FLOOD & DROUGHT MANAGEMENT TOOLS

Technical Training: Chao Phraya Basin Report

24-26 November 2015

Sukosol Hotel

Bangkok, Thailand

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1. Executive summary / รายงานสรุปสำหรับผู้บริหาร

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 DSS.

Understanding how to use the 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 DSS, as well as giving stakeholders an opportunity to provide feedback on the functionality of the 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 intends 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 DSS. Feedback from these workshops is being gathered and will be included in the further development and refinement of the DSS.

The objective of the technical trainings are to:

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

With support from CapNet and the Hydro and Agro Informatics Institute (HAII), DHI and the International Water Association (IWA) organised the first 3 day technical training in Bangkok, Thailand from November 24-26, 2015. 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 sample the platform interphase consisting of the MIKE Customised platform (the central tool of the DSS) and QGIS. The following days focused on specific functionality of the DSS. Day two consisted of two parallel tracks, one addressing the integration of tools to support WSP in the DSS and another track on analysing drought status and planning. The final day looked at how seasonal forecasting is being integrated in the system and how users can develop and incorporate new indicators into the platform.

The focus of trainings is based on the functionality available at that specific point in time. This training focused on drought management and functionality that supports drought management and planning and initial ideas around tools supporting Water Safety Planning (WSP).

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ปัจจุบันนี้ความจำเป็นเร่งด่วนในการปรับปรุงความยืดหยุ่นภายในลุ่มน้ำมีเพิ่มมากขึ้นและยังเป็นส่วนสำคัญส่วนหนึ่งในการวางแผนบริหารจัดการน้ำ
การเพิ่มขึ้นของความถี่และความไม่แน่นอนของการเกิดน้ำท่วมและภัยแล้งเป็นประเด็นสำคัญที่ต้องพิจารณาทั้งในระดับข้ามพรมแดนและท้องถิ่น รวมถึงปัจจัยที่เกี่ยวข้องอื่น ๆ
ที่ทำให้เกิดการลดลงและการเสื่อมสภาพของแหล่งน้ำที่ใช้ร่วมกัน

โครงการจัดทำเครื่องมือในการบริหารจัดการน้ำท่วมและภัยแล้ง (http://fdmt.iwlearn.org/)
ได้รับเงินทุนจากกองทุนสิ่งแวดล้อมโลก (Global Environment Facility, GEF) ด้านน้ำระหว่างประเทศ

(International Waters, IW)และดำเนินการโดยโครงการสิ่งแวดล้อมแห่งสหประชาชาติ (United Nations Environment Programme, UNEP) โดยมีสมาคมน้ำนานาชาติ (International Water Association, IWA) และ DHI เป็นหน่วยงานปฏิบัติงานสำหรับโครงการ
โครงการนี้ได้พัฒนาโปรแกรมคอมพิวเตอร์สำหรับระบบสนับสนุนการตัดสินใจ (Decision Support System, DSS) ที่มีเครื่องมือสนับสนุนการวางแผนสำหรับระดับลุ่มน้ำระหว่างประเทศจนถึงระดับการผลิตน้ำประปา รวมถึงข้อมูลน้ำท่วมและภัยแล้ง โครงการนี้มีระยะเวลาดำเนินการระหว่างปีพ.ศ. 2557-2561 ในลุ่มน้ำนำร่องทั้ง 3 แห่ง คือ ลุ่มน้ำโวลต้า (Volta) ทะเลสาบวิคตอเรีย (Lake Victoria) และลุ่มน้ำเจ้าพระยา เพื่อทำการพัฒนาและทดสอบระบบสนับสนุนการตัดสินใจ

การศึกษาทำความเข้าใจวิธีการใช้งานระบบสนับสนุนการตัดสินใจมีความสำคัญสำหรับการใช้งานและดำเนินการในอนาคตและยังส่งผลถึงความยั่งยืนของโครงการจัดทำเครื่องมือในการบริหารจัดการน้ำท่วมและภัยแล้ง ดังนั้นความสามารถในการใช้งานและการประยุกต์ใช้งานระบบสนับสนุนการตัดสินใจ รวมถึงการให้โอกาสแก่ผู้มีส่วนได้ส่วนเสียในการแสดงความคิดเห็นต่อฟังก์ชั่นการทำงานของระบบจึงเป็นขั้นตอนที่ต้องใช้เวลาเพื่อให้ประสบความสำเร็จ

