

# 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 22<sup>nd</sup>, 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...**





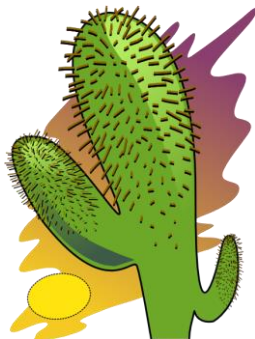


**...damage to assets and infrastructure.**

# IMPACTS FROM CLIMATE CHANGE INCLUDE:



Precipitation/flooding



Drought



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

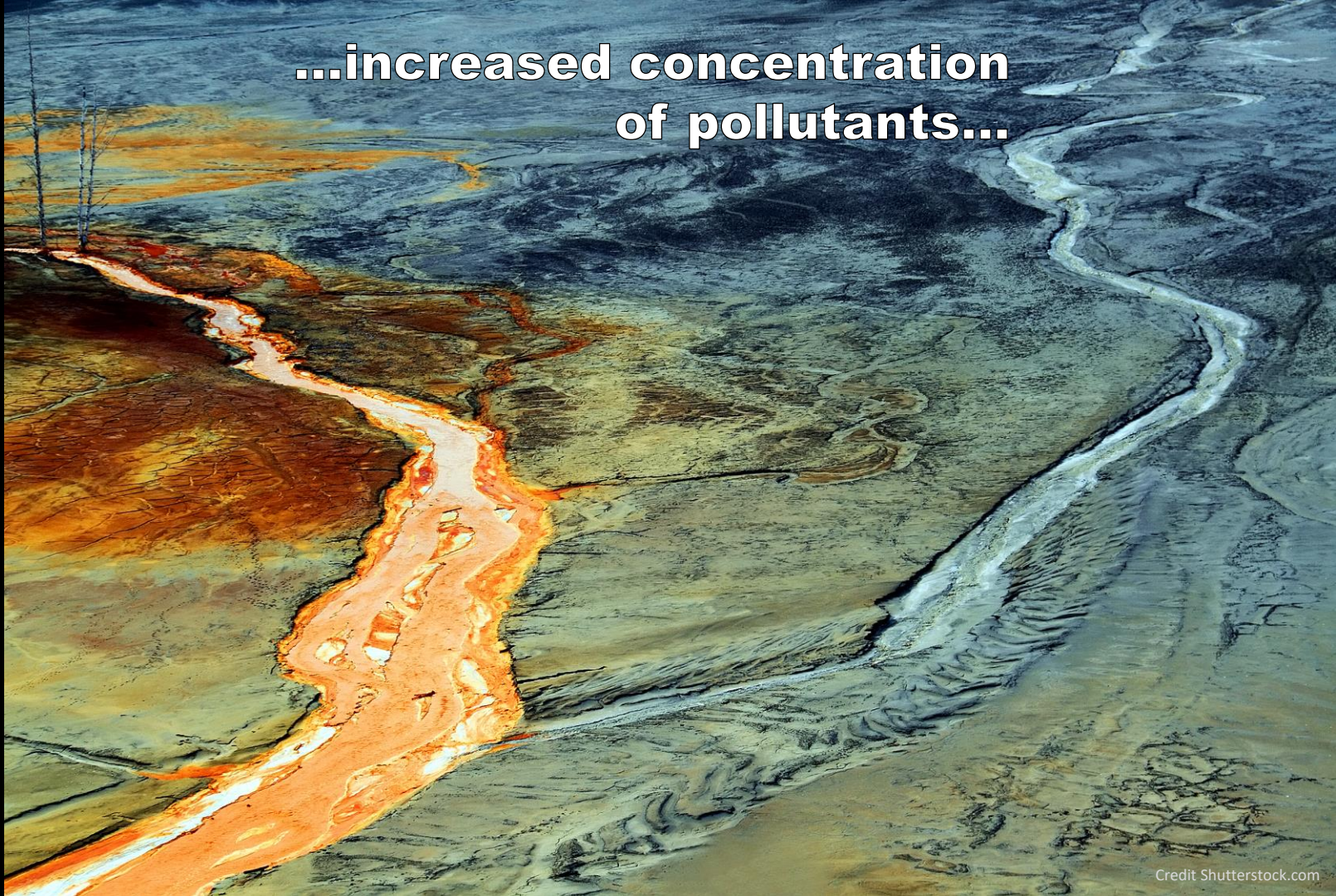




...increased  
dependence on  
less-safe alternatives...



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





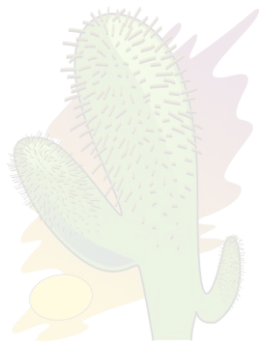
A photograph of a rocky shoreline. The foreground shows shallow, rippling water. The middle ground is filled with a dense layer of smooth, rounded rocks in various shades of brown, tan, and grey. The background is a continuation of the rocky shore, sloping slightly upwards.

