FLOOD & DROUGHT MANAGEMENT TOOLS

Technical Training: Lake Victoria Basin Report

26-29 January 2016

The Vic Hotel

Kisumu, Kenya

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1. Executive summary

There is a growing sense of urgency around the need to improve resilience within river basins, and for this to become a critical part of water management plans. The increased frequency and unpredictability of floods and droughts is a priority concern across scales from transboundary to local, along with the other multiple drivers that cause depletion and degradation of shared water resources.

The Flood and Drought Management Tools (FDMT) project (http://fdmt.iwlearn.org/) is financed by the Global Environment Facility (GEF) International Waters (IW) and implemented by UNEP, with the International Water Association (IWA) and DHI as executing agencies. The project is developing a computer software-based decision support system (DSS) with tools to support planning from the transboundary basin to water utility level by including better information on floods and droughts. The project is being implemented from 2014 - 2018, and 3 pilot basins (Volta, Lake Victoria and Chao Phraya) have been identified for development and testing of the planning DSS.

Understanding how to use the planning DSS is an important aspect of the future operational use and sustainability of the FDMT project, therefore, capacity on the use and application of the planning DSS, as well as giving stakeholders an opportunity to provide feedback on the functionality of the planning DSS will go a long way to achieving this.

The project is holding a series of technical trainings targeting technical staff and junior to senior level water resource professionals from different organisations. Trainings intend to provide a basis for bringing basin organisations, water utilities and other organisations together around a common planning tool, while being able to test and validate the planning DSS. Feedback from these workshops is being gathered and will be included in the further development and refinement of the planning DSS.

The objective of the technical trainings are to:

- Enhance stakeholders understanding of the planning DSS
- Provide stakeholders with an opportunity to give feedback on the functionality of the planning DSS
- Refine the development of the planning DSS based on stakeholder feedback

With support from the Lake Victoria Basin Commission (LVBC), DHI and the International Water Association (IWA) organised the second 4 day technical training in Kisumu, Kenya from January 26-29, 2016. The training focused on the functionality available at this stage of the project. The training opened with an overview of the project followed by an explanation of the DSS planning platform. Participants were given a chance to explore the platform interphase consisting of the MIKE Customised platform (the central tool of the planning DSS) and QGIS. The following days focused on specific functionality of the planning DSS: day two focussing on drought status and crop water modelling, day 3 on planning and on Water Safety Planning (WSP) support and the final day on seasonal forecasting and climate change and the link to planning.

2. Project background

The ‘Flood and Drought Management Tool’ (FDMT) project (http://fdmt.iwlearn.org/) is funded by the Global Environment Facility (GEF) International Waters (IW) and implemented by UNEP, with the International Water Association (IWA) and DHI as the executing agencies. The project is developing methodologies and tools within a decision support system (DSS) with tools to support planning from the transboundary basin to water utility level by facilitating the inclusion of information about floods, droughts and future scenarios into Integrated Water Resources Management (IWRM) planning, Water Safety Planning (WSP), Transboundary Diagnostic Analyses (TDA) and Strategic Action Plans (SAP). The project is being implemented from 2014 - 2018, and 3 pilot basins (Volta, Lake Victoria and Chao Phraya) have been identified for development and testing of the planning DSS.

The project responds to a growing sense of urgency around the need to improve resilience within river basins, and for this to become a critical part of water management plans. Consequently, the IW focal area of the GEF has identified the increased frequency and unpredictability of floods and droughts as a priority concern in transboundary contexts, along with the other multiple drivers that cause depletion and degradation of shared water resources.

The project will integrate information on climate including floods and droughts for planning at both transboundary and national basin and local (specifically water utilities) levels by providing tools for both scales within a single planning DSS.

The planning DSS being developed is a computer-based decision support system (or piece of software) containing various technical functionality in the form of ‘tools’ to integrate information on climate including floods and droughts for planning at both transboundary and national basin and local (specifically water utilities) levels by providing tools for both scales within a single planning DSS. Although the planning DSS is being tested and validated with available data at both basin and local levels in the 3 pilot basins, the tool is intended for all other GEF IW basins. This also includes training modules available at the end of the project to ensure that methods can be applied to other basins. The aim is to develop an approach that interfaces with existing planning practices; e.g. TDA/SAP, IWRM or WSP, but will not embrace all activities within the planning methods. The outcome will enable stakeholders to compile information, from models, indicators and existing planning approaches, so as to develop future planning scenarios that are robust, resilient and pragmatic.

3. Technical training

3.1 Overview of training

Technical training on the use of the planning DSS is scheduled on a yearly basis within each of the pilot basins. The technical training intends to provide capacity building as well as give the stakeholders an opportunity to give feedback on the functionality and use of the planning DSS. The feedback will be included in the further development and refinement of the planning DSS and is of great value for the project.

The technical training targets stakeholders from different organisations, and provides a basis for bringing basin organisations, water utilities and other organisations together around a common planning tool. The training was organised with a number of sessions some relevant for all stakeholders and other sessions specialised for groups of stakeholders based on the technical areas of expertise and needs.

The technical training was based on real data from the Lake Victoria Basin with some functionality using data from the Chao Phraya Basin. The training sessions reflect the developed functionality within the planning DSS, hence the first technical training will focus on the functionality available at the time of the training, while the last training will include the functionality of the full planning DSS.

