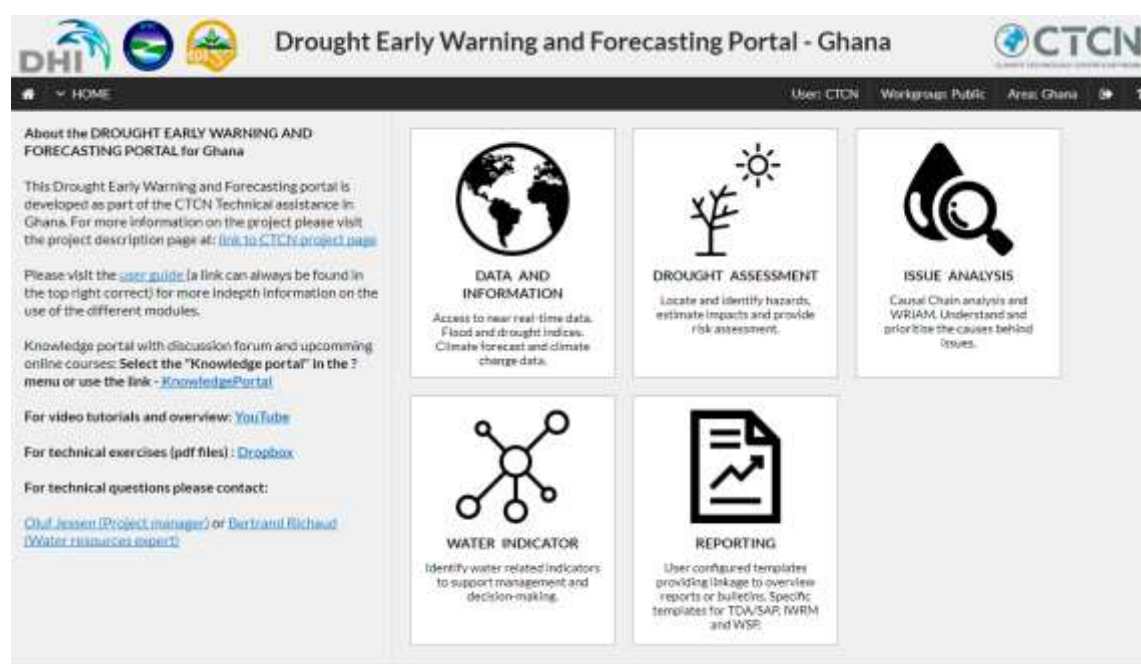


CTCN assistance in Ghana

Improving Resiliency of Crops to Drought through Strengthened Early Warning within Ghana

Technology description and User guide (activity 2.2)



This report has been prepared under the DHI Business Management System certified by Bureau Veritas to comply with ISO 9001 (Quality Management)



Approved by

22-02-2018

X

Approved by
Head of Projects
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CTCN assistance in Ghana

Improving resiliency of crops to drought through strengthened early warning within Ghana Needs Assessment report

Technology description and User guide (activity 2.2)

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Project number	11819285-1
Approval date	22-02-2018
Revision	Final
Classification	Restricted

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LIST OF ABBREVIATIONS

ASI	Agricultural stress index
CCA	Causal Chain Analysis
CDI	Combined Drought Indicator
CFS	Climate Forecast System
CHIRPS	Climate Hazards Group Infrared Precipitation with Station Data
CRU	Climate Research Unit
CTCN	Climate Technology Centre & Network
DSS	Decision support systems
EDI	Effective Drought Index
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographical Information System
GIS	Geographic Information System
GPM	Global Precipitation Measurement
NDVI	Normalized Difference Vegetation Index
SPI	standardized precipitation index
SVI	Standardised vegetation index
SWI	Soil Water Index
TCI	Temperature condition index
TRMM	Tropical Rainfall Measuring Mission
VCi	vegetation condition index
VHI	Vegetation health index
WRC	Water Resources Commission
WRIAM	Water Resource Issues Assessment Method

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1 Background

The CTCN funded technical assistance relates to improving resiliency of crops to drought through strengthened early warning within Ghana. The objective is to facilitate transfer and capacity building for climate change adaptation focusing on dry season management and planning. The proposed support will utilise existing knowledge and capacity and further develop and validate these for applications to local issues within Ghana.

The technical assistance was initiated in October 2016 by a national workshop held in Accra. Based on feedback and discussions from stakeholder consultations and a Needs Assessment report prepared to present the objectives and requirements for the technical assistance, the recommendations have then been taken into consideration to draft a more detailed description of the proposed outcome in the Technology specification report delivered in February 2017.

Based on the outlined requirement the Drought Monitoring and Early warning system for Ghana has been developed and a first version was presented at the second the national workshop held in Accra in October 2017. This was the opportunity to give insight into the developed system and get feedback from the key stakeholders.

Following this workshop, the main applicant (Water Resources Commission, WRC) has carried out a thorough review of the system followed by a validation of the performance of the portal. Methodology of the validation of the technical outcomes has been detailed as part of Activity 2.1 (Methodology for validation and testing). The outcomes of the review and validation processes have been described in the Technology Validation report delivered in January 2018.

2 Introduction

The overall objective is the development and implementation of a **drought early warning system** facilitating the provision of timely and effective information related to the water and agriculture sectors allowing these sectors to take actions to **mitigate impacts** of upcoming droughts. The established drought early warning system is a web-based allowing relevant stakeholders to utilize the system without the installation of any software. The technical design of the system is based on the feedback from the national workshop and the stakeholder consultation meetings during the initial part of the technical assistance.

The drought early warning system enables decision makers and stakeholders to use the transferred knowledge, practices and technologies actively in the dry season planning. The solution focuses on **improving the adaptation** to upcoming drought events by supporting elements within the **risk management** part of the drought management process. The crisis management or the response to an already occurred drought event or disaster will not as such be included in the outcomes of the CTCN assistance.

The Web-based drought early warning and forecasting portal covers the following main topics:

- **Issue analysis**
- **Web-based drought early warning and forecasting portal** providing access to the technical functionalities, and enable stakeholders to view and download data and information;
- **Data and information** to avail near real-time satellite products related to drought warning and forecasting, and provide the required data input for the drought warning and forecasting system

- **Risk management components** supporting the risk-based drought management through drought early warning and detection for increased adaptation and preparedness to upcoming drought events
- **Dissemination** relating to how the technical information is conveyed from the web-based system to the end-users in form of reports, messages or warnings.

3 User guide

3.1 Core components of the portal

The main output from the CTCN assistance is the Drought Early Warning and Forecasting Portal, which is accessible through the following link: www.flooddroughtmonitor.com.

The web-based portal contains a number of web applications assisting the user within drought management and drought early warning.

Introduction to the Drought Early Warning and Forecasting Portal, see Figure 1.

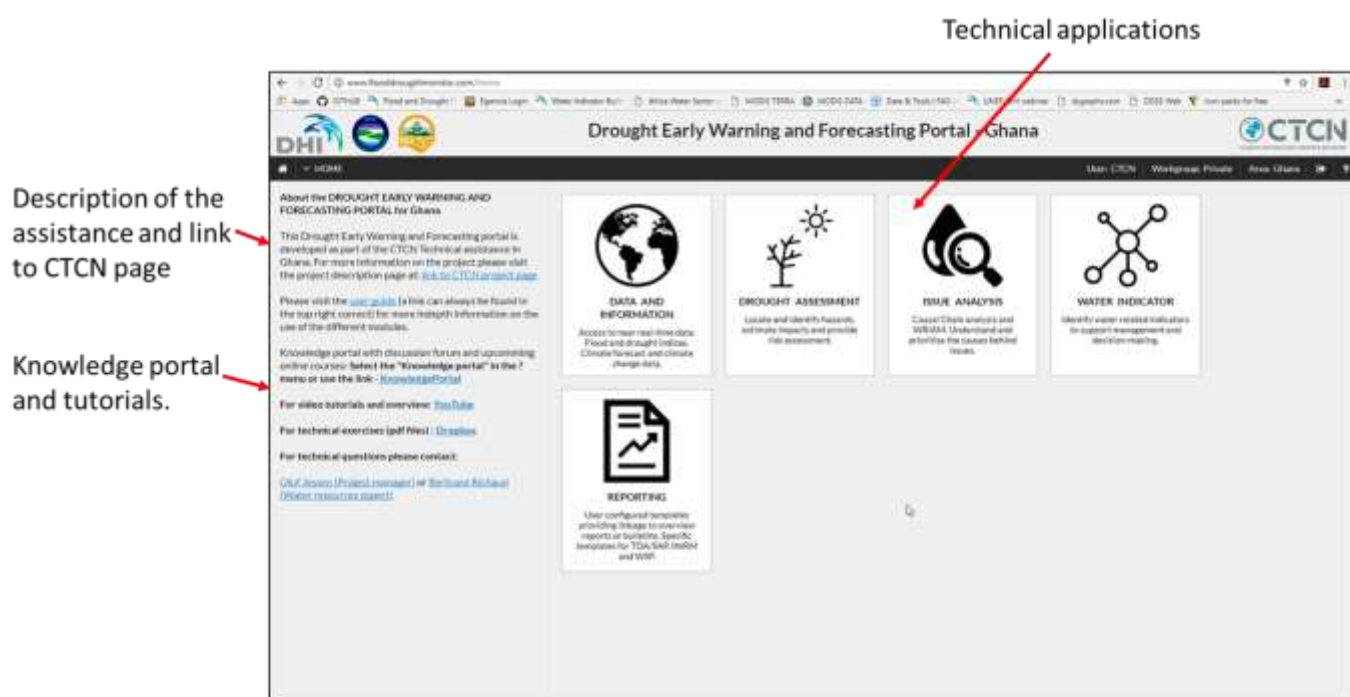


Figure 1 The Drought Early Warning and Forecasting Portal developed as part of the CTCN assistance (www.flooddroughtmonitor.com)

3.1.1 Registration and login

All stakeholders in Ghana will be able to register to the Drought Early Warning and Forecasting Portal by registering as a new user on the web site. There will be unlimited and free access to all stakeholders from Ghana.

3.1.1.1 Registration

The registration page can be accessed from this direct link

<http://www.flooddroughtmonitor.com/home?register=true&ug=CTCN>

Alternatively, users can connect to <http://www.flooddroughtmonitor.com>, and under Login page select the registration as follows:

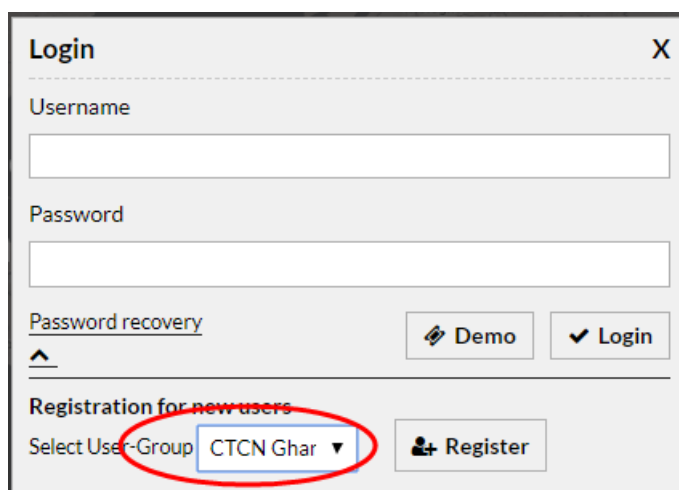


Figure 2 Registration page of the portal

In the registration page, user have to fill in their detailed information.

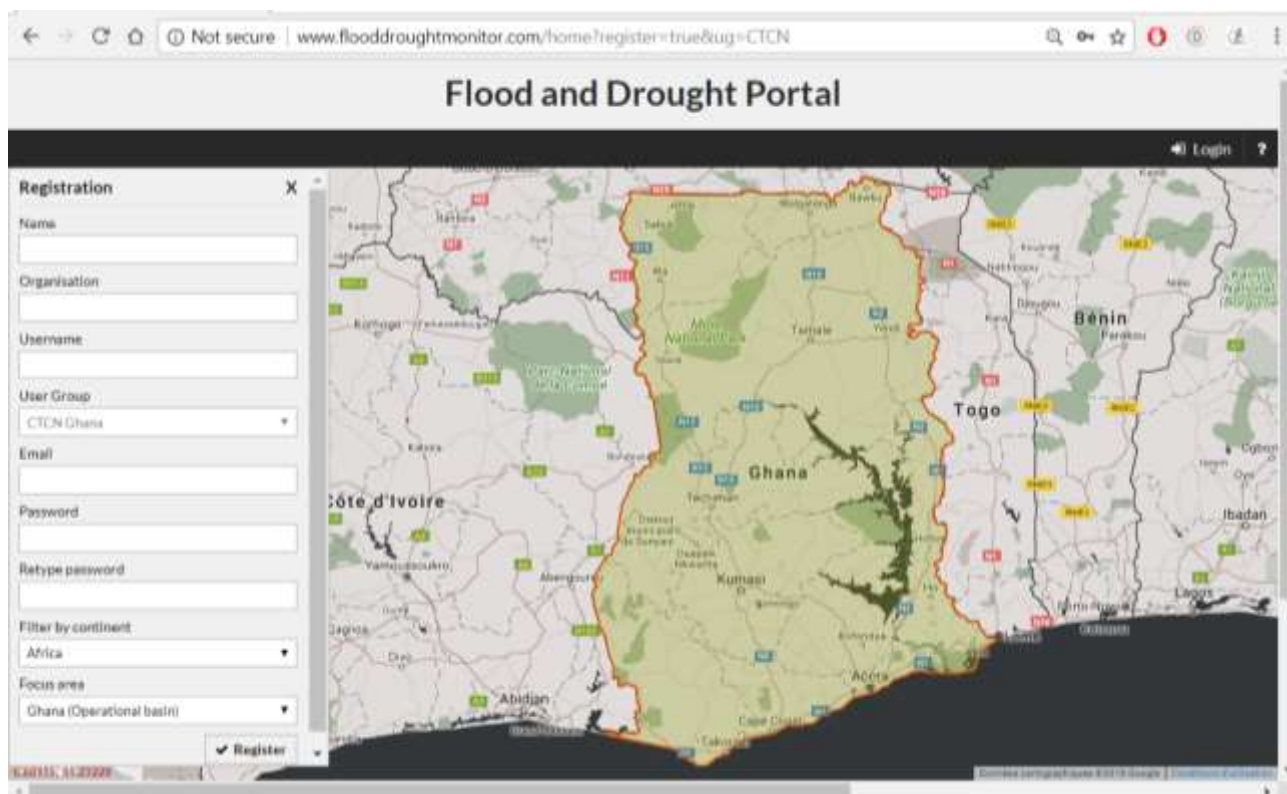


Figure 3 User registration page

3.1.1.2 Login

All user have a unique username associated to a password, which is used when logging to the portal.

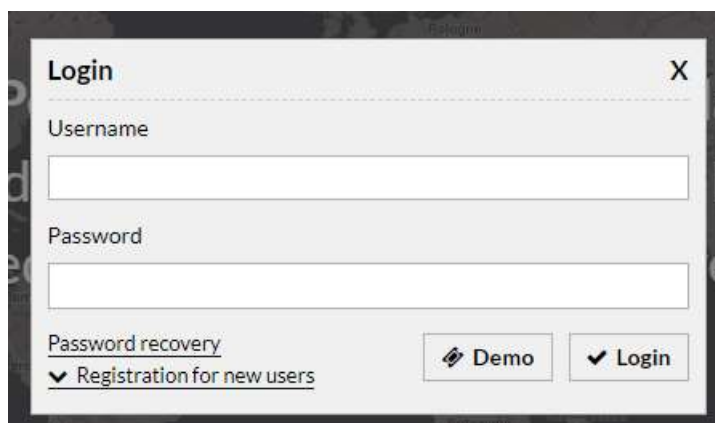


Figure 4 User login page

A password recovery function allows the user to receive his/her own password by email.

3.1.2 Support

Several means of support tools are available within the portal:

- **User guide:** this user guide is made available as PDF for online viewing and also in a print-friendly version
- **Training material:** all the training material are accessible directly from the home page
- **Knowledge portal:** this discussion forum allows all users to interact together and with the administrator of the system to post question or comment.

3.1.2.1 Access to this user guide

User guides are available through the main landing page – see the location to access it in Figure 5.

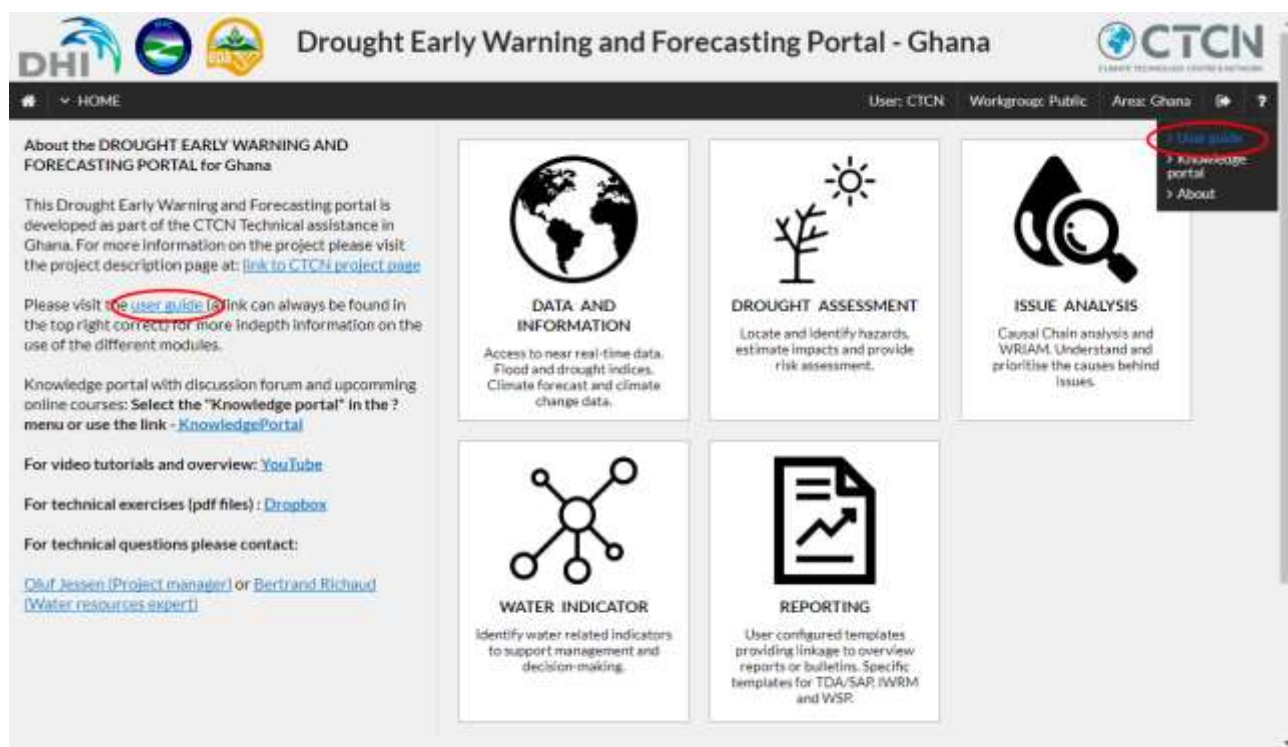


Figure 5 Access to user guide

3.1.2.2 Training material

The material used during the training courses consist of technical exercises and step-by-step guides. It is made available for viewing and can be accessed directly from the landing page of the portal - Figure 6

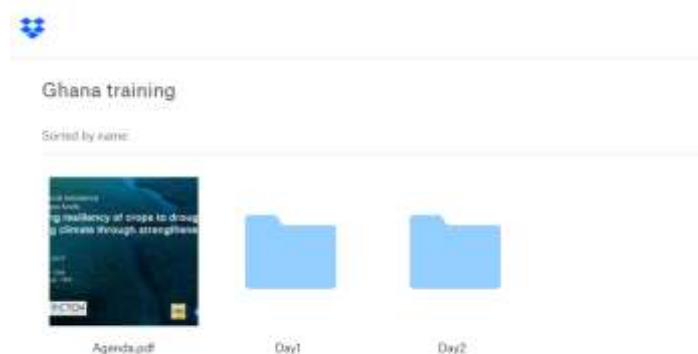


Figure 6 Training exercises

3.1.2.3 Knowledge portal

The Knowledge Portal, accessible from the web portal, allows users to share knowledge and experience within drought management and drought early warning in Ghana. Users are able to post a question, which will be visible for the other users in the system as well as being able to read previous postings by users.

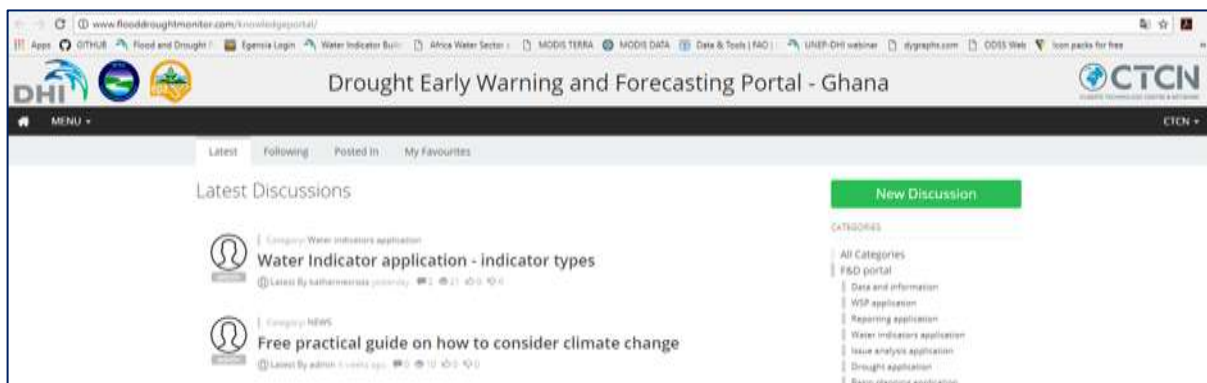


Figure 7 Knowledge Portal allowing users to share knowledge and experience

3.1.3 Applications

The Drought Early Warning and Forecasting Portal contains a number of applications all tailored to support the users within drought management and drought early warning. Each application is described in details to the participants through separate sessions. The available applications are:

- **Issue Analysis** – *Identify and prioritize the key environmental impacts from drought using a CCA and WRIAM approach*
- **Water Indicator** – *Identify relevant indicators for measuring the state of the causes for drought in Ghana*
- **Data and Information** – *Overview, understand and access available near real time data for drought assessment in Ghana*
- **Drought Assessment** – *Understand and implement workflow for drought early warning in Ghana*
- **Reporting** – *Access relevant status reports or bulletins regarding drought status in Ghana*

3.2 Issue Analysis

3.2.1 Background

The Issue Analysis application aims at analysing environmental issues and the causes behind the impacts from the environmental issues. The application is based on the Causal Chain Analysis (CCA) method and the Water Resource Issues Assessment Method (WRIAM).

The key objectives with the application is to:

1. Evaluate the key issues and assess the causes behind the associated environmental impacts
2. Prioritise the environmental impacts based on a rapid assessment (WRIAM)

The Issue Analysis application is intended for a workshop setting supporting the following outcomes:

- Understand the causes behind specific issues
- Able to target the planning towards the “deeper” causes
- Increase the efficiency of the planning process

3.2.1.1 Background to Causal Chain Analysis

Causal Chain Analysis (CCA), often also called Root Cause Analysis is closely related to systems thinking and the DPSIR approach.

At its most basic, a causal chain is an ordered sequence of events linking the causes of a problem with its effects. Each link in the causal chain is created by repeatedly answering the question Why? A simple schematic showing the major components of a CCA is shown below.

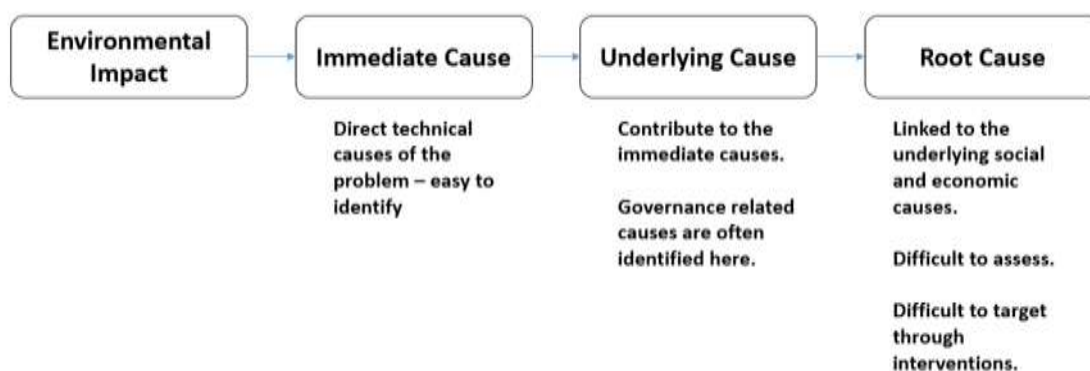


Figure 8 Main components of a CCA

Immediate Cause

Immediate or technical causes (sometimes known as primary causes) are usually the direct technical causes of the problem. They are predominantly tangible (e.g. enhanced nutrient inputs), and with distinct areas of impact (with the exception of causes such as atmospheric deposition or climate change).

Immediate causes, usually being technical in nature are the most straightforward to quantify, prioritise and geographically locate using maps.

Underlying Cause

Underlying causes are those that contribute to the immediate causes. They can broadly be defined as underlying resource uses and practices, and their related social and economic causes. Governance related causes are often identified here.

Resource uses and practices will tend to fall into areas such as:

- Land uses (reclamation/drainage operations, deforestation, agriculture etc.)

- Damaging or unsustainable practices (intensive livestock production, lack of treatment technology etc.)
- Uses of water (diversion, storage etc.)
- Lack of investment, operation and maintenance
- Poor awareness or education
- Governance failures, legislation, regulation or enforcement

Root Cause

Root causes are linked to the underlying social and economic causes and sectoral pressures but they are often related to fundamental aspects of macro-economy, demography, consumption patterns, environmental values, and access to information and democratic processes. Many of these may be beyond the scope of project interventions, but it is important to document them for two reasons:

1. Some proposed solutions might be unworkable if the root causes of the problem are overwhelming.
2. Actions taken nearer to the root causes are more likely to have a lasting impact on the problem

Root causes can be divided into the following categories:

- Climate change
- Population pressure and demographic change
- Poverty, wealth and inequality
- National, regional and international governance issues
- Education and formulation of values
- Social change and development biases
- Development models and national macro-economic policies

3.2.1.2 Background to WRIAM

The Water Resource Issues Assessment Method (WRIAM) has been conceived to allow the allocation of reasonably qualified, quantitative values to subjective judgements of the water resource issues, thus offering an evaluation of a given issue, which can be used for comparison with other issues and a record that can be re-assessed in the future.

The method is based on a standard definition of the important assessment criteria as well as the means, by which semi-quantitative values for each of these criteria can be assigned, with the aim of giving a precise and independent score for each issue.

The important assessment criteria fall into two groups:

- (A) Criteria related to the importance of the issue or effect, and which can individually change the score obtained considerably;

- (B) Criteria that are of value to the given situation, but individually have a lesser effect on the score obtained.

For group A, the overall scoring system was based on multiplying the scores allocated to each criterion. The principle of the multiplication is very important since it ensures that the weight of each score is expressed, whereas a summation of the scores could give identical results for groups of different scores.

Group A contains the following components:

- **Extent of the impact (4 to 0):** Transboundary, national, regional, local to no importance
- **Seriousness of the impact (3 to 0):** Major change, significant change, negative change to no change

For group B, the scoring system consists of adding the scores allotted to each criterion. This ensures that an individual score cannot influence the overall result very much. On the other hand, the summation ensures that the collective importance of all scores in group B is taken fully into account.

Group B contains the following components:

- **Permanence (3 to 1):** Permanent, temporary to no change
- **Irreversibility (3 to 1):** Irreversible, reversible to no change
- **Cumulative character (3 to 1):** Strong, moderate to light

For each issue, the score representing the importance of the issue is calculated as follows:

$$\text{Score} = (\text{Extent} \times \text{Seriousness}) \times (\text{Permanence} + \text{Irreversibility} + \text{Cumul. character})$$

The screenshot shows the 'ISSUE ANALYSIS' application interface. Callouts point to the following features:

- Overview and switch between issues:** Points to the 'Overview' button in the top toolbar.
- Create new issue for analysis:** Points to the 'New' button in the top toolbar.
- Clone current issue:** Points to the 'Clone' button in the top toolbar.
- Edit current issue:** Points to the 'Edit' button in the top toolbar.
- Delete current issue:** Points to the 'Delete' button in the top toolbar.
- User information:** Points to the 'User: oaj' text in the top right header.
- Workgroup management:** Points to the 'Workgroup: Public' text in the top right header.
- Result of analysis for specific issue:** Points to the 'Extent' column in the analysis table.
- Assessment score:** Points to the 'Score' column in the analysis table.

The main content area displays an issue titled 'Water quantity and seasonal flows' with a description: 'Relates to the availability of water across the basin for socio-economic and cultural uses.' Below this is the 'Issue analysis' table.

Immediate impact	Immediate cause	Underlying cause	Root cause	Extent	Seriousness	Permanence	Irreversibility	Cumulative character	Level of documentation	Score	Assessment
Loss of biodiversity	Creation of dams and impoundments	Unsustainable practices	Migration from rural to urban - urban growth	Regional/national	Significant change	Permanent	Irreversible	Moderate	Some	30	Negative impact
Water availability	Damming of the basin rivers, extensive water abstraction, intensive harvesting	Poor agricultural and livestock practices, inadequate legislation framework	Low level of education, poverty, climate change	Regional/national	Significant change	Temporary	Reversible	Moderate	Some	18	Moderate negative impact
Water scarcity	Transboundary issues	Land cover and poor precipitation	Poor water resource development and planning	National/international	Negative change	Permanent	Reversible	Light	Some	12	Moderate negative impact

Figure 9 Main functionality in the Issue Analysis application

3.2.2 Quick guide for first time user

This section contains a brief introduction of the Issue Analysis application for first time users. For a more detailed description, see Annex A.

3.2.2.1 Access the Issue Analysis application

The Issue Analysis app is accessible from the landing page by clicking on the icon “Issue Analysis”.

