for various geoprocessing tasks.

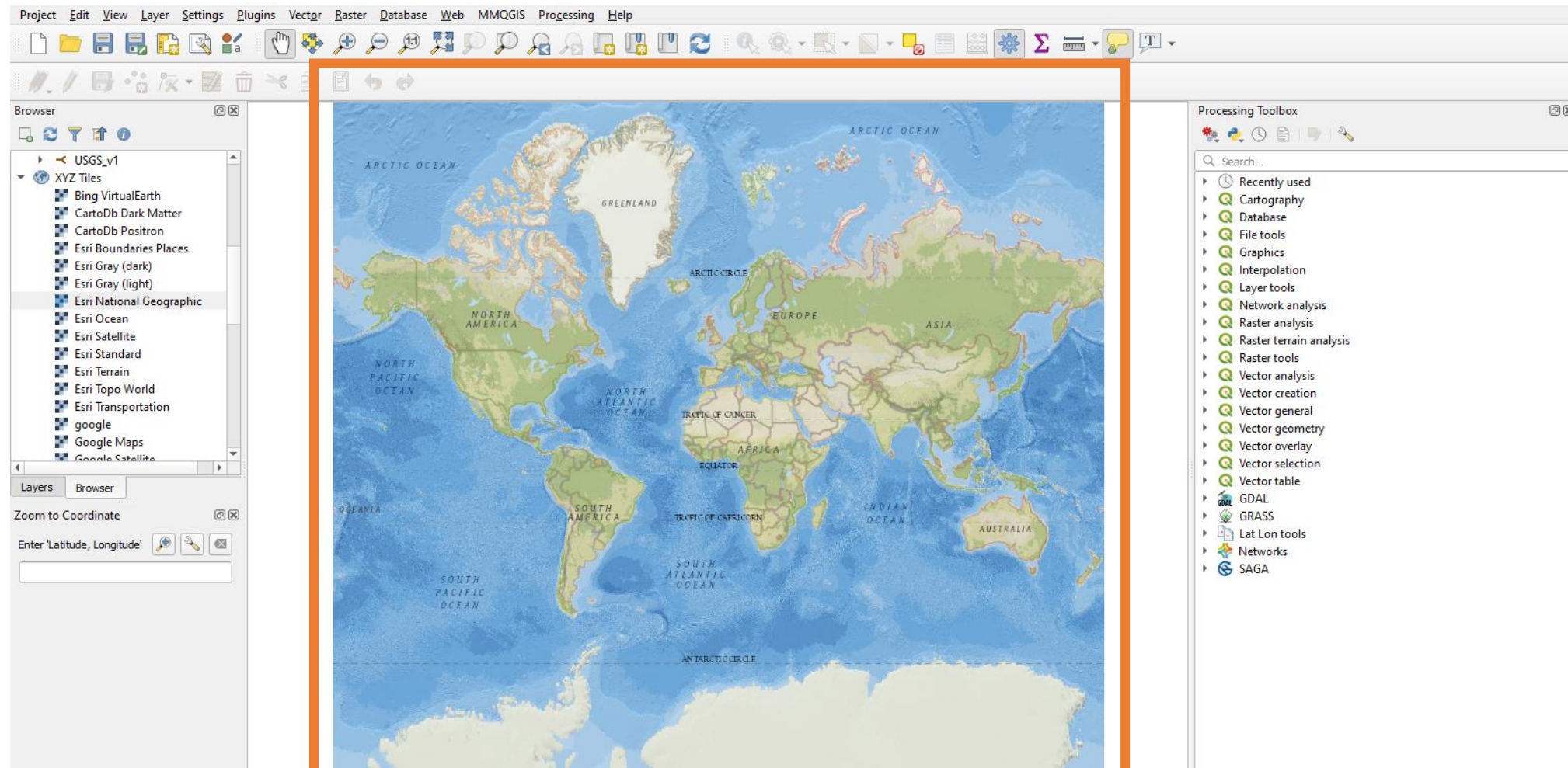
QGIS Interface - Toolbars



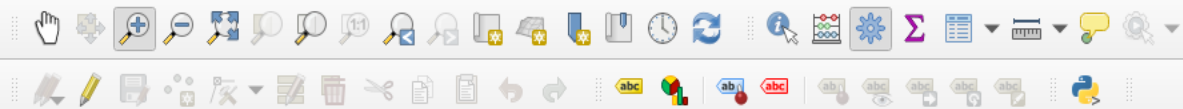
The image displays the QGIS interface with several toolbars highlighted by orange boxes. A 'Toolbars' configuration panel is shown on the right, listing various toolbars with checkboxes. Blue arrows indicate the mapping between the checked items in the panel and the corresponding toolbars in the interface:

- Attributes Toolbar
- Digitizing Toolbar
- Map Navigation Toolbar
- Project Toolbar

QGIS Interface – Map canvas



QGIS Interface – Layers Panel



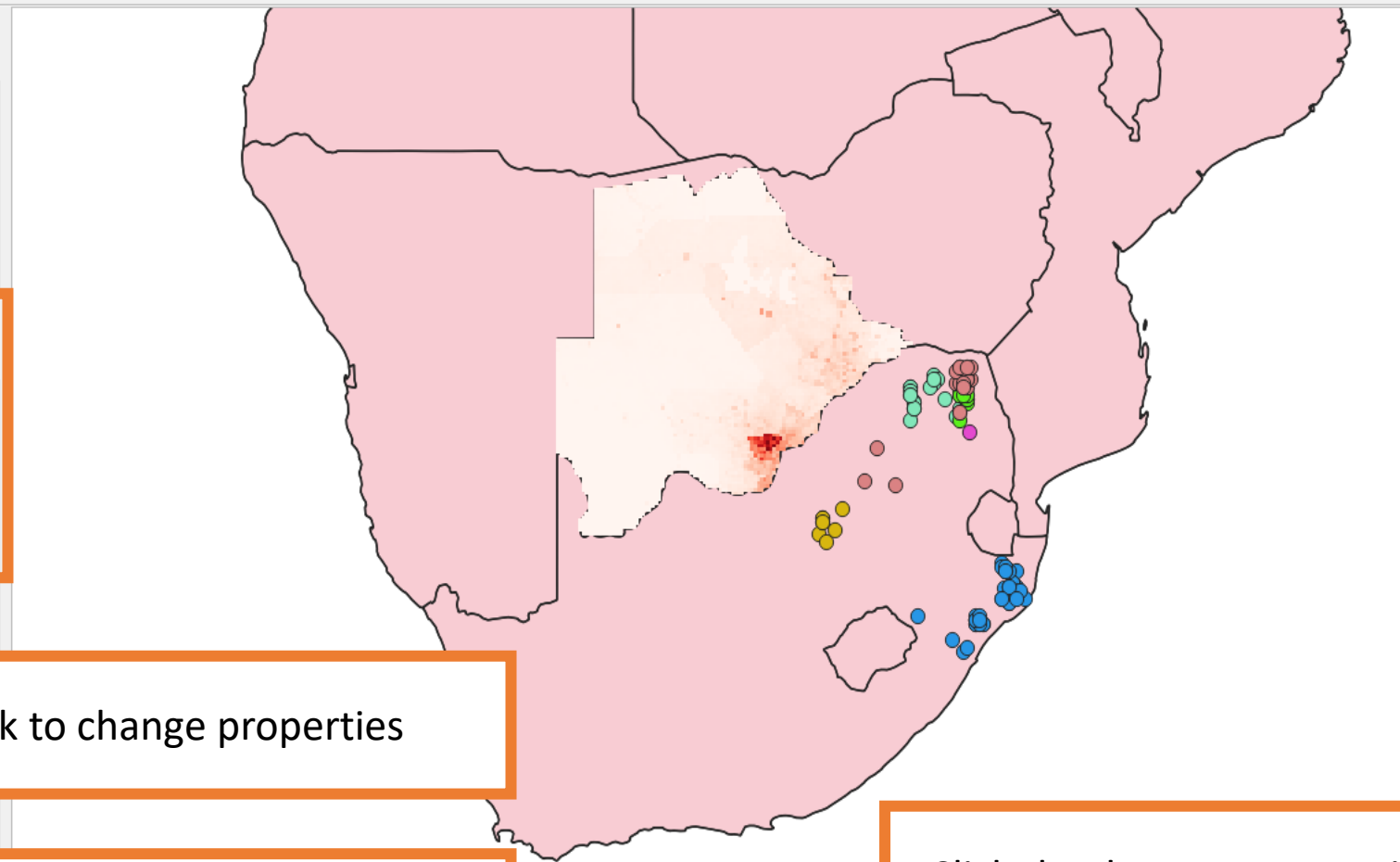
Layer type is shown

Browser

- ★ Favorites
- ▶ Spatial Bookmarks
- ▶ Home
- ▶ C:\ (OS)
- ▶ D:\ (HDDTB)
- ▶ G:\ (Google Drive)

Layers

- rsafmd
- cattleDensity
- countries
- continents



Processing Toolbox

Search...

- ▶ Recently used
- ▶ Cartography
- ▶ Database
- ▶ File tools
- ▶ GPS
- ▶ Interpolation
- ▶ Layer tools
- ▶ Mesh
- ▶ Network analysis
- ▶ Plots
- ▶ Raster analysis
- ▶ Raster creation
- ▶ Raster terrain analysis
- ▶ Raster tools
- ▶ Vector analysis
- ▶ Vector creation
- ▶ Vector general
- ▶ Vector geometry
- ▶ Vector overlay

GRASS

Double click to change properties

Right click for common functions

Click the down arrow to view symbology

QGIS Interface – Browser Panel



Access csv and shapefiles

Access online data sets
(Look for XYZ Tiles)