Objective

The objective of the technical training is to:

- Enhance the stakeholders understanding of the developed planning DSS
- Provide the stakeholders with an opportunity to give feedback on the functionality of the planning DSS
- Refine the development of the planning DSS based on the stakeholder feedback

Expected outcome of the workshop

The expected outcome of the technical training is that target stakeholders will understand the developed functionality, how to use the planning DSS, and how the output from the planning DSS can be used in decision making around flood and drought management planning across scales.

For the project, this will be an opportunity to get valuable feedback from the stakeholders on the functionality and how the developed planning DSS could be used in decision-making.

Target group

The target group of the technical training is the technical staff within the project stakeholders, junior to senior level water resource professionals as recommended by key stakeholders. The training in Kisumu focused on staff from the water utilities; National Water and Sewerage Cooperation (NWSC) and Kisumu Water and Sewerage Company (KIWASCO) and national ministry representatives from Kenya, Tanzania, Uganda, Rwanda and Burundi and the basin organisation for the Lake Victoria Basin, the Lake Victoria Basin Commission (LVBC).

3.2 Technical training

From January 26-29, 2016, the FDMT project held a 4 day technical training with support from LVBC at the Vic Hotel, Kisumu. The 4 days gave participants a first impression of the planning DSS in which they could test the functionality of the different components and provide feedback to further develop the DSS and ensure that functionality is available to address the needs of the users for planning.

Day 1. Introduction and QGIS functionality

Tuesday 26th January 2016

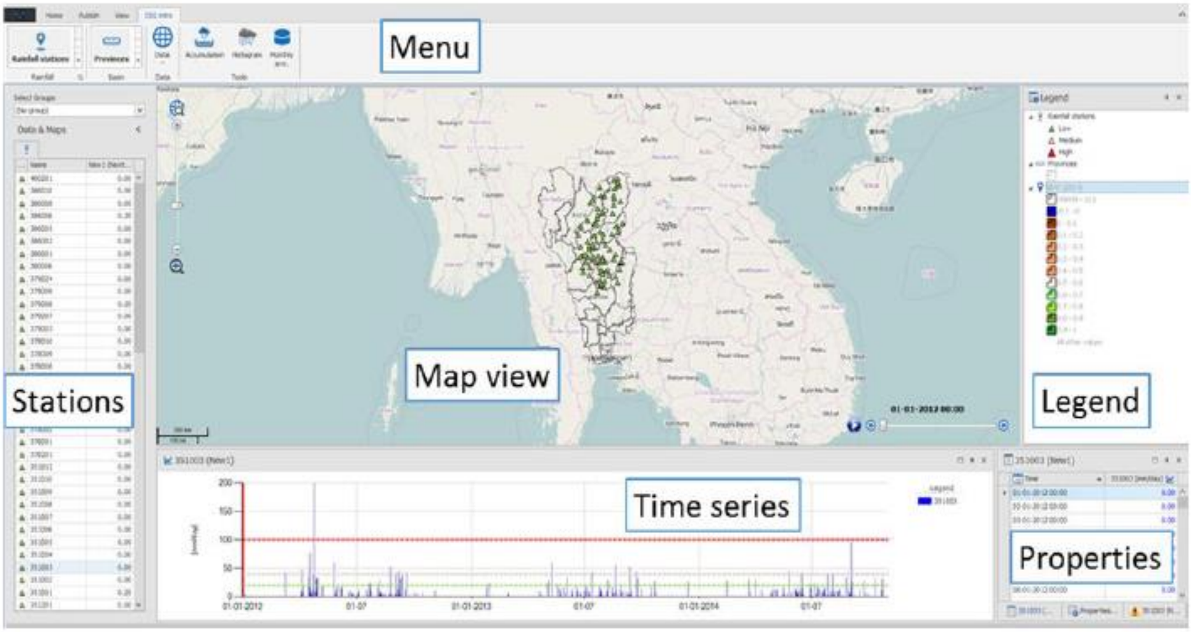
In the Lake Victoria Basin, flood and drought events are becoming more frequent. There is a need for a tool that will assist organisations in their planning for the future of the basin. Raymond Mngodo, Regional Project Coordinator of LVBC, in his opening address, urged for participants to test the tools developed rigorously. The training provides those present with a unique opportunity to run the tool and provide the necessary feedback to ensure that what the project develops will help address the issues being faced in the basin.

Project overview and status

There is ongoing developments of selected functionality within the DSS. At this point, the developments focused on the:

- Platform and tools for the DSS
- Drought management
- Support for Water Safety Planning (WSP)
- Seasonal forecasting
- Climate change projections
- Web portal to view and download data

The DSS platform is based on the MIKE Customised platform and QGIS. The MIKE Customised platform is the central platform for the developed DSS, integrating all tools in one place (it links GIS, time series, meta data, and other applications such as AquaCrop). QGIS, which is a free and open source GIS tool, has been integrated into the platform and customised for the project enabling users to plan, view and analyse spatial data and temporal data, creating maps (e.g. NDVI maps), graphs and tables for reports.



The DSS platform shows you for the selected data for that station or combination of stations. It enables you to calculate monthly average rainfall, among other functions that can be defined by the user based on the available data and needs.

Additional modelling software or tools can be added to the platform. For example, AquaCrop has been integrated as a spreadsheet with relevant input fields. The model links up to information that is already on the system (e.g. if you have already put your rainfall data in the system, the AquaCrop model can easily use this information in its calculations). A unique feature is that users are not required to import the information in the format required by AquaCrop.