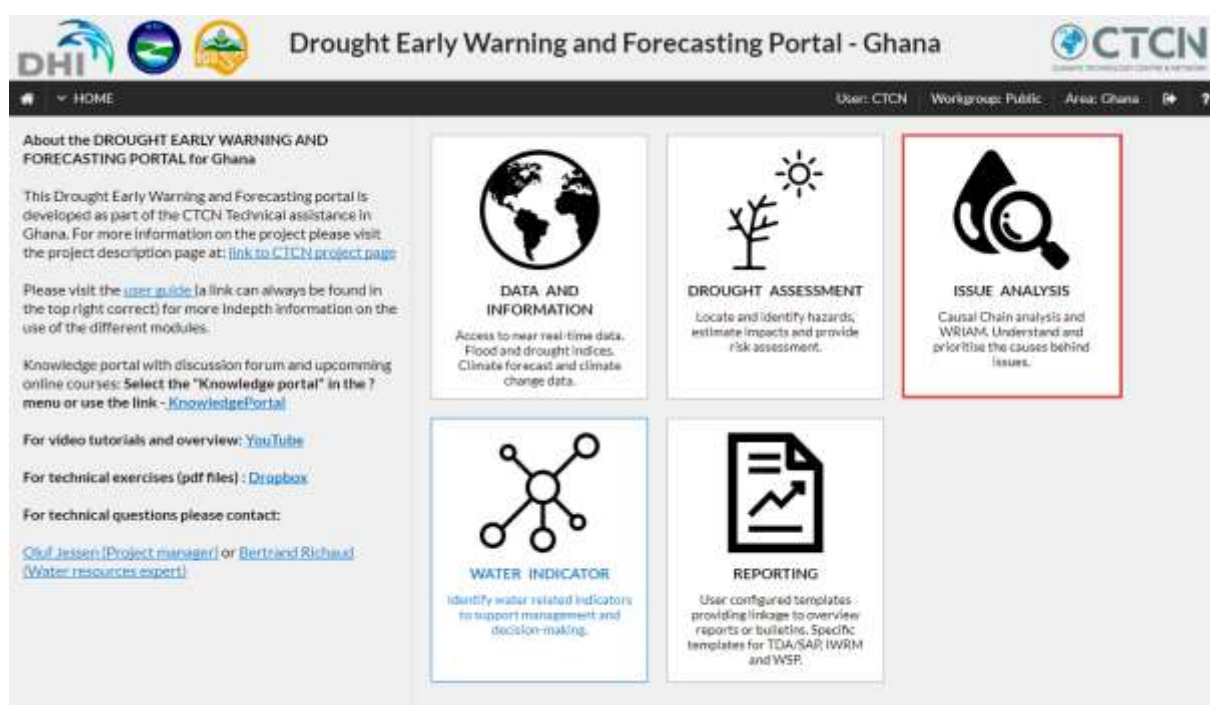


Figure 10 Issue Analysis application on the landing page

3.2.2.2 Overview or open an Issue

Click on “Overview” to view all the available Issues, the associated immediate impacts and the results of the rapid assessment. Click on an issue to open the connected Issue Analysis.

Issue overview		
	Immediate impact	Assessment
▶ water quality		
1 Introduction of pesticides		Moderate negative impact
▶ Water quality concerns		
1 Water quality degradation		Moderate negative impact
▶ Water quantity and seasonal flows		
1 Water availability		Moderate negative impact
2 Water scarcity		Moderate negative impact
3 Loss of biodiversity		Negative impact
▶ water unavailability		
1 low production of crops, fish, livestock		Negative impact
2 water users conflicts		Slight negative impact

Figure 11 Overview available Issues

3.2.2.3 Add Issue Analysis

Add a new Issue Analysis by clicking on the “Add” menu. This will open a dialog allowing the user to specify the parameters for the Issue Analysis. The following parameters are needed:

- **Immediate impact:** Describe the immediate impact
- **Immediate cause:** Describe the immediate cause
- **Underlying cause:** Describe the underlying cause
- **Root cause:** Describe the root cause
- **Extent:** Extent of the impact. Note that no impact will set group A score to zero.
- **Seriousness:** Seriousness of impact. Note that no change will set group A score to zero.
- **Permanence:** Specify if the impact is permanent or not
- **Irreversibility:** Specify if the impact if reversible or not.
- **Cumulative character:** Specify if the impact is cumulative or not
- **Level of documentation:** Specify the level of documentation. Please note that this is not included in the assessment.

Add
X

Immediate impact

General problem of use of water resources due to the presence of the water weeds

Immediate cause

Water bodies have a high amount of aquatic weeds

Underlying cause

Water bodies are highly polluted with nutrients from point and non-point sources

Root cause

Ineffective pollution control measures, non enforcement of regulations pertaining to pollution control in rivers and poor farming practices

Extent

Regional/national

Seriousness

Significant change

Permanence

Temporary

Irreversibility

Irreversible

Cumulative character

Moderate

Level of documentation

None

Update

Figure 12 Add Issue Analysis

3.3 Water Indicators

3.3.1 Background

The main objective for indicators is to enable or promote information exchange regarding the issue they address. An example of a simple indicator and often used indicator is our body temperature to monitor our health.

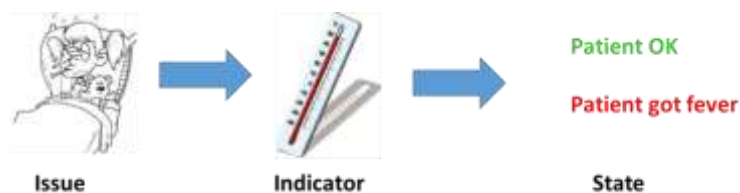


Figure 13 Indicator example

Based on the state (the patient is fine or has a fever), you can decide what action to take to improve the situation (e.g. go to the hospital, take medicine, do nothing).

Water indicators can be used to understand the current state of water resources, the changes in these resources and whether or not interventions in a river basin produce the desired effect (e.g. reducing the number of people affected by flooding). The results from gathering information around a specific indicator can be both in the form of maps and graphs.

Although indicators are critical to understand what is happening in a system (river basin, water supply system, etc.), there are a large number (literally thousands) and information is often not complete. Furthermore, it should be noted, that ideal indicators may not be practical; the feasibility of using certain indicators can be constrained by the availability of data and financial and human resources.

A useful indicator should be:

- relevant for monitoring the state or the pressure of the issue
- easy to interpret
- able to give information on the current status and the status in relation to the historical change
- based on available data or information

Also, the more defined an indicator is, the less room there will be for later confusion or complications.

The Water Indicator application which has been developed as part of the **Flood and Drought Management Tools project** can help users identify water related indicators to understand the current state of water resources, the changes in these resources and whether or not interventions produce the desired effect.

The application provides the following support:

- Assists user in selecting relevant indicators based on a specific issue
- Used as a learning tool for basin or catchment organisations/other users

- Provides a starting point through a default indicator framework that can be adjusted and complemented to match user needs
- Provides an online tool for stakeholders to share their indicator frameworks with others to allow for consistency (it helps if you are all measuring the same thing)
- Used as a tool for storing indicator information to support the design of decision support systems (DSS).

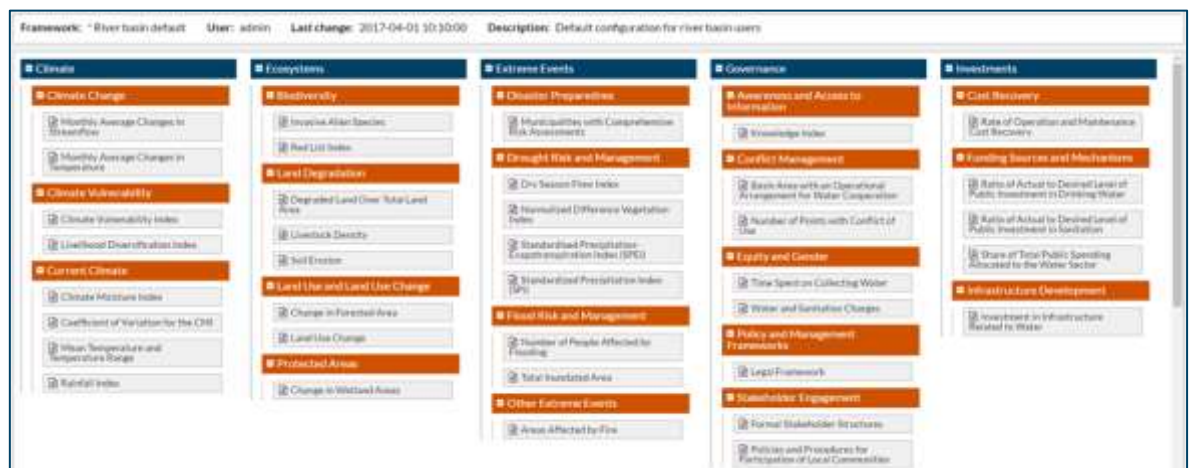


Figure 14 Example of default framework for river basin planning

3.3.2 Quick guide for first time user

This section contains a brief introduction to the Water Indicator application for first time users. For a more detailed description, see Annex B.

3.3.2.1 Access the Water Indicator application

The Water Indicator app is accessible from the landing page by clicking on the icon “Water Indicator”.

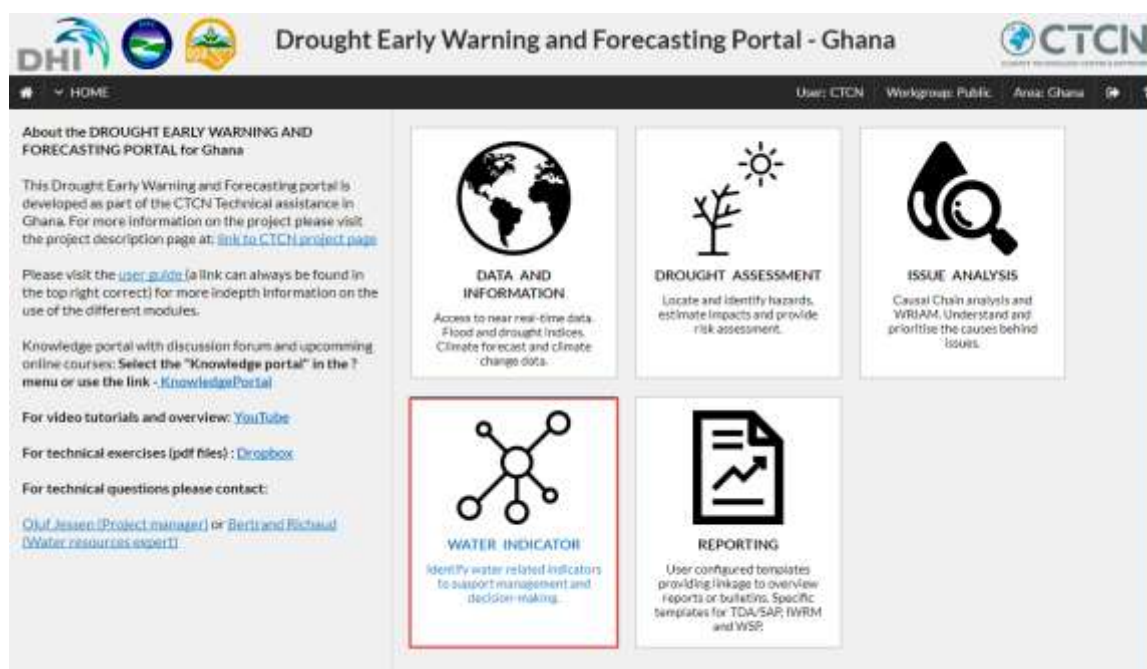


Figure 15 Water Indicator application on the landing page

3.3.2.2 Key content

The Water Indicator application is based on Indicators and Indicator Frameworks.

Indicator

The Water Indicator application contains a large number of indicators or descriptions of indicators. The Indicators are described using the following items (see Figure 20):

- **Name:** Name of the indicator
- **User:** user creating or uploading the indicator
- **Description:** brief description of the indicator
- **Keywords:** keywords or tags describing the use of the indicator. Keywords are used to search for indicators
- **Metadata sheet:** pdf document containing a detailed description of the indicator

Indicator Framework

An Indicator Framework is a tabular description of the linkage between environmental issues and indicators used to monitor the state of the issues. The environmental issues are divided into main and sub-groups. The Water Indicator application contains a number of default Indicator

Frameworks, available for all users, and users are also able to create their own Indicator Frameworks (see Figure 19).

3.3.2.3 View Indicator Framework

Existing Indicator Frameworks are available using the “Open” menu in the Framework tab. The “Open” menu will list all Indicator Frameworks available for the current user. Note that Frameworks with a “*” are default Indicator Frameworks (view and clone for all users).

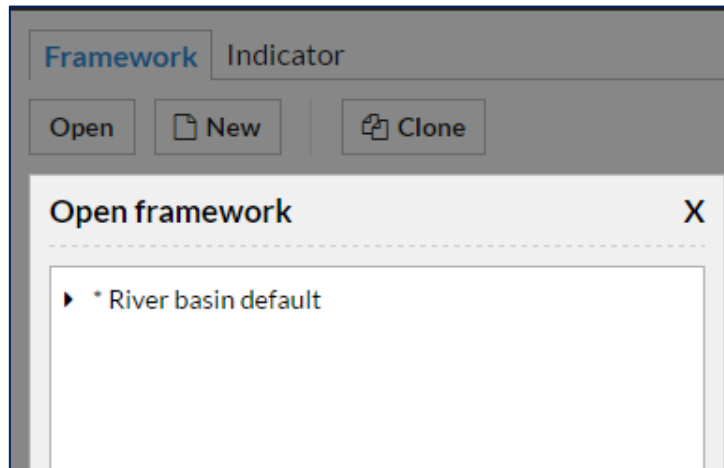


Figure 16 Open available indicator frameworks

3.3.2.4 View Indicator sheet

Indicator sheets or metadata sheets are available by i) clicking on the indicator in the Indicator Framework or ii) by clicking on the metadata sheet in the indicator list (in the Indicator tab).

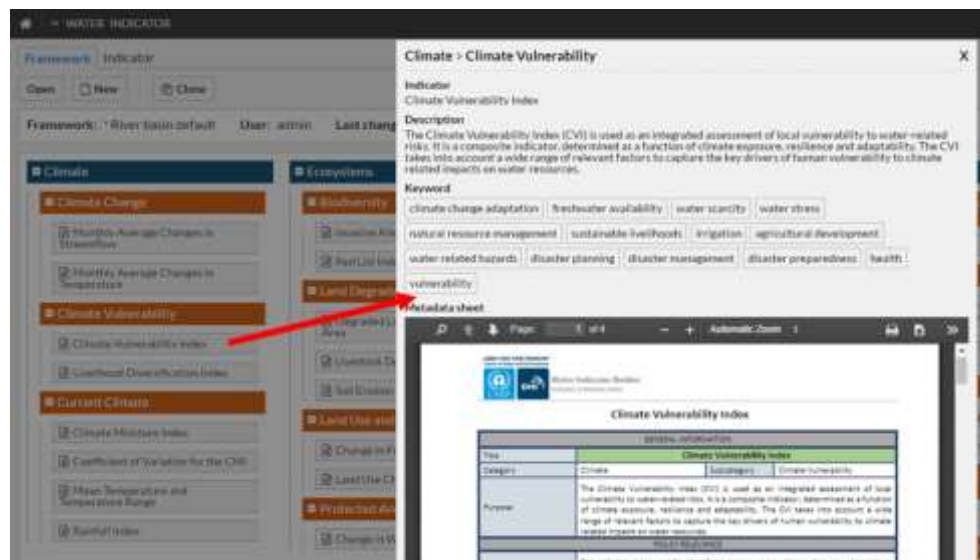


Figure 17 Open indicator sheet

3.3.2.5 Search for indicator

The user is able to search for indicators in the following way:

- **Indicator tab:** type a search name in the search box and click “search”. The search will use the keywords and all indicators containing the search item in the keywords will appear.
- **Indicator tab:** Click on a keyword to view all indicators containing the same keyword
- **Framework tab:** Open an indicator and click on a keyword. This will open the Indicator tab and list all indicators containing the same keyword.



Figure 18 Search for indicator

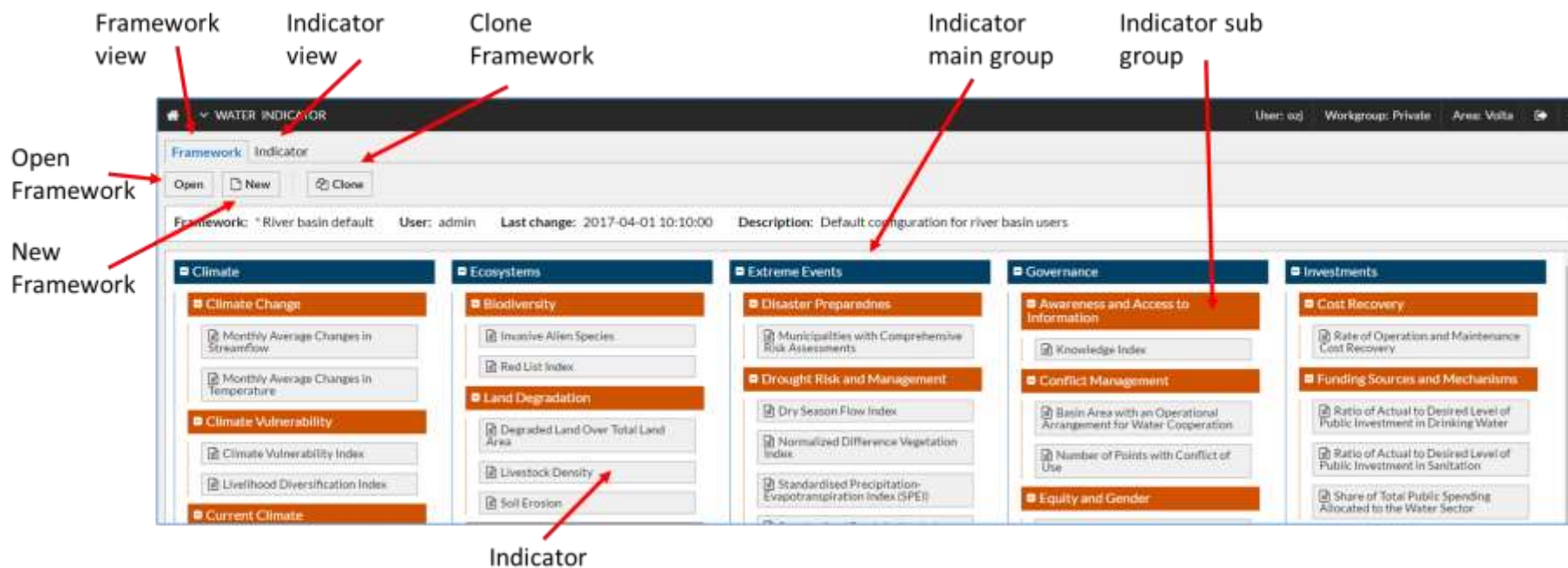


Figure 19 Main functionality in the Framework tab

Framework view Indicator view

New Indicator

Show all Indicators Indicator search

Name	User	Description	Keyword	Metadata sheet
Agriculture Withdrawals	admin	This indicator measures total water withdrawals used for agricultural purposes, including irrigation and livestock watering, as share of total withdrawals. It gives an indication the importance of agriculture in the country's/basin's water balance.	Agricultural water requirements Irrigation water demand livestock watering livestock production water stress water scarcity climate change vulnerability irrigation water efficiency drought planning drought preparedness food security agricultural development rural livelihoods water allocation agricultural water pollution	Agriculture water withdrawals_Aug2016.pdf
Area Irrigated by Groundwater	admin	This indicator calculates the share of total irrigated land which is irrigated by groundwater, which gives an indication of the dependence on groundwater for the irrigation of agricultural land.	Agricultural water demand Irrigation water demand water stress; water scarcity climate change vulnerability Irrigation water efficiency soil moisture soil quality food security	Area Irrigated by Groundwater_Aug2016.pdf

Indicator keywords

Figure 20 Main functionality in the Indicator tab

3.4 Data and Information

3.4.1 Background

This section contains a brief introduction to the **Data and Information** application for first time users. For a more detailed description see Annex C, where the specific data types are described in details.

3.4.2 Quick guide for first time user

3.4.2.1 Access the Data and Information application

The Data and Information app is accessible from the landing page by clicking on the icon “Data and Information”.

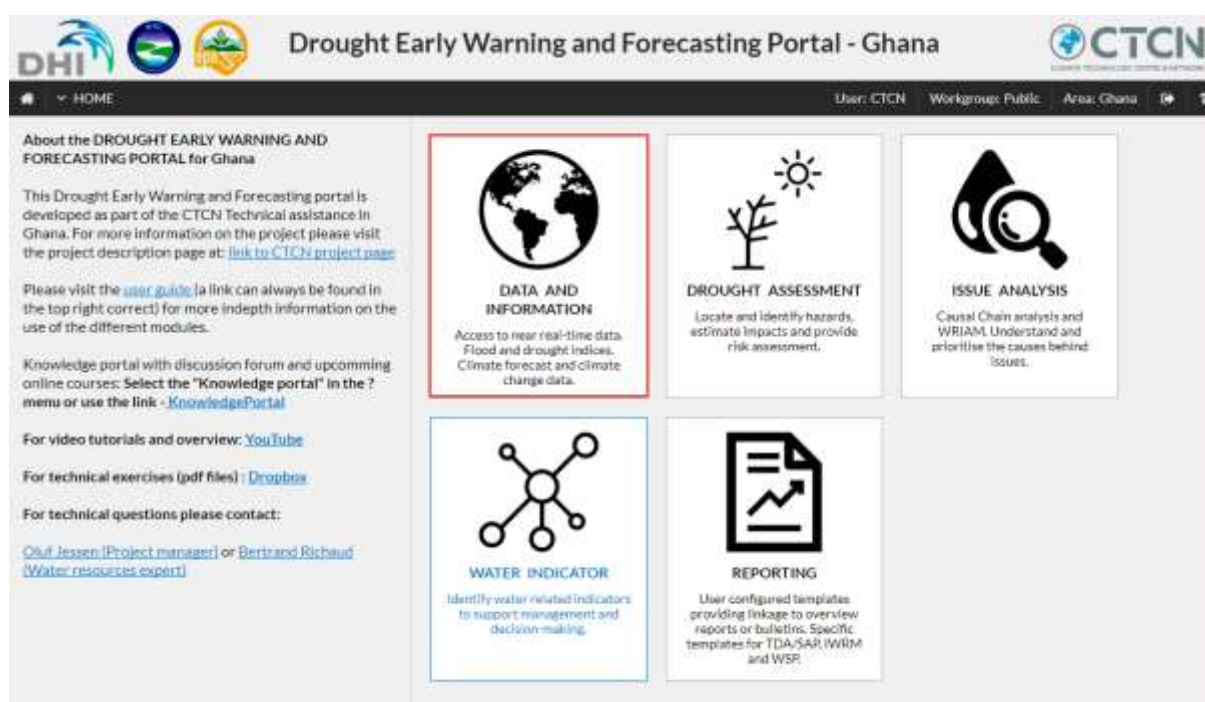


Figure 21 Data and Information application on the landing page

3.4.2.2 Select data to view or analyse

Once you have logged in, the available data types are listed in the *Select* menu. Open the *Select* menu to select, which should be made available (this selection can be changed later on).



Figure 22 Select menu

The selected data will be available for viewing, download and analysis. Note that it is **ONLY** the data selected in the Select menu that are available for further processing.

See section Annex C for a detailed description of the available data.

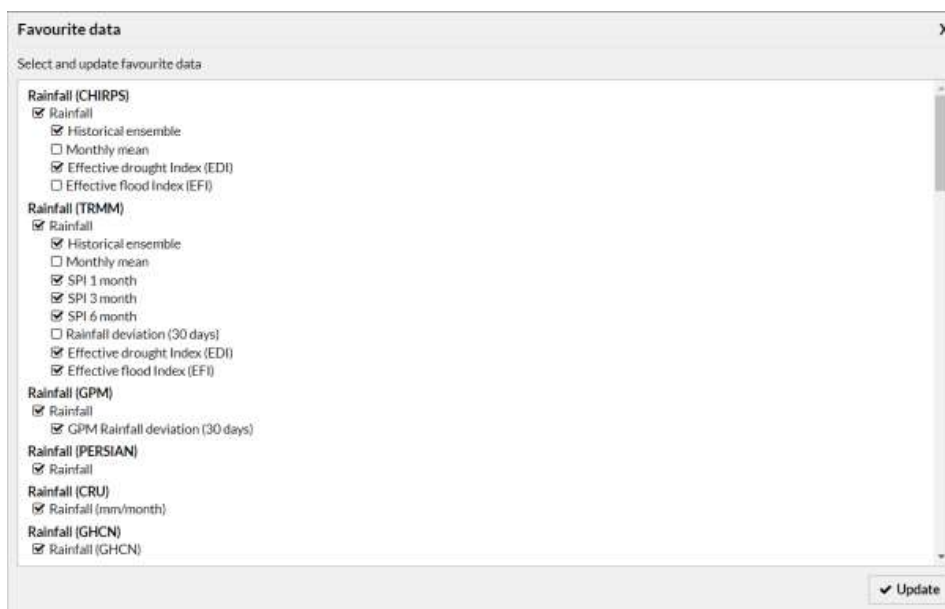


Figure 23 Selection the favourite data to work with

3.4.2.3 View data

The selected data could be viewed from the *Data* tab, which allows you to view each time step of a selected data type.

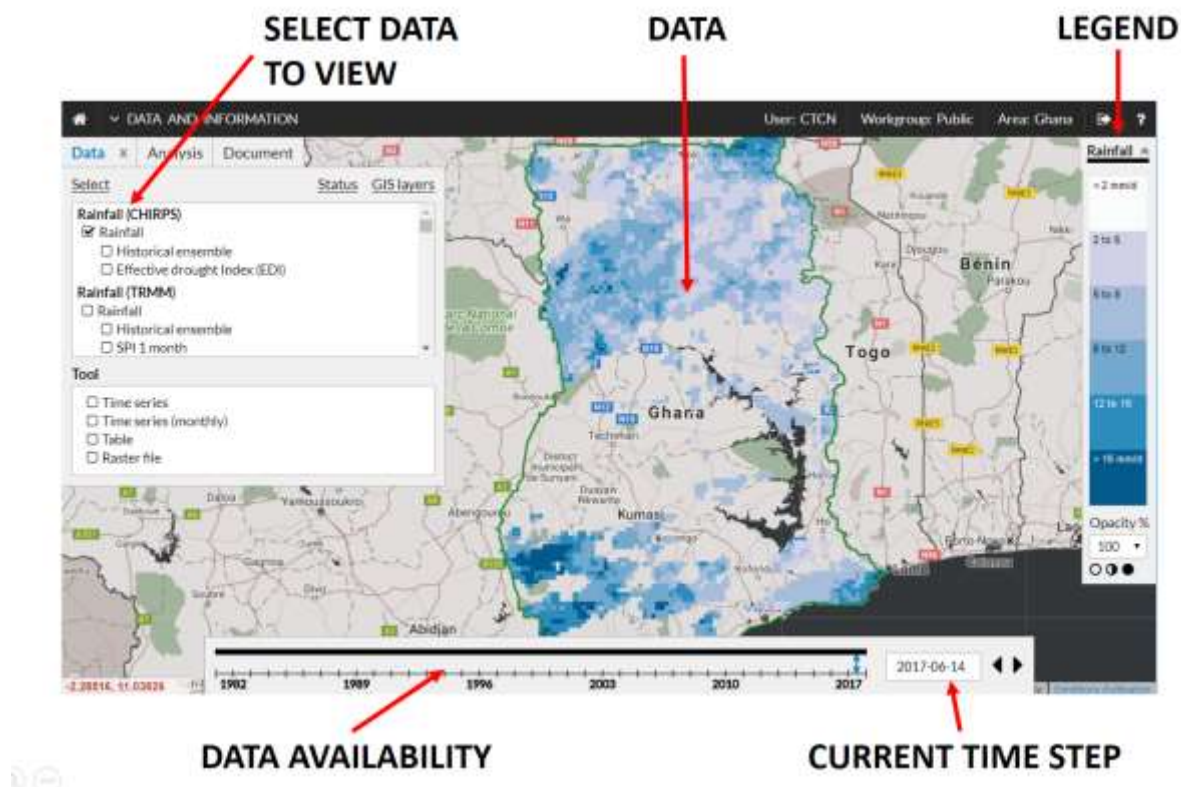


Figure 24 View data from the Layer menu

3.4.2.4 Download data as netcdf files

The tools menu is used to download and process the selected data. Use the tool called "Raster file" to download any of the available data files as a netcdf file. To download a data file:

- Select the layer you would like to download data from
- Select the *Raster File* under the *Tools* section
- Specify the period and press *Download*
- Then on the following dialog showing the file size, and the file name, press *Download*.

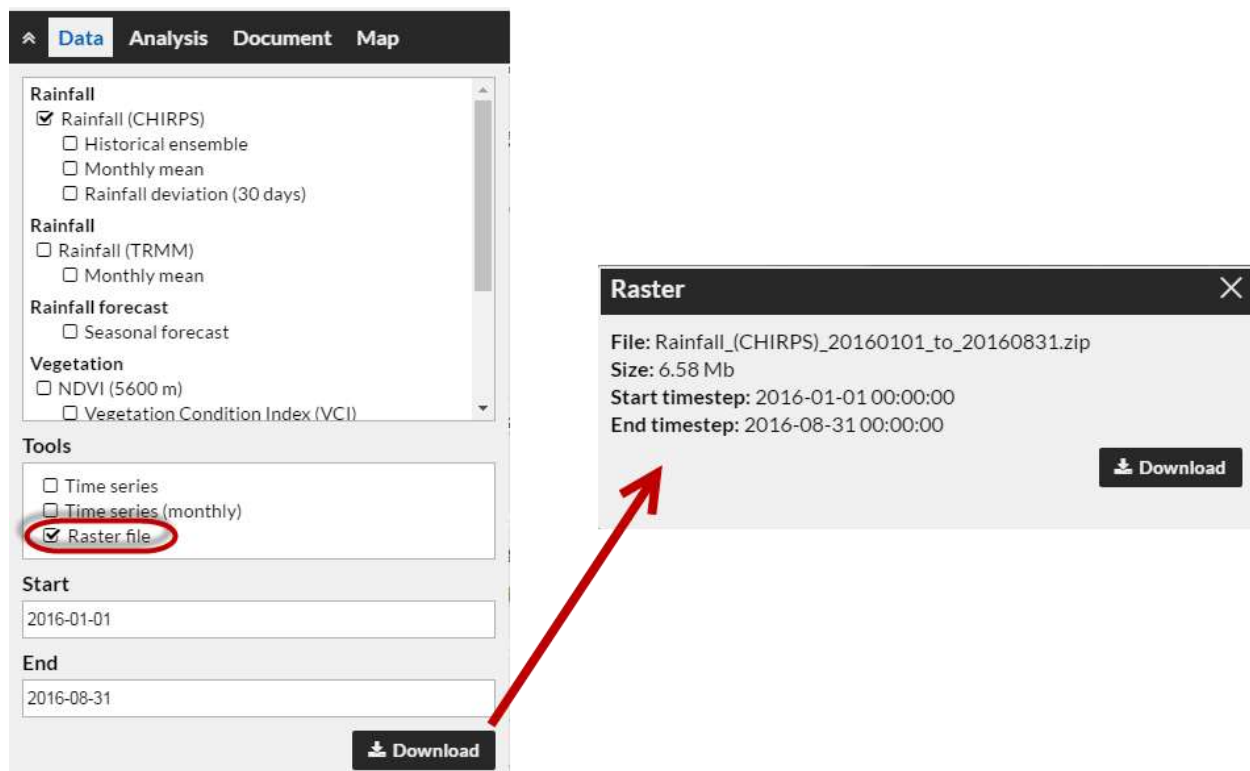


Figure 25 Download data as netcdf files

Note: the zip file contains the raster as .nc file, which can be open in most GIS tools. In addition, a legend file as .qml are associated to the .nc file. This legend file can be used in QGIS to load the default symbology.

3.4.2.5 View or download time series

The tools menu contains a number of different options for processing and analysing the selected data types. Data can be extracted at different spatial resolutions from the entire focus area to point locations, and can be presented as time series, envelope plots or chart plots.

