Renewables for African Agriculture:
Integrating Modelling Excellence and Robust Business Models

THE RE4AFAGRI DASHBOARDS

www.re4afagri.africa

LEAP-RE

Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy

RE4AFAGRI

Renewable Energy for African Agriculture

The LEAP-RE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under Grant Agreement 963530.

THE RE4AFAGRI modelling platform

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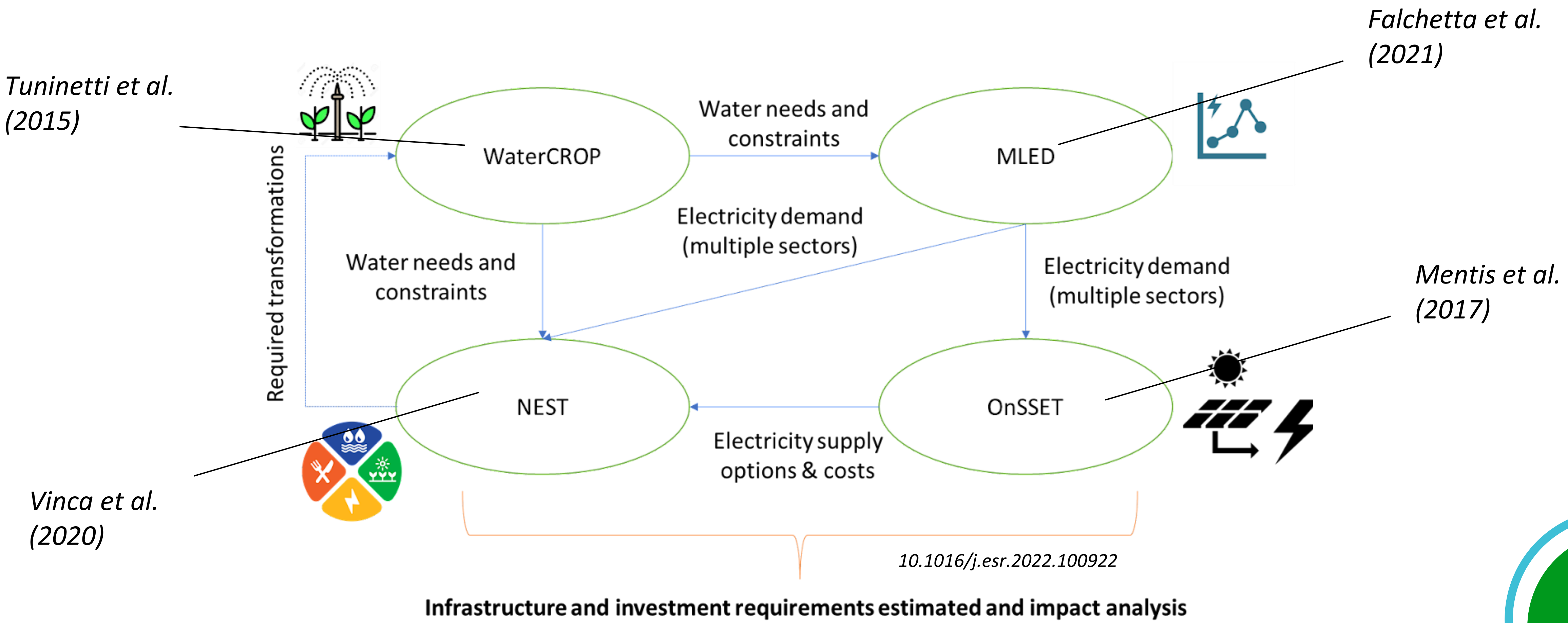
The RE4AFAGRI platform is a multi-model framework to analyse deficits, requirements, and optimal solutions for integrated land-water-agriculture-energy-development nexus interlinkages in developing countries. **Four models** representing land-water-crop-food-energy requirements and dynamics *(WaterCROP, M-LED, OnSSET and MESSAGE-NEST)* are calibrated and soft-linked through **the RE4AFAGRI platform.**



The RE4AFAGRI visualisation dasbhoards

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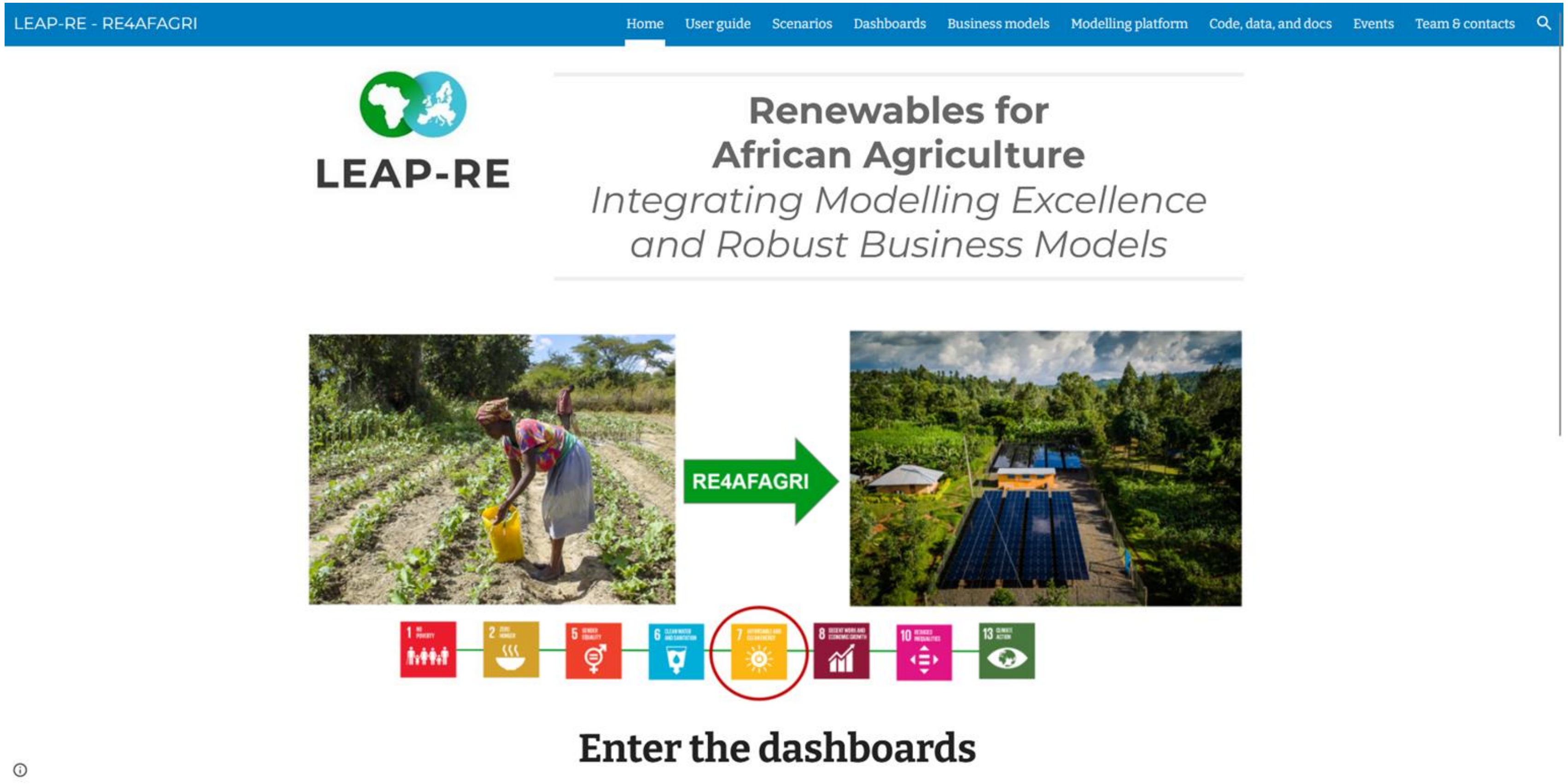

- A **powerful decision support tool with interactive dasbhoards**
- Support **private infrastructure developers** in site selection for maximising financial sustainability and development impact
- Support **policymaking** through sub-national gaps and needs assessment for tailored measures and investments
- Enriched with **direct access to download the raw output data**

The RE4AFAGRI visualisation dasbhoards

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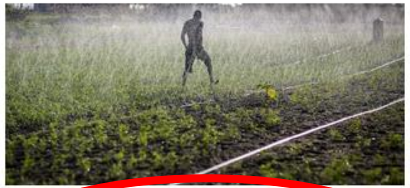
Dashboards - Zambia



Cropland and water requirements

Assess the current agricultural area, by crop and irrigation regime, and visualize water requirement estimates to close the irrigation gap

Multi-sectoral electricity demand

Browse local estimates of electricity demand from different sectors, including agricultural and other sources of demand.

Yield and yield growth potential

Navigate the current crop yields and estimates of productivity growth potential thanks to the input of irrigation

Crop processing

Navigate the crop throughput potential and corresponding energy requirement estimates for processing and storing crop yields in rural communities

Electricity access planning

Assess the cost-optimal technologies and related investment requirements for electrifing communities

Multi-sectoral insights

Draw policy-relevant insights on how electricity access, food security, water management and climate change objectives interact