The strength of this DSS is in the ability to bring all information in one place and link the GIS information with time series, with meta-data, and also use this in other applications such as the AquaCrop model.

Currently the focus has been on drought management. As the project progresses, functionality to address flood issues will be integrated into the DSS.

Introduction to QGIS

Why use QGIS?

- Essential for planning, in particular for viewing and analysing spatial and temporal data; creating maps, graphs and tables for reports; to maintain spatial data.
- Free and open source product – anyone can download it and it is very close to being as good as ArcGIS, as it is open source (no license required), there are bugs, but these can be reported and you can also see how to fix these (these can be found on forums, for example).
- Useful for professional application.
- The field of remote sensing is improving.
- Accepts a variety of data sets (data formats); data conversion is better with QGIS (compared to ArcGIS, which is also not a free and open source product).

Participants explored the functionality of QGIS; understanding how to set up a QGIS project, from adding, modifying and analysing data to mapping, grouping and ordering of data, layer styling and labelling, mapping (create maps), importing and creating and editing GIS layer. This exercise was to get familiar with the basic functionality of QGIS to know what the possibilities are.

Day 2. DSS and Drought monitoring and warning

Wednesday 27th January 2016

DSS introduction

The developed DSS allows you to both view data but also analyse data. System and data visualisation and analysis in the planning DSS consists of:

- Map views
- GIS layers
- Station lists
- Observation times
- Time series

There are two key parts of the planning DSS; configuration and the system interface. The configuration option provides the user with different options to configure the DSS and define specific setups. This section, for example, enables the user to define functionality (e.g. tools to calculate monthly average rainfall, etc. – this can be user specific as there is no limit to the additional functionality that can be defined by the user) or defining stations, attributing data (can associate more data information to one station, e.g. turbidity, salinity, water level, etc.) and defining thresholds, among other options. The system interface is used to view and analyse the data.

Of interest for users is that the planning DSS can link to a system database on a central server to which you log on to. Inputting data can be automised by importing a script into the DSS system, however, this would need to be done by an IT person.

Furthermore, different types of user profiles can be created with different access rights (levels). These levels can be modified to suit the needs of the organisation.

Other functionality of the planning DSS includes the possibility to link to web pages, and perhaps more interesting, spreadsheet interfaces. An example of this functionality was demonstrated using the project website and the integration of the AquaCrop model from the Land and Water Division of FAO.

Crop model

AquaCrop is a crop water productivity model that estimates the crop yield of the crop water demand under defined conditions

- Weather conditions (rainfall, air temperature, and the evaporative demand of the atmosphere) – data can be taken directly from the system if it was already put there.
- Soil characteristics (how was the water infiltrates)

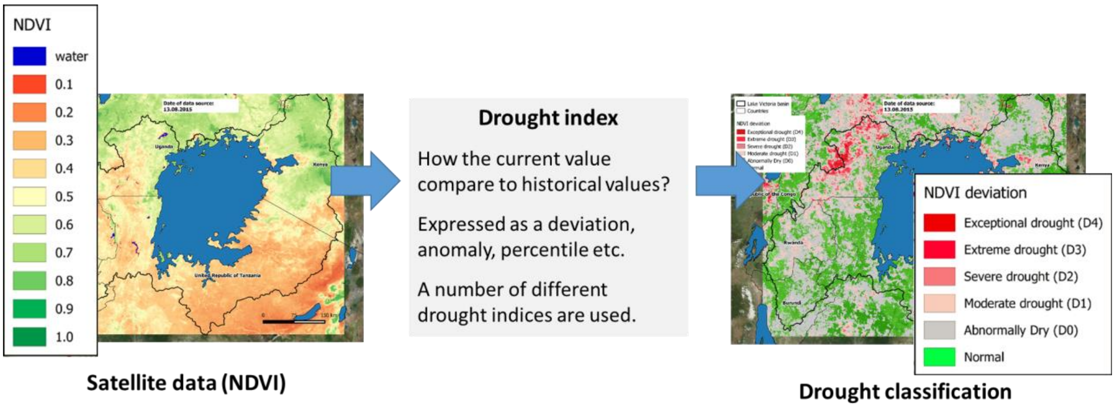
- Crop characteristics (type of crop and water demand)
- Field management practices (fertiliser management, irrigation, etc.).

This is particularly useful to simulate crop production and yield under simulated environmental conditions, for example a drought situation for a certain period. The integration of forecasted or projected weather conditions can be used to study the impact on yield and crop water demand under various climate change scenarios, adding another dimension useful for planning.

Drought management in the DSS and remote sensing
Tools integrated in the planning DSS platform for drought management is based on information downloaded and analysed from remote sensing data (though QGIS). The tools process different data sets and enable users to open and visualise the information as needed. The intention is to develop technical tools to support drought management in existing planning methods (TDA/SAP, IWRM, WSP, etc.)

