

Climate Resilient Water Safety Planning

November 28, 2018

10:00 hrs Amsterdam local time



WEBINAR



CLIMATE SMART UTILITIES WEBINAR SERIES



- Why the webinar series?
 - Climate change is impacting availability and quality of water worldwide
 - Frequent rainfall leads to increased water turbidity and higher numbers of pathogens in the water;
 - Reduced rainfall leads to limited water availability and an increased concentration of contaminants in the water.
 - Demand for water supply in urban areas increasing
 - Push for urban stakeholders (cities, utilities, etc.) to better plan and manage the impacts affecting the water supply system

- 3 part webinar series
 - Integrating climate information for water utilities (25 October 2018)
 - Climate resilient water safety planning (28 November 2018)
 - From vision to action: how water utilities are building climate resilience (January 22nd, 2018)

AGENDA

Host: *Rui Sancho* (Águas do Algarve)

- Climate Resilient Water Safety Planning
Rory McKeown
World Health Organization (WHO)
- Q/A
- Technical tools to support integrating climate information into WSP
Kizito Masinde
International Water Association (IWA)
- Q/A

Climate Resilient Water Safety Planning

DR RORY MOSES MCKEOWN
SENIOR TECHNICAL CONSULTANT, WHO



**World Health
Organization**



OVERVIEW

- 1. Impacts of climate variability & change on water supply systems**
- 2. Water safety planning for climate resilient water supplies**

Climate change is expected to alter the frequency & intensity of weather events...



...expected to increase existing stresses on water resources...

...further impacting the safety and security of drinking-water supplies.

Water suppliers must consider their ***resilience***
to the impacts of climate variability & change...

RESILIENCE



Anticipate

Respond

Cope

Recover

Adapt

How may climate change impact water supply systems?

IMPACTS FROM CLIMATE CHANGE INCLUDE:



Precipitation/flooding

Increased precipitation and flooding may result in...

**...increased upstream
erosion, run-off**

**...overwhelm wastewater & water
treatment facilities...**

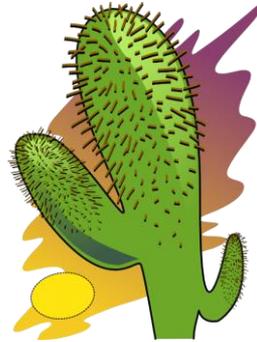


...damage to assets and infrastructure.

IMPACTS FROM CLIMATE CHANGE INCLUDE:



Precipitation/flooding



Drought

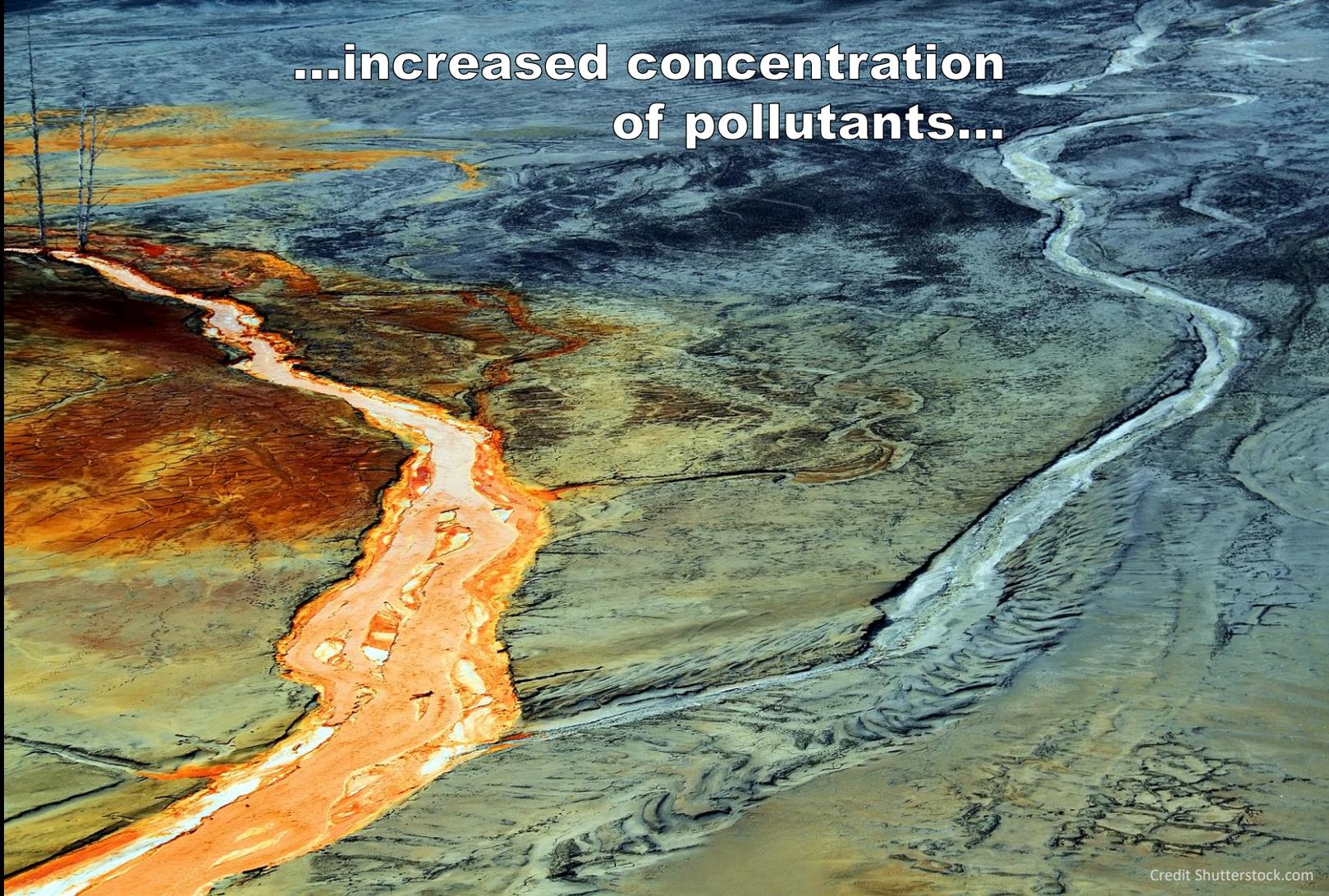


**...increased competition for
scare water resources...**



...increased
dependence on
less-safe alternatives...

**...increased concentration
of pollutants...**



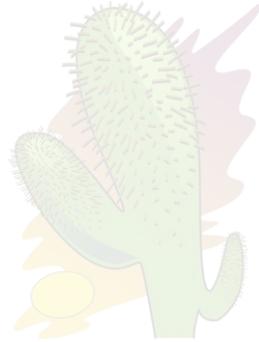
A photograph of a rocky shoreline. The foreground shows shallow, clear water flowing over a bed of smooth, rounded stones in shades of yellow, orange, and brown. The background is a dense field of similar stones extending to the top of the frame. The lighting is bright, suggesting a sunny day.