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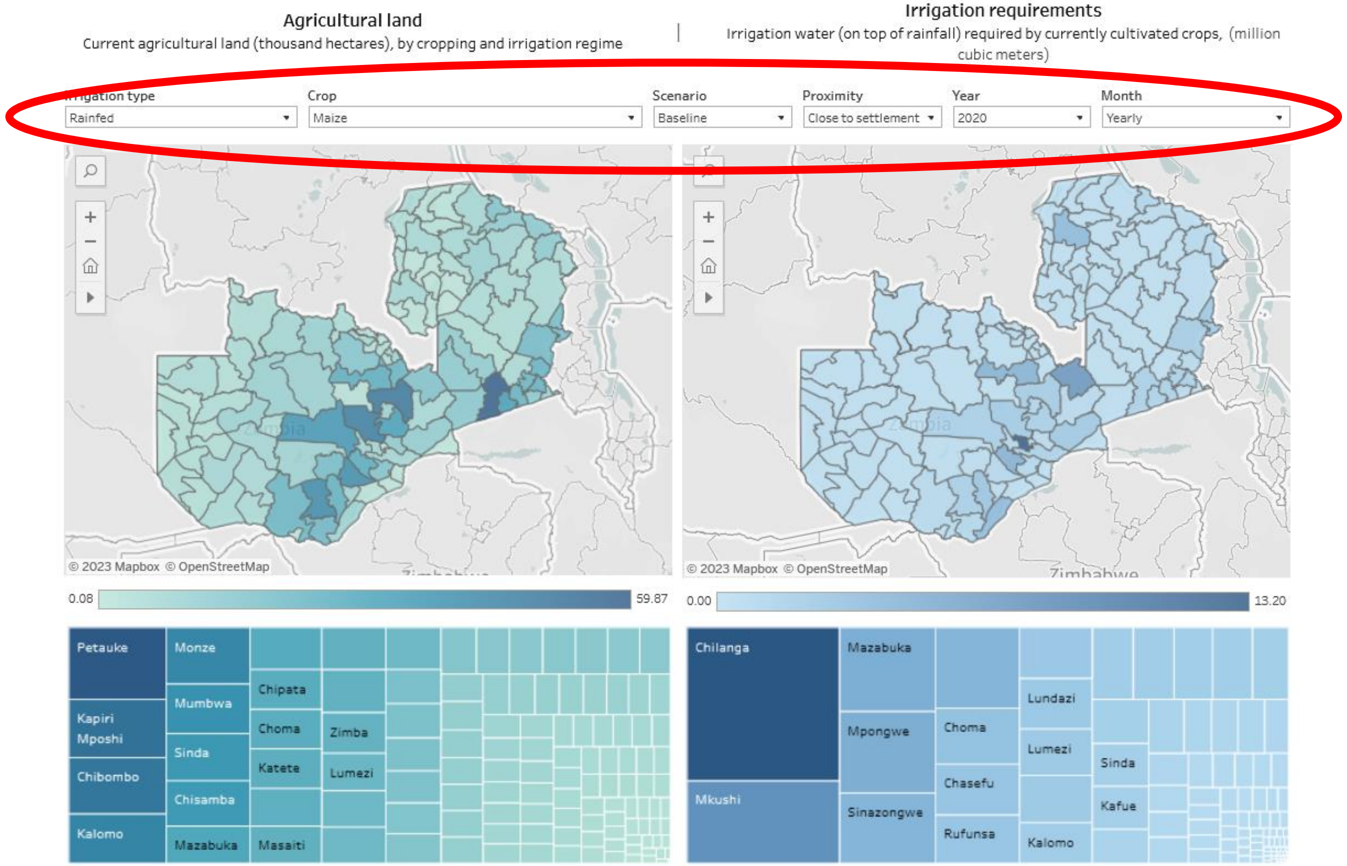
Agriculture requirements

For each administrative unit: the **left** panel illustrates the **current agricultural area** (year 2017) by crop and irrigation regime; the **right** panel shows the **water requirements to expand irrigation** and meet the yield and food production objectives in each scenario, month and year (between 2020 and 2050). Refer to the Scenarios page for a detailed characterisation of each scenario's assumptions and objectives.

The **proximity** parameter allows distinguishing between agricultural land (and the relative water requirements) in proximity (<5 km) or remote (>5 km) from the closest human settlement. This has important implications for the selection of off-grid vs. on-grid electricity supply for on-the-field water pumping.



Selectors

- Scenarios
- Months
- Projection year
- Options (dashboard-specific)
  - Crops
  - Technologies
  - Sectors
  - …

Inside the dasboards

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Hands-on session

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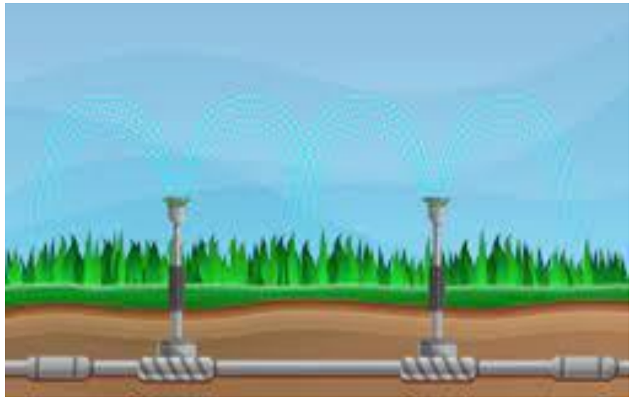
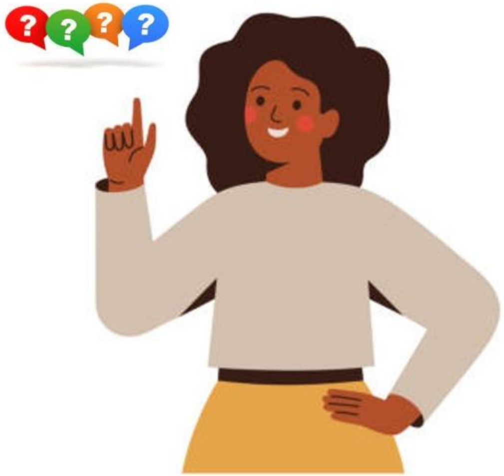
Use case 1: agriculture and irrigation





Anne wishes to identify which regions have the **strongest need and potential for expanding maize irrigation**

Anne, president of smallholder farmers association of Zambia

Use case 1: agriculture and irrigation

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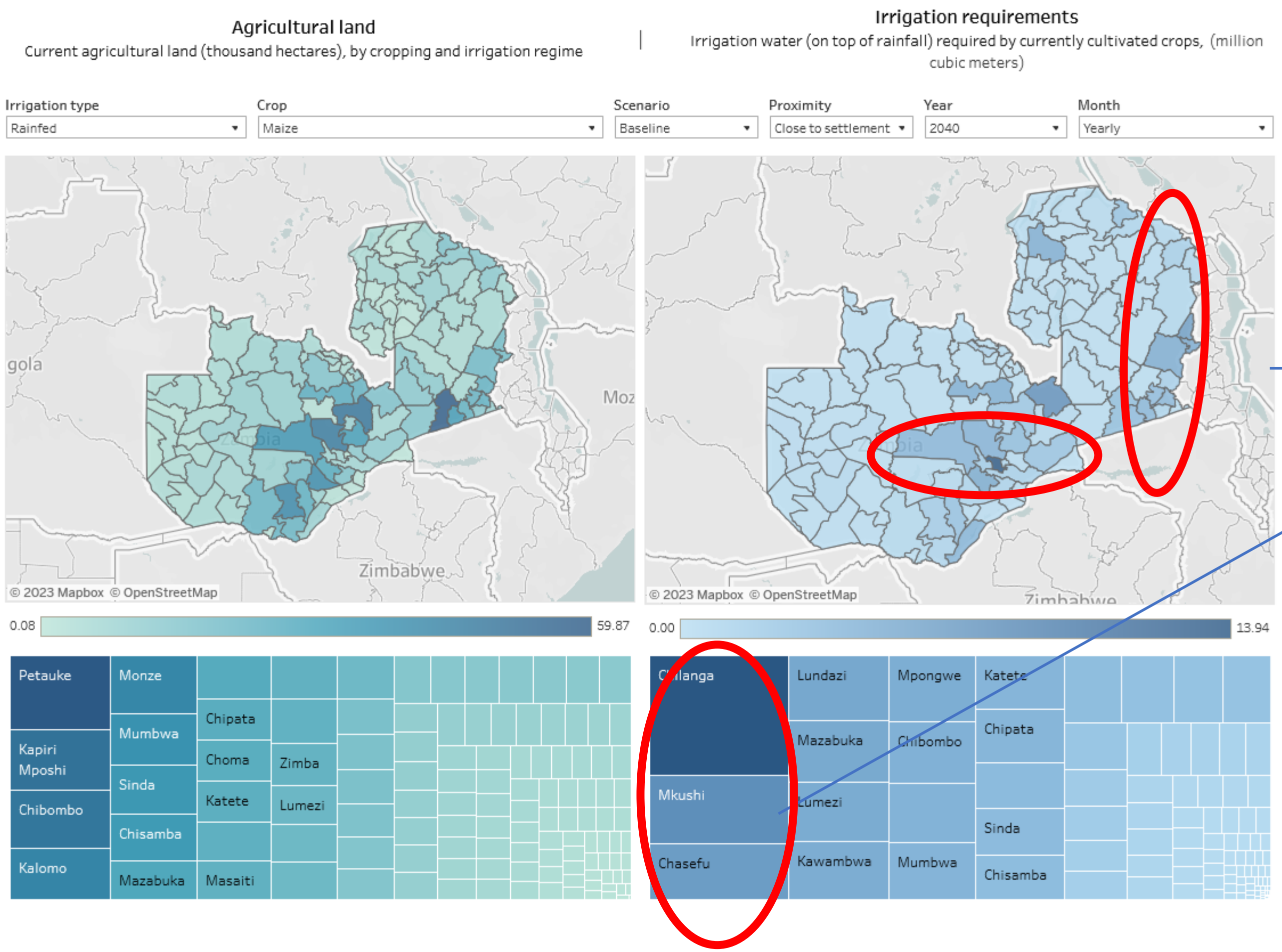
- In which regions it is most effective and potentially profitable AND impactful to **invest in maize irrigation expansion?**
- **How much water and pumping energy is required** in those regions?

Drip irrigated maize

To address these questions, we will use **water, energy demand, and crop yield dashboards and output data.**

