What is the Uganda National Drought Monitoring System?

This is an online monitoring system that to provide timely data and warning on droughts within Uganda to the various stakeholders to enhance drought preparedness and response. It has been developed by Food and Agriculture Organization (FAO) and the National Emergency Coordination and Operations Centre (NECOC) based on the recognition of Uganda's growing vulnerability to droughts and natural hazards.

What datasets have been used?

The combined drought index uses three key datasets to generate an index that depicts that drought conditions within the preceding month. They include the Precipitation Drought Index (PDI), the Temperature Drought Index (TDI) and the Vegetation Drought Index (VDI). These datasets have been summarized below.

Component	Dataset	Spatial Resolution	Temporal Resolution	Temporal Coverage	Purpose
Precipitation Drought Index (PDI)	**Climate Hazards Group Infrared Precipitation with Station Data (CHIRPS)**	5566 m (~0.05 degrees)	Daily, aggregated to monthly	2001–Present	Monitors rainfall deficits to assess drought severity.
Temperature Drought Index (TDI)	**Moderate Resolution Imaging Spectroradiometer (MODIS) Land Surface Temperature (LST)**	1000 m	Daily and 8-day composites, aggregated to monthly	2001–Present	Tracks temperature excess and heat stress as proxies for drought severity.
Vegetation Drought Index (VDI)	**MODIS/VIIRS Normalized Difference Vegetation Index (NDVI)**	MODIS: 500 m; VIIRS: 375 m	16-day composites, aggregated to monthly	MODIS: 2001–Present; VIIRS extends coverage	Measures vegetation health as a proxy for soil moisture deficit and dry soil persistence.

What is the data frequency?

Datasets such as PDI, VDI, and CDI are produced on a monthly basis with a one-month lag. Consequently, if viewing the system on March 27, 2025, the most recent dataset will be for

February 2025. This delay is due to the release schedule of the CHIRPS dataset, as the observed rainfall estimates—considered the most reliable—are typically published after the month ends.

Historical datasets in the system date back to 2002 and are continuously updated.

What is the procedure for the generation of CDI?

On a monthly basis, the Precipitation Drought Index (PDI), Temperature Drought Index (TDI), and Vegetation Drought Index (VDI) are computed using Google Earth Engine from the dataset described above. They are calculated using the formulas below where :

- VDI/TDI/PDI$_{i,m}$: Respective Index for year **i** and month **m**.
- IP: Interest period (e.g., 3 months).
- LTM: Long-term average.

I. Precipitation Drought Index (PDI):

$$PDI_{i,m} = \left(\frac{\text{Actual average precipitation for IP}}{\text{LTM precipitation for IP}} \right) \times \left(\frac{\text{Actual run length of deficit}}{\text{LTM run length of deficit}} \right)$$

II. Temperature Drought Index (TDI):

$$TDI_{i,m} = \left(\frac{\text{Actual average temperature for IP}}{\text{LTM temperature for IP}} \right) \times \left(\frac{\text{Actual run length of excess}}{\text{LTM run length of excess}} \right)$$

III. Vegetation Drought Index (TDI):

$$VDI_{i,m} = \left(\frac{\text{Actual average NDVI for IP}}{\text{LTM NDVI for IP}} \right) \times \left(\frac{\text{Actual run length of deficit}}{\text{LTM run length of deficit}} \right)$$

The indices are then be combined to form the Combined Drought Index (CDI), calculated as a weighted average using the formula below:

$$CDI_{i,m} = 0.5 \times PDI_{i,m} + 0.25 \times TDI_{i,m} + 0.25 \times VDI_{i,m}$$

The layers processing and classification are described in the manual below;

How are the CDI, PDI, TDI and VDI values classified and what do these classifications mean?

The various indexes are categorized to facilitate month-on-month comparisons. This classification has been used through the system and is described on the legends below.

Combined Drought Index

COLOR	VALUE	TAG	DESCRIPTION
	> 1.0	Normal	No drought
	0.8 - 1.0	Mild	Going into drought, short term dryness slowing planting, growth of crops. Also coming out of a drought – water deficits, partial loss of crops and pasture
	0.6 - 0.8	Moderate	Damage to crops, pastures, drying of shallow reservoirs; voluntary water rationing
	0.6 - 0.4	Severe	Wider scale of loss of crops and pastures, imposed water rationing and livestock migration
	< 0.4	Extreme	Major loss of crops and pasture, extreme fire danger, total water shortages, drying of deep reservoirs and usage restrictions

Precipitation Drought Index

COLOR	VALUE	DESCRIPTION
	> 1.0	Above average rainfall
	0.8 - 1.0	Average rainfall
	< 0.8 - 0.4	Below average rainfall
	< 0.4	Significantly below average rainfall

Temperature Drought Index

| Color	Value	Description
	> 0.8	Normal to below normal temperatures
	0.4 - 0.8	Average rainfall
	< 0.4	Exceptionally higher than normal temperatures

Vegetation Drought Index

Color	Value	Tag	Description
	> 1.0	Above average vegetation conditions	Above average vegetation conditions
	0.8 - 1.0	Average vegetation conditions	Average vegetation conditions
	< 0.8 - 0.4	Below average vegetation conditions	Below average vegetation conditions
	< 0.4	Significantly below average vegetation conditions	Significantly below average vegetation conditions

Normalized Difference Vegetation Index Anomaly

Color	Value	Description
	<= (- 0.125)	Large Decrease
	(- 0.125) – (-0.050)	Small Decrease
	(-0.050) - 0.050	No Change
	0.050 – 0.125	Small Increase

Color	Value	Description
	> 0.125	Large Increase

Total Rainfall Estimates

Rainfall Total (mm)

- <= 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 299
- 299 - 400
- 400 - 500
- > 500
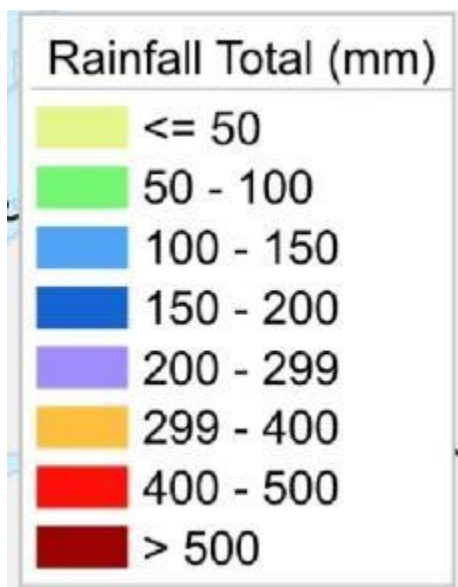
What is the Dataset Geographical Extent?

