1

Design and Implementation of Automated Atlas

1.1. From map to atlas

Given the multiplication of spatial data, automated workflows are becoming important in GIS environments (graphical modeler, programming). Beyond data processing (geometry, topology, attributes, analysis), automation can also be used for symbology or layout to facilitate map design and publication.

If your organization publishes printed or online maps, you often would need to create many maps with the same template – usually one for each administrative unit or region. With the evolution of print composers, GIS software offer more and more layout features, notably for the creation of atlases enabling the compilation of ordered maps and information in the template. Unlike isolated maps, the atlas provides readers with a more in-depth representation of the spaces and themes addressed by combining maps at different scales and graphic or text elements.

The automation of maps and indicators in the form of standardized templates allows both time saving for the production of maps but also a greater graphical consistency of the maps by the homogenization of the layout. This dimension is particularly interesting for the setting up of a graphic charter in the publishing of cartographic documents. This chapter proposes to explore several methods and tools to produce new indicators and to implement a homogeneous, original and stylized cartographic atlas with the QGIS software.

Chapter written by Boris MERICSKAY.

1.2. Automation of maps and indicators

The objective of this chapter is to automate with QGIS the production of an atlas, combining maps and indicators, of the Corsica local region. By using different datasets at the municipal level (population census, agricultural census) and by using several spatial analysis tools, the idea is to initially calculate several key indicators aiming at characterizing these new territories. The combination of different maps and key figures provides the reader with additional complementary elements (statistics and maps).

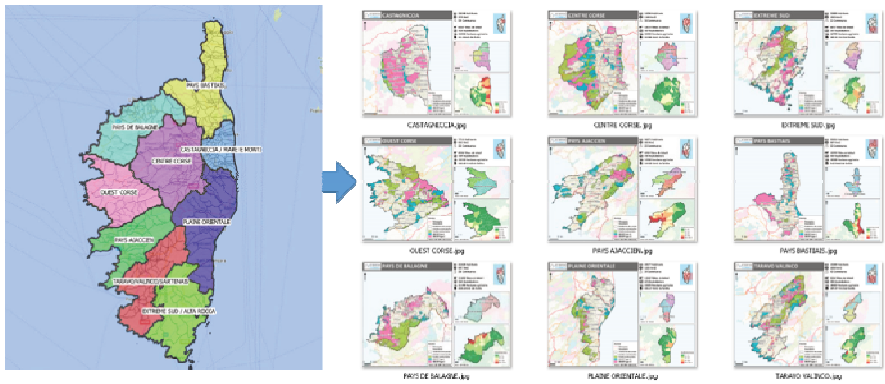


Figure 1.1. *Atlas of Corsica local regions. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

The implementation of this atlas is based on automated map production combined with several indicator-creation processes. Figure 1.1 illustrates the processing steps for atlas implementation in QGIS. To facilitate its reading, processing and handlings are grouped into five main stages, from the conceptualization to the publication of the atlas:

1) atlas template designing;

2) data preparation and indicators creation;

3) atlas implementation in QGIS environment;

4) atlas implementation in the print composer;

5) atlas publication.

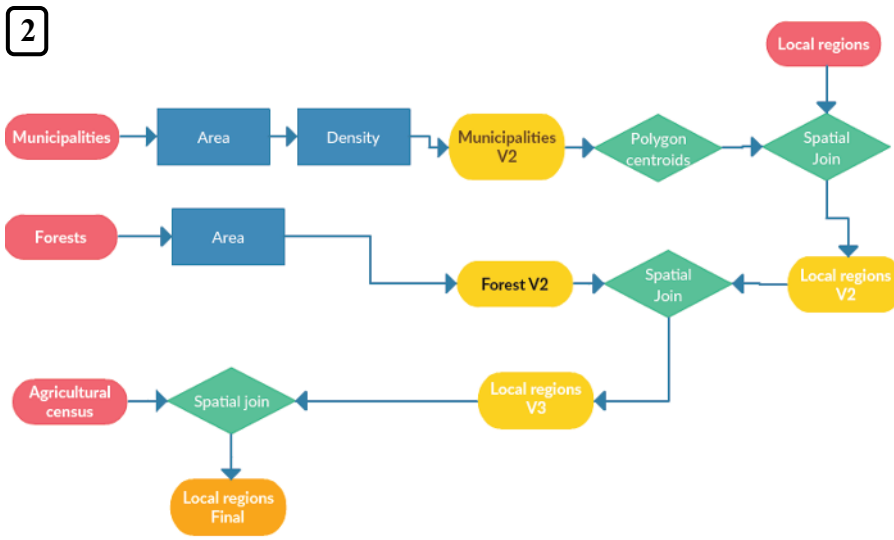


Figure 1.2. *Workflow for calculating indicators*

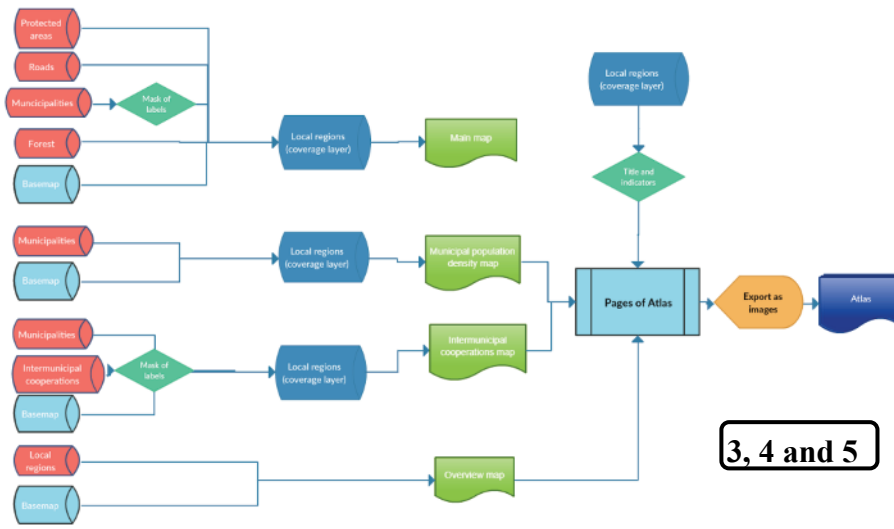


Figure 1.3. *Handling flow for atlas implementation*

1.2.1. *Step 1: atlas template designing*

The first step is to design the atlas template (items and layout). The items depend on the objective of the atlas (communication, decision-making and analysis).

We propose in this chapter an atlas template to present the local regions of Corsica based on seven items as illustrated in Figure 1.4:

1) main map (municipalities, main roads, protected areas, forests);

2) municipal population density map;

3) intermunicipal cooperations map;

4) overview map;

5) name of local region;

6) logo;

7) indicators.

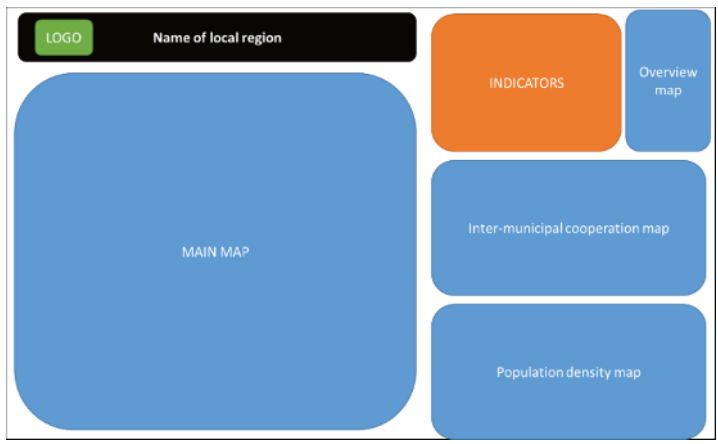


Figure 1.4. *Atlas template*

1.2.2. *Step 2: data preparation and indicators creation*

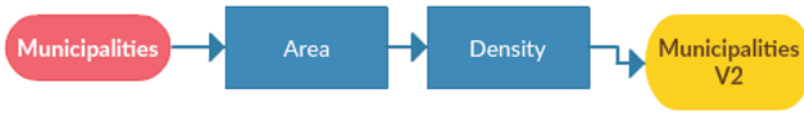
The second step is to prepare the datasets (reproject, transformation) and create indicators for the map atlas. The objective of this step is to enrich the atlas coverage layer of basic and derived statistics (number of communes, population, forest area, number of farms, etc.) to create indicators.

Datasets use different coordinate reference systems (CRS) – WGS 84 and Lambert 93. To facilitate processing it is necessary to harmonize the CRS of spatial datasets using the Lambert 93 projection as the reference coordinate reference system for all layers of the project.