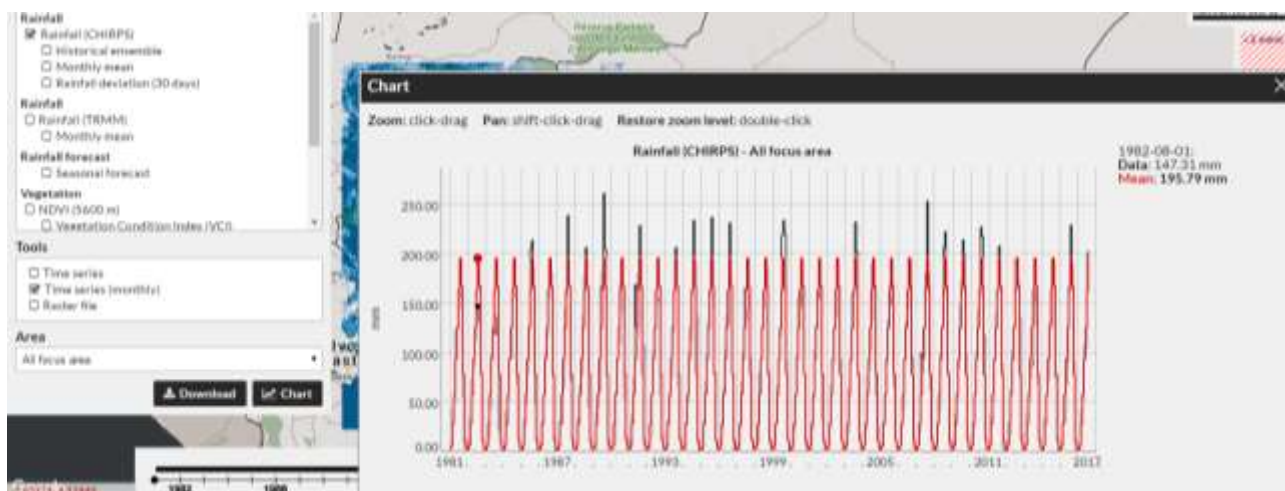


Figure 26 View or download time series

3.5 Drought Assessment

3.5.1 Background

Drought early warning systems are an important component of the risk management part of the drought management process as highlighted in Figure 27. It provides an identification of a current or upcoming hazard and provides an assessment of the associated risk related to the hazards.

The main objective of a drought early warning system is to detect when and if a drought hazard might occur and the location and severity of the hazard. Drought warnings could be expressed based on the hazard itself or on the associated risk towards specific vulnerable sectors or areas.

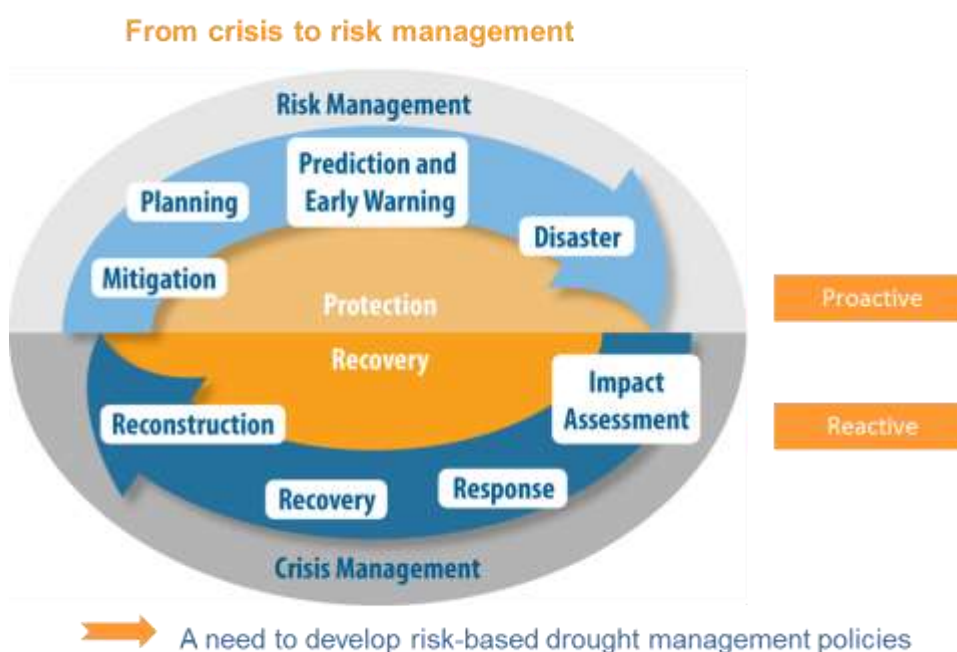


Figure 27 Drought management (adapted from (Center National Drought Mitigation, u.d.))

The identification of the timing and location of a drought event is the first step in a drought assessment or drought management process. The impact assessment aims at quantifying how the identified hazards affect specific areas or sectors exposed to this hazard.

The vulnerability analysis provides a mean for analysing the causes behind the drought impact and the priority of these causes. This is an important step for increasing the effectiveness of drought risk management as it provides the means for drought interventions or mitigations measures to be targeted specifically against the underlying causes for the drought impact.

The risk is expressed based on the vulnerability towards the impact from a specific hazard, or as the likelihood of harm, loss or disaster for a specific drought related hazard (see illustration in Figure 28).

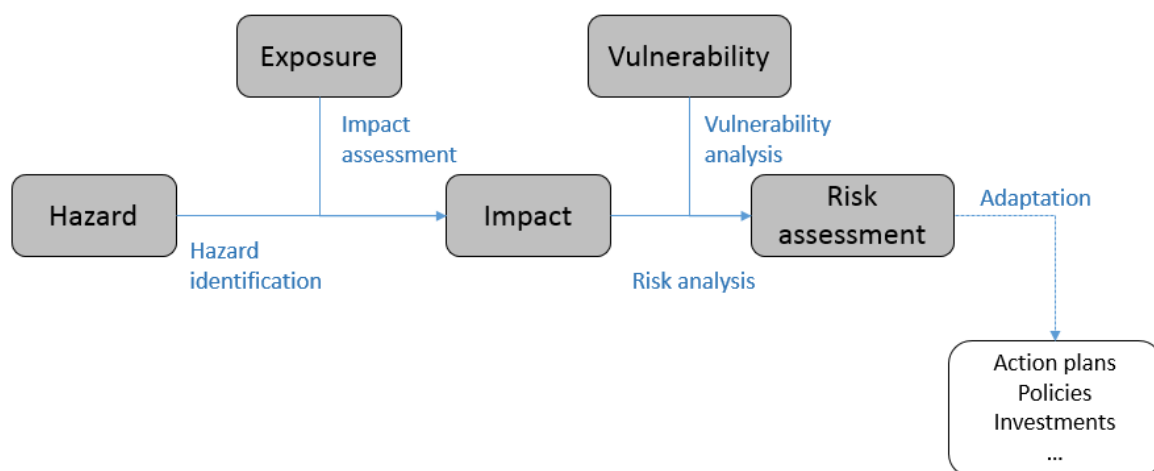


Figure 28 Risk assessment workflow

3.5.1.1 Hazard identification

The identification of the timing and location of a drought event is the first step in a drought assessment or drought management process. It is typically based on different types of drought indices each representing the state of a specific drought related issue at different times. Drought indices could cover the entire spectrum of drought types: meteorological, agricultural and hydrological drought (see Figure 29).

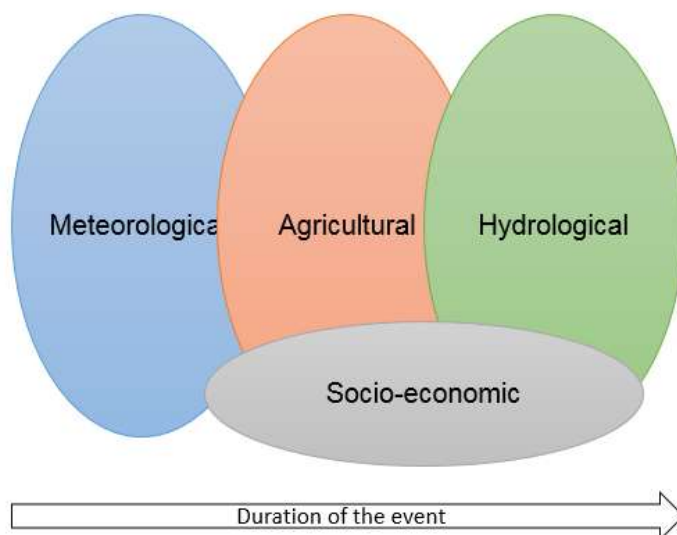


Figure 29 Different types of drought indices

An example could be climate based drought indices describing the state of meteorological drought. The specific drought indices to be included should be based on locally accepted indices as well as scientific sound and validated indices.

Examples of drought indices:

- Rainfall deviation expressed through the standardized precipitation index (SPI),

- Crop related drought hazard described through the vegetation condition index (VCI).

The key requirement is that the indices should represent the current or future state, hence should be available in close to real time or as forecasted values. Spatially distributed indices are often a requirement as well, as the location of the drought hazard is critical. Exceptions would be indices related to specific locations as reservoirs, lakes, rivers etc.

3.5.1.2 Exposure

The exposure to drought relates to the identification of sectors or areas particularly sensitive to drought through impacts or consequences such as reduced crop yield, livestock losses, socio-economic impacts or reservoir depletion. Examples of areas exposed to drought could be rainfed agricultural areas or urban areas relying on surface water resources. The exposure would often be illustrated in the form of GIS shape files or raster maps delineating areas of specific exposure.

3.5.1.3 Hazard categories

In order to express the severity of the drought hazard, drought categories are often used to classify the severity and impact of the hazard. The classification for drought categories could be inspired from the US drought monitor system using drought categories from D0 (abnormally dry) to D4 (Exceptional drought) (for more information see Figure 30).

Category	Description	Impact
Normal	Normal	<i>Normal conditions</i>
D0	Abnormally Dry	<i>Short-term dryness some water deficit</i>
D1	Moderate Drought	<i>Some damage to crops</i>
D2	Severe Drought	<i>Crop or pasture losses likely; water shortages common</i>
D3	Extreme Drought	<i>Major crop/pasture losses; widespread water shortages</i>
D4	Exceptional Drought	<i>Exceptional and widespread crop/pasture losses</i>

Source: U.S. Drought Monitor Classification Scheme

Figure 30 Drought classification scheme (National Drought Mitigation Center, u.d.)

3.5.1.4 Impact assessment

The impact assessment aims at quantifying how the identified hazards affects specific areas or sectors exposed to this hazard. The outcome will describe how specific drought related hazards impact e.g. the agricultural production or the water supply. Impact could be expressed in terms of direct losses, or changes but also in terms of hazard or drought categories within a specific exposed area.

A typical way to illustrate the drought impact is through the use of drought categories where the areas within specific drought categories are calculated and presented in tables. The impact would be divided into exposed categories, e.g. rainfed areas, urban areas etc.

The correlation between drought categories and specific impacts would often be assessed through a regression analysis looking at the correlation between past drought events and the impact.

3.5.1.5 Risk analysis

The risk will be expressed based on the vulnerability towards the impact from a specific hazard, or as the likelihood of harm, loss or disaster for a specific drought related hazard.

Risk is defined as the likelihood of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions (UN-ISDR, 2009, EC, 2011). The risk analysis will identify areas or groups at different risk levels, which will be the targets for the following adaptation or mitigation planning.

Risk is often expressed as hazard x vulnerability.

3.5.2 Quick guide for first time user

This section contains a brief introduction for first time users. For a more detailed description, see Annex D.

3.5.2.1 Access to the Drought Assessment application

The Drought assessment app is accessible from the landing page by clicking on the “Drought assessment” icon.

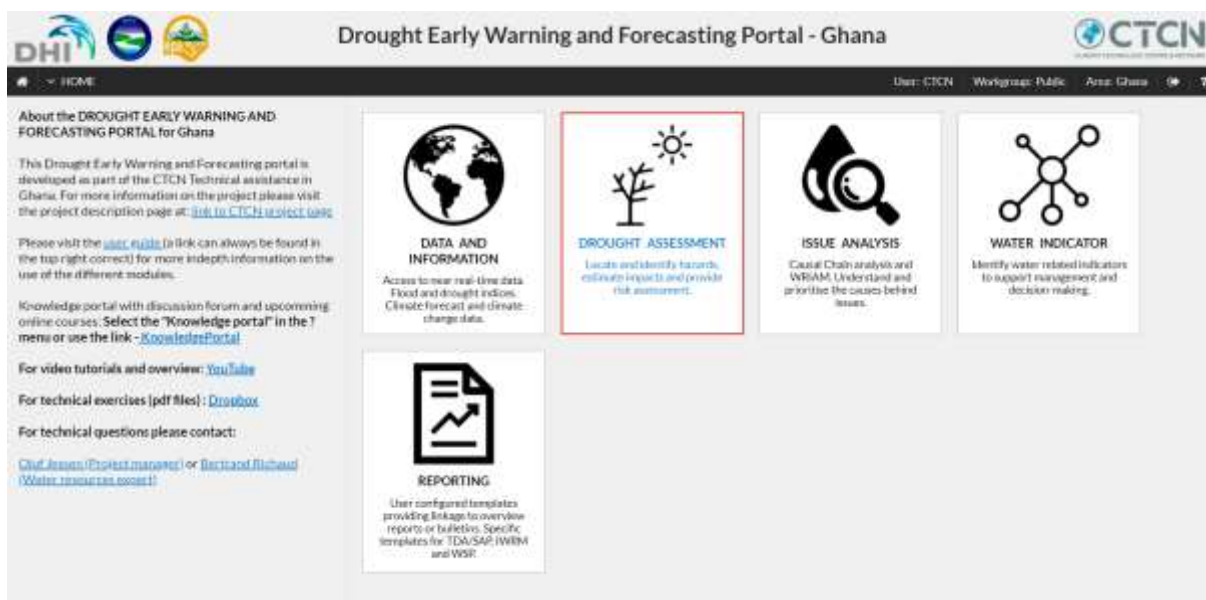


Figure 31 Drought Assessment application on the landing page

3.5.2.2 Main content

The Drought Assessment app is a map based application, which has two main menus:

- Drought Warning

- Drought Risk

Drought Warning

The Drought Warning page allows the user to select a specific layer and apply a threshold value to highlight the areas that are affected by a specific hazard.

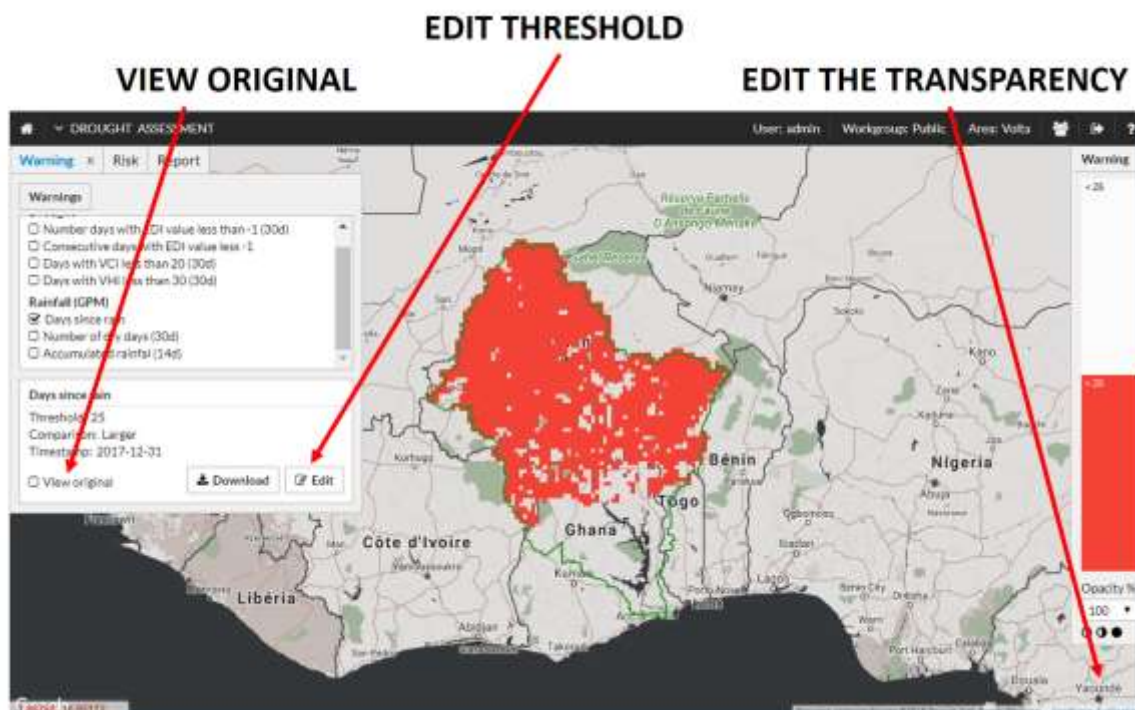
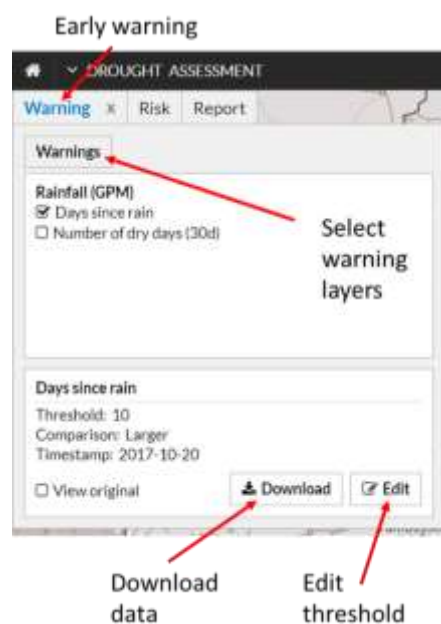


Figure 32 Drought Warning page of the Drought Assessment app

Warnings: The selection of layer is done by clicking on the Warning button. The selected layers will then appear in the tree view. It is always possible to edit them later.

Edit: This is to edit the user-defined warning level. The Edit button is used to edit the threshold value as well as the comparison type to be applied on the hazard. The maps is instantaneously updated.

View original: This allows the user to view on the map the original hazard layer without applying any warning level.



Drought Risk

The drought risk page provides an interface to assess risk based on hazards and vulnerability. The main output of this page is a map with overlaid hazard and vulnerability.

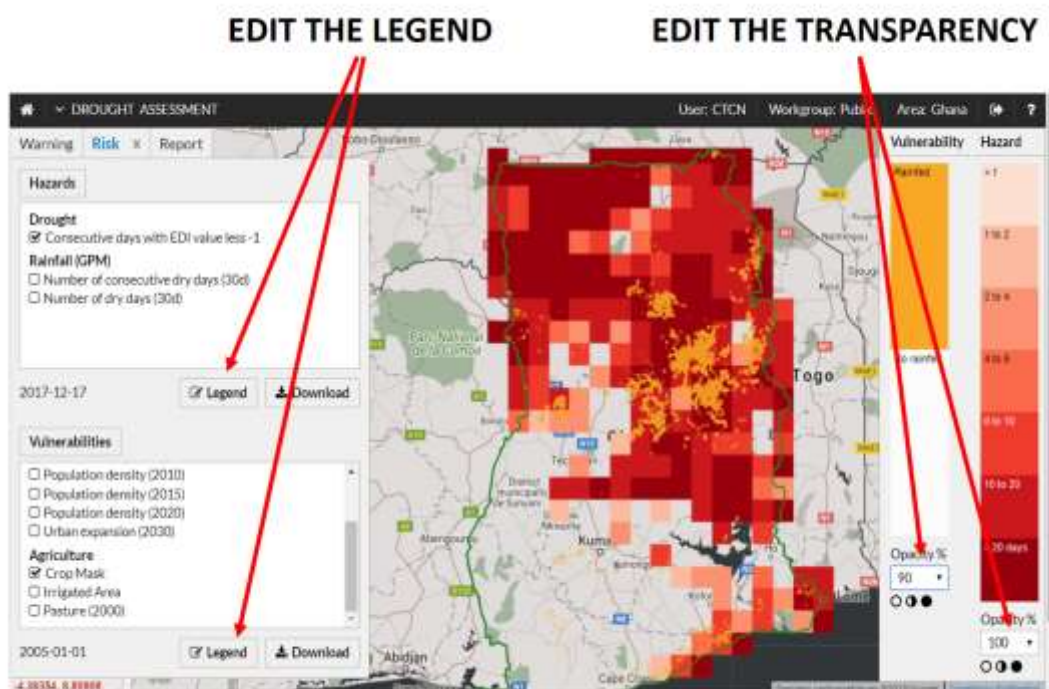


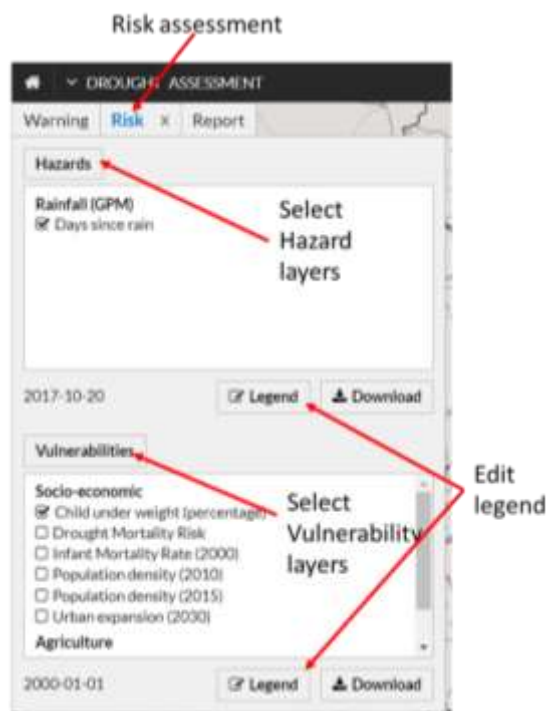
Figure 33 Drought Risk page of the Drought Assessment application

Hazards:

- **Layer:** layers for the hazard can be selected from a list.
- **Legend:** the user is able to edit the color code and values in the legend

Vulnerabilities:

- **Layer:** layers for the vulnerabilities can be selected from a list.
- **Legend:** the user is able to edit the color code and values in the legend



3.6 Reporting

3.6.1 Background

Dissemination in the form of reports or bulletins are critical in relation to planning as this enables the decision or policy makers to disseminate the actual plans or the background for the decision process to stakeholders. The content and format of the dissemination depends to a large extent on the specific content of the decision and the intended receiver of the report or bulletin. In some cases the reports or bulletins need to be very detailed with technical content and in other cases it should highlight the key issues using non-technical terms. For this reason the reporting application is based on a process allowing the user to select between a number of default reports, or develop their own reports based on the specific requirements.

The reporting application is based on reporting templates (Word documents) containing a number of tags, where the user is able to specify which type of content the reporting application should replace the tags with. Currently the tags could be replaced with images, text, charts or tables.

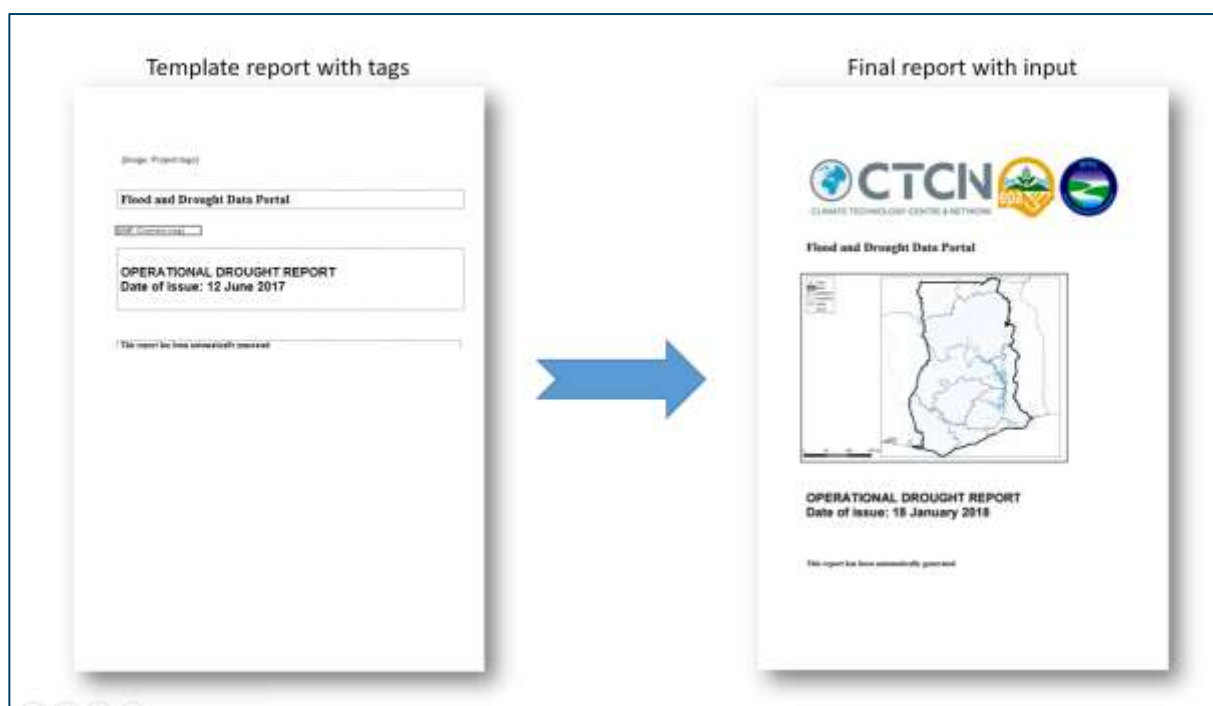


Figure 34 Template report with tags and final report with input in the form of images, chart or text replacing the tags

3.6.1.1 Template reports and tags

Template reports are one of the key features in the Reporting application. A template report is a Word document (docx file) containing the overall framework of the report. The Reporting application is able to insert objects in the form of images, text, chart or tables at user specified locations in the template report, and converting the template report into a final report containing for example tables with the latest climate information, drought hazards or other information from the Flood and Drought Portal.

The location of the inserted objects (images, text, chart or tables) are specified by adding tags in the report, where a tag is specified by brackets (start and end bracket) with a text in between, e.g. "{this is a reporting tag}". See Figure 35 for an example of a reporting template with reporting tags.

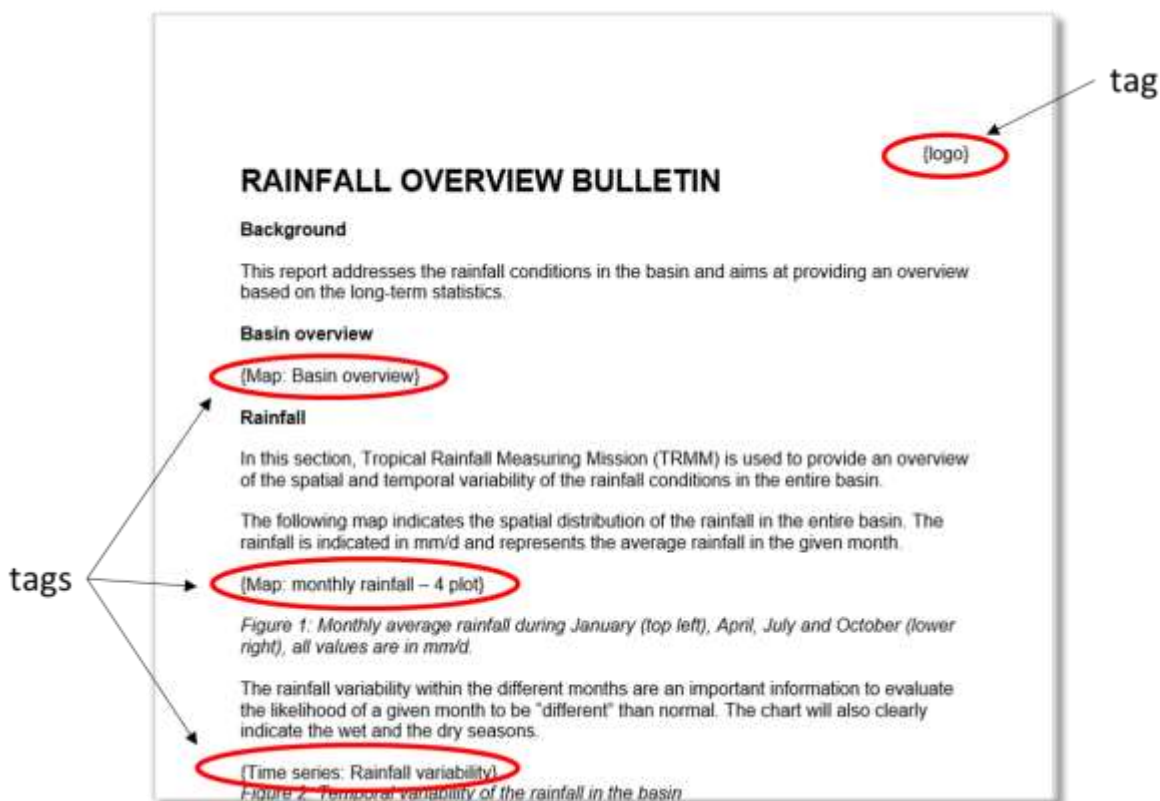


Figure 35 Example of a template reports with reporting tags

When loading the reporting template in the Reporting application, all tags are listed and the user is able to specify what the reporting application should insert instead of each tag (images, text, chart or tables). See Figure 36 for an example.

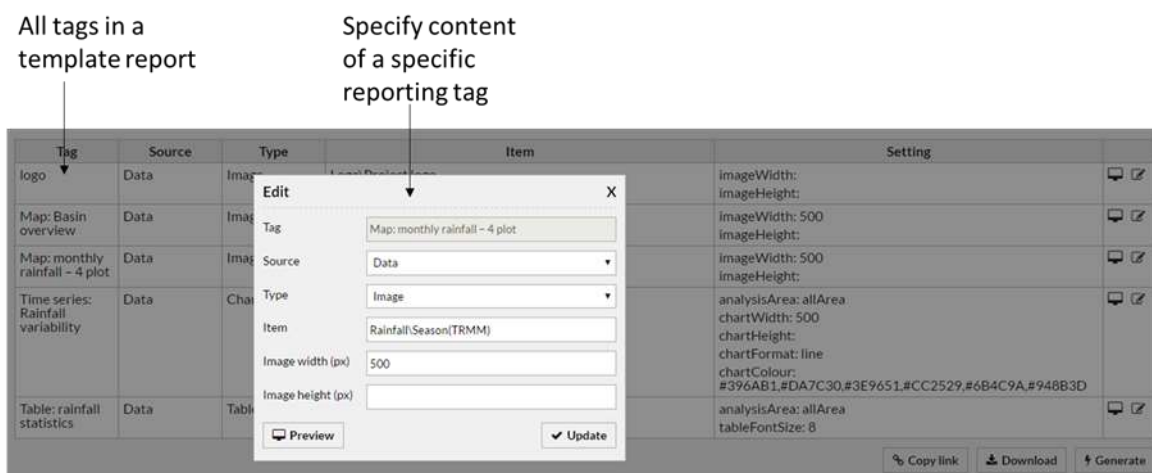


Figure 36 Example of how tags are converted to reporting objects within the Reporting application

3.6.1.2 Automated reporting

Another feature of the Reporting application is the ability of generating reports automatically based on a user-defined schedule. Reports will be generated automatically – without any user action – based on the latest data available. A notification email will also be sent to all the recipients of the report. The email will contain a link to download the latest version of the report.