Data is produced for the whole country. For localized view, zonal statistics for each index I.e. CDI, PDI, VDI and TDI are the computed for each district (ADM Level 3) in Uganda.

However, the maps are visualized at pixel level whereby the native raster resolution is 5566 m based on the CHIRPS datasets which is the coarsest among the input datasets.

Getting Started with the System

System Overview

A working version of the system can be accessed at the following public-facing address: https://cdi-frontend-olive.vercel.app/.

The system is structured into four main pages—*Overview, Dashboard, Comparison, and Maps*—each containing distinct sections or tabs to facilitate easy navigation and information retrieval. Further, a user can easily switch from one tab to another, by clicking on the various tabs, which are always affixed at the top centre of the user's page.

The current tab highlighted in white to indicate the user's current position on the platform as shown below (highlighted with red outline)
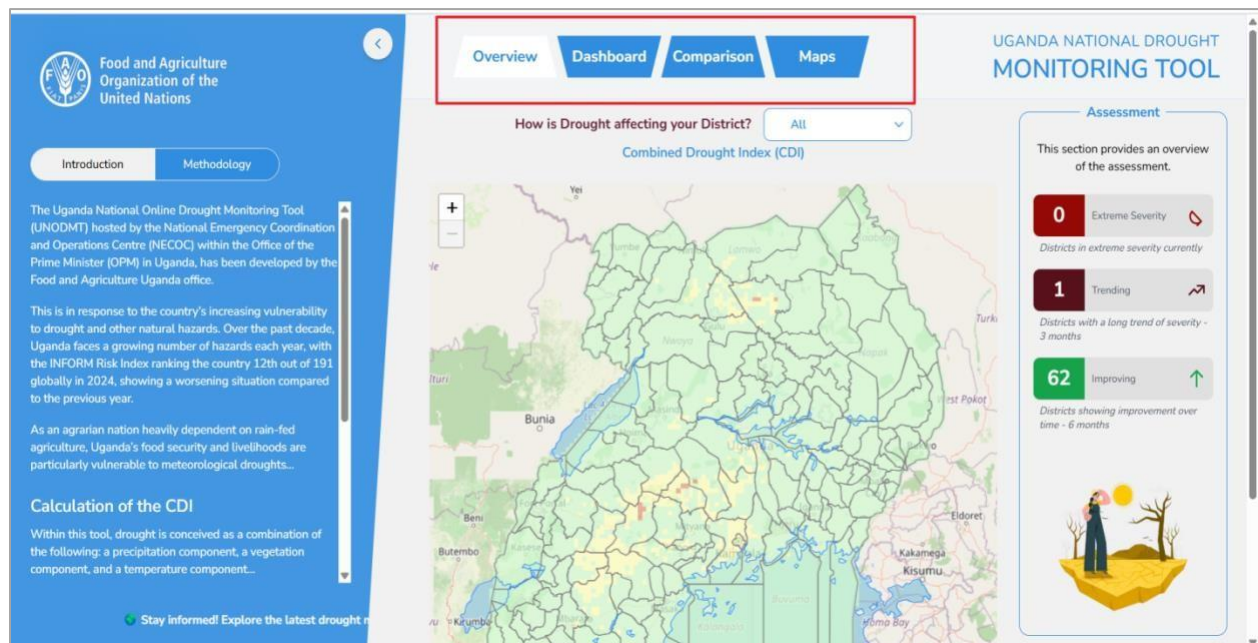
What is The Overview Page?

This is the drought portal default landing page. It presents a top overview of the data that allows the user to understand the rationale for the system development, and to have broad view of drought conditions across multiple districts of Uganda.

This page is divided into three main sections: a collapsible left sidebar, a map view, and a drought assessment section, labelled 1, 2, and 3 in below.
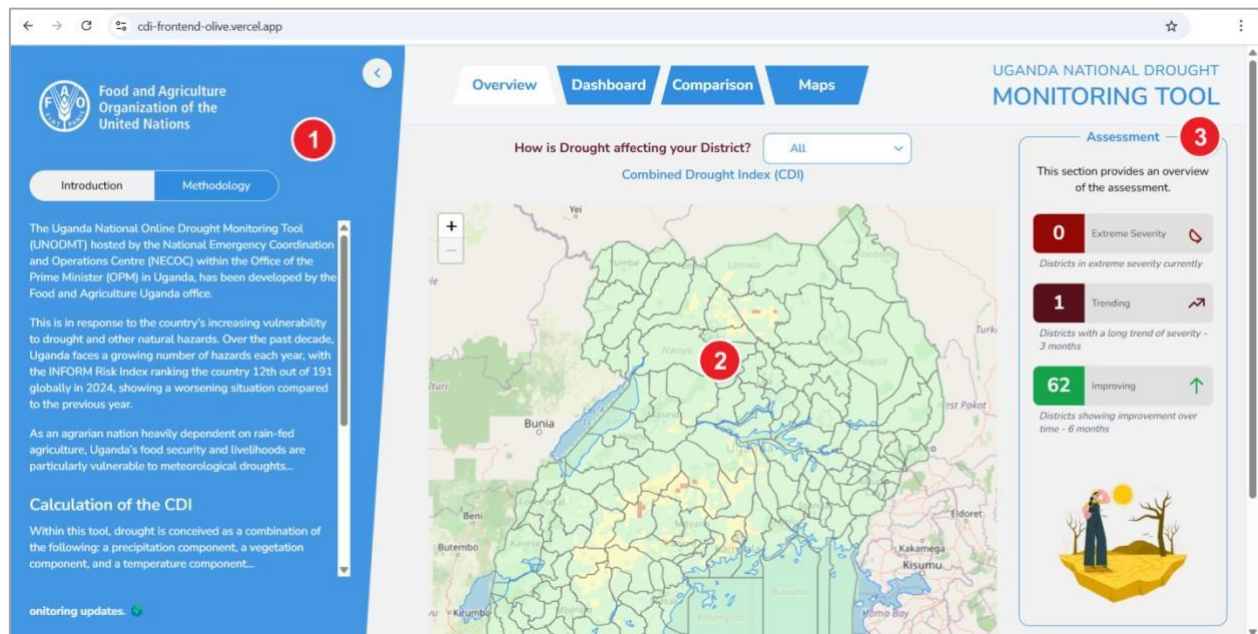
What is the Left Side Bar?