QGIS functionalities:
- Reproject layer: *QGIS geoalgorithms > Vector general tools*

1.2.2.1. *Calculate basic statistics*

***Municipalities* layer**: Calculate the municipal population density.



***Forests* layer**: Calculate the area of forests.

QGIS functionalities:
- Field Calculator

1.2.2.2. *Aggregating municipal data at the scale of local regions*

The second step of data preparation is to change the analysis scale by aggregating municipal data at the local regional scale. In order to carry out this transformation of the data, it is necessary to mobilize the **spatial join**[1], which makes it possible to associate and aggregate attributes from one layer to another according to topological relationships between objects in space (intersect, within, contains). A spatial join involves matching rows from the Join Features to the Target Features based on their relative spatial locations.

To spatially join the attributes of the common layer to that of the project territories, it is important to be vigilant about the topology of the objects. Indeed the topological consistency that defines the quality of the join is not always good. As illustrated in Figure 1.5, the topological coherence of the boundaries of municipalities and project boundaries is not of good geomatric quality.

1 Joins attributes from one feature to another based on the spatial relationship. The target features and the joined attributes from the join features are written to the output feature class.

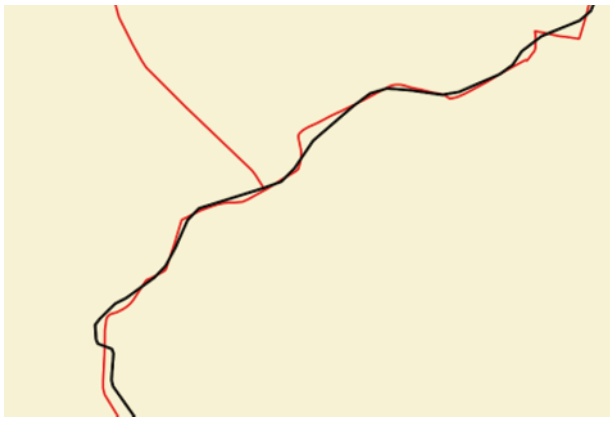


Figure 1.5. *Example of topological errors between the boundaries of municipalities and local regions*

This current situation can be solved by transforming the geometry of one of the layers and more precisely by using the polygonal centroids to facilitate spatial joining (Figure 1.6).

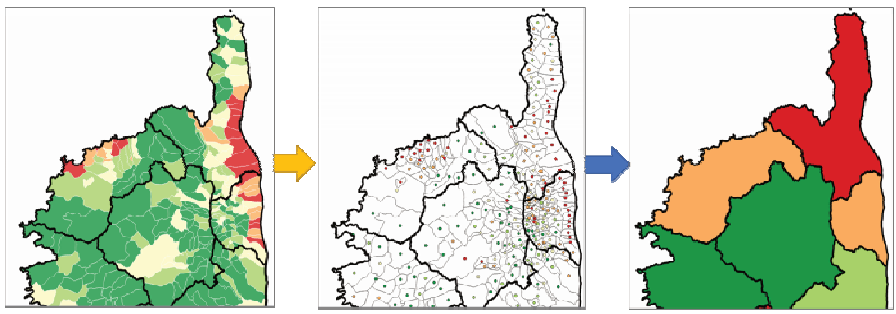


Figure 1.6. *Polygons spatial join based on centroids. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

We must also be vigilant about the geometric transformation of polygons in points. As shown in Figure 1.7, the centroid of the municipality of Saint-Florent is located outside the perimeters of local areas. It is therefore necessary to replace the centroid within the boundaries of the project territories in order not to compromise the spatial junction.

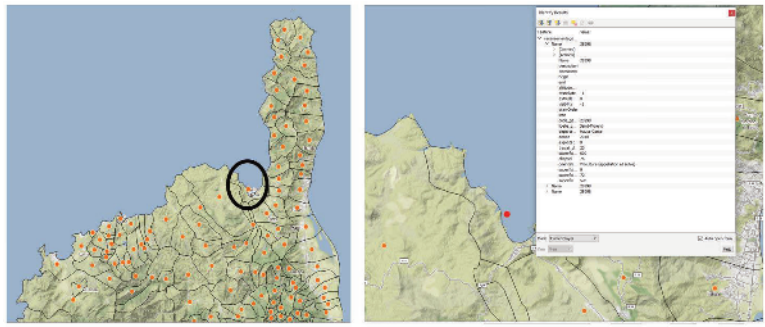
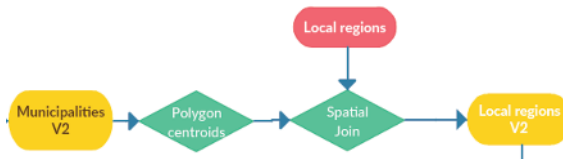


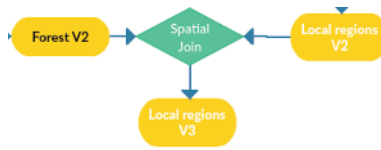
Figure 1.7. *Example of topological error following the transformation*

QGIS functionalities:
- Polygon centroids: *QGIS geoalgorithms > Vector geometry tools OR SAGA > Vector polygon tools*
- Move feature: *Digitizing toolbar*

Aggregating municipal population at the scale of local regions



Aggregating forest areas at the scale of local regions



Aggregating agricultural census data at the scale of local regions

Once the various spatial joins have been realized, the area of the project territories must be calculated. The atlas coverage layer (*Final Local regions*) now contains a series of new fields that will be mobilized thereafter. To facilitate the creation of the atlas and in particular the dynamic display of the created indicators, it is advisable to clean the attribute table of the *Final Local regions* layer by deleting the unnecessary fields and renaming the fields that will be mobilized (Figure 1.8)

	objectid_1	pays	Nb commune	Population	Surface TP	Sup foret	Nb exploit	Sup Agrico	Cheptel
1	1.00000	PAYS DE BALAGNE	36	22823	957.38	309	345	21395	13092
2	2.00000	CASTAGNICCIA / MARE E MONTI	59	20451	378.87	19	320	10036	6547
3	3.00000	CENTRE CORSE	56	16306	1347.73	422	347	32403	18519
4	4.00000	EXTREME SUD / ALTA ROCCA	21	25439	1065.14	263	247	12799	6672
5	5.00000	OUEST CORSE	33	7596	923.22	248	189	18318	8304
6	6.00000	PAYS AJACCIEN	25	98273	859.31	207	256	12358	6910
7	7.00000	PAYS BASTIAIS	53	93124	967.04	13	342	18598	10395
8	8.00000	PLAINE ORIENTALE	34	20791	1224.57	302	471	23325	12047
9	9.00000	TARAVO/VALINCO/SARTENAIS	43	15405	1036.49	264	293	18682	9214

Figure 1.8. *Attribute table of Final Local regions layer after attribute table cleaning*

QGIS functionalities:
- Spatial Join: *QGIS geoalgorithms > Vector general tools > Join attributes by location*
- Attribute table cleaning: *Fields calculator > Erase field*

1.2.3. *Step 3: atlas implementation in QGIS project*

Once the data have been prepared, it is time to move on to formatting. The idea is to provide here a series of tips to optimize the formatting of the data in order to produce aesthetically pleasing, comprehensible and original maps that will be integrated into the atlas boards (atlas coverage layer, rule-based display, masks, custom labels).

1.2.3.1. *Configure atlas coverage layer*

The first step is to configure the atlas coverage layer (Figure 1.9). It is on the objects of this layer that the atlas will be based for map automation. To define this parameter, it is necessary to apply to the coverage layer a rule-based style by mobilizing the filter *@atlas_featureid = $ id*.

It is also possible to mobilize a symbology of the Inverted Polygons type so that the emphasis at the graphic level is put on the selected project territory. They need to be rule based (style) and need to contain the following rules (in Style):

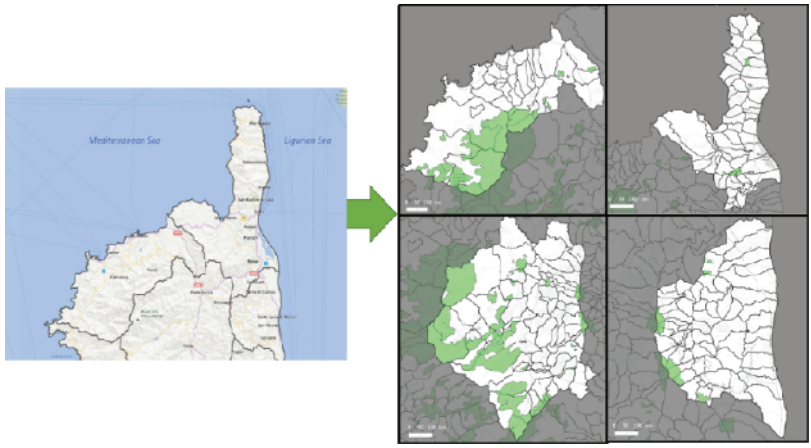


Figure 1.9. *Principle of atlas coverage layer. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

QGIS functionalities:
- Rule-based style: *Layer properties > Style > Rule*
- Inverted polygons style: *Layer properties > Style > Inverted polygons*

1.2.3.2. *Designing the main map*

The main map represents the local regions by combining reference data and environmental data relating to protection:

– local regions;

– municipalities with labels (names);

– main roads;

– forests;

– protected environmental areas (ZNIEFF);

– basemap.