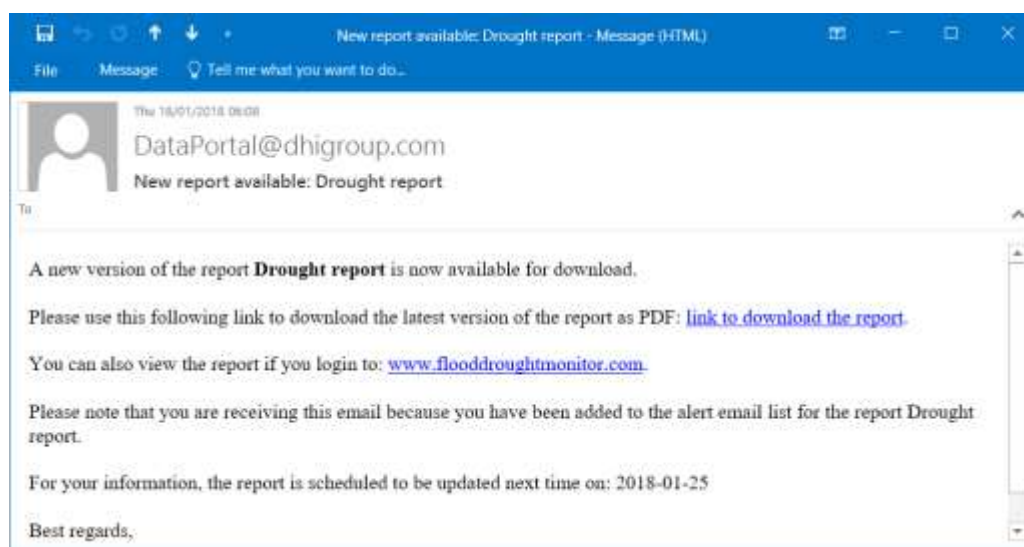


Figure 37 Example of an email notification when a new report has been generated.

3.6.2 Quick guide for first time user

This section contains a brief introduction for first time users. For a more detailed description, see Annex E.

This section explains how to use one of the default reporting templates built in to the system. For description on how to make a new report or upload user specific content, please refer to the following sections.

3.6.2.1 Access the Reporting application

The reporting application is available from the landing page by clicking on the icon “Reporting”, see Figure 38. The reporting application will use the workgroup concept to determine which reports are available for viewing, editing and download.

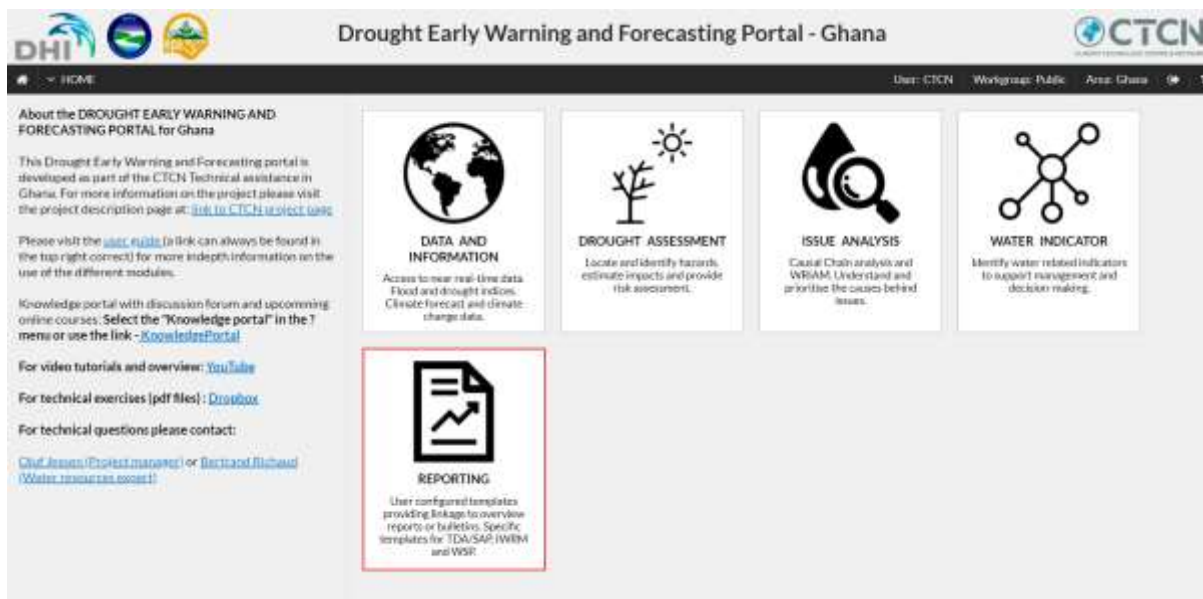


Figure 38 Open the Reporting application on the landing page

3.6.2.2 Default reporting templates

The Reporting application contains a number of built in default reporting templates enabling the user generate reports with a default content without having to develop their own Word based template. The default templates could also be used as a starting point for a user defined report.

The default reporting templates are accessed through the “Open” menu, where the all the default templates are marked with a “*” in from of the name, see Figure 39. Please note the following:

- Default reporting templates are all developed by the system and are available as read-only templates (user needs to clone the template to use them).
- “Generate” option is disabled

In order to use a default reporting template within a specific basin please follow the following procedure:

- Select a default reporting template (through the “Open” menu”)
- Clone the reporting template
 - Specify a name for the cloned version
 - Specify the workgroup for the cloned version of the report
 - Update the description if needed
- Press “Clone” to copy the default reporting template.

After the reporting template is cloned the “Generate” option will be enabled and the user can generate the report for this specific basin. The report will be populated with updated content and can be viewed after the “Generate” option is executed.

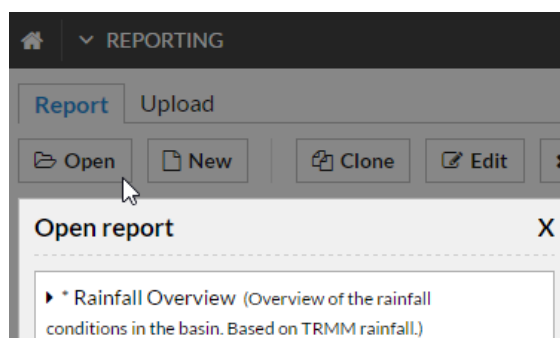
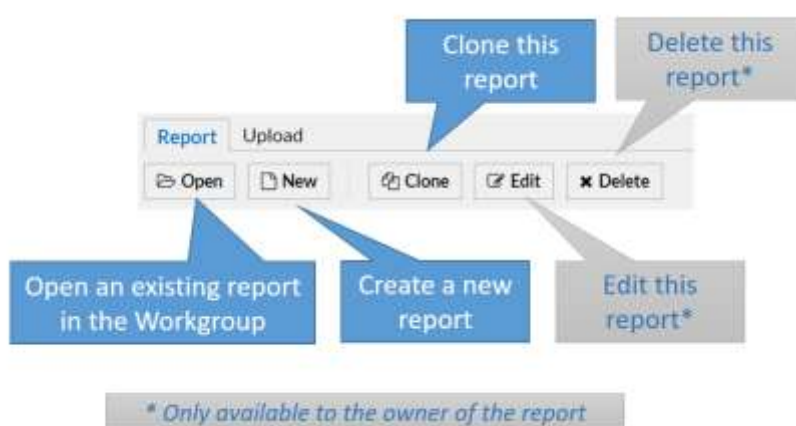


Figure 39 Default reporting templates



Main option to manage the reports are as follow:








When working with a report, there are a few options available:



3.6.2.3 View or edit content

When opening a report with editing rights, refer to user workgroup, all the content of the reporting template will be editable. When pressing the edit button () an Edit dialog is opened and the user is able to specify the content for the specific tag. Pressing the preview button () enables the user to preview the content of the specific tag.

Tag	Source	Type	Item	Setting	
logo	Data	Image	Logo\Project logo	imageWidth: imageHeight:	
Map: Basin overview	Data	Image	Overview	imageWidth: 500 imageHeight:	
Map: monthly rainfall - 4 plot	Data	Image	Rainfall\Season(TRMM)	imageWidth: 500 imageHeight:	
Time series: Rainfall variability	Data	Chart	Rainfall Climate\TRMM	analysisArea: allArea	
Table: rainfall statistics	Data	Table	Rainfall\TRMM	3E9651,#CC2529,#6B4C9A,#948B3D	

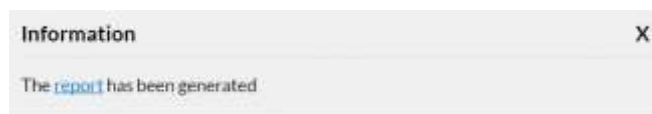
Edit X
 Tag: Map: monthly rainfall - 4 plot
 Source: Data
 Type: Image
 Item: Rainfall\Season(TRMM)
 Image width (px): 500
 Image height (px):
 Preview Update

Copy link Download Generate

Figure 40 Edit reporting content

3.6.2.4 Generate report

The “Generate” menu generates the report by inserting all the user specified content into the reporting template and converting the report to pdf format. A dialog will appear at the end of the process allowing the user to download the generated report.



3.6.2.5 Download report

The “Download” menu enables the user to download an already generated report. Note that the report is not updated when using this option.

3.6.2.6 Copy link to report

The “Copy link” function provides a link to report. The link is automatically copied to the clipboard and can be used to access the generated report. The link can be used to share the report. Note: it is not needed to login to the Portal to access the report via this link.



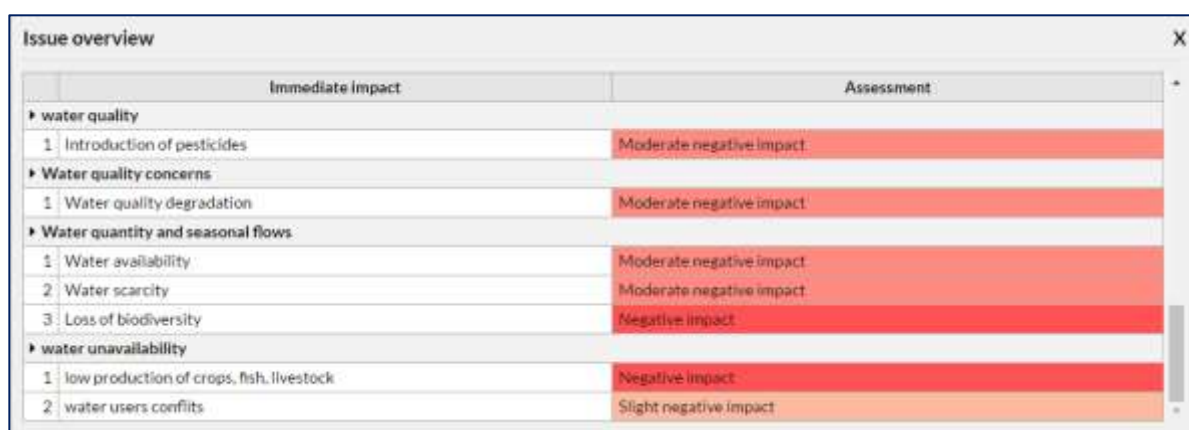
APPENDICES

1 Annex A: Issue Analysis

This section contains a description of the functionalities in the Issue Analysis application.

1.1 Overview or Open Issues

Click on “Overview” to view all the available Issues, the associated immediate impacts and the results of the rapid assessment. Click on an issue to open the connected Issue Analysis.

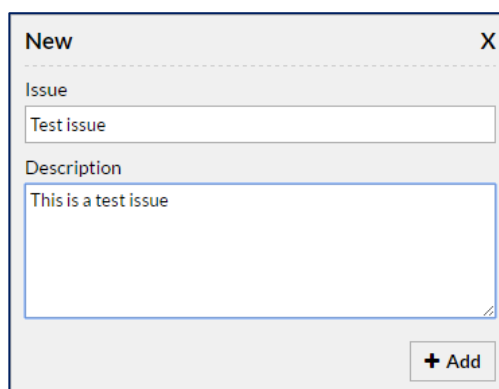


Issue overview		
	Immediate impact	Assessment
▶ water quality		
1	Introduction of pesticides	Moderate negative impact
▶ Water quality concerns		
1	Water quality degradation	Moderate negative impact
▶ Water quantity and seasonal flows		
1	Water availability	Moderate negative impact
2	Water scarcity	Moderate negative impact
3	Loss of biodiversity	Negative impact
▶ water unavailability		
1	low production of crops, fish, livestock	Negative impact
2	water users conflicts	Slight negative impact

Figure A-1 Overview available Issues

1.2 New Issue

Opens a dialog allowing the user to specify the name of the issue and a description. Press “Add” to generate a new Issue. Please note that a new Issue always will be located in the current workgroup.



New X

Issue

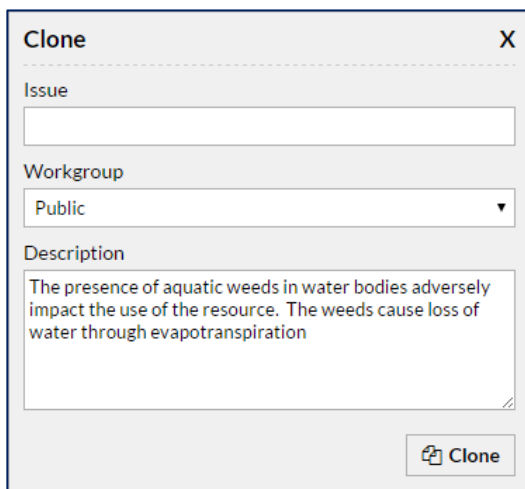
Description

+ Add

Figure A-2 Add new Issue

1.3 Clone Issue

Enables the user to clone an issue by specifying a new name and the workgroup which the cloned issue should be located in.



Clone X

Issue

Workgroup

Public

Description

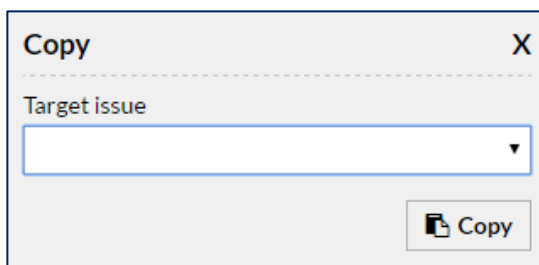
The presence of aquatic weeds in water bodies adversely impact the use of the resource. The weeds cause loss of water through evapotranspiration

Clone

Figure A-3 Clone issue

1.4 Copy Issue

Enables the user to copy the environmental impacts from one issue to another existing issue. The environmental impacts will be added to the existing issue (selected in the “Copy” dialog). Please note that this requires an existing issue created by the current user.



Copy X

Target issue

Copy

Figure A-4 Copy issue

1.5 Edit Issue

Enables the user to edit the name and description of the issue. Only enabled for authors of the specific issue.

1.6 Delete Issue

Enables the user to delete an Issue. Only enabled for authors of the specific issue.

1.7 Add Issue Analysis

Add a new Issue Analysis by clicking on the “Add” menu. This will open a dialog allowing the user to specify the parameters for the Issue Analysis. The following parameters are needed:

- **Immediate impact:** Describe the immediate impact
- **Immediate cause:** Describe the immediate cause
- **Underlying cause:** Describe the underlying cause
- **Root cause:** Describe the root cause
- **Extent:** Extent of the impact. Note that no impact will set group A score to zero.
- **Seriousness:** Seriousness of impact. Note that no change will set group A score to zero.
- **Permanence:** Specify if the impact is permanent or not
- **Irreversibility:** Specify if the impact if reversible or not.
- **Cumulative character:** Specify if the impact is cumulative or not
- **Level of documentation:** Specify the level of documentation. Please note that this is not included in the assessment.

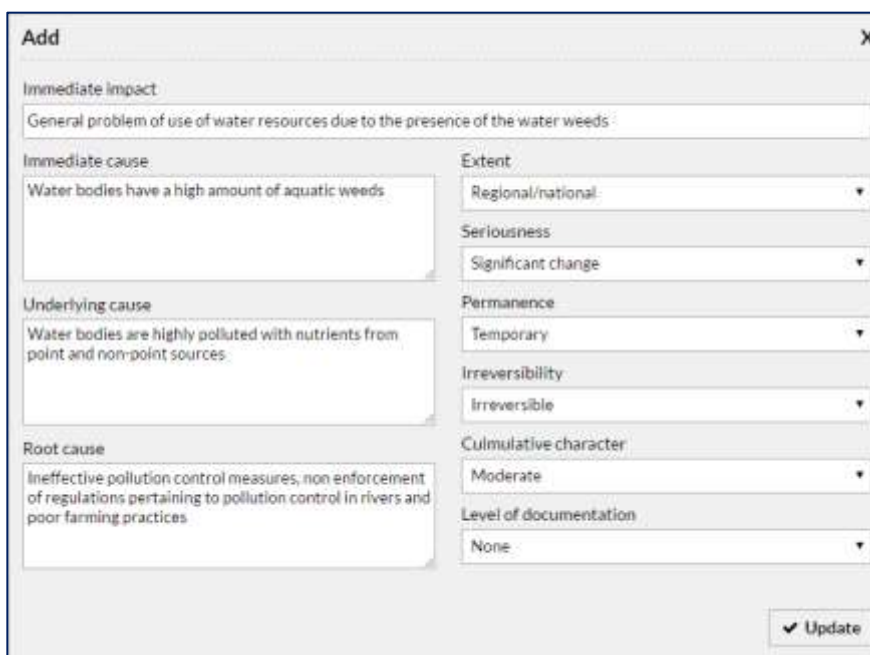


Figure A-5 Add Issue Analysis

Note that the assessment score is not calculated before the “Update” button is pressed.

1.8 Edit Issue Analysis

Opens the Issue Analysis dialog allowing the user to edit the Issue Analysis. This requires that the user is the author of the Issue.



Figure A-6 Edit Issue Analysis icon

1.9 Delete Issue Analysis

Deletes a specific Issue Analysis. This requires that the user is the author of the Issue.



Figure A-7 Delete Issue Analysis icon

2 Annex B: Water Indicator

This section contains a description of all the functionalities in the Water Indicator application.

2.1 Framework tab

The Framework tab is the main tab and provides access to the Indicator Frameworks and the individual indicator descriptions. The following section contains a brief description of all the functionality within the Framework tab.

2.1.1 Open Indicator Framework

Open all the available Indicator Frameworks. The user is able to view the following Indicator Frameworks:

- Default Indicator Frameworks: these are marked with a “*” and are available for all users. The default Indicator Frameworks can be viewed or cloned by all users. Only the administrator is able to delete or edit the default Indicator Frameworks.
- All Frameworks developed by the same user will be available
- All Frameworks available within the current workgroup will be available

2.1.2 New Indicator Framework

Developing a new Indicator Framework requires the following steps:

- Press “New” to open a dialog to specify the name and description for the Indicator Framework.
- Press “Add” to generate the Indicator Framework

Please Note the new Indicator Framework will be located in the current workgroup.

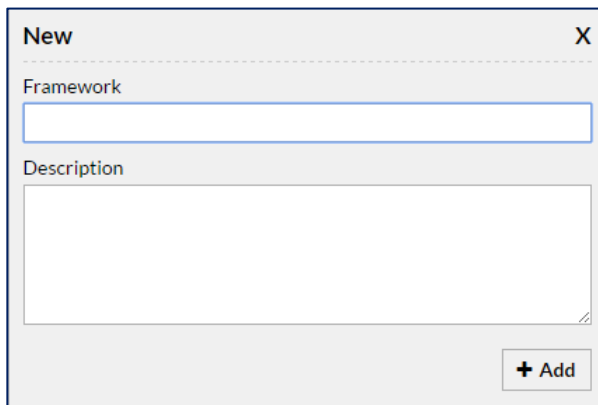


Figure B-1 New Indicator Framework

The Indicator Framework tab will now appear with a blank screen without any groups or indicators. To add groups and associated indicators follow these steps:

- Add Main Indicator groups by pressing on the “+ Group” menu, specify the name of the indicator group and press “Add”.

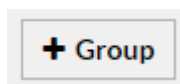


Figure B-2 Add main groups

Edit the main groups by clicking on the group name, which will enable the below dialog. The user have the following options:

- **+ Group:** Add a sub-group
- **+ Indicator:** Add indicator. This will open the indicator list. The user should select the indicators to be added to the specific group and press “Add to Framework”
- **Rename:** Rename the specific indicator group
- **Delete:** Delete the specific indicator group. Note that this will also remove all sub-groups and all associated indicators.

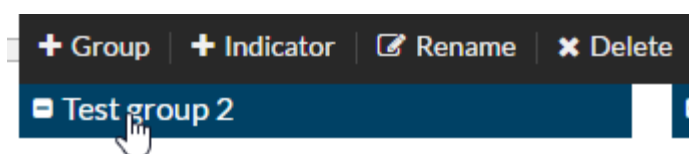


Figure B-3 Main group editing options

2.1.3 Clone Indicator Framework

All users are able to clone an Indicator Framework. When cloning an Indicator Framework the user is prompted to specify a name for the new Indicator Framework, a description and the workgroup where the Indicator Framework is to be located in.

Clone

X

Framework

Workgroup

Private

Description

This is a test framework

Clone

Figure B-4 Clone an Indicator Framework

2.1.4 Delete Indicator Framework

Delete the current Indicator Framework. Please note that the delete option is only available if the Indicator Framework is developed by the current user. For all other users the Delete option will be hidden.

2.1.5 Main/sub- groups

Indicator groups are used to store indicator descriptions. Each indicator group corresponds to an environmental issue. To rename, delete or add an indicator group please refer to section 2.1.2

2.1.6 Indicator

Indicators are available from the Indicator Framework. Clicking on an Indicator opens the Indicator metadata sheet, see Figure 17 or Figure B-6.

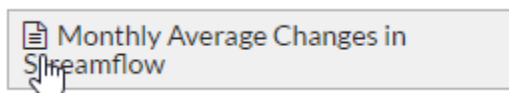


Figure B-5 Indicator

2.1.7 Indicator metadata sheet

Clicking on an indicator opens the Indicator metadata sheet, see Figure B-6. The following functionality is available:

- **Keyword:** list all the keywords for the current indicator. Clicking on a keyword opens the indicator list displaying all indicators with the same keyword.
- **Print:** Prints the metadata sheet (pdf file)
- **Download:** Download the metadata sheet (pdf file)

Climate > Climate Vulnerability
X

Indicator
 Climate Vulnerability Index

Description
 The Climate Vulnerability Index (CVI) is used as an integrated assessment of local vulnerability to water-related risks. It is a composite indicator, determined as a function of climate exposure, resilience and adaptability. The CVI takes into account a wide range of relevant factors to capture the key drivers of human vulnerability to climate related impacts on water resources.

Keyword

climate change adaptation
freshwater availability
water scarcity
water stress


natural resource management
sustainable livelihoods
irrigation
agricultural development

water related hazards
disaster planning
disaster management
disaster preparedness
health

vulnerability

Metadata sheet

Page: 1 of 4
Automatic Zoom


Water Indicator Builder
 Indicator metadata sheet

Climate Vulnerability Index

GENERAL INFORMATION	
Title	Climate Vulnerability Index
Category	Climate Subcategory Climate Vulnerability
Purpose	The Climate Vulnerability Index (CVI) is used as an integrated assessment of local vulnerability to water-related risks. It is a composite indicator, determined as a function of climate exposure, resilience and adaptability. The CVI takes into account a wide range of relevant factors to capture the key drivers of human vulnerability to climate related impacts on water resources.
POLICY RELEVANCE	
Policy Relevance	This indicator is relevant for identifying regions or populations that are vulnerable to climate change impacts in relation to water resources. It can be useful in prioritizing policy actions related to disaster planning and preparedness, as well as natural resource allocation. When combined with socioeconomic or demographic variables, the CVI may help to identify trends in equity and may contribute to poverty reduction efforts. Reporting on this indicator supports ongoing assessment of climate related risks and strategic action to combat human vulnerability to climate change.

Figure B-6 Indicator metadata sheet

2.2 Indicator tab

The Indicator tab contains all the available indicators enabling the user to edit and delete their own indicators and clone indicators developed by other users. The following section contains a brief description of all the functionality within the Indicator tab.

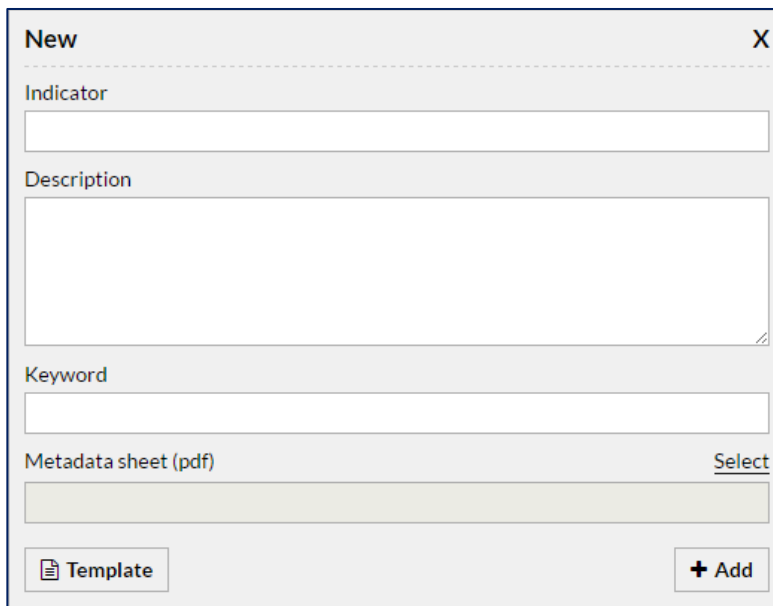
Please note that all indicators will be available for all users as the workgroup functionality is not applied to the indicators (the Indicator Framework is using the workgroup concept).

2.2.1 New Indicator

Press the “New” button to initiate the process for adding a new indicator. The “New” dialog appears, see Figure B-7. The user is prompted to specify the following information:

- **Indicator:** Indicator name. Please note that the indicator name needs to be unique.
- **Description:** Specify the description for the indicator.

- **Keyword:** Specify keywords connected to the indicator. Please note that keywords are separated by a “,”.
- **Metadata sheet:** Click on “Select” to upload the metadata sheet for the indicator. Please note that the metadata sheet needs to be in pdf format.
- **Template:** Press on “Template” to download an empty template for the metadata sheet. Remember to convert the metadata sheet to pdf before uploading it to the system.



New [X]

Indicator

Description

Keyword

Metadata sheet (pdf) Select

Figure B-7 New Indicator

2.2.2 Search Indicators

The user is able to search for indicators in the following way:

- **Indicator tab:** type a search name in the search box and click “search”. The search will use the keywords and all indicators containing the search item in the keywords will appear.
- **Indicator tab:** Click on a keyword to view all indicators containing the same keyword
- **Framework tab:** Open an indicator and click on a keyword. This will open the Indicator tab and list all indicators containing the same keyword.



The screenshot shows the 'INDICATOR' tab selected in the top navigation bar. A search box in the top right corner contains the text 'Agriculture'. Below the search bar, a table lists indicators. The first indicator is 'Agriculture Withdrawals' with a description: 'This indicator measures total water withdrawals used for agricultural purposes, including irrigation and livestock watering, as share of total withdrawals. It gives an indication the importance of agriculture in the country's/region's water balance.' The second indicator is 'Area Irrigated by Groundwater' with a description: 'This indicator calculates the share of total irrigated land which is irrigated by groundwater, which gives an indication of the dependence on groundwater for the irrigation of agricultural land.' Both indicators have a 'Keyword' column and a 'Metadata sheet' column. The 'Keyword' column for 'Agriculture Withdrawals' contains: 'Agricultural water requirement', 'agricultural water demand', 'livestock watering', 'livestock production', 'water stress', 'water scarcity', 'climate change vulnerability', 'irrigation water efficiency', 'drought planning', 'drought preparedness', 'food security', 'agricultural development', 'rural livelihoods', 'water allocation', 'agricultural water pollution'. The 'Metadata sheet' column for 'Agriculture Withdrawals' contains: 'Agriculture water withdrawal_Aug2016.pdf'. The 'Keyword' column for 'Area Irrigated by Groundwater' contains: 'Agricultural water demand', 'irrigation water demand'. The 'Metadata sheet' column for 'Area Irrigated by Groundwater' contains: 'Area irrigated by Groundwater_Aug2016.pdf'.

Name	User	Description	Keyword	Metadata sheet
Agriculture Withdrawals	admin	This indicator measures total water withdrawals used for agricultural purposes, including irrigation and livestock watering, as share of total withdrawals. It gives an indication the importance of agriculture in the country's/region's water balance.	Agricultural water requirement, agricultural water demand, livestock watering, livestock production, water stress, water scarcity, climate change vulnerability, irrigation water efficiency, drought planning, drought preparedness, food security, agricultural development, rural livelihoods, water allocation, agricultural water pollution	Agriculture water withdrawal_Aug2016.pdf
Area Irrigated by Groundwater	admin	This indicator calculates the share of total irrigated land which is irrigated by groundwater, which gives an indication of the dependence on groundwater for the irrigation of agricultural land.	Agricultural water demand, irrigation water demand	Area irrigated by Groundwater_Aug2016.pdf

Figure B-8 Search for indicator

2.2.3 All

Clicking on the “All” menu displays all the available indicators.

2.2.4 Clone Indicator

Clone an indicator by pressing on the “Clone” icon, see Figure B-9.



Figure B-9 Clone a specific indicator

The user needs to specify the following information when cloning an indicator:

- **Indicator:** Indicator name. Please note that the indicator name needs to be unique.
- **Description:** The description from the original indicator is displayed, but the user is able to edit the description.
- **Keyword:** The list of keywords from the original indicator is displayed, but the user is able to edit the list of keywords. Please note that keywords are separated by a “,”.
- **Metadata sheet:** The original metadata sheet is shown, but the user have the option of uploading a new metadata sheet in the form of a pdf document.

Clone

X

Indicator

Description

This indicator measures total water withdrawals used for agricultural purposes, including irrigation and livestock watering, as share of total withdrawals. It gives an indication the importance of agriculture in the country's/basin's water balance.

Keyword

Agricultural water requirements, irrigation water demand, livestock watering, livestock

Metadata sheet (pdf)

Select

Agriculture water withdrawals_Aug2016pdf.pdf

Template

Clone

Figure B-10 Clone menu

2.2.5 Keywords

The keywords are used to describe the indicator and is added by the user during the creation of the indicator. Keywords are also used by the indicator search as the search is using the indicator keywords.

2.2.6 Metadata sheet

The metadata sheet is a pdf document containing a detailed description of the indicator. The Metadata sheet is uploaded during creation of the indicator.

3 Annex C: Data and information

3.1 Data description

3.1.1 Rainfall related data

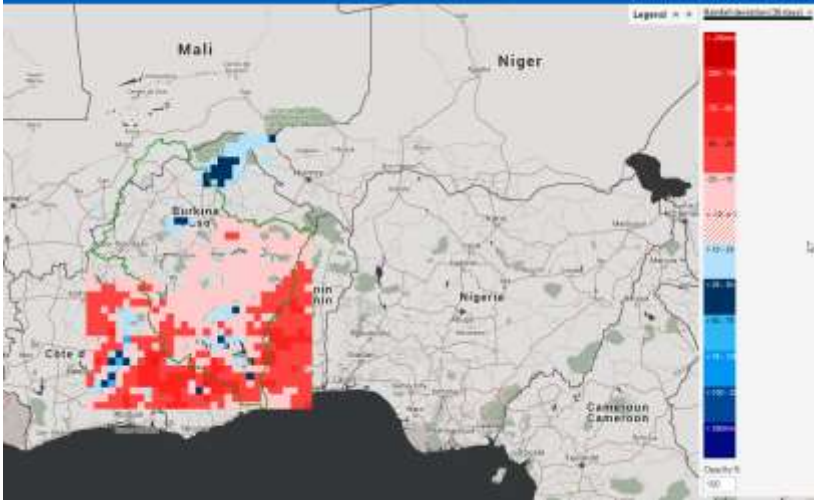
3.1.1.1 TRMM

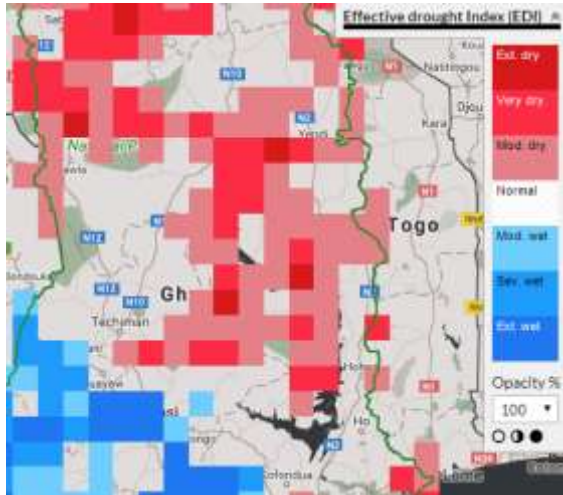
The Tropical Rainfall Measuring Mission (TRMM) is the first Earth Science mission dedicated to studying tropical and subtropical rainfall. It is a joint mission between the National Aeronautics and Space Administration (NASA) and Japanese Aerospace Exploration Agency (JAXA) dedicated to monitor rainfall in the tropics through microwave and visible infrared sensors, including the first space-borne rain radar. By use of a low-altitude orbit (350km), TRMM is complemented with state-of-the-art instruments providing high accurate measurements.