The project addresses three types of drought:
- Meteorological drought: Rainfall and potential evaporation (using Tropical Rainfall Measuring Mission (TRMM) to estimate the change in rainfall) – the use of GPM will replace TRMM once there is sufficient historical data (this has a higher resolution)
- Hydrological drought: Look at soil moisture (using Soil Water Index (SWI) to estimate changes to the moisture content in the upper soil layers)
- Agricultural drought: Vegetation cover (using Normalized Difference Vegetation Index (NDVI) to estimate the vegetation growth)

A common point for the above indices is their potential use to categorise the climate conditions or situations; in this case drought classification. NDVI indicates vegetation cover and analyses how the current situation compares to the normal (or average) historical condition; comparing whether the conditions over time are above or below the normal mean. If vegetating is low, this will be flagged with a red colour indicating a certain level of drought (there are 5 classes of drought from abnormally dry to exceptional drought). A similar process is done with SWI and TRMM data.



The information obtained can be used for operational drought reporting.

Day 3. Planning and DSS support for Water Safety Planning
Thursday 28th January 2016

Mekuria Beyane started off day 3 with a presentation on the development of Operational Decision Support System (ODSS) being developed for the Shire River Basin in Malawi. With the increasing impacts of both flooding and water scarcity, an increased need to base decision making on more informed basis is important to manage and respond to the impacts of flooding and water scarcity. The ODSS project is creating an integrated, short-term meteorological, hydrological and hydraulic flood forecasting (does not consider flash floods as they occur in a short time frame, making it difficult to model) and warning system based on the MIKE Customised software. The aim is to support sound decision-making related to optimal water use through dedicated scenario analyses. At the end of the day it is also about people understanding the nature of floods and being prepared for the impacts.

There are several links between the ODSS and the FDMT DSS and initiatives undertaken by stakeholders in the basin. Some of the drought functionality discussed on day 2 is, for example, being integrated into the ODSS for Malawi relevant for forecasting and drought assessments.

About 80% of the technical aspects are completed for the ODSS. For the next two years, the reliability and sustainability of the ODSS will be addressed. The validation of the system needs to be done before it is handed over. This applies for any system that is developed and the reason behind the yearly technical trainings in the FDMT project. For the ODSS, training are given to staff that will take on the responsibility of the system on a day-to-day basis; to maintain and update the system.

Just as important is ensuring the manifestation of improved and strong capacity levels; this is addressed through trainings and awareness workshops in the FDMT project.

The ODSS focuses on real-time forecasting for early warning. While the FDMT provides seasonal forecasting and climate change projects, the focus of the platform is more on how planning for flood and drought impacts can be supported through the integration of information on floods and droughts in already exiting planning approaches of basin organisations, utilities, and other end users; the TDA / SAP, IWRM, WSP, etc. In Malawi, the ODSS focuses on flood preparedness, however, the ODSS is a component of a larger programme (consisting of about 30 projects handled by the Ministry of Water in Malawi), which means there are other projects that use the information from the ODSS to inform planning, the subject matter of day 3.

Decision-making tools and planning

The planning session provided participants with the opportunity to influence the development of the planning DSS by shaping the workflow for how planning should be done. This resonates with the opening remark by Raymond Mngodo on the need for participants to thoroughly assess the system and where improvements are needed.

Planning is the process of deciding how to solve a specific issue and decision making methods help to find the ideal decisions or formulate a plan to address the issue. Participants shared their experiences, demonstrating some of the challenges faced with planning. Representatives from the Kisumu Water and Sanitation Company (KIWASCO) explained that the utility often face issues with implementing strategic planning around policies and operating guidelines as the person in a position to make the decision does not consider what is needed for strategic planning. In Uganda, along the Nile, information provided from the stations was incorrect, giving the wrong long term average. This information was used by the Ministry in an upgrade plan for an irrigation area, which they ended up over-sizing.

Water resource planners (whether basin organisations or utilities) make decisions today without perfect knowledge of the future. The planning DSS will help guide users in a workflow approach through a decision making process by providing the tools to perform the analysis necessary in the decision making process which takes into account the unknown future; the user can define external factors, interventions and indicators in the DSS and provides the possibility of scenario generation and methods to choose among different scenarios considering uncertainty

In more simple words the DSS will provides a workflow to derive a decision for solving specific issues which is robust with respect to future uncertainty.

Participants were divided in groups and asked to identify interventions needed over the next 50 years to meet water demand while minimising water deficit and maximising benefits. The following table summarises the main interventions from each group:

Group 1	**Group 2**	**Group 3**
• Dam(structural) to store	Underlying assumption dry	• Building dam or reservoir

more water and release water in a controlled manner • Invest more in catchment related activities (catchment protection to ensure sustainable and efficient use of water) • Exploring alternative sources of water (e.g. looking at ground water or basin to basin transfer) • Invest time to ensure consumer use water efficiently and sustainably – using less water so that demand does not increase – as well as investing in water efficient technology. • Look at the capacity of treatment – build more units to treat more water (increase treatment capacity / expansion plans/upgrade plans)	period flow is enough to supply dry season demand • Alternative water source – from a dam or ground water source • Sensitisation and water use efficiency (consumer level) • Better tools to provide overview of water resources • IWRM involving all stakeholders • Expanding infrastructure (expansion plans/upgrade plans)	upstream • Looking for alternative sources: rain water harvesting at household level, looking at ground water (central provision) • New water treatment plant to complement the old one (downstream) and increasing the capacity of the existing one (renovation, expansion plans/upgrade plans) • Increase water prices to enable people to use water efficiently (the more expensive the more conscious people will become) • Recycling of water (using water for cleaning clothes to flush toilets) • Catchment management to maintain the quality of water so as not to increase the cost for treatment

