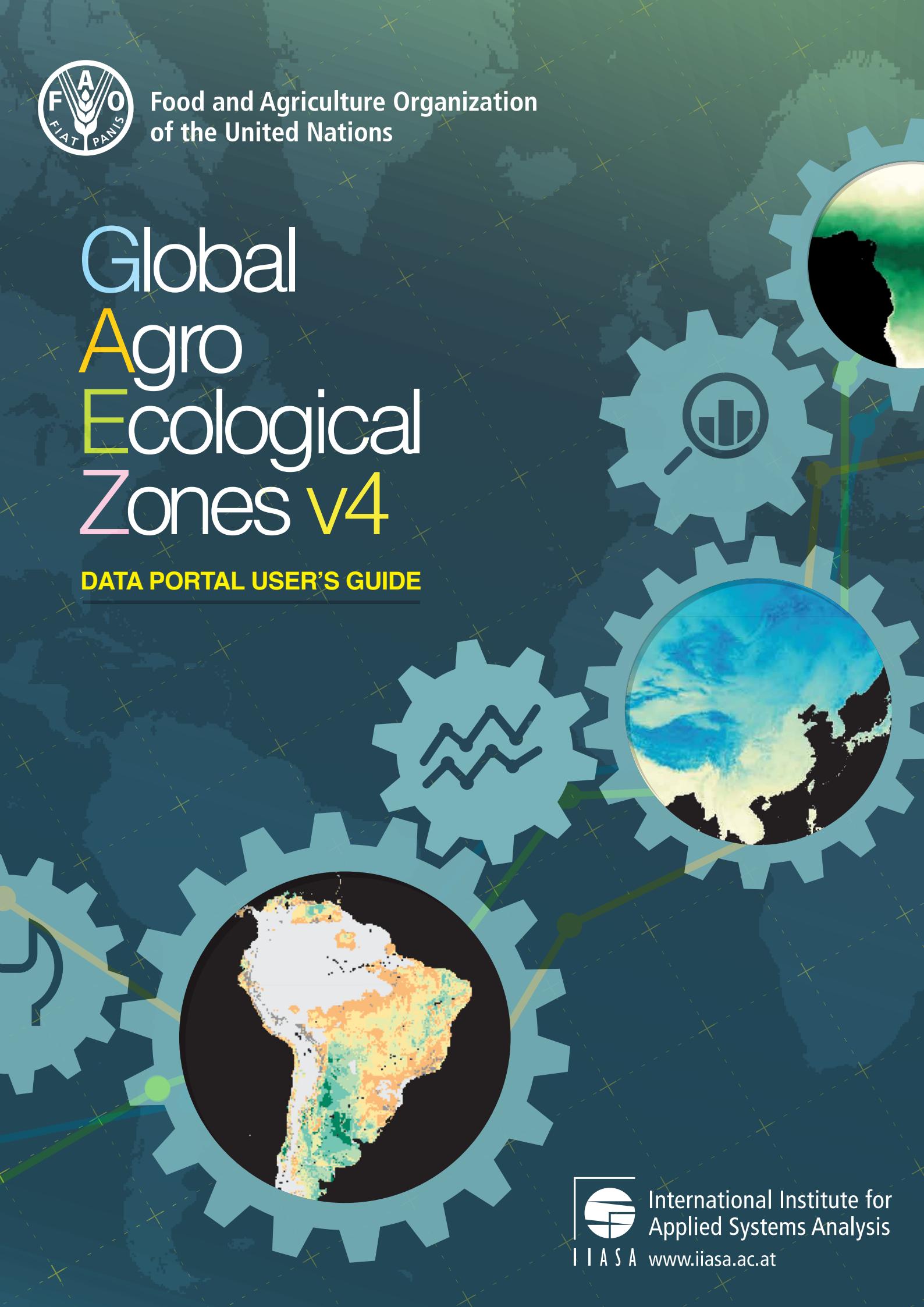




Food and Agriculture Organization  
of the United Nations

# Global Agro Ecological Zones v4

**DATA PORTAL USER'S GUIDE**



International Institute for  
Applied Systems Analysis

IIASA [www.iiasa.ac.at](http://www.iiasa.ac.at)



# **Global Agro-Ecological Zones (GAEZ v4)**

## **Data Portal user's guide**

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# Contents

<b>1. About .....</b>	<b>1</b>
<b>2. GAEZ v4 Data Portal .....</b>	<b>2</b>
<b>3. Data viewer .....</b>	<b>5</b>
<b>4. Data access and download .....</b>	<b>10</b>
<b>5. Summary tables.....</b>	<b>11</b>
<b>6. Supporting documentation .....</b>	<b>13</b>
<b>Annex I – GAEZ v4 variable listing .....</b>	<b>14</b>
Theme 1: Land and water resources .....	14
Theme 2: Agro-climatic resources .....	16
Theme 3: Agro-climatic potential yield .....	17
Theme 4: Suitability and attainable yield .....	17
Theme 5: Actual yields and production.....	18
Theme 6: Yield and production gaps .....	18
<b>Annex II – GAEZ v4 renderers listing .....</b>	<b>19</b>
Theme 1: Land and water resources .....	19
Theme 2: Agro-climatic resources .....	22
Theme 3: Agro-climatic potential yield .....	25
Theme 4: Suitability and Attainable Yield .....	26
Theme 5: Actual yields and production.....	27
Theme 6: Yield and production gaps .....	27
<b>Annex III – Import symbology in desktop GIS Software .....</b>	<b>28</b>
Import symbology in ArcGIS Pro .....	28
Import symbology in QGIS.....	31

# 1. About

The [Global Agro-Ecological Zones v4 Data Portal](#) (GAEZ v4, highlighting version 4.0 of this dataset) is an interactive multi-language web application designed to provide open access to this dataset, which reports on the state and trends of agricultural production and crop suitability under past, current and future climate scenarios at a global scale across a variety of crop types. The GAEZ v4 portal development has followed a stepwise process with new functionalities becoming available over time as well as access to updated files and databases, with a focus on new functionality supporting query, search, display, and download of the raster output files.

The GAEZ v4 terminology, database and model are fully documented and the information is available at the [Supporting documentation](#) webpage. GAEZ users are recommended to consult the user's guide and the Model Documentation prior to downloading and using the outputs of the database. Users need to consider limitations and constraints on using GAEZ products prior to further elaboration and use of the outputs. This detailed metadata also provides key information about the methodologies used to calculate GAEZ v4 raster maps, the contents of the data file, the pixel values, data types and ranges of the data.

The objective of this user's guide is to provide detailed information about the GAEZ v4 website and platform, along with relevant details of the GAEZ dataset structure. You are welcome to contact us at [GAEZ@fao.org](mailto:GAEZ@fao.org) with any specific questions or requests.

The screenshot shows the homepage of the GAEZ v4 Data Portal. At the top, there is a blue header bar with the FAO logo and the text "Food and Agriculture Organization of the United Nations | GAEZ v4 Data Portal". Below the header, there is a navigation menu with links for "Select", "DATA VIEWER", "GAEZ THEMES", "DATA ACCESS", "SUMMARY TABLES", and "GLOSSARY". On the right side of the header, there is a "Translate Home Page" dropdown. The main content area has a green background with a world map. The title "Global Agro-Ecological Zones" is prominently displayed, followed by the subtitle "Global Agro-Ecological Zoning version 4 (GAEZ v4)". Below the title, there is a paragraph of text explaining the collaboration between FAO and IIASA to develop the AEZ modelling framework and databases. Another paragraph describes the evolution of the AEZ methodology from the 1980s to the present, mentioning the first global assessment in 2000 (GAEZ v1), the releases in 2002 (GAEZ v2) and 2012 (GAEZ v3), and the most recent update in 2014 (GAEZ v4). A final paragraph states that GAEZ v4 is the most ambitious global assessment to date and provides a large volume of spatial natural resources indicators and results of agro-ecological crop analysis.

The Food and Agriculture Organization of the United Nations (FAO) and the International Institute for Applied Systems Analysis (IIASA) have cooperated over several decades to develop and implement the Agro-Ecological Zones (AEZ) modelling framework and databases. AEZ relies on well-established land evaluation principles to assess natural resources for finding suitable agricultural land utilization options. It identifies resource limitations and opportunities based on plant eco-physiological characteristics, climatic and edaphic requirements of crops and it uses these to evaluate suitability and production potentials for individual crop types under specific input and management conditions. Managing the constraints imposed by agro-ecological conditions and knowing what the most viable crop options are, facilitates planning decisions. In this way choices can be made, which are not only more productive, but also sustainable and resilient to climatic variability. The AEZ framework contributes to several of the United Nations Sustainable Development Goals (SDGs) by providing information about current and future agricultural production risks and opportunities, irrigation water demand, and crop development and adaptation options.

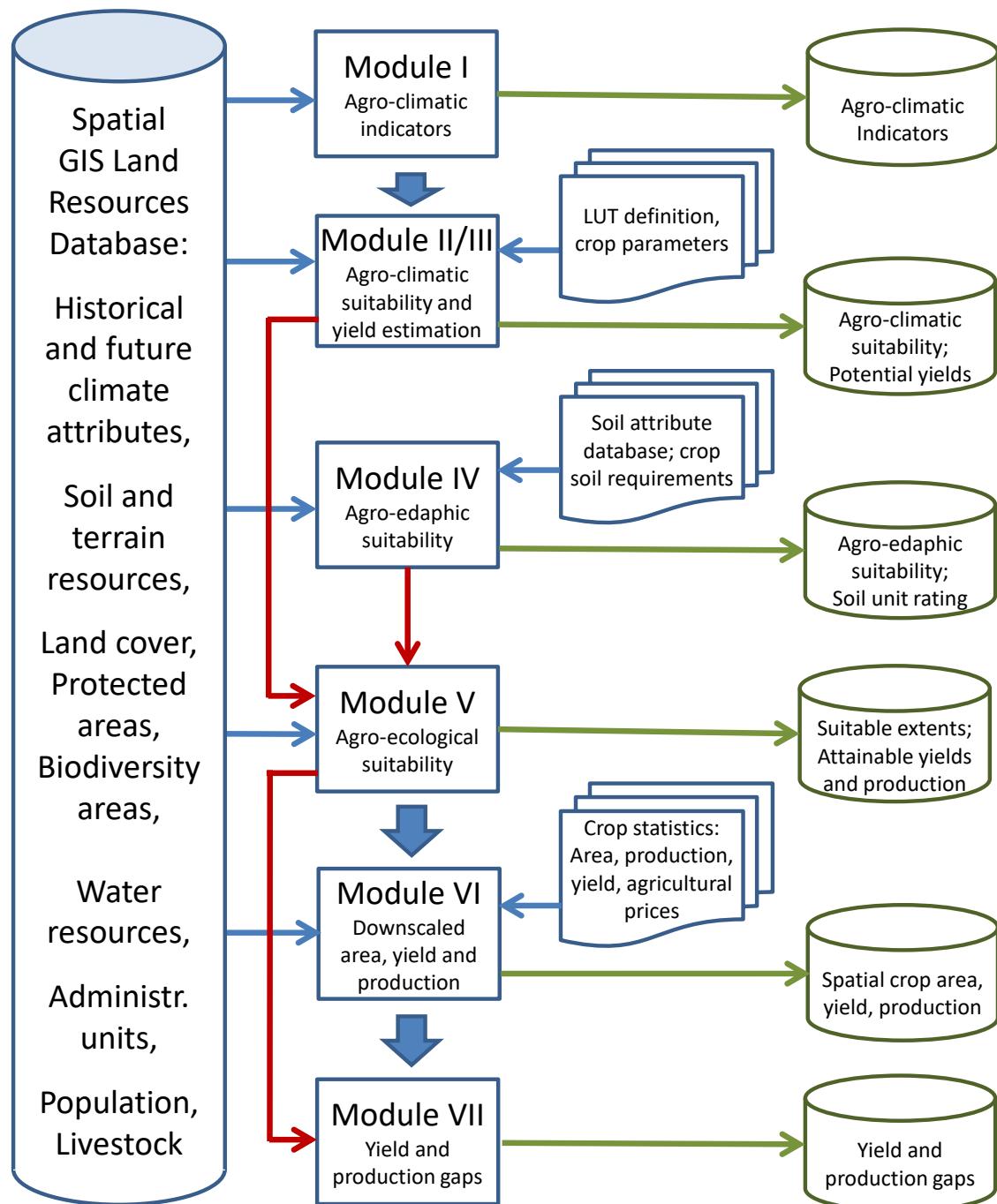
The AEZ methodology was initially implemented in the 1980s to assess the capacity of the world's natural resources to meet the needs for food of a fast-growing global population, particularly in developing countries. Rapid developments in computing and geo-information technology have produced increasingly detailed global databases and IT resources, which made possible the first global AEZ assessment in 2000 (GAEZ v1). Since then, global AEZ resource evaluations have been released in 2002 (GAEZ v2) and 2012 (GAEZ v3). With each update of the system, the methodological refinement and database content evolved to provide guidance for agro-ecological development at global, regional and national scales and support for assessments and indicators needed to achieve SDGs.