**...release of contaminants from
reservoir sediments
(e.g. nutrients, metals).**

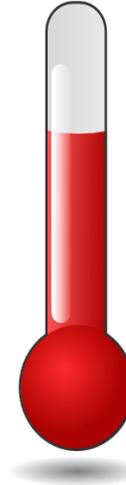
IMPACTS FROM CLIMATE CHANGE INCLUDE:



Precipitation/flooding



Drought



Increased
temperature

**Increased temperatures
may result in...**

**...increase in cyanobacterial
blooms (\pm toxigenic)...**

A large, billowing white cloud, likely a cumulus or cumulonimbus cloud, dominates the center of the frame. The cloud is illuminated from the side, giving it a soft, golden-yellow glow. The sky is a clear, pale blue. In the foreground, dark, out-of-focus silhouettes of trees and leaves frame the scene, creating a sense of depth and a natural setting. The overall mood is serene yet powerful, suggesting a significant weather event.

**...increased risk
of bushfires...**

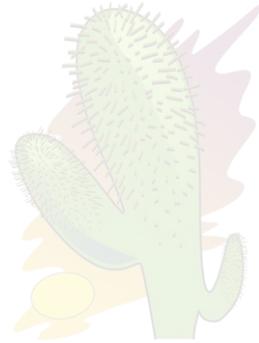
A photograph of a man in a blue knit hat drinking water from a public tap. The tap is mounted on a concrete pillar with a red cross symbol. The man is cupping his hands under the running water. In the background, another person is partially visible, and the setting appears to be outdoors with greenery.

**...increased risk
from microbial
contamination.**

IMPACTS FROM CLIMATE CHANGE INCLUDE:



Precipitation/flooding



Drought



Increased
temperature



Sea-level rise

Sea-level rise may result in...



**...inundation of critical
assets & infrastructure...**

...intrusion into aquifers...





**...intrusion
into
distribution
networks.**

**How best to manage current and predicted risks from
climate variability & change?**

OVERVIEW

1. Impacts of climate variability & change on water supply systems
2. Water safety planning for climate resilient water supplies

WHAT IS A WATER SAFETY PLAN (WSP)?

*A comprehensive
risk assessment & risk
management approach that includes
all steps in the water supply*



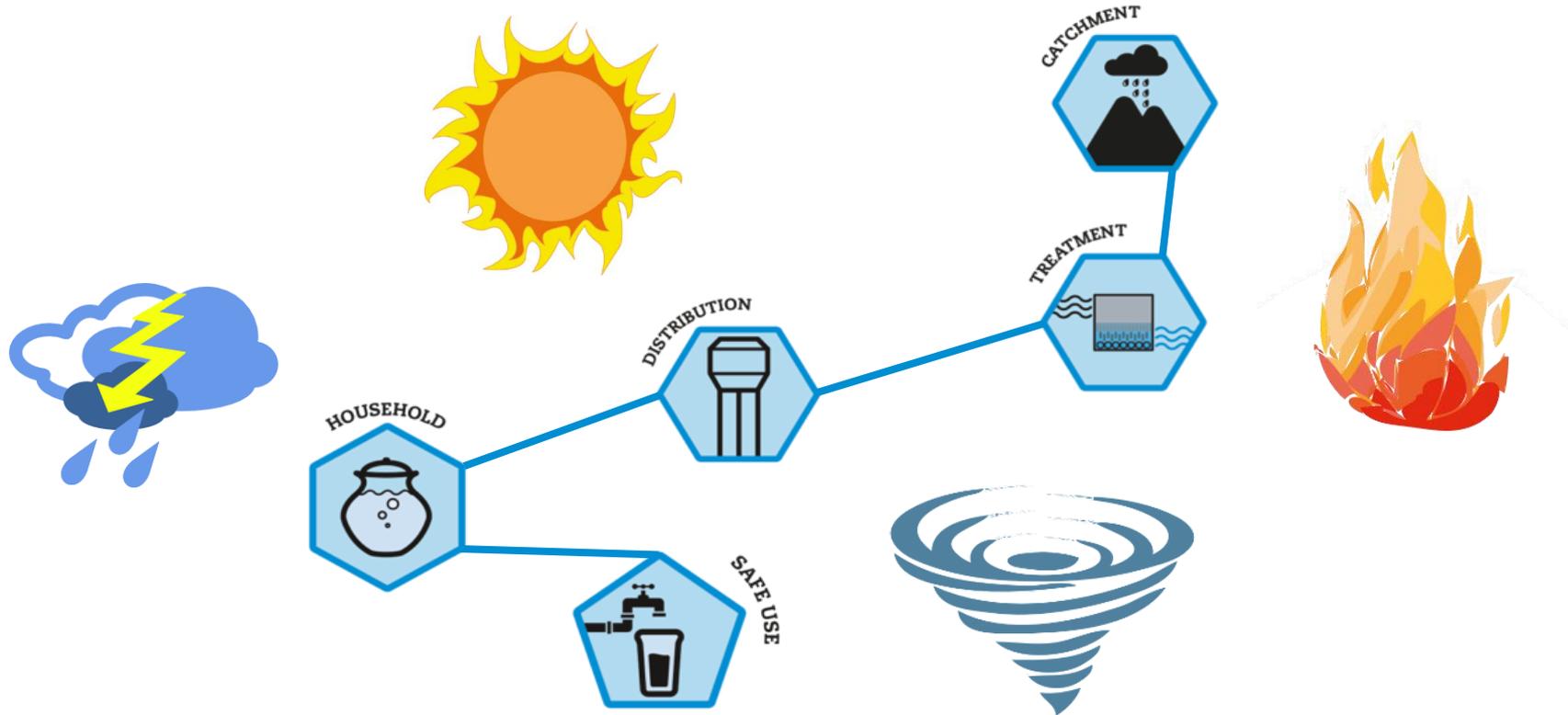
***“Most effective means of
consistently ensuring the safety
of drinking-water supply”¹***



¹ WHO (2017). Guidelines for drinking-water quality. 4th Edn. 1st add., World Health Organization, Geneva.

Water safety plans provide a proactive approach to assess & manage current/future climate-related risks

WSPS MAY SUPPORT THE MANAGEMENT OF CLIMATE-RELATED RISKS AT ALL STEPS OF WATER SUPPLY...



INTEGRATING CLIMATE RESILIENCE INTO THE WSP APPROACH

Module 1: Assemble team

Module 2: Describe the water supply system

Module 3: Identify the hazards & assess the risks

Module 4: Determine & validate control measures, re-assess & prioritize risks

Module 5: Develop, implement & maintain an improvement plan

Module 6: Define monitoring of control measures

Module 7: Verify the effectiveness of the WSP

Module 8: Prepare management procedures

Module 9: Develop supporting programs

Module 10/11: Review and revise the WSP regularly and following an incident

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***Key
elements
to consider***

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MODULE 1: WSP TEAM ASSEMBLY

Platform to engage necessary expertise to integrate climate considerations into WSP e.g.

- Meteorologists, climatologists
- Hydro(geo)logists
- Adaptation/disaster/emergency management specialists
- Strategic planners, economists
- Public health specialists
- Sanitation safety planning team...