Having identified a number of interventions, the groups were asked to specify external factors (that cannot be controlled), which hinder the uptake and implementation of the interventions. The following table summarises the external factors of each group:

Group 1	**Group 2**	**Group 3**
• Legal and policy • Population growth (natural process or migration) • Climate change (floods can destroy infrastructure and drought have their own implications)	• Capital investment (lack of financing) needed to construct infrastructure (but also no influence on design) • Environmental catastrophe and extreme events • Legal, regulation, policy • Social factors (if you want to build a dam, communities might say no even if they would be compensated)	• Population dynamics (increase or decrease in population) • Agricultural act ivies may increase or decrease 9irrigation0 • Climate change may cause drought or floods (fluctuation quality and quantity of water) • Land availability (not enough space to build new infrastructure • Finances and willingness of the government to invest and of the people to accept changes • Political factors (e.g. change in regime, or president)

Using the common interventions and external factors identified by the groups, the participants were asked how to evaluate the impact of the intervention and external factor.

Item	Group 1	Group 2	Group 3
Dam construction	• Tool: Model • Indicator: Storage capacity, water availability, service level	• Indicator: Benefits in terms of availability of water, generate hydro-power, recreation, fishing	• Indicator: How many people have been supplied (new people) • Indicator: Reduced complaints (of people with no water) • Indicator: Reduced deficit (of water)
Catchment management	• Indicator: Population displacement • Indicator: Improved flow • Indicator: Vegetation cover • Indicator: Agricultural productivity	• Indicator: Improved water quality and quantity (flow) • Indicator: Treatment needs • Indicator: Improved agricultural productivity (irrigation and yield)	• Indicator: Treatment cost • Indicator: Water quality
Alternative sources		• Indicator: Improved water availability	• Indicator: Volume of water supplied from the central system • Indicator: Revenue *This considers the NRW for both points*
Legal and policy*			
Population dynamics (growth)*			
Climate change*			

*participant ran out of time and were not able to discuss these items

The main point of the exercise was to hear from the groups the most relevant external factors (and related uncertainties) and interventions (decisions), and identifying the evaluation methods/indicators to evaluate the performance of intervention plans. This helped to understand what they consider to be relevant for decision making and to help them define a solution to a problem through a decision making framework.

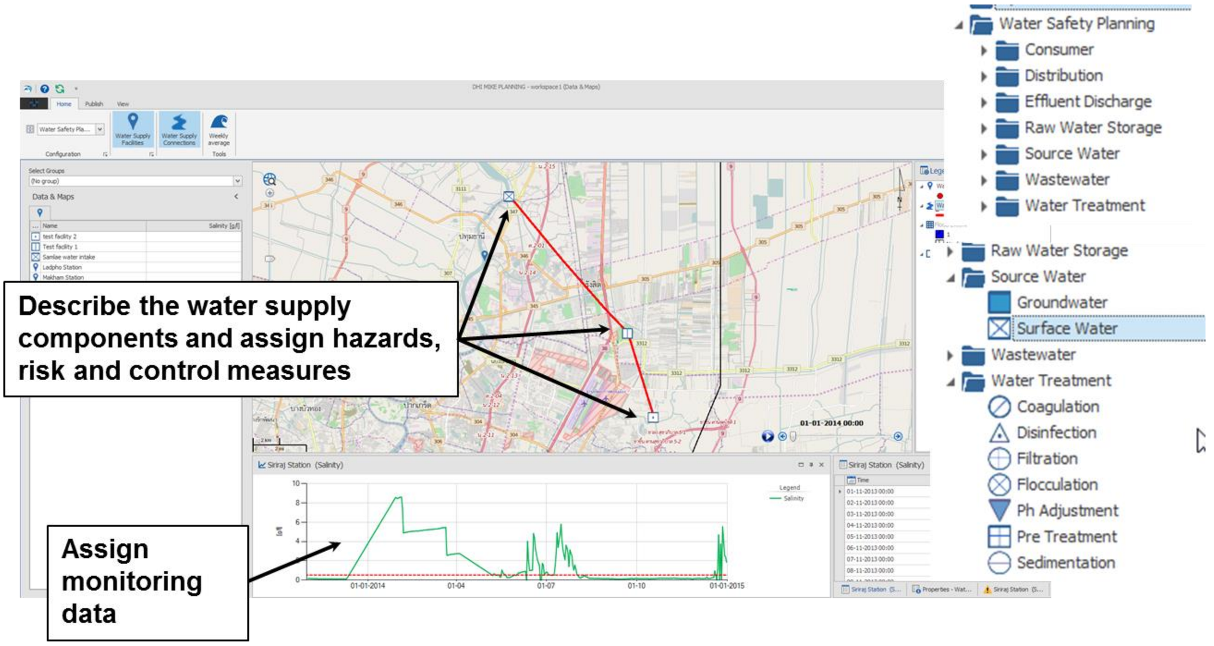
WSP in the DSS

Water utilities assess risks and make decisions on safety measures in order to guarantee a safe and sustainable drinking water supply. Due to the potential hazards in the raw water sources, treatment plants, their distribution systems, water supply systems and consumers are exposed to a wide range of risks. In addition, climate change, societal development and the emergence of new hazards constantly provide new risks. As a result, water utilities continuously have to assess risks and prioritise water safety measures in order to obtain a safe and sustainable supply system.