**...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)...**



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



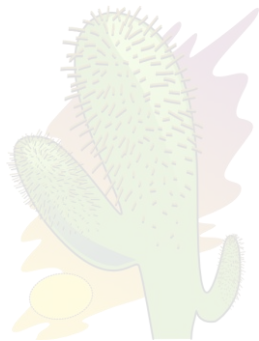
A close-up photograph of a man wearing a grey knitted hat and a dark jacket, drinking water from a public tap. The tap is mounted on a weathered concrete pillar that features a faded red cross symbol. Water is flowing from the tap into the man's cupped hands. In the background, another person is partially visible, and the scene is set outdoors with green foliage.

**...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”<sup>1</sup>***

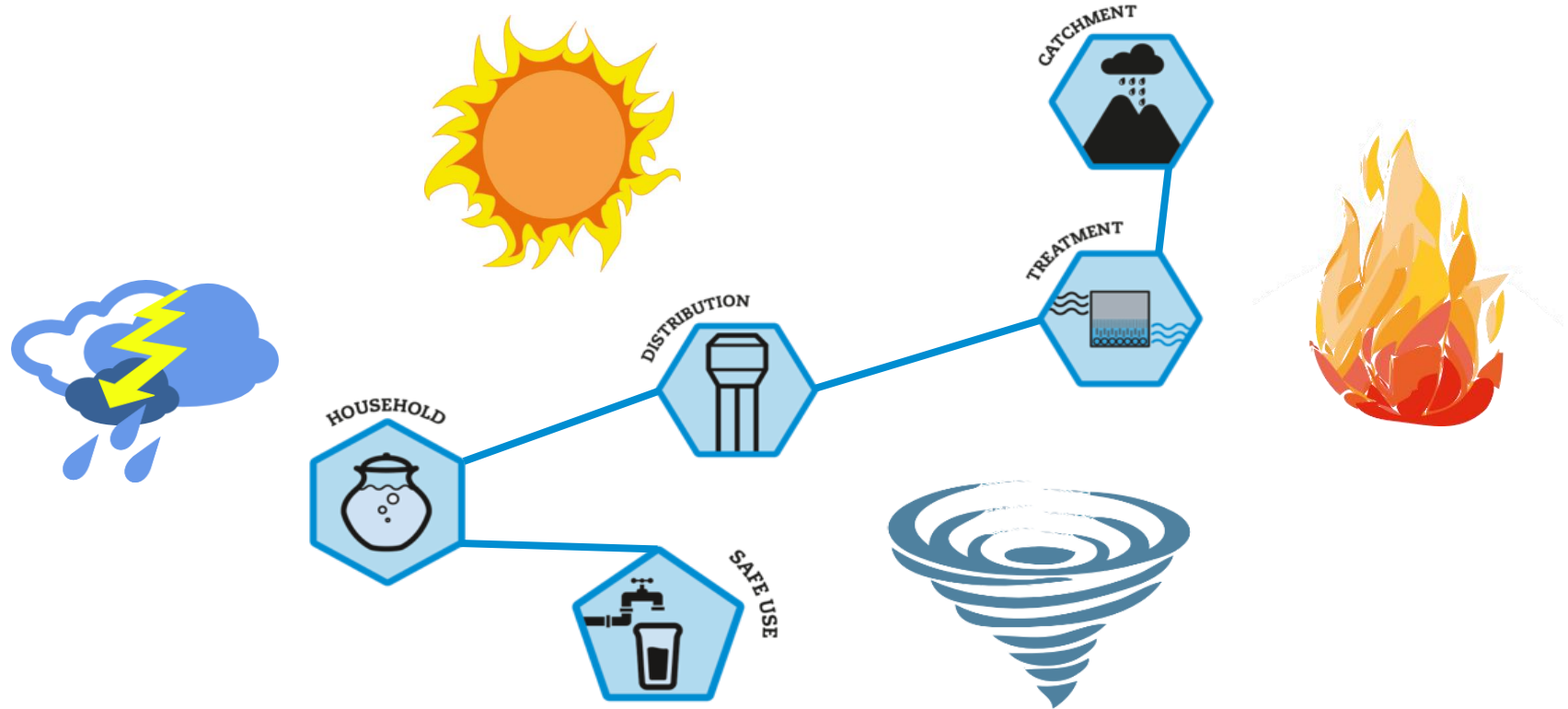


Credit: Shutterstock

<sup>1</sup> WHO (2017). Guidelines for drinking-water quality. 4<sup>th</sup> Edn. 1<sup>st</sup> 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