INTEGRATING CLIMATE RESILIENCE INTO THE WSP APPROACH

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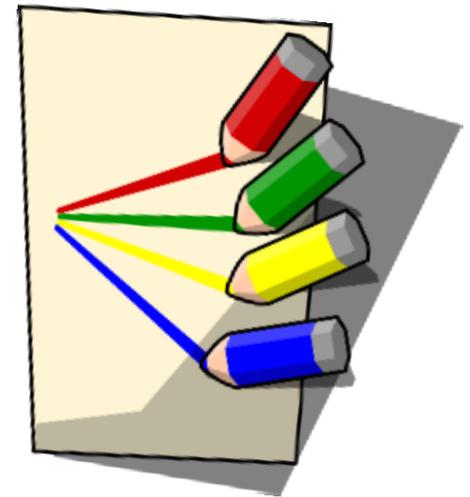
**Key
elements
to consider**

MODULE 2: WATER SUPPLY SYSTEM DESCRIPTION

Capture relevant climate information that will support hazard identification and risk assessment...

For example:

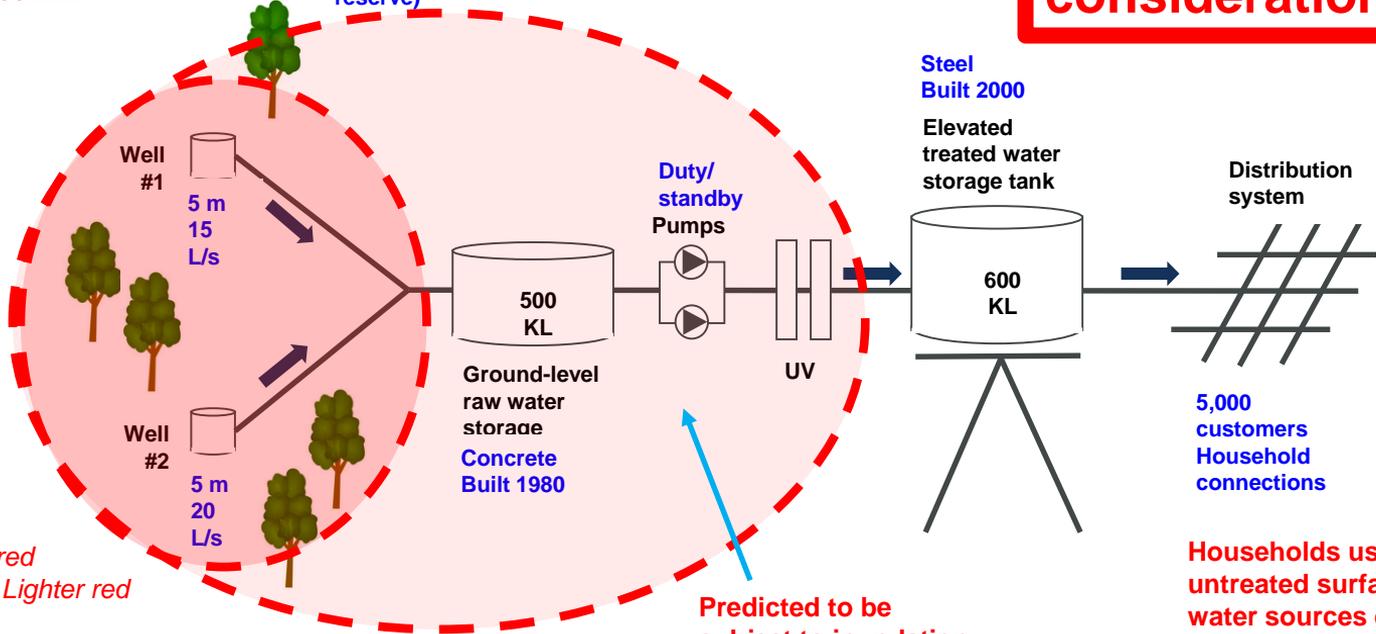
- ✓ Climate information (e.g. historical v. projected rainfall, temperature etc.)
- ✓ Projected sea-level rise; inundation/flooding zones
- ✓ Historical vs. projected surface water flows, aquifer recharge rates
- ✓ Yield vs. demand (historical vs. projected)
- ✓ Alternative water sources (\pm additional treatment requirements)



Annual rainfall:
2018 – 75 mm
2025 – 150 mm

Protected
catchment (nature
reserve)

Climate considerations



Flood zone:
Current – darker red
Projected 2025 – Lighter red

Well #3  60 m
Potential future water source (high fluoride) 20 L/s

Households use untreated surface water sources during flood



What sources of climate information should I use & how do I integrate it effectively???



...all will be revealed...

INTEGRATING CLIMATE RESILIENCE INTO THE WSP APPROACH

Module 1: Assemble team ✓

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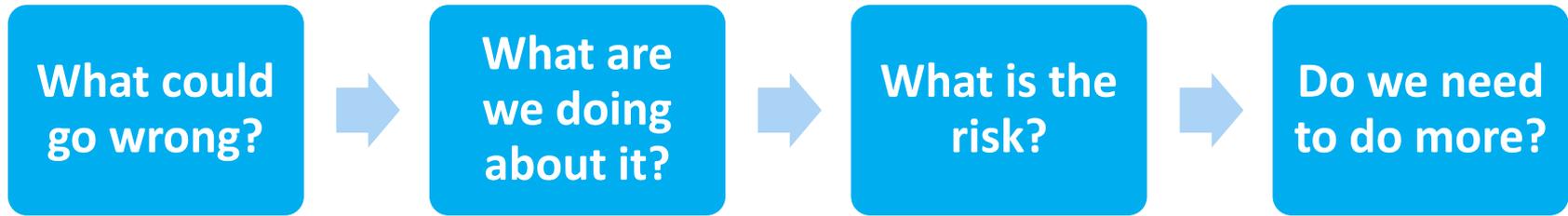
Module 9: Develop supporting programs

Module 10/11: Review and revise the WSP regularly and following an incident



**Key
elements
to consider**

HAZARD IDENTIFICATION, CONTROL MEASURE ASSESSMENT & RISK PRIORITIZATION



INTEGRATING CLIMATE CONSIDERATIONS INTO RISK ASSESSMENT

Climate resilient water safety planning considers:

- ✓ impact on the effectiveness of existing control measures (barriers)
- ✓ impact on the risk profile of existing hazards/hazardous events (i.e. likelihood v. severity of consequences)
- ✓ potential new risks associated with climate-related hazards/hazardous events



Prioritization of all system risks...

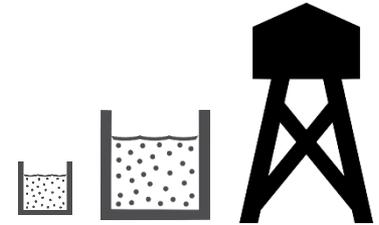


PRIORITIZATION OF SIGNIFICANT CLIMATE RISKS SUPPORTS INCREMENTAL IMPROVEMENT PLANNING

Examples of climate resilient improvement planning include:

Designing adaptable/resilient infrastructure

- e.g. elevating critical assets above flood-level



Utilizing a range of options to achieve an outcome

- e.g. diversifying use of water sources



Supporting infrastructure with non-infrastructure measures

- e.g. water tariffs to influence customer usage/behaviour



INTEGRATING CLIMATE RESILIENCE INTO THE WSP APPROACH

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**Key
elements
to consider**

MODULE 8: MANAGEMENT PROCEDURES

Management procedures can consider climate-related emergencies

↳ Emergency response planning supports preparedness for climate-related incidents, extreme events & disasters

Emergency plans may consider:

- ✓ Response actions (including monitoring)
- ✓ Roles/responsibilities (internal/external)
- ✓ Communication, notification protocols
- ✓ Emergency/alternative water supplies

Integrating disasters & their consequences into a WSP can assist Disaster Risk Reduction (DRR)



Credit: UNICEF Pakistan/2012/Asad Zaidi

INTEGRATING CLIMATE RESILIENCE INTO THE WSP APPROACH

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**Key
elements
to consider**



MODULE 9: SUPPORTING PROGRAMS

Supporting program can build capacity to manage climate-related risks

Capacity building programs e.g.