GAEZ v4 is the most ambitious global assessment to date and this Data Portal has been developed to make the database widely and easily accessible for users. It comprises a large volume of spatial natural resources indicators and results of agro-ecological crop analysis.

## 2. GAEZ v4 Data Portal

GAEZ makes use of best available global spatial databases to estimate the biophysical crop production potential for over 100 crops and crop sub-types. The estimation procedures consecutively consider factors relevant for crop production over time and for different management conditions. An overview of the overall GAEZ v4 model structure and data integration is shown in Figure 1 and detailed information about the process and methodology are provided in the Model Documentation.

**Figure 1. Overall structure and data integration of GAEZ v4 (Module I-VII)**



The GAEZ v4 Data Portal provides access to many of the outputs generated by GAEZ. It includes more than 180 variables organized hierarchically into 6 main themes and 25 sub-themes (Figure 2).

**Figure 2. Structure of data organized in GAEZ v4 Data Portal**

GAEZ V4 DATA PORTAL					
THEME	Theme 1 Land and Water Resources	Theme 2 Agro-climatic Resources	Theme 3 Agro-climatic Potential Yield	Theme 4 Suitability and Attainable Yield	Theme 5 Actual Yields and Production
SUB-THEMES	<ul style="list-style-type: none"> <li>• Agro-ecological Zones</li> <li>• Land Cover</li> <li>• Soil Resources</li> <li>• Soil Suitability</li> <li>• Terrain Resources</li> <li>• Exclusion areas</li> <li>• Water Resources</li> <li>• Selected Socio-economic Data</li> </ul>	<ul style="list-style-type: none"> <li>• Climate Classification</li> <li>• Thermal Regime</li> <li>• Moisture Regime</li> <li>• Growing Period</li> </ul>	<ul style="list-style-type: none"> <li>• Agro-climatic Yield</li> <li>• Constraint Factors</li> <li>• Growth Cycle Attributes</li> <li>• Land Utilization Types (LUT) Selection</li> </ul>	<ul style="list-style-type: none"> <li>• Suitability Class</li> <li>• Suitability Index</li> <li>• Agro-ecological Attainable Yield</li> <li>• Crop Water Indicators</li> </ul>	<ul style="list-style-type: none"> <li>• Area, Yield and Production</li> <li>• Aggregate Crop Production Value</li> </ul>
Nº VARIABLES	74	44	11	14	4

The different GAEZ model outputs shown in Figure 1 are made available through the GAEZ v4 Data Portal:

- Theme 1 “Land and Water Resources” compiles land cover, soil and terrain resources, selected soil suitability ratings, and environmental exclusions areas. selected GAEZ It also includes the Agro-Ecological Zones classification (see Chapter 10 of the Model Documentation);
- Agro-climatic indicators assessed in Module I are included in Theme 2 “Agro-Climatic Resources”;
- Agro-climatic suitability and potential yields (Module II/III) are in Theme 3 “Agro-climatic Potential Yield”;
- Theme 4 “Suitability and Attainable Yield” includes crop-specific suitable extents, attainable yields and production, i.e. outputs of Module V, which integrates the climatic and the edaphic (i.e. soil/slope combination rating in Module IV) evaluation ;
- Theme 5 “Actual Yields and Production” include spatial crop area, yield and production outputs (Module VI) ;
- Theme 6 “Yield and Production Gaps” presents the difference between Actual Production (Theme 5) and Potential Production (Theme 4), i.e. yield and production gap outputs (Module VII).

Please refer to Annex I for a complete list of themes, sub-themes and variables.

In the Data Portal, users can access the different themes, sub-themes and variables from the [GAEZ themes](#) page or from the specific webpage of each theme.

The screenshot shows the GAEZ v4 Data Portal homepage. At the top, there is a header with the Food and Agriculture Organization of the United Nations logo and the text "GAEZ v4 Data Portal". Below the header is a navigation bar with links for "Select", "DATA VIEWER" (which is highlighted in orange), "GAEZ THEMES", "DATA ACCESS", "SUMMARY TABLES", and "GLOSSARY". On the far right of the navigation bar is a "Translate Home Page" link. The main content area features a scenic landscape image of a valley with a stream and trees. Overlaid on the image is the text "GAEZ v4 Themes". Below the image, a text box contains the following information:

The GAEZ v4 dataset is organized into six themes, representing both inputs and outputs to the modeling.

**Theme 1: Land and Water Resources**

The quality and availability of land and water resources, together with socio-economic conditions and institutional factors, are essential to assure sustainable food security. GAEZ provides a framework for establishing a spatial inventory of land resources. Global environmental datasets provide the spatial characteristics required for land productivity assessments concerning location-specific agro-ecological conditions. The land resources inventory contains spatial layers of climate, land cover, soil, elevation and terrain slopes, protected areas and areas of high biodiversity value, administrative units, watersheds, population and livestock distribution.

This theme provides selected layers of the GAEZ v4 land resources database organized in several sub-themes of (1) Agro-ecological Zones, (2) Land Cover, (3) Soil Resources, (4) Soil Suitability, (5) Terrain Resources, (6) Exclusion Areas, (7) Water Resources, and (8) Selected Socio-economic Data.

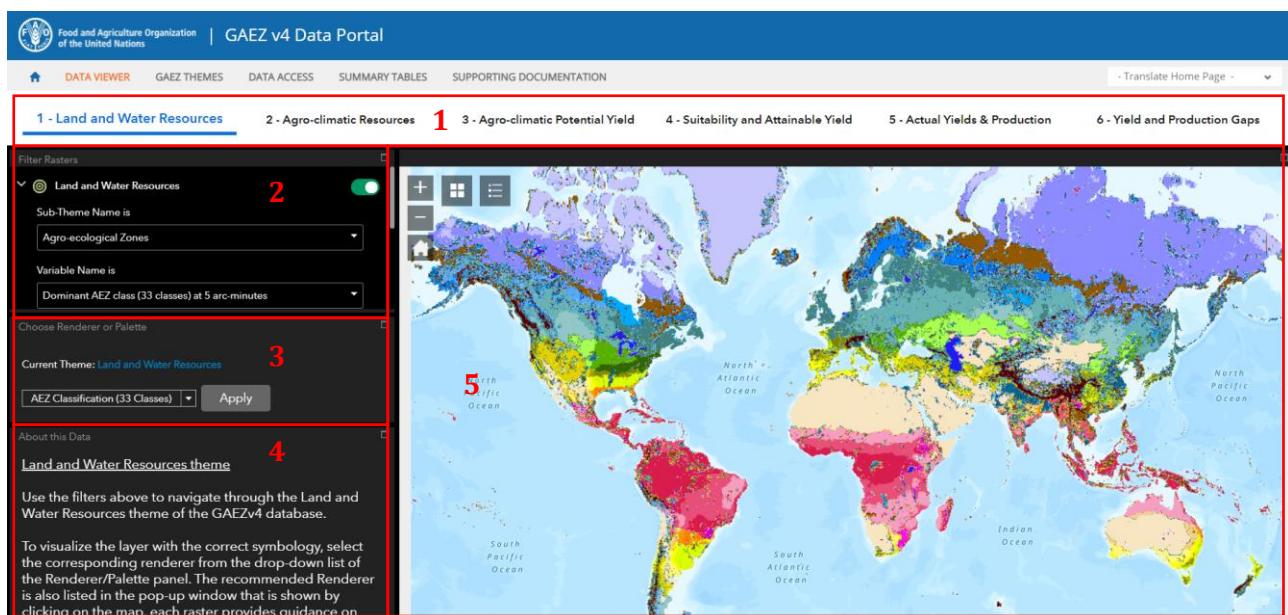
At the bottom of this section, there are three buttons: "View the Data", "Access the Data", and "Theme Details". The "View the Data" and "Access the Data" buttons are highlighted with a red border.

For each theme, the data can be viewed through the [Data viewer](#) (clicking on the button “View the Data”) or accessed and downloaded through the [Data access and download](#) webpage by clicking on the button “Access the Data”. By clicking on the “Theme Details” button users will be directed to the specific theme page with details on the theme and sub-theme contents.

# 3. Data viewer

The [Data viewer](#) is a dynamic web mapping application that allows the user to easily filter and navigate through the entire GAEZ database, to query for specific variables or conditions, and visualize and export the selected spatial data. The Data Viewer is organized into four main sections:

1. the header bar;
2. the filters panel;
3. the renderer panel;
4. the information or “About” panel, and
5. the map display.



## Header bar

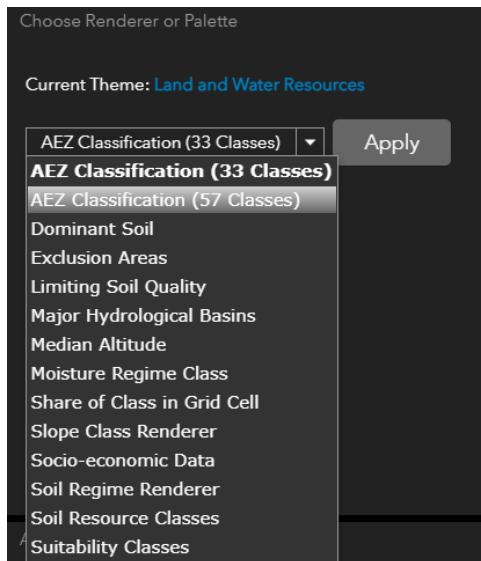
Access to the six different thematic areas is available through the data viewer bar at the top part of the main frame of the screen. Click on one of the themes to switch to the viewer for that theme. The Themes are separated to allow for different rendering rules, filtering and metadata on a per-theme basis.

## Renderer or palette panel

To change the rendering of the data, users can select different renderers. The correct and appropriate renderer to use for a specific raster can be found by clicking on the map, and reviewing the Recommended Renderer attribute in the pop-up window that appears.

Land & Water resources: aez_v9v2red_5m_CRUTS32_Hist_8110_100_avg	
File Name	aez_v9v2red_5m_CRUTS32_Hist_8110_100_avg
File Identifier	00000009
Sub-Theme Name	Agro-ecological Zones
Variable Name	Dominant AEZ class (33 classes) at 5 arc-minutes
Description	Dominant AEZ class (33 classes) at 5 arc-minutes
Time Period	1981-2010
Climate Model	CRUTS32
RCP	Historical
Data Units	Class
Recommended Renderer	AEZ Classification (33 classes)
Download URL	<a href="#">More info</a>
Thumbnail	
Raw Service Pixel Value	20
Class Name	Temperate, cool; moist

The recommended renderer can be selected from the drop-down list of available renderers in the Renderer or Palette panel. The complete list of the renderers available for each themes and variable is provided in Annex I. Once the renderer is selected, click on the Apply button to visualize the layer with the correct symbology.



## Filters panel

Each module of the GAEZ v4 dataset contains hundreds to tens of thousands of individual raster files. For data selection, the app allows a user to browse the database by navigating on the left-hand side of the GAEZ data viewer. Data are organized hierarchically by theme, sub-theme and variables (Figure 2). Once the thematic area is selected, the corresponding sub-themes and variables become available in the filters panel. Depending on the chosen variable the data viewer dynamically displays additional filters for the selection of time period and farm management options.

Depending on the sub-theme and variable selected, additional options (filters) may become available in the left menu. The filters (where available) may include:

Agro-climatic Potential Yield

Sub-Theme Name is

- empty -

Variable Name is

- empty -

Time Period is

- empty -

Climate Model is

- empty -

RCP is

- empty -

Crop is

- empty -

Water Supply is

- empty -

Input Level is

- empty -

- Sub-theme name;
- Variable name;
- Time period;
- Climate model;
- RCP;
- Crop;
- Water supply;
- Input level, and
- CO<sub>2</sub> fertilization.

Figure 3 presents a comprehensive summary of GAEZ methods, data and context specific user selection options of the Filters panel.