Module 1: Assemble team ✓

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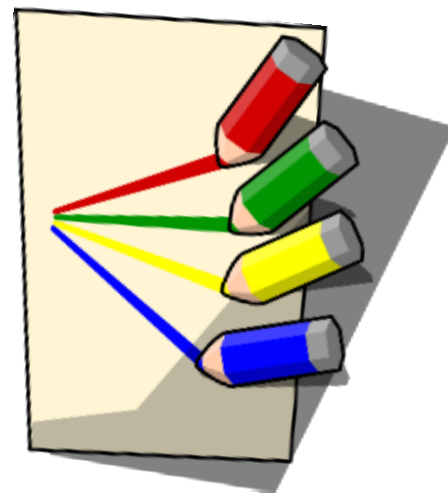


## MODULE 2: WATER SUPPLY SYSTEM DESCRIPTION

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

***For example:***

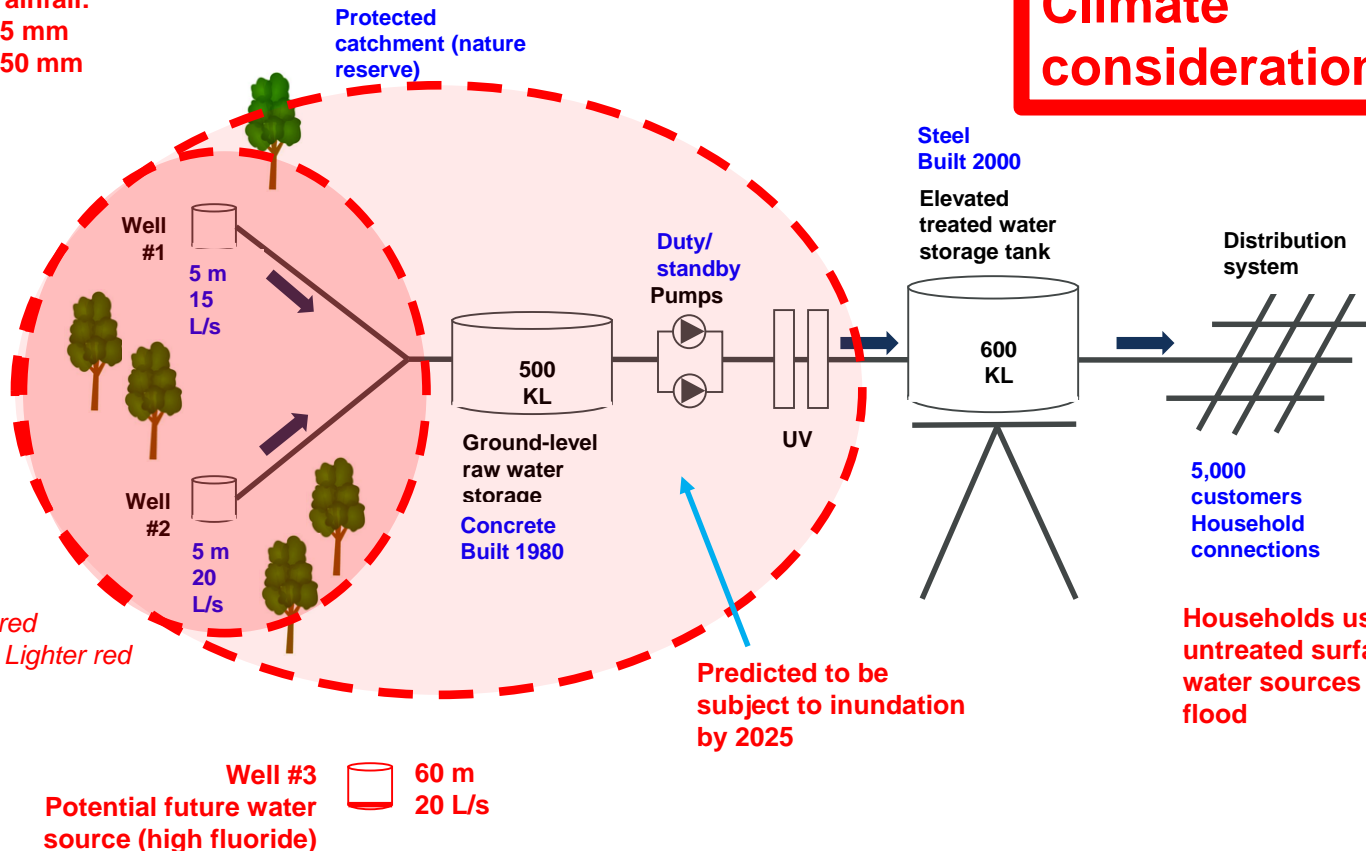
- ✓ Climate information (e.g. historical v. projected rainfall, temperature etc.)
- ✓ Projected sea-level rise; inundation/flooding zones
- ✓ Historical vs. projected surface water flows, aquifer recharge rates
- ✓ Yield vs. demand (historical vs. projected)
- ✓ Alternative water sources ( $\pm$  additional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