- flood/drought event management & planning
- demand management

Stakeholder engagement and outreach programs e.g.

- building partnerships for improved management of water resources & quality

Research programs e.g.

- water supply system modelling to support increased operational & water efficiency



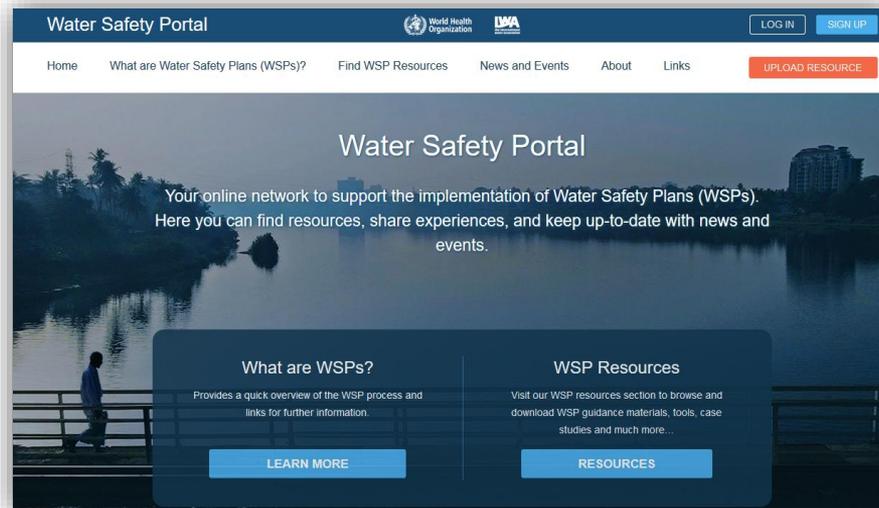
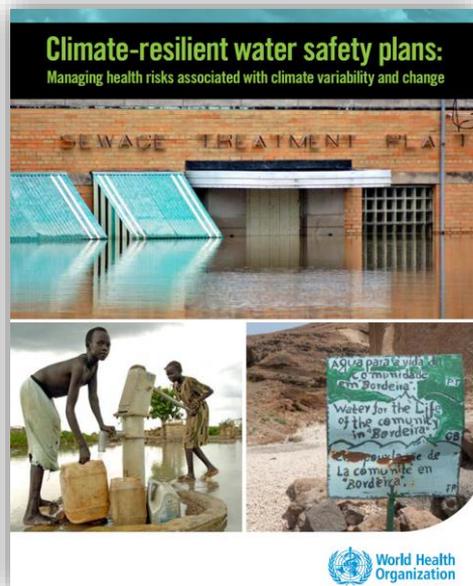
Credit: Eyemage/flickr.com

IN CONCLUSION

- Climate resilient WSP approach is ***FLEXIBLE*** and should be ***TAILORED*** to suit the local context
- Important to consider both climate and non-climate risks
- Seek necessary support/tools to make climate information accessible for local-level water safety planning...



FURTHER GUIDANCE ON CLIMATE RESILIENT WATER SAFETY PLANNING...



www.who.int/water_sanitation_health/

www.wspportal.org

Technical tools to support integrating climate information into WSP

KIZITO MASINDE
PROGRAMMES OFFICER, IWA

Water Safety Plan Manual
Step-by-step risk management
for drinking-water suppliers

OVERVIEW



1. Background to the Flood and Drought Management Tools project
2. Tools supporting integration of climate information into water safety planning



Damage to infrastructure

High levels of rainfall and runoff can increase loading of pathogens, chemicals, and suspended sediment in surface waters



Floods impact the quality of surface water and ground water in multiple ways:



Contaminated water entering groundwater through wells



Overflow and contamination from sewerage systems





Low flows and reduced water levels can increase the concentration of pollutants and nutrients.

Higher temperatures can create conditions for increased waterborne pathogens in the supply system.

Reduced groundwater tables and surface water flows, leading to reduced supply and potentially the use of unsafe water sources.

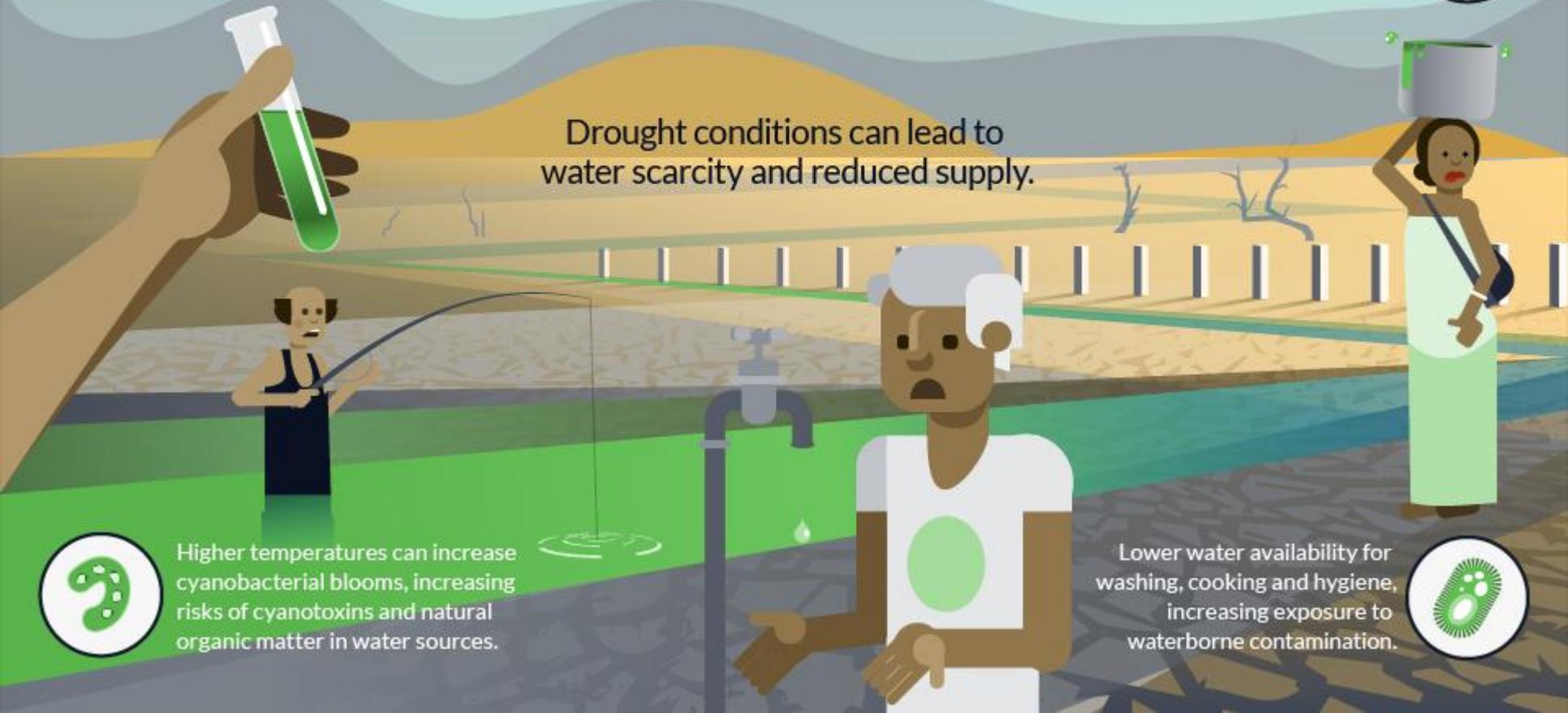


Drought conditions can lead to water scarcity and reduced supply.