One of the most effective ways of continuously ensuring a safe supply of drinking water (safe is understood from a heath perspective; you can drink the water and not have any negative impact on your health) is through a comprehensive and continuous risk assessment and risk management approach that involves all steps in supplying water; from catchment to consumer, known as Water Safety Planning (WSP). The development and implementation of the WSP follows 11 modules that broadly address the following:

- Establishing a team and decide a methodology by which a WSP will be developed
- Identifying all the hazards and hazardous events that can affect the safety of a water supply from the catchment, through treatment and distribution to the consumers' point of use
- Assessing the risk presented by each hazard and hazardous event

- Considering if controls or barriers are in place for each significant risk and if these are effective
- Validating the effectiveness of controls and barriers
- Implementing an improvement plan where necessary
- Demonstrating that the system is consistently safe



The project is developing technical tools to support some of the WSP modules, however in different capacities. The overall idea is to digitalise the WSP process for utilities as this will help when a utility needs to update its plan.

The planning DSS will fit into the WSP framework and assist water utilities in the different stages of WSP implementation. It will not create additional work and should not replace the existing WSP manual.

The WSP supporting tools are divided into:
1. Schematic description of the water supply system.
2. Assigning potential hazards, risks, control measures and monitoring mechanisms to each of the water supply components (e.g. abstraction points, pumping stations, pipes, etc.).

The exercise allowed participants to add shape files in order to have layers to zoom to and to define observation stations and associate time series to the stations. They were then able define new components of the water supply system and to assign hazards, control measures and monitoring options to these components. When defining control measures, utilities define measures within their boundaries (from the point of abstraction to meter). Beyond their boundaries, there is limited control which makes it hard to put in place preventative measures. There is a need for an effective way to communicate beyond for the utility, for example if water is contaminated by an incident upstream. The planning DSS can help in relaying information at the different scales.

Feedback form the WSP session will be used to further develop the WSP functionality of the planning DSS. Users (the utilities) are the experts and know what they need, so they can indicate how outputs should be visualised or reported.

More work will be done on linking WSP to flood and drought information and improvements are expected on the reporting capability for the WSP. Continuous consultation with utilities is needed to ensure that the right information and functionality is available to utilities and adds value to their efforts in ensuring a safe supply of water.

Day 4. Planning, seasonal forecast and climate change
Friday 29th January 2016

Enabling basin organisation and other water users to access and share information will foster cooperation and planning which will help build resilience and improved capacity to manage and reduce the impacts of flood and droughts form local to transboundary level.

Information in the form of seasonal forecasting and climate change projects can provide a general expectation of possible futures and associated impacts. This information can help determine what the right actions are needed, which can ensure the sustainability of the basin and its resources.

Functionality to model climate change projects and seasonal forecasting are being developed in the planning DSS.

Seasonal forecasting
Currently, functionality for seasonal forecasting has been developed to forecast drought impact. The seasonal forecast is based on a global climate model, using satellite based information updated every day, making 20 ensembles of the forecasted climate available for the user (this means that no one future is predicted but several futures all equal in terms of probability, this enables you to study multiple scenarios).

The functionality for seasonal forecast is used to describe how the drought is expected to evolve over the coming weeks to months (information needed for the drought indices) or to analyse crop production (using AquaCrop).

Participants worked on probabilistic forecasting to indicate where there is rainfall below or above normal; comparing the forecast with climatology data (historical daily TRMM data). This is one way to show your ensemble and the probability of having less or more rainfall in the future.

The goal is to use the planning DSS to operationalise – downloading forecasting to processing, extracting relevant time series and generating products, and reporting and dissemination.

This information is useful for asset management, for example to optimise the management of a dam in relation to the agriculture sector. However, the information would be more valuable if linked to a hydrological model. Just forecasting rainfall is not enough.

Climate change
Climate change is an external factor, one that we have limited to no control over. The objective is to develop functionality supporting climate processing seamlessly across different temporal scales, from short to seasonal to decadal climate processing.

The current status is:

- Functionality for automated download and processing of seasonal forecast is implanted (global 9 month daily forecast updated daily)
- Seamless climate processing across different temporal scales

Regional Climate Model (RCM) ensembles and different downscaling methods are used to produce input to (hydrological) impact models. Ensemble of projected impacts are used as input to decision making methods and the output of decision making methods can be used to formulate adaptation strategies.

RCM exist of each continent. The spatial resolution is 50 km (and some regions 12km), the temporal resolution is 6h, day, month and season.

Climate projects can be used in strategic planning to plan around infrastructure development, investments, policies and operating guidelines.

3.3 Next steps (Q2, Q3 and Q4 2016)

As the project continues, there will be more developments, especially to the DSS platform. Some of the activities planned for the first and second quarter of 2016 are:

- Finalise WSP support (easy overview and analysis of components with high risk, improve the hazard, control measure and monitoring flow, improve the reporting and dissemination functionality, and incorporating flood and drought elements)
- Finalise drought early warning and dissemination
- Development and validation of climate processing functionality
- Implementation of planning methods
- Support for Transboundary Diagnostic Analysis (TDA)
- Concept for climate change and flood management

Annex 1 – Agenda

Tuesday the 26th of January 2016 *Introduction and QGIS functionality*		
Time	**Title**	**Responsible**
08:00 – 09:00	**Registration**	
09.00 – 09.30	Welcome and presentation of the objective with the technical training	LVBC
9:30 – 11:00	**Session 1: Project overview**	IWA/DHI
11.00 – 12.30	**Session 2: QGIS basic**	DHI
12.30 – 13.30	**Lunch**	
13.30 – 14.30	**Session 2: QGIS basic - continued**	DHI
14.30 – 16.00	**Session 3: QGIS climate and drought functionality**	DHI
16.15 – 17.00	Discussion and wrap up	