Annual rainfall:  
2018 – 75 mm  
2025 – 150 mm

# Climate considerations

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





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 ✓

Module 2: Describe the water supply system ✓

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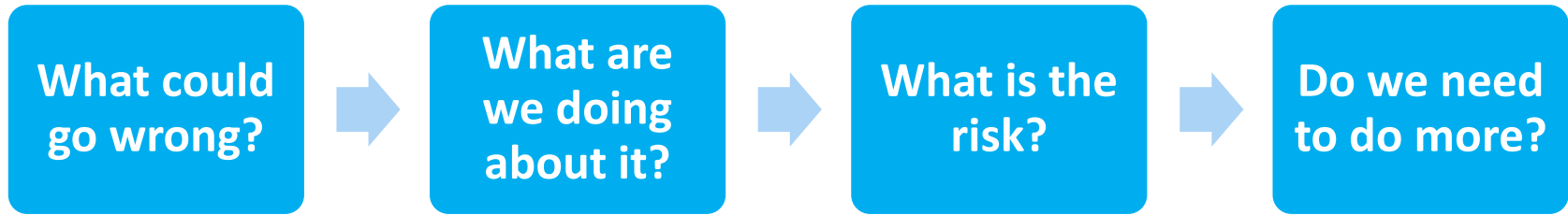
Module 9: Develop supporting programs

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

**Key  
elements  
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# 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...***

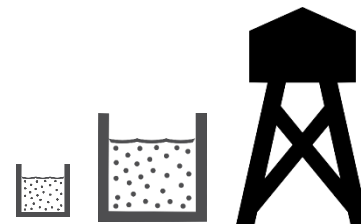


# PRIORITIZATION OF SIGNIFICANT CLIMATE RISKS SUPPORTS INCREMENTAL IMPROVEMENT PLANNING

*Examples of climate resilient improvement planning include:*

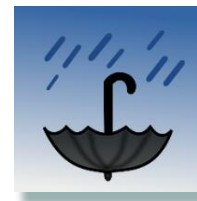
## Designing adaptable/resilient infrastructure

- 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

Module 1: Assemble team ✓

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# 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)**



# INTEGRATING CLIMATE RESILIENCE INTO THE WSP APPROACH

Module 1: Assemble team ✓

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**Key  
elements  
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# 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

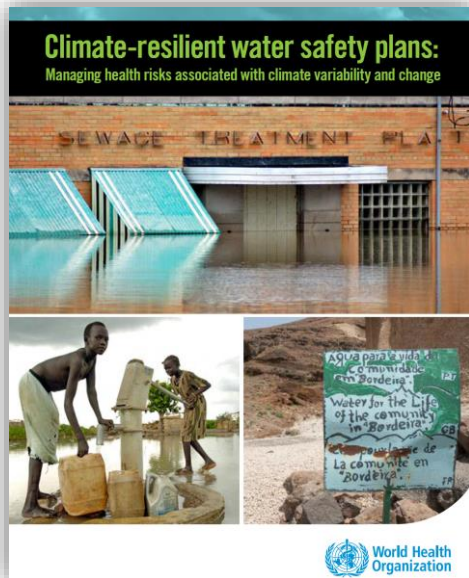
## IN CONCLUSION

- 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...

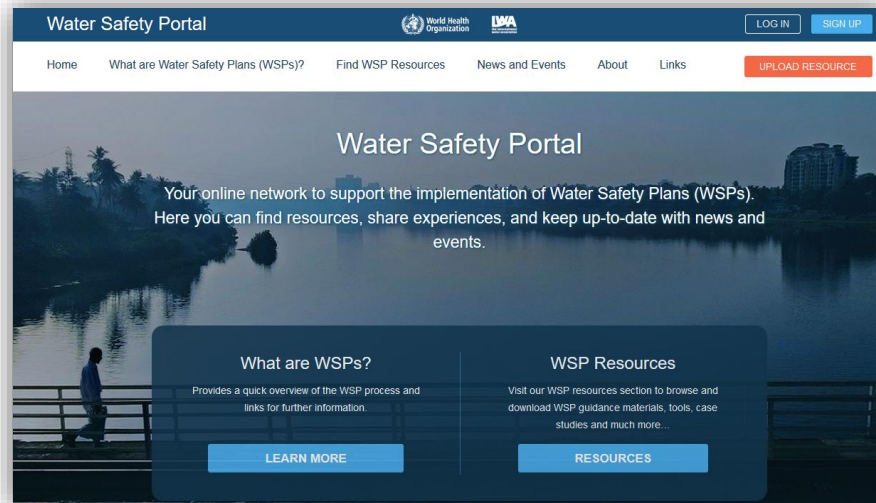




# FURTHER GUIDANCE ON CLIMATE RESILIENT WATER SAFETY PLANNING...



[www.who.int/water\\_sanitation\\_health/](http://www.who.int/water_sanitation_health/)