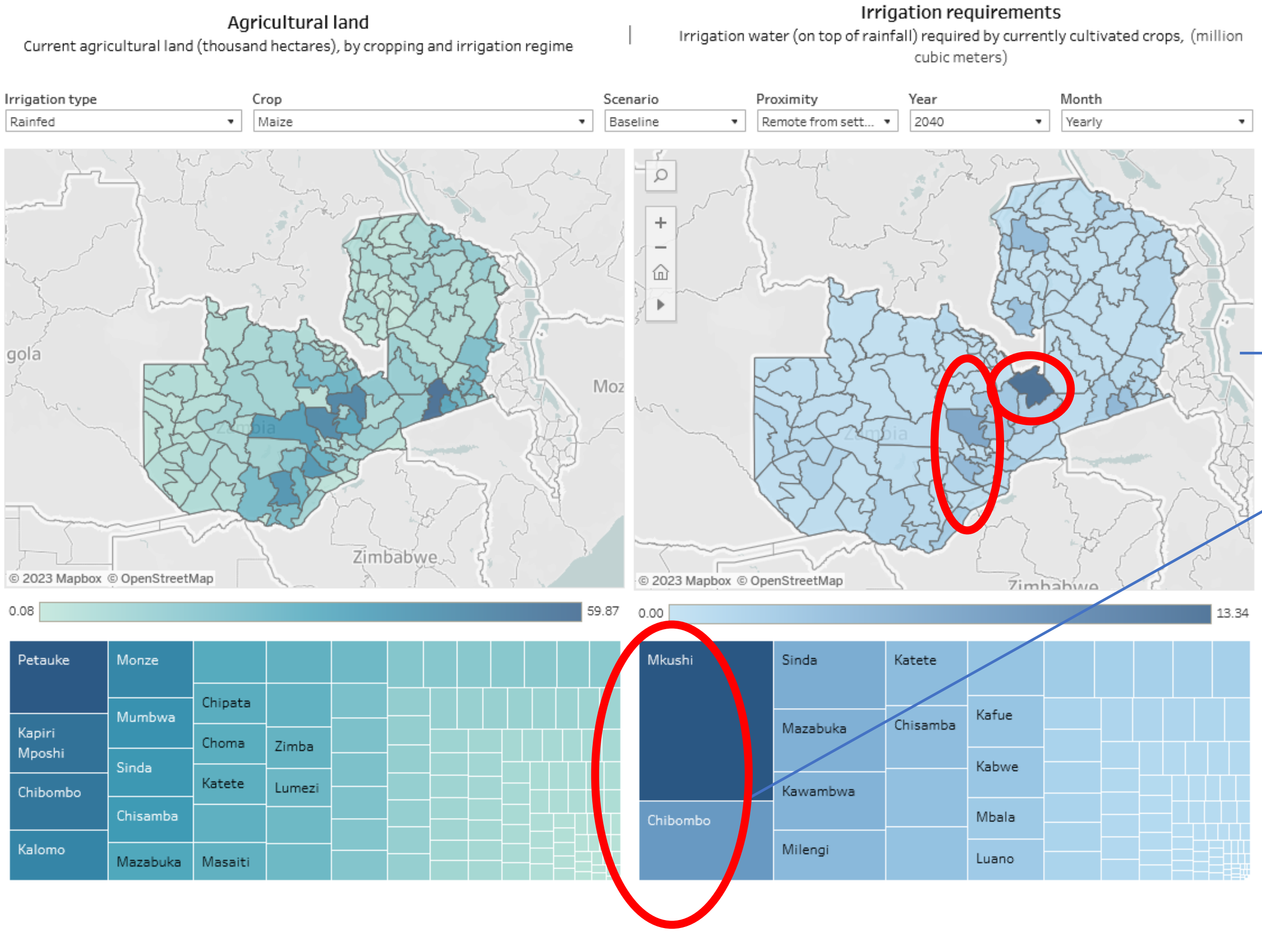
Use case 1: agriculture and irrigation



Regions with the estimated largest irrigation water gap for rainfed maize fields **CLOSE TO SETTLEMENT**

Cropland that is close to settlement might be more suitable to be connected to centralised water infrastructure and electricity generation options

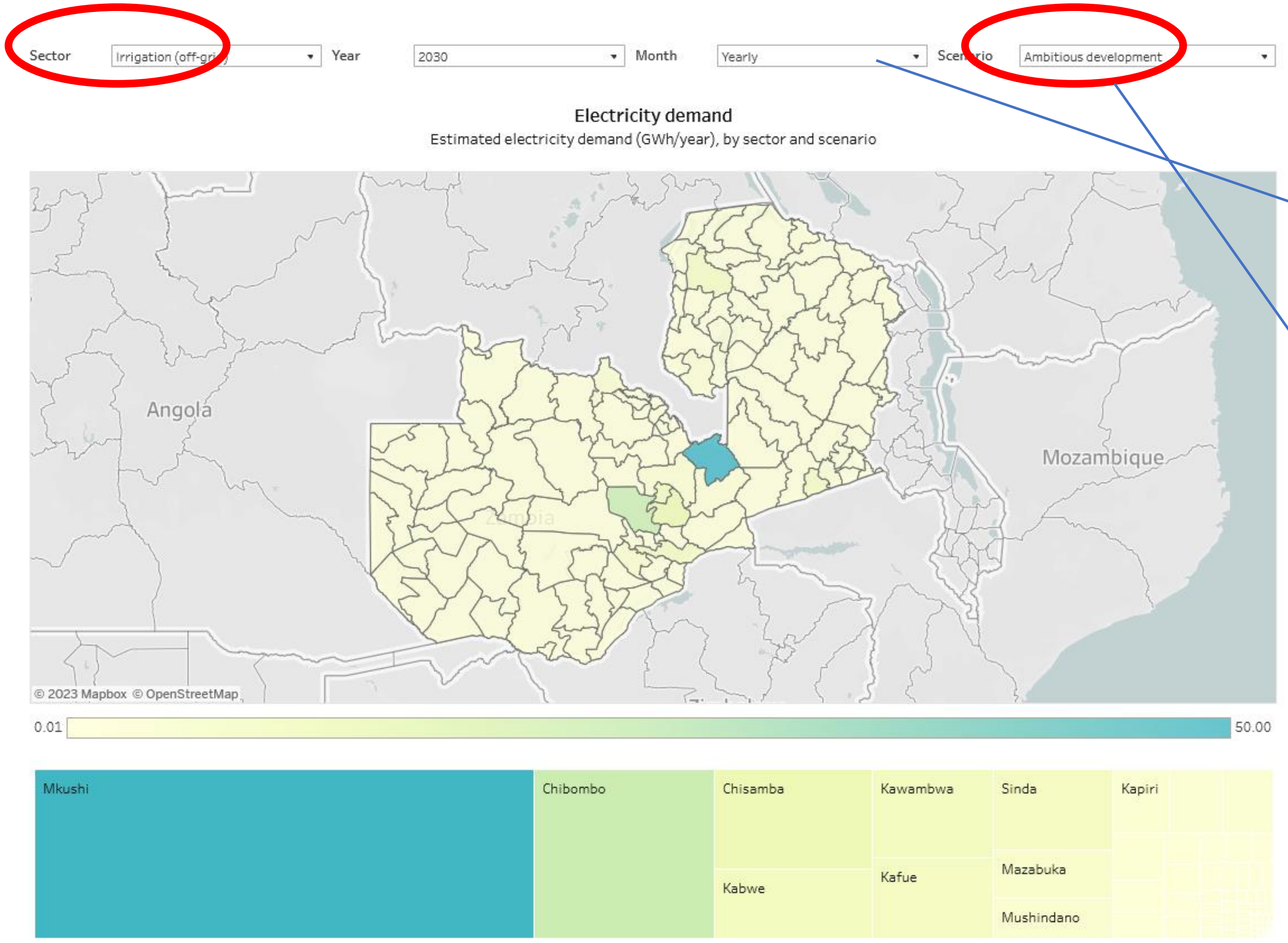
Use case 1: agriculture and irrigation



Regions with the estimated largest irrigation water gap for rainfed maize fields **REMOTE FROM SETTLEMENT**

Cropland that is remote from settlement might be more suitable to rely on standalone water infrastructure and electricity generation options, e.g. off-grid pumping and irrigation systems

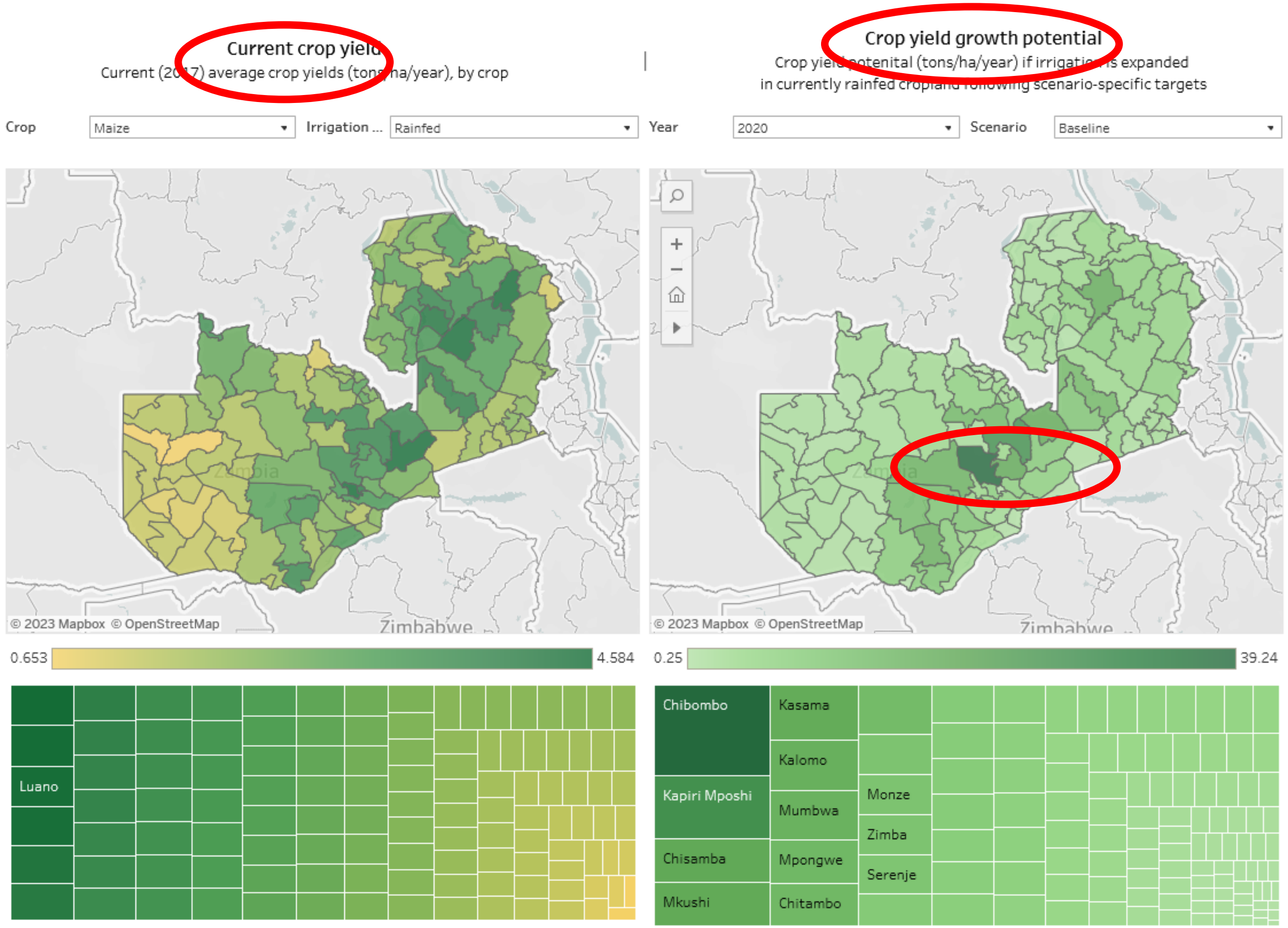
Use case 1: agriculture and irrigation



Check **seasonality of demand**

Compare the three scenarios to observe the difference of switching from base production to increased production to meet food and nutrition security goals

Use case 1: agriculture and irrigation



Regions where rainfed maize is expected to have **the strongest yield growth response** if irrigation is performed in currently rainfed cropland

Use case 1: agriculture and irrigation

Considerations

1. What is the **ultimate goal**?
   - Small-scale, highly effective projects, or large-scale schemes deployment?
   - check the **total rainfed maize AREA** in each province side-by-side with the **yield growth potential** and multiply the two numbers to get the TOTAL potential yield growth increase