Browser

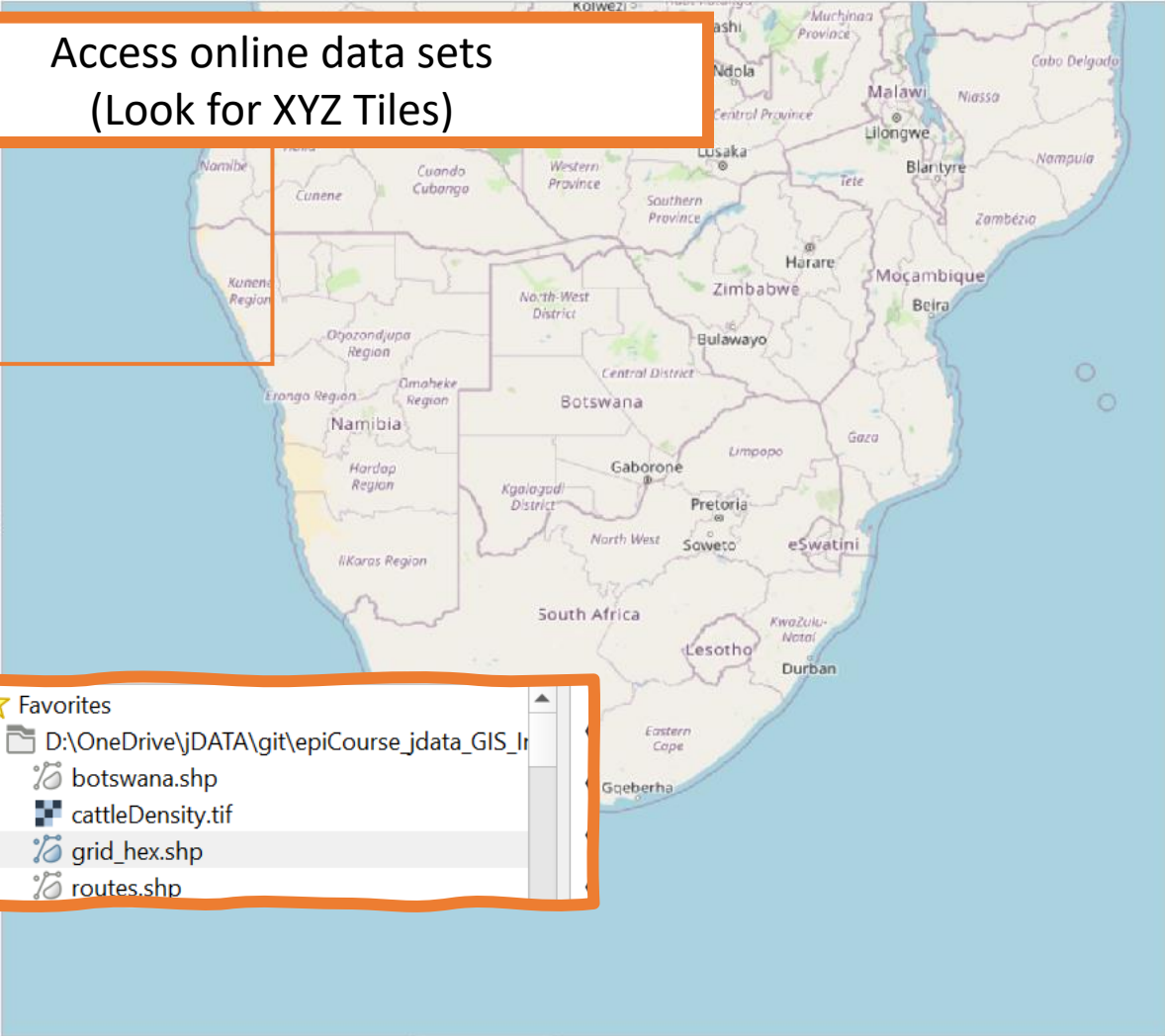
- SpatialLite
- PostGIS
- SAP HANA
- MSSQL
- Oracle
- WMS/WMTS
- Vector Tiles
- XYZ Tiles
- cartoLightNoLabels
- OpenStreetMap**
- WCS

Layers

- OpenStreetMap**
- rsafmd
- cattleDensity
- countries
- continents

★ Favorites

- D:\OneDrive\jDATA\git\epiCourse_jdata_GIS_Ir
 - botswana.shp
 - cattleDensity.tif
 - grid_hex.shp
 - routes.shp

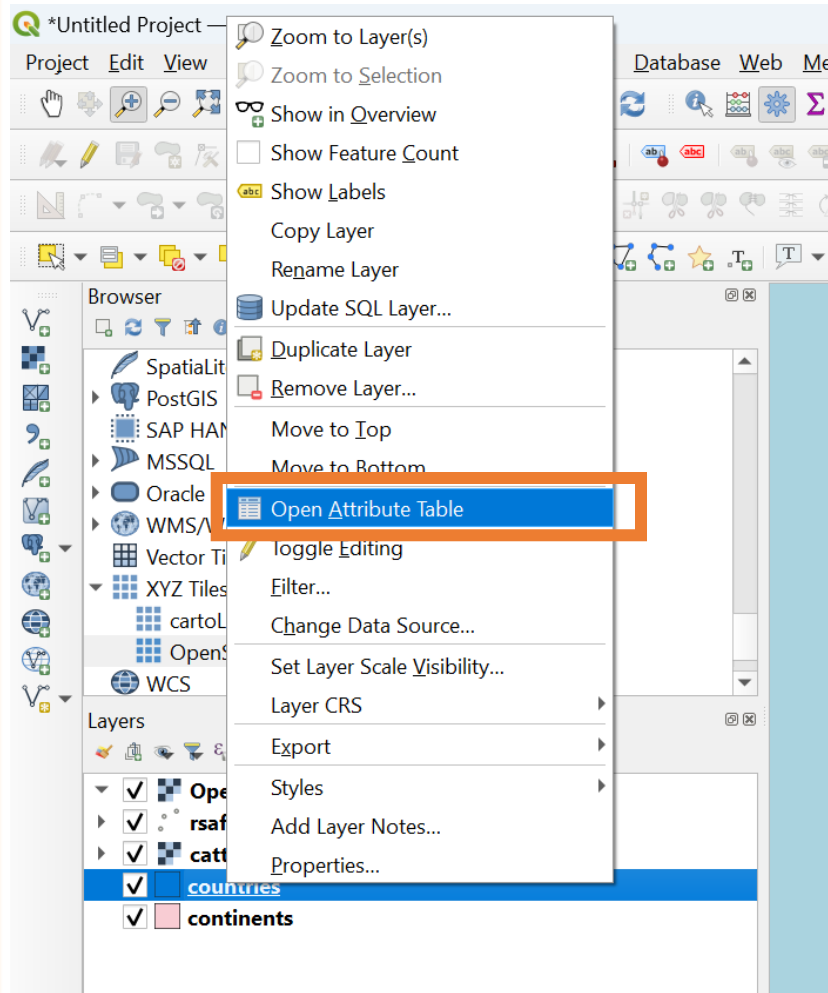
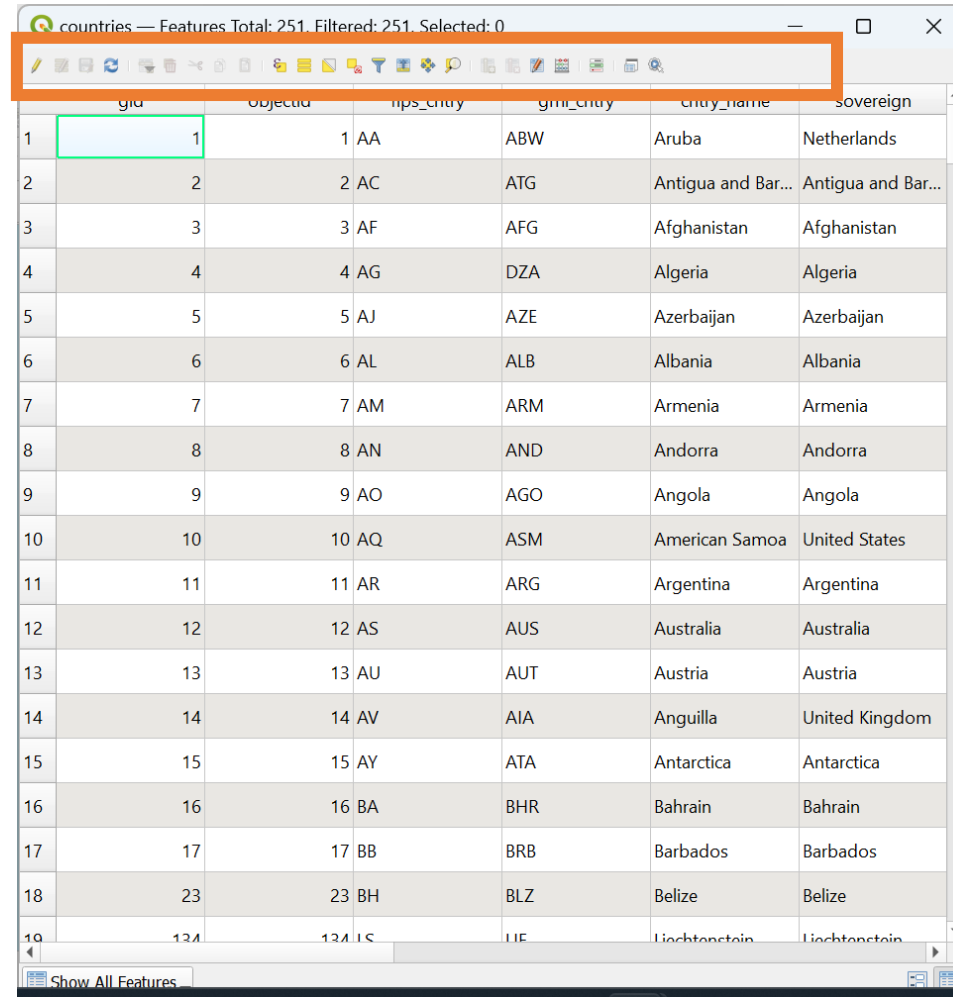


Processing Toolbox

Search...

- Recently used
- Cartography
- Database
- File tools
- GPS
- Interpolation
- Layer tools
- Mesh
- Network analysis
- Plots
- Raster analysis
- Raster creation
- Raster terrain analysis
- Raster tools
- Vector analysis
- Vector creation
- Vector general
- Vector geometry
- Vector overlay
- Vector selection
- Vector table
- Vector tiles
- GDAL
- GRASS