The idea here is to combine several modes of representation of the data in order to obtain aesthetically pleasing, clear and customizable maps that will be generated in an automated way (atlas filter, inverted polygon and label mask).

The choice of the basemap is an important step for map design. With Web services as WMS (Web Map Service), it is possible to integrate a diverse selection of basemaps into QGIS. In addition to the classical basemaps like streets or imagery,

it is now possible to mobilize more minimalist or customized basemaps for use as adapted basemaps. The best service to personalize and use original basemaps in QGIS is Mapbox (https://www.mapbox.com). Mapbox allows the user to quickly create their own basemap using data from OpenStreetMap and display it in QGIS using a WMTS.

After configuring the layout of the layers, the basemap and the display of labels, the Mask extension must then be used to display with a mask only the labels of the municipalities of the local region selected.

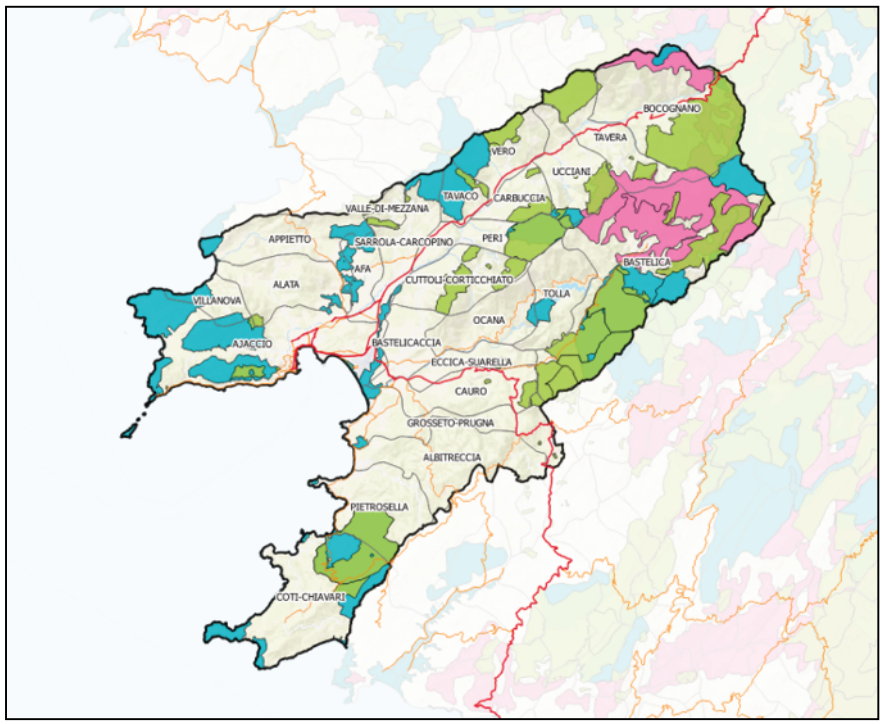


Figure 1.10. *Example of layout of main map. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

QGIS functions:
- Symbology: *Layer properties > Style*
- OpenLayers Plugin or QuickMaps Services to add basemaps from Internet
- *Mask* Extension to display only certain labels
- Inverted Polygons: *Layer properties > Style*
- Original basemap: WM(T)S *connection*

1.2.3.3. *Municipal population density map*

The objective is here to design a map to present the population density of the municipalities (Figure 1.11). It is necessary to duplicate the layer in the layer manager in order to apply a symbology in plots of colors to represent the values.

The classification step is particularly important and requires real work and reflection on the part of the map designer. Indeed, the different automated methods of discretization proposed in GIS software must be used with caution, since they are rarely relevant.

A good classification concerns both the choice of the number of classes and the selection of a data classification method. The reflection and labor of the cartographer must mobilize the histogram of the values and the basic statistics of the statistical series to be generalized (mean, standard deviation, minimum and maximum). As is often the case, the map maker uses a type of data classification to produce their own unique choropleth map. Each data classification method impacts the reader differently.

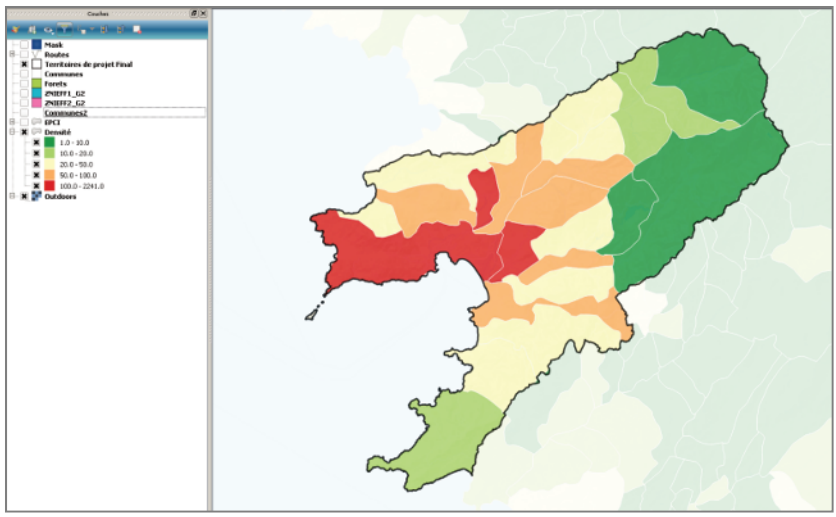


Figure 1.11. *Example of municipal population density map. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

QGIS functionalities:
- Symbology: *Layer properties > Style > Graduated*
- Classification: *Histogram of Distribution, Statist (extension), Basic statistics for numeric fields*

1.2.3.4. *Intermunicipal cooperations map*

The objective is to produce here a map representing the various Corsican Intermunicipal cooperations (Figure 1.12). In addition to applying a categorizated symbology, it is also necessary to configure the label display of the Intermunicipal cooperations names (update the Mask extension to apply a label mask on the Intermunicipal cooperation layer). To complete the map, it is necessary to duplicate the Intermunicipal cooperation layer to apply a suitable formatting (blank contours without filling for example).

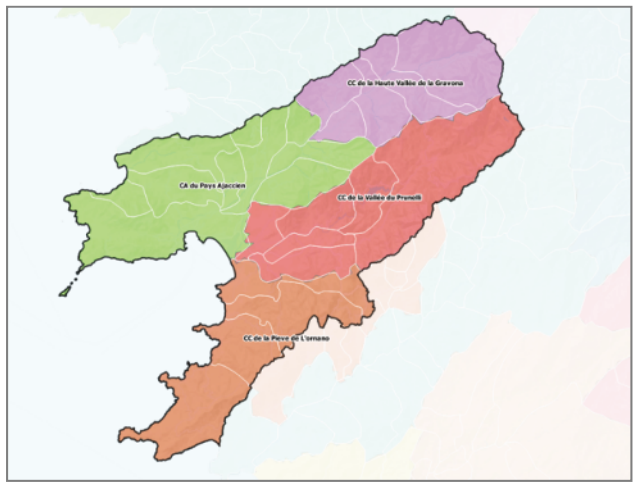


Figure 1.12. *Example of an Intermunicipal cooperation map in Corsica. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

QGIS functions:
- Symbology tool: *Layer properties*
- *Mask* extension to display only labels of the selected project territory

1.2.3.5. *Overview map*

The objective here is to produce an overview map which will allow us to locate the project territory of the atlas plate at the level of Corsica. It is necessary to duplicate the layer of the project territories and to apply to it a simple symbology.

1.2.4. *Step 4: atlas implementation in print composer*

1.2.4.1. *Configuration and implementation of atlas*

The first step to implement an atlas in print composer is to configure and generate the atlas. To do this, you must activate the atlas functions, define the coverage layer and configure the main map (dimension, position, frame, scale, legend, arrow, sources). Once the map is implemented, you must lock the layer and its style in the properties of the map (Figure 1.13).