TRMM is especially useful in cases where consistency in precipitation data is required over many years, such as the case for hydrological design, flood risk assessment and water resources management.

Spatial extent	From 50 degrees north to 50 degrees south of the equator
Spatial and temporal resolution	Spatial resolution: 0.25 degree Temporal resolution: resampled to daily rainfall product from 2000 to present
Reference	http://trmm.gsfc.nasa.gov
Data requirements and calculation	The original 3-hourly real-time rainfall data in mm/h from NASA is resampled to a daily product in mm/day, this daily product is then downloaded from the TRMM data provider and disseminated via the portal. Negative values are removed during the processing.
Update Frequency	Daily
Related indices	SPI 1-month, SPI 3-month, etc
Data source	TRMM_3B42RT_Daily

Based on TRMM rainfall dataset we will generate the indicators presented in the following tables.

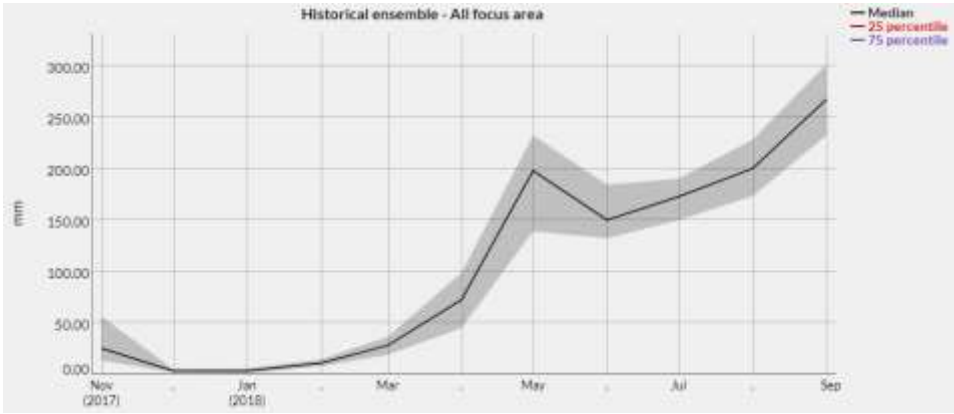
Title	Rainfall deviation (30 days)
Description	Deviation of accumulated rainfall from the long term mean within the last 30 days. Calculated based on the TRMM rainfall where the long term mean is based on TRMM data since 2000.
	INDICATOR USAGE
Index interpretation	Used to locate areas with rainfall surplus or deficit within the last 30 days.
Spatial extent	As TRMM data
Spatial and temporal resolution	Spatial resolution: 0.25 degree Temporal resolution: Updated daily as TRMM rainfall gets updated.
Reference	Processed based on TRMM data
Example of usage	<p>Illustrates the how the accumulated rainfall deviates from the mean accumulation within a given area. Used to locate areas with rainfall surplus or deficit across the last 30 days.</p> 
	INDICATOR CALCULATION
Data requirements and calculation	Based on daily TRMM rainfall and calculated as $\sum \text{TRMM} - \sum \text{TRMM}_{\text{mean}}$ for the last 30 days
Update Frequency	Daily updated in the web portal
Related indices	-
Data source	Based on TRMM data

Title	Effective Drought Index (EDI)
Description	<p>The Effective Drought Index (EDI) was developed by Byun and Wilhite (1999) as a measure that considers daily water accumulation with a weighting function for time passage. More information is available via http://om.ciheam.org/om/pdf/a95/00801330.pdf</p>
	INDICATOR USAGE
Index interpretation	<p>Used to locate areas that are very dry to very wet as a measure of drought. The "drought range" of the EDI indicates the following:</p> <p>extreme drought at EDI = -2, severe drought at $-2.0 < \text{EDI} = -1.5$ moderate drought at $-1.5 < \text{EDI} = -1.0$. Near normal conditions are indicated by $-1.0 < \text{EDI} = 1.0$</p>
Spatial extent	As TRMM data
Spatial and temporal resolution	<p>Spatial resolution: 0.25 degree</p> <p>Temporal resolution: Updated daily as TRMM rainfall gets updated.</p>
Reference	<p>Hi-Ryong Byun and Donald A. Wilhite, Objective Quantification of Drought Severity and Duration, 1999.</p> <p>http://journals.ametsoc.org/doi/full/10.1175/1520-0442%281999%29012%3C2747%3A%3E2.0.CO%3B2</p>
Example of usage	<p>Example of the EDI coverage for Ghana:</p> 
	INDICATOR CALCULATION
Data requirements and calculation	<p>Based on daily TRMM rainfall and calculated for the last 30 days as:</p> $\text{EDI} = \text{Deviation(PE)} / \text{Std(PE)}$ <p>Where PE is :</p>

	$P_{E_i} = \sum_{N=1}^D \left[\frac{\sum_{m=1}^N P_m}{N} \right]$
Update Frequency	Daily
Related indices	-
Data source	Based on TRMM data

Title	Standardised Precipitation index (SPI)														
Description	<p>The SPI is based on the probability of precipitation for any time scale. The probability of observed precipitation is then transformed into an index. It is being used in research or operational mode in more than 70 countries. More information is available via http://www.wamis.org/agm/pubs/SPI/WMO_1090_EN.pdf</p>														
	INDICATOR USAGE														
Index interpretation	<p>SPI is typically categorized using the following classification:</p> <table border="1" data-bbox="722 674 1107 909"> <tbody> <tr> <td>> 2</td><td>Extremely wet</td></tr> <tr> <td>1.5 to 2</td><td>Very wet</td></tr> <tr> <td>1 to 1.5</td><td>Moderately wet</td></tr> <tr> <td>-1 to 1</td><td>Near normal</td></tr> <tr> <td>-1.5 to -1</td><td>Moderately dry</td></tr> <tr> <td>-2 to -1.5</td><td>Severely dry</td></tr> <tr> <td>< -2</td><td>Extremely dry</td></tr> </tbody> </table> <p>A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end, and an intensity for each month that the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude".</p> <p>Because the SPI is normalized, wetter and drier climates can be represented in the same way; thus, wet periods can also be monitored using the SPI. However, it must be stressed that the SPI is not suitable for climate change analysis because temperature is not an input parameter.</p>	> 2	Extremely wet	1.5 to 2	Very wet	1 to 1.5	Moderately wet	-1 to 1	Near normal	-1.5 to -1	Moderately dry	-2 to -1.5	Severely dry	< -2	Extremely dry
> 2	Extremely wet														
1.5 to 2	Very wet														
1 to 1.5	Moderately wet														
-1 to 1	Near normal														
-1.5 to -1	Moderately dry														
-2 to -1.5	Severely dry														
< -2	Extremely dry														
Spatial extent	As TRMM data														
Spatial and temporal resolution	<p>Spatial resolution: 0.25 degree</p> <p>Temporal resolution: Updated daily as TRMM rainfall gets updated.</p>														
Reference	http://www.wamis.org/agm/pubs/SPI/WMO_1090_EN.pdf														
Example of usage	<p>The following SPI products are available:</p> <ul style="list-style-type: none"> ● SPI -month: the one-month SPI provides a comparison of the precipitation over a specific one month period with the precipitation totals from the same period for all the years included in the historical record. 1-month SPI reflects relatively short-term conditions, its application can be related closely with short-term soil moisture and crop stress, especially during the growing season. ● SPI 3-month: the three-month SPI provides a comparison of the precipitation over a specific 3-month period with the precipitation totals from the same 3-month period for all the years included in the historical record. A 3-month SPI reflects short- and medium-term moisture conditions and provides a seasonal estimation of precipitation. ● SPI 6-month: the 6-month SPI compares the precipitation for that 														

	period with the same 6-month period over the historical record. The 6-month SPI indicates medium-term trends in precipitation.
	INDICATOR CALCULATION
Data requirements and calculation	The original 3-hourly real-time rainfall data in mm/h from NASA is resampled to daily product in mm/day. Negative values are removed during the processing.
Update Frequency	Daily
Related indices	SPI 1-month, SPI 3-month, etc
Data source	TRMM 3B42RT

Title	Climatology or historical ensembles
Description	Climatology or historical ensembles is a way to generate ensembles based on the historical rainfall to be used as a “prediction” of how the future rainfall will evolve. Climatology is very useful if forecasted rainfall is not available or the skill of the forecasted rainfall is poor.
	INDICATOR USAGE
Index interpretation	Provides ensemble input of forecasted rainfall based on the historical observations.
Spatial extent	From 50 degrees north to 50 degrees south of the equator (similar to TRMM data)
Spatial and temporal resolution	Spatial resolution: 0.25 degree Temporal resolution: daily
Reference	TRMM data
Example of usage	<p>Ensemble members used as climate input for hydrological, water resource or crop models for evaluation of a future situation. These can also be used to produce statistical monthly envelope charts as shown below.</p> 
	INDICATOR CALCULATION
Data requirements and calculation	Based on TRMM data from 2000 until today. Climatology is yearly time series of the historical TRMM rainfall.
Update Frequency	Daily
Related indices	SPI 1-month, SPI 3-month, etc. based on forecasted rainfall
Data source	TRMM data

3.1.1.2 GPM

The Global Precipitation Measurement (GPM) mission is an international network of satellites that provide the next-generation global observations of rain and snow.

GPM, initiated by NASA and the Japan Aerospace Exploration Agency (JAXA) as a global successor to TRMM, comprises a consortium of international space agencies.

Spatial extent	Spanning 50°S-50°N (and all longitudes)
Spatial and temporal resolution	Spatial resolution: 0.1 degree Temporal resolution: daily rainfall product starting in 2014 to near-present
Reference	https://pmm.nasa.gov/GPM
Data requirements and calculation	No processing of the data is required
Update Frequency	Daily
Related indices	None
Data source	https://pmm.nasa.gov/GPM

3.1.1.3 CHIRPS

Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.

Spatial extent	Spanning 50°S-50°N (and all longitudes)
Spatial and temporal resolution	Spatial resolution: 0.05 degree Temporal resolution: daily rainfall product starting in 1981 to near-present
Reference	http://chg.geog.ucsb.edu/data/chirps/
Data requirements and calculation	No processing of the data is required
Update Frequency	Monthly
Related indices	None
Data source	version 2.0 of CHIRPS, read more at http://chg.geog.ucsb.edu/data/chirps/

3.1.1.4 CRU

Datasets are month-by-month variation in climate over the last century or so as produced by the Climatic Research Unit (CRU) at the University of East Anglia. These are calculated on high-resolution (0.5x0.5 degree) grids, which are based on an archive of monthly means provided by more than 4000 weather stations distributed around the world.

This dataset provides a long record of historical rainfall data based on weather stations.

Spatial extent	All land areas (excluding Antarctica)
Spatial and temporal resolution	Spatial resolution: 0.5° resolution Temporal resolution: monthly (period 1901-2013)
Reference	https://crudata.uea.ac.uk/cru/data/hrg/#info
Data requirements and calculation	No processing of the data is required
Update Frequency	None
Related indices	None
Data source	https://crudata.uea.ac.uk/cru/data/hrg/#info

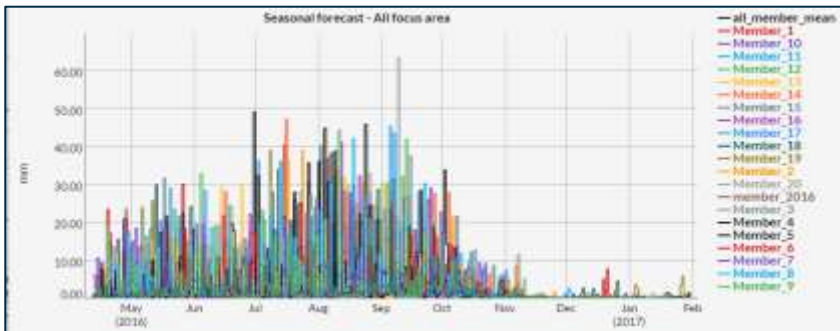
3.1.1.5 PERSIANN-CCS

PERSIANN-Cloud Classification System (PERSIANN-CCS) is a real-time global high-resolution satellite precipitation product developed by the Center for Hydrometeorology and Remote Sensing (CHRS) at the University of California, Irvine (UCI). PERSIANN-CCS system enables the categorization of cloud-patch features based on cloud height, areal extent, and variability of texture estimated from satellite imagery.

Spatial extent	60 deg S to 60 deg N
Spatial and temporal resolution	Spatial resolution: 0.04 deg x 0.04 deg or 4km x 4km Temporal resolution: daily (January 2003 - Present)
Reference	http://chrsdata.eng.uci.edu
Data requirements and calculation	Resampled to daily rainfall product
Update Frequency	Daily
Related indices	None
Data source	ftp://persiann.eng.uci.edu/CHRSdata/PERSIANN/daily

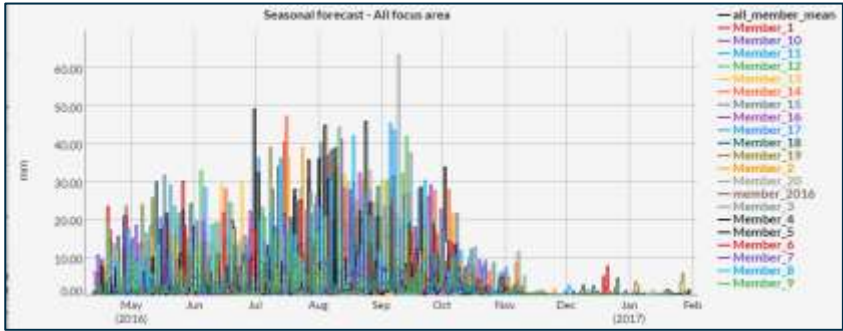
3.1.2 Seasonal forecasts

The Climate Forecast System (CFS) version 2 is run by the Environmental Modeling Center at National Centers for Environmental Prediction (NCEP), National Oceanic and Atmospheric Administration (NOAA) and became operational in March 2011. It is a fully coupled model representing the interaction between the Earth's atmosphere, oceans and land. The variables available include precipitation and surface temperature. The forecast data is made available in a form of an ensemble forecast with several months lead time and provides ensemble input of forecasted rainfall.

Spatial extent	Global coverage (Longitude Range: 180W to 180E, and Latitude Range: 90S to 90N)
Spatial and temporal resolution	Spatial resolution: 1 degree Temporal resolution: daily
Reference	http://cfs.ncep.noaa.gov/
Example of usage	Ensemble members used as climate input for hydrological, water resource or crop models for evaluation of a future situation. 
Data requirements and calculation	The computation consists of construction of the 20-member ensemble forecast. The original product is resampled from 6-hourly to daily.
Update Frequency	Daily
Related indices	SPI 1-month, SPI 3-month, etc. based on forecasted rainfall
Data source	NCEP CFS v2

A corrected seasonal forecast is also available. A bias correction is applied to the forecast using the scale factor method.

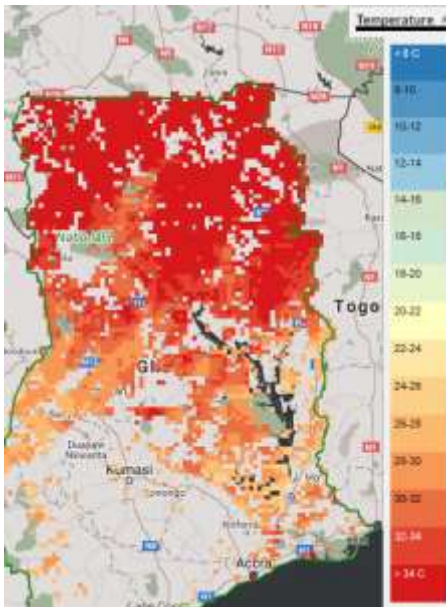
Spatial extent	Global coverage (Longitude Range: 180W to 180E, and Latitude Range: 90S to 90N)
-----------------------	---

Spatial and temporal resolution	<p>Spatial resolution: 1 degree</p> <p>Temporal resolution: daily</p>
Reference	http://cfs.ncep.noaa.gov/
Example of usage	<p>Ensemble members used as climate input for hydrological, water resource or crop models for evaluation of a future situation.</p> 
Data requirements and calculation	<p>The computation consists of construction of the 20-member ensemble forecast. The original product is resampled from 6-hourly to daily.</p> <p>CFS forecast is bias corrected based on a monthly scale factor. The scale factors have been derived from an analysis of the entire TRMM record (available from March 2000). The scale factors are estimated for each month of the year and for each lead-time horizon, and they represent the deviation of the forecast (reforecast data) with observation (TRMM data).</p> <p>The scale factors are then applied automatically to the forecast in order to take into account the deviation that observed in reforecast dataset.</p>
Update Frequency	Daily
Related indices	SPI 1-month, SPI 3-month, etc. based on forecasted rainfall
Data source	NCEP CFS v2

3.1.3 Temperature

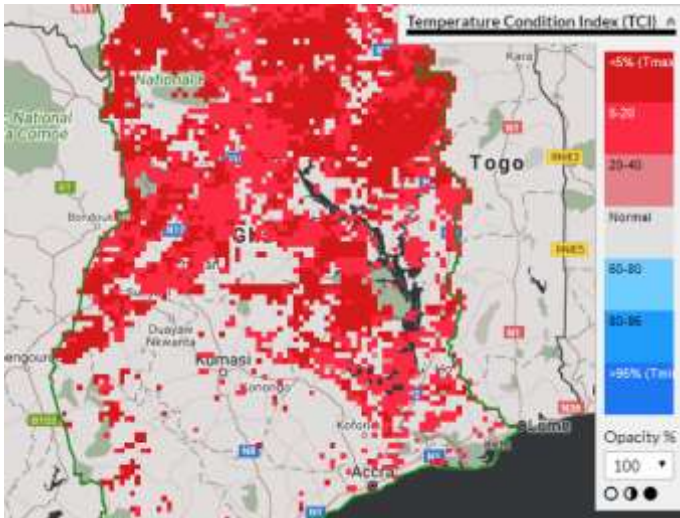
The level-3 MODIS¹ global Land Surface Temperature (LST) and Emissivity 8-day data (MOD11A2) are composed from the daily 1-kilometer LST product (MOD11A1) and stored on a 1-kilometer Sinusoidal grid as the average values of clear-sky LSTs during an 8-day period.²

LST and especially the change in temperature over time is a valuable indicator for climate change and drought events.

Spatial extent	Global coverage
Spatial and temporal resolution	Spatial resolution: 1 km but resampled to 5 km Temporal resolution: 8 day product from 2000 to present
Reference	https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11a2
Example of usage	<p>Temperature in itself is NOT an index, but could be used to detect changes in the temperature pattern from year to year.</p> 
Data requirements and calculation	Download of MOD11A2 1 km 8 day product. Data resampled to 5 km resolution using a simple mean of the grid cells.
Update Frequency	8 day
Data source	MOD11A2

¹ The Moderate Resolution Imaging Spectroradiometer

² https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11a2

Title	Temperature condition index (TCI)
Description	TCI is estimated relative to the maximum and minimum temperatures and modified to reflect different vegetation responses to temperature.
	INDICATOR USAGE
Index interpretation	Used to determine stress on vegetation caused by temperatures and excessive wetness.
Spatial extent	Global coverage
Spatial and temporal resolution	Spatial resolution: 5 km Temporal resolution: 8 daily
Reference	Daytime land surface temperature based on the 1 km MOD11C2 product. https://lpdaac.usgs.gov/dataset_discovery/modis/modis_products_table/mod11c2
Example of usage	<p>Example of the TCI coverage over Ghana:</p> 
	INDICATOR CALCULATION
Data requirements and calculation	TCI is calculated as: $100 \cdot (T_{max} - T) / (T_{max} - T_{min})$
Update Frequency	8 days
Related indices	-
Data source	MOD11C2

3.1.4 Vegetation related data

The Normalized Difference Vegetation Index (NDVI) is used as an index of vegetation health and density.

$$NDVI = (\lambda_{NIR} - \lambda_{red}) / (\lambda_{NIR} + \lambda_{red})$$

where: λ_{NIR} and λ_{red} are the reflectance in the NIR and red bands, respectively.

MODIS vegetation indices are produced on 16-day intervals and at multiple spatial resolutions. NDVI is closely correlated to vegetation canopy greenness, a composite property of leaf area, chlorophyll and canopy structure, and could be used as a base data set for monitoring of crop and vegetation status.

It varies between -1 and +1. Strong correlation with leaf area index and biomass

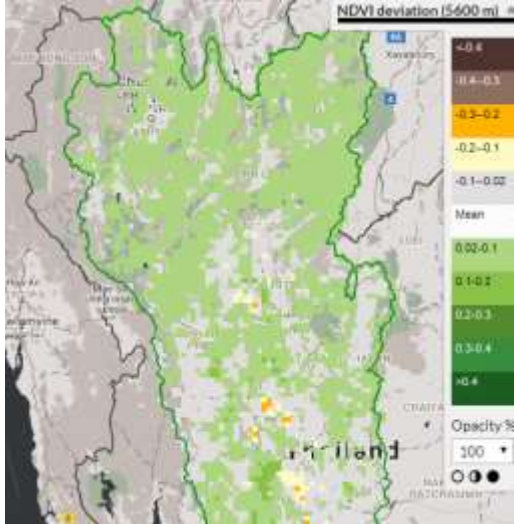
NDVI in itself does not reflect drought or non-drought conditions, but could be used to detect vegetation cover.

NDVI values	Vegetation condition
0.1 to 0.7	Vegetated land
> 0.5	Dense vegetation
< 0.1	Near zero vegetation such as barren area, rock, sand or snow

NDVI in itself is NOT a drought index, but could be used to detect changes in the vegetation pattern from year to year. , used as source data for a number of vegetation indices.

Spatial and temporal extent	Global coverage
Spatial and temporal resolution	Spatial resolution: from 5600 m to 250 m Temporal resolution: Updated every 16 day based on two daily passes. The value is based on the maximum value during the 16 day period (Available from 2000 to present)
Reference	http://modis-land.gsfc.nasa.gov/vi.html and http://e4ftl01.cr.usgs.gov/MOLT/
Data requirements and calculation	Converted to netcdf format
Update Frequency	16 day
Related indices	Vegetation based indices
Data source	Terra-MOD13C1 (5600 m)

The following tables define the indicators we will calculate based on the NDVI dataset.

Title	NDVI deviation										
Description	NDVI deviation is calculated as the deviation from the long-term mean. It expresses the current vegetation growth compared to the long term mean for the same period.										
	INDICATOR USAGE										
Index interpretation	<p>NDVI deviation could be used to define a drought as it is defined as the difference between the NDVI for the current time step and the long term mean NDVI for the same month.</p> $DEV_{NDVI} = NDVI_i - NDVI_{mean,m}$ <p>Where: $NDVI_i$: NDVI for the current time step and $NDVI_{mean,m}$: Long term mean NDVI for the same month</p> <ul style="list-style-type: none"> When DEV_{NDVI} is negative, it indicates the below-normal vegetation condition/health and, therefore, suggests a prevailing drought situation. The greater the negative departure the greater the magnitude of a drought. <p>The limitation is that the deviation from the mean does not take into account the variability in the vegetation within the region. Hence a negative DEV_{NDVI} could be caused by a different crop type.</p> <table border="1"> <thead> <tr> <th>DEV_{NDVI} values</th><th>Condition</th></tr> </thead> <tbody> <tr> <td>≤ -0.2</td><td>Severe drought (extremely dry)</td></tr> <tr> <td>-0.05 to -0.2</td><td>Drought (moderately dry)</td></tr> <tr> <td>-0.05 to 0.1</td><td>Near normal</td></tr> <tr> <td>> 0.1</td><td>Above optimal (extremely wet)</td></tr> </tbody> </table>	DEV_{NDVI} values	Condition	≤ -0.2	Severe drought (extremely dry)	-0.05 to -0.2	Drought (moderately dry)	-0.05 to 0.1	Near normal	> 0.1	Above optimal (extremely wet)
DEV_{NDVI} values	Condition										
≤ -0.2	Severe drought (extremely dry)										
-0.05 to -0.2	Drought (moderately dry)										
-0.05 to 0.1	Near normal										
> 0.1	Above optimal (extremely wet)										
Spatial extent	Global coverage										
Spatial and temporal resolution	Spatial resolution: 5600 m to 250 m Temporal resolution: 16 day										
Reference	Processed based on the NDVI data										
Example of usage	Location of areas with a vegetation growth below the long-term average. 										

	INDICATOR CALCULATION
Data requirements and calculation	$DEV_{NDVI} = NDVI_i - NDVI_{mean,m}$ Where: $NDVI_i$: NDVI for the current time step and $NDVI_{mean,m}$: Long term mean NDVI for the same month
Update Frequency	16 day
Related indices	Vegetation based indices
Data source	Based on the NDVI data

Title	Vegetation condition index (VCI)										
Description	Vegetation condition index (VCI) shows how close the NDVI of the current month is to the minimum NDVI calculated from the long-term record.										
	INDICATOR USAGE										
Index interpretation	VCI values reflects the following: <table border="1"> <thead> <tr> <th>VCI values</th><th>Condition</th></tr> </thead> <tbody> <tr> <td>50 to 100 %</td><td>Optimal or above normal conditions</td></tr> <tr> <td>35 to 50%</td><td>Fair vegetation condition</td></tr> <tr> <td>0 to 35%</td><td>Severe drought (local trigger values apply)</td></tr> <tr> <td>0%</td><td>Extremely dry and equal to the long term minimum</td></tr> </tbody> </table>	VCI values	Condition	50 to 100 %	Optimal or above normal conditions	35 to 50%	Fair vegetation condition	0 to 35%	Severe drought (local trigger values apply)	0%	Extremely dry and equal to the long term minimum
VCI values	Condition										
50 to 100 %	Optimal or above normal conditions										
35 to 50%	Fair vegetation condition										
0 to 35%	Severe drought (local trigger values apply)										
0%	Extremely dry and equal to the long term minimum										
Spatial extent	Global coverage										
Spatial and temporal resolution	Spatial resolution: 5600 m to 250 m Temporal resolution: 16-day										
Reference	Kogan, F. N. F. Remote sensing of weather impacts on vegetation in non-homogeneous areas. International Journal of Remote Sensing 1990, 11, 1405–1419.										
	INDICATOR CALCULATION										
Data requirements and calculation	VCI shows how close the NDVI of the current month is to the minimum NDVI calculated from the long term record. $VCI_j = \frac{(NDVI_j - NDVI_{min})}{(NDVI_{max} - NDVI_{min})} * 100$ Where: $NDVI_{min}$ and $NDVI_{max}$ are calculated for the same month from a long										

	term record.
Update Frequency	16 day
Related indices	Vegetation based indices
Data source	Based on the NDVI data

Title	Standardised vegetation index (SVI)												
Description	SVI is NDVI normalized for each pixel on the basis of the maximum statistical range over the historical record.												
	INDICATOR USAGE												
Index interpretation	<table border="1"> <thead> <tr> <th>SVI values</th><th>Condition</th></tr> </thead> <tbody> <tr> <td>0 to 0.05</td><td>Very poor conditions</td></tr> <tr> <td>0.05 to 0.25</td><td>Poor conditions</td></tr> <tr> <td>0.25 to 0.75</td><td>Average conditions</td></tr> <tr> <td>0.75 to 0.95</td><td>Good conditions</td></tr> <tr> <td>0.95 to 1</td><td>Very good conditions</td></tr> </tbody> </table> <p>Zero is the baseline condition where the NDVI is lower than all possible NDVI values for that period in other years.</p>	SVI values	Condition	0 to 0.05	Very poor conditions	0.05 to 0.25	Poor conditions	0.25 to 0.75	Average conditions	0.75 to 0.95	Good conditions	0.95 to 1	Very good conditions
SVI values	Condition												
0 to 0.05	Very poor conditions												
0.05 to 0.25	Poor conditions												
0.25 to 0.75	Average conditions												
0.75 to 0.95	Good conditions												
0.95 to 1	Very good conditions												
Spatial extent	Global coverage												
Spatial and temporal resolution	Spatial resolution: 5600 m to 250 m Temporal resolution: 16-day												
Reference	Processed based on the NDVI data												
	INDICATOR CALCULATION												
Data requirements and calculation	SVI is NDVI normalized for each pixel on the basis of the maximum statistical range over the historical record. Low SVI values indicate poor vegetation condition that could be the result of climate conditions. The SVI is based on a z score. The z score is a deviation from the mean in units of standard deviation.												
Update Frequency	16 day												
Related indices	Vegetation based indices												
Data source	Based on the NDVI data												

Title	Vegetation health index (VHI)
Description	VHI is combination of vegetation condition index (VCI) and temperature condition index (TCI).
	INDICATOR USAGE
Index interpretation	<p>The following classification is used for drought related vegetation stress:</p> <p>< 10 Extreme drought 10 to 20 Severe drought 20 to 30 Moderate drought 30 to 40 Mild drought 40 to 100 No drought</p>
Spatial extent	Global coverage
Spatial and temporal resolution	<p>Spatial resolution: 5600 m to 250 m</p> <p>Temporal resolution: 16 day</p>
Reference	Processed based on the NDVI data
	INDICATOR CALCULATION
Data requirements and calculation	<p>Calculated as:</p> $VHI = 0.5 * VCI + 0.5 * TCI$
Update Frequency	16 day
Related indices	Vegetation based indices
Data source	Based on the NDVI data

3.1.5 Soil moisture related data

The Soil water index (SWI) product contains daily synthesis of SWI derived from Advanced Scatterometer Surface Soil Moisture (ASCAT SSM) data at 25 km resolution (then resampled to 0.1 degree).

The SWI algorithm, originally developed at Vienna University of Technology (TU Wien) and later improved by other research groups, uses an infiltration model describing the relation between surface soil moisture and profile soil moisture as a function of time. The algorithm is based on a two-layer water balance model.

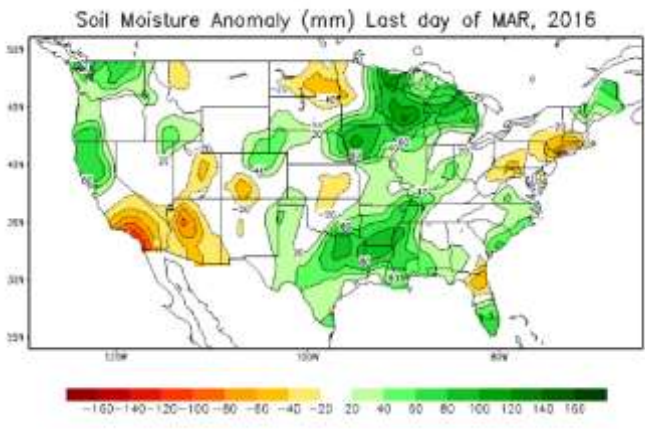
The data value used are using the largest characteristic time length giving the deepest penetration within the soil layers, and the values represent an average SWI across 0.5 to 1 meter of the topsoil.