Higher temperatures can increase cyanobacterial blooms, increasing risks of cyanotoxins and natural organic matter in water sources.

Lower water availability for washing, cooking and hygiene, increasing exposure to waterborne contamination.



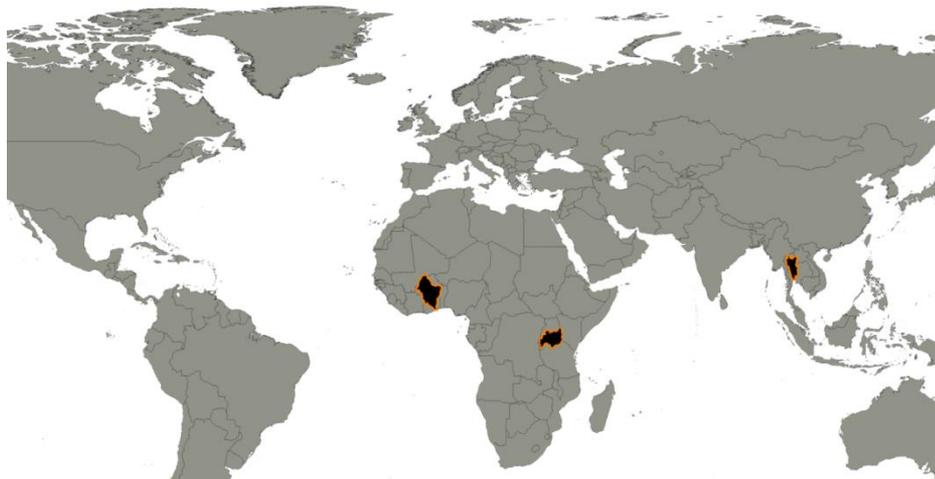
FLOOD AND DROUGHT MANAGEMENT TOOLS

Development of technical tools to improve the ability to address floods and droughts in the planning process at basin and local scale.



The project is funded by the Global Environmental Facility (GEF) and implemented by the UN Environment. The executing agencies are DHI and the International Water Association (IWA)

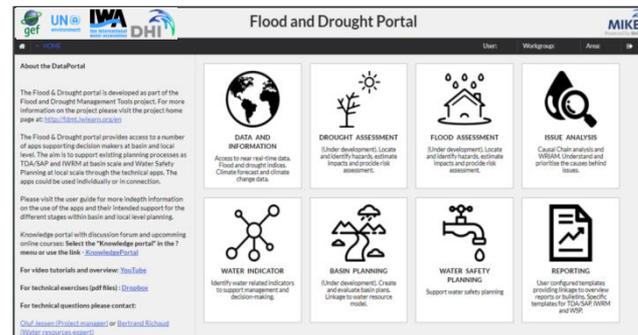
THE FLOOD AND DROUGHT MANAGEMENT TOOLS



The project works in three pilot basins: the Volta, Lake Victoria and Chao Phraya Basins

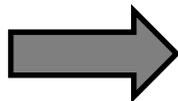
www.floaddroughtmonitor.com

The Flood and Drought Portal is a key output of the FDMT project



THE FLOOD AND DROUGHT MANAGEMENT TOOLS

Global approach



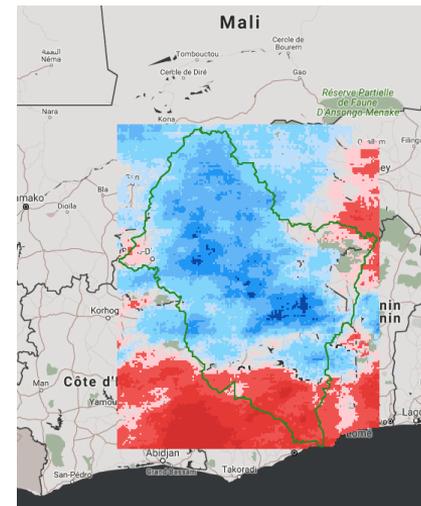
Tools/guidelines

Technical tools supporting decision making into planning processes at basin and water utility levels

Training
Guidelines



Local application



Freely available tools supporting planning at transboundary and local level

TOOLS FOR INTEGRATING CLIMATE INFORMATION INTO WATER SAFETY PLANNING

About the DataPortal

The Flood & Drought portal is developed as part of the Flood and Drought Management Tools project. For more information on the project please visit the project home page at: <http://fdmt.iwlearn.org/en>

The Flood & Drought portal provides access to a number of apps supporting decision makers at basin and local level. The aim is to support existing planning processes as TDA/SAP and IWRM at basin scale and Water Safety Planning at local scale through the technical apps. The apps could be used individually or in connection.

Please visit the [user guide](#) for more indepth information on the use of the apps and their intended support for the different stages within basin and local level planning.

Knowledge portal with discussion forum and upcoming online courses: Select the "Knowledge portal" in the ? menu or use the link - [KnowledgePortal](#)

For video tutorials and overview: [YouTube](#)

For technical exercises (pdf files) : [Dropbox](#)

For technical questions please contact:

[Oluf Jessen \(Project manager\)](#) or [Bertrand Richaud \(Water resources expert\)](#)



ISSUE ANALYSIS

Causal Chain analysis and WRIAM. Understand and prioritise the causes behind issues.



WATER INDICATOR

Identify water related indicators to support management and decision-making.



DATA AND INFORMATION

Access to near real-time data. Flood and drought indices. Climate forecast and climate change data.



DROUGHT ASSESSMENT

Locate and identify hazards, estimate impacts and provide risk assessment.



CROP APPLICATION

Visualise crop calendar, estimate crop water requirement and crop yield.



FLOOD ASSESSMENT

Locate and identify hazards, estimate impacts and provide risk assessment.



BASIN PLANNING

Create and evaluate basin plans. Linkage to water resource model.



WATER SAFETY PLANNING

Support water safety planning



RDM TOOL

Robust Decision Making Tool



REPORTING

User configured templates providing linkage to overview reports or bulletins. Specific templates for TDA/SAP, IWRM and WSP.

TOOLS FOR INTEGRATING CLIMATE INFORMATION INTO WATER SAFETY PLANNING



ISSUE ANALYSIS

Causal Chain analysis and WRIAM. Understand and prioritise the causes behind issues.

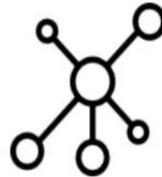
What are the issues and underlying causes in my area



DATA AND INFORMATION

Access to near real-time data. Flood and drought indices. Climate forecast and climate change data.