2. What **water and energy volumes** should be ideally provided to meet those goals?

2. What does this entail for water-energy systems planning?

Use case 2: region/site selection for mini-grid project investment

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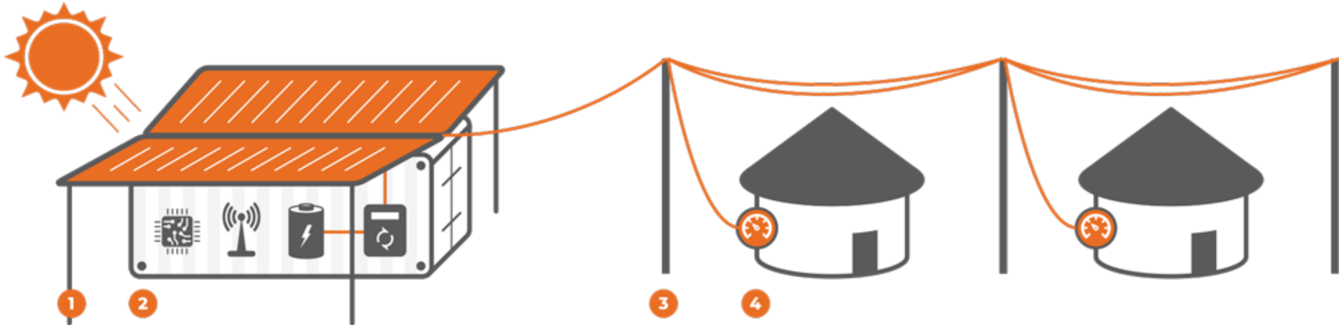

Joseph wishes to identify which regions have the **strongest potential to build productive energy uses-focused mini-grids**

Joseph, CEO of Zambian mini-grid company

Use case 2: region/site selection for mini-grid project investment

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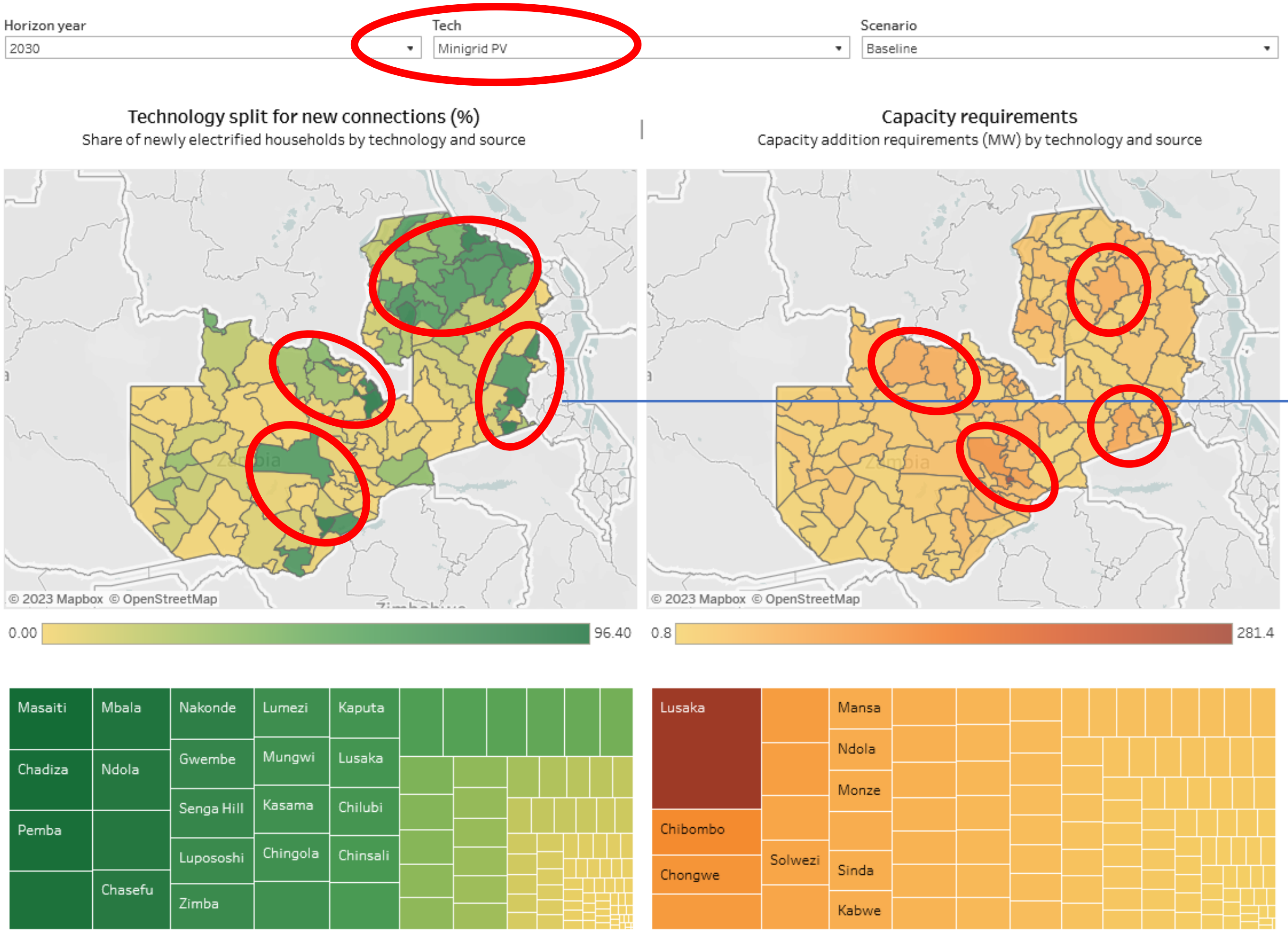
- What are the regions with the **highest projected share of minigrids PV** as cost-effective electrification option?
- Which regions have the highest level of **potential productive energy demand** to support electrification private investment and customers' affordability to pay?

Rural solar PV minigrid

To address these questions, we will use **energy demand and supply dashboards and output data**

Use case 2: region/site selection for mini-grid project investment



Look for…

regions with **highest projected share of PV mini-grids in technology split** (%)

AND/OR

the **largest capacity requirements for PV mini-grids** (MW)

as the cost-effective electrification solutions

Use case 2: region/site selection for mini-grid project investment

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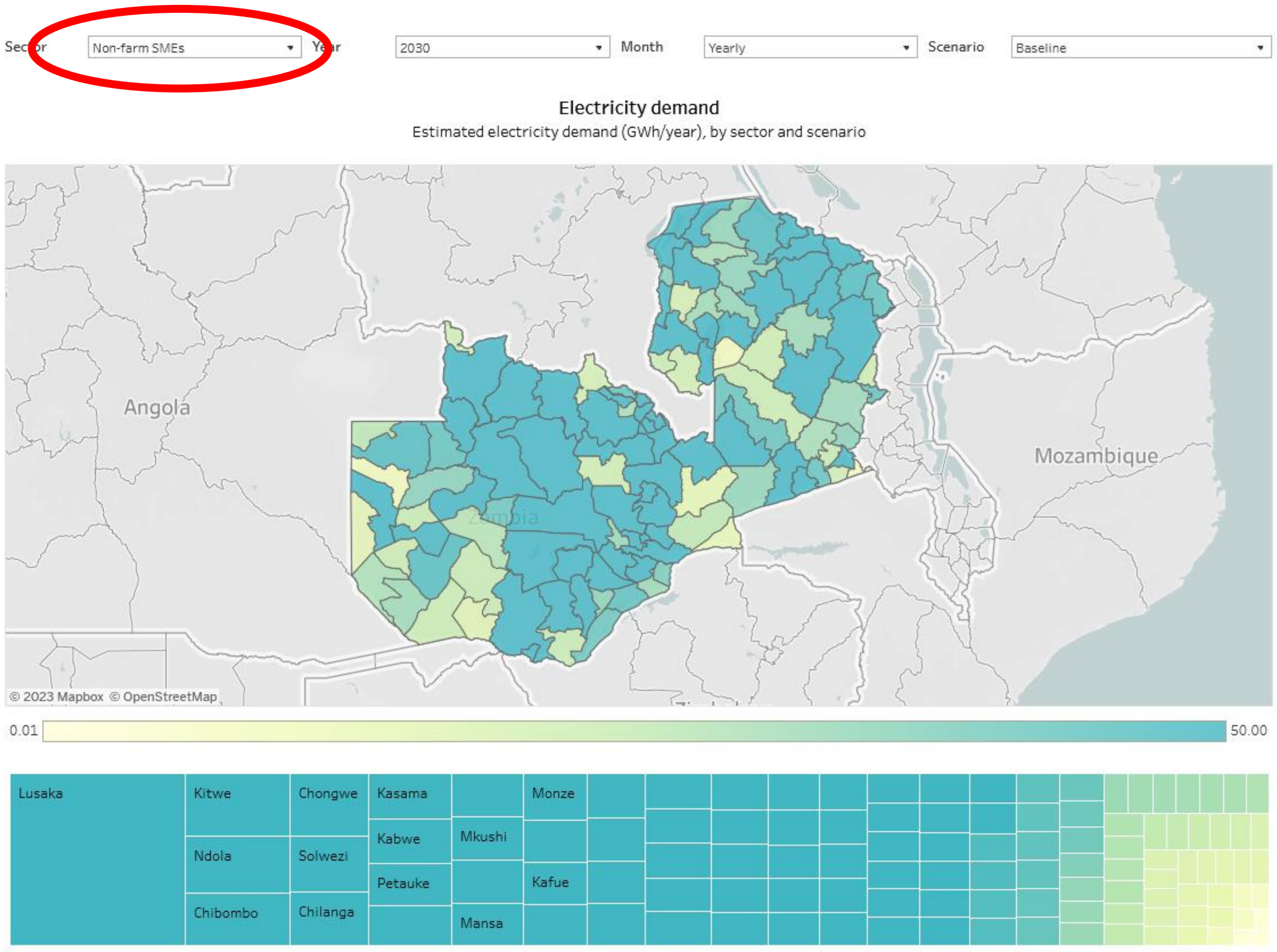

SMEs potential energy demand in 2030

- Compare the regions identified as the most promising for minigrids PV in the previous slide
- Where the colour ramp does not help, **use the mouse overlay and the box ribbon**

Use case 2: region/site selection for mini-grid project investment

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Considerations

1. First-order **overview** through the dashboards to **identify provinces/areas with the largest estimated potential** and productive demand

1. Then, recommended step: **download cluster data** for a specific region with potential and **explore the clusters in QGIS** to analyse more in detail within-province heterogeneity and find most promising communities / districts

1. Also, for each settlement cluster, have a look at currently estimated:
    - **electrification status**
    - **population**
    - **GDP per capita**

Use case 3: potential for solar milling development

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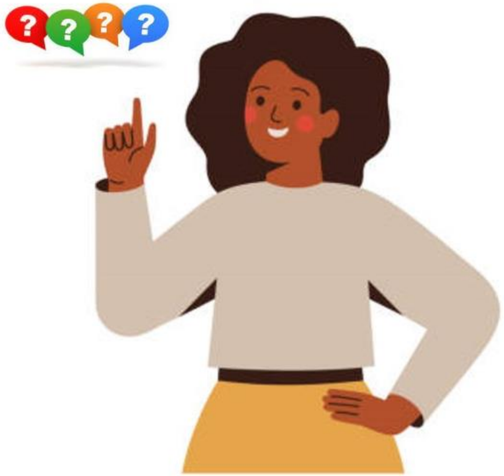
Anne wishes to identify which regions have the **strongest potential to promote pay-as-you go solar mills**