Wednesday the 27th of January 2016 *DSS and Drought monitoring and warning*		
Time	**Title**	**Responsible**
09.00 – 09.30	Questions based on experience from day 1	
09:30 – 12.30	**Session 10: Introduction to DSS**	DHI
12.30 – 13.30	**Lunch**	
13.30 – 15.30	**Session 5: Drought status**	DHI
15.30 – 16.30	**Session 6: Crop model**	DHI
16.30 – 17.00	Discussion and wrap up	

Thursday the 28th of January 2016 *Water safety planning*		
Time	**Title**	**Responsible**
09.00 – 09.30	Questions based on experience from day 2	DHI
09.30 – 11.30	**Session 11: Planning**	DHI
11.30 – 12.30	**Session 4: WSP in the DSS**	IWA/DHI
12.30 – 13.30	**Lunch**	
13.30 – 16.00	**Session 4: WSP in the DSS**	DHI
16.00 – 17.00	Discussion and wrap up	

Friday the 29th of January 2016 Planning and climate forecast/change		
Time	**Title**	**Responsible**
09.00 – 9.30	Questions based on experience from day 3	
09.30 – 11.30	**Session 12: Climate change**	DHI
11.30 – 12.30	**Session 8: Climate forecast (seasonal)**	DHI
12.30 – 13.30	**Lunch**	
13.30 – 14.45	**Session 8: Climate forecast (seasonal)**	DHI
14.45 – 16.00	**Discussion and wrap up**	

**note: not all items on the agenda were addressed to ensure engagement levels remained high.*

Annex 2 – Participants

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Annex 3 – Evaluation form

Evaluation of Flood and Drought Management Tools Technical training

Name: **Organisation:**

What was your overall impression of the training?

Excellent	Good	Acceptable	Below expectations
☐	☐	☐	☐

Would you recommend this training to others?

Yes ☐	No ☐

General	Agree				Disagree
Technical content of the course was satisfactory	1	2	3	4	5
The duration of the course was satisfactory	1	2	3	4	5
The time for discussions and group work was sufficient	1	2	3	4	5
The time for hands-on exercises was satisfactory	1	2	3	4	5
The support during hands-on training was satisfactory	1	2	3	4	5

Project overview	Agree				Disagree
I have a good understanding of the Flood and Drought Management Tools project and what it is trying to achieve	1	2	3	4	5
What could be improved and made clearer?					

QGIS	Agree				Disagree
The explanations of how to use QGIS were clear	1	2	3	4	5
The training material on how to do the QGIS exercises were clear and comprehensive	1	2	3	4	5
From the exercises I feel confident in using QGIS	1	2	3	4	5
What could be improved and made clearer?					

WSP in the DSS	Agree				Disagree
The discussion on WSP Asia Network was useful	1	2	3	4	5
I will engage with the WSP Asia Network in the future	1	2	3	4	5
The explanation on how to use WSP in the DSS were clear	1	2	3	4	5
The training material on how to use WSP in the DSS were clear and comprehensive	1	2	3	4	5
From the exercises I feel confident in using the DSS in relation to WSP	1	2	3	4	5

What could be improved and made clearer?

Drought status	Agree				Disagree
The presentation on drought status was clear and has given me a good understanding of the different indices and how they are used	1	2	3	4	5
The training material on drought status using QGIS were clear and comprehensive	1	2	3	4	5
I feel confident on working with drought data in QGIS	1	2	3	4	5
The training exercises and material on interpreting drought reports was useful	1	2	3	4	5
The exercises have improved my understanding of different drought indices and how to analyse drought status	1	2	3	4	5
What could be improved and made clearer?					

Planning DSS	Agree				Disagree
The presentations to explain the planning DSS was clear	1	2	3	4	5
The training material to understand how to use the DSS was clear and comprehensive	1	2	3	4	5
I have a good understanding on how to use the DSS	1	2	3	4	5
What could be improved and made clearer?					

Use of indicators	Agree				Disagree
The presentation on indicators was clear	1	2	3	4	5
After the exercises I understand how to use the Water Indicator Builder	1	2	3	4	5
What could be improved and made clearer?					

Course practicalities	Agree				Disagree
The venue was satisfactory	1	2	3	4	5
Lunch and refreshments were satisfactory	1	2	3	4	5
The course was well organized	1	2	3	4	5
I received practical information well in advance	1	2	3	4	5