### Figure 3. GAEZ v4 Data Portal themes, methods and user selection options

THEMES	METHODS / APPROACH	Selection options depend on Theme, Sub-theme and Variable <sup>1</sup>				
		TIME PERIOD		FARM MANAGEMENT		
		Historic	Future	Crops	Water supply	Input level
Theme 1: Land and Water Resources	Spatial characteristics required for AEZ land productivity assessments	30-yr avg <sup>21</sup>		77 crops & (sub-) types	200 mm/m soil water	High Low
Theme 2: Agro-climatic Resources	Climate analysis to develop diverse agro-climatic indicators	Annual 30-yr avg	2011-2040 2041-2070 2071-2100	50 Crops	Rainfed Irrigated <sup>4</sup>	High Low <sup>4</sup>
Theme 3: Agro-climatic Potential Yield	Biomass and yield model and estimation of climate constraint factors	30-year averages 1961-1999 1971-2000 1981-2010	RCP and climate model scenarios <sup>3</sup>	31 Crops / groups	Total of which Rainfed Irrigated	
Theme 4: Suitability and Attainable Yield	Combining agro-climatic yields with reduction factors imposed by local soil and terrain conditions	Year 2000 and 2010	Assumption With/without CO <sub>2</sub> fertilization	26 Crops / groups		
Theme 5: Actual Yields and Production	Downscaling statistically reported crop production					
Theme 6: Yield and Production Gaps	Compares actual (Theme 5) and attainable (Theme 4) yields					

<sup>1</sup> See Figure 2 and Annex I for Sub-themes and Variables. <sup>2</sup> Land resources generally represent one time point (about current conditions), except the variable Agro-Ecological Zones, for which the three 30-year averages (1961-1990; 1971-2000; 1981-2010) can be selected. <sup>3</sup> Future climate change assessments refer to 30-year averages for combinations of 4 RCPs, 5 climate models and the climate model ensemble average. <sup>4</sup> Depending on crop, Theme 4 includes up to three irrigation types (gravity, drip, and sprinkler). For future conditions AEZ assumes only high input farm management.

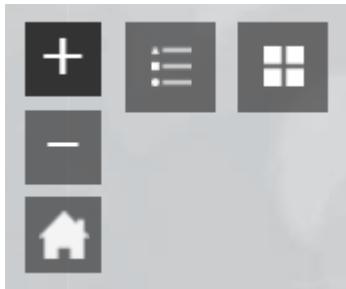
## Information panel

The information panel contains general information about the thematic area and how to use filters, renderer and widgets.

## Map Display

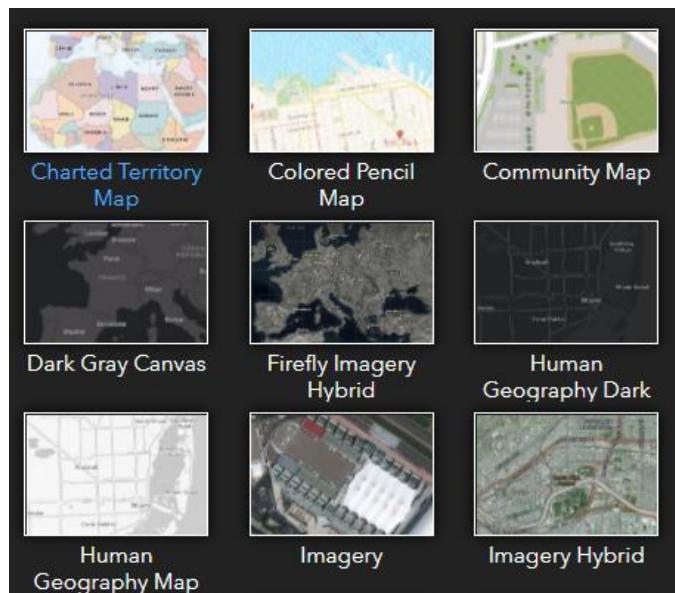
The resulting map layer is shown on the map display panel. Note, the portal cache stores filter dimensions that were selected in a former session. Therefore, the map shown changes dynamically during the user selection process. It is recommended to finalize all required filters before exploring the map displayed. By clicking on the map, a pop-up window appears (see below), which provides information about the current map and underlying selected filters dimensions.

The interactive map allows the user to visualize and interact with the selected data by specific tools. In detail the user can:



- zoom in – out;
- zoom to full extent;
- zoom to user's location;
- display the legend, and
- change basemap.

The heading in the legend window shows the theme name. The pop-up window described below shows all currently selected filters and the recommended renderer. It is important to apply the recommended renderer, especially for maps showing discrete numbers (e.g. different suitability classes for potential yields).



The Basemap Gallery Widget allows a user to switch from the default basemap, which is a UN-provided basemap suitable for smaller (more zoomed-out) scales, to other basemaps provided by Esri, including Imagery and topographic details, or the OpenStreetMap tiled basemap. Note that the designations employed and the presentation of material in the maps do not imply the expression of

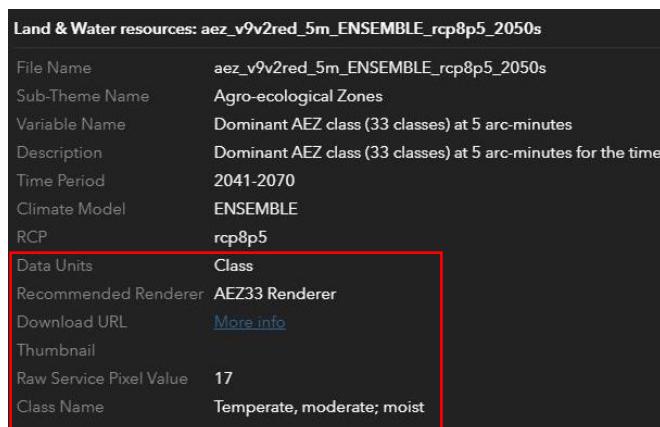
any opinion whatsoever on the part of FAO concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

## Pop-up window

By clicking on the map, a pop-up window (below an example) appears with comprehensive information about the currently selected variable and filter dimensions. The pop-up window includes the names of the file, sub-theme and variable selected and a comprehensive description of the map layer displayed on each of the dimensions filtered. Further, it recommends the user a best applied renderer for the specified variable selected (see above Renderer window).

The pop-up window also includes information about the data value of the particular location clicked on the map, about the data units and (if applicable) the corresponding class name for that specified value.

It provides the URL for the download of the raster displayed. By clicking on the link, the layer displayed in the Data Viewer will be automatically downloaded as .TIF file. Please refer to the Supporting Documentation for accessing related .clr files for categorial data.



## Attribute table

The user can switch from maps to tables by clicking on the Table tab at the bottom of the map. A table is displayed with the list of all the rasters in a given module that satisfy the query defined in the Filter panel.



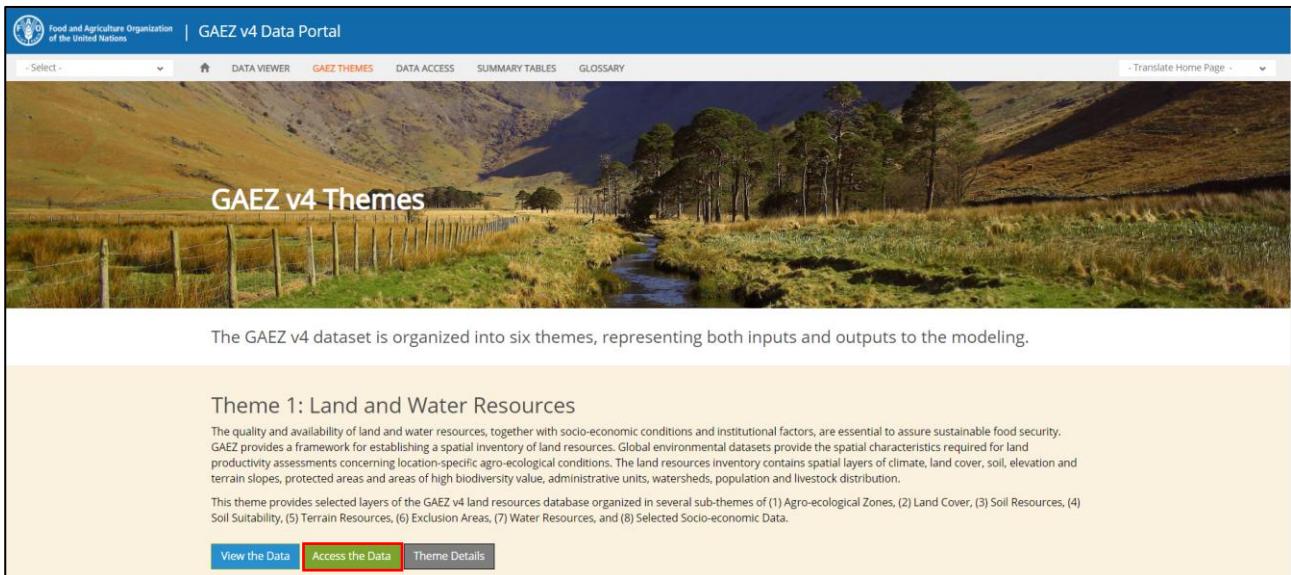
The attribute table allows users to define an *ad hoc* filter, sort based on any of the attribute columns, select the download URLs, and export a .csv of the table rows for further analysis.

Land and Water Resources										
Options		Filter by map extent		Zoom to		Clear selection		Refresh		
Name	Sub-Theme Name	Variable Name	Description	Time Period	Climate Model	RCP	Data Units	Recommended Renderer	Download URL	Thumbnail
aez_v9v2red_5m_CRUT	Agro-ecological Zones	Dominant AEZ class (33 classes) at 5 arc-minutes	Dominant AEZ class (33 classes) at 5 arc-minutes for the time period 1981-2010 using model CRUTS32 based on Hist	1981-2010	CRUTS32	Hist	Class	AEZ33 Renderer	https://s3.eu-west-1.amazonaws.com/data/	
aez_v9v2red_5m_ENSEMBLE	Agro-ecological Zones	Dominant AEZ class (33 classes) at 5 arc-minutes	Dominant AEZ class (33 classes) at 5 arc-minutes for the time	2011-2040	ENSEMBLE	rcp2p6	Class	AEZ33 Renderer	https://s3.eu-west-1.amazonaws.com/data/	

13 features 0 selected

## 4. Data access and download

The user can access and download the data through the [Data access and download](#) webpage or by clicking directly on the buttons “Access the Data” from the [GAEZ themes](#) webpage.



The screenshot shows the GAEZ v4 Data Portal homepage. At the top, there's a navigation bar with the FAO logo, a search bar, and links for DATA VIEWER, GAEZ THEMES (which is highlighted in orange), DATA ACCESS, SUMMARY TABLES, and GLOSSARY. Below the navigation is a large landscape photograph of a valley with a stream and trees. Overlaid on the image is the text "GAEZ v4 Themes". A descriptive paragraph below the image states: "The GAEZ v4 dataset is organized into six themes, representing both inputs and outputs to the modeling." Underneath this, a section titled "Theme 1: Land and Water Resources" provides a detailed description of the theme, mentioning land and water resources, socio-economic conditions, and institutional factors. It also describes the GAEZ framework for establishing a spatial inventory of land resources and lists eight sub-themes: Agro-ecological Zones, Land Cover, Soil Resources, Soil Suitability, Terrain Resources, Exclusion Areas, Water Resources, and Selected Socio-economic Data. At the bottom of this section are three buttons: "View the Data" (blue), "Access the Data" (red, with a white border), and "Theme Details" (grey).

The GAEZ v4 datasets have been published by FAO as ArcGIS Image Services, dynamic web services that allow for visualization, analysis and extraction of raster-based datasets.

For each thematic area a corresponding Image Service URL is provided. Each image available through these images services includes an attribute that presents a URL where the original .tif file can be downloaded. The .tif files are provided as full-resolution files with the original data contents, pixel values and configurations from the GAEZ v4 analysis.

To download any of the raw raster datasets, use the Data Viewer to filter down to an image of interest and then select a pixel on the map - the popup window will provide a download link to the raw .tif file for that image. Alternately, the attribute table can be expanded from the bottom of the application and this will include the download links for all rasters visible in the table.

A .csv file exported from the Attribute Table widget will allow users to export multiple URLs if needed. To activate the tool click on the “Open in Full Screen” button on the upper right corner of the map display, proceed with the selection using the filters and then select the option “Export all as CSV” in the Attribute Table widget.

# 5. Summary tables

In the [Summary tables](#) section of the platform are presented the results of the crop evaluation in Module V, which are part of Theme 4 - Suitability and Attainable Yield - of the GAEZ v4 Data Portal.

The results have been aggregated and tabulated by administrative units (country or country/province for some major countries, and by sub-continental and continental regional aggregations) and by broad hydro-regions. The crop summary tables are organized by land cover class, protection/exclusion class and AEZ class and summarize by suitability class the suitable extents, attainable production and yields, various constraint factors (due to thermal regime, moisture deficits, agro-climatic constraints due to pest, disease and workability limitations, and due to soil/terrain limitations) and aggregate simulated water deficits (rain-fed conditions) respectively net irrigation requirements (irrigated conditions).