Anne, president of smallholder farmers association of Zambia

Use case 3: potential for solar milling development

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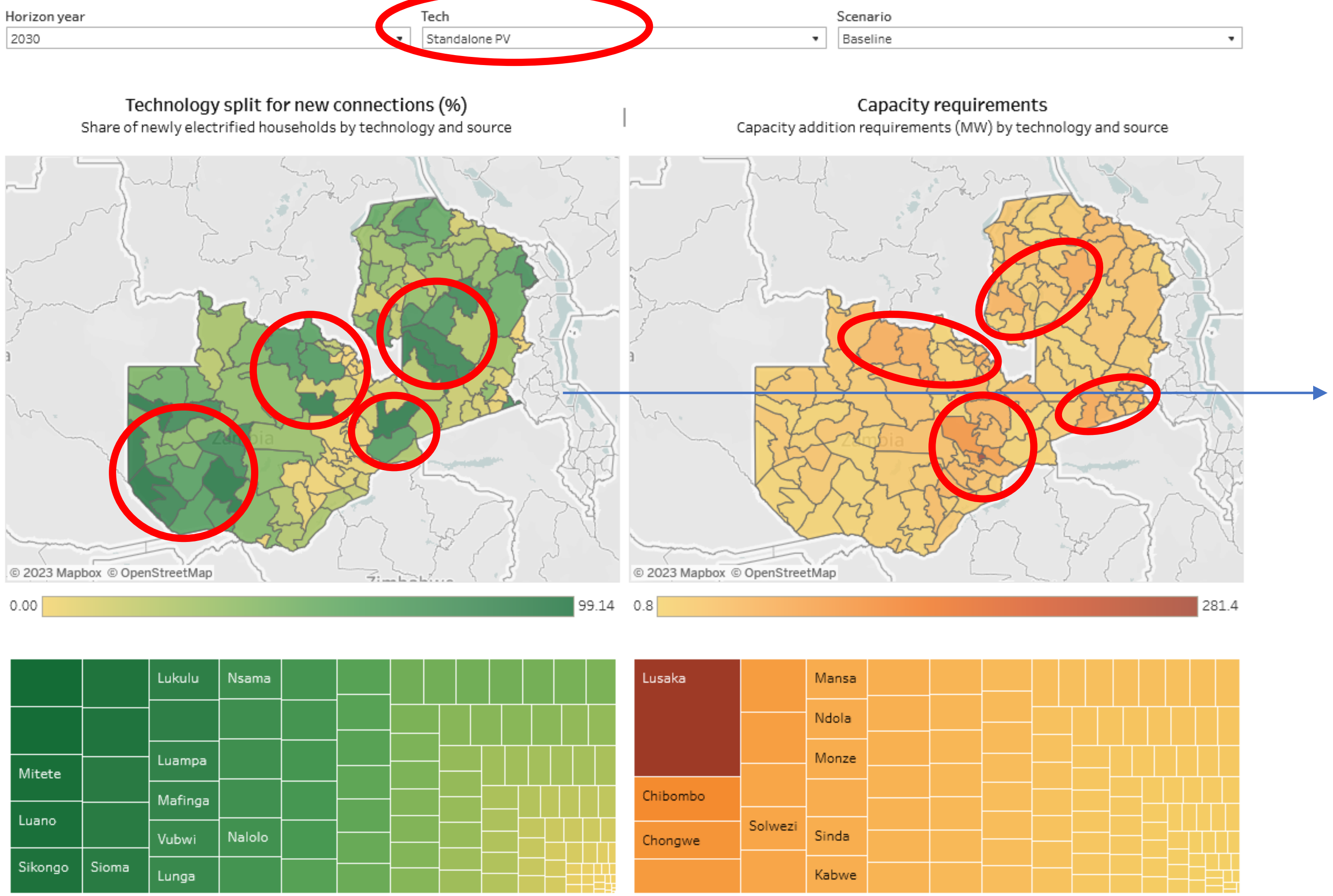
- In which regions is there **high potential crop processing throughput, but low projected economic feasibility of central grid connections or mini-grid development?**

A solar rice miller

To address these questions, we will use **electricity supply and crop processing dashboards and output data.**

Use case 3: potential for solar milling development



Look for…

regions with <u>highest projected share of Standalone PV in technology split</u> (%)

AND/OR

the <u>largest capacity requirements for Standalone PV</u> (MW)

as the cost-effective electrification solutions

Crop processing potential

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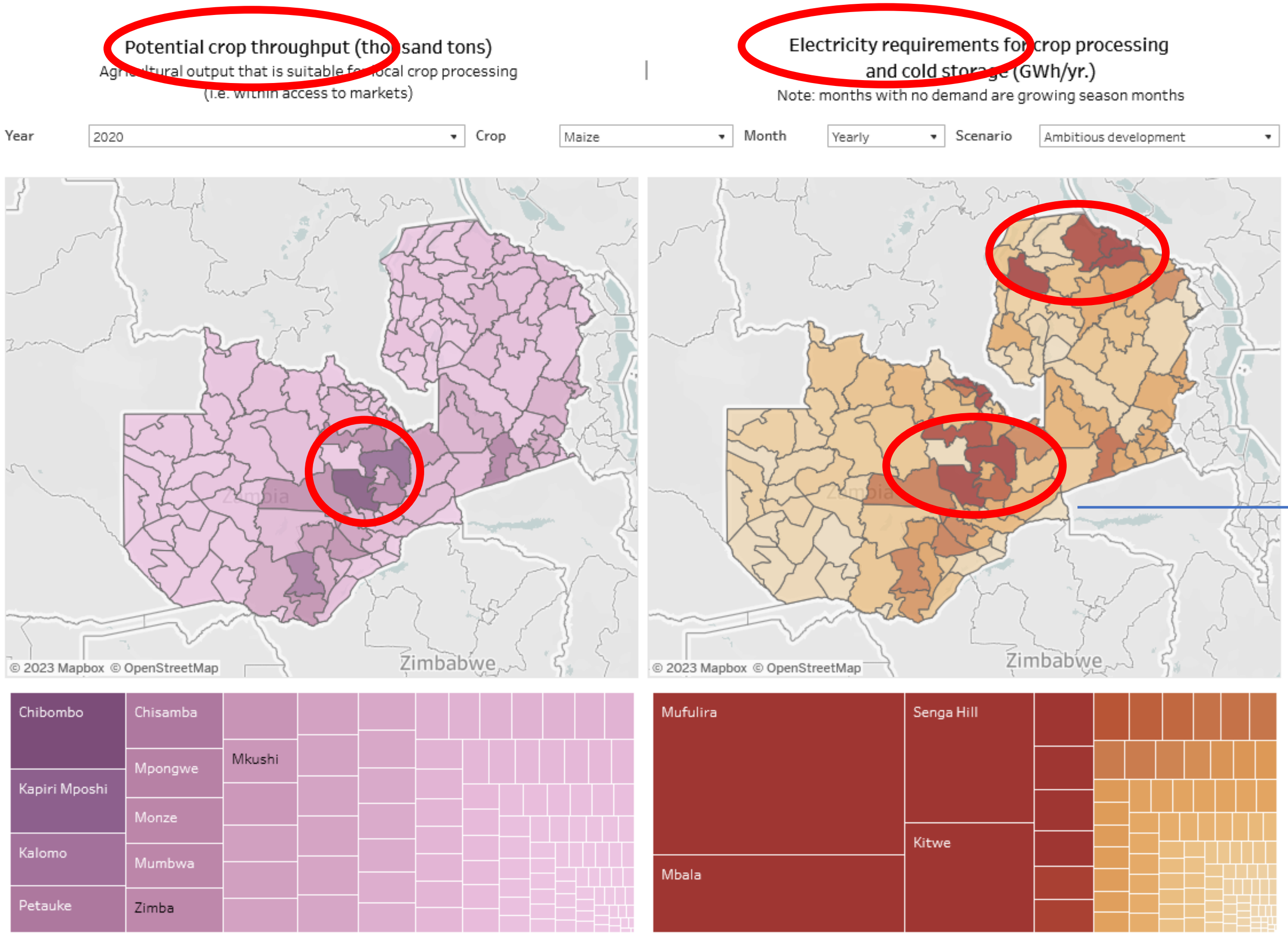

Look for the **regions with highest crop processing demand**

Use case 3: potential for solar milling development

LEAP-RE

Considerations

1. First-order **overview** through the dashboards to **identify provinces/areas with the largest estimated** crop processing demand and SA PV shares

1. Then, recommended step: **download cluster data** for a specific region with potential and **explore the clusters in QGIS** to analyse more in detail within-province heterogeneity and find most promising communities / districts

1. Also, for each settlement cluster, have a look at currently estimated:
    - **electrification status**
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    - **GDP per capita**