Annex 4 – Feedback

What was your overall impression of the training?	*Excellent*	*Good*	*Acceptable*	*Below expectation*
	1	11		
	1	*11*	*0*	*0*

n *12*

Would you recommend this training to others	*Yes*	*No*
	11	1
	11	*1*

n *12*

General					
Questions	**Response**				
	Agree 1	*2*	*3*	*4*	*Disagree* 5
Technical content of the course was satisfactory	5	4	2		1
The duration of the course was satisfactory	2	1	6	3	
The time for discussions and group work was sufficient	1	4	4	3	
The time for hands-on exercises was satisfactory	2	4	5	1	
The support during hands-on training was satisfactory	6	3	1	1	1
	11	*12*	*16*	*8*	*1*

n *12*

Project overview					
Questions	**Response**				
	Agree 1	*2*	*3*	*4*	*Disagree* 5
I have a good understanding of the Flood and Drought Management Tools project and what it is trying to achieve	3	6	1	2	
What could be improved and made clearer?	• Not yet user friendly • The stakeholders who will be collecting and analysing the data • The DSS tools need to be made lighter and user friendly. It looks very complex in present state • An improved workflow of the session step-by-step guides; Usage of more case specific • Improve on user friendliness for first time users • Data availability + updated • The bug realities to be dealt with				
	3	*6*	*1*	*2*	*0*

n *12*

QGIS						*n*	*12*
Questions	**Response**						
	Agree 1	*2*	*3*	*4*	*Disagree* 5		
The explanations of how to use QGIS were clear	4	6		2			
The training material on how to do the QGIS exercises were clear and comprehensive	6	3		3			
From the exercises I feel confident in using QGIS	1	7	2	2			
What could be improved and made clearer?	• The climate and drought functionality • Improve documentation • The plugins are just too many • Provision of a comprehensive manual for QGIS and the MIKE planning • Complete exercises that involve both the QGIS and the DSS and their inter-relations in the overall objectives of the DSS • Downloading of satellite data; Raw data processing • Output interpretation • Download data on internet						
	11	*16*	*2*	*7*	*0*		

WSP in the DSS						*n*	*11*
Questions	**Response**						
	Agree 1	*2*	*3*	*4*	*Disagree* 5		
The explanation on how to use WSP in the DSS were clear	1	4	4	2			
The training material on how to use WSP in the DSS were clear and comprehensive	2	3	5	1			
From the exercises I feel confident in using the DSS in relation to WSP	1	3	4	3			
What could be improved and made clearer?	• Display the risk and external factors in DSS • More hazards and hazardous events need to be added. The tool needs to be made lighter as it is very heavy in the present state - option of using offline map (background) • Case specific examples relevant directly to the basin • Time was not enough to explore the software (functionality) • Events/hazards should be fewer (2-4) and concise						
	4	*10*	*13*	*6*	*0*		

Drought status						*n*	*11*
Questions	**Response**						
	Agree 1	*2*	*3*	*4*	*Disagree* 5		
The presentation on drought status was clear and has given me a good understanding of the different indices and how they are used	1	6	2	2			

The training material on drought status using QGIS were clear and comprehensive	2	5	4		
I feel confident on working with drought data in QGIS		7	4		
The training exercises and material on interpreting drought reports was useful	2	5	3		1
The exercises have improved my understanding of different drought indices and how to analyse drought status	2	4	3	2	
What could be improved and made clearer?	• The training needs more time than allocated • Time was not enough to explore the software (functionality) and provided material • More examples and interpretation (case study) are needed • As one of the functionality of the tool having stream flow forecast so that it can be used during planning to operate reservoirs during flood and drought events				
	7	*27*	*16*	*4*	*1*

Planning DSS						*n* *11*
Questions	**Response**					
	Agree 1	*2*	*3*	*4*	*Disagree* 5	
The presentations to explain the planning DSS was clear	3	5	1	2		
The training material to understand how to use the DSS was clear and comprehensive	3	4	2	2		
I have a good understanding on how to use the DSS	1	5	3	2		
What could be improved and made clearer?	• There should be a link to directly download the data from TRMM, NOAA, ... • More time is needed for the training • To align various tools and commands to earlier DSS development • Interpreting scenarios to avoid false positives x false negatives is critical (case studies) • I would be more comfortable to comment on this after the flood forecast part is done (finished) because to be an innovative tool incorporating hydrologic models is necessary; • The cool thing about the planning DSS it is like with the portal which could widen the use of the tool and the information it generates					
	7	*14*	*6*	*6*	*0*	

Use of indicators						*n* *9*
Questions	**Response**					
	Agree 1	*2*	*3*	*4*	*Disagree* 5	
The presentation on indicators was clear	2	5		2		
After the exercises I understand how to use the Water Indicator Builder	3	2	2	2		

What could be improved and made clearer?	• How to include them in the DSS • Constant and varying variables • More time for the training and more materials on the tools • Criteria for selecting suitable indicators

	5	*7*	*2*	*4*	*0*

n 11

Course practicalities					
Questions	**Response**				
	Agree				*Disagree*
	1	*2*	*3*	*4*	*5*
The venue was satisfactory	6	2	1	1	1
Lunch and refreshments were satisfactory	5	4	1		1
The course was well organised	5	3	1	1	1
I received practical information well in advance	2	2	5	1	1
	18	*11*	*8*	*3*	*4*

Any other comments	• Please consider adding more time for the training and make the tools available online; Work on the compatibility issues for the DSS tool with given challenges we got when trying to install on various computers; Make the tool be able to work offline • Kindly incorporate more stakeholders for better assimilation; Increase the number of training and refresher workshops; Separate clearly the request for features sessions (technical - computer system specific) and the usage training general • Expedite the development of the DSS planning tool for full scale testing • The DSA should be managed by the participant • The tool developed is very useful and hope to see it in the future (the final version). What would be more useful for training would be to let the trainees develop the input datasets by theme selves (input to the model like the data system we used for forecast, climate change and other exercises) • The tool development is progressing well, I hope that I will understand it better when I continue using it