Crop summary tables are provided for 53 crops, separately for rain-fed and irrigated conditions, and for historical and future climate scenarios. For 12 major countries, summary statistic were prepared also at sub-national level. Those countries have been selected based on their ranking in terms of three criteria: (i) total country area, (ii) total cropland area, and (iii) average size of sub-national administrative units.

Users can filter the data by crop, geographic level, climate data source, and input level. The result is downloadable as .zip file containing the crop summary tables in .csv format.

The table below explains the column headings used in the crop summary tables.

**Table 1. Column heading abbreviations used in crop summary tables**

Column heading	Description
ADM0/CTR	Country-level administrative ISO 3166-1 alpha-3 code (admin. Level 0);
ADM1	Province-level administrative code (admin. Level 1);
REG1	Regional aggregation level 1 (sub-continental regions);
REG2	Regional aggregation level 2 (continental regions);
REG3	Regional aggregation level 3 (classification by World Bank income groups);
HYD0	Major hydro-basin 4-digit code
HR1	Code of continental-level hydro-region
LC	Land cover class indicator;
EXC	Protection/exclusion class indicator;
AEZ	AEZ class indicator (by aggregate 33-class system);
CRP	Crop acronym
Land extents	Total area of spatial unit in square kilometers (km <sup>2</sup> );
<b>Suitability classes</b>	Suitable area (km <sup>2</sup> ), by suitability class, for:
VS	- very suitable land;
S	- suitable land;
MS	- moderately suitable land;
mS	- marginally suitable land;

<b>Column heading</b>	<b>Description</b>
vmS	- very marginally suitable land;
NS	- not suitable land.
<b>Potential production</b>	Attainable production, in 1000 tons dry matter (DM)*, by suitability class. Note, estimates of attainable production account for (input level specific) fallow requirements.
<b>Potential yield</b>	Attainable agro-ecological yield, in kg/ha DM*:
Ymax	- highest occurring class yield in spatial unit
VS, S, etc.	- average class yield by suitability class in spatial unit;
<b>Crop production constraints</b>	Constraint indicators (range 0-10000) are provided by suitability class:
fc1	- thermal constraints indicator;
fc2	- moisture constraints indicator;
fc3	- agro-climatic constraints indicator;
fc4	- soil and terrain constraints indicator.
	Constraint scale runs from 10000 (=no constraint) to 0 (=100 percent constraint).
<b>Water deficits / Net irrigation requirement</b>	Provides by suitability class estimates (in mm) of simulated water deficits (rain-fed conditions) respectively net irrigation requirements (irrigated conditions); values are average (wd), minimum (wn) and maximum (wx) levels for each spatial unit.
<b>Area, production and yield aggregated data</b>	Summarizes area (A), production (P) and yield (Yld) results for combinations of suitability classes, by VS+S land, VS+S+MS land and VS+S+MS+mS land.

For more information about the process for the tabulation of Module V outputs please consult chapter 7 of the GAEZ v4 Model Documentation and related appendices.

# 6. Supporting documentation

In the [Supporting documentation](#) section of the platform, the user can access and download the following documents:

- GAEZ v4 Model Documentation and excel file with related appendices;
- List of all the themes, sub-themes, variables, crops and corresponding units available in the GAEZ v4 platform;
- Zip file with files in .clr format to use in desktop GIS software to visualize the categorical layers with the correct symbology and classes and .xml files for the visualization of the symbology for continuous layers. Instructions on how to load .clr files in QGIS and ArcGIS softwares is provided in Annex III of this user's guide;
- Frequently Asked Questions document;
- User's guide;
- GAEZ v4 brochure, and
- Glossary with definitions of terms.

Also available a number of case studies about the application of the Agro-Ecological Zoning methodology in different countries.

# Annex I – GAEZ v4 variable listing

## Theme 1: Land and water resources

Sub-theme	Variable	Unit
Agro-Ecological zones	AEZ classification by climate/soil/terrain/LC (57 classes)	Class
	Simplified AEZ classification (33 classes)	Class
	Dominant AEZ class (33 classes) at 5 arc-minutes	Class
	Moisture regime class	Class
	Soil/terrain and special purpose land cover classes	Class
	Thermal regime class	Class
Land cover	Dominant land cover/use	Class
	Artificial surfaces	%
	Cropland	%
	Grassland	%
	Tree-covered land	%
	Shrub-covered land	%
	Herbaceous, regularly flooded	%
	Mangroves	%
	Sparsely vegetated land	%
	Bare land	%
	Permanent snow/glacier	%
	Water	%
	Cropland, equipped for full control irrigation	%
Soil resources	Dominant soil (5 arc-minute)	Class
	Dominant soil (30 arc-second)	Class
	Most limiting soil quality, high inputs	Class
	Most limiting soil quality, low inputs	Class
	Most limiting soil quality rating factor, high inputs	Class
	Most limiting soil quality rating factor, low inputs	Class
	Nutrient availability, low inputs	Class
	Nutrient retention capacity, high inputs	Class
	Rooting conditions, high inputs	Class
	Rooting conditions, low inputs	Class
	Oxygen availability to roots, high inputs	Class
	Oxygen availability to roots, low inputs	Class
	Presence of salinity and sodicity, high inputs	Class
	Presence of salinity and sodicity, low inputs	Class
	Presence of lime and gypsum, high inputs	Class
	Presence of lime and gypsum, low inputs	Class
	Workability, high inputs	Class
	Workability, low inputs	Class
Soil suitability	Soil suitability, rain-fed, high inputs	Class
	Soil and terrain suitability, rain-fed, high inputs	Class
	Soil suitability, rain-fed, low inputs	Class
	Soil and terrain suitability, rain-fed, low inputs	Class
Terrain resources	Median altitude (5 arc-minute)	meters
	Median altitude (30 arc-second)	meters
	Terrain slope 0-0.5% (5 arc-minute)	%
	Terrain slope 0.5-2% (5 arc-minute)	%

<b>Sub-theme</b>	<b>Variable</b>	<b>Unit</b>
Terrain	Terrain slope 2-5% (5 arc-minute)	%
	Terrain slope 5-8% (5 arc-minute)	%
	Terrain slope 8-16% (5 arc-minute)	%
	Terrain slope 16-30% (5 arc-minute)	%
	Terrain slope 30-45% (5 arc-minute)	%
	Terrain slope >45% (5 arc-minute)	%
	Terrain slope 0-0.5% (30 arc-second)	%
	Terrain slope 0.5-2% (30 arc-second)	%
	Terrain slope 2-5% (30 arc-second)	%
	Terrain slope 5-8% (30 arc-second)	%
	Terrain slope 8-16% (30 arc-second)	%
	Terrain slope 16-30% (30 arc-second)	%
	Terrain slope 30-45% (30 arc-second)	%
	Terrain slope >45% (30 arc-second)	%
	Median terrain slope class (5 arc-minute)	Class
	Median terrain slope class (30 arc-second)	Class
	Exclusion class	Class
Exclusion areas	Share of IUCN class protected area in 5 arcmin grid cell	%
	Share of non-IUCN class protected area in 5 arcmin grid cell	%
	Share of KBA area in 5 arcmin grid cell	%
	Share of GLW3 class 4-9 area in 5 arcmin grid cell	%
	Share of protected area buffer in 5 arcmin grid cell	%
Water resources	Cropland, equipped for full control irrigation	%
	Major hydrological basins (30 arc-second)	Class
	Major hydrological basins (5 arc-minute)	Class
	Water collecting sites (30 arc-second)	%
	Water collecting sites (5 arc-minute)	%
Selected socio-economic data	Population number (year 2010)	persons
	Ruminant livestock density (year 2010)	LSU/km <sup>2</sup>

## Theme 2: Agro-climatic resources

Sub-theme	Variable	Unit
Climate classification	Koeppen-Geiger (2-character) classification	Class
	Koeppen-Geiger (3-character) classification	Class
	Total number of growing period days class	Class
	Thermal Zones	Class
	Classification by Thermal Climates and Thermal Zones	Class
	Multi-cropping class (with irrigation)	Class
	Thermal Climates (temperatures reduced to sea level)	Class
	Multi-cropping class (rain-fed)	Class
	Permafrost zones (classes)	Class
Thermal regime	Snow-adjusted air frost number	Index
	Air frost number	Index
	Temperature growing period (LGPt=5); number of days with Ta > 5 °C	days
	Temperature growing period (LGPt=10); number of days with Ta > 10 °C	days
	Number of days with Tmin < 0 °C	days
	Number of days with Tmin < 10 °C	days
	Number of days with Tmin < 15 °C	days
	Annual temperature amplitude (°C)	deg C
	Mean annual temperature (°C)	deg C
	Annual temperature sum for days with Ta>5 °C (degree-days)	degC*days
	Annual temperature sum for days with Ta>10 °C (degree-days)	degC*days
	Number of days with Tmax > 35 °C	days
	Number of days with Tmax > 40 °C	days
	Number of days with Tmax > 45 °C	days
Moisture regime	Reference potential evapotranspiration (using AWC=100 mm/m)	mm
	Reference actual evapotranspiration (using AWC=100 mm/m)	mm
	Total number of rain days (days with P > 1 mm)	days
	Annual precipitation (mm)	mm
	Modified Fournier Index (mm)	Fm mm
	P/PET (*100) for days with Ta > 5 °C	%
	Annual P/PET ratio (*100)	%
	Seasonal P/PET ratio (*100) in summer (April-September in northern hemisphere)	%
	Seasonal P/PET ratio (*100) in winter (October-March in northern hemisphere)	%
	Quarterly P/PET ratio (January-March)	Class
	Quarterly P/PET ratio (April-June)	Class
	Quarterly P/PET ratio (July-September)	Class
	Quarterly P/PET ratio (October-December)	Class
	Reference evapotranspiration deficit (mm; AWC=100)	mm
Growing period	Length of longest component LGP (days)	days
	Beginning date of longest component LGP (day-of-year)	Number
	Total number of growing period days	days
	Longest period of consecutive dry days in temperature growing period LGPt=5(days)	days
	Number of dry days during temperature growing period LGPt=5 (days)	days
	Net primary production (with irrigation)	kg C/ha
	Net primary production (rain-fed)	kg C/ha

## Theme 3: Agro-climatic potential yield

Sub-theme	Variable	Unit
Agro-climatic yield	Agro-climatic potential yield	kg DW/ha*
Constraint factors	Total climate related crop yield constraint factor '0'	Index
	Crop yield constraint factor '1' (thermal)	Index
	Crop yield constraint factor '2' (moisture)	Index
	Crop yield constraint factor '3' (agro-climatic)	Index
Growth cycle attributes	Beginning of crop growth cycle (day)	day of year
	Length of crop growth cycle (days)	days
	Crop-specific actual evapotranspiration (mm)	mm
	Crop-specific accumulated temperature during crop growth cycle	degC*days
	Crop water deficit (mm)	mm
Land Utilization Types (LUT) selection	Selected LUT sequence number	Class

\*: For most crops the yields are given in kg dry weight per hectare. For alfalfa, miscanthus, napier grass, reed canary grass, pasture legumes and grasses the yields are in 10 kg dry weight (above ground biomass) per hectare. For sugar beet and sugarcane, the yields are in kg sugar per hectare and for olive and oil palm in kg oil per hectare. Cotton yields are given as kg lint per hectare.

## Theme 4: Suitability and attainable yield

Sub-theme	Variable	Unit
Suitability class	Crop suitability index in classes; current cropland in grid cell	Class
	Crop suitability index in classes; all land in grid cell	Class
Suitability index	Suitability index range (0 – 10000); current cropland in grid cell	Index
	Suitability index range (0 – 10000); all land in grid cell	Index
	Share of grid cell assessed as VS or S (range 0 – 10000)	Index
	Share of VS+S+MS land in grid cell (range 0 – 10000)	Index
	Share of VS+S+MS+mS land in grid cell (range 0 – 10000)	Index
Agro-ecological attainable yield	Average attainable yield of current cropland	kg DW/ha*
	Output density (potential production divided by total grid cell area)	kg DW/ha*
	Average attainable yield of best occurring suitability class in grid cell	kg DW/ha*
Crop water indicators	Actual crop evapotranspiration (excluding irrigation), for current cropland	mm
	Actual crop evapotranspiration (excluding irrigation), average for grid cell	mm
	Water deficit/net irrigation requirement during crop cycle, current cropland	mm
	Water deficit/net irrigation requirement during crop cycle, total grid cell	mm

\*: For most crops the yields are given in kg dry weight per hectare. For alfalfa, miscanthus, napier grass, reed canary grass, pasture legumes and grasses the yields are in 10 kg dry weight (above ground biomass) per hectare. For sugar beet and sugarcane, the yields are in kg sugar per hectare and for olive and oil palm in kg oil per hectare. Cotton yields are given as kg lint per hectare.