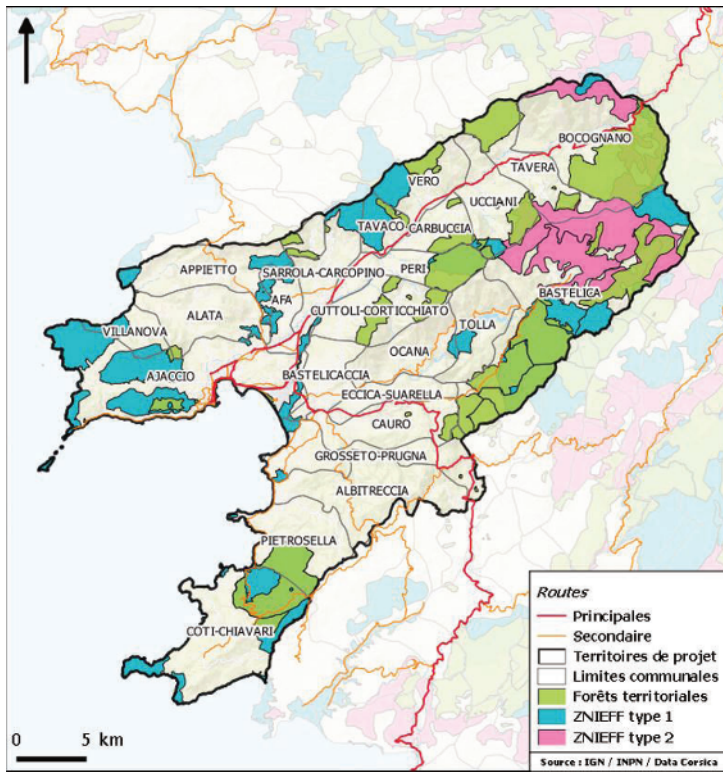


Figure 1.13. *Add main map to the atlas template. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

1.2.4.2. *Add dynamic items (title, indicators)*

In this step, it is necessary to add to the pages of the atlas a series of dynamic items, which will update according to the pages of the atlas:

– title (based on the field "pays" of the *local region* layer);

– indicators (based on the fields computed and aggregated upstream) with the mobilization of pictograms for an infographic-type rendering.

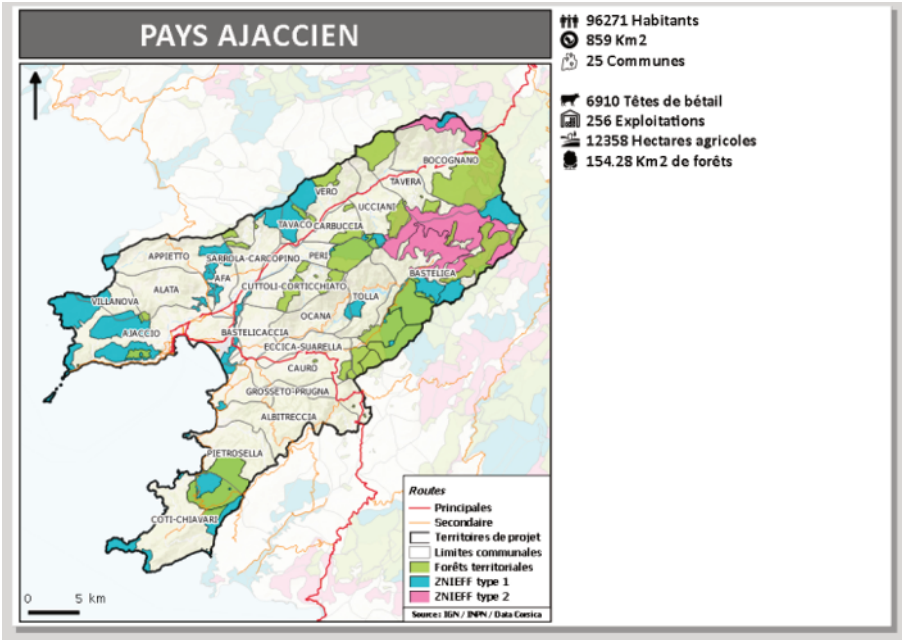


Figure 1.14. *Add title and indicators to the atlas template. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

1.2.4.3. *Add static items*

The idea here is to enrich the pages of the atlas with static items (such as logo or pictos) that will always be similar regardless of the pages of the atlas.

1.2.4.4. *Add municipal population density*

The aim here is to activate a symbology for the municipal population density map in the QGIS project. Then add the map legend, scale and source. It is also necessary to configure the parameters controlled by the atlas. Once the map is implemented, it should lock the layer and its style in the properties of the map.

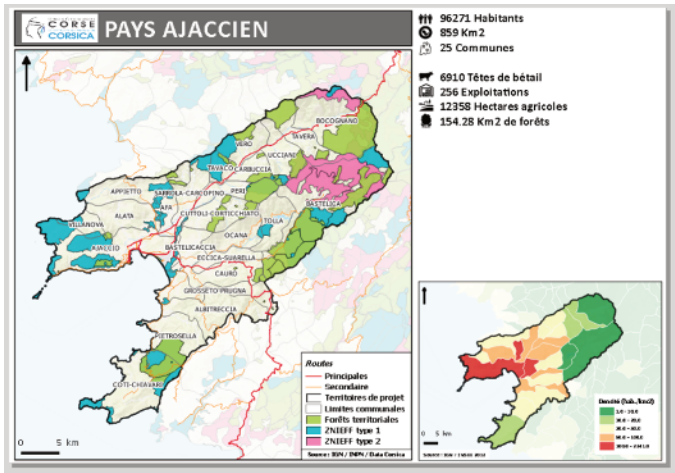


Figure 1.15. *Add municipal population density map to the atlas template. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

1.2.4.5. *Add intermunicipal cooperation map*

As before, the aim here is to activate the symbology of the Intermunicipal cooperation layers in the QGIS project. Next, configure the map in print composer and add the scale and source. Once the map is implemented, it should lock the layer and its style in the properties of the map.

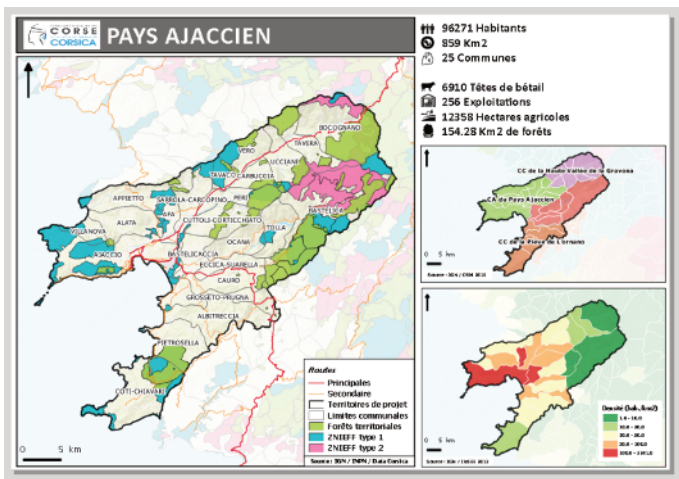


Figure 1.16. *Add Intermunicipal cooperation map to the atlas template. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

1.2.4.6. *Add overview map*

First, activate the Local regions layers in the QGIS project and apply a basic symbology. Add the map to the composer and configure it as a preview map. Once the map is formatted, it is advisable to lock the layer and its style in the properties of the map.

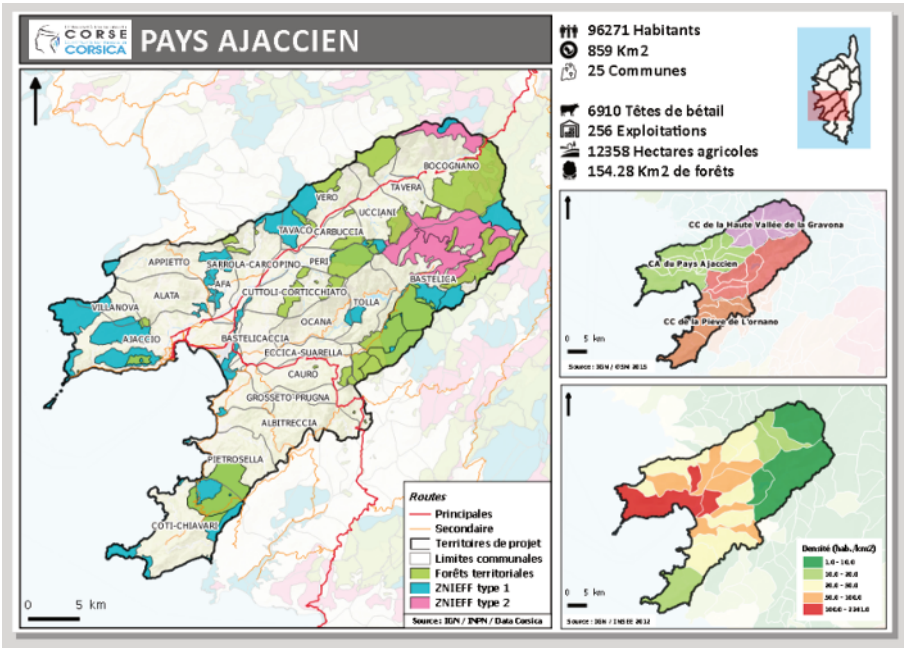


Figure 1.17. *Example of completed atlas template. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

1.2.5. *Step 5: atlas publication*

Once the different structuring elements of the template are configured, it is time to publish the atlas (as image, svg or pdf) by launching map automation. The Atlas tool will iterate through each feature in the coverage layer and create a separate map image based on the template we created. You can see the images in the directory once the process completes.