SWI is used as an indicator for the water availability in the upper part of the root zone.

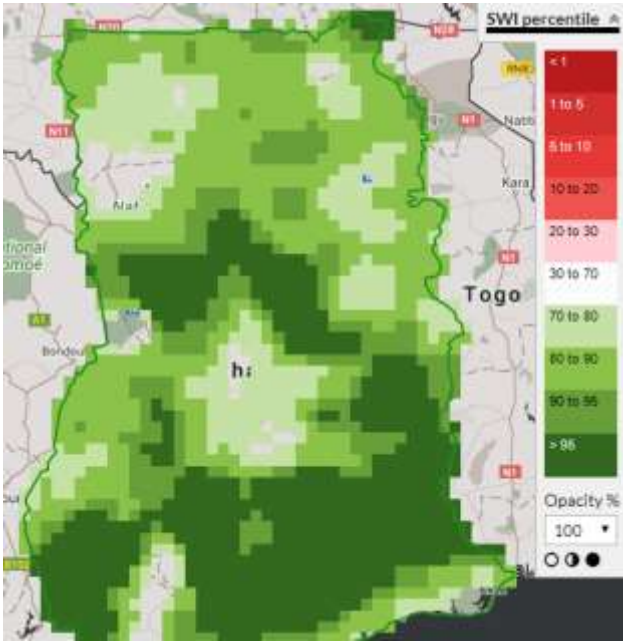
SWI in itself is NOT a drought index, but could be used to detect changes in the soil moisture pattern from year to year.

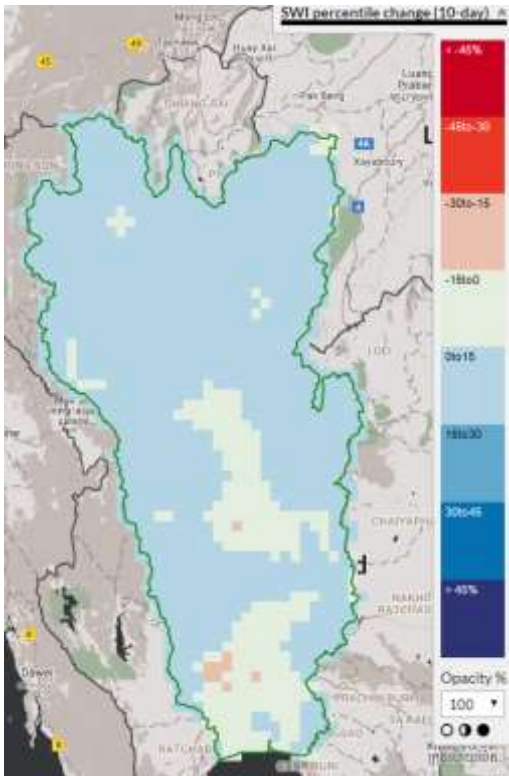
Spatial extent	Global
Spatial and temporal resolution	Spatial resolution: 0.1 degree Temporal resolution: daily METOP-ASCAT satellite, from 2007 – present
Reference	http://land.copernicus.vgt.vito.be/PDF/datapool/ and http://land.copernicus.eu/global/products/swi
Update Frequency	Daily
Related indices	Soil moisture based indices

The following tables define indicators based on the SWI included in the web portal.

Title	SWI deviation
Description	SWI deviation is calculated as the deviation from the long-term mean. It expresses the current soil moisture compared to the long term mean for the same period.
	INDICATOR USAGE
Index interpretation	<p>SWI deviation could be used to define areas with unexpected low water availability in the root zone as it is defined as the difference between the SWI for the current time step and the long term mean SWI for the same period.</p> $DEV_{SWI} = SWI_i - SWI_{mean,m}$ <p>Where: SWI_i : SWI for the current time step and $SWI_{mean,m}$: Long term mean SWI for the same month</p> <p>When DEV_{SWI} is negative, it indicates the below-normal water availability and, therefore, suggests a prevailing drought situation. The greater the negative departure the greater the magnitude of a potential drought.</p>
Spatial extent	Global coverage
Spatial and temporal resolution	<p>Spatial resolution: 0.1 degree</p> <p>Temporal resolution: Daily or 10 daily</p>
Reference	Processed based on SWI data
Example of usage	<p>Example of how a SWI anomaly map from the Climate Prediction Centre (http://www.cpc.ncep.noaa.gov)</p> 
	INDICATOR CALCULATION
Data requirements and calculation	$DEV_{SWI} = SWI_i - SWI_{mean,m}$ where: SWI_i : SWI for the current time step and $SWI_{mean,m}$: Long term mean SWI for the same month(from 2007 to present)
Update Frequency	Daily or 10 daily

Data source	Based on SWI data
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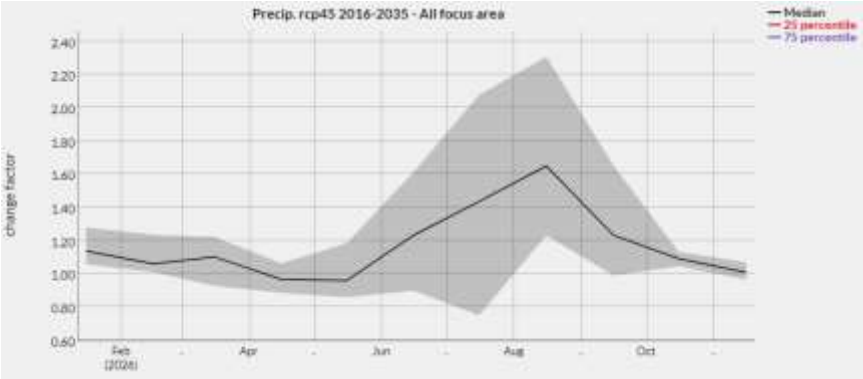
Title	SWI percentile
Description	SWI percentile expresses the percentage of soil moisture that is equal or below a certain amount for each year in the entire record.
	INDICATOR USAGE
Index interpretation	A drought or water scarcity is often defined when the soil moisture percentile drops below 30 or 20 %.
Spatial extent	Global coverage
Spatial and temporal resolution	Spatial resolution: 0.1 degree Temporal resolution: daily or 10 daily
Reference	Processed based on SWI data
Example of usage	<p>Example of SWI percentile map</p> 
	INDICATOR CALCULATION
Data requirements and calculation	Calculated as the percentile value for the same period as the observed data (based on data from 2007 to present).
Update Frequency	Daily or 10 daily
Data source	Based on SWI data

Title	SWI percentile change
Description	Change in soil moisture percentile is used to evaluate the trend over a given period and locate areas where the soil moisture is increasing or decreasing. The SWI percentile is calculated for 1 week, 2 week and 1 month change.
	INDICATOR USAGE
Index interpretation	Positive values indicate an increase in soil moisture across the period while negative values indicate a decrease in soil moisture across the period.
Spatial extent	Global coverage
Spatial and temporal resolution	Spatial resolution: 0.1 degree Temporal resolution: Daily or 10 daily
Reference	Processed based on SWI data
Example of usage	<p>Example of SWI percentile change (10 days) showing areas where the soil is getting wetter or dryer over the last month.</p> 
	INDICATOR CALCULATION
Data requirements and calculation	Calculated as the change in percentile value.
Update Frequency	Daily or 10 daily
Data source	Based on SWI data

3.1.6 Climate change data

Coordinated Regional Climate Downscaling Experiment (CORDEX) is a World Climate Research Programme (WCRP) project with the goal to produce coordinated sets of regional downscaled climate projections worldwide, i.e. for each continent a model domain was defined to run a set of Regional Climate Models (RCMs). The initiative responsible for the generation of RCMs for Africa is called CORDEX Africa. The RCMs are driven by the new generation radiative concentration pathway (RCP) scenarios at a horizontal resolution of 0.44 degree.

The RCM outputs are processed into so-called delta change factors for monthly mean rainfall in order to indicate projected changes in monthly mean rainfall. The factors represent for each month the ratio between the average in the control model run (1986-2005) and the projection model run (2081-2100). Changes are estimated for the medium radiation forcing scenario RCP4.5 and the extreme radiation forcing scenario RCP8.5.

Spatial extent	Global
Spatial and temporal resolution	Spatial resolution: 0.44 degree Temporal resolution: resampled to monthly METOP-ASCAT satellite, from 2007 – present
Reference	https://esg-dn1.nsc.liu.se/search/esgf-liu/ (ESGF Data Node)
Example of usage	Monthly envelope chart of precipitation delta change factors showing expected increase or decrease in precipitation over a certain basin. 
Update Frequency	Static dataset
Related indices	None

Based on the delta change factors we will calculate the climate change projection series of precipitation. These time series will be named and identified after the carbon dioxide emissions scenarios and the projection time period:

- Precip. rcp45 2016-2035
- Precip. rcp85 2016-2035
- Precip. rcp45 2081-2100
- Precip. rcp85 2081-2100

Based on the precipitation datasets listed, we will generate an index expressing the number of dry days per month for each RCP scenario and projection time period. Finally, alongside precipitation, the datasets of temperature and potential evapotranspiration will also be generated and named:

- PET rcp45 2016-2035
- PET rcp85 2016-2035
- PET rcp45 2081-2100
- PET rcp85 2081-2100
- TEMP rcp45 2016-2035
- TEMP rcp85 2016-2035
- TEMP rcp85 2081-2100
- TEMP rcp45 2081-2100

This dataset is static and will be made available through the web portal.

3.1.7 Water body data

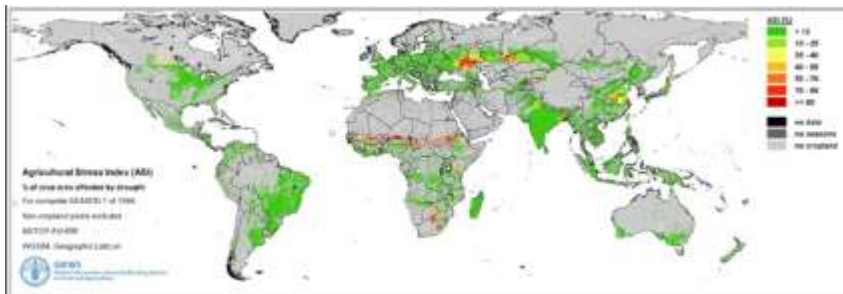
The Water body data produced by the Copernicus Global Land Service (CGLS) is a component of the Land Monitoring Core Service (LMCS) of Copernicus, the European Earth Observation programme. With this dataset it is possible to detect areas covered by inland water along the year providing the maximum and the minimum extent of the water surface as well as the seasonal dynamics.

Spatial extent	Global
Spatial and temporal resolution	Spatial resolution: 300 m Temporal resolution: 10 day composite product. PROV-B sensor, from January 2014 – present
Reference	http://land.copernicus.eu/global/products/wb
Update Frequency	10 days
Related indices	-

3.1.8 Other related drought indices

3.1.8.1 ASI

The agricultural stress index is a combined index based VHI and crop related information. It is available as a seasonal index and annual one.

Title	Agricultural stress index
Description	The Agricultural Stress Index (ASI) is an index based on the integration of the Vegetation Health Index (VHI) in two dimensions that are critical in the assessment of a drought event in agriculture: temporal and spatial.
	INDICATOR USAGE
Index interpretation	ASI maps highlight anomalous vegetation growth, and potential drought, in crop zones during the growing season.
Spatial extent	Global coverage
Spatial and temporal resolution	Spatial resolution: resampled to the crop mask resolution Temporal resolution: 16-day
Reference	http://www.fao.org/giews/earthobservation/asis/index_1.jsp
Example of usage	<p>This is an extract from the Earth observation page by FAO, where the ASI is also calculated in near real-time.</p>  <p>Agricultural Stress Index (ASI) % of crop area affected by drought For composite 16.0.2020: 1 of 1666 Non-completed pixels excluded 16.0.2020 WRC/CTCN - Geographical Location</p>
	INDICATOR CALCULATION
Data requirements and calculation	<p>The first step of the ASI calculation is a temporal averaging of the VHI, assessing the intensity and duration of dry periods occurring during the crop cycle at pixel level.</p> <p>The second step determines the spatial extent of drought events by calculating the percentage of pixels in arable areas with a VHI value below 35 percent (this value was identified as a critical threshold in assessing the extent of drought in previous research by Kogan, 1995).</p> <p>Finally, each administrative area is classified according to its percentage of affected area to facilitate the quick interpretation of results by analysts.</p>
Update Frequency	<ul style="list-style-type: none"> Seasonal: 16-day Annual: yearly
Data source	<ul style="list-style-type: none"> Crop mask (raster): link to source Growing season start and end (SOS/EOS) (3 seasons): link to source VHI

	<ul style="list-style-type: none"> Administrative area: http://www.naturalearthdata.com/
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3.1.8.2 CDI

The **Combined Drought Indicator** is a composite indicator based on SPI, SWI and NDVI related indices.

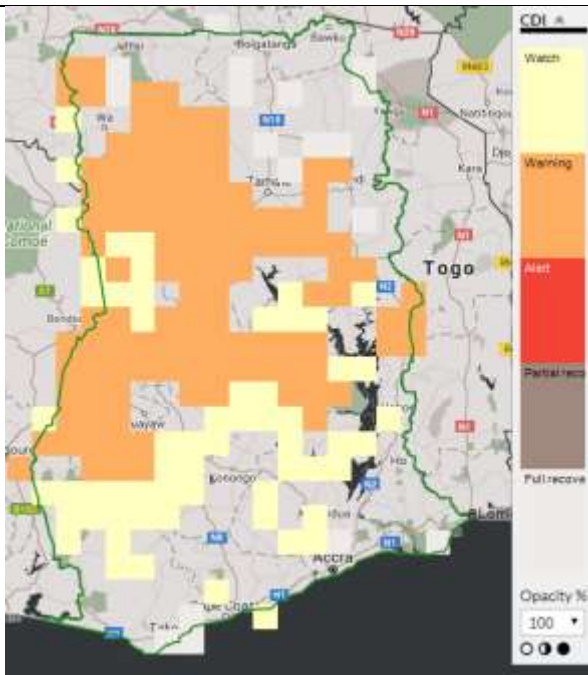
Title	Combined Drought Indicator (CDI)
Description	The Combined Drought Indicator is a composite product based in these layers: SPI (SPI-1 and SPI-3), SWI anomaly and NDVI anomaly.
	INDICATOR USAGE
Index interpretation	The output of this indicator is a classified layer with 5 categories named as Watch, Warning, Alert, Partial recovery and Recovery.
Spatial extent	Global coverage
Spatial and temporal resolution	Spatial resolution: based on the SPI resolution (from TRMM data) Temporal resolution: based on NDVI data (16 days)
Reference	http://edo.jrc.ec.europa.eu/documents/factsheets/factsheet_combinedDroughtIndicator.pdf
Example of usage	
	INDICATOR CALCULATION
Data requirements and calculation	The calculation is based on the following logic to determine the category:

Table 1 Combined Drought Indicator description	
Classification	Characteristics
Watch	$SPI-3 < -1$ or $SPI-1 < -2$
Warning	$\Delta pF > 1$ & ($SPI-3 < -1$ or $SPI-1 < -2$)
Alert	$\Delta fAPAR < -1$ & ($SP-3 < -1$ or $SPI-1 < -2$)
Partial recovery	$(\Delta fAPAR < -1 \text{ \& } (SP-3_{m-1} < -1 \text{ \& } SPI-3 > -1))$ or $(\Delta fAPAR < -1 \text{ \& } (SP-1_{m-1} < -2 \text{ \& } SPI-1 > -2))$
Full recovery	$(SP-3_{m-1} < -1 \text{ \& } SPI-3 > -1)$ or $(SP-1_{m-1} < -2 \text{ \& } SPI-1 > -2)$

- SPI-1 and SPI-3 month are the SPI indices calculated from TRMM data
- pF: represents the Soil moisture based on SWI anomalies
- fAPAR: is replaced by the vegetation index based on NDVI anomalies

Update Frequency	16-day
Data source	<ul style="list-style-type: none"> • SPI computed from TRMM data • SWI • NDVI

3.2 Functionality

This section contains a brief description of the functionalities currently available from the Data and Information application.

3.2.1 Info menu

The information menu allows the user to access the *User guide*, *About* description, the *Data status* for the basin and *Download all GIS layers* associated to this basin.

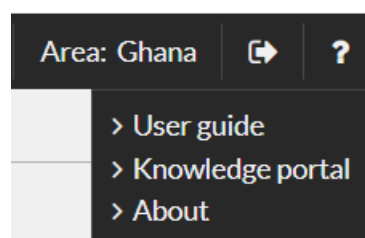


Figure C-11 Information menu

3.2.1.1 User guide

Opens a pdf version of the user guide.

3.2.1.2 Knowledge portal

Opens and login to the knowledge portal, which is a discussion forum for all users of the portal.

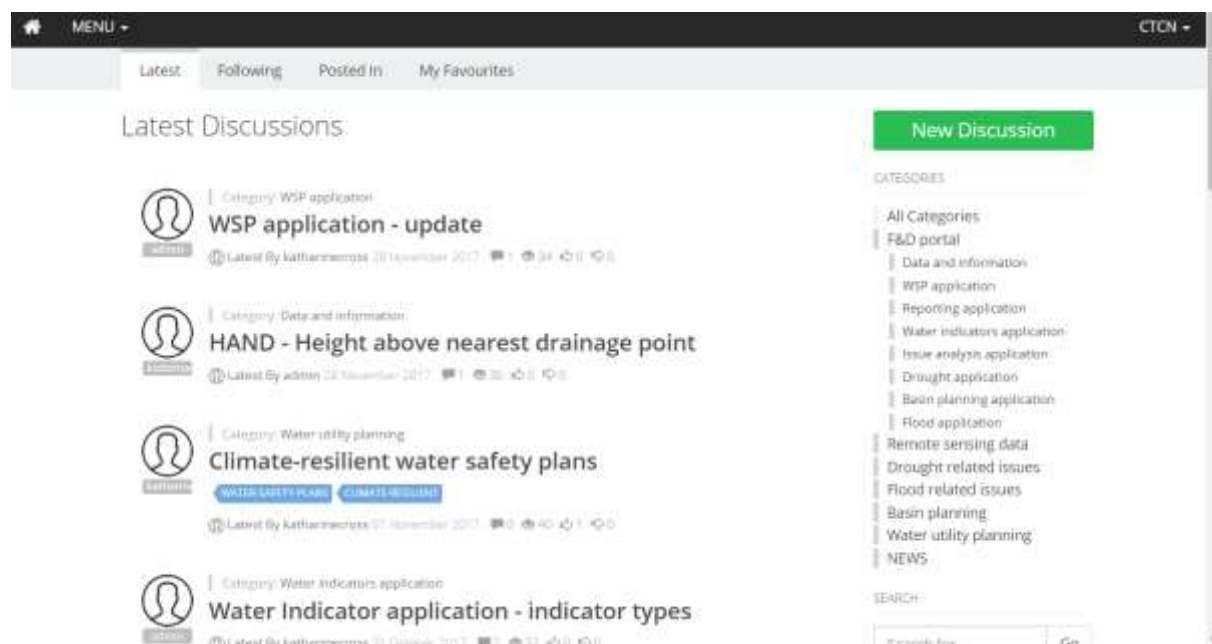


Figure C-12 Knowledge portal landing page

3.2.1.3 About

Opens a short description of the system and contact information to the administrator.

3.2.2 Data menu

3.2.2.1 Select menu

The *Select* menu is used to select the favourite data or the data available for viewing and analysis. The user selection is stored and will be used the next time the user logs in.

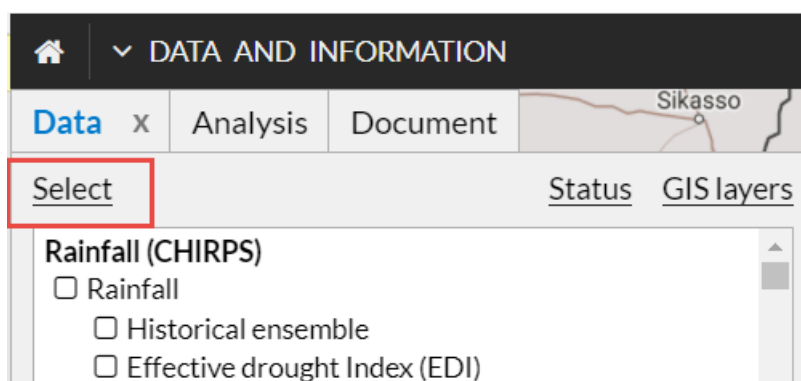


Figure C-13 To open the Select menu

The *Select favourite data* dialog contains the following information:

- Overview of all available data in the Data and Information application (for the particular focus area)
- When clicking on a data type a brief description is displayed.
- When selecting one or several data types and pressing “Update” the selected data will be available for viewing and analysis.

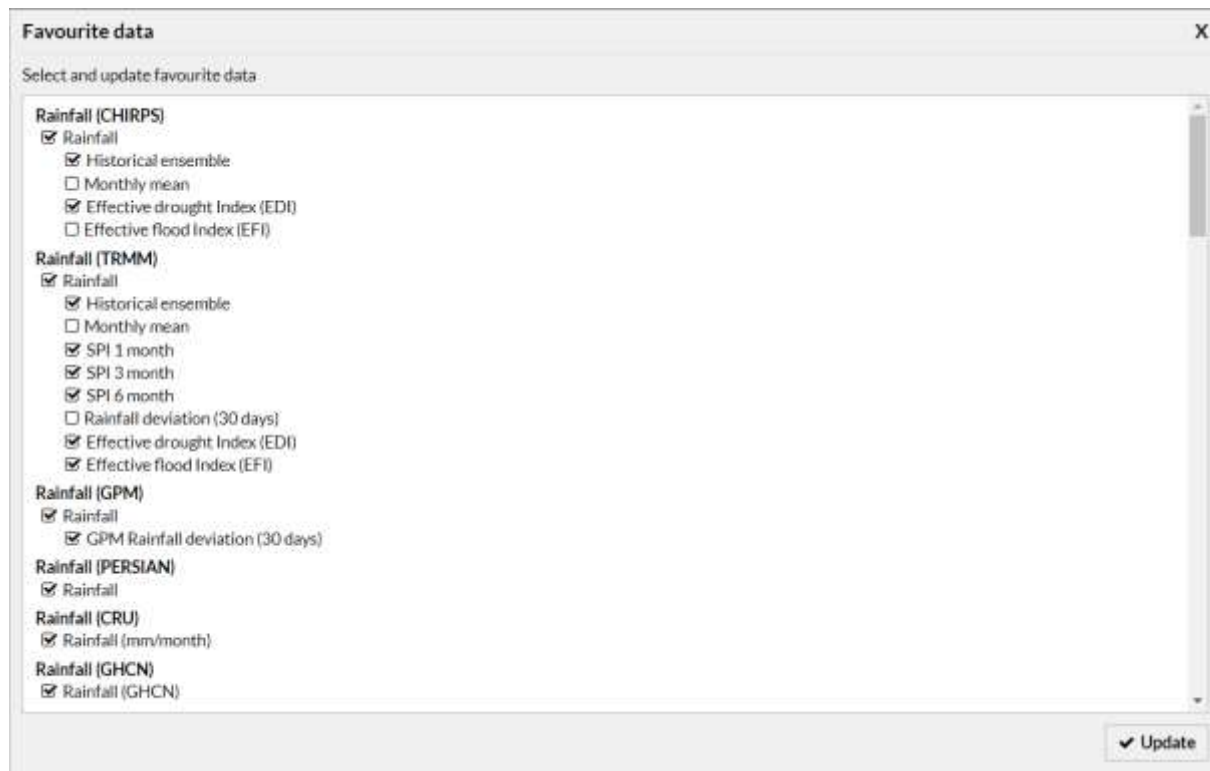


Figure C-14 Select menu



Figure C-15 Available data in the Data tab is updated based on the selection in the Select menu.

3.2.2.2 Layer visibility

The *Data* menu is used for viewing the data types selected in the *Select* dialog. The following functionality and information is available:

- **List of available data types** (based on the selection in the *Select* dialog)
 - Select or unselect a data type from the list
 - When selecting a data type it appears on the map view showing the most recent time stamp
- **Legend** for the selected data type could be toggled on and off through the “Legend” option
- **Timeline** for the selected data type is shown at the bottom of the screen. Gaps in the time line denotes periods with missing data
 - Click within the time line to view the data at the specific time step
- **Current time step** is shown at the lower right part of the screen
 - Use the step forward or backwards buttons to change the time step

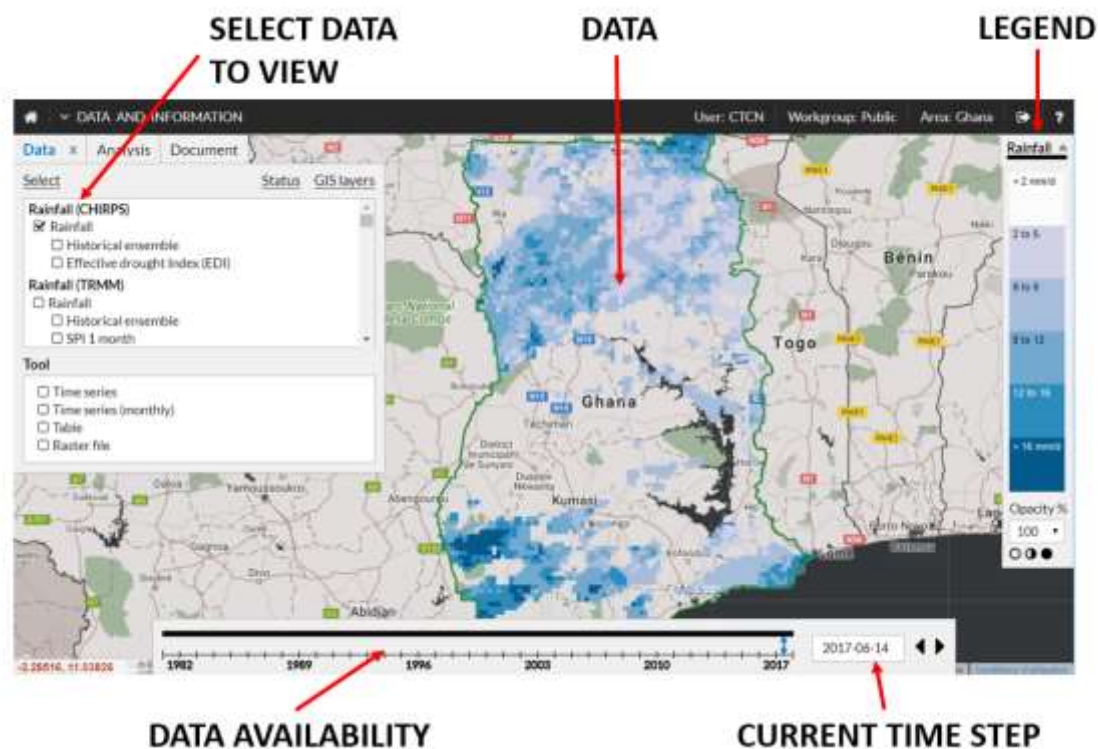


Figure C-16 Overview of functionality in the Data menu

3.2.2.3 Tool functionality

The *Tools* menu opens below the data type selection allowing the user to download data and perform a simple processing such as area-weighted time series.

AVAILABLE TOOLS

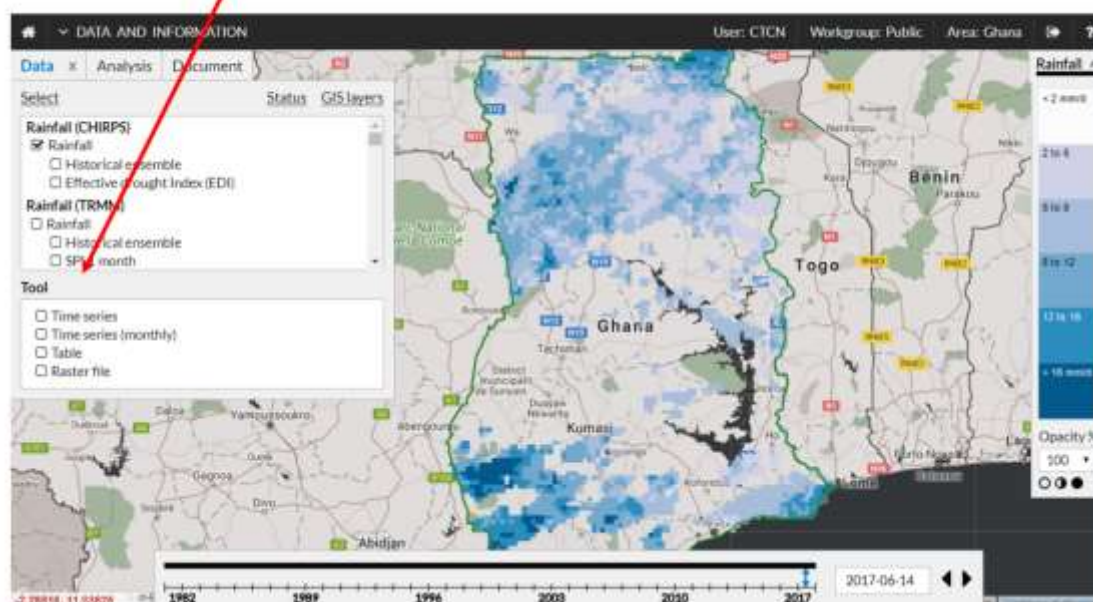


Figure C-17 Available tools

When opening the *Tools* menu a dialog with options for a) tool selection and b) tool configuration.

The available tools depends on the selected data layer.

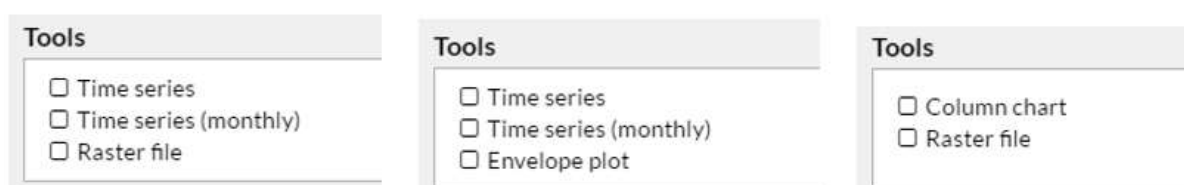


Figure C-18 Available tools will be displayed depending on the selected data layer

Tool raster file (download netcdf file)

The “Raster file” tool is used to download the selected data type as a netcdf file. To download the data file:

- Select the data type and select the “Raster file” tool
- Specify the time period to download data for
- Press the “Extract” button which will calculate the estimate file size and display this in a dialog
- Press “Download” to download the file as a netcdf file

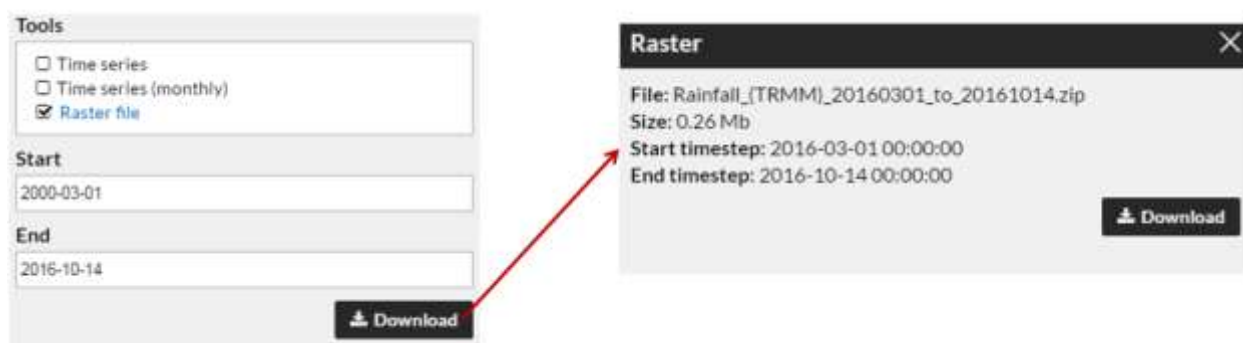


Figure C-19 Specify the time period to download data for, click on Download and then a dialog with the estimated file size will appear.