This is a collapsible container that has two *navigation* buttons labelled *Introduction and methodology.* By default, the container is expanded, as shown in above. However, at the top right of the container, there is an arrow which when clicked collapses the container, as shown in below. The sidebar collapse to a three-lined button, often called a *'hamburger menu*,' which, when clicked, shows the hidden sidebar.
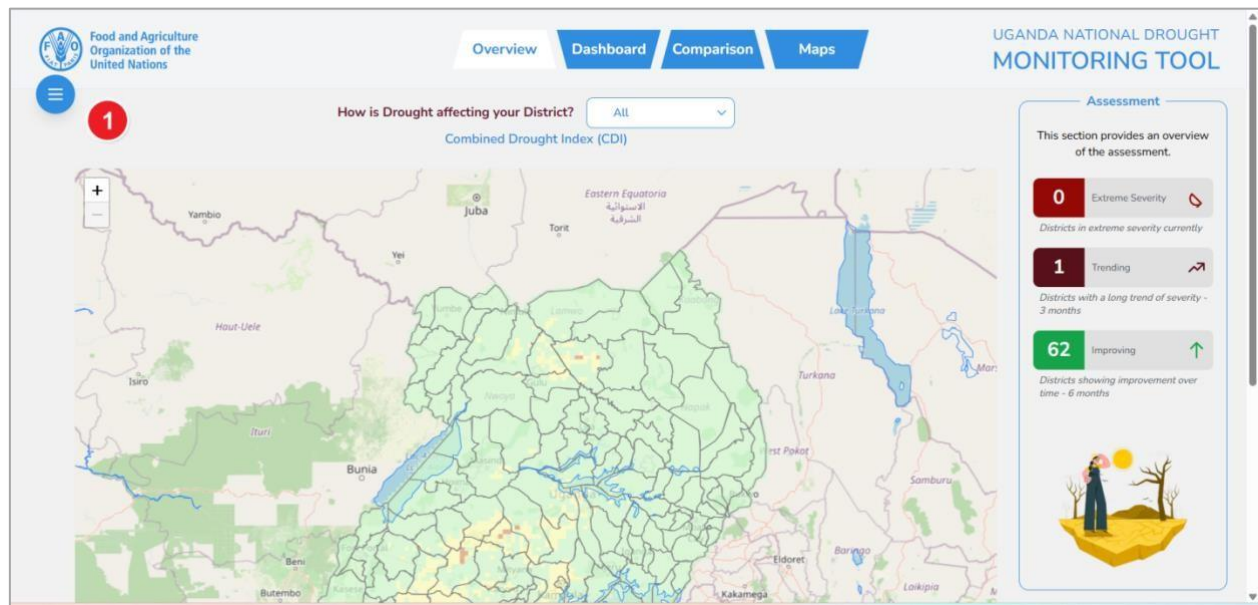
What is the Introduction section?

This section within the Left Sidebar provides the user with an introductory text and the rationale for the development of the Uganda National Drought Monitoring system and its relevance monitoring the vulnerability of the different districts in Uganda to droughts. Further, It provides guidance to the user on how to interpret the Temperature Drought Index (TDI), Precipitation Drought Index (PDI), Vegetation Drought Index (VDI) and Combined Drought Index (CDI) values and a description of the legend used to visualize the various drought severity on the maps and charts.

What is the Methodology Section?

This sidebar section provides the user with an explanation of how the various intermediate values including TDI, PDI and VDI are computed and how the final CDI is computed through the weighted approach of combining the 3 indices. It provides the formulas, tools and the weights that were applied to each index in deriving the final CDI.
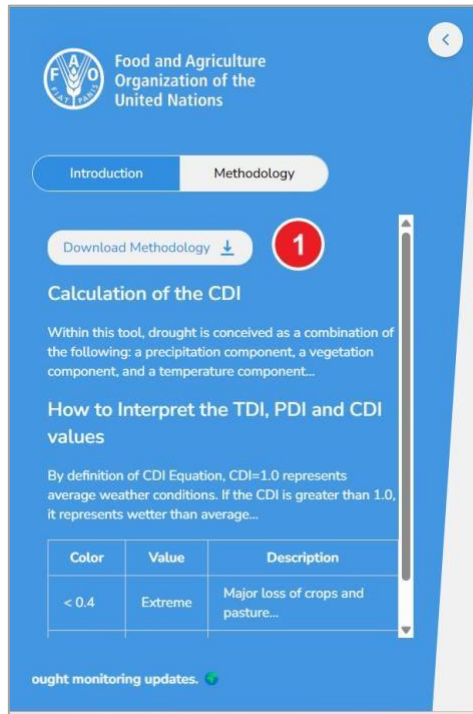
What is the Overview Map

This map provides the users with a spatial overview of the drought conditions across the various districts in the country specifically highlighting districts facing the most severe drought conditions where attention such as humanitarian assistance may be required based on drought severity. Specifically, these are districts whose drought classification for the month is classified as *Extreme* or *Severe*. All other districts are grouped under a general category called "Other."