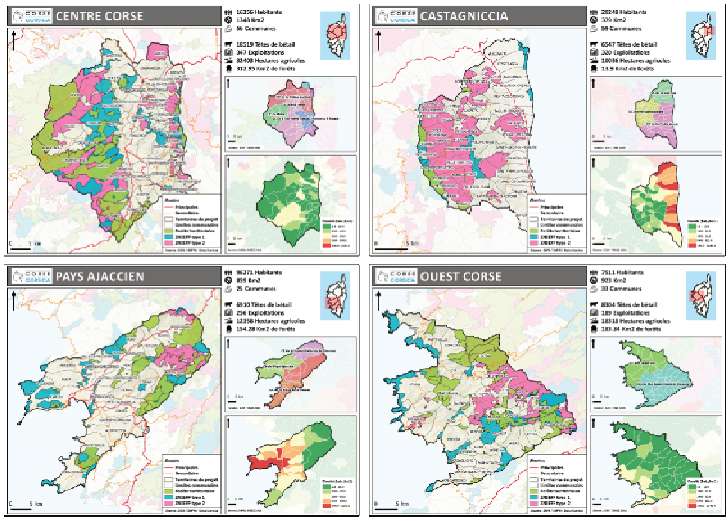


Figure 1.18. *Overview of the pages of the atlas. For a color version of the figure, see www.iste.co.uk/baghdadi/qgis3.zip*

1.3. Implementation of the application

1.3.1. *Software and data*

1.3.1.1. *Software required*

The process discussed in this chapter uses the basic functionality of the QGIS software (version 2.18). It is also necessary to install some additional extensions to carry out the processing chain: GroupStats, Mask, OpenLayerPlugin, Statist.

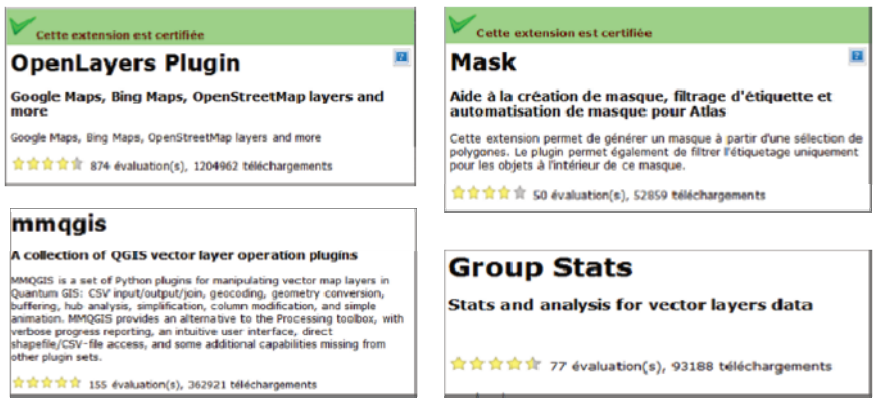


Figure 1.19. *QGIS extensions*

1.3.1.2. *Data*

This chapter is based on eight open data datasets from different organizations (Corsica region, National Geographic Institute, OpenStreetMap).

Name layer	Source	Year	CRS
Municipalities	IGN	2016	2154
Intermunicipal cooperations	OSM	2016	4326
Local regions	Opendata Corsica	2017	4326
Main roads	IGN	2017	2154
Agricultural census	Opendata Corsica	2010	4326
ZNIEFF type 1	INPN	2016	2154
ZNIEFF type 2	INPN	2016	2154
Forest	Opendata Corsica	2017	4326

Table 1.1. *Summary of the data used*

Here are some links for downloading referential data:

1) Municipalities

Name of layer: GEOFLA® 2016 v2.2 Communes France Métropolitaine

URL: http://professionnels.ign.fr/geofla

2) Intermunicipal cooperation

Name of layer: Contours des EPCI 2015 (simplifié à 100 m)

URL: https://www.data.gouv.fr/fr/datasets/contours-des-epci-2015

3) Local regions

Name of layer: Territoires de projet de la Collectivité Territoriale de Corse

URL: https://www.data.corsica/explore/dataset/territoires-de-projet-de-la-collectivite-territoriale-de-corse/export

4) Main roads

Name of layer: ROUTE 120®

URL: http://professionnels.ign.fr/route120

And here are the links for downloading thematic data:

5) Agricultural census

Name of layer: Recensements Agricoles par communes (1988, 2000 and 2010)

URL: https://www.data.corsica/explore/dataset/recensementagricole/export

6) ZNIEFF from type 1

Name of layer : Zones Naturelles d'Intérêt Ecologique Faunistique et Floristique de type 1

URL : https://inpn.mnhn.fr/telechargement/cartes-et-information-geographique/inv/znieff1

7) ZNIEFF from type 2

Name of layer: Zones Naturelles d'Intérêt Ecologique Faunistique et Floristique de type

URL: https://inpn.mnhn.fr/telechargement/cartes-et-information-geographique/inv/znieff2

8) Forests

Name of layer: Forêts de Corse

URL: https://www.data.corsica/explore/dataset/forets-de-corse/export

1.3.2. *Step 2: data preparation and indicators creation*

1.3.2.1. *Calculate municipal population density*

Process	Handling in QGIS
1. Select Corsica municipalities	In **QGIS**: • Open Attributes table  In Select by expression: • Write the query: "NOM_REG" = 'CORSE' In the Attributes table: • Invert the selection • Switch to Editing mode • Delete selected features • Stop Editing mode and save

2. Calculate municipal population density	In **Field calculator**: • Create new Field "AREA" (decimal type) > Calculate area of municipalities with function *$area* by writing the query "$Area/1000000" (convert m^2 to km^2) In **Field calculator**: • Create new field "Density" (integer type) > Calculate municipalities population density by writing the query "Population/AREA"

Table 1.2. *Steps for the calculation of population density in the layer "Municipalities"*

1.3.2.2. *Calculate forest area*

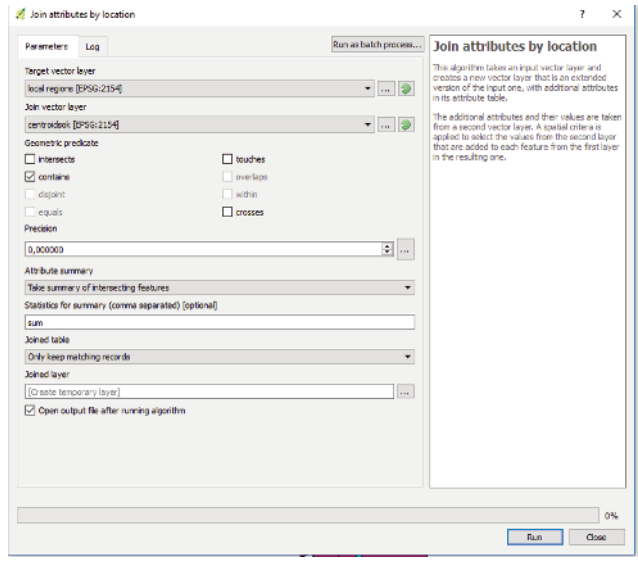
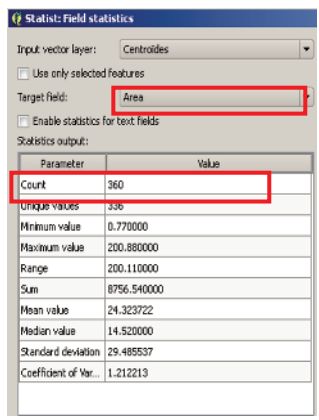
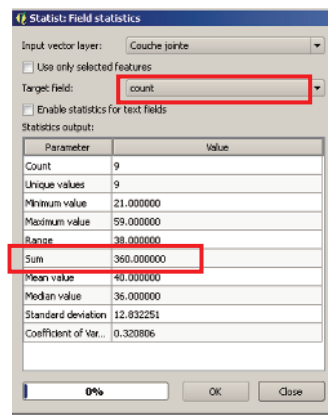
Process	Handling in QGIS
1. Calculate Forest Area	In **Field calculator**: • Create new Field "AREA" (decimal type) > Calculate Forest Area with the expression *$Area/1000000* (convert m^2 to km^2)

Table 1.3. *Step for the calculation of forest area*

1.3.2.3. *Aggregate municipal data at scale of local regions*

1.3.2.3.1. Aggregate data from municipalities layer at scale of local regions (population and number of municipalities)

Process	Handling in QGIS
1. Create polygon centroids	In **QGIS**: • Vector > Geometry tools > **Polygon centroids** • To facilitate spatial joining, it is recommended to create a new field (integer type) with the value of the column POPULATION > Field Calculator
2. Reproject local region layer	• Save vector layer with CRS 2154 (Lambert 93)

3. Aggregate municipal data at scale of local regions	• Vector > Data Management Tools > **Join attributes by location**  It is essential to verify if the spatial join has performed well at the aggregation level: • Use a statistical tool to compare the fields of the joined layer and the new fields resulting from the aggregation (Basic statistics for numeric fields or Statist extension)  