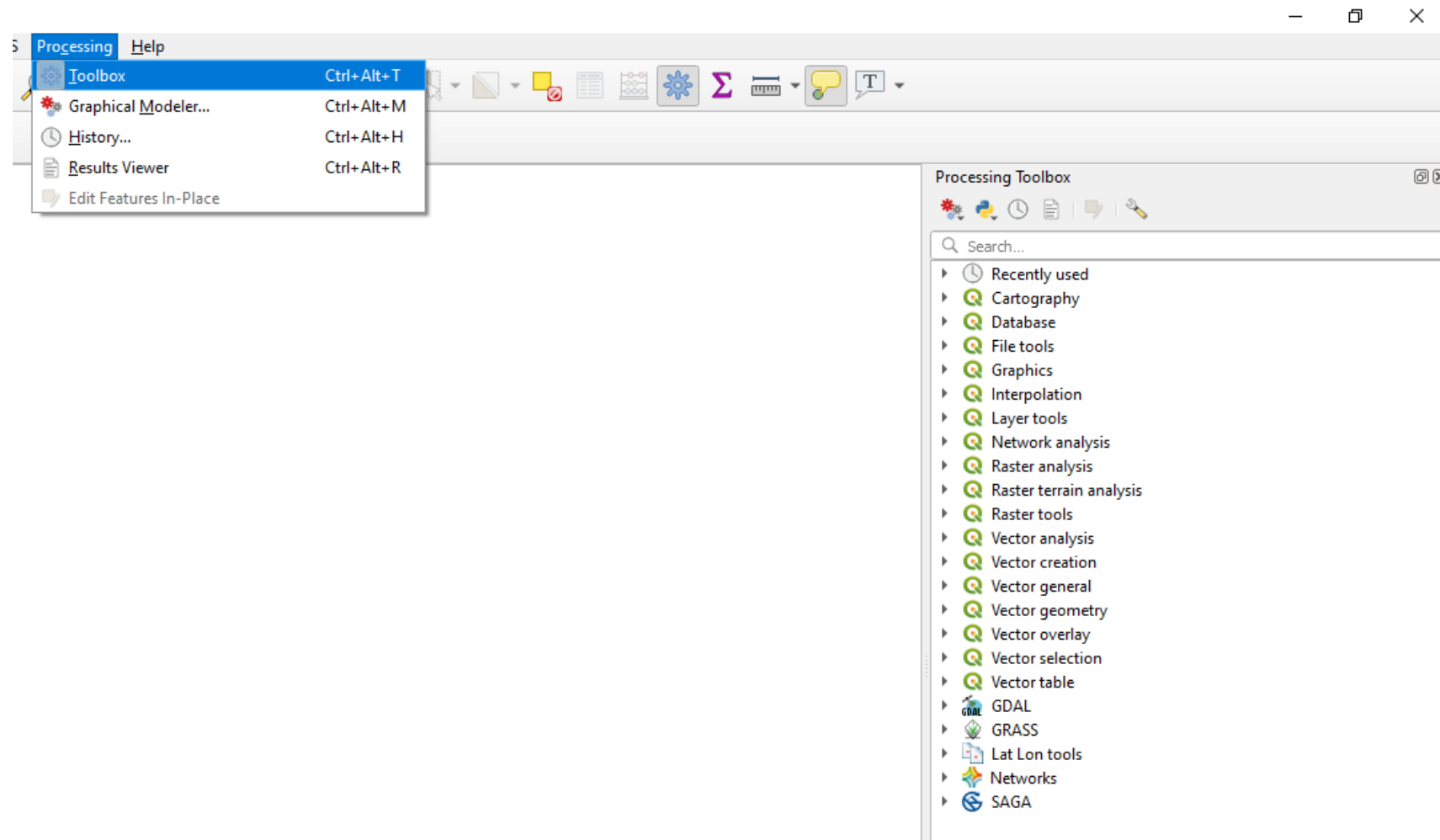
QGIS Interface – Attribute Table

The screenshot shows the QGIS Attribute Table for the 'countries' layer. The table title 'countries' is highlighted with an orange box. The table has 6 columns: 'id', 'objectid', 'hps_entry', 'gmt_entry', 'entry_name', and 'sovereign'. The first row is highlighted with a green box. The table contains 251 rows of data, with the first 19 rows visible. The 'Show All Features' button is visible at the bottom left of the table.

	id	objectid	hps_entry	gmt_entry	entry_name	sovereign
1	1	1	AA	ABW	Aruba	Netherlands
2	2	2	AC	ATG	Antigua and Bar...	Antigua and Bar...
3	3	3	AF	AFG	Afghanistan	Afghanistan
4	4	4	AG	DZA	Algeria	Algeria
5	5	5	AJ	AZE	Azerbaijan	Azerbaijan
6	6	6	AL	ALB	Albania	Albania
7	7	7	AM	ARM	Armenia	Armenia
8	8	8	AN	AND	Andorra	Andorra
9	9	9	AO	AGO	Angola	Angola
10	10	10	AQ	ASM	American Samoa	United States
11	11	11	AR	ARG	Argentina	Argentina
12	12	12	AS	AUS	Australia	Australia
13	13	13	AU	AUT	Austria	Austria
14	14	14	AV	AIA	Anguilla	United Kingdom
15	15	15	AY	ATA	Antarctica	Antarctica
16	16	16	BA	BHR	Bahrain	Bahrain
17	17	17	BB	BRB	Barbados	Barbados
18	23	23	BH	BLZ	Belize	Belize
19	134	134	LS	LIE	Liechtenstein	Liechtenstein

QGIS Interface – Processing Toolbox

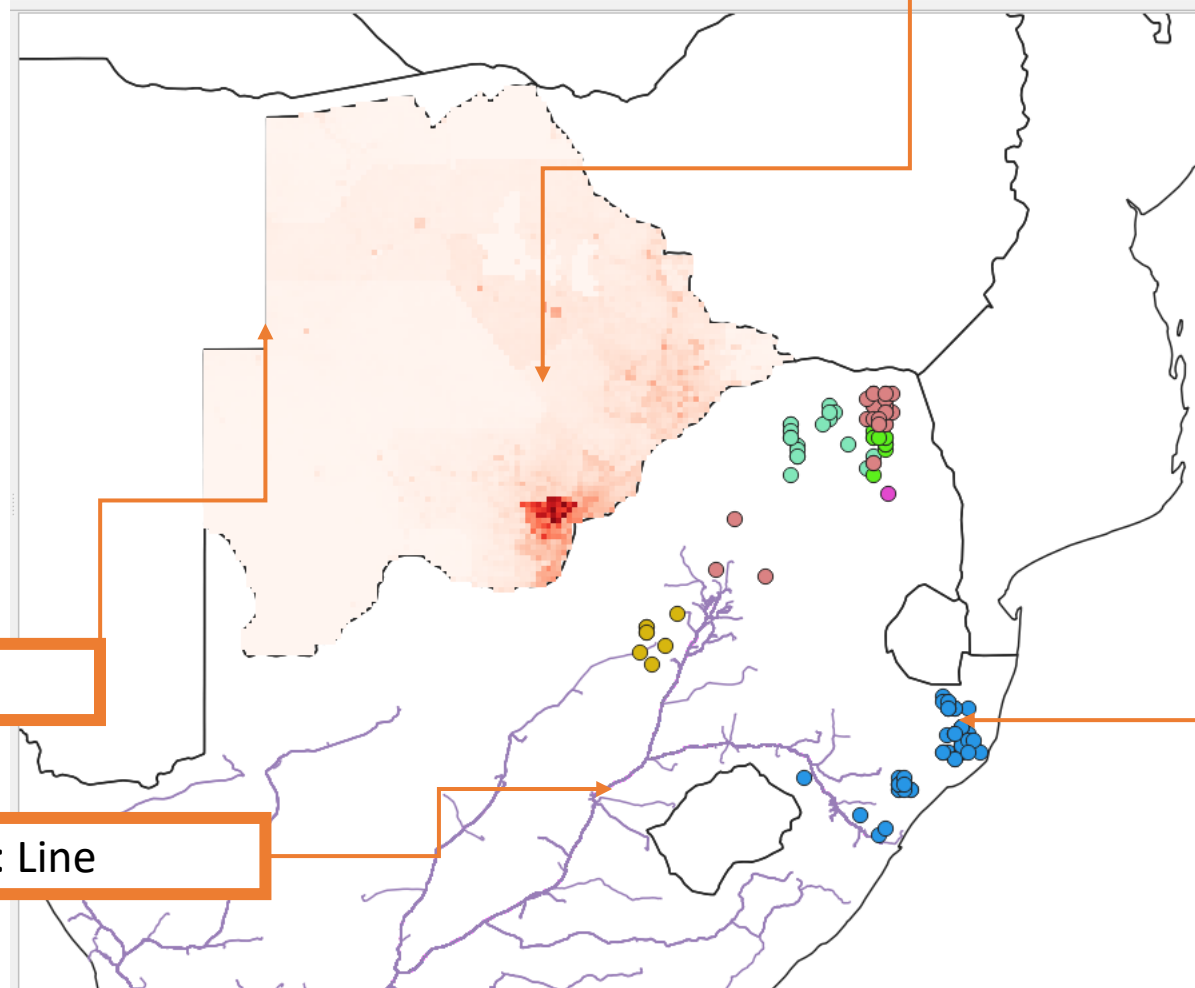


Basic Operations

- Adding vector layers
- Symbolising layers
- Adding labels
- Creating maps for publication