Getting the high-resolution output data

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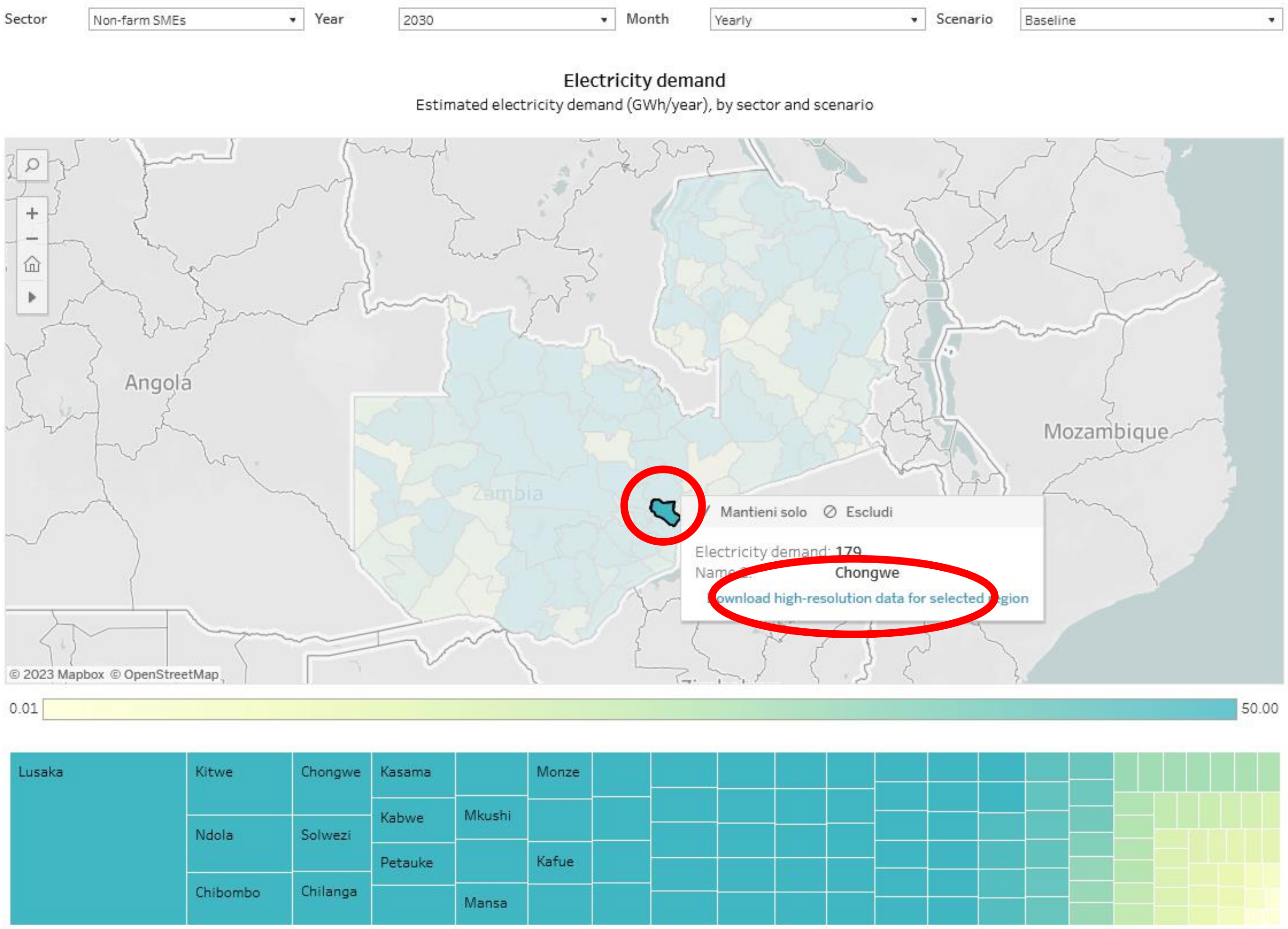
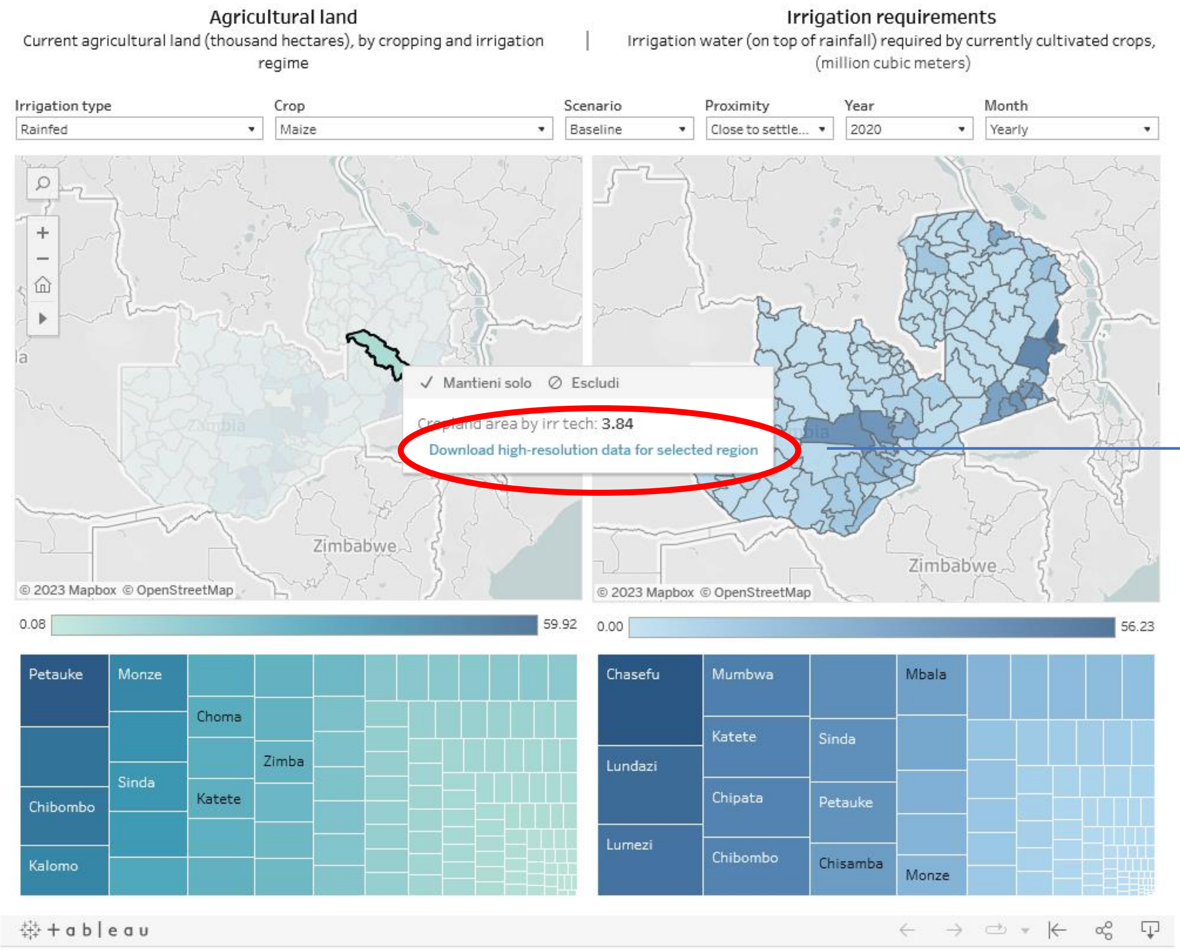
Next steps: getting the high-resolution output data

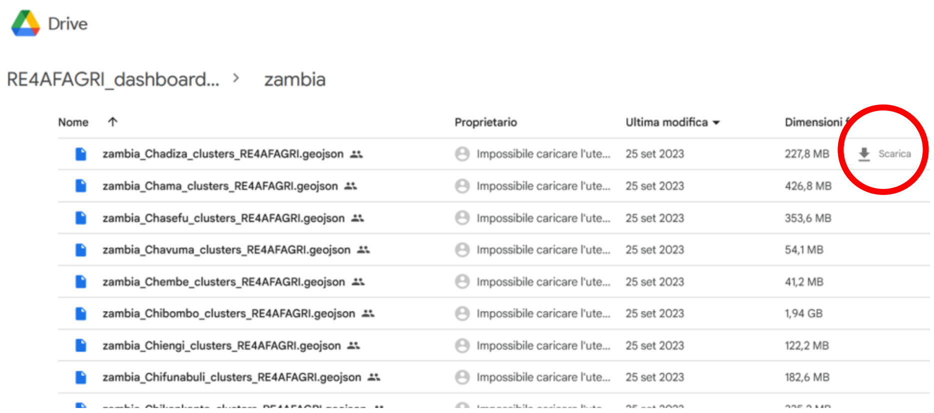


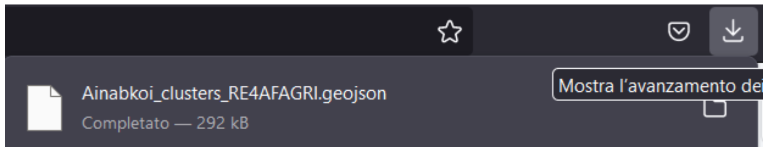
Access sub-province settlement-level data

- To look at distribution of demand across settlements in the region
- To evaluate socio-economic and demographic variables, and visually assess settlement with the aid of satellite imagery

Next steps: getting the high-resolution output data







Opening the high-resolution output data

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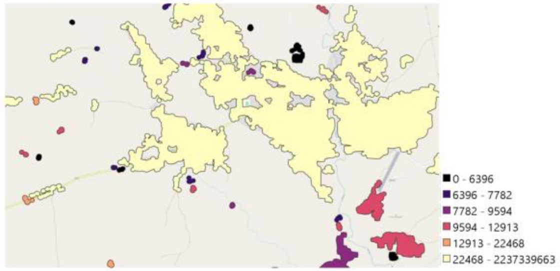
- Geopackage outputs are ideally opened using a GUI-based GIS software, e.g. **QGIS**
- This will allow the user to **browse** through a country/region and visually observe a field
- This will require defining a colour ramp for each field of interest
- …as well as adding a background base map

QGIS



QGIS settlement clusters visualisation

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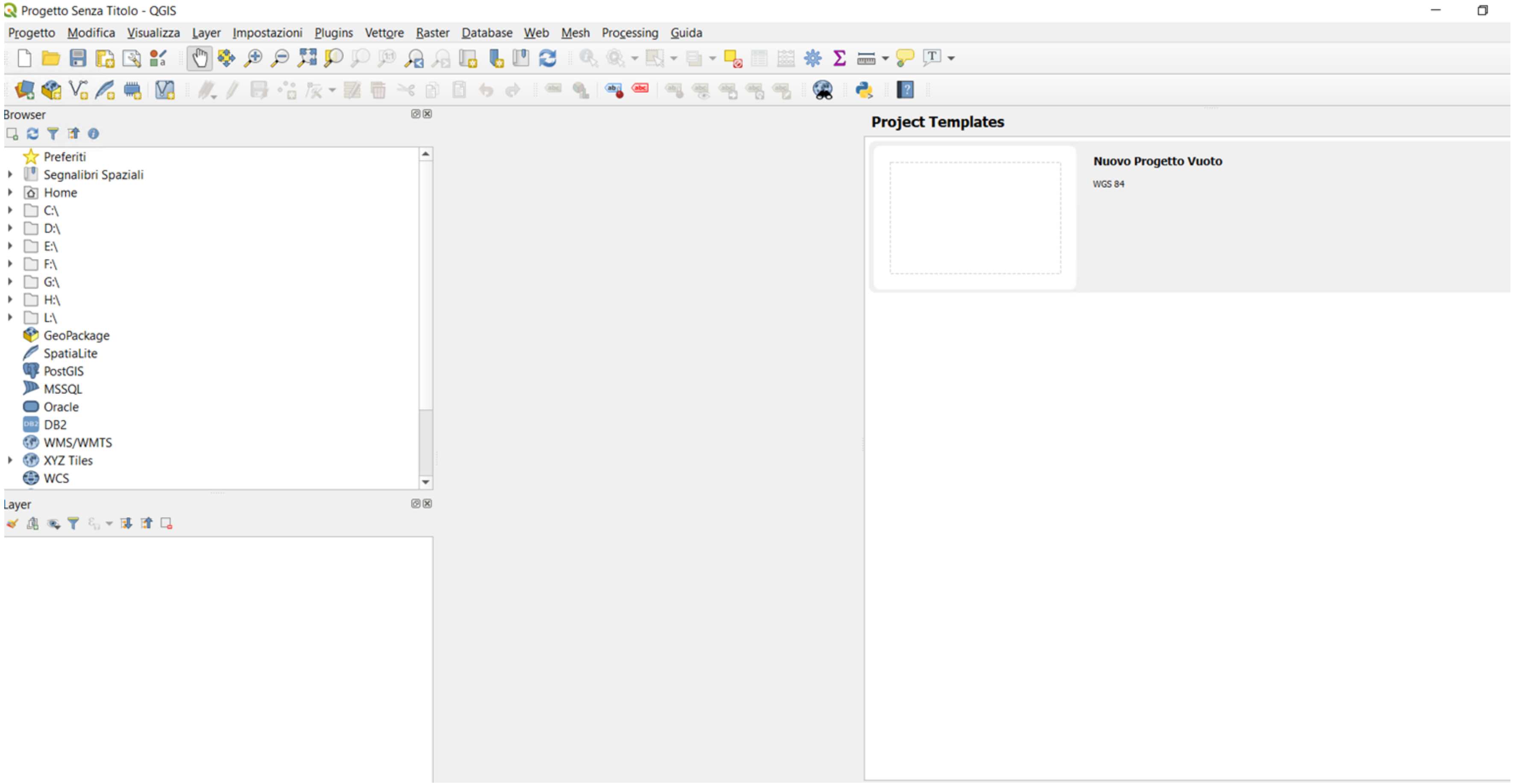
- 1- Open QGIS