For example, if Acholi and Karamoja Districts are classified as Extreme or Severe in February 2025, they will appear in their respective color as described on the CDI Legend, while all other districts will be grayed out as shown below.
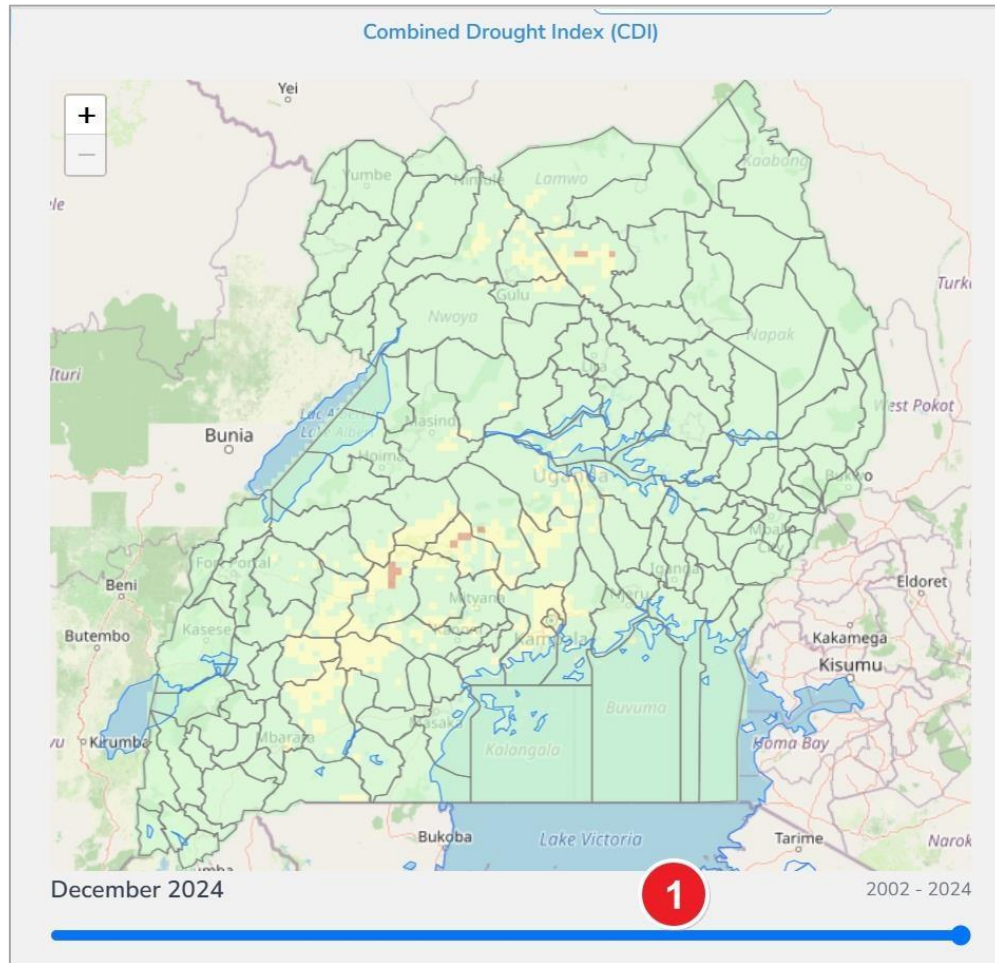
Figure 1: Overview Page, CDI Map

The time slider (*labelled 1 in figure above*) that allows users to scroll through and view previous months overviews for the whole data range from 2002 to 2004.

How can I get Drought conditions for a specific district?

Above the overview map, there is a section titled, '*how is drought affecting your area?*' as shown by the label 1 on figure below. On clicking this dropdown, a list of districts will appear from where you can select your district of interest. Once clicked, you will be rerouted to the dashboard where the filter for the selected district will have been applied.
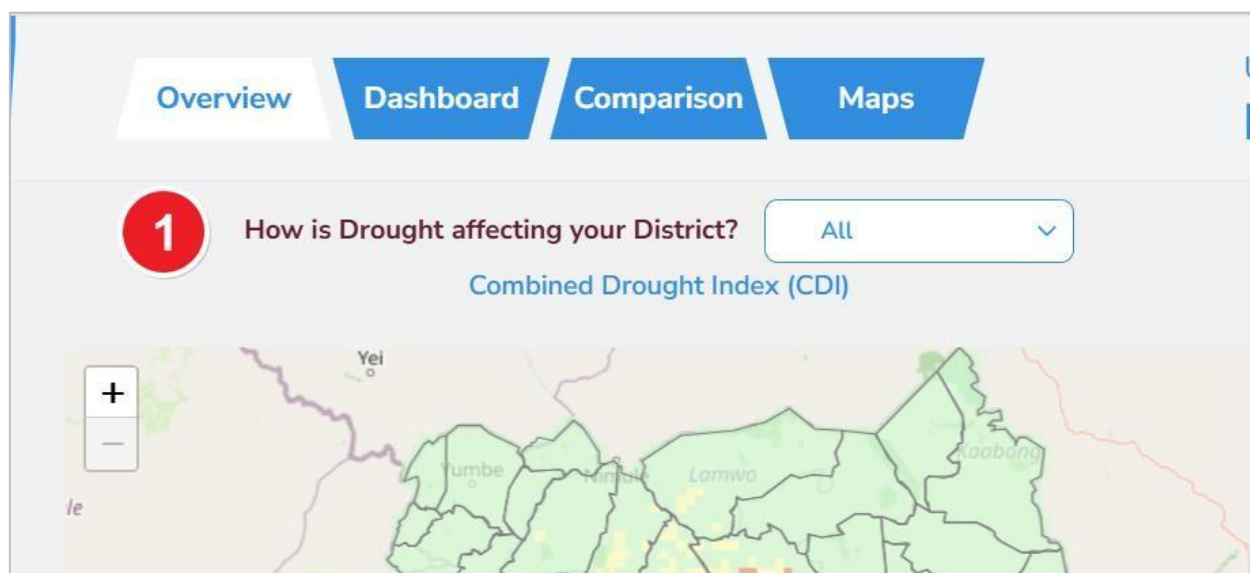
What is the Drought Assessment?

The drought assessment section located on the right sidebar (*as shown on figure below)* provides users with 3 key insights related to the drought severity within the focused month as shown below.
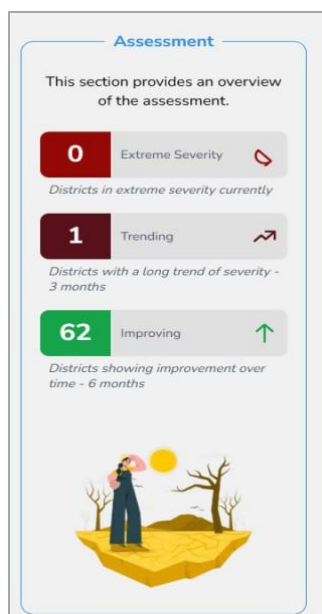

Figure 2: Drought Assessment

It is linked to the overview map, and it primarily provides a summary assessment of drought conditions based on the month selected in the map view. When you move the time slider on the map, the drought assessment updates accordingly.

These 3 key insights answer three questions namely:

i. Which districts are facing the most severe drought conditions during the assessment period? This includes districts classified as experiencing severe or extreme drought.

ii. Which districts have been in severe drought conditions for an extended period of at least 3 months? This focuses on districts that have maintained *severe or extreme* drought classification over the last 3 months.

iii. Which districts show signs of recovery or improvement? This is based on districts that have sustained a lower drought classification, such as moderate, mild, or no drought, for the last 3 months, after previously being classified as extreme or severe. For example, a district that was classified as extreme in November but is now moderate in February.