Note: the zip file contains the raster as .nc file, which can be open in most GIS tools. In addition, a legend file as .qml are associated to the .nc file. This legend file can be used in QGIS to load the default symbology.

Tool area (time series and plotting tools)

The tools operate on different spatial resolutions – available options depend on the selected tools. The options are:

- **All focus area.** The tools produces an area weighted time series for the entire focus area.
- **User location.** Time series extracted at user specified locations (see following section for more details).
- **Subarea layer.** Time series processed as area weighted time series for a user specified subarea.
- **Point layer.** Time series processed as area weighted time series for a user specified point location.

Pressing the “Download” button downloads the data as a csv file. Pressing the “Chart” button displays a plot with the tool result.

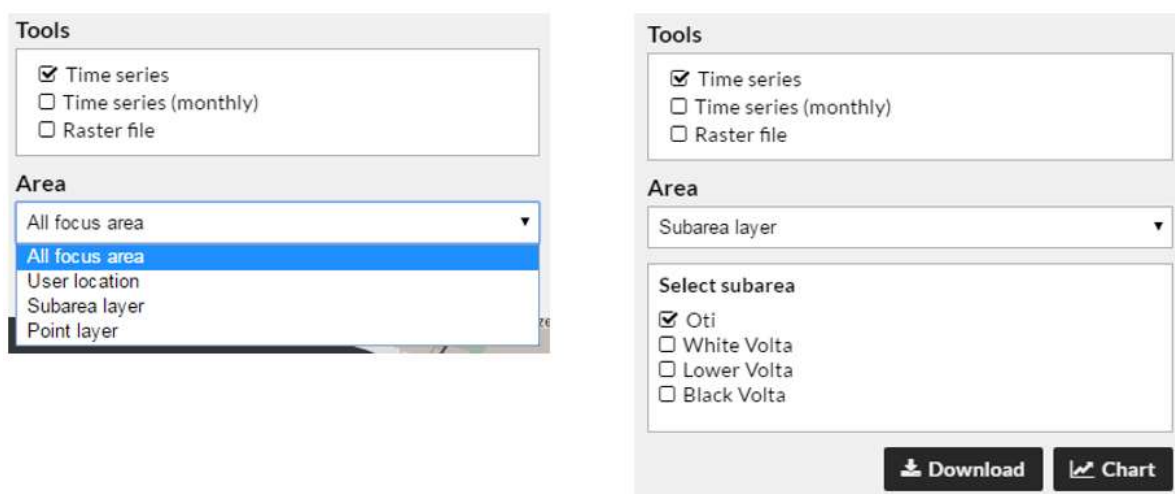


Figure C-20 Tools are available at different spatial resolutions (options depend on the selected tool)

All focus area

Selecting the “All focus area” produces an area-weighted result of the data type for the entire focus area, see Figure C-21 for an example with a time series tool. The time series plot is shown with area weighted data and long term average data.

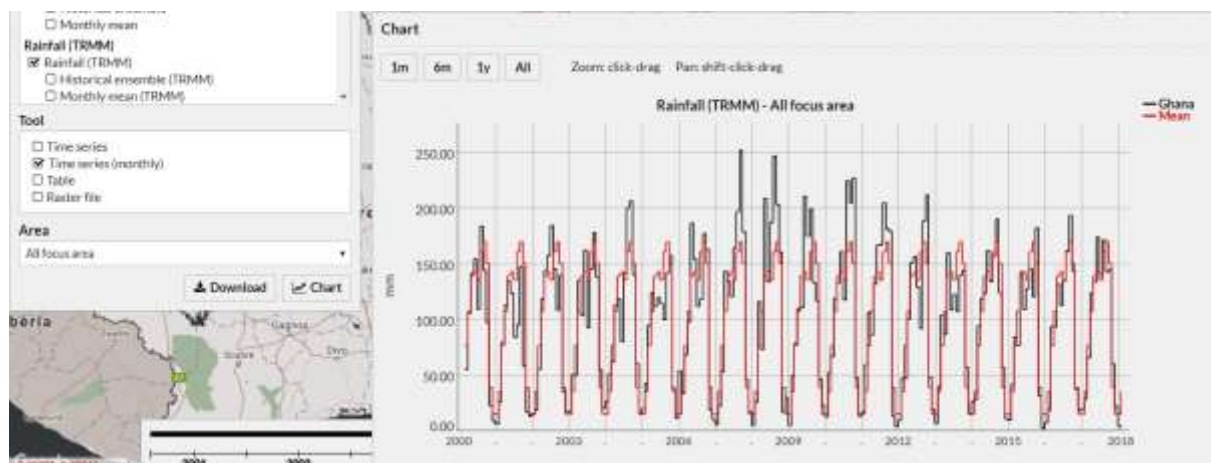


Figure C-21 Area weighted plot for the entire focus area

Subarea layer

When selecting the “Subarea layer” a selection of the available subareas appears. Selecting a subarea will highlight the area on the map. Pressing “Chart” will produce a plot with the area weighted results, pressing “Download” will download the data.

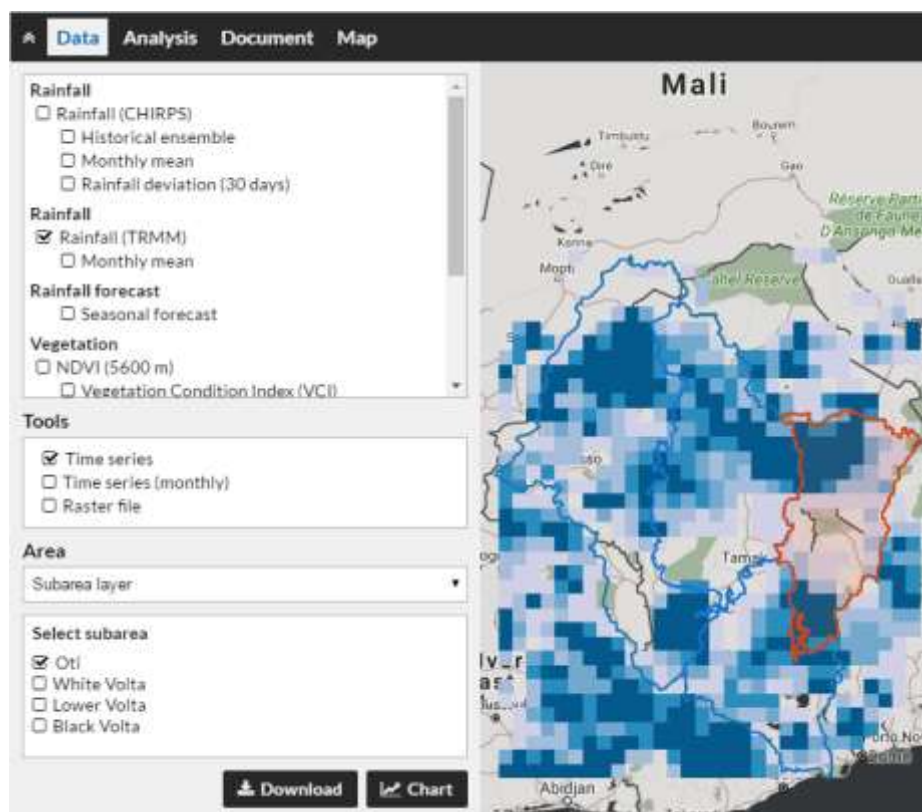


Figure C-22 Subarea selection

Point layer

When selecting the “Point layer” a selection of the available locations appears. Selecting a point will highlight the location on the map. Pressing “Chart” will produce a plot with the area-weighted results, pressing “Download” will download the data.

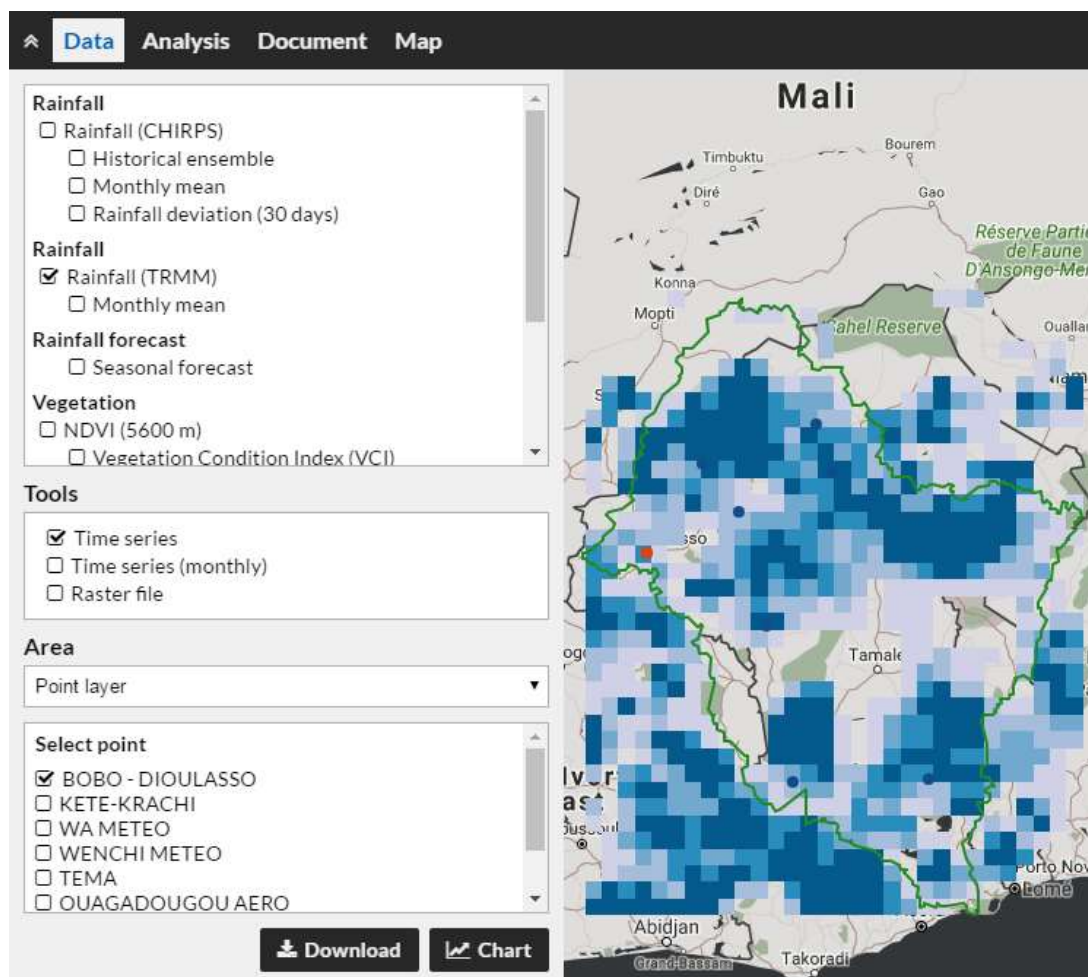


Figure C-23 Point layer selection

User location

The “User location” allows the user to extract data from the data layer at user specified locations. The procedure are:

- Click on the map to define the location.
- The system will retrieve the data at the location.
- Several locations can be retrieved.
- Press the “Download” button to get the data

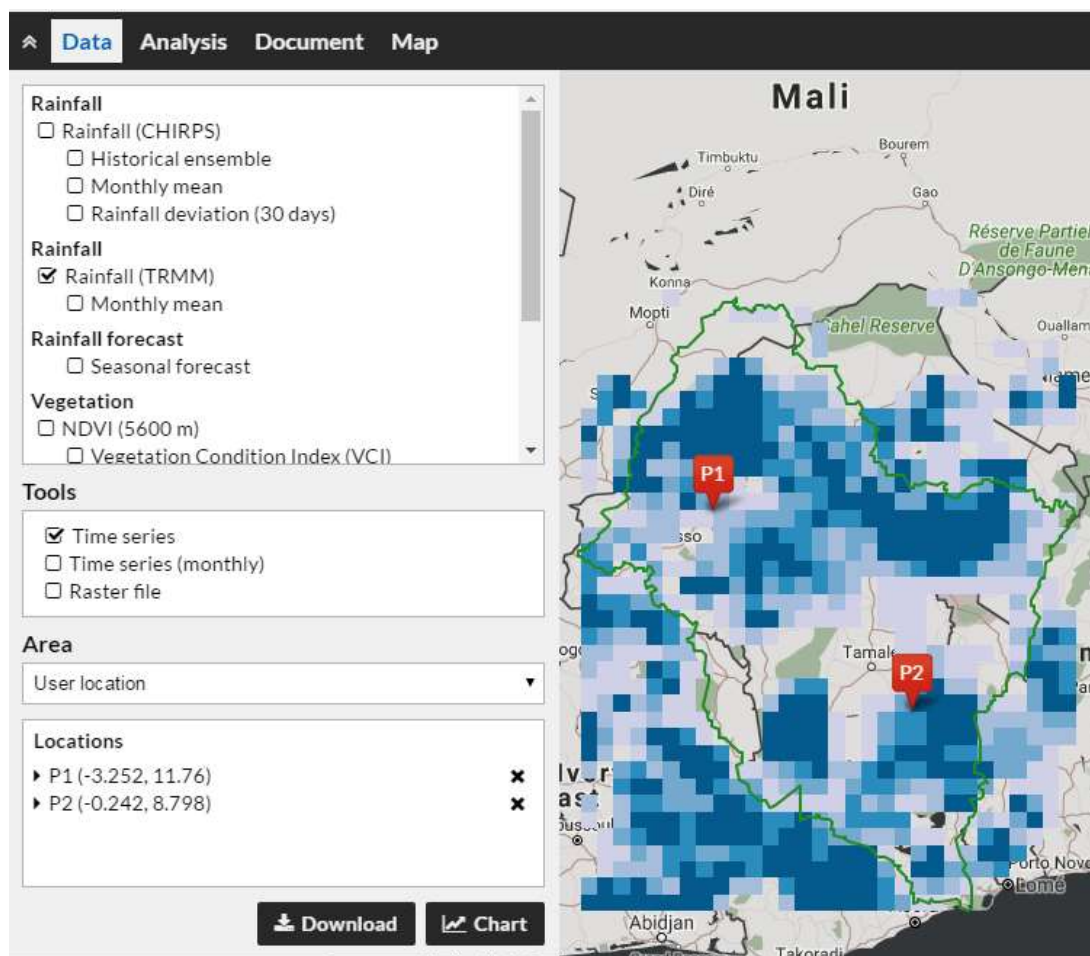


Figure C-24 User location selection

Time series Tool

The time series tool produces an area weighted time series for the selected area. The time series uses the same temporal resolution as in the data file.

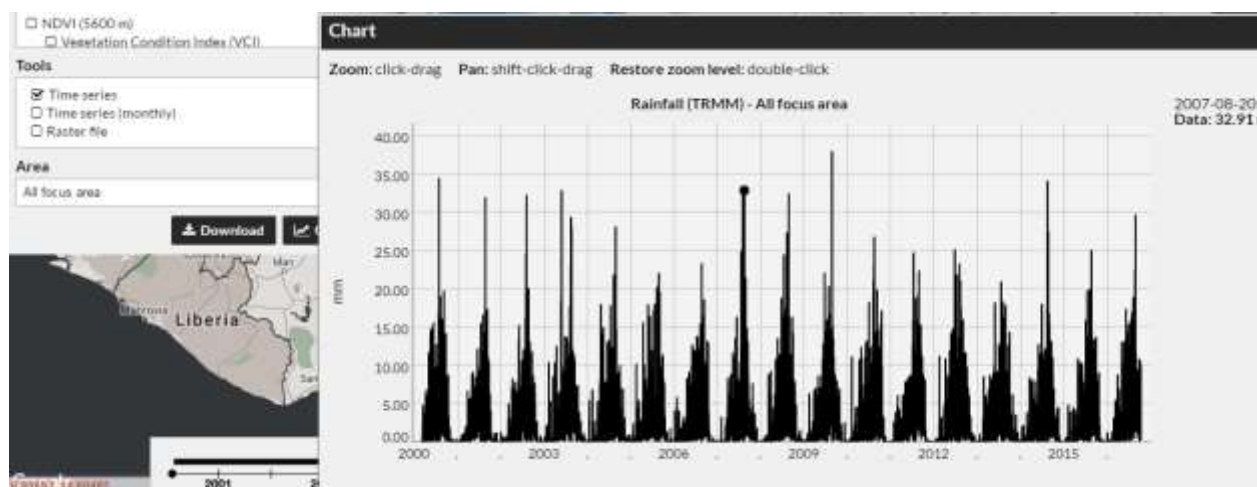


Figure C-25 Output from Time series tool

Time series (monthly) Tool

The time series tool produces an area weighted time series for the selected area. The time series contains monthly accumulated values, and contains an item with the actual data (black) and an item with the long-term mean of each of the monthly time steps (red).

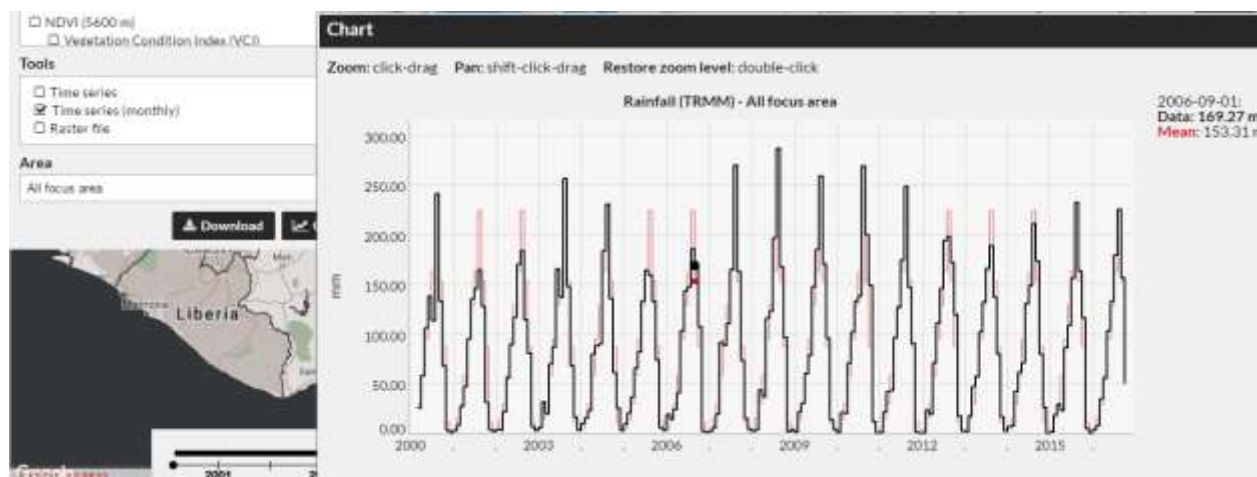


Figure C-26 Output from Time series (Monthly) tool

Envelope plot Tool

This tool is only available for ensemble based data types, and produces a plot showing the median, 25 percentile and 75 percentile of the ensemble values.

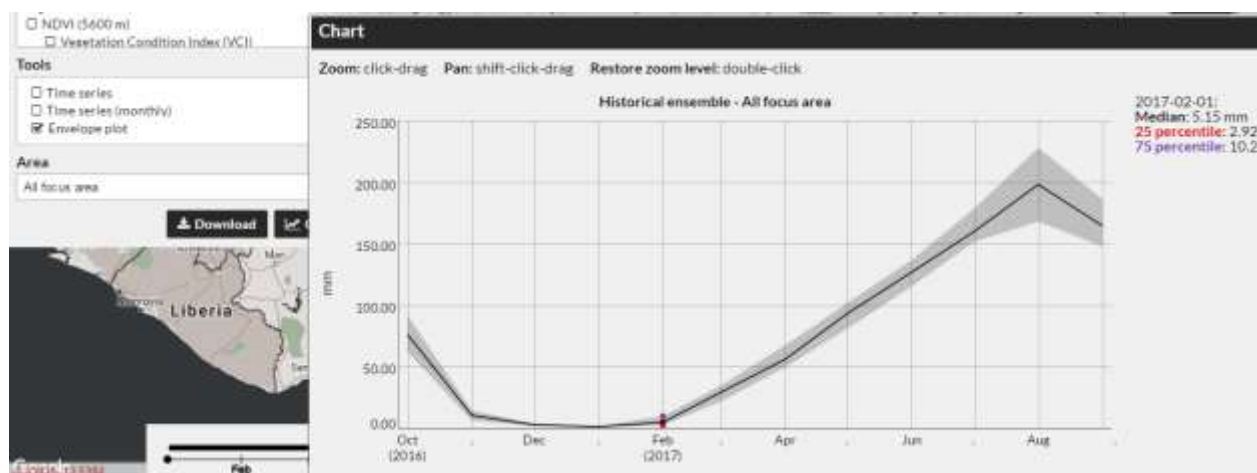


Figure C-27 Output from Envelope tool

Column chart Tool

The column chart tool is only available for selected indices, and produces a plot showing the coverage, in percentage, of different drought or flood categories.

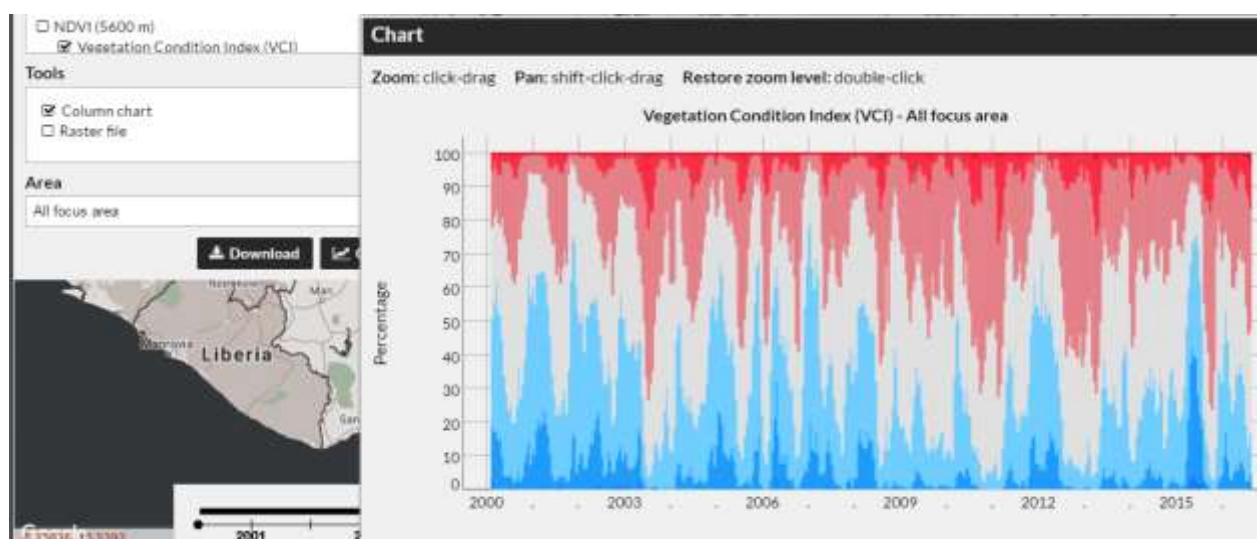


Figure C-28 Output from "Column chart" tool

3.2.2.4 Tool tips

Tips are available for all layers and tools by clicking on the layer name or tool name.

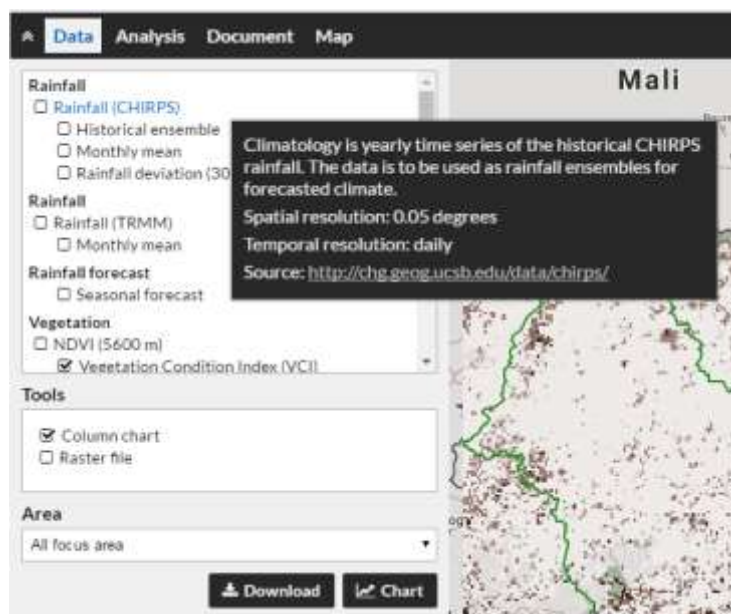


Figure C-29 Tips displayed for a selected layer.

3.2.3 Document menu

The document menu opens a dialog listing the available documents associated with the particular focus area. The documents could be fact sheets with more information on specific data types, video showing the temporal and spatial change of a data type, custom made drought reports or other documents associated with the specific focus area.

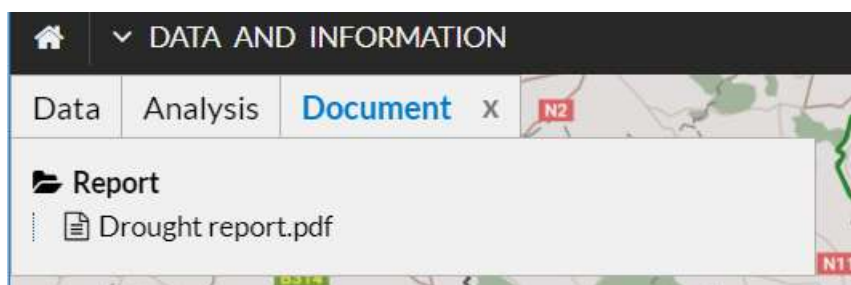


Figure C-30 Document menu showing a list of available documents

3.2.4 Map menu

The map menu allows the user to select between different background maps.

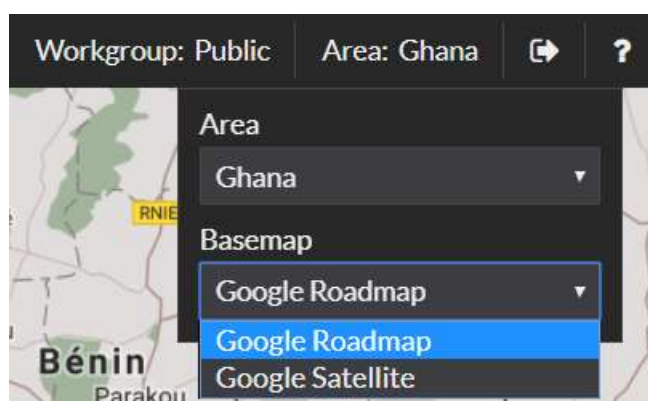


Figure C-31 Base map menu to select background map

4 Annex D: Drought Assessment

This section contains a description of the functionalities in the Drought Assessment application.

4.1 Drought Warning

The Drought Warning page allows the user to select a specific layer and apply a threshold value to highlight the areas that are affected by a specific hazard.

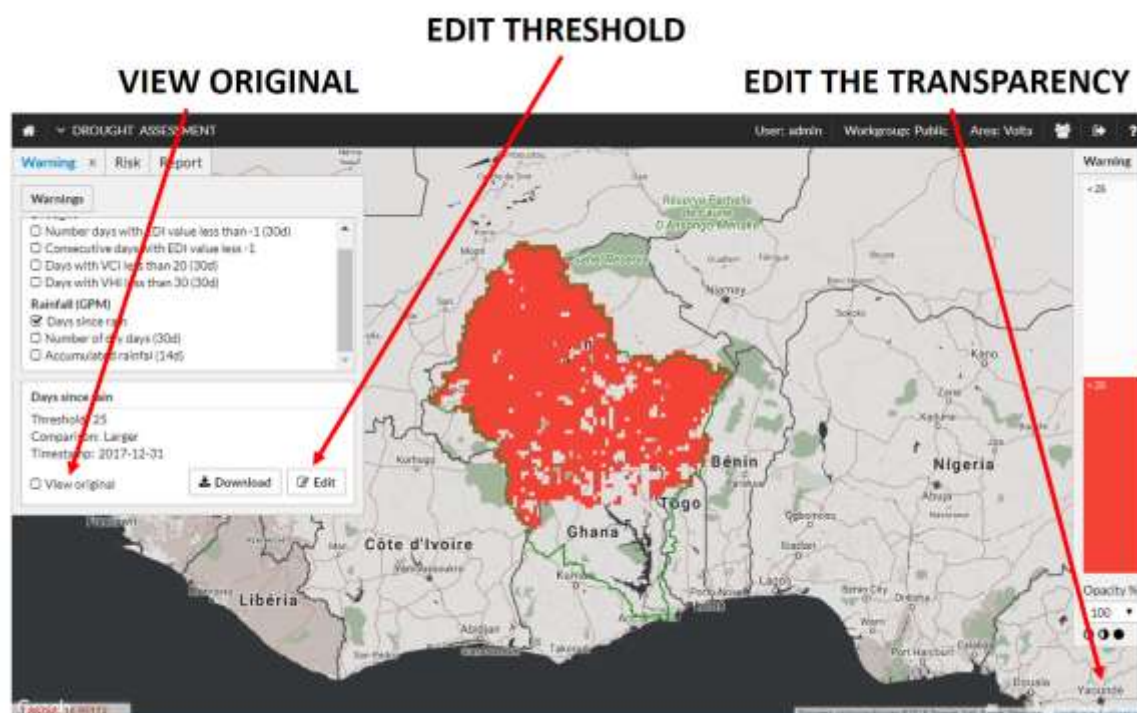


Figure D-32 Drought Warning tab in Drought Assessment app

4.1.1 Warning threshold and comparison

The warning functionality allows the user to filter out the area of the basin that are under a given hazard.

Consecutive days with EDI value less -1

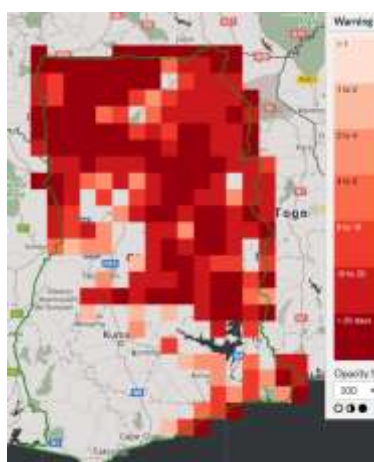
Threshold

Comparison

☐ View original

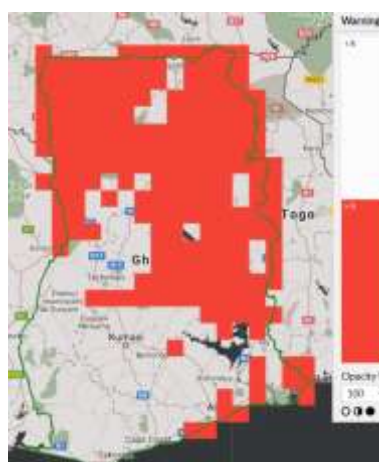
- **Threshold:** this is a user-defined value. The unit changes for each layer.
- **Comparison:** The choice is either larger or lower.
- **View original:** this option displays the original layer without any threshold applied.