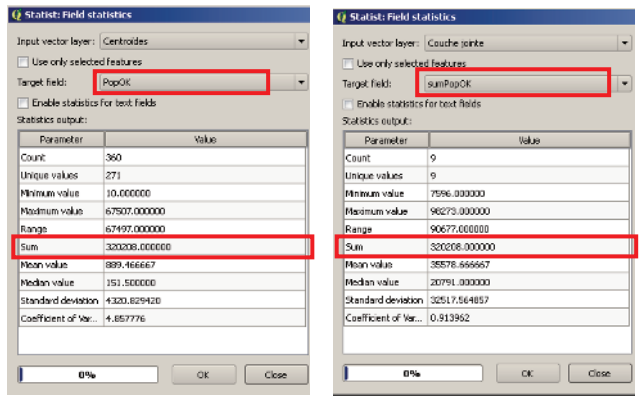
	

Table 1.4. *Steps for aggregating population data*

1.3.2.3.2. Aggregate forest area at the scale of local region

Process	Handling in QGIS
1. Reproject forest layer	In **QGIS**: • Save vector layer with CRS 2154 (Lambert 93)
2. Create polygon centroids	• Vector > Geometry tools > **Polygon centroids**
3. Aggregate data at scale of local regions	• Vector > Data Management Tools > **Join attributes by location** Other available tool: • Extension **MMQGIS** > Combine > Spatial Join

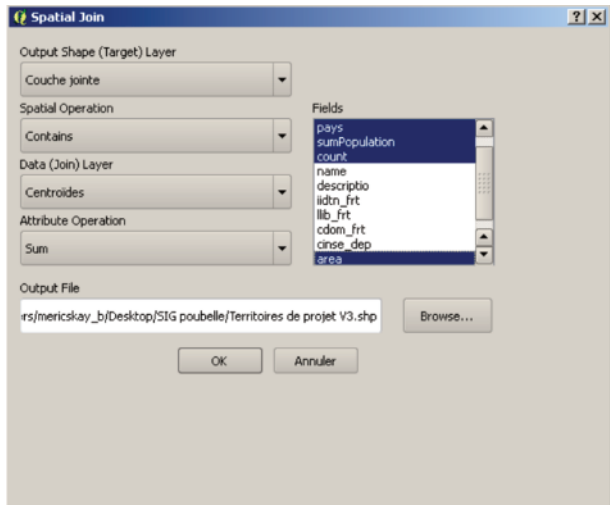
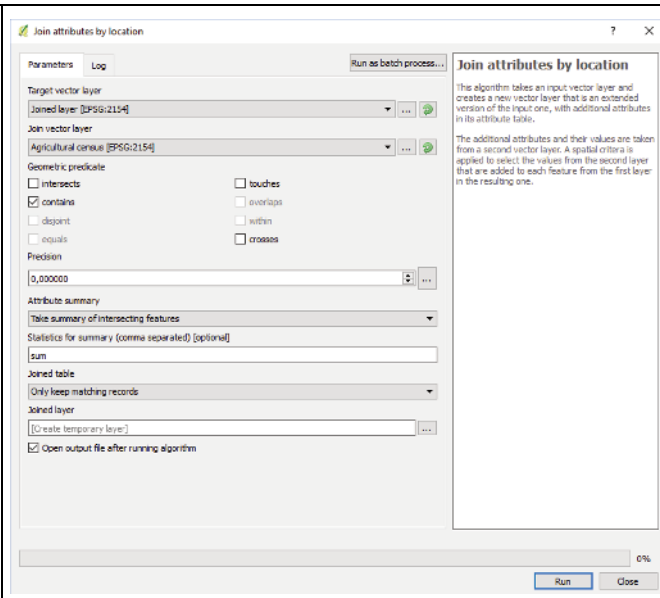
	

Table 1.5. *Steps for aggregating forest data*

1.3.2.3.3. Aggregate data of the layer agricultural census (livestock/area/number of exploitations)

Process	Handling in QGIS
1. Keep only the 2010 Agricultural census data	In **QGIS**: • Open Attributes table  In the attribute selector : • Write the query: “annee” = ‘2010’ In the Attributes table: • Invert selection • Switch to Editing mode • Delete selected features • Stop Editing mode and save
2. Reproject Agricultural census layer	• Save vector layer with CRS 2154 (Lambert 93)
3. Aggregate data at scale of local regions	• Vector > Data Management Tools > **Join attributes by location**



- Check results of the spatial join

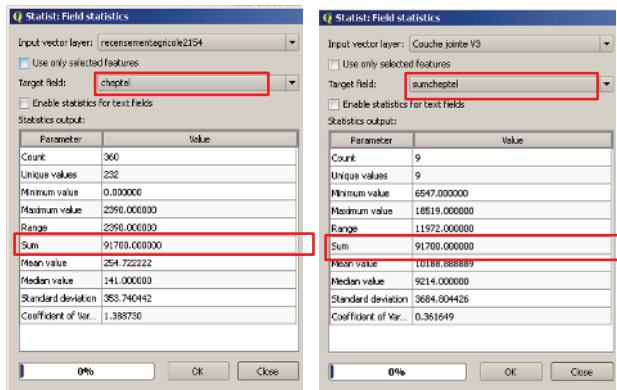


Table 1.6. *Steps for aggregating agricultural census data*

1.3.2.3.4. Calculate area of local region and clean attribute table

1. Calculate area of local region	In Field calculator: • Create new Field "AREA" (decimal type) > Calculate area of municipalities with function *$area* by writing the query *$Area/1000000* (convert m^2 to km^2)
2. Clean Attribute table	In the Attribute table: • Switch to Editing mode • Delete unnecessary fields  • Rename fields with field calculator 

Table 1.7. *Calculate area of local region and clean attribute table*

1.3.2.4. *Prepare intermunicipal cooperations layer*

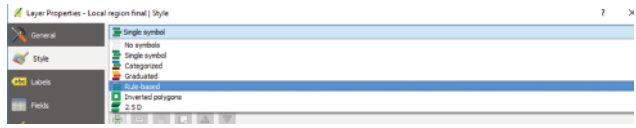
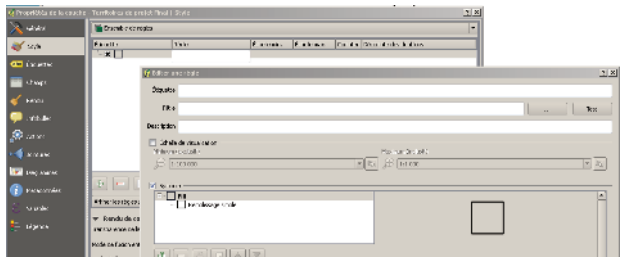
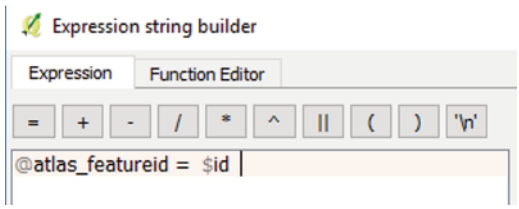
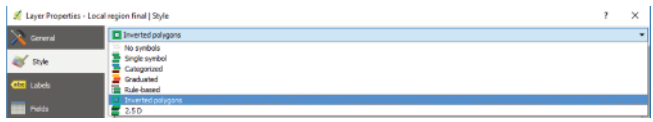
Process	Handling in QGIS
1. Reproject intermunicipal cooperations layer	In **QGIS**: • Save vector layer with CRS 2154 (Lambert 93)
2. Keep only the intermunicipal cooperations of Corsica	In **QGIS**: • Vector > Research tools > Select by location • Select intermunicipal cooperations layer that intersects with the municipalities of Corsica In the **Attributes table**: • Invert selection • Switch to Editing mode • Delete selected features • Stop Editing mode and save

Table 1.8. *Steps for the preparation of the intermunicipal cooperations layer*

1.3.3. *Step 3: atlas implementation in QGIS project*

This step consists in shaping the different layers of data that will be mobilized in the various maps of the atlas. The other dimensions of this step revolve around the definition of the style of the coverage layer (on which the atlas is based) and the configuration of the display masks for the labels.