**How do I download this Assessment?**

Above this assessment section on the User Interface, there is a button labelled download assessment, When clicked, it allows you to download a full drought assessment report that provides a monthly synthesized drought overview or bulletin released by FAO and its partners.

What is the Dashboard Page?

The dashboard is a page that provides interactive visualizations and customizable filters that enables you to:

i. Visualize drought conditions of the various intermediate indexes such as PDI, TDI and VDI and the final CDI across various districts in Uganda using maps, charts and tables.

ii. Analyze temporal trends and patterns in drought severity.

iii. Download a report on drought trends across target districts in Uganda.

It is organized into two main sections, namely Map View and Table view. A user can switch between the Map and Table View by clicking on the respective tabs as shown below.
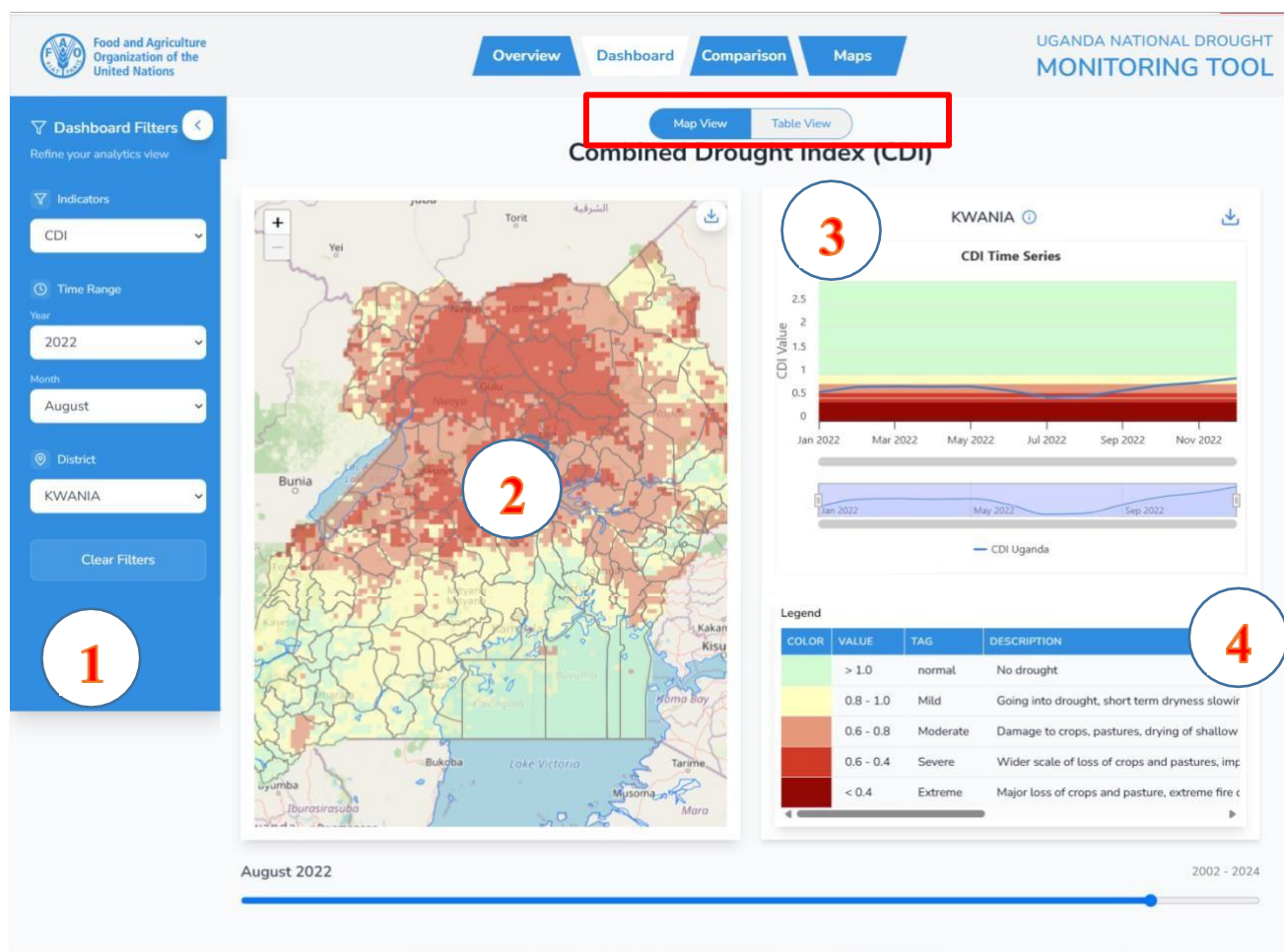
What is the Map View Tab?

This is the default view when you click on the Dashboard Tab. This view has 3 main sections namely Filters, Map, Time Series Chart as shown above.

a) Filters

The filter section is affixed on the left sidebar as shown by the label 1 on **Error! Reference source not found.** above. There are four filter options on the Map View section of the dashboard. These allow the user to refine their analysis across 3 parameters namely *indicators*, *Time Range*, and *District* as described below.

    i.   *Indicators*: This allows the user to filter across the 3 intermediate drought indices namely TDI, PDI and VDI and the combined CDI, with CDI being the default selection.

ii. *Time Range:* The user can specify the time range using two filters, namely *year* and *month*. By default, the current data is specified.

iii. *District:* A specific district can be selected from a drop-down menu of all the districts in Uganda.

iv. *Clear Filters:* This button allows users to reset all filters to their default values.

As you make changes on a filter, the Map view and time series dynamically updates to reflect your selection. You can equally use the slider on the map to quickly slice the data and view only a specific time period. Further, by clicking on a severity type on the legend, you can filter to only display districts that have that severity type.

Similar to the introduction sidebar, a user can collapse the filter section thus slightly expanding the map and chart area.

b) Map

The Map, positioned at the center, is an interactive map and this allows you to seamlessly navigate and filter data by severity, offering a dynamic visual representation of the information. By default, the CDI for the most recent month and year is visualized on the map based on the default filters. To filter a specific district, simply click on the district's boundaries within the map area. This filters the map to display data for that district for the specified period.