## Theme 5: Actual yields and production

Sub-theme	Variable	Unit
Area, yield and production	Harvested area	1000 ha
	Production	1000 t*
	Yield	t/ha**
Aggregate crop production value	Total crop production volume	1000 GK\$

\*: For most crops the production is given in harvest weight as 1000 tonnes, except for aggregate groups (pulses, vegetables, stimulants, fodder crops and crops NES (residual not elsewhere specified) where production is listed in volumes of million GK\$.

\*\*: For most crops the yield is given in harvest weight as t/ha, except for aggregate groups (pulses, vegetables, stimulants, fodder crops, crops NES (residual not elsewhere specified) and all crops) where yield is listed in volumes per hectare of 1000 GK\$/ha.

## Theme 6: Yield and production gaps

Sub-theme	Variable	Unit
Crop yield achievement ratio	Crop yield achievement ratio	Class
Production gap	Production gap	1000 t or mill. GK\$
Aggregate yield achievement ratio	Aggregate yield achievement ratio	Class

# Annex II – GAEZ v4 renderers listing

## Theme 1: Land and water resources

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Agro-Ecological Zones	AEZ classification by climate/soil/terrain/LC (57 classes)	categories	AEZ Classification (57 classes)	AEZ_57classes.clr
	Simplified AEZ classification (33 classes)	categories	AEZ Classification (33 classes)	AEZ_33classes.clr
	Dominant AEZ class (33 classes) at 5 arc-minutes	categories	AEZ Classification (33 classes)	AEZ_33classes.clr
	Moisture regime class	categories	Moisture Regime Class	MoistureRegime_class.clr
	Soil/terrain and special purpose land cover classes	categories	Soil Regime Renderer	Soil/terrain_SPLC_classes.clr
	Thermal regime class	categories	Thermal Regime Class	ThermalRegime_classes.clr
Land cover	Dominant land cover/use	categories	Dominant Land Cover/Use	Dominant_LandCoverUse.clr
	Artificial surfaces	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp_ColorRamp.xml
	Cropland	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Grassland	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Tree-covered land	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Shrub-covered land	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Herbaceous, regularly flooded	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Mangroves	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Sparsely vegetated land	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Bare land	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Permanent snow/glacier	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Water	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Cropland, equipped for full control irrigation	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
Soil resources	Dominant soil (5 arc-minute)	categories	Dominant Soil	DominantSoil.clr
	Dominant soil (30 arc-second)	categories	Dominant Soil	DominantSoil.clr
	Most limiting soil quality, high inputs	categories	Limiting Soil Quality	LimitingSoil_quality.clr

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Soil resources	Most limiting soil quality, low inputs	categories	Limiting Soil Quality	LimitingSoil_quality.clr
	Most limiting soil quality rating factor, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Most limiting soil quality rating factor, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Nutrient availability, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Nutrient retention capacity, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Rooting conditions, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Rooting conditions, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Oxygen availability to roots, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Oxygen availability to roots, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Presence of salinity and sodicity, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Presence of salinity and sodicity, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Presence of lime and gypsum, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Presence of lime and gypsum, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Workability, high inputs	categories	Soil Resources Classes	SoilResources_classes.clr
	Workability, low inputs	categories	Soil Resources Classes	SoilResources_classes.clr
Soil suitability	Soil suitability, rain-fed, high inputs	categories	Suitability Classes	CropSuitabilityIndex_classes_all_land.clr
	Soil and terrain suitability, rain-fed, high inputs	categories	Suitability Classes	CropSuitabilityIndex_classes_all_land.clr
	Soil suitability, rain-fed, low inputs	categories	Suitability Classes	CropSuitabilityIndex_classes_all_land.clr
	Soil and terrain suitability, rain-fed, low inputs	categories	Suitability Classes	CropSuitabilityIndex_classes_all_land.clr
Terrain resources	Median altitude (5 arc-minute)	continuous	Median Altitude	MedianAltitude_ColorRamp.xml
	Median altitude (30 arc-second)	continuous	Median Altitude	MedianAltitude_ColorRamp.xml
	Terrain slope 0-0.5% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 0.5-2% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 2-5% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
	Terrain slope 5-8% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 8-16% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 16-30% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 30-45% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope >45% (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 0-0.5% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 0.5-2% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 2-5% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 5-8% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 8-16% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 16-30% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope 30-45% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Terrain slope >45% (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Median terrain slope class (5 arc-minute)	categories	Slope Class Renderer	SlopeClass.clr
	Median terrain slope class (30 arc-second)	categories	Slope Class Renderer	SlopeClass.clr
Exclusion areas	Exclusion class	categories	Exclusion Areas	ExclusionAreas.clr
	Share of IUCN class protected area in 5 arcmin grid cell	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Share of non-IUCN class protected area in 5 arcmin grid cell	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Share of KBA area in 5 arcmin grid cell	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Share of GLW3 class 4-9 area in 5 arcmin grid cell	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Share of protected area buffer in 5 arcmin grid cell	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
Water resources	Cropland, equipped for full control irrigation	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Major hydrological basins (30 arc-second)	categories	Major Hydrological Basins	MajorHydrologicalBasins.clr
	Major hydrological basins (5 arc-minute)	categories	Major Hydrological Basins	MajorHydrologicalBasins.clr
	Water collecting sites (30 arc-second)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml
	Water collecting sites (5 arc-minute)	continuous	Share of Class in Grid Cell	ShareClass_ColorRamp.xml

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Selected socio-economic data	Population number (year 2010)	continuous	Socio-economic Data	SocioEconomicData_ColorRamp.xml
	Ruminant livestock density (year 2010)	continuous	Socio-economic Data	SocioEconomicData_ColorRamp.xml

\*.Zipfile of symbology templates for QGIS and ArcGIS can be downloaded from the [Supporting documentation](#) webpage

## Theme 2: Agro-climatic resources

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Climate classification	Koeppen-Geiger (2-character) classification	categories	Climate Classification - 2-character Koeppen-Geiger	KG2_ClimateClassification.clr
	Koeppen-Geiger (3-character) classification	categories	Climate Classification - 3-character Koeppen-Geiger	KG3_ClimateClassification.clr
	Total number of growing period days class	categories	Number of Growing Period Days	N_GrowingPeriodDays_class.clr
	Thermal Zones	categories	Thermal Zones Renderer	ThermalZones.clr
	Classification by Thermal Climates and Thermal Zones	categories	Classification by Thermal Climates and Thermal Zones	ThermalClimates_ThermalZones_classes.clr
	Multi-cropping class (with irrigation)	categories	Multi-cropping Class	MultiCropping_classes.clr
	Thermal Climates (temperatures reduced to sea level)	categories	Thermal Climates	ThermalClimates.clr
	Multi-cropping class (rain-fed)	categories	Multi-cropping Class	MultiCropping_classes.clr
	Permafrost zones (classes)	categories	Permafrost Zones - Classes	PermafrostZones_classes.clr
Thermal regime	Snow-adjusted air frost number	continuous	Thermal Regime Symbology	ThermalRegime_ColorRamp.xml
	Air frost number	continuous	Thermal Regime Symbology	ThermalRegime_ColorRamp.xml
	Temperature growing period (LGPt=5); number of days with Ta > 5 °C	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Temperature growing period (LGPt=10); number of days with Ta > 10 °C	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Number of days with Tmin < 0 °C	continuous	Thermal Regime Symbology	ThermalRegime_ColorRamp.xml
	Number of days with Tmin < 10 °C	continuous	Thermal Regime Symbology	ThermalRegime_ColorRamp.xml

<b>Sub-theme</b>	<b>Variable</b>	<b>Legend type</b>	<b>Name of renderer to use in the GAEZ v4 Data Viewer</b>	<b>Symbolology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*</b>
Moisture regime	Number of days with Tmin < 15 °C	continuous	Thermal Regime Symbology	ThermalRegime_ColorRamp.xml
	Annual temperature amplitude (°C)	continuous	Thermal Regime Symbology	ThermalRegime_ColorRamp.xml
	Mean annual temperature (°C)	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Annual temperature sum for days with Ta>5 °C (degree-days)	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Annual temperature sum for days with Ta>10 °C (degree-days)	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Number of days with Tmax > 35 °C	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Number of days with Tmax > 40 °C	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Number of days with Tmax > 45 °C	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Reference potential evapotranspiration (using AWC=100 mm/m)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
Soil	Reference actual evapotranspiration (using AWC=100 mm/m)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Total number of rain days (days with P > 1 mm)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Annual precipitation (mm)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Modified Fournier Index (mm)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	P/PET (*100) for days with Ta > 5 °C	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Annual P/PET ratio (*100)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Seasonal P/PET ratio (*100) in summer (April-September in northern hemisphere)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Seasonal P/PET ratio (*100) in winter (October-March in northern hemisphere)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml
	Quarterly P/PET ratio (January-March)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRam.p.xml

<b>Sub-theme</b>	<b>Variable</b>	<b>Legend type</b>	<b>Name of renderer to use in the GAEZ v4 Data Viewer</b>	<b>Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*</b>
Growing period	Quarterly P/PET ratio (April-June)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
	Quarterly P/PET ratio (July-September)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
	Quarterly P/PET ratio (October-December)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
	Reference evapotranspiration deficit (mm; AWC=100)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
	Length of longest component LGP (days)	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
	Beginning date of longest component LGP (day-of-year)	continuous	Beginning Date of Longest Component LGP	BeginningDate_LGP_ColorRamp.xml
	Total number of growing period days	continuous	Agro-climatic Resources Symbology - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
Soil	Longest period of consecutive dry days in temperature growing period LGPt=5(days)	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Number of dry days during temperature growing period LGPt=5 (days)	continuous	Agro-climatic Resources Symbology - Days	AgroClimaticDays_ColorRamp.xml
	Net primary production (with irrigation)	continuous	Growing Period Renderer	YieldSymbology_ColorRamp.xml
	Net primary production (rain-fed)	continuous	Growing Period Renderer	YieldSymbology_ColorRamp.xml

\*Zipfile of symbology templates for QGIS and ArcGIS can be downloaded from the [Supporting documentation webpage](#)

## Theme 3: Agro-climatic potential yield

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Agro-climatic yield	Agro-climatic potential yield	continuous	Agro-climatic Potential Yield Symbology	YieldSymbology_ColorRamp.xml
Constraint factors	Total climate related crop yield constraint factor '0'	continuous	Agro-climatic Potential Yield Symbology	YieldSymbology_ColorRamp.xml
	Crop yield constraint factor '1' (thermal)	continuous	Agro-climatic Potential Yield Symbology	YieldSymbology_ColorRamp.xml
	Crop yield constraint factor '2' (moisture)	continuous	Agro-climatic Potential Yield Symbology	YieldSymbology_ColorRamp.xml
	Crop yield constraint factor '3' (agro-climatic)	continuous	Agro-climatic Potential Yield Symbology	YieldSymbology_ColorRamp.xml
Growth cycle attributes	Beginning of crop growth cycle (day)	continuous	Beginning of Crop Growth Cycle (day)	Beginning_CropGrowthCycle_ColorRamp.xml
	Length of crop growth cycle (days)	continuous	Agro-climatic potential yield symbology	YieldSymbology_ColorRamp.xml
	Crop-specific actual evapotranspiration (mm)	continuous	Growth Cycle Attributes - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
	Crop-specific accumulated temperature during crop growth cycle	continuous	Growth Cycle Attributes - Temperature	AgroClimaticDays_ColorRamp.xml
	Crop water deficit (mm)	continuous	Growth Cycle Attributes - Precipitation	AgroClimaticPrecipitation_ColorRamp.xml
Land Utilization Types (LUT) selection	Selected LUT sequence number	categories	Selected LUT Sequence Number	SelectedLUT_SequenceNumber.clr

\*Zipfile of symbology templates for QGIS and ArcGIS can be downloaded from the [Supporting documentation webpage](#)