What data can be used to measure the indicators



WATER INDICATOR

Identify water related indicators to support management and decision-making.

What indicators can be used to monitor the state of the issues identified



WATER SAFETY PLANNING

Support water safety planning

What procedures are needed to address risks to water supply?

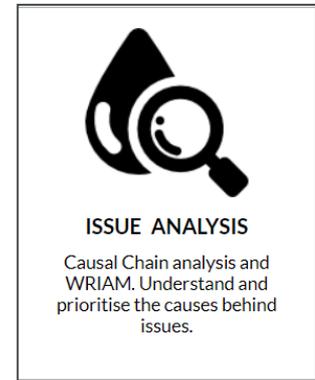
ISSUE ANALYSIS TOOL

The tool can inform the Water Safety Planning (WSP) process through identifying and assessing the main threats by:

- Identifying issues that impact the water supply system
- Evaluating issues and their causes
- Prioritising impacts of the issues

This information can then be used to assess:

- The current preparedness of the utility to eliminate or reduce threats
- The Capacity of the utility to implement new measures to address threats

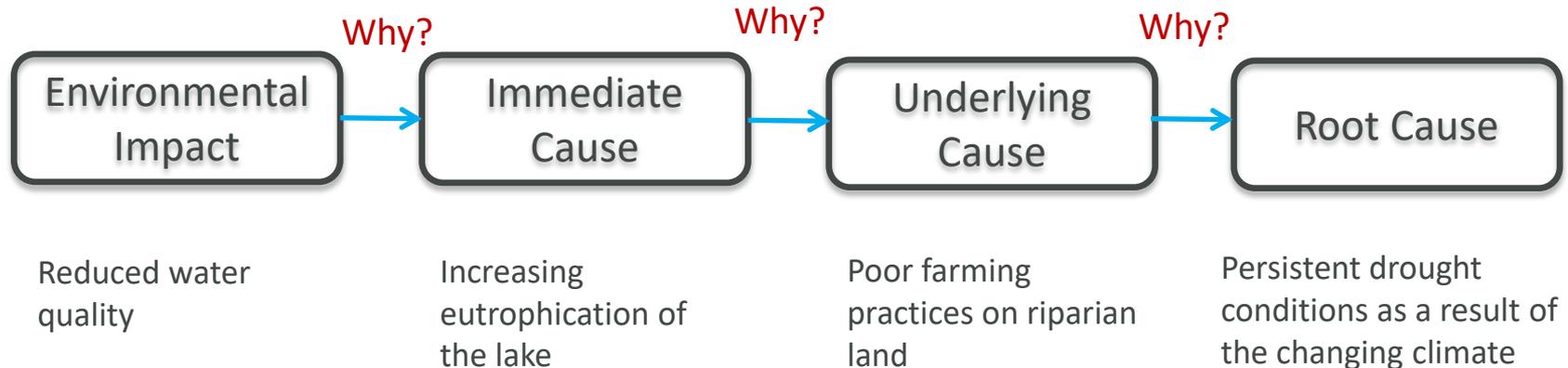


ISSUE ANALYSIS TOOL

The tool is based on:

- The Causal Chain Analysis (CCA):
- The Water Resource Issues Assessment Method (WRIAM)

The Causal Chain Analysis determines a cause or an environmental impact by asking the question ‘why’ (CCA):



ISSUE ANALYSIS TOOL



The Water Resource Issues Assessment Method (WRIAM) is a rapid assessment impact evaluated against two groups of criteria:

- (A) Criteria related to the importance of the issue, and which can individually change the score obtained considerably;
- (B) Criteria that are of value to the given situation, but individually can affect less the score obtained.

ISSUE ANALYSIS TOOL






Flood and Drought Portal



ISSUE ANALYSIS
Last Update: 2018-11-21 ● User: iwa_test Workgroup: Private Area: Volta ↻ ?

Open
New
Clone
Copy
Edit
Delete

Issue: Invasion of the water hyacinth on the lake
User: iwa_test
Last change: 2018-11-22 22:34:28
Description: There has been increase on the number of times the lake surface is covered by water hyacinth

Issue analysis

No importance Slight negative impact Moderate negative impact

Immediate impact	Immediate cause	Underlying cause	Root cause
Reduced water quality	Increasing eutrophication of the lake	Poor farming practices on riparian land	Persistent drought conditions as a result of the changing climate

Add
✕

Immediate impact
Reduced water quality

Immediate cause
Increasing eutrophication of the lake

Underlying cause
Poor farming practices on riparian land

Root cause
Persistent drought conditions as a result of the changing climate

Extent
Transboundary (4)

Seriousness
Major change (3)

Permanence
Temporary (2)

Irreversibility
Reversible (2)

Cumulative character
Strong (3)

Level of documentation
Good (3)

✓ Update

Cumulative character	Level of documentation	Score	Assessment	
Strong (3)	Good (3)	84	Major negative impact	✕

ISSUE ANALYSIS TOOL

Open New Clone Copy Edit Delete

Issue: Invasion of the water hyacinth on the lake

User: iwa_test

Last change: 2018-11-22 22:46:39

Description: There has been increase on the number of times the lake surface is invaded by thick mats of the water hyacinth in the previous years

Issue analysis

Add

No importance Slight negative impact Moderate negative impact Negative impact Significant negative impact Major negative impact

Immediate impact	Immediate cause	Underlying cause	Root cause	Extent	Seriousness	Permanence	Irreversibility	Cumulative character	Level of documentation	Score	Assessment	
Reduce d water quality	Increasing eutrophication of the lake	Poor farming practices on riparian land	Persistent drought conditions las a result of the changing climate	Transboundary (4)	Major change (3)	Temporary (2)	Reversible (2)	Strong (3)	Good (3)	84	Major negative impact	<input type="checkbox"/> <input checked="" type="checkbox"/>

The tool enables you to score the issue as per the set criteria and color codes the final assessment depending on the severity of the issue, enabling a utility to prioritise

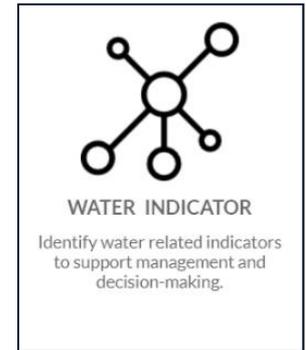
THE WATER INDICATOR TOOL

Framework for water utilities

- Gives relevant indicators from catchment to intake for specific issues
- Provides consistency in how threats are measured
- Linked to the issue analysis application

Purpose:

- To understand the current state of water resources
- To understand the changes in these resources (e.g. due to climate change)
- To understand the impact of interventions in a basin



THE WATER INDICATOR TOOL

Framework **Issue** Indicator

Open

Issue: Invasion of the water hyacinth on the lake User: iwa_test Last change: 2018-11-22 23:18:28
Description: There has been increase on the number of times the lake surface is invaded by thick mats of the water hyacinth in the previous years

Immediate impact Immediate Cause Underlying Cause Root Cause Related Indicator

Major negative impact, Score:84

Reduced water quality

- Biochemical Oxygen Demand
- Dissolved Organic Carbon
- Total Dissolved Solids
- turbidity