The map displays raster values of the selected indicator. This is useful in indicating to the user the varied distribution of the drought conditions across the district. The pixels have different color shades that are used to represent varying levels of drought severity based on the specified indices e.g. CDI. A dynamic legend providing the color visualization and the description of each category for the specific indicator is shown on the right of the map. This legend changes based on the indicator shown above. The map view is linked to both the time series and the filters on the left sidebar, ensuring the display remains consistent with your selections and it updates based on new choices. Further, on each map, the user has an option to download the map, that is accessible at the top -right of the map container.

c) Timeseries

The time series is located to the right of the map area within the map view as shown by the label 3 on figure above. It displays on a time series the recorded values for the specific indices, for the specified district based on the user filters. By default, the time series displays the values for the respective district, for the year under selection e.g 2024 as shown in the image below.
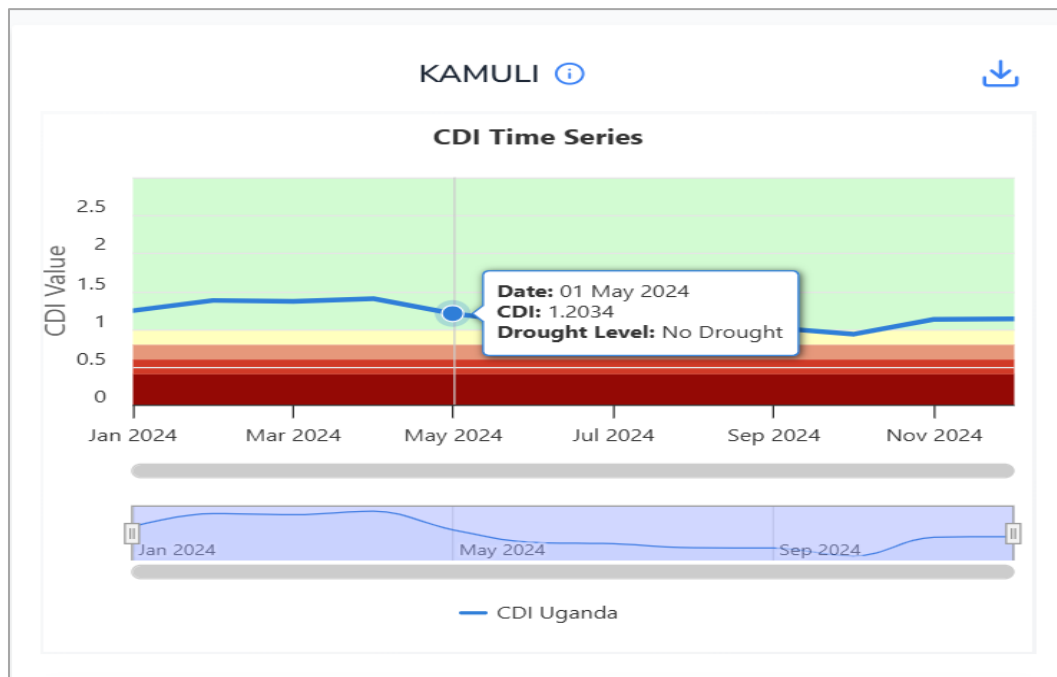
The current district and indicator selection are displayed on the chart title as shown above. By hovering over the map along the line, you are presented with the indicator value and the drought severity classification as at selected time as shown in the image above.

To view the full data extent i.e 2002 to the current data on the time series for the respective district, there is an informational icon next to the district name on the chart that allows the user to clear the year filter from the chart as shown below.

Further, below, the map container, a timeline slide spans from 2001 to 2025, enabling users to explore historical drought data across different years. Additionally, using a slicer chart, a user can select a specific period (e.g., Jan to Dec 2025) by adjusting the two ends of the slicer on the chart. Equally, a user can be able to download the chart for use in other documents.

Further, the drought severity is displayed on the chart area using the same color ranges displayed on the legend which is located below the chart area. The legend is provided on the bottom the left to offer contextual guidance to help users interpret the data effectively.

What is the Table View?

The table view section presents the drought data in a tabular format for more detailed numerical analysis as shown on below.

Like the *Map View*, the table view has a filter section. However, a user has only two filter options namely the *Indicator* and the *Year* as shown by label 1 in below. These share the same characteristics as those described under the map view.

By default, it displays a tabular record of the Combined Drought Index (CDI) for each district within the selected year, which is initially set to the most recent year, as shown in below. The table includes the district name, the current CDI value, the previous CDI value, the deviation of the current CDI from the previous CDI, the deviation of the current CDI from the long-term mean, and a status indicator. The status indicates whether the current CDI is improving, worsening, or remaining the same compared to the previous value.

Figure 3: Table View

Further, you can be able to download a comma separated values table for further analysis as shown by the label 3 on Figure 3 above.
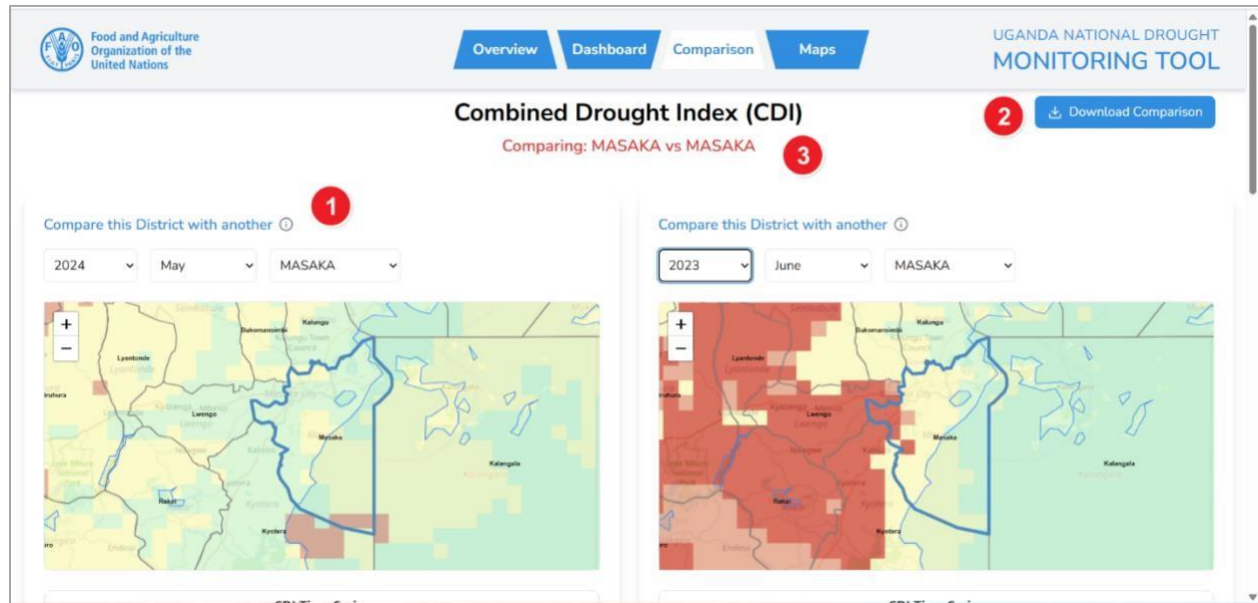
What is the Comparison Page?