## Theme 4: Suitability and Attainable Yield

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Suitability class	Crop suitability index in classes; current cropland in grid cell	categories	Crop Suitability Index in Classes - Current Cropland in Grid Cell	CropSuitabilityIndex_classes_cropland.clr
	Crop suitability index in classes; all land in grid cell	categories	Crop Suitability Index in Classes - All Land in Grid Cell	CropSuitabilityIndex_classes_all_land.clr
Suitability index	Suitability index range (0 – 10000); current cropland in grid cell	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
	Suitability index range (0 – 10000); all land in grid cell	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
	Share of grid cell assessed as VS or S (range 0 – 10000)	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
	Share of VS+S+MS land in grid cell (range 0 – 10000)	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
	Share of VS+S+MS+mS land in grid cell (range 0 – 10000)	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
Agro-ecological attainable yield	Average attainable yield of current cropland	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
	Output density (potential production divided by total grid cell area)	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
	Average attainable yield of best occurring suitability class in grid cell	continuous	Suitability and Attainable Yield Symbology	YieldSymbology_ColorRamp.xml
Crop water indicators	Actual crop evapotranspiration (excluding irrigation), for current cropland	continuous	Crop Water Indicators	AgroClimaticPrecipitation_ColorRamp.xml
	Actual crop evapotranspiration (excluding irrigation), average for grid cell	continuous	Crop Water Indicators	AgroClimaticPrecipitation_ColorRamp.xml
	Water deficit/net irrigation requirement during crop cycle, current cropland	continuous	Crop Water Indicators	AgroClimaticPrecipitation_ColorRamp.xml
	Water deficit/net irrigation requirement during crop cycle, total grid cell	continuous	Crop Water Indicators	AgroClimaticPrecipitation_ColorRamp.xml

\*Zipfile of symbology templates for QGIS and ArcGIS can be downloaded from the [Supporting documentation webpage](#)

## Theme 5: Actual yields and production

Sub-theme	Variable	Legend type	Name of renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Area, yield and production	Harvested area	continuous	Actual Yields and Production Symbology	YieldSymbology_ColorRamp.xml
	Production	continuous	Actual Yields and Production Symbology	YieldSymbology_ColorRamp.xml
	Yield	continuous	Actual Yields and Production Symbology	YieldSymbology_ColorRamp.xml
Aggregate crop production value	Total crop production volume	continuous	Actual Yields and Production Symbology	YieldSymbology_ColorRamp.xml

\*Zipfile of symbology templates for QGIS and ArcGIS can be downloaded from the [Supporting documentation webpage](#)

## Theme 6: Yield and production gaps

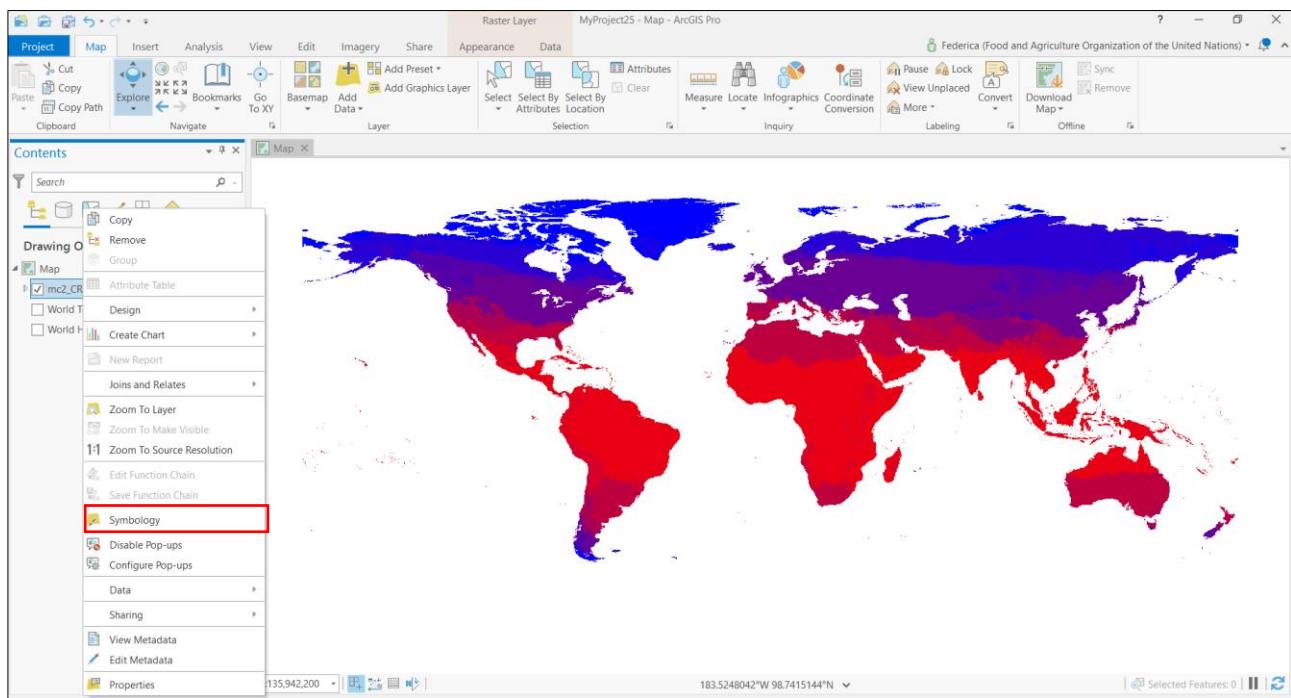
Sub-theme	Variable	Legend type	Name of Renderer to use in the GAEZ v4 Data Viewer	Symbology to use in GIS (.clr file for categorical data and color ramp in .xml format for continuous data)*
Crop yield achievement ratio	Crop yield achievement ratio	categories	Yield and Production Gaps Symbology	Yield_ProductionGaps.clr
Production gap	Production gap	continuous	Production Gap	YieldSymbology_ColorRamp.xml
Aggregate yield achievement ratio	Aggregate yield achievement ratio	categories	Yield and Production Gaps Symbology	Yield_ProductionGaps.clr

\*Zipfile of symbology templates for QGIS and ArcGIS can be downloaded from the [Supporting documentation webpage](#)

# Annex III – Import symbology in desktop GIS Software

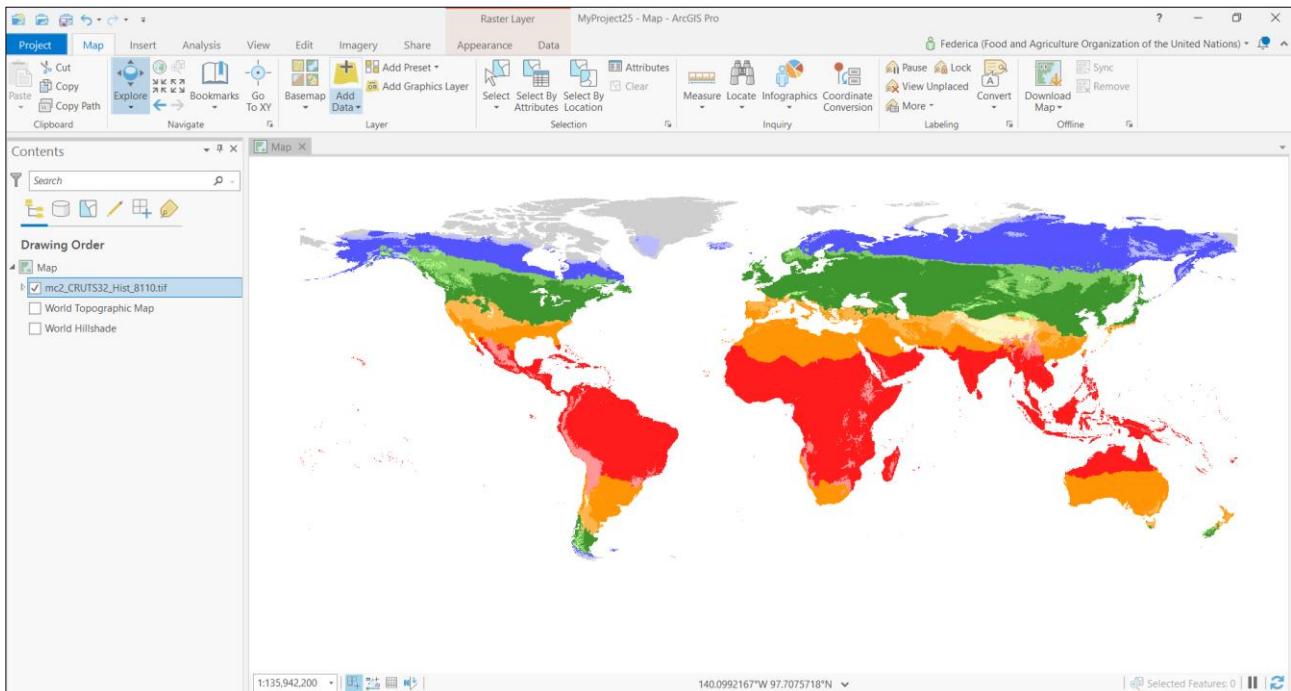
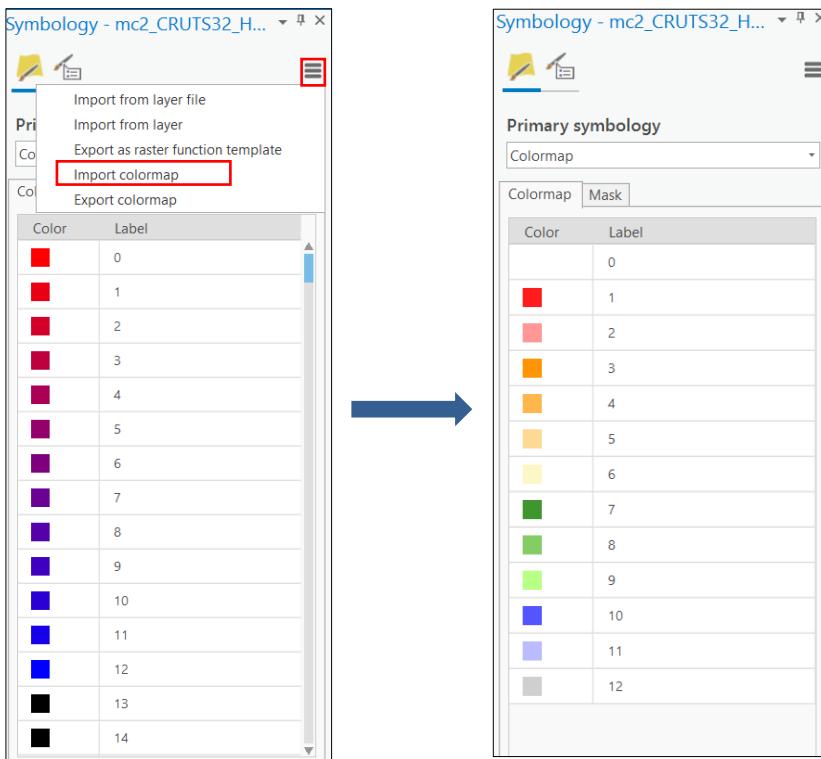
## Import symbology in ArcGIS Pro

When loaded in desktop GIS softwares, categorical data are visualized with random colors for each class. To visualize in ArcGIS Pro the categorical GAEZ v4 data with the correct symbology, load the data in the Map, right-click on the layer name and select the Symbology menu.



This will open the Symbology menu, click on the three lines button on the top right corner and select the Import Colormap option.