Increasing eutrophication of the lake

- Dissolved Nitrogen
- Dissolved Organic Carbon
- Dissolved Phosphorus

Poor farming practices on riparian land

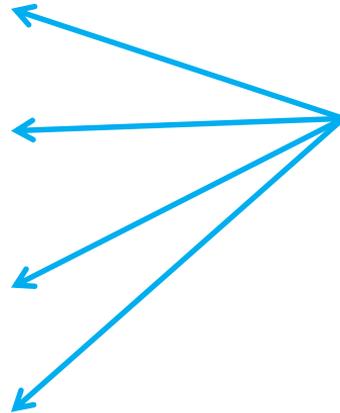
- Change in Wetland Areas
- Soil Erosion

Persistent drought conditions has a result of the changing climate

- Agriculture Withdrawals
- Climate Moisture Index
- Combined Drought Indicator

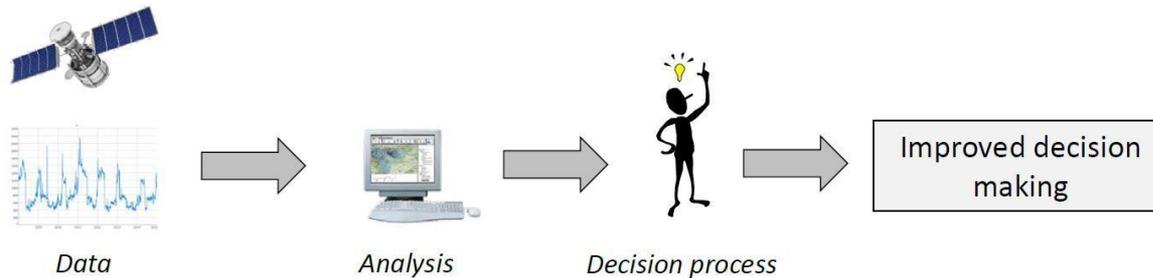
For an identified issue, the tool enables you identify the relevant indicators for monitoring

Indicators are identified to monitor the Environmental Impact, Immediate Cause, Underlying Cause and the Root Cause



THE DATA AND INFORMATION TOOL

- Reliable data is essential to identify hazards, assess risks and for making decisions
- Data is often unavailable and inaccessible in many countries and basins
- Satellite data combined with station data can provide robust monitoring for indicators



THE DATA AND INFORMATION TOOL

Supports transboundary planning globally

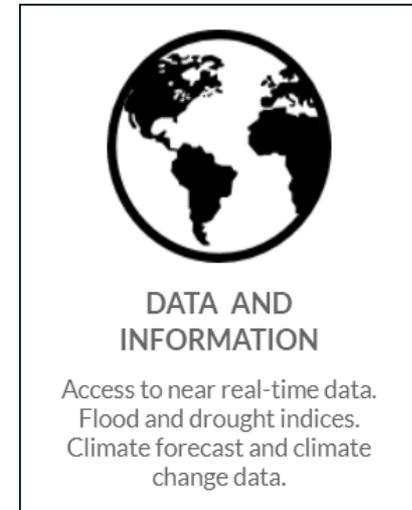
- Data made available for any transboundary basin
- Data updated in near real time

Based on freely available data sources

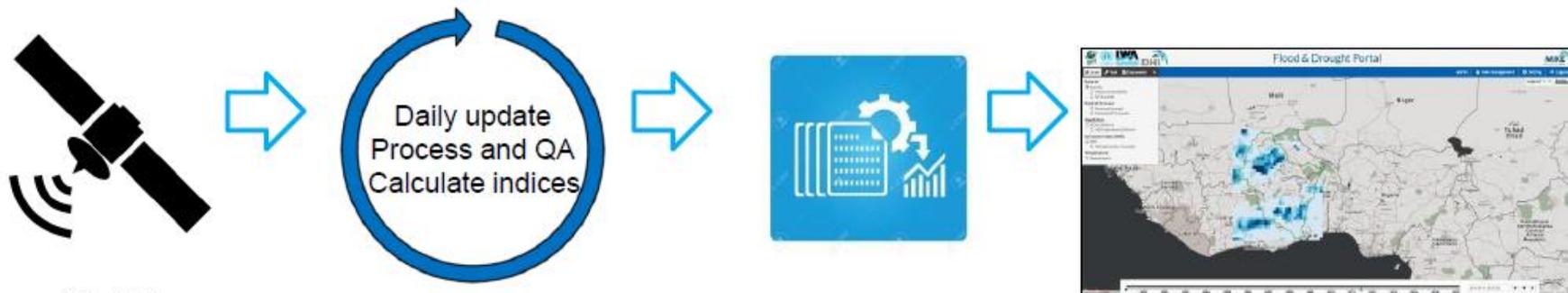
- All data are processed to netcdf and csv formats

Provides a basic dataset for catchment planning

- E.g. Climate data, Climate forecast etc.



THE DATA AND INFORMATION TOOL



Various global data sources



Managed by DHI daily

Download on global scale
Reproject and convert to netcdf
QA of data quality

Data processing

Subset to basin scale
Calculate indices
Calculate weighted time series
QA and monitor process
Push to web-server

Data available on web portal

Data available as GIS layers and time series
User configuration and control

NASA: https://lpdaac.usgs.gov/dataset_discovery

Copernicus(ESA): <http://land.copernicus.eu/>

NOAA: <https://www.ncdc.noaa.gov/data-access>

THE DATA AND INFORMATION TOOL

Climate data:

- TRMM, CHIRPS, CRU, GPM rainfall
- Temperature and PET
- Flood index and combined drought index

Forecast and climate change

- Seasonal and 2-week forecast
- Climate change (CORDEX)

Vegetation and soil moisture

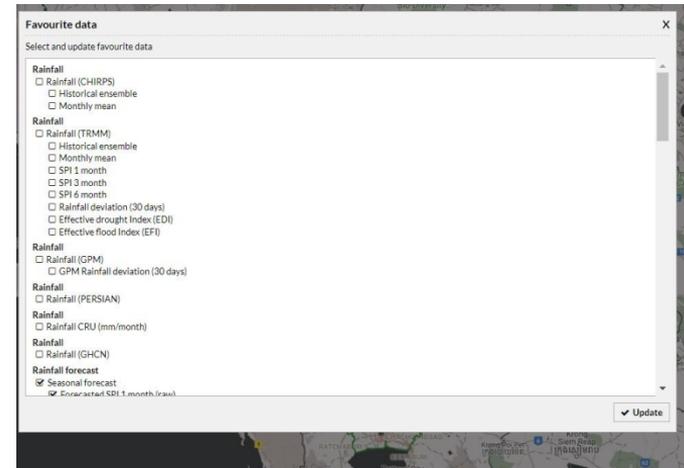
- NDVI
- Soil Water Index
- Agricultural stress index

Lakes and reservoirs

JASON data

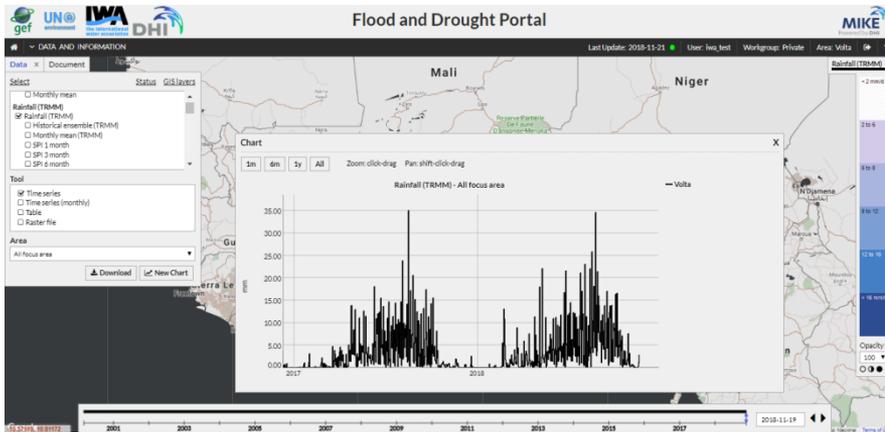
Physical and Socioeconomic data

Population, Urban expansion, flood risk



THE DATA AND INFORMATION TOOL

The information from the data and information tool inform the planning tools:



ISSUE ANALYSIS

Causal Chain analysis and WRIAM. Understand and prioritise the causes behind issues.