Data Types in QGIS

Raster

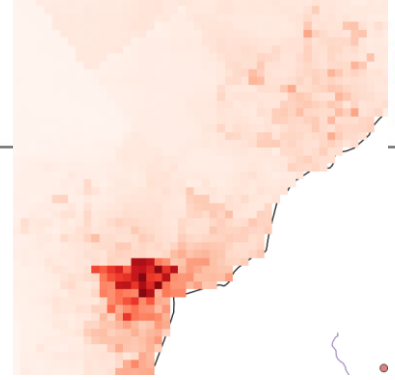


Vector: Polygon

Vector: Line

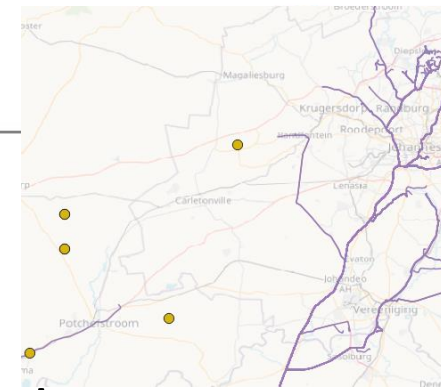
Vector: Point

Raster data



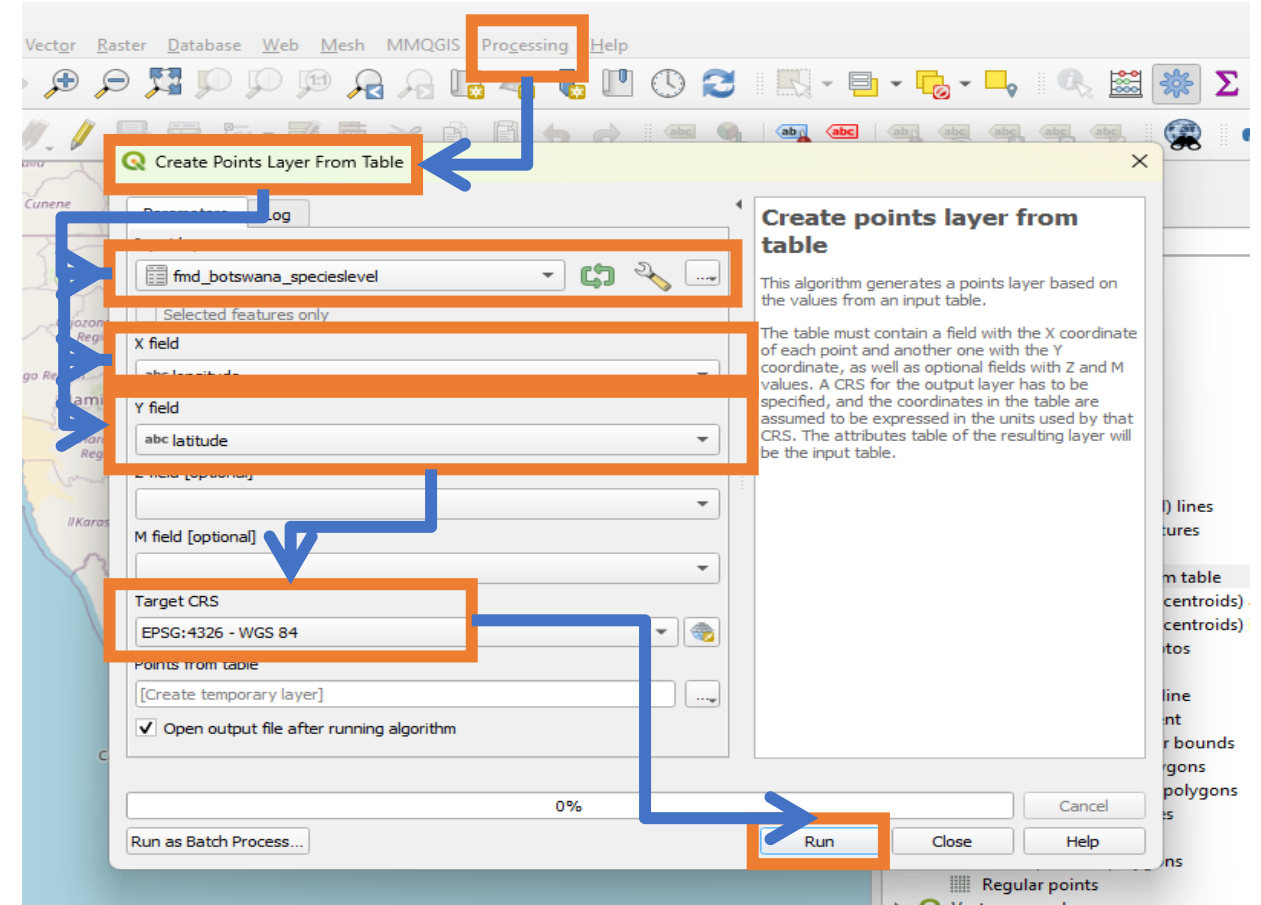
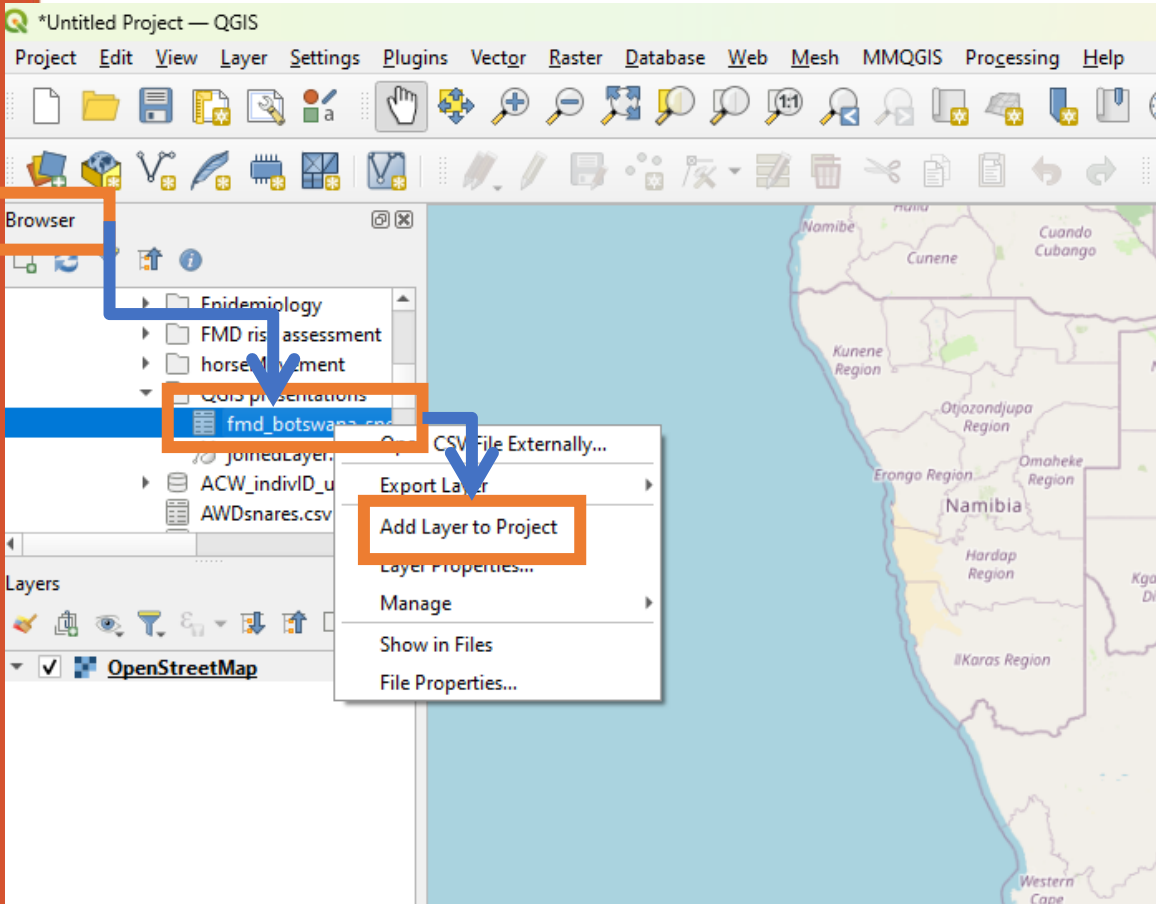
- A raster data type is essentially a grid-based representation of a spatial area. Each cell in the grid holds a value that represents some attribute like elevation, temperature, or color.
 - Climate modeling
 - Elevation mapping
 - Land cover analysis
- GeoTIFF, JPEG, PNG
- Good for representing continuous data
- Easier and quicker to process computationally
- Less accurate for representing sharp boundaries or lines
- Large file sizes for high-resolution data

Vector Data

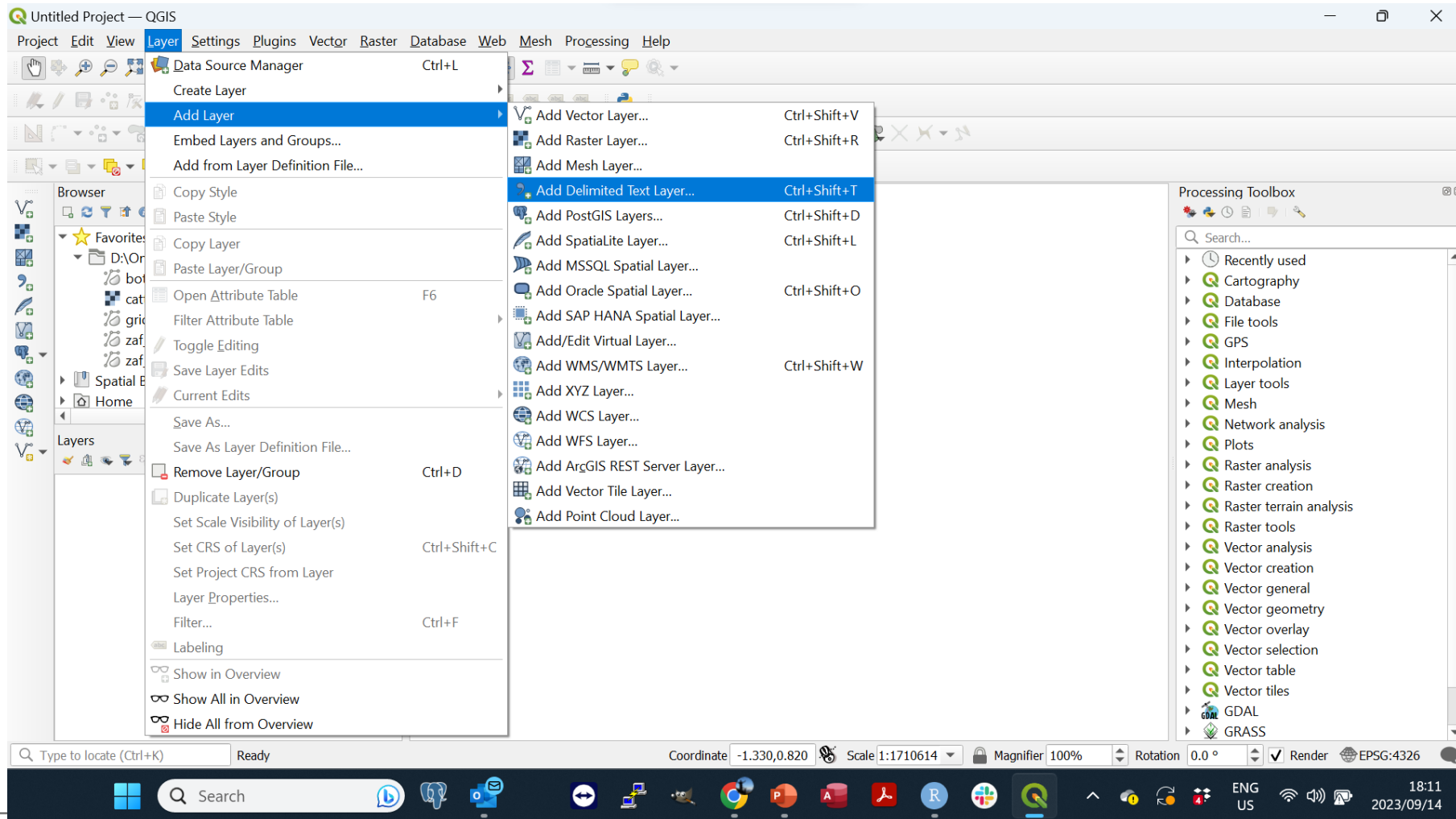


- Vector data consists of geometries defined by vertices and paths to describe real-world features. There are three main types: points, lines, and polygons.
- Shapefiles (.shp), GeoJSON, KML
- Precise representation of features
- Attribute tables for complex metadata
- Can be computationally intensive for complex geometries
- Requires more work to set up attribute tables and feature classes

Importing CSV Data



Importing CSV Data (alternative)



- Browser
- Vector
- Raster
- Mesh
- Point Cloud
- Delimited Text**
- GeoPackage
- GPS
- SpatialLite
- PostgreSQL
- MSSQL
- Oracle
- Virtual Layer
- SAP HANA
- WMS/WMTS
- WFS / OGC API - Features
- WCS
- XYZ
- Vector Tile
- ArcGIS REST Server
- GeoNode

File name D:\OneDrive\jDATA\git\epiCourse_jdata_GIS_Introduction\data\fmd_botswana_outbreaklevel.csv

Layer name fmd_botswana_outbreaklevel Encoding UTF-8

File Format

- CSV (comma separated values)
- Regular expression delimiter
- Custom delimiters

Record and Fields Options

- Number of header lines to discard: 0
- First record has field names
- Detect field types
- Decimal separator is comma
- Trim fields
- Discard empty fields

Geometry Definition

- Point coordinates
 - X field: longitude
 - Y field: latitude
 - Z field: [empty]
 - M field: [empty]
- Well known text (WKT)
- No geometry (attribute only table)
- DMS coordinates
- Geometry CRS: EPSG:4326 - WGS 84

Layer Settings

Sample Data

	region	country	diseases	outbreakRef	eventRef	eventStartDate	latitude	longitude	species
1	Africa	Botswana	Foot and mouth disease virus (Inf. with)	10326	1000018554	2011-02-04	-20.58317	22.3368	all
2	Africa	Botswana	Foot and mouth disease virus (Inf. with)	10548	1000019500	2011-04-29	-21.4586	27.823117	all
3	Africa	Botswana	Foot and mouth disease virus (Inf. with)	10548	1000020022	2011-05-22	-21.46037	27.74133	all
4	Africa	Botswana	Foot and mouth disease virus (Inf. with)	10548	1000029274	2012-12-17	-21.571044	27.975556	all