The **Comparison Page** is designed for detailed analysis and reporting, offering several powerful tools. The **Filter** feature allows you to select the desired indicator for analysis, while the **Split Column** tool enables side-by-side visualizations and time series comparison of districts based on specific criteria such as year, month, and district.

it enables you to:

i.   Compare differences in drought severity between two selected districts.
ii.   Understand temporal patterns and trends in drought conditions for the selected district. You can equally compare the same districts at two different time intervals.
iii. Make informed decisions regarding resource allocation, intervention strategies, and policy development.

By default, the current drought conditions for two districts from the list of districts in extreme conditions are compared. However, you can select new districts, and the report will be updated as shown below.

You will get a text highlighting the districts that are currently being compared as shown by the label 3 on the figure above. This helps you to cross-check if the comparison being made is the intended one.

When a comparison is run, you get a side by side comparison of the drought situation in the two districts including all the intermediate layers such as PDI, TDI and VDI as shown below.
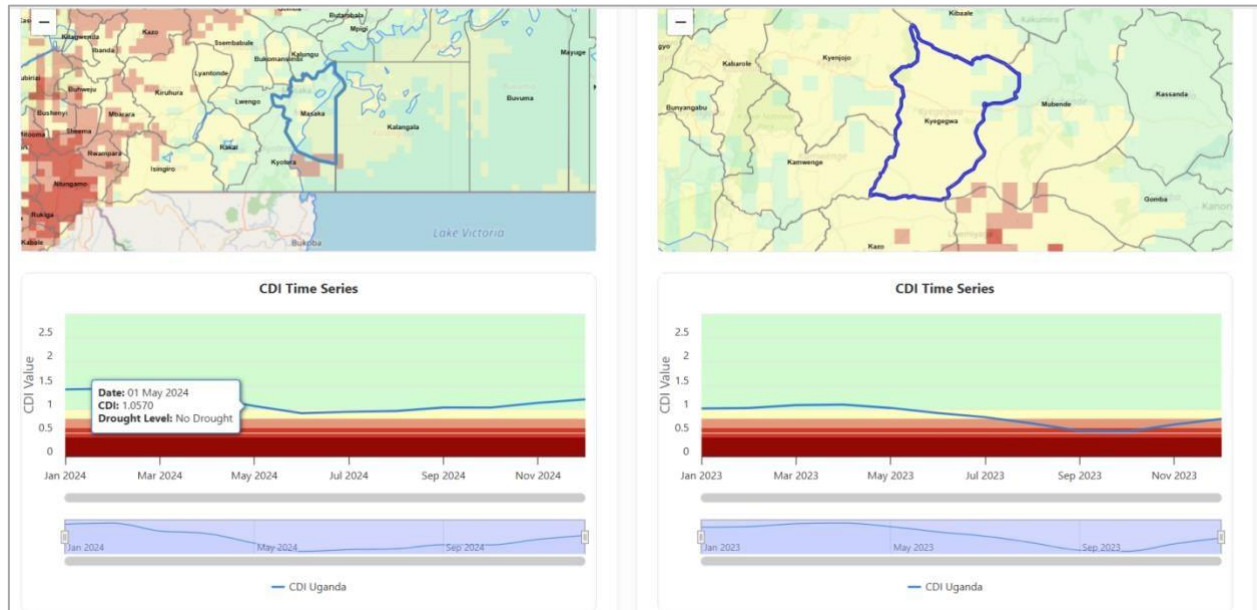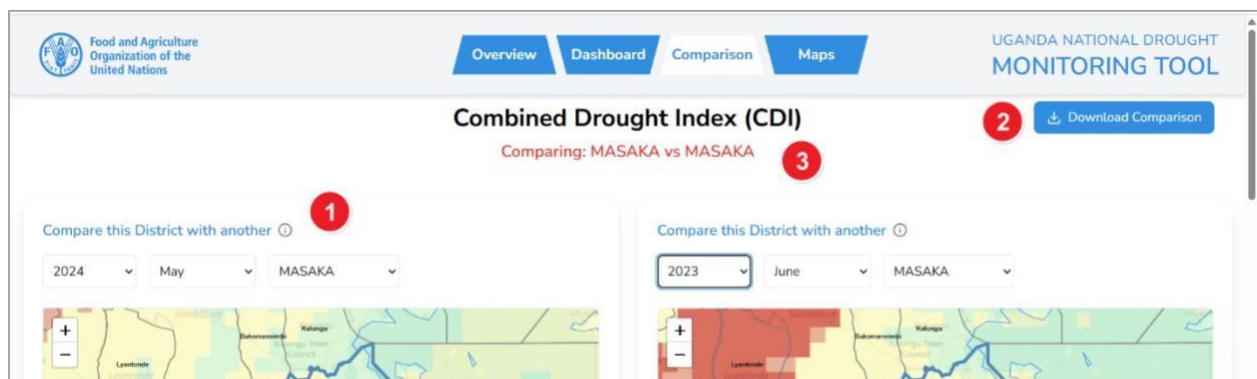
Figure 4: Comparison Time Series

Equally, from the dropdown, a user can select '*all'* to compare across the whole country at specified periods of time.

How Do I download the comparison?

Once a comparison has been run, you can download the report by clicking on the *Download comparison* tab as shown by the label 2 on figure below.


What is the Maps Page?

The maps page provides you with monthly **Static Maps** for all the indicators from the year 2002 to present. By default, you will be presented with thumbnails of monthly maps of the last 5 years where by maps for each year are organized as a column and an additional year stacked as a column as shown in figure below.

There are two sets of **Filters** on top left and top right that allows you to filter the maps individually. On the top right, there is an *indicator* selector which allows the you to switch from one indicator to the next as shown by the label 2 on the figure below.