[www.wsportal.org](http://www.wsportal.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

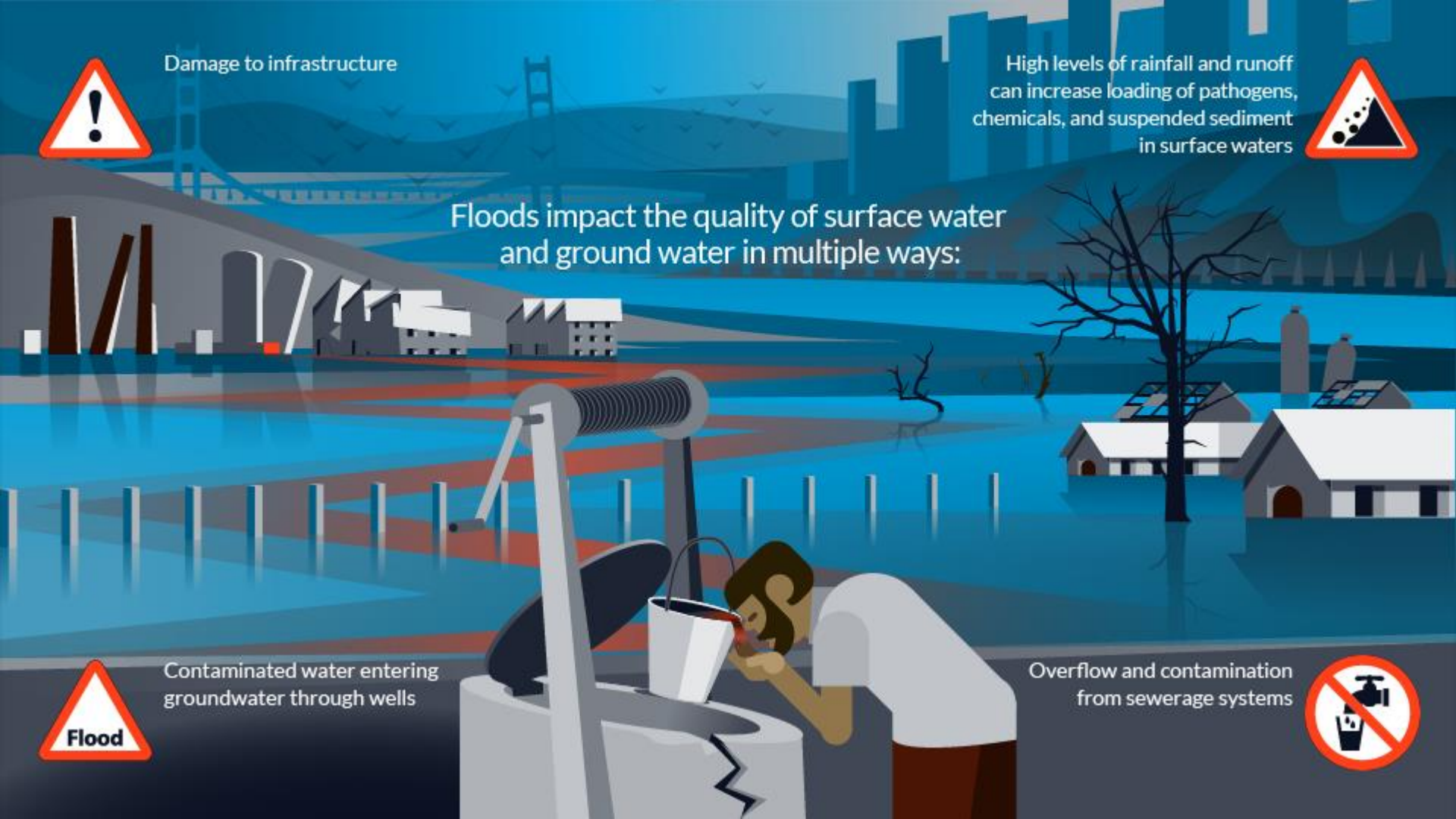


Floods impact the quality of surface water and ground water in multiple ways:



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.