WATER SAFETY PLANNING

Support water safety planning

Real-Time & Historical Data
Forecast data, Climate change
Physical and socio-economic data

Planning tools

THE WATER SAFETY PLANNING TOOL

Considering climate change during the development and implementation of WSPs ensures that safe water is supplied to users in enough quantities sustainably

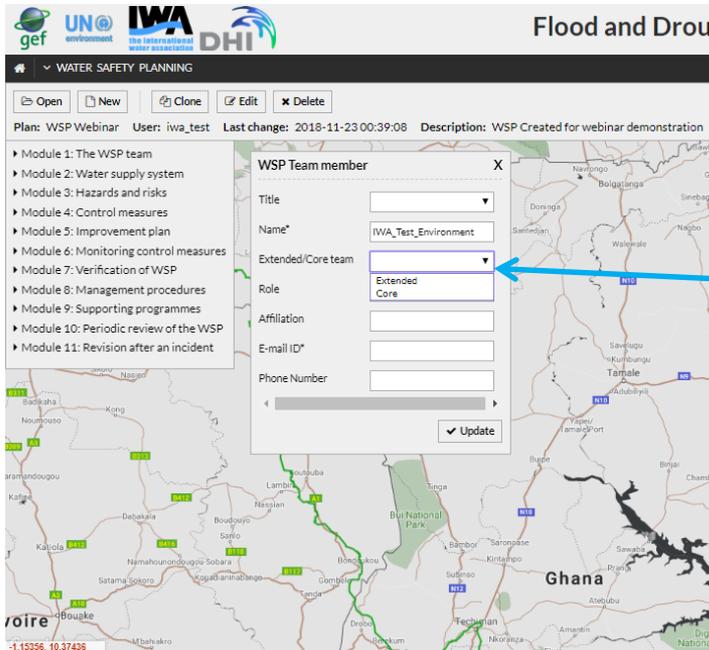
Important concepts linked to CC adaptation resilience:

- Capacity to anticipate, respond to, cope with, recover from and adapt to stress and change
- Ability of the system to keep on functioning in a way that it maintain its essential function, identity and structure



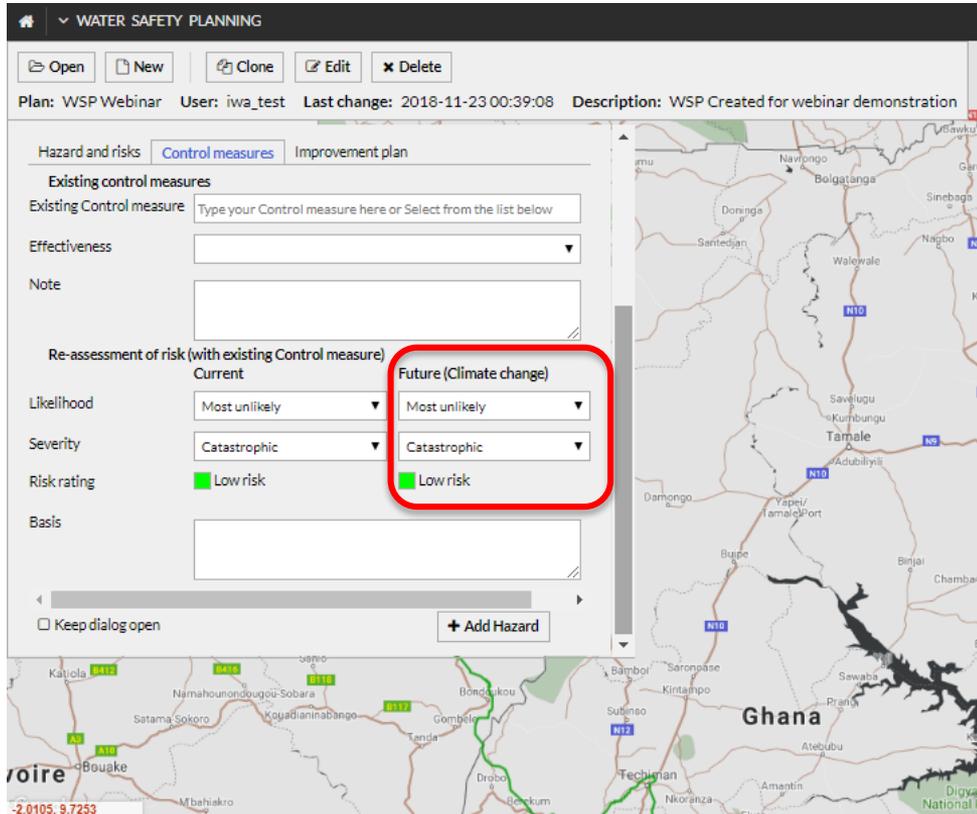
THE WATER SAFETY PLANNING TOOL

The water safety planning tool enables you integrate climate change considerations in the modules



In selecting the WSP team, it allows you to add both Core team members (those from the utility), and Extended team members (relevant stakeholders)

THE WATER SAFETY PLANNING TOOL



WATER SAFETY PLANNING

Open New Clone Edit Delete

Plan: WSP Webinar User: iwa_test Last change: 2018-11-23 00:39:08 Description: WSP Created for webinar demonstration

Hazard and risks Control measures Improvement plan

Existing control measures

Existing Control measure Type your Control measure here or Select from the list below

Effectiveness

Note

Re-assessment of risk (with existing Control measure)

	Current	Future (Climate change)
Likelihood	Most unlikely	Most unlikely
Severity	Catastrophic	Catastrophic
Risk rating	Low risk	Low risk

Basis

Keep dialog open Add Hazard

When assessing risks, the tool enables you to do your assessment considering climate change effects on the particular hazard

TOOLS FOR INTEGRATING CLIMATE INFORMATION INTO WATER SAFETY PLANNING

Operational planning



Strategic planning



The tools available in the portal can help a utility integrate climate information in their WSP, ensuring that their short-term and long term investments adapt and are resilient to climate shocks

QUESTIONS FROM AUDIENCE



JOIN US FOR THE NEXT WEBINAR OF THE SERIES:



From vision to action: how water utilities are building climate resilience

22 January 2019, 15:00 hrs Amsterdam time



Find out more at <http://www.iwa-network.org/iwa-learn/>