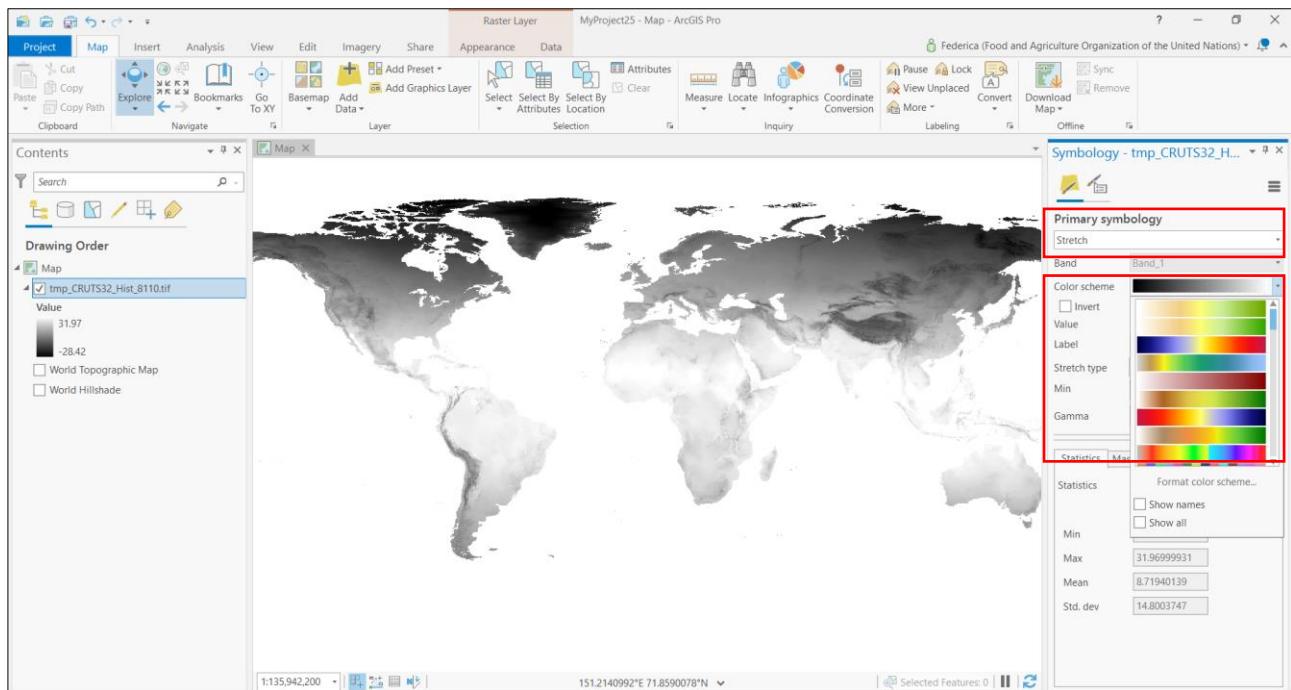
Select the corresponding .clr file depending on the GAEZ v4 data that has been downloaded and added in ArcGIS Pro. Information about the corresponding color map file to use are given in Annex II of this User's Guide. Click OK. The Colormap will be added to the layer. This will allow the user to display the layer with the pre-defined set of colors for each class.



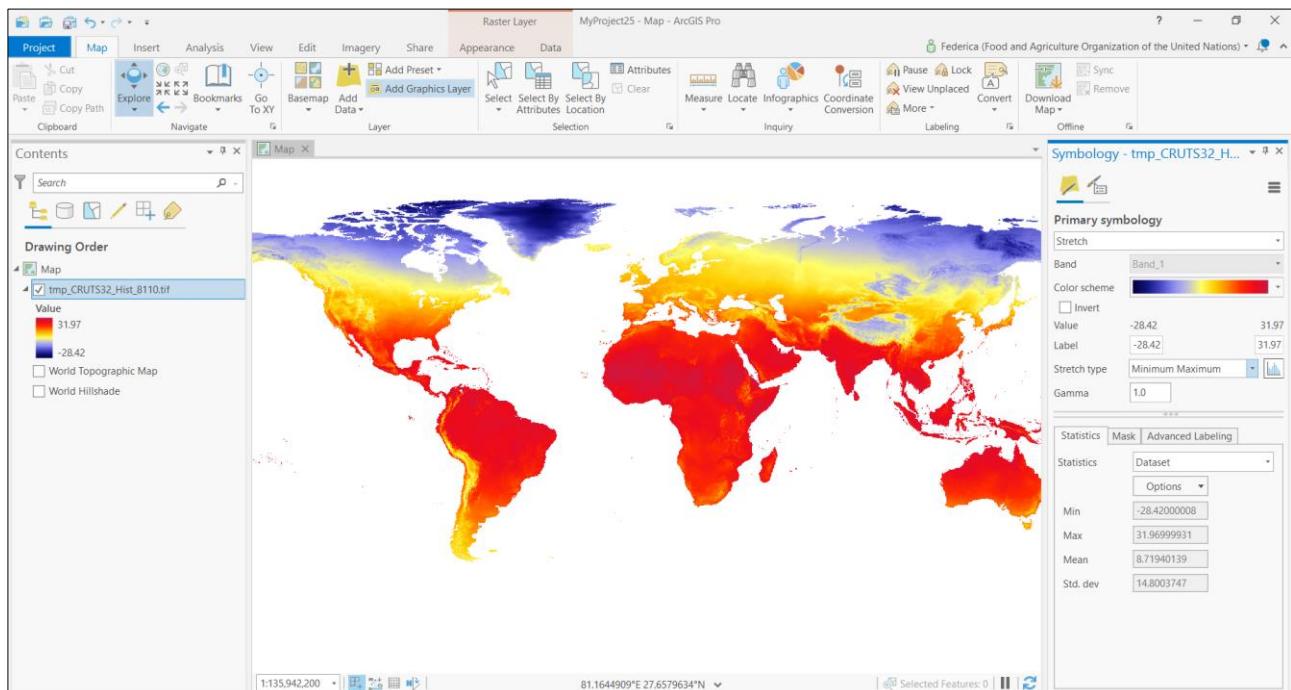
It is suggested to use the same styles as in the GAEZ v4 Data Portal also for continuous data. Colors ramps to use for continuous GAEZ v4 data are stored in the ArcGIS Pro style file (GAEZv4 Styles.stylex). To add a style to an ArcGIS project, follow these steps:

- On the Insert tab, in the Styles group, click Add and then Add Style;
- Browse to the location of the style
- Click OK to add the style to the project.

Load the data downloaded from the GAEZv4 Data Portal in the Map, right-click on the layer name and select the Symbology menu. The available color schemes will be in the drop down list of the Symbology panel. Ensure that a Stretch Symbology is applied with Minimum Maximum Stretch type.

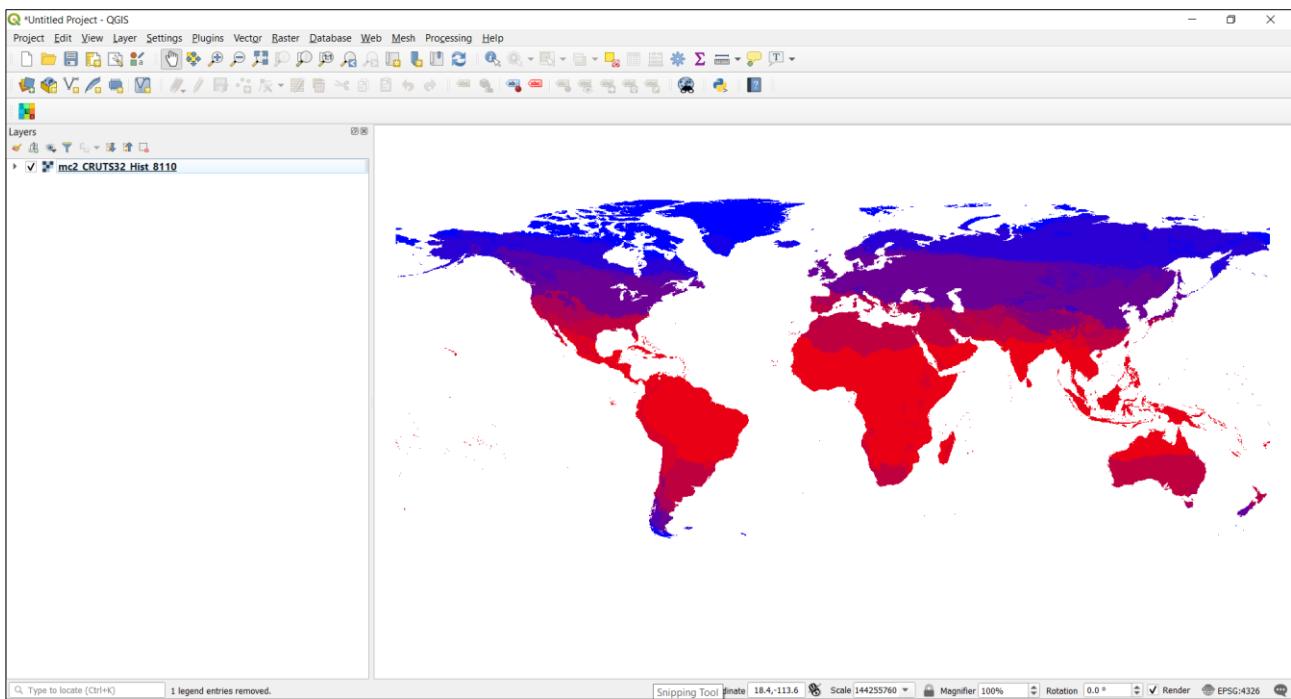


Select the corresponding color ramp from the drop down list (i.e. in the example below, with the Mean annual temperature (°C) layer, the corresponding color ramp to adopt is AgroClimaticDaysColorRamp, see Annex II). Now the layer is visualized with the correct color scheme.



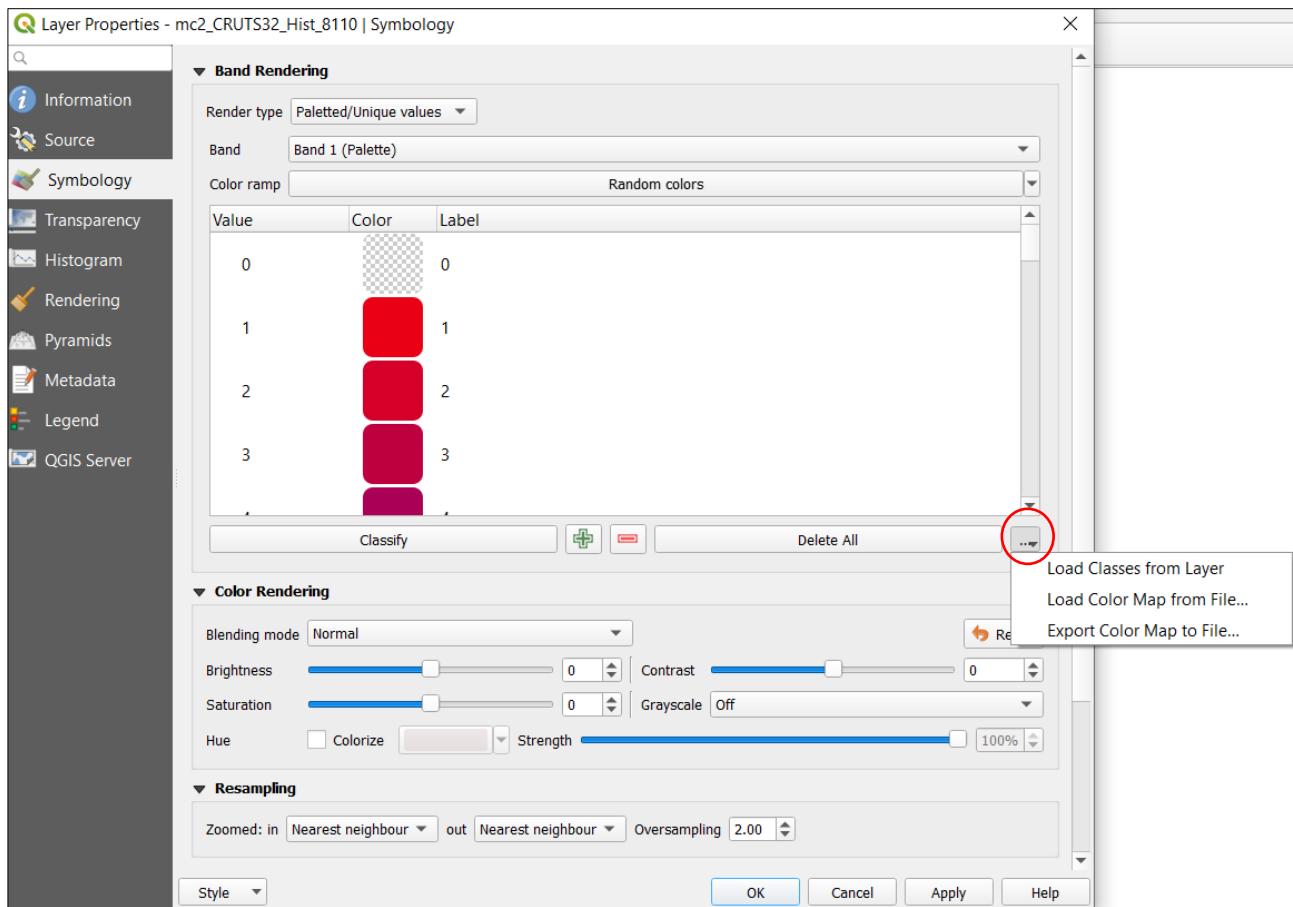
# Import symbology in QGIS

After having downloaded the layer from the GAEZ v4 platform, open the .TIF file in QGIS.