1.3.3.1. *Defining the coverage layer of the atlas*

Process	Handling in QGIS
1. Defining the coverage layer of the atlas	**In the style properties of the coverage layer**: • Choose a style based on a **set of rules**  • Click on the Rule for **edit rule** • **Click on filter to edit the filter**  • Enter the expression: *@atlas_featureid = $id* 
2. Apply Inverted polygons style	In the style properties of the coverage layer: • Select **Inverted polygons**  • Configure: o white fill o 20% of transparency o black outline, width of 1

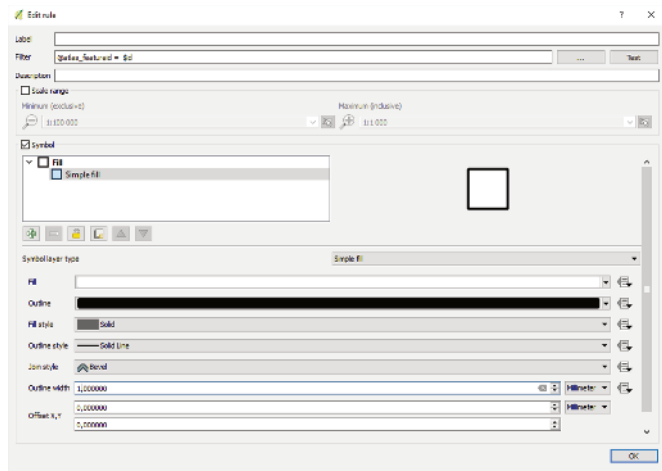
	

Table 1.9. *Steps for defining the coverage layer of the atlas*

1.3.3.2. *Configuration of municipalities labels mask*

Process	Handling in QGIS
1. Apply a symbology	In **QGIS**: • Format the data • Configure labels of municipalities
2. Apply a mask to display only the municipalities labels of selected feature	In **QGIS**: • **Select a feature of the local region layer**  • **Run the Mask extension** • **Configure the Mask Extension**

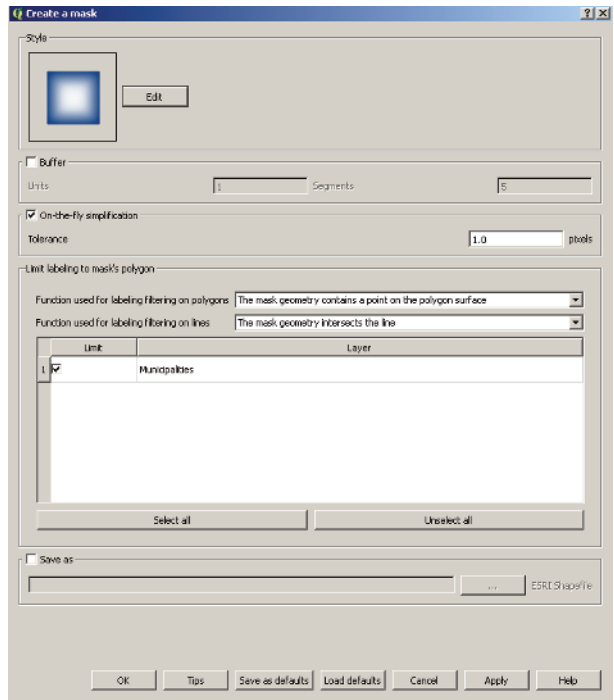
	

Table 1.10. *Steps for the configuration of municipalities labels mask*

1.3.3.3. *Configuration of mask of intermunicipal cooperations labels*

Process	Handling in QGIS
1. Apply a mask to display only the intermunicipal cooperations labels of the selected local region	In **QGIS**: • **Select a feature of the local regions layer** • **Update the current mask** • **Configure the Mask Extension**

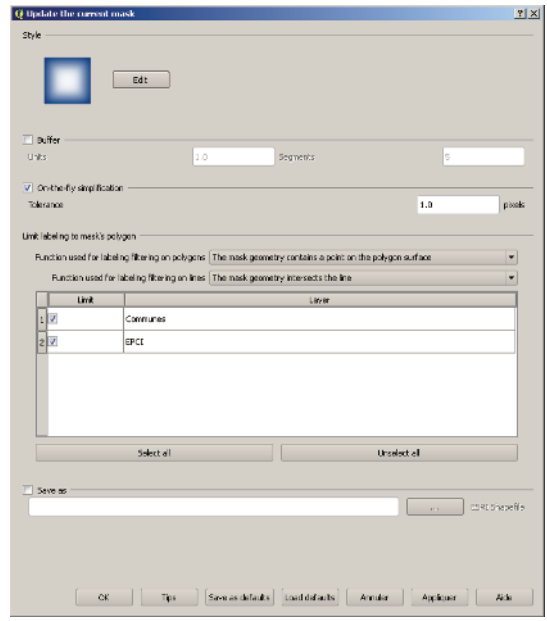
	

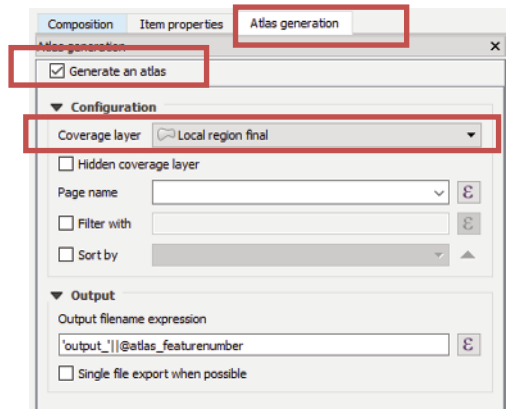
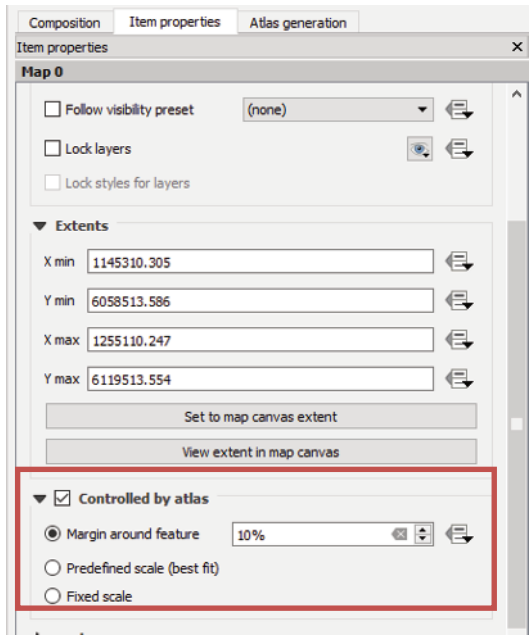
Table 1.11. *Steps for the configuration of intermunicipal cooperations labels mask*

1.3.4. *Step 4: atlas implementation in print composer*

This fourth step has as its objective the configuration and the implementation of the atlas in the composer.

1.3.4.1. *Activation of atlas in print composer*

Process	Handling in QGIS
1. Define map symbology	In **QGIS**: • Activate layers of main map
2. Configuration of coverage layer	In the composer: • Add map  • Activate and configure atlas properties ○ **Click on the Atlas generation tab** ○ **Click on Generate an atlas** ○ **Select the Coverage layer**

	
3. Configuration of map	In the **Item properties** tab: • Activate the function **Controlled by atlas** • Configure **Margin around feature** 

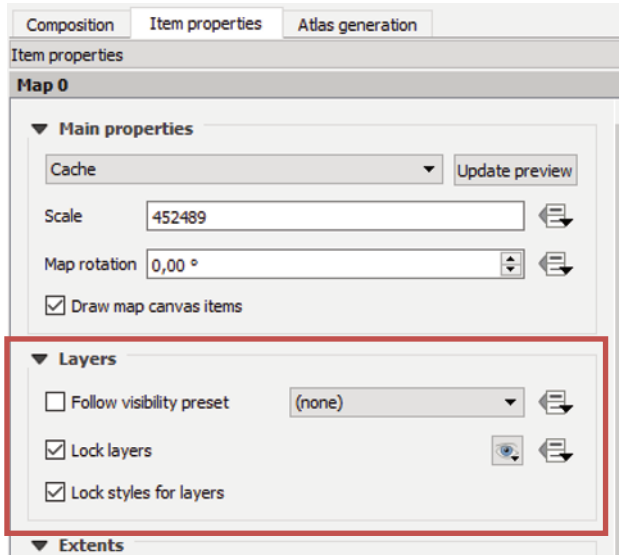
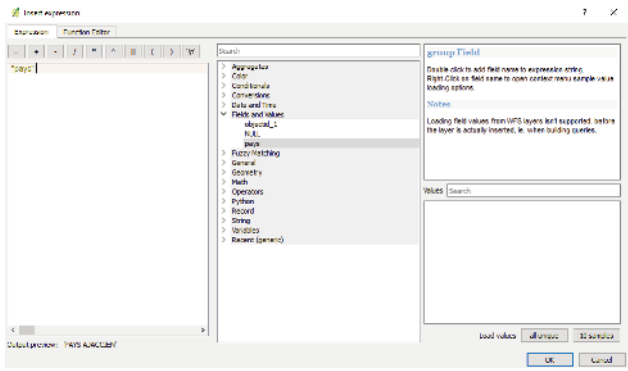
4. Generate atlas in print composer	In the **composer toolbox**: • Click on Preview atlas • Use the arrows to view the different maps generated automatically: 
5. Lock layer and style layer	In the **Item properties** tab: • Lock layers • Lock styles for layers 
6. Finalize the main map	In print composer: • Add map items: Arrow, scalebar, source, legend

Table 1.12. *Steps for the activation of atlas in print composer*

1.3.4.2. *Add dynamic items*

At this stage, it is necessary to configure the dynamic elements that will be displayed in the atlas maps according to the local regions (project name and indicators).