QGIS settlement clusters visualisation

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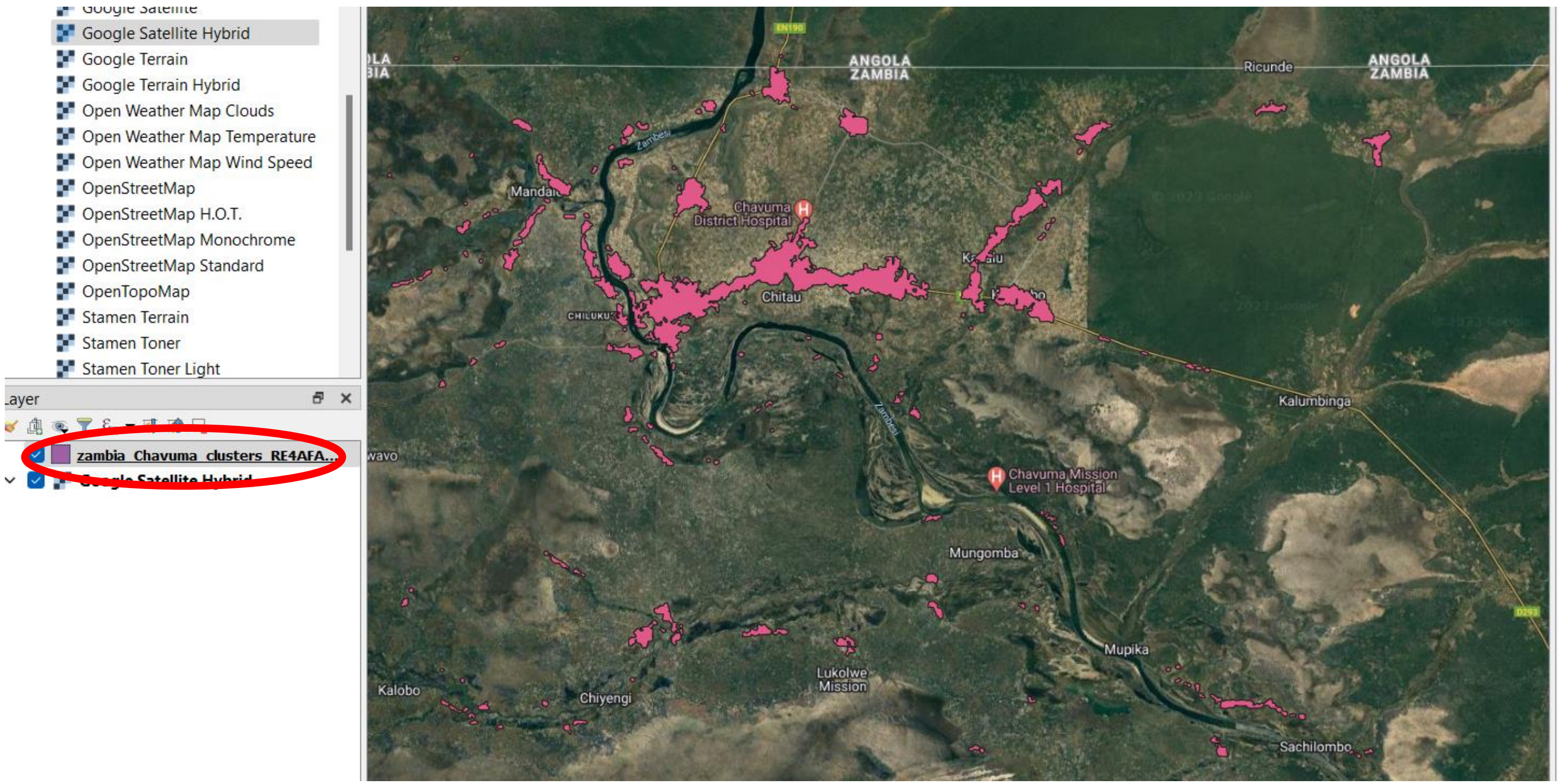
- 2- Set a reference satellite basemap

QGIS settlement clusters visualisation

- 3- Drag the downloaded file and wait for it to load



Population clusters (the unit of reference of M-LED and OnSSET models)

QGIS settlement clusters visualisation

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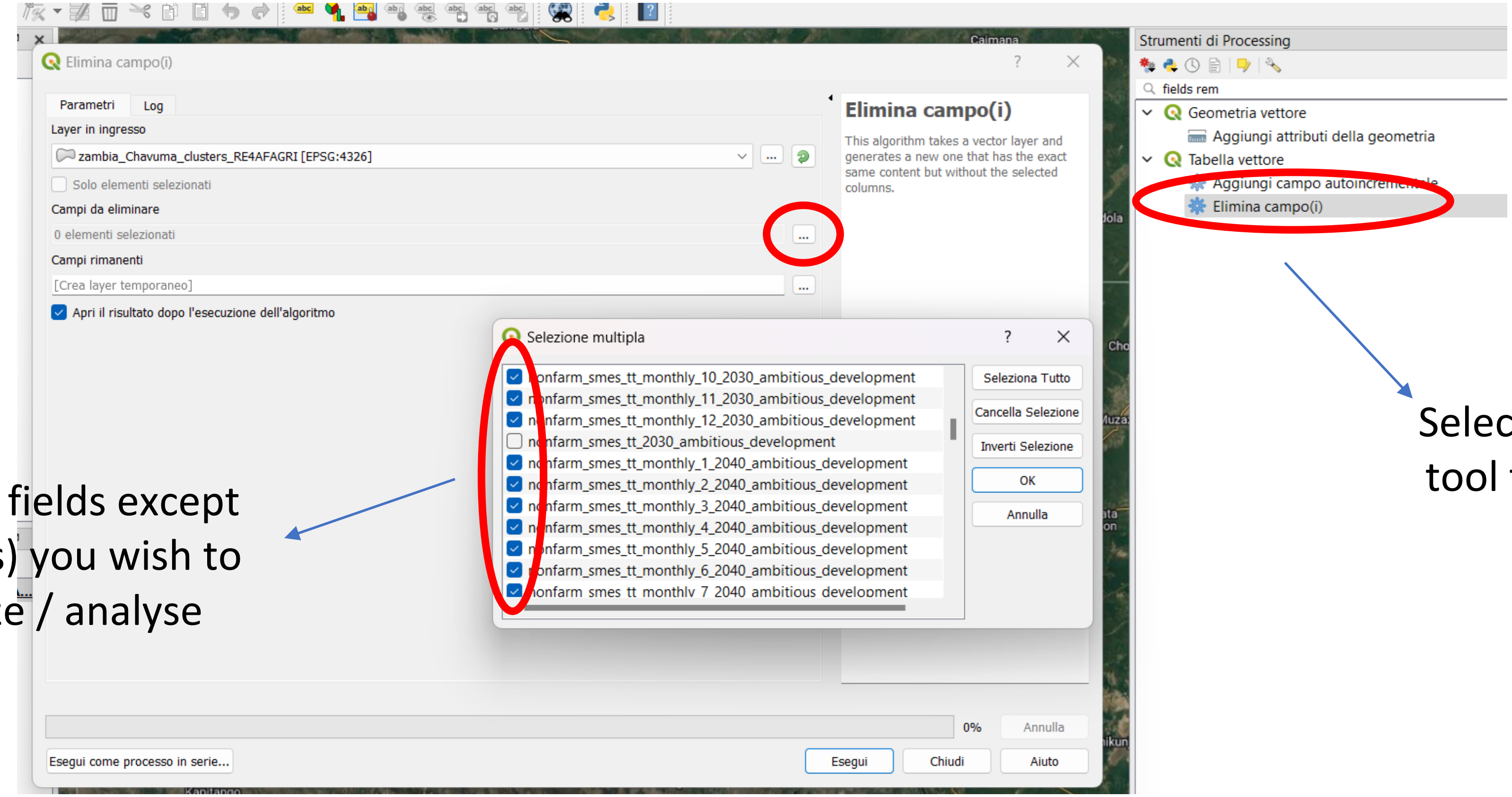
- 4- Select a field of interest and filter the geopackage attributes (to make the file lighter and QGIS utilisation smoother)