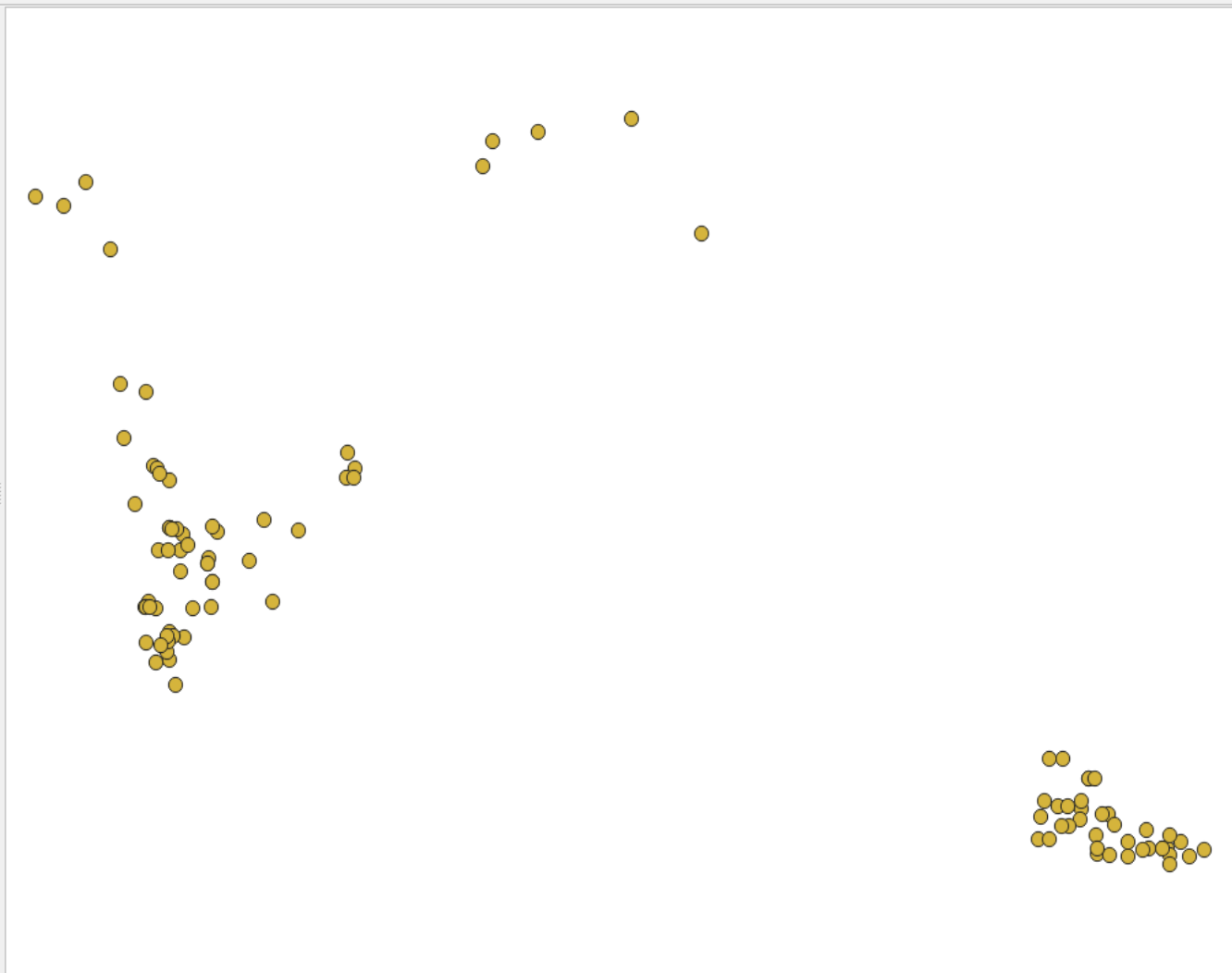


Browser

- ★ Favorites
 - D:\OneDrive\jDATA\git\epiCourse_jdata_GIS_In
 - botswana.shp
 - cattleDensity.tif
 - grid_hex.shp
 - zaf_fmd.shp
 - zaf_localmunicipality.shp
- Spatial Bookmarks
- Home

Layers

- **fmd_botswana_outbreaklevel**



Processing Toolbox

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- GRASS

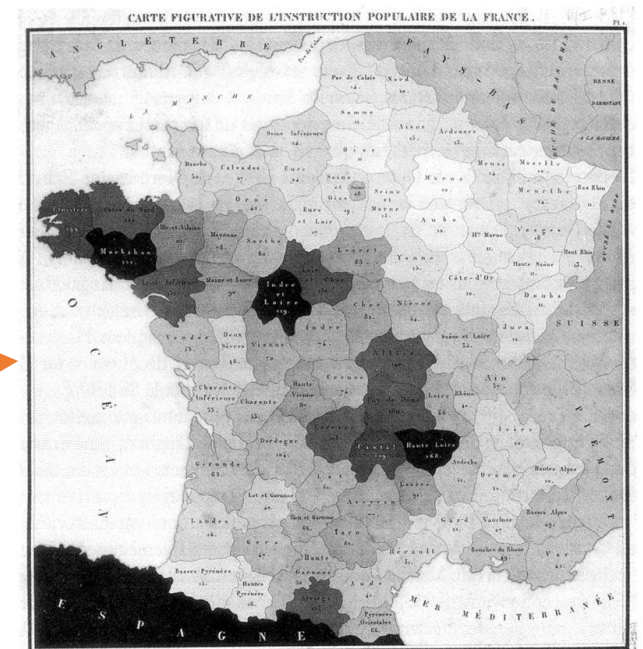
Practical - Import Disease Data from CSV

- Find the *fmd_botswana_outbreaklevel.csv* data in the data folder and import and depict it as a point layer
- Find the *botswana.shp* polygon layer and add it as a polygon
 - Try change the symbology to make it see through
- Find the *cattleDensity.tif* raster layer and add it to your map
- **Bonus**
 - Load the density and hex styles from the GIS folder and style your Botswana and raster files respectively

What is a Choropleth Map?

- A choropleth map is a thematic map where areas are shaded or patterned in proportion to the value of a variable being represented. This variable could be anything from population density to number of disease cases.
- Key components
 - Geographical Boundaries
 - Colour Scale
 - Legend

Early choropleth map
showing literacy in France

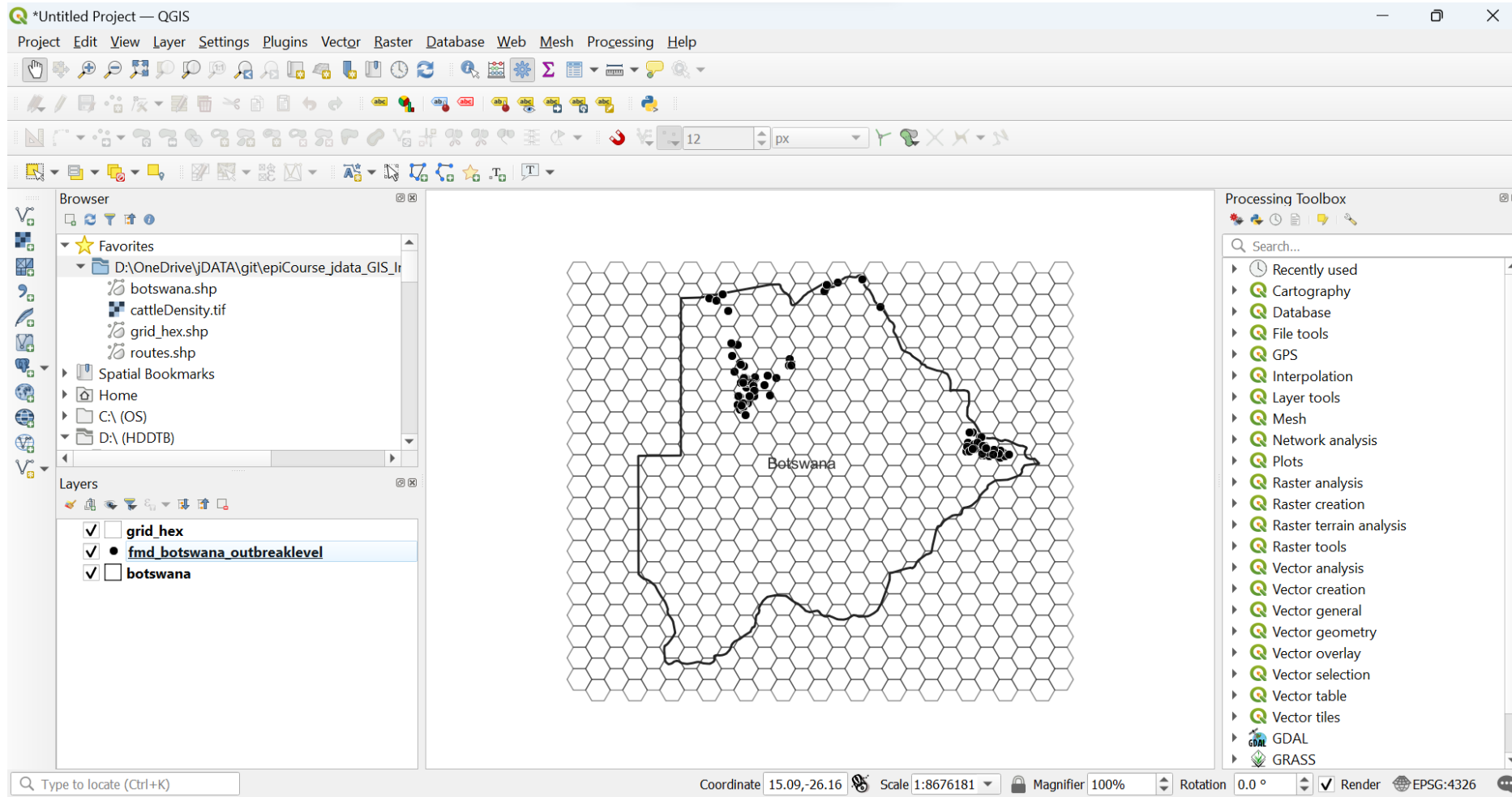


By Charles Dupin (1784-1873) -
http://math.yorku.ca/SCS/Gallery/images/dupin1826-map_200.jpg, Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=29383521>

Preparing Data for Choropleth

- Need an underlying polygon to aggregate data to
- We've prepared a hexagon grid to depict this – but commonly used examples are administrative areas or geopolitical polygons

Creating a Choropleth in QGIS



*Untitled Project — QGIS

Project Edit View Layer Settings Plugins **Vector** Raster Database Web Mesh Processing Help

- Geoprocessing Tools
- Geometry Tools
- Analysis Tools**
 - Count Points in Polygon...**
 - Line Intersections...
 - Mean Coordinate(s)...
 - Nearest Neighbour Analysis...
 - Sum Line Lengths...
 - Basic Statistics for Fields...
 - Distance Matrix...
 - List Unique Values...
- Research Tools
- Data Management Tools