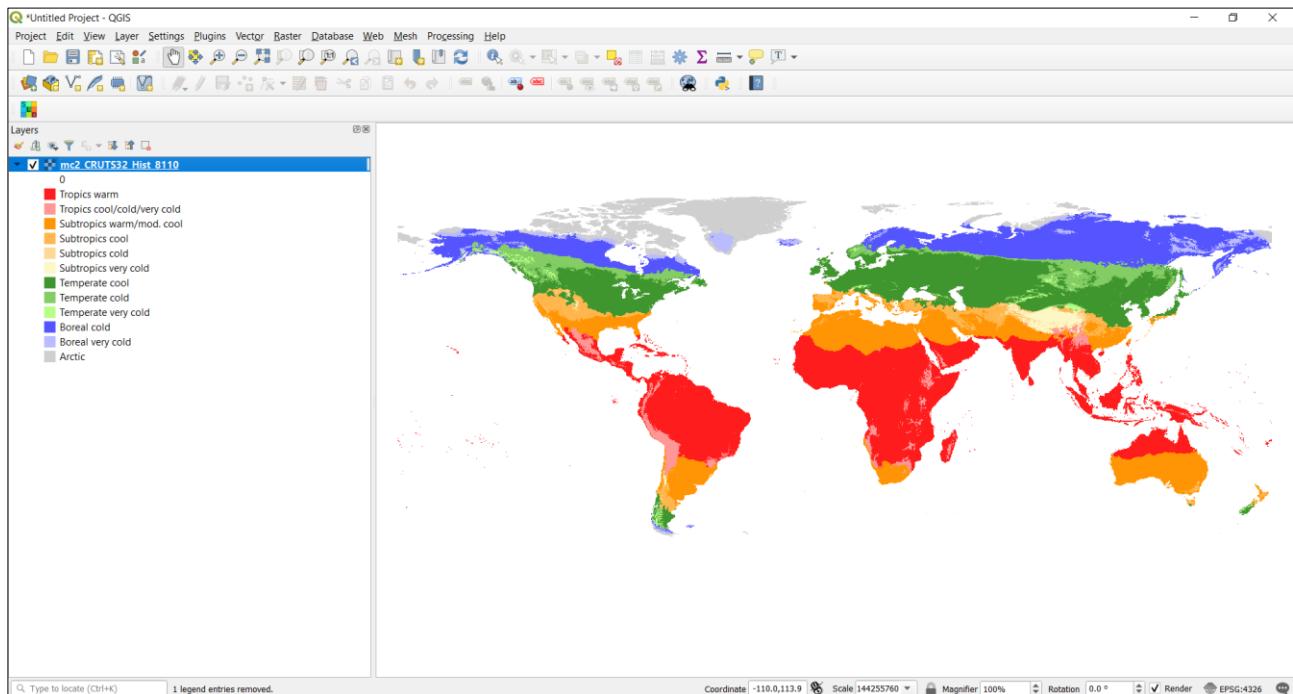


Categorical data are visualized with random colors for each class. To visualize the layer with the correct symbology, open the layer properties window by double clicking on the layer in the Layers panel and go to the Symbology tab.

For categorical data ensure to choose the Palettes/Unique values as Renderer type. Click on the three dots button (red circle in screenshot below) and use the option Load colour map from file to load the corresponding .clr file that can be downloaded from the GAEZ v4 platform (i.e. in the example below, with the Thermal Zones layer select the ThermalZones.clr file, see Annex II). Click Apply.

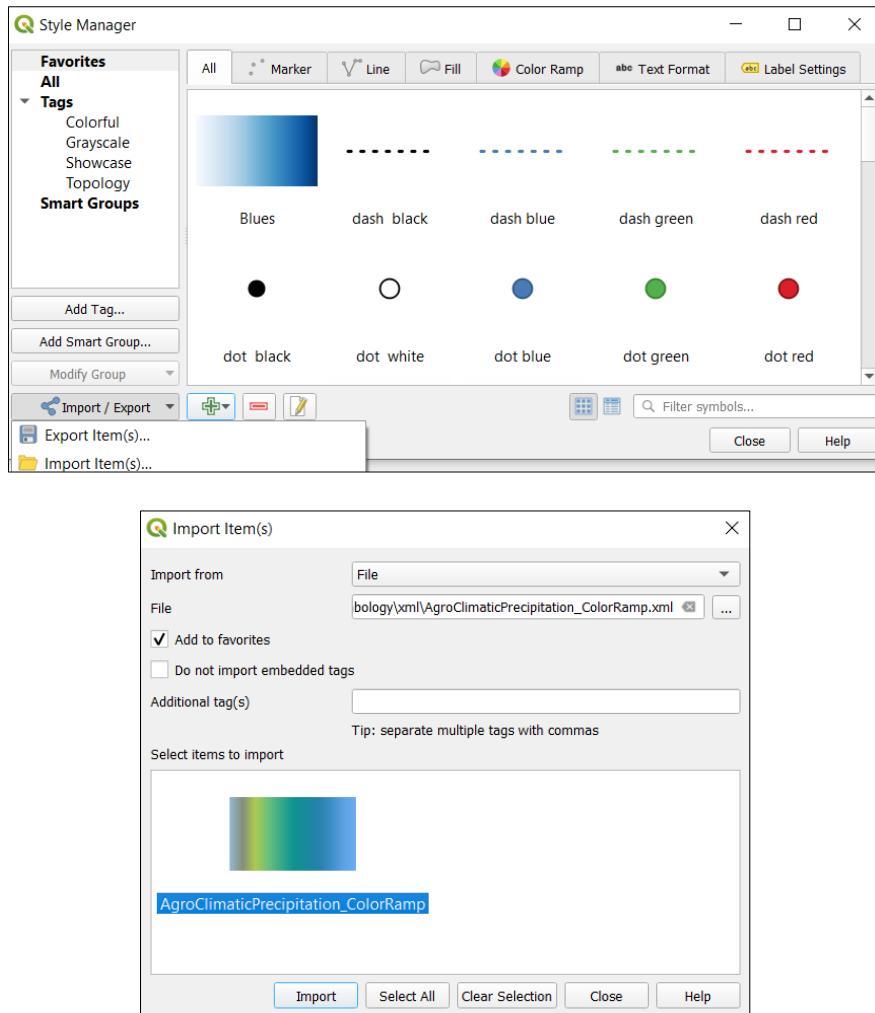


Once loaded, the layer will be visualized with the pre-defined set of colors for each class and with the corresponding class name.



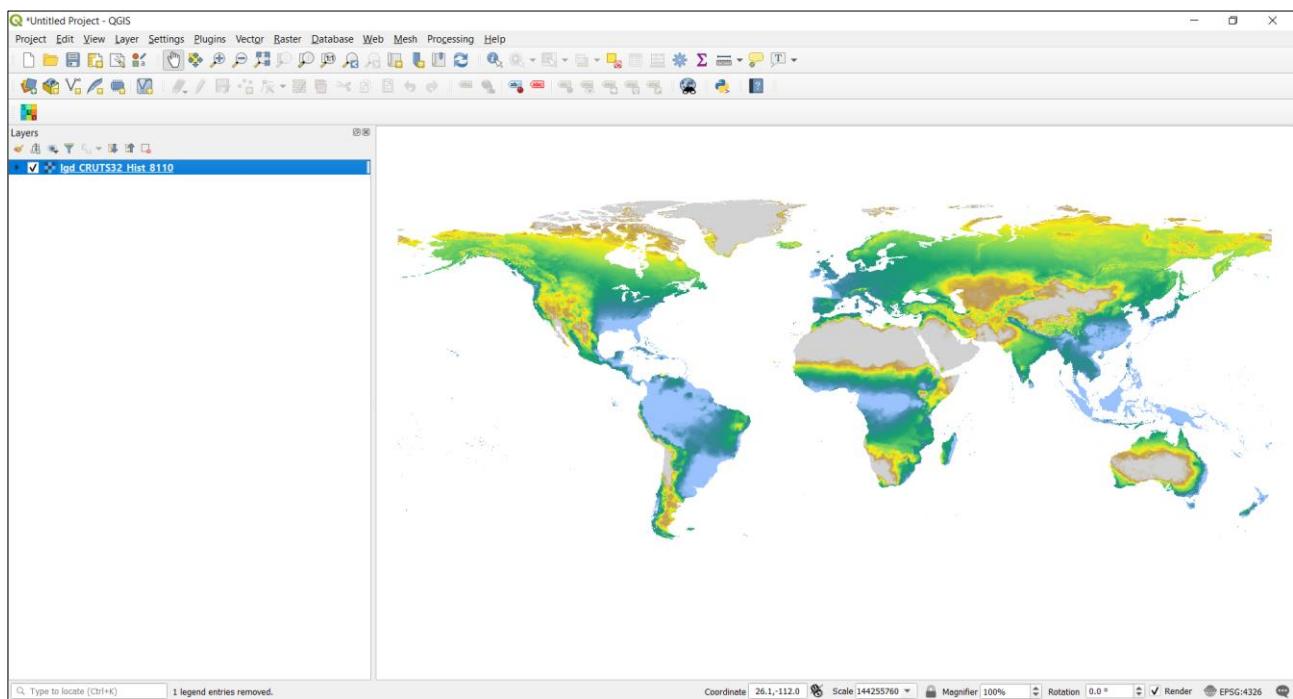
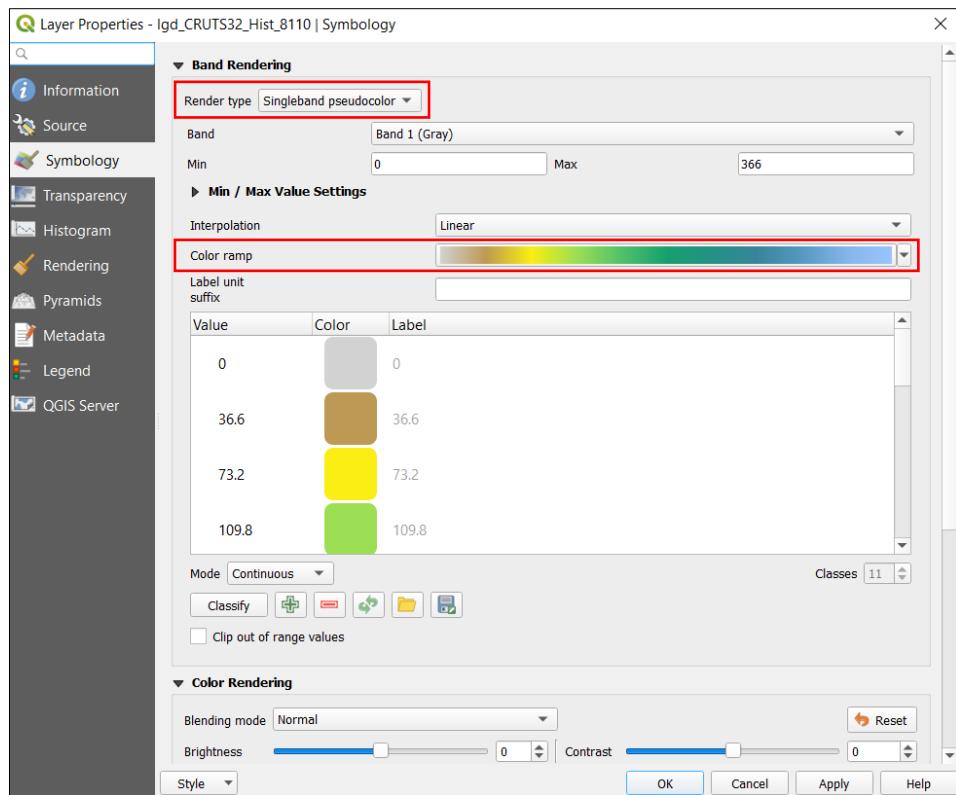
For continuous data it is suggested to use the same styles as in the GAEZ v4 Data Portal.

Color ramps have been saved as .xml files. To add color ramps in QGIS, load the .xml files from the Settings – Style Manager menu, click on the Import button and search for the GAEZ .xml files.



Select the .xml file, select the “Add to favourites” option and the item to import. Click on Import.

After having opened the .TIF file in QGIS, open the layer properties window by double clicking on the layer in the Layers panel and go to the Symbology tab. Choose Singleband pseudocolor as Render type and select the corresponding color ramp from the drop down list (i.e. in the example below, with the Total number of growing period days layer the color ramp to use is the AgroClimaticPrecipitation\_ColorRamp.xml, see Annex II). Click on Apply.



# Global Agro-Ecological Zones (GAEZ v4)

## Data Portal user's guide

The GAEZ v4 Data Portal (highlighting version 4.0 of the Global Agro-Ecological Zones) is an interactive multi-language web application designed to query, search, display, analyze and report on state and trends agricultural production and crop suitability under past, current and future climate scenarios. The GAEZv4 portal development has followed a stepwise process with new functionalities becoming available over time as well as access to updated files and databases. The objective of this user's guide is to provide detailed information about how to use the GAEZ version 4 portal.



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