Process	Handling in QGIS
1. Add Title	In **print composer**: • **Add new label for the title of template (name of local region)**  In **Item properties**: • Click on **Insert** an expression In **window**: • **Indicate the name of the field where we will find the information of the names of local regions**  • **Configure Appearance of the title** (Font, font color, size, alignment)
2. Add indicators	In **print composer**: • **Add new label for indicators**  In **Item properties**: • Click on Insert an expression In **window**: • Indicate the **name** of the field where we will find the information of the names of local regions In the **main properties of the indicator label**: • Indicate, after the expression, the unit of the indicator

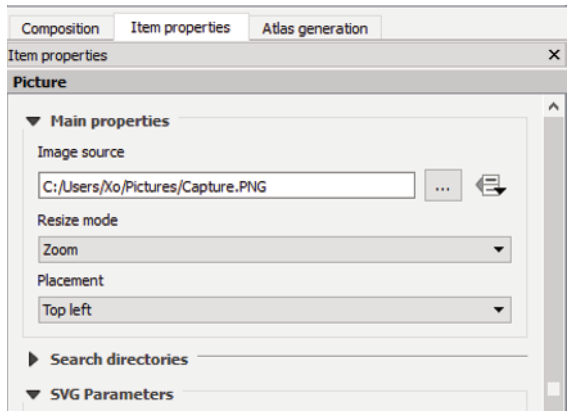
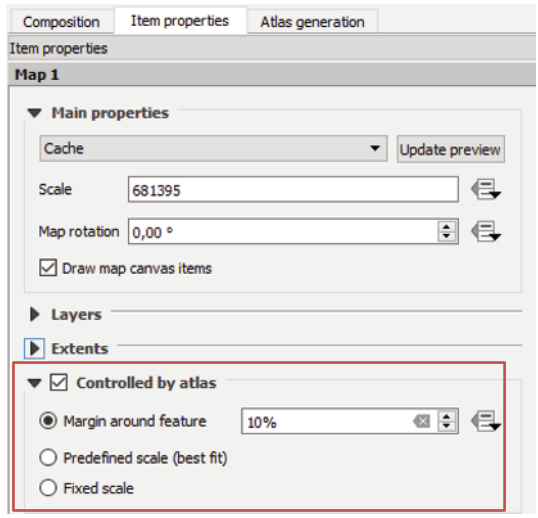
	 Change the appearance (size, font,…)
3. Add icons	➔ **To give an infographic style to the indicators you can add icons after each indicator (http://www.flaticon.com):** In **print composer**: • Add image  • Define the location of the image (use the SVG format for better rendering) 

Table 1.13. *Steps for adding dynamic items*

1.3.4.3. *Add municipal population density map*

Process	Handling in QGIS
1. Define map symbology	In **QGIS:** • Activate *municipalities V2* layer • Use a good symbology (graduated style) for representing these data
2. Add map in print composer	In **print composer:** • Click Add Map  • Define map position, scale and dimensions
3. Configuration of map	In **Item properties** tab**:** • Activate the function Controlled by atlas • Configure Margin around feature 
4. Lock layers and style layers of the maps	In **Item properties** tab**:** • Lock layers • Lock styles for layers

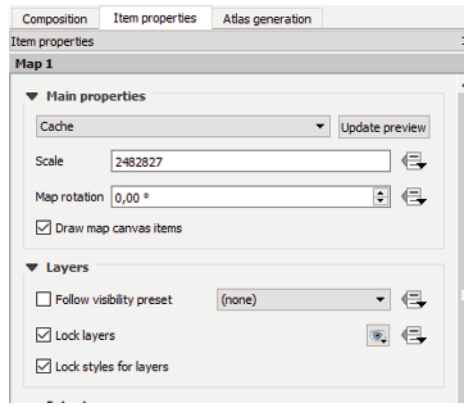
	

Table 1.14. *Steps to configure municipal population density map*

1.3.4.4. *Add Intermunicipal cooperations map*

Process	Handling in QGIS
1. Define map symbology	In **QGIS**: • Activate *Intermunicipal cooperation* layer • Use a good symbology (Categorized style) for representing these data
2. Add map in print composer	In **print composer**: • Click Add Map  • Define map position, dimensions and scale
3. Configuration of map	In **Item properties** tab: • Activate the function Controlled by atlas • Configure Margin around feature
4. Lock layers and style layers of the maps	In **Item properties** tab**:** • Lock layers • Lock styles for layers

Table 1.15. *Steps to configure intermunicipal cooperations map*

1.3.4.5. *Add overview map*

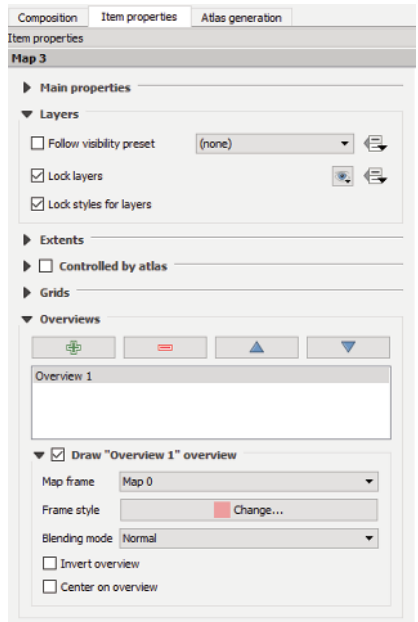
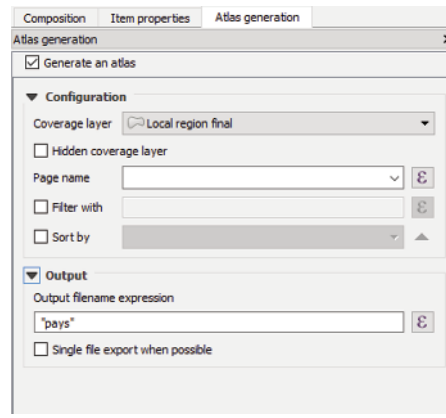
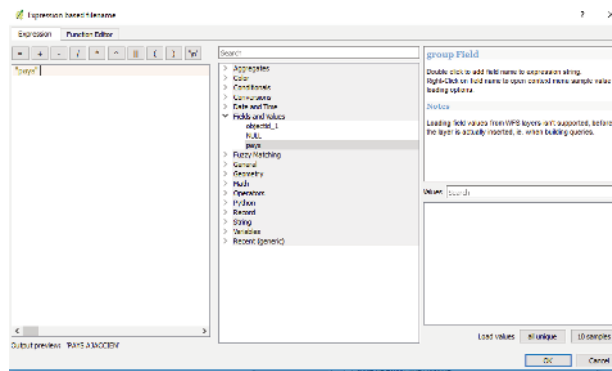
Process	Handling in QGIS
1. Define map symbology	In **QGIS**: • Activate *final local region* layer • Use a basic symbology (Categorized style) for representing these data
2. Add map in print composer	In **print composer:** • Click Add Map  • Define map position and dimensions
3. Configure overview parameters of the map	In **Item properties**: • Add an Overview  • Configure this overview with a map frame of Map 0 (the main map) • Lock layers • Lock styles for layers 

Table 1.16. *Steps to configure the overview map*

1.3.5. *Step 5: atlas publication*

The different elements of the atlas are configured (maps, indicators, title, etc.). In this last step, the production of the atlas boards is carried out by exporting them as images.

Process	Handling in QGIS
1. Customize output filename with expression	In the **Atlas generation** tab: • Configure the output filename by assigning the value of the field “pays” (name of local regions)   **NB** *:* If the field “pays” as the name of files generated by the atlas causes an error under GNU / Linux, then either change the values that caused the problem in the layer or change the output file name by putting the expression as the following: ("pays", "/", "-")

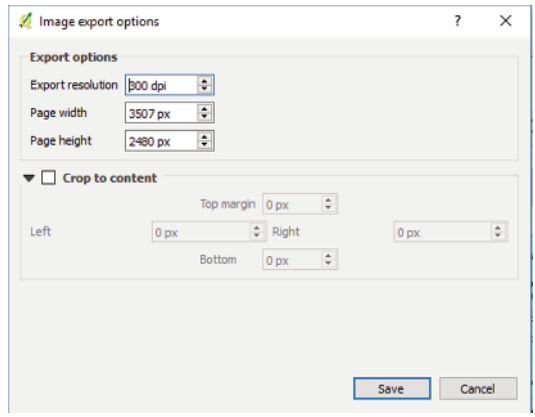
2. Run export	In **print composer**: • Click on **Export Atlas as Images**  • **Create a folder** in which the pages (images) of the atlas will be stored • Select this directory and choose
3. Configure image export options	**Choose the export resolution** according to the end use of the atlas  Web publication 100dpi; PDF Publication 300dpi; Printing minimum 400dpi. • **Click on Save** • **Check the export**

Table 1.17. *Steps for the publication of the atlas*