Browser




- ★ Favorites
 - D:\OneDrive\jDATA\git\epiCourse_jdata_GIS_Ir
 - botswana.shp
 - cattleDensity.tif
 - grid_hex.shp
 - routes.shp
 - Spatial Bookmarks
 - Home
 - C:\ (OS)
 - D:\ (HDDTB)

Layers




- grid_hex
- **fmd_botswana_outbreaklevel**
- botswana

Count Points in Polygon

Parameters | Log

Polygons
   

Selected features only



Points
   

Selected features only

Weight field [optional]

Class field [optional]

Count field name

Count
  

Open output file after running algorithm

0%

Run as Batch Process... Run Close Help Cancel

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 polygon 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

choropleth — Features Total: 540, Filtered: 540, Selected: 0

	id	left	top	right	bottom	totalOutbr
1	186	22.2291371350...	-20.228527667...	22.8064874042...	-20.728527667...	17.0000000000...
2	449	27.8583022596...	-21.478527667...	28.4356525288...	-21.978527667...	13.0000000000...
3	187	22.2291371350...	-20.728527667...	22.8064874042...	-21.228527667...	11.0000000000...
4	469	28.2913149615...	-21.728527667...	28.8686652307...	-22.228527667...	11.0000000000...
5	185	22.2291371350...	-19.728527667...	22.8064874042...	-20.228527667...	9.0000000000...
6	429	27.4252895577...	-21.728527667...	28.0026398269...	-22.228527667...	7.0000000000...
7	225	23.0951625388...	-19.728527667...	23.6725128080...	-20.228527667...	5.0000000000...
8	206	22.6621498369...	-19.978527667...	23.2395001061...	-20.478527667...	4.0000000000...
9	428	27.4252895577...	-21.228527667...	28.0026398269...	-21.728527667...	3.0000000000...
10	450	27.8583022596...	-21.978527667...	28.4356525288...	-22.478527667...	3.0000000000...
11	142	21.3631117312...	-18.228527667...	21.9404620004...	-18.728527667...	2.0000000000...
12	261	23.9611879425...	-17.728527667...	24.5385382117...	-18.228527667...	2.0000000000...
13	162	21.7961244331...	-17.978527667...	22.3734747023...	-18.478527667...	1.0000000000...
14	163	21.7961244331...	-18.478527667...	22.3734747023...	-18.978527667...	1.0000000000...
15	164	21.7961244331...	-18.978527667...	22.3734747023...	-19.478527667...	1.0000000000...
16	165	21.7961244331...	-19.478527667...	22.3734747023...	-19.978527667...	1.0000000000...
17	166	21.7961244331...	-19.978527667...	22.3734747023...	-20.478527667...	1.0000000000...

propleth — Symbology

Graduated

Value: 1.2 totalOutbr

Symbol: [Solid Brown Bar]

Legend format: %1 - %2

Color ramp: [Red to White Gradient]

Classes: Histogram

Symbol	Values	Legend
<input checked="" type="checkbox"/> [White]	0.00 - 0.00	0
<input checked="" type="checkbox"/> [Light Pink]	0.00 - 2.00	0 - 2
<input checked="" type="checkbox"/> [Pink]	2.00 - 7.00	2 - 7
<input checked="" type="checkbox"/> [Red-Orange]	7.00 - 13.00	7 - 13
<input checked="" type="checkbox"/> [Red]	13.00 - 17.00	13 - 17

Mode: Natural Breaks (Jenks)

Classes: 5

Classify [Add] [Remove] Delete All

Link class boundaries

Layer Rendering

Opacity: 75.0

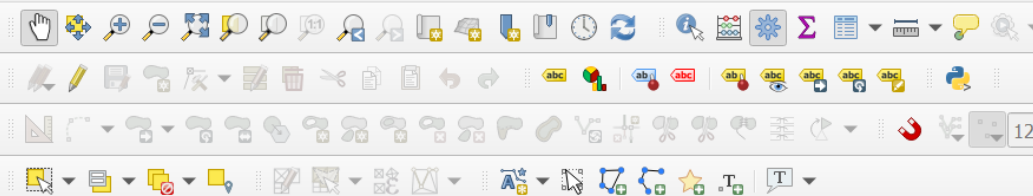
Blending mode: Layer: Normal, Feature: Normal

Draw effects

Control feature rendering order

Style

OK Cancel Apply Help

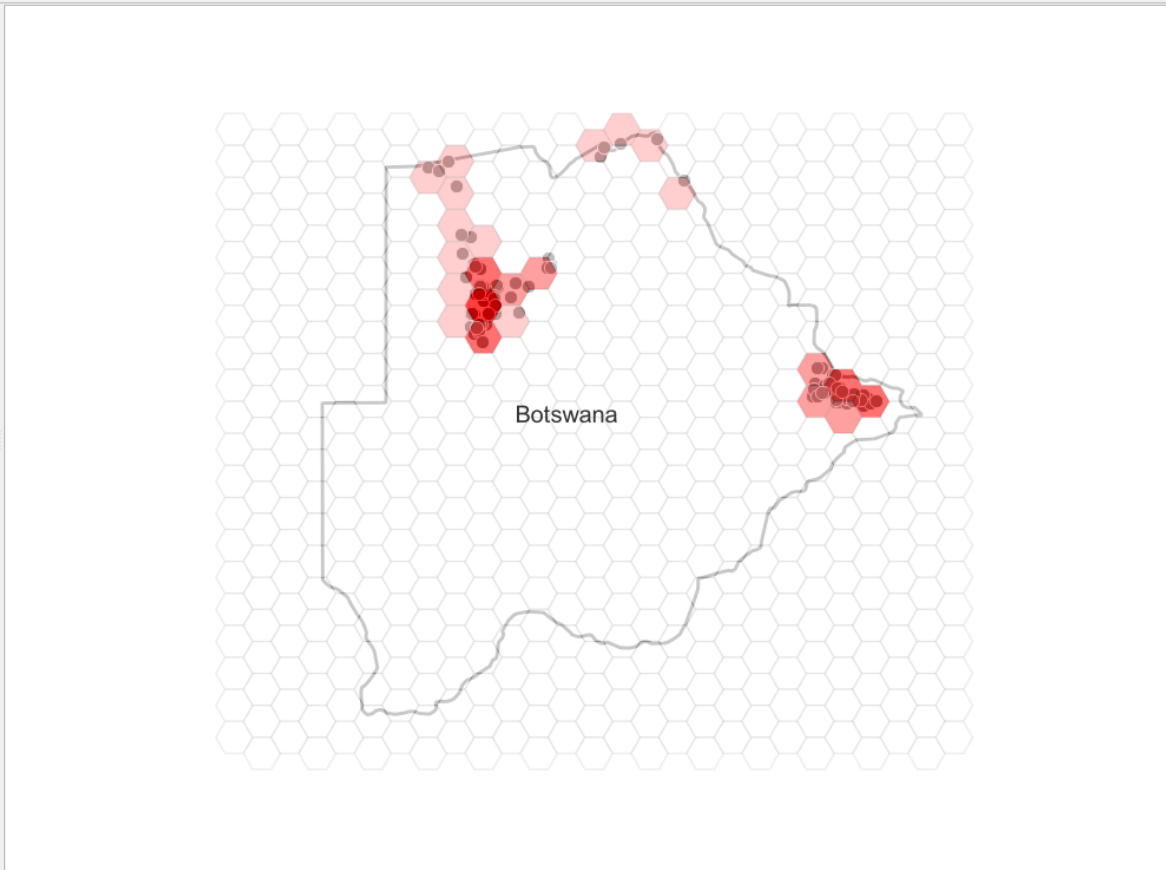


Browser

- ★ Favorites
 - D:\OneDrive\jDATA\git\epiCourse_jdata_GIS_Ir
 - botswana.shp
 - cattleDensity.tif
 - grid_hex.shp
 - routes.shp
- Spatial Bookmarks
- Home
- C:\ (OS)
- D:\ (HDDTB)

Layers

- grid_hex
- choropleth**
 - 0
 - 0 - 2
 - 2 - 7
 - 7 - 13
 - 13 - 17
- fmd_botswana_outbreaklevel
- botswana



Processing Toolbox

Search...