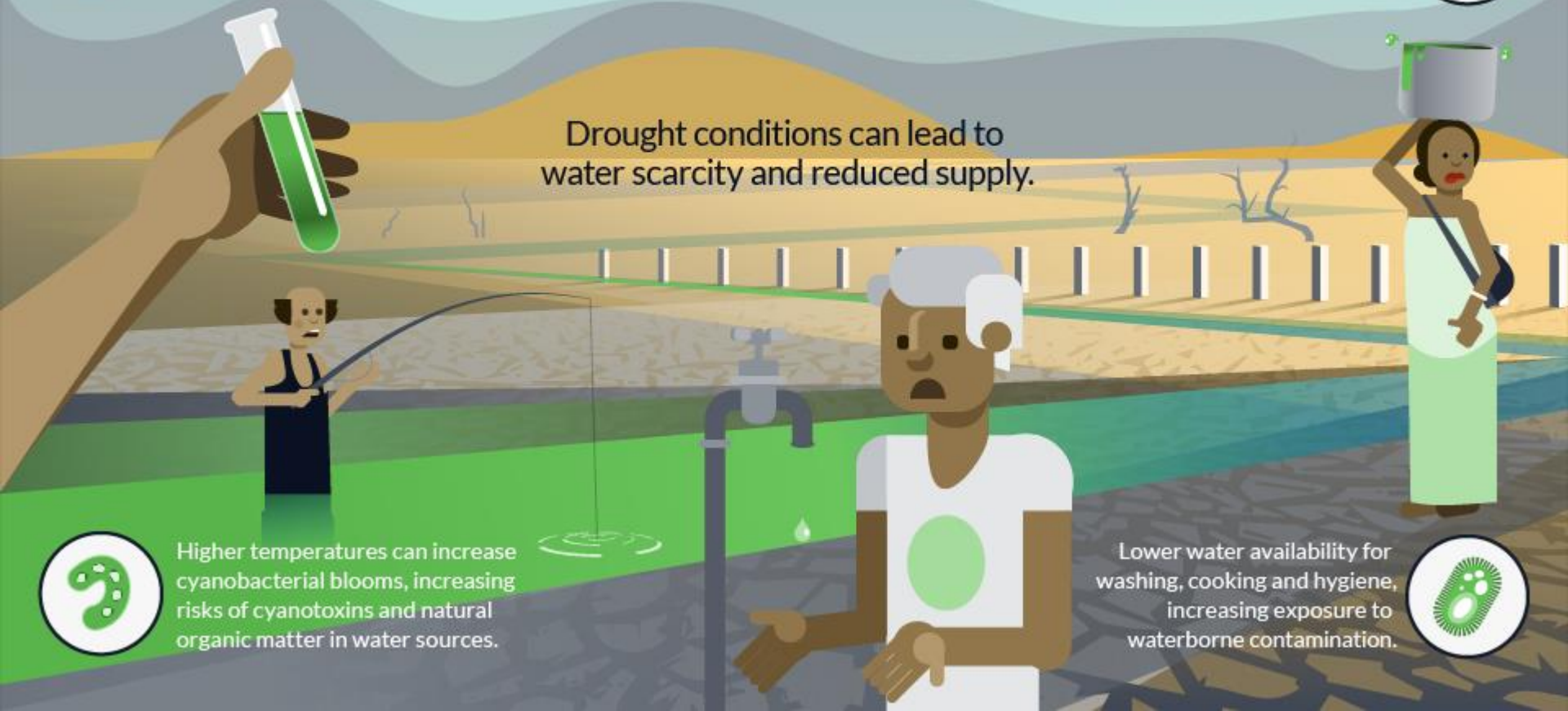


Drought conditions can lead to water scarcity and reduced supply.



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)

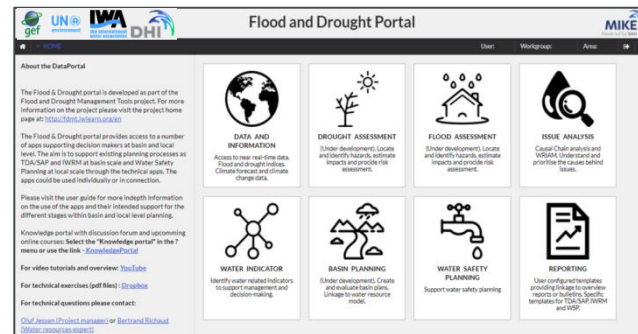
# THE FLOOD AND DROUGHT MANAGEMENT TOOLS



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

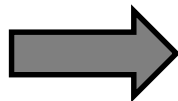
The project works in three pilot  
basins: the Volta, Lake Victoria and  
Chao Phraya Basins

[www.flooddroughtmonitor.com](http://www.flooddroughtmonitor.com)



# THE FLOOD AND DROUGHT MANAGEMENT TOOLS

Global approach



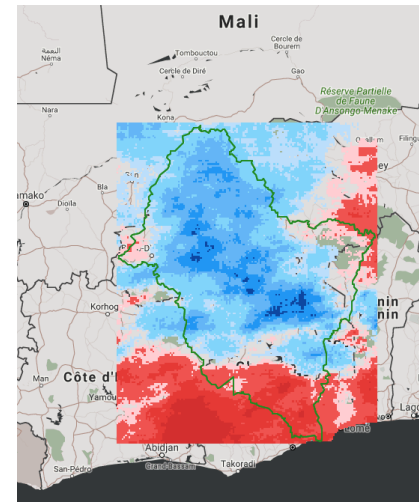
Tools/guidelines

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

[HOME](#)