On the left, you have access to the period filter where you can select a beginning and end year where both are inclusive. Currently, you can visualize of either 1 or 5 years by default. By default, a 5 year range is displayed.
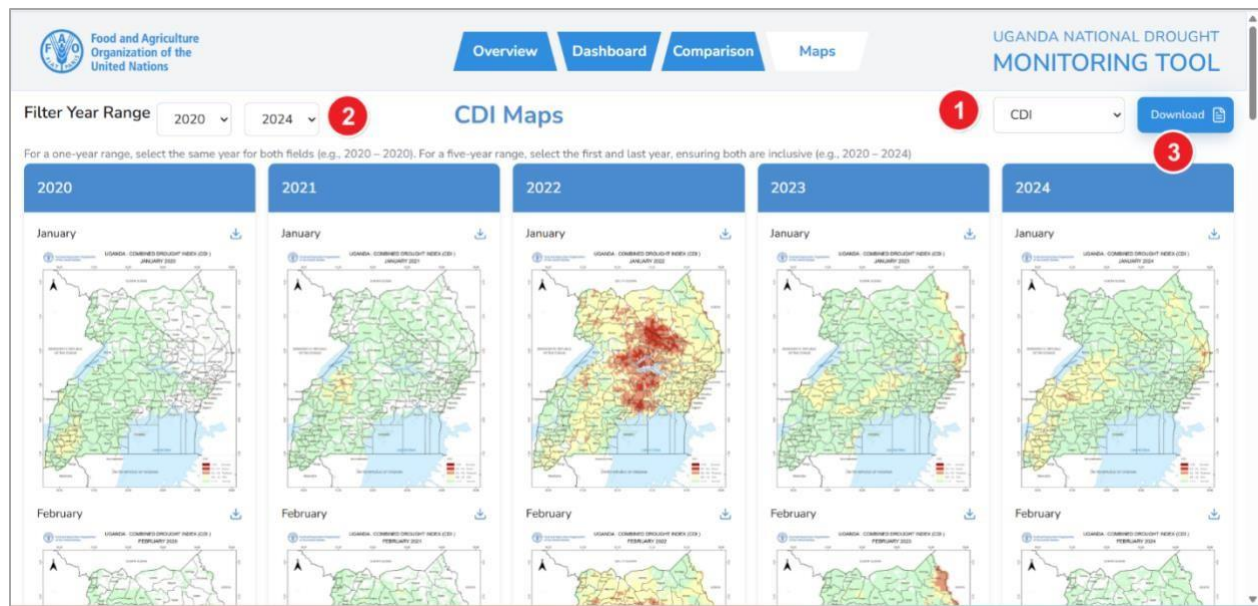
How Do I display a single year range?

To display a single year, enter the same year on both the before and after time range selectors as shown above.

When a single year is selected, the months are arranged horizontally across the screen on a 6*2 grid as shown below.
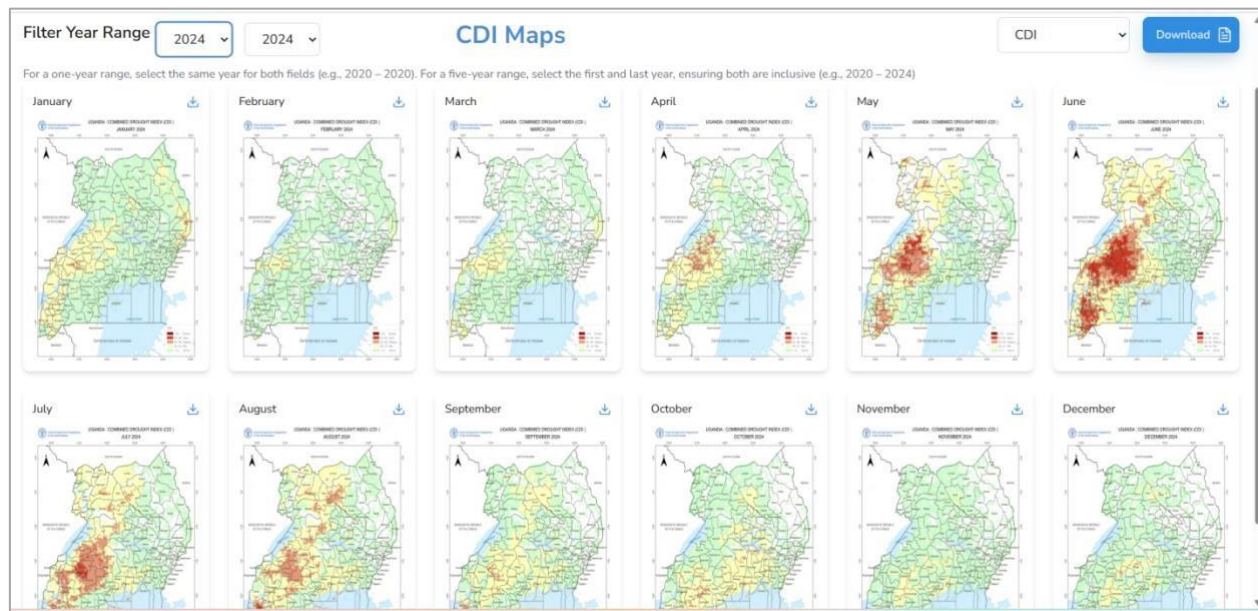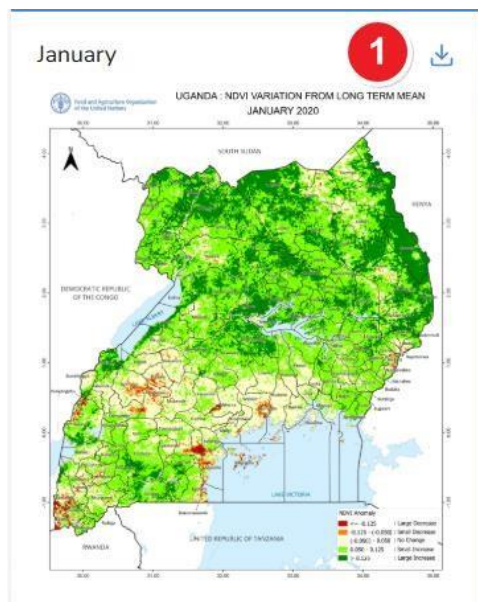
How do I enlarge the maps?

When you click on the map thumbnail, a full screen map is presented to you to allow for further exploration.

How do I Download the Maps?

You can be able to download a single map by clicking on the download button that is located on the top right of the respective map container as shown below.

Additionally, you have the option to download all the maps by clicking on the **Download Maps** button on the top right of the Maps page as shown above. On clicking the button, you will be presented with a preview of the selected data for download and a button to save the report to your device as shown below.