Select all fields except the one(s) you wish to visualize / analyse

Select the ‘remove fields’ tool from the processing toolbox

QGIS settlement clusters visualisation

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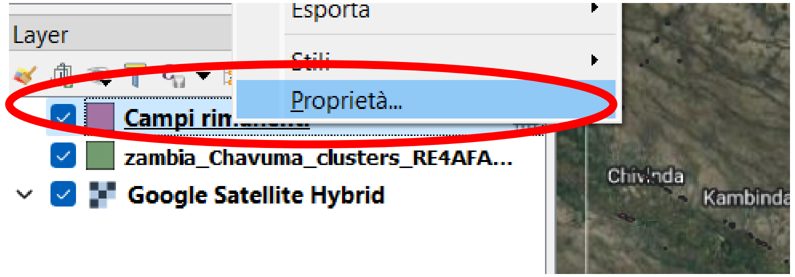
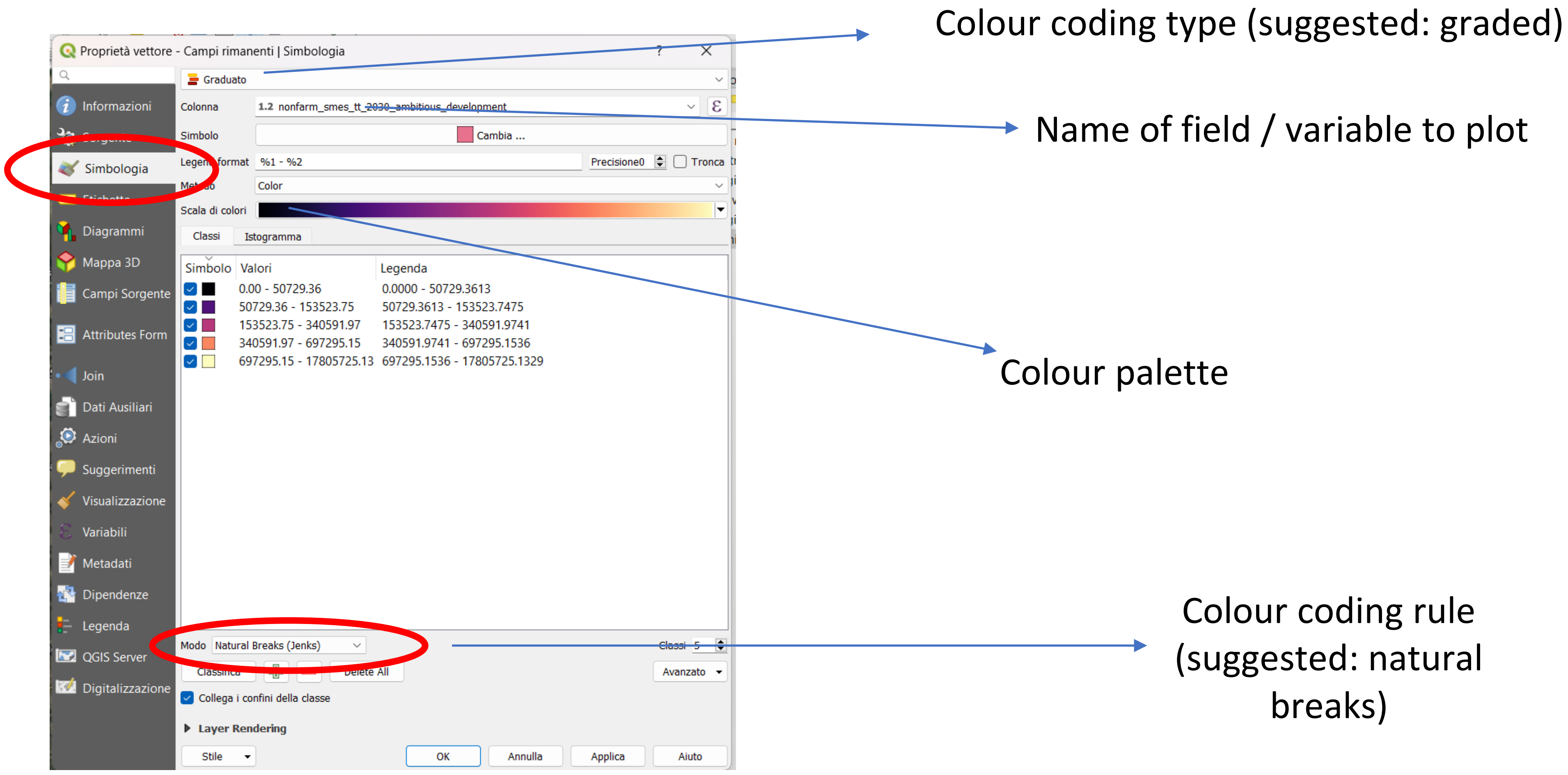
- 5- Define a colour ramp for it



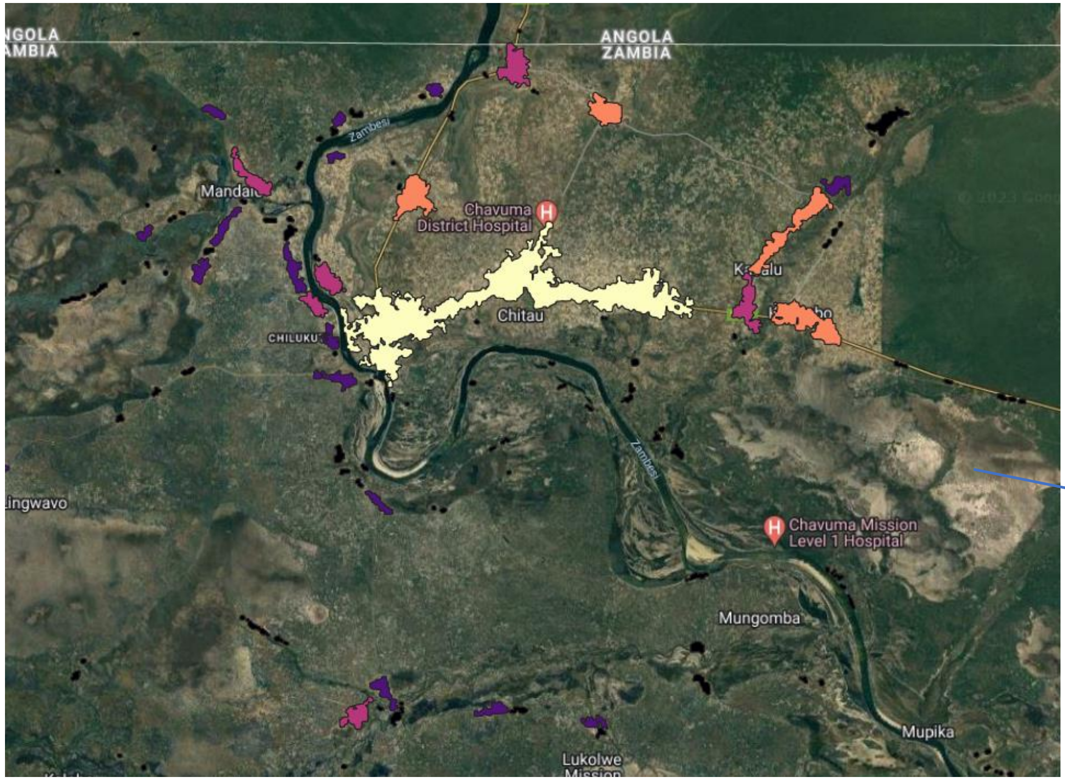
NB: ensure to select the newly generated layer that only contains the desired fields

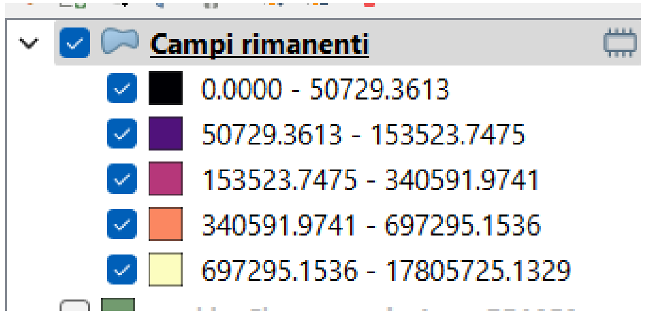
QGIS settlement clusters visualisation

- 5- Define a colour ramp for it



- 6- Navigate the data





Light yellow clusters have higher estimated non-farm SMEs electricity demand in 2030, ambitious development scenario

QGIS settlement clusters visualisation

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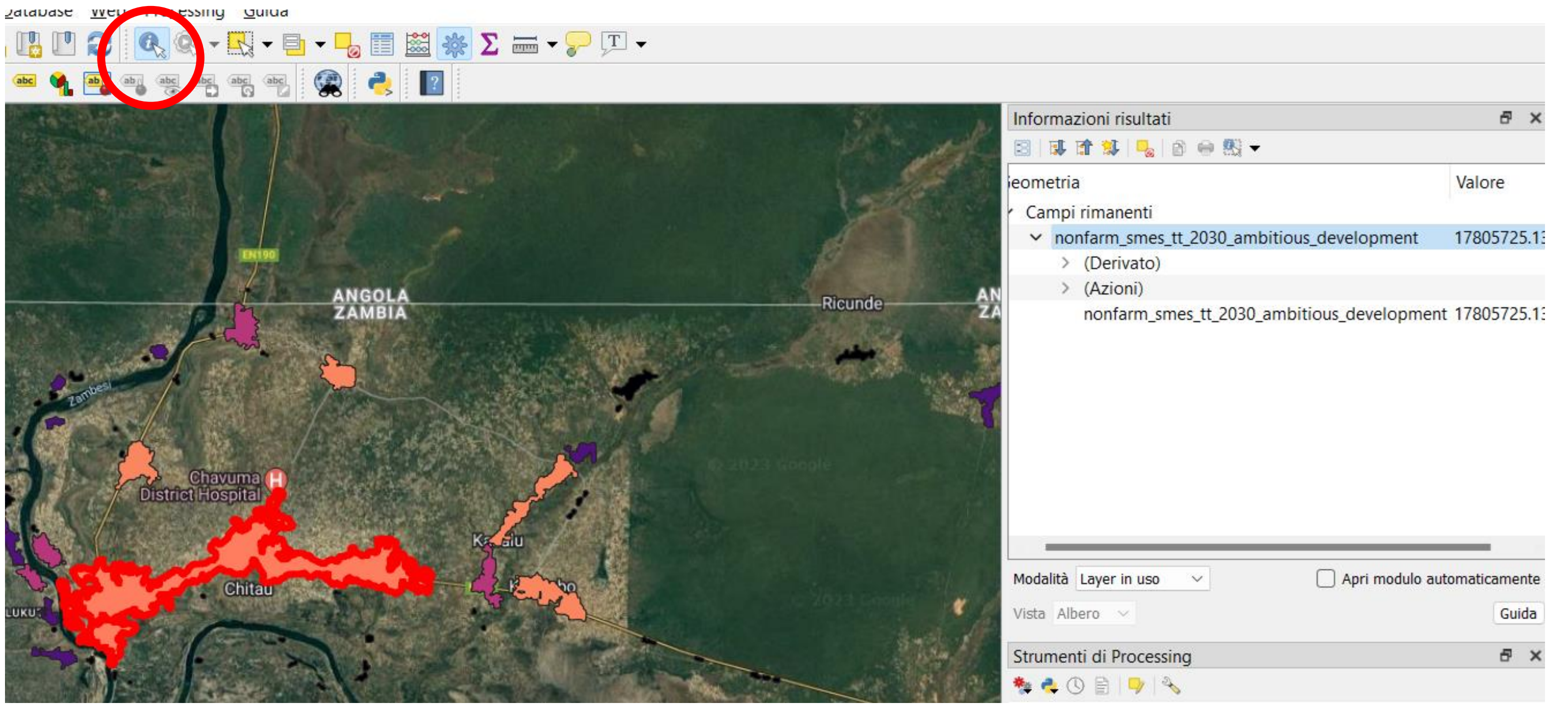
- 7- Check the values



Click on the cluster for which you would like to obtain information about its variable values

Thank you

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