The example below illustrates how the warning threshold functionality can be used to highlight the area under meteorological drought based on the EDI value. The number of consecutive days with EDI value below the critical value is computed for the entire basin (left picture). Then a first threshold of 5 days is applied (middle picture). The user is also able to modify the threshold value to update the map (right picture).



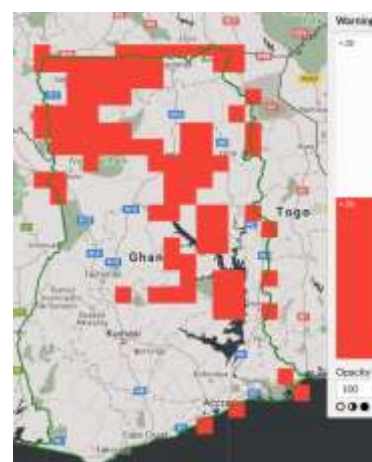
Original layer

Consecutive days with EDI value less -1



Warning layer 1

Area where number of consecutive days with EDI value less -1 is more than 5 days



Warning layer 2

Area where number of consecutive days with EDI value less -1 is more than 20 days

4.1.2 Warning descriptions

The layers used for warning are computed automatically with the latest available information. The layer is always made of one time step (the latest available in the related dataset).

The layers are grouped based on the dataset there calculated from. Below is a description all the layers currently available with a short description.

Drought: based on the various drought indices

- **ASI latest value:** Latest value of the ASI for Season 1
- **Number days with EDI value less than -1 (30d):** Number of days with EDI value less than -1 during the last 30 days
- **Consecutive days with EDI value less -1:** Maximum number of consecutive days with EDI value less than -1 during the last 30 days

- **Days with VCI less than 20 (30d):** Number of days with VCI value less than 20 during the last 30 days
- **Days with VHI less than 30 (30d):** Number of days with VCI value less than 30 during the last 30 days

Rainfall forecast: Based on the latest medium range forecast

- **Acc. rainfall next 10 days:** Accumulated rainfall for the coming 10 days (date is the last day in the accumulation)

Rainfall (GPM): Based on the latest GPM data

- **Number of consecutive dry days (30d):** Number of consecutive dry days (< 2 mm/day) during the last 30 days
- **Days since rain:** Number of days since last rainfall event (> 2 mm/day)
- **Number of dry days (30d):** Number of dry days (< 2 mm/day) during the last 30 days
- **Accumulated rainfall (14d):** Accumulated rainfall during the last 14 days
- **Accumulated rainfall (1d) :** Accumulated rainfall during the last 1 day
- **Accumulated rainfall (30d) :** Accumulated rainfall during the last 30 days
- **Accumulated rainfall (7d) :** Accumulated rainfall during the last 7 days
- **Number of wet days (30d):** Number of wet days (> 2 mm/day) during the last 30 days

Rainfall (TRMM): Based on the latest TRMM data

- **Number of consecutive dry days (30d):** Number of consecutive dry days (< 2 mm/day) during the last 30 days
- **Days since rain:** Number of days since last rainfall event (> 2 mm/day)
- **Number of dry days (30d):** Number of dry days (< 2 mm/day) during the last 30 days
- **Accumulated rainfall (14d):** Accumulated rainfall during the last 14 days
- **Accumulated rainfall (1d) :** Accumulated rainfall during the last 1 day
- **Accumulated rainfall (30d) :** Accumulated rainfall during the last 30 days
- **Accumulated rainfall (7d) :** Accumulated rainfall during the last 7 days
- **Number of wet days (30d):** Number of wet days (> 2 mm/day) during the last 30 days

4.2 Drought Risk

The Drought Risk page provides an interface to assess risk based on hazards and vulnerability. The main output of this page is a map with overlaid hazard and vulnerability.

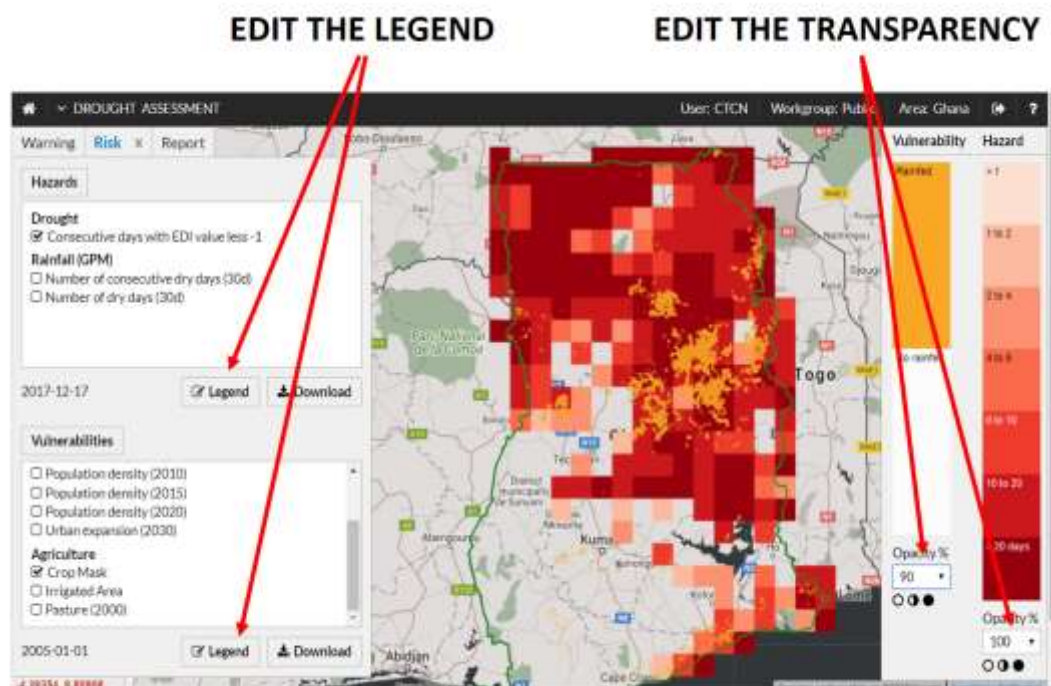


Figure D-33 Drought Risk tab in Drought Assessment app

4.2.1 Edit the legend

The legend of each layer can be edited as shown in Figure D-34. For each category it is mandatory to specify:

- **Min value:** this value should match the previous Max value (if any)
- **Max value:** this value should match the next Min value (if any)
- **Colour:** this is a hexadecimal colour code³

³ Web site such as <http://colorbrewer2.org> can be used to get hexadecimal color codes.

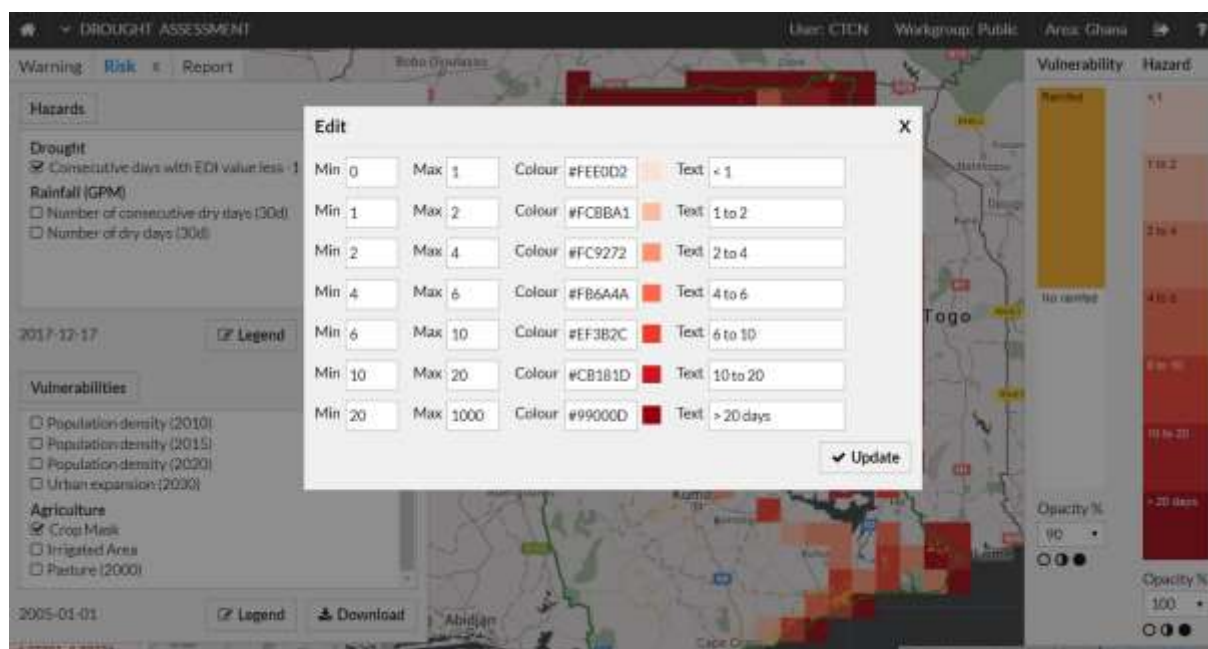


Figure D-34 Edit the legend of the risk layers

4.2.2 Edit the transparency

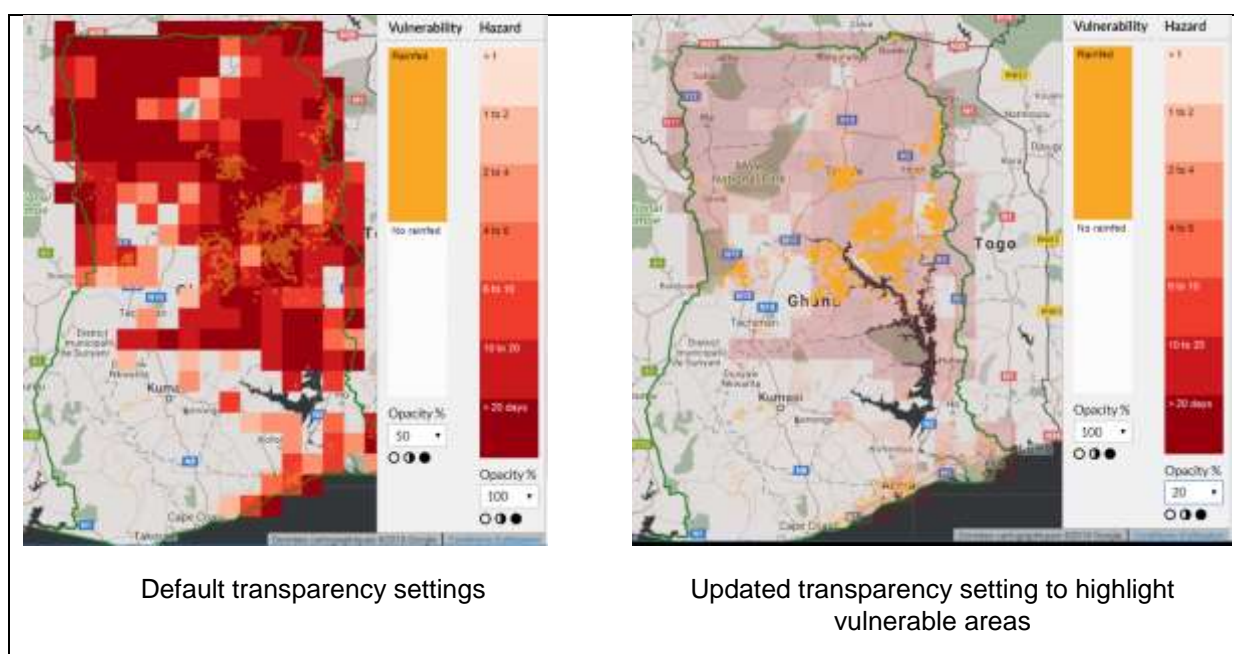


Figure D-35 Risk layers opacity/transparency settings

4.2.3 Hazard description

The hazards layers are similar to the layer found in the Drought Warning tab, without the threshold applied.

The layers are grouped based on the dataset there calculated from. Below is a description all the layers currently available with a short description.

Drought: based on the various drought indices

- **ASI latest value**: Latest value of the ASI for Season 1
- **Number days with EDI value less than -1 (30d)**: Number of days with EDI value less than -1 during the last 30 days
- **Consecutive days with EDI value less -1**: Maximum number of consecutive days with EDI value less than -1 during the last 30 days
- **Days with VCI less than 20 (30d)**: Number of days with VCI value less than 20 during the last 30 days
- **Days with VHI less than 30 (30d)**: Number of days with VCI value less than 30 during the last 30 days

Rainfall forecast: Based on the latest medium range forecast

- **Acc. rainfall next 10 days**: Accumulated rainfall for the coming 10 days (date is the last day in the accumulation)

Rainfall (GPM): Based on the latest GPM data

- **Number of consecutive dry days (30d)**: Number of consecutive dry days (< 2 mm/day) during the last 30 days
- **Days since rain**: Number of days since last rainfall event (> 2 mm/day)
- **Number of dry days (30d)**: Number of dry days (< 2 mm/day) during the last 30 days
- **Accumulated rainfall (14d)**: Accumulated rainfall during the last 14 days
- **Accumulated rainfall (1d)**: Accumulated rainfall during the last 1 day
- **Accumulated rainfall (30d)**: Accumulated rainfall during the last 30 days
- **Accumulated rainfall (7d)**: Accumulated rainfall during the last 7 days
- **Number of wet days (30d)**: Number of wet days (> 2 mm/day) during the last 30 days

Rainfall (TRMM): Based on the latest TRMM data

- **Number of consecutive dry days (30d)**: Number of consecutive dry days (< 2 mm/day) during the last 30 days
- **Days since rain**: Number of days since last rainfall event (> 2 mm/day)
- **Number of dry days (30d)**: Number of dry days (< 2 mm/day) during the last 30 days

- **Accumulated rainfall (14d):** Accumulated rainfall during the last 14 days
- **Accumulated rainfall (1d) :** Accumulated rainfall during the last 1 day
- **Accumulated rainfall (30d) :** Accumulated rainfall during the last 30 days
- **Accumulated rainfall (7d) :** Accumulated rainfall during the last 7 days
- **Number of wet days (30d):** Number of wet days (> 2 mm/day) during the last 30 days

4.2.4 Vulnerability description

Socio-economic

- **Child under weight (percentage):** Percentage of children, under the age of 5, who are underweight (year period: 1990-2002)
- **Drought Mortality Risk:** Global Drought Mortality Risks and Distribution is a 2.5 minute grid of global drought mortality risks. Gridded Population of the World, Version 3 (GPWv3) data provide a baseline estimation of population per grid cell from which to estimate potential mortality risks due to drought hazard. Mortality loss estimates per hazard event are calculated using regional, hazard-specific mortality records of the Emergency Events Database (EM-DAT) that span the 20 years between 1981 and 2000.
- **Flood Mortality Risk:** Global Flood Mortality Risks and Distribution is a 2.5 minute grid of global flood mortality risks. Gridded Population of the World, Version 3 (GPWv3) data provided a baseline population per grid cell from which to estimate potential mortality risks due to flood hazard. Mortality loss estimates per flood event are calculated using regional, hazard-specific mortality records of the Emergency Events Database (EM-DAT) that span the 20 years between 1981 and 2000.
- **Gross Domestic Product:** In the distributed global GDP dataset sub-national GRP and national GDP data are allocated to approximately 1km grid cells in proportion to the population residing in that cell. The method also distinguishes between rural and urban population, assuming the latter to have a higher GDP per capita.
- **Infant Mortality Rate (2000):** Infant mortality rate, adjusted to the year 2000, in deaths per 10,000 live births.
- **Population density (2010):** estimate of population density for the years 2010 based on counts consistent with national censuses and population registers, as raster data to facilitate data integration.
- **Population density (2015)** estimate of population density for the years 2015 based on counts consistent with national censuses and population registers, as raster data to facilitate data integration.
- **Population density (2020)** estimate of population density for the years 2020 based on counts consistent with national censuses and population registers, as raster data to facilitate data integration.

- **Urban expansion (2030)** estimate of population density for the years 2030 based on counts consistent with national censuses and population registers, as raster data to facilitate data integration.

Agriculture

- **Crop Mask:** provides an estimate of the rainfed croplands areas
- **Irrigated Area:** The map shows the amount of area equipped for irrigation around the year 2005 in percentage of the total area on a raster with a resolution of 5 minutes.
- **Pasture (2000):** Global Agricultural Lands in 2000 represent the proportion of pixel that is either under cropland or pasture.

5 Annex E: Reporting

This section contains a description of the functionalities in the Reporting application.

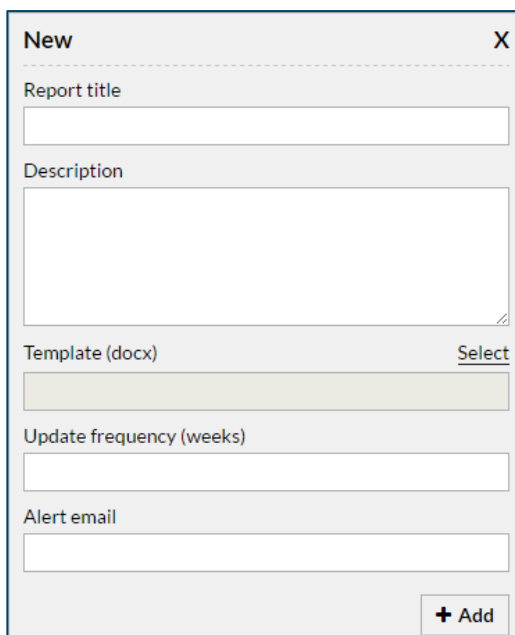
5.1 Open report

The “Open” menu enables an overview of all accessible reports, based on the workgroup concept.

5.2 New report

The “New” menu enables the user to generate a new report. The following input are required:

- **Report title:** Report title as it will appear in the system
- **Description:** Short description of the report.
- **Template:** Report template in Word format (docx format). The reporting template should contain tags in the form of brackets with a text (e.g. ” {this is a reporting tag}”)
- **Update frequency (optional):** The frequency for automated update of the reports in weeks. The minimum time between two reports will be one day. No report will be generated automatically if left blank.
- **Alert email (optional):** Email addresses to be notified when updated report has been generated based on the frequency. Several email addresses can be specified. No report will be generated automatically if left blank.



The screenshot shows a web form titled "New" with a close button (X) in the top right corner. The form contains the following fields:

- Report title:** A single-line text input field.
- Description:** A multi-line text area with a small icon in the bottom right corner.
- Template (docx):** A dropdown menu with a "Select" button to its right.
- Update frequency (weeks):** A single-line text input field.
- Alert email:** A single-line text input field.

At the bottom right of the form is a button labeled "+ Add".

Figure E-1 New report

When pressing the “Add” button a new reporting template will be generated and the list of the tags in the report template will be listed. The user should then specify the content of each of the tags before generating the report.

5.2.1 Default report templates

All reports marked with a “*” in front of the name are default report templates. The Reporting application contains a number of built in default reporting templates enabling the user to generate reports with a default content without having to develop their own Word based template. The default templates could also be used as a starting point for a user defined report.

The default reporting templates are accessed through the “Open” menu, where the all the default templates are marked with a “*” in from of the name, see Figure 39. Please note the following:

- Default reporting templates are all developed by the system and are available as read only templates (user needs to clone the template to use them).
- “Generate” is disabled

In order to use a default reporting template within a specific basin please follow the following procedure:

- Select a default reporting template (through the “Open” menu)
- Clone the reporting template
 - Specify a name for the cloned version
 - Specify the workgroup for the cloned version of the report
 - Update the description if needed
- Press “Clone” to copy the default reporting template.

After the reporting template is cloned the “Generate” option will be enabled and the user can now generate the report for this specific basin. The report will be populated with updated content and can be viewed after the “Generate” option is executed.

5.2.2 New report template

It is possible to create a new template as a Report template in Word format (docx format). The reporting template should contain tags in the form of brackets with a text (e.g. “{this is a reporting tag}”)

For maps, it is recommended to add a frame around the text, this frame will then be adjusted around the map added as picture to the Word document. The best way is actually to create a one cell table, inside which the picture will be added, see below an example. Please note that a negative left indent will give better result.

{MAP:VHI-4.parts}

Figure E-2 Tags to be used as a map placeholder

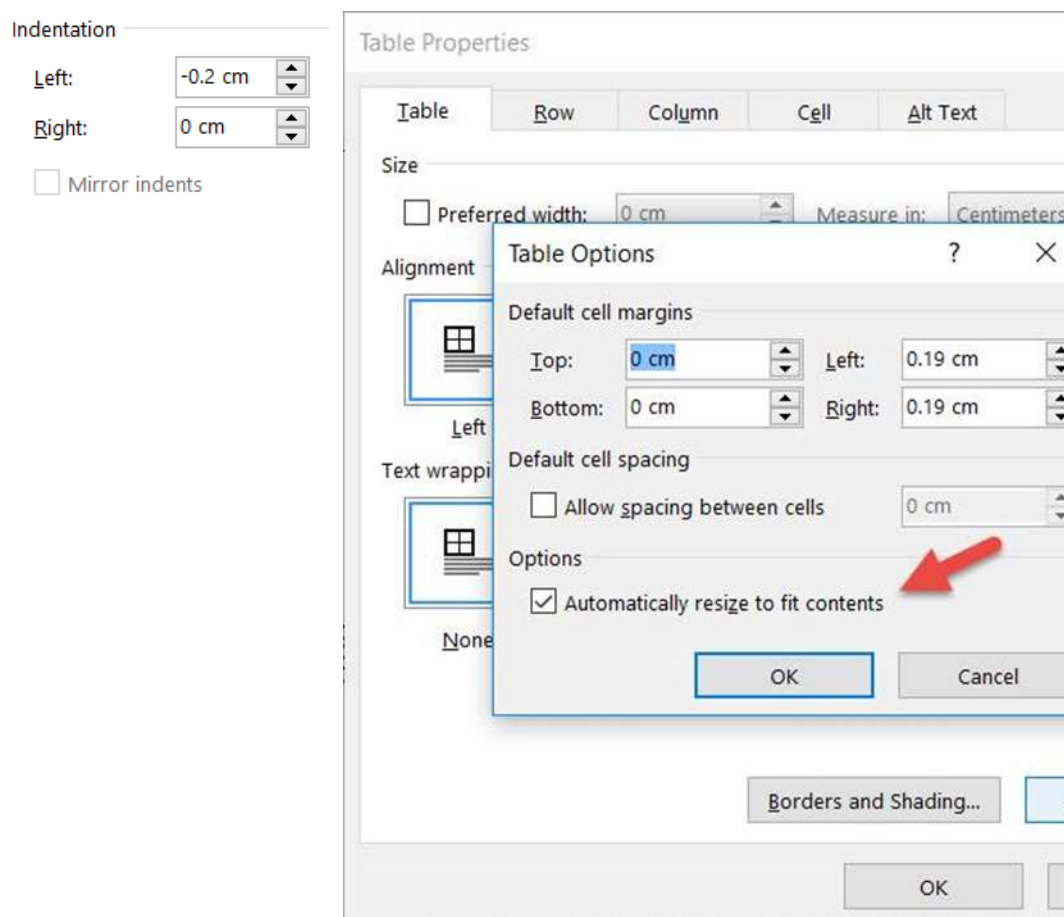


Figure E-3 Properties of the table

5.3 Clone report

The “Clone” menu creates a copy of a report and saves it in a new user specified name. Note that the user has the option of selecting the workgroup for the cloned report.

5.4 Edit report

The “Edit” menu enables the user to change or edit the report title, the description, change the reporting.

Edit
X

Report title

Description

Template (docx) Select

Update frequency (weeks)

Alert email




 **Update**






Figure E-4 Edit dialog

5.5 Delete report

The “Delete” menu deletes the current report. Please note that the template and all the settings will be deleted from the system. The “Delete” menu is only enabled if the user is the author of the current report.

5.6 Edit or preview reporting tags

When opening a report with editing rights, refer to user workgroup, all the content of the reporting template will be editable. When pressing the edit button () an Edit dialog is opened and the user is able to specify the content for the specific tag. Pressing the preview button () enables the user to pre-view the content of the specific tag.

Tag	Source	Type	Item	Setting	
logo	Data	Image	Logo\Project logo	imageWidth: imageHeight:	
Map: Basin overview	Data	Image	Overview	imageWidth: 500 imageHeight:	
Map: monthly rainfall - 4 plot	Data	Image	Rainfall\Season(TRMM)	imageWidth: 500 imageHeight:	
Time series: Rainfall variability	Data	Chart	Rainfall Clima\TRMM	analysisArea: allArea	
Table: rainfall statistics	Data	Table	Rainfall\TRMM	3E9651,#CC2529,#6B4C9A,#948B3D	

Edit X
 Tag: Map: monthly rainfall - 4 plot
 Source: Data
 Type: Image
 Item: Rainfall\Season(TRMM)
 Image width (px): 500
 Image height (px):
 Preview Update

Copy link Download Generate

Figure E-5 Edit reporting content

5.7 Generate report

The “Generate” menu creates the report based on template file and the user input for each of the reporting tags. The final report is converted to pdf format and will be available for download or through a link. The “Generate” option is used when a user needs to update the content of the report.

5.8 Download report

The “Download” menu enables the user to download already generated reports. Please note that this menu only downloads the existing report with the current content, the content of the report is not updated.

5.9 Copy link

The “Copy link” function copies a url or link to the latest generated report. The link could be used when submitting an email providing a link to the latest generated report. Pasting the link into any internet explorer would provide access to the report.

5.10 Upload reporting content

The user is able to upload content into the system, which could be a specific logo or a description within a txt file. The upload function is enabled by selecting “Upload” tab.

Report Upload


 New

Figure E-6 Upload tab

User uploaded items could be in the form of images (*.png files), chart (*.csv file), tables (*.csv files) or text (*.txt files). The procedure for uploading an item and making it available for a reporting tag is explained below, see also Figure E-7.

Procedure for uploading an item and making it available for a reporting tag:

- Select the “Upload” tab
- Press “New” and specify the information for the item to upload
 - **Item:** Name for the item as it will appear for the user
 - **Description:** Description as it will appear for the user
 - **Type:** Select the type of item to upload. Please note that the system will NOT validate the uploaded images or csv files and errors might occur if a file type is specified with a wrong extension type.
 - **File:** Browse and select the file to upload
- The uploaded item will now appear in the list of uploaded items
 - Note that an uploaded item can be deleted, edited or cloned by the user
- When editing a tag in a reporting template all user uploaded items are available by selecting the source type “Upload”.
- Selecting an item within the source type “Upload” adds the uploaded item to the specific reporting tag.

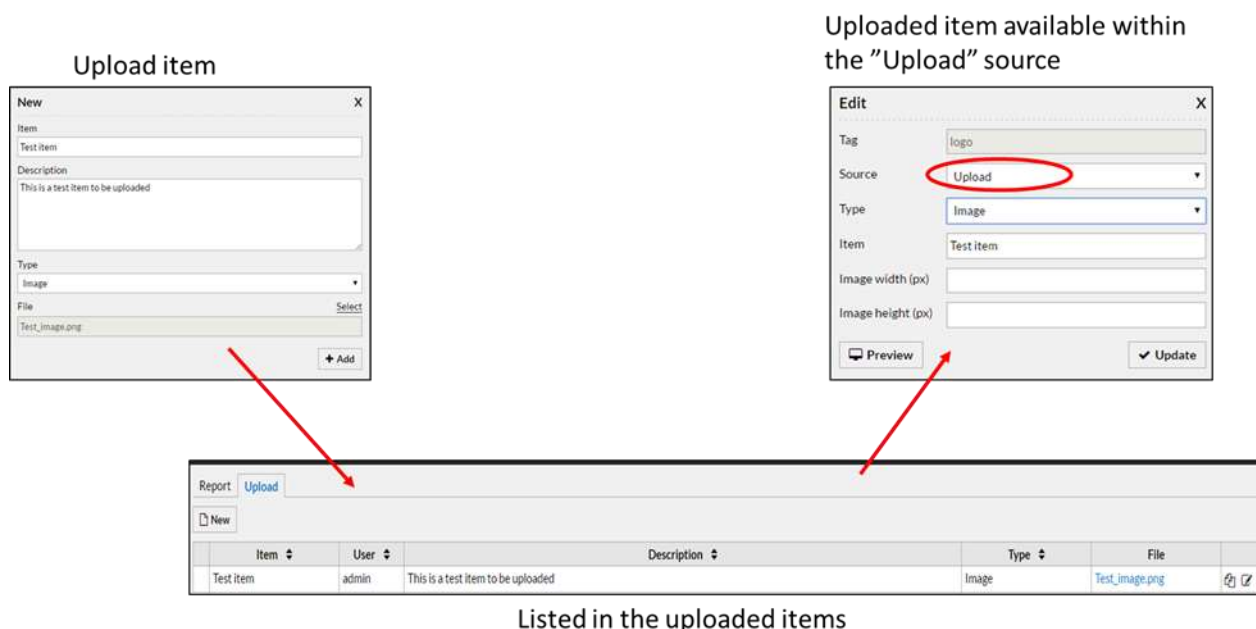


Figure E-7 Process for uploading an item and making it available for a reporting tag

5.11 Automated reporting

Based on the frequency, the update of reports can be automated. The Reporting application will automatically generate a new report, when the last generated report is older than the user-defined frequency. Several email recipients can be specified in the Alert email field to be informed when a new report has been produced.



Figure E-8 Edit dialog of the report where frequency and email can to be specified.

A notification is sent by email when a new report has been generated. The email contains a link to download the report as PDF without having to login to the Flood and Drought portal. Indication about the next report is also added to the email to the recipients have an idea when will the next update.

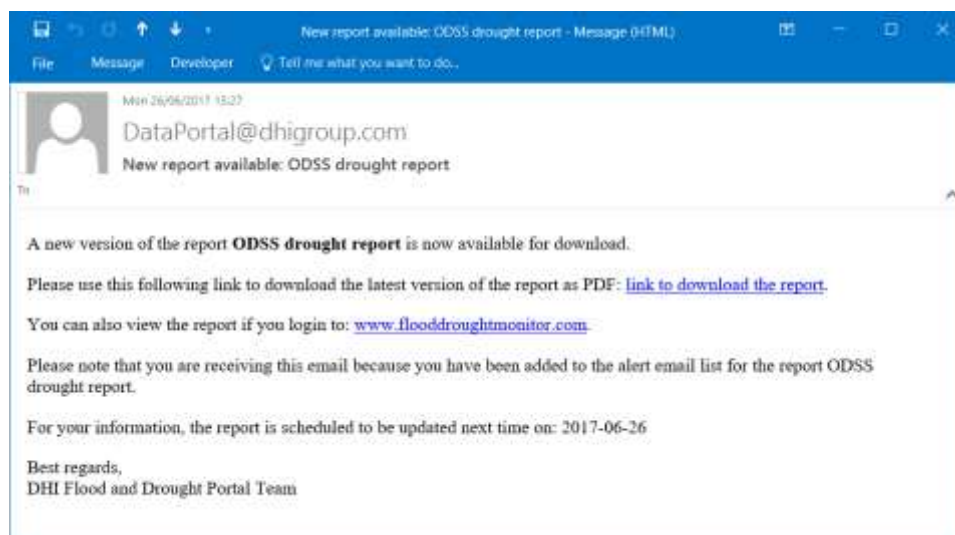


Figure E-9 Example of email notification sent when a new report has been generated