Last Update: 2018-11-21 • User: iwa\_test • Workgroup: Private • Area:

### 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



## 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



## 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 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

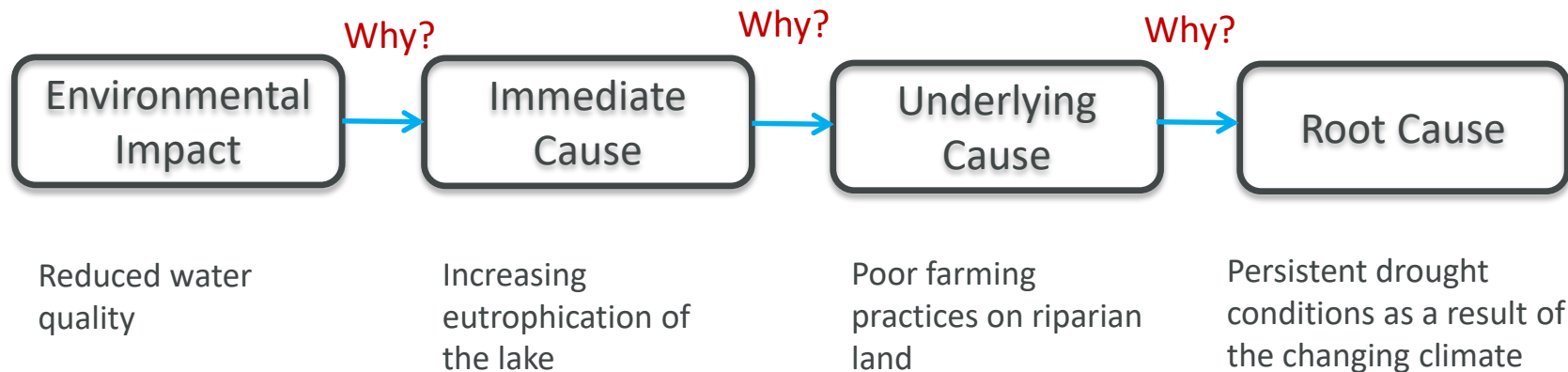
Causal Chain analysis and  
WRIAM. Understand and  
prioritise the causes behind  
issues.

## 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

  
Powered by DHI

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



## Flood and Drought Portal

  
Powered by DHI

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 22:46:39

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

☐ 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	 

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

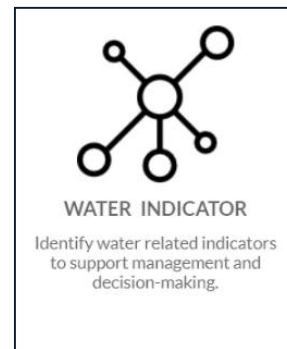
# THE WATER INDICATOR TOOL

## 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**

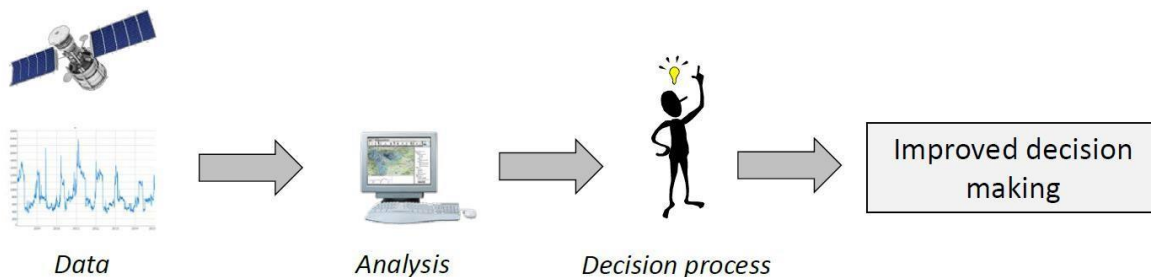
- Agriculture Withdrawals
- Climate Moisture Index
- Combined Drought Indicator

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.