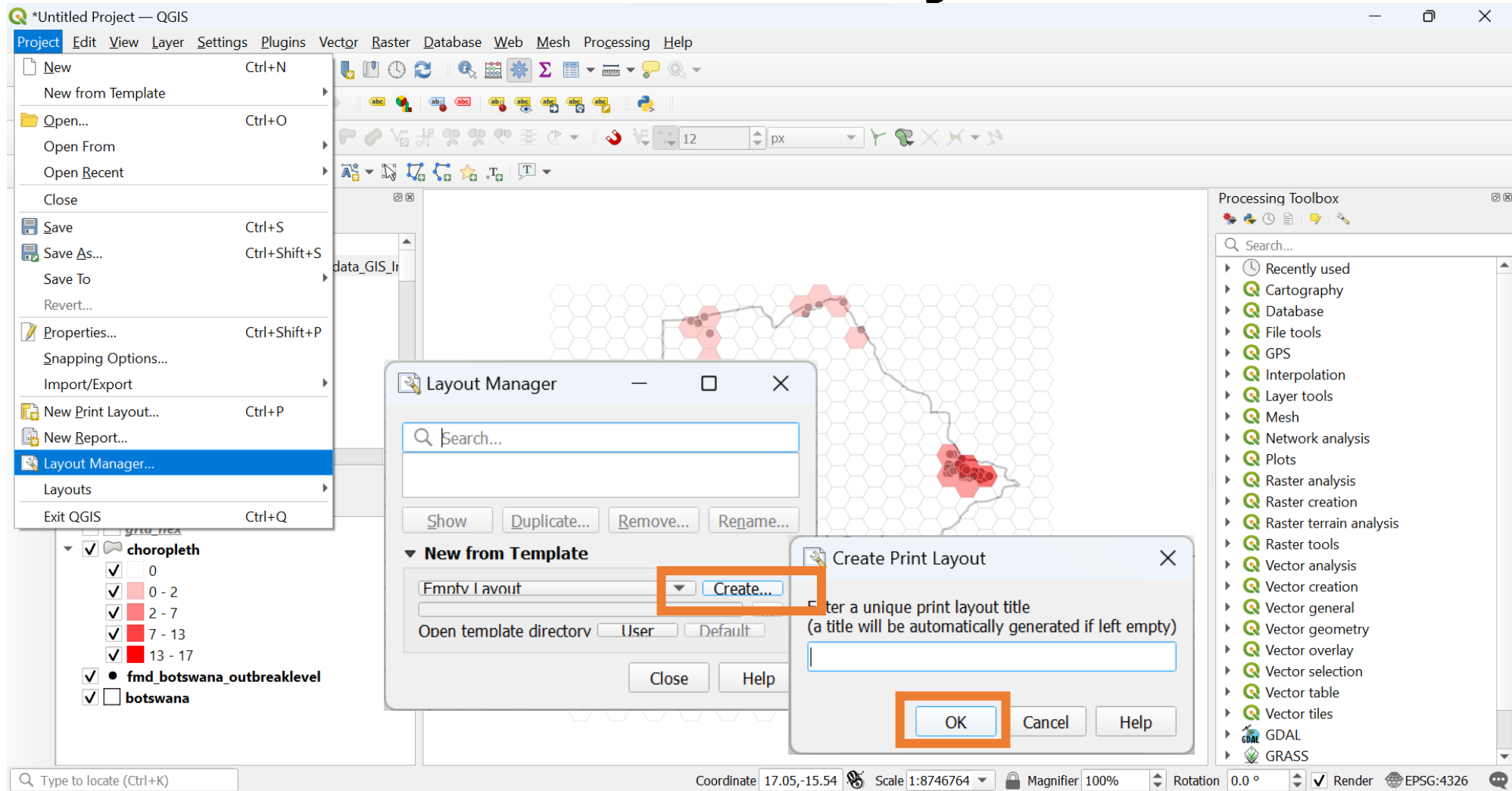
- Recently used
- Cartography
- Database
- File tools
- GPS
- Interpolation
- Layer tools
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- Raster analysis
- Raster creation
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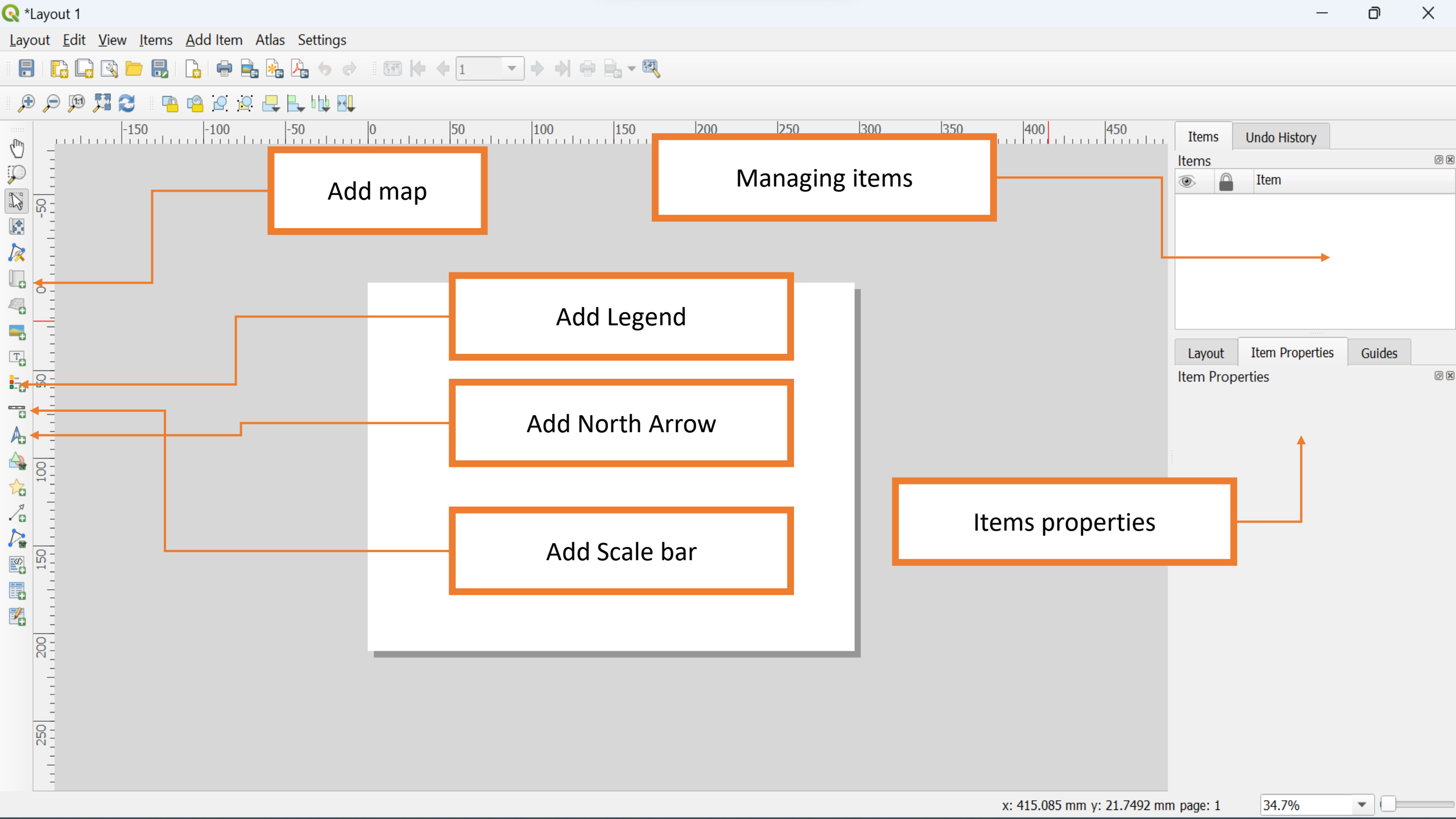
Practical - Create a Choropleth Map

- Create your own choropleth map using the Botswana data depicted
- Create your own choropleth map using the *zaf_localmunicipality* polygons and *zaf_fmd* point data

Introduction to Print Layout



The screenshot displays the QGIS interface with the 'Layout Manager' dialog box open. The 'Layout Manager' dialog has a search bar and a list of templates. The 'Create Print Layout' dialog box is also open, showing a search bar and a text input field for a unique print layout title. The 'OK' button in the 'Create Print Layout' dialog is highlighted with an orange box.



Add map

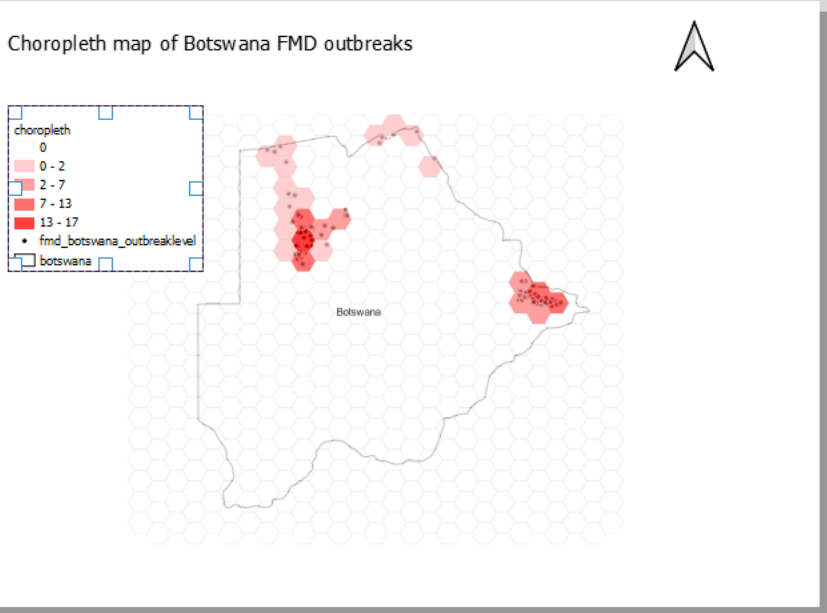
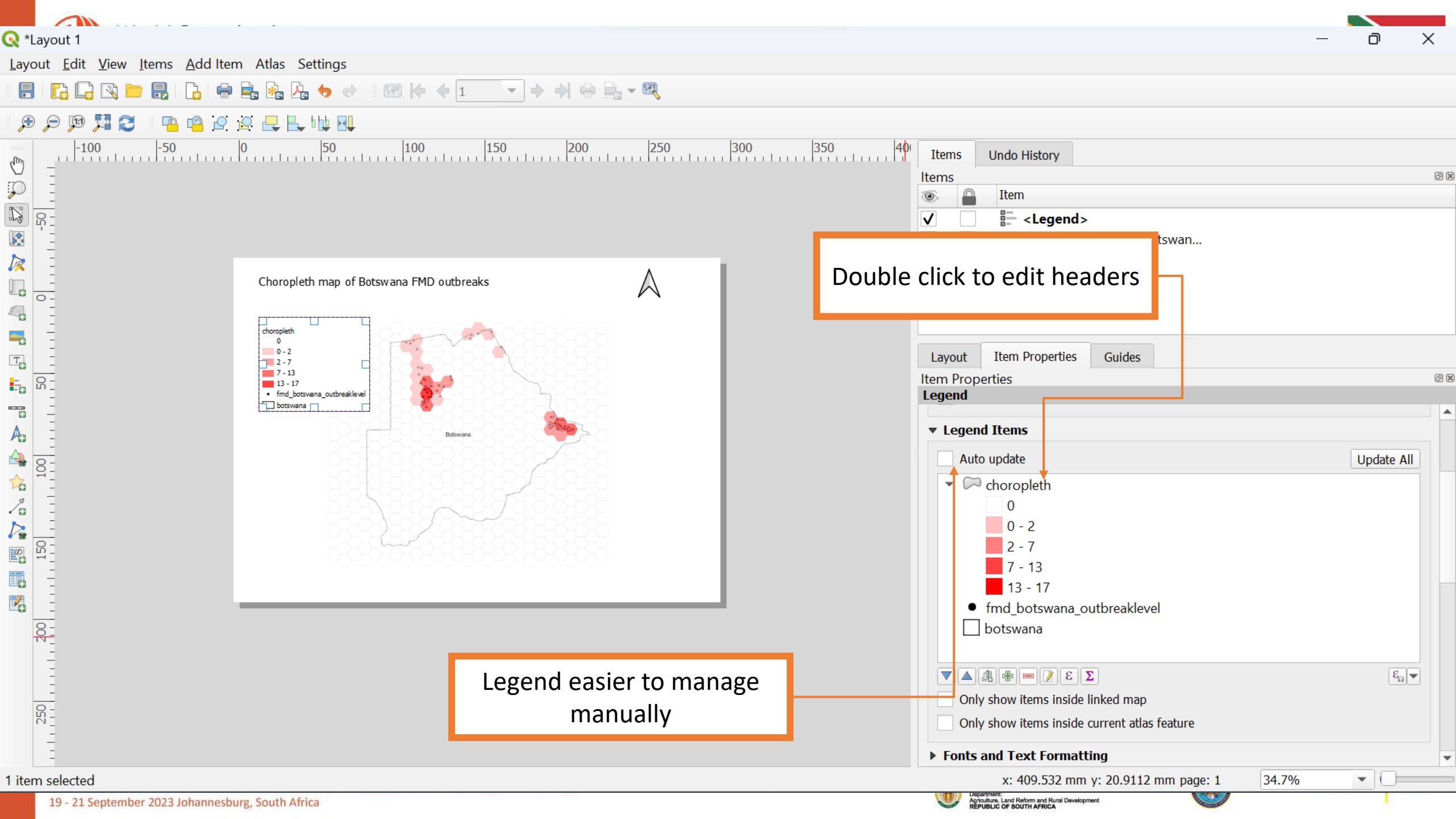
Managing items