### **DATA AND INFORMATION**

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

# THE DATA AND INFORMATION TOOL



*Various global data sources*

WCRP  
CORDEX

Copernicus



CHG Climate Hazards Group

## ***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](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

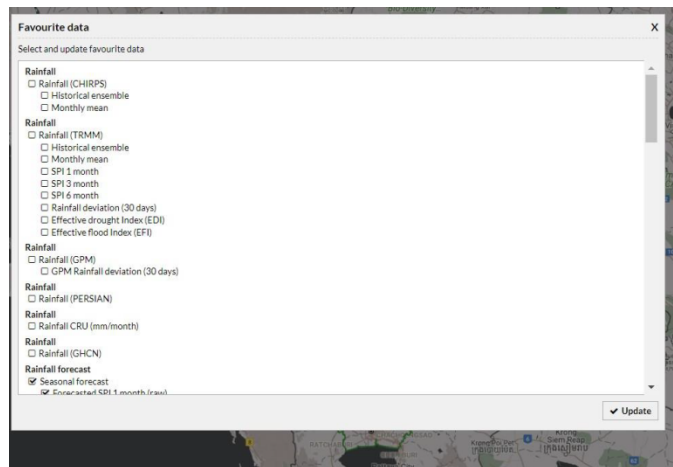
- NDVI
- Soil Water Index
- Agricultural stress index

## Lakes and reservoirs

JASON data

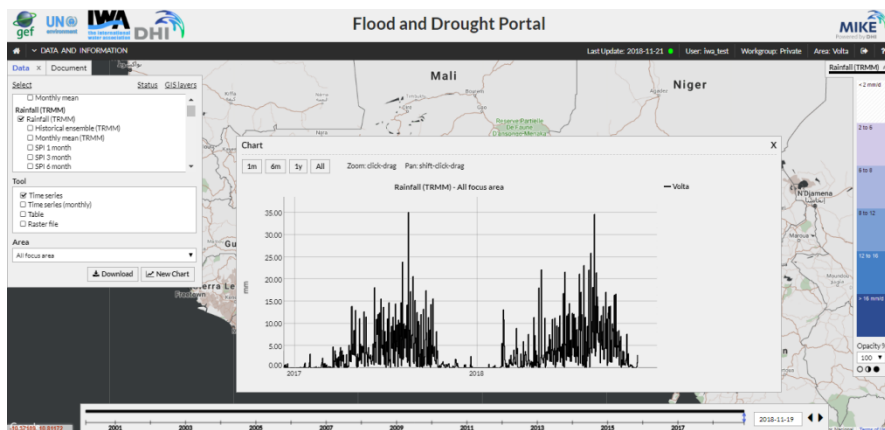
## Physical and Socioeconomic data

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

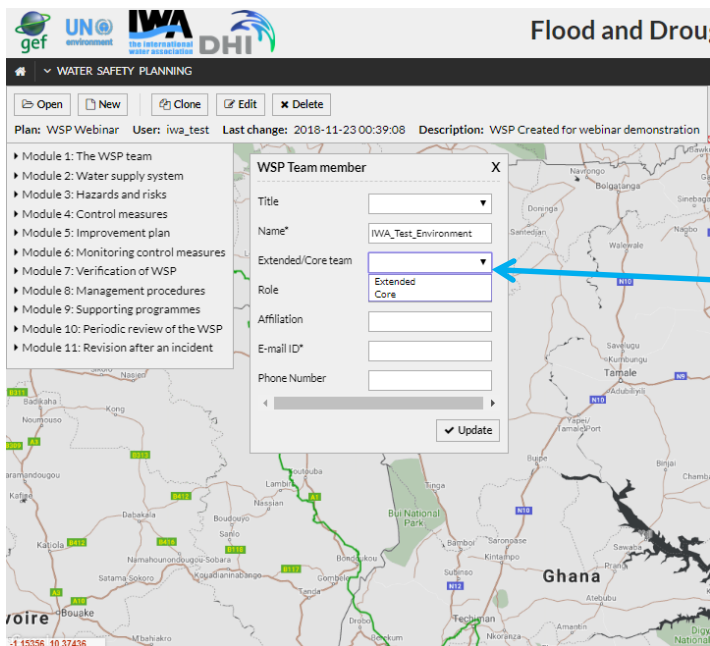
Important concepts linked to CC adaptation resilience:

- 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

The screenshot displays the 'WATER SAFETY PLANNING' tool interface. At the top, there are buttons for 'Open', 'New', 'Clone', 'Edit', and 'Delete'. Below these, the plan details are shown: 'Plan: WSP Webinar', 'User: iwa\_test', 'Last change: 2018-11-23 00:39:08', and 'Description: WSP Created for webinar demonstration'. The main form is divided into two tabs: 'Hazard and risks' (selected) and 'Improvement plan'. Under 'Hazard and risks', there are sections for 'Existing control measures', 'Re-assessment of risk (with existing Control measure)', and 'Basis'. The 'Re-assessment of risk' section has two columns: 'Current' and 'Future (Climate change)'. Both columns have dropdowns for 'Likelihood' (set to 'Most unlikely') and 'Severity' (set to 'Catastrophic'), resulting in a 'Low risk' rating. A red box highlights the 'Future (Climate change)' section. At the bottom, there is a map of Ghana with a red location marker. The bottom left corner shows coordinates: '-2.0105, 9.7253'. A '+ Add Hazard' button is located at the bottom right of the form.

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

Ghana

-2.0105, 9.7253

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/>