Add Legend

Add North Arrow

Add Scale bar

Items properties



Double click to edit headers

Legend easier to manage manually

Items Undo History

Items

Item

<Legend>

Layout Item Properties Guides

Item Properties

Legend

Legend Items

Auto update Update All

choropleth

- 0
- 0 - 2
- 2 - 7
- 7 - 13
- 13 - 17

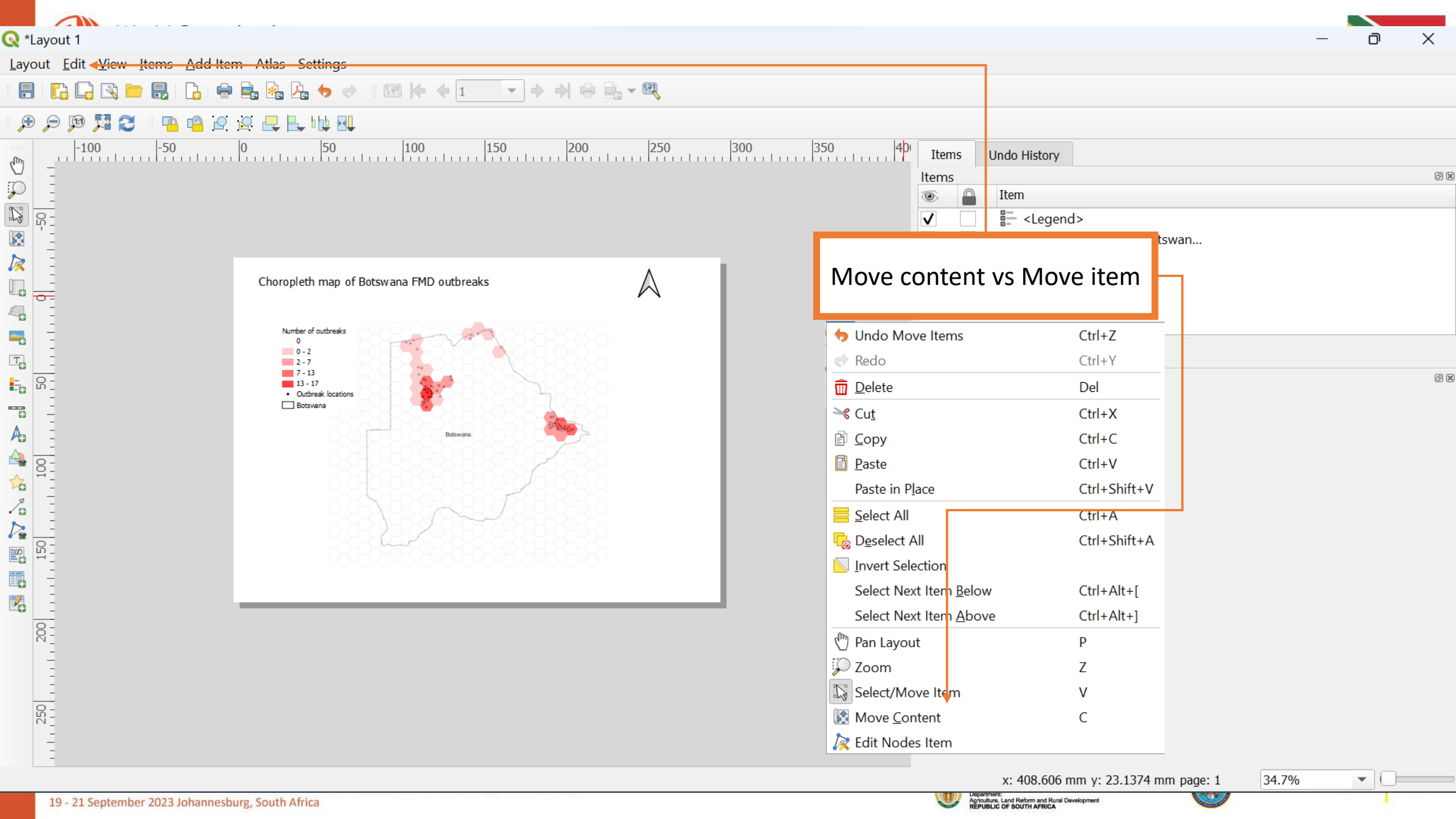
fmd_botswana_outbreaklevel

botswana

Only show items inside linked map

Only show items inside current atlas feature

Fonts and Text Formatting



Move content vs Move item

- Undo Move Items Ctrl+Z
- Redo Ctrl+Y
- Delete Del
- Cut Ctrl+X
- Copy Ctrl+C
- Paste Ctrl+V
- Paste in Place Ctrl+Shift+V
- Select All Ctrl+A
- Deselect All Ctrl+Shift+A
- Invert Selection
- Select Next Item Below Ctrl+Alt+[
- Select Next Item Above Ctrl+Alt+]
- Pan Layout P
- Zoom Z
- Select/Move Item V
- Move Content C
- Edit Nodes Item

Exporting Layout

Crop to content

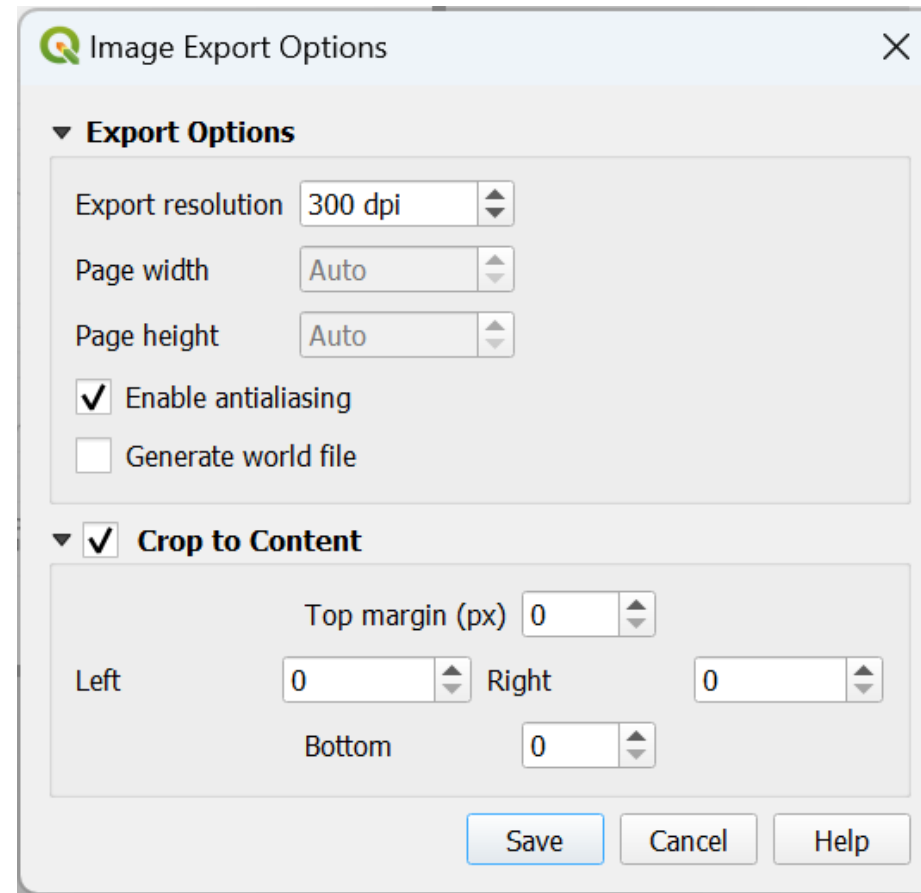


Image Export Options

▼ **Export Options**

Export resolution 300 dpi

Page width Auto

Page height Auto

Enable antialiasing

Generate world file

▼ **Crop to Content**

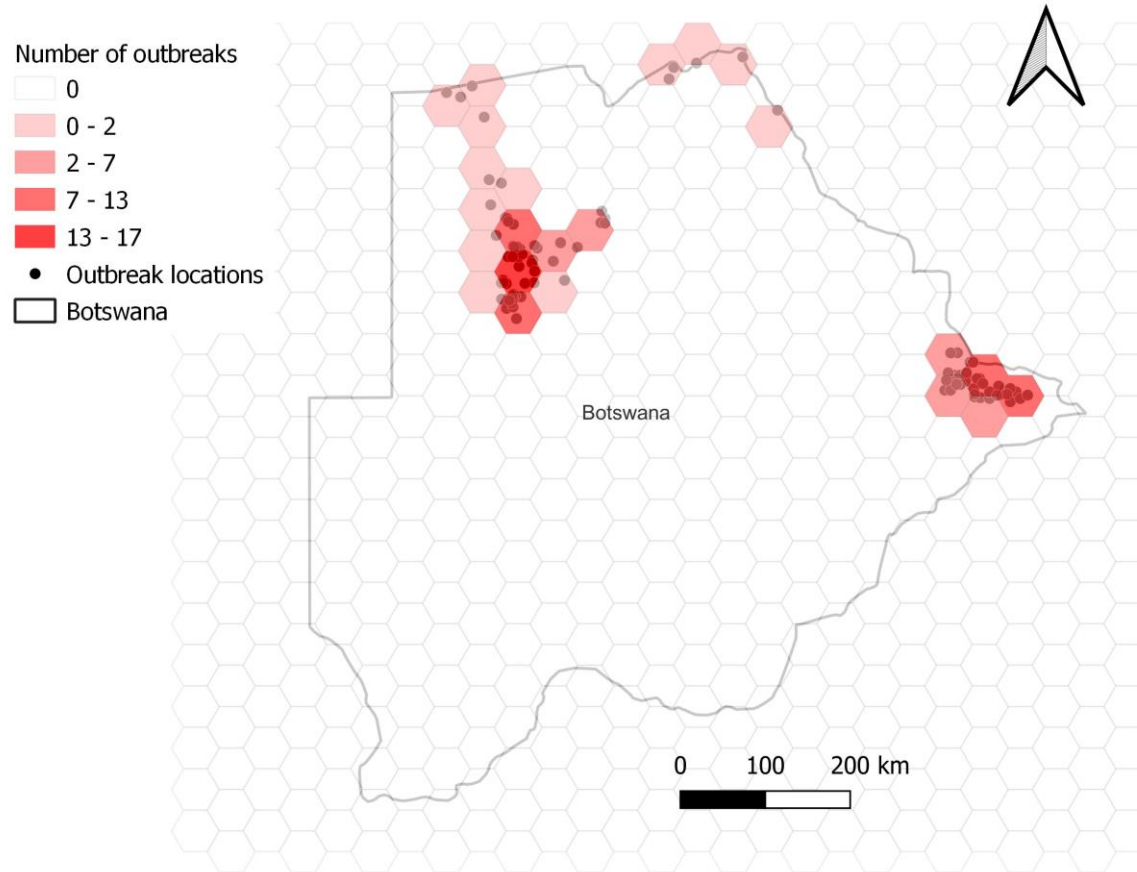
Top margin (px) 0

Left 0 Right 0

Bottom 0

Save Cancel Help

Choropleth map of Botswana FMD outbreaks



Practical - Create a Layout for Publication

Q&A