โครงการนี้จะจัดการฝึกอบรมทางเทคนิคอย่างต่อเนื่องเป็นลำดับให้แก่เจ้าหน้าที่ด้านเทคนิคและผู้เชี่ยวชาญด้านแหล่งน้ำทุกระดับอาวุโสจากหน่วยงานต่างๆ การฝึกอบรมมีความมุ่งหมายที่จะให้หน่วยงานลุ่มน้ำต่างๆ หน่วยงานสาธารณูปโภคต่างๆ และหน่วยงานอื่นๆ ใช้เครื่องมือในการวางแผนร่วมกัน ในขณะที่สามารถที่จะทดสอบและตรวจสอบระบบสนับสนุนการตัดสินใจได้ ความคิดเห็นจากผู้เข้าร่วมประชุมจะถูกนำมาพิจารณาในการพัฒนาและปรับปรุงระบบสนับสนุนการตัดสินใจต่อไป

วัตถุประสงค์ของการฝึกอบรมทางเทคนิค ได้แก่

- เพื่อให้ผู้มีส่วนได้ส่วนเสียมีความรู้ความเข้าใจระบบสนับสนุนการตัดสินใจ
- เพื่อให้ผู้เกี่ยวข้องหลักมีโอกาสแสดงความคิดเห็นต่อการฟังก์ชั่นทำงานของระบบสนับสนุนการตัดสินใจ
- เพื่อปรับปรุงการพัฒนาระบบสนับสนุนการตัดสินใจให้ดีขึ้น โดยข้อเสนอแนะจากผู้มีส่วนได้ส่วนเสีย

DHI และ IWA ได้จัดการฝึกอบรมด้านเทคนิคครั้งแรกขึ้นที่กรุงเทพมหานคร ระหว่างวันที่ 24-26 พฤศจิกายน 2558 โดยได้รับการสนับสนุนจาก CapNet และสถาบันสารสนเทศทรัพยากรน้ำและการเกษตร (สสนก.) การฝึกอบรมมุ่งเน้นที่ฟังก์ชั่นการใช้งานที่ใช้ได้ ณ เวลาที่ฝึกอบรม การฝึกอบรมเริ่มจากการบรรยายสรุปเกี่ยวกับโครงการและบรรยายเกี่ยวกับระบบสนับสนุนการตัดสินใจสำหรับการวางแผน ผู้เข้าร่วมประชุมได้ทดลองใช้งาน MIKE Customised ซึ่งเป็นเครื่องมือหลักสำหรับระบบสนับสนุนการตัดสินใจและ QGIS การฝึกอบรมวันที่สองมุ่งเน้นไปที่ฟังก์ชั่นการใช้งานเฉพาะของระบบสนับสนุนการตัดสินใจ ซึ่งได้แบ่งการฝึกอบรมเป็นสองส่วน โดยจัดขึ้นพร้อมๆกัน ส่วนหนึ่งเน้นไปที่การบูรณาการเครื่องมือเพื่อใช้สนับสนุนแผนจัดการน้ำสะอาด (Water Safety Plans, WSP) ในระบบสนับสนุนการตัดสินใจและอีกส่วนหนึ่งเน้นเรื่องการวิเคราะห์สถานการณ์ภัยแล้งและการวางแผน การฝึกอบรมวันสุดท้ายเน้นเรื่องวิธีการบูรณาการคาดการณ์การใช้น้ำตามฤดูกาลเข้าไปในระบบและวิธีการที่ผู้ใช้งานจะสามารถพัฒนาและทำงานเพิ่มดัชนีชี้วัดเข้าไปในระบบการทำงาน

เป้าหมายของการฝึกอบรมจะนี้ขึ้นอยู่กับฟังก์ชั่นที่สามารถใช้งานได้ของระบบ ณ เวลาที่ทำการฝึกอบรม ซึ่งในการอบรมครั้งนี้มุ่งเน้นในเรื่องการบริหารจัดการภัยแล้งและฟังก์ชั่นที่สนับสนุนการบริหารจัดการและวางแผนสำหรับภัยแล้ง และเครื่องมือที่ใช้สนับสนุน WSP

2. Project background

The Flood and Drought Management Tool (FDMT) project 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) to facilitate 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 DSS.

The project is responding 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.

Based on these issues, the project is developing a decision support system that supports the integration of information on floods and droughts into planning across scales. 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 DSS.

The DSS being developed is a computer software-based system containing a number of ‘tools’ with different technical functionality. The DSS is being tested and validated with available data at both basin and local levels in the 3 pilot basins; however it will be available 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 including TDA/SAP, IWRM planning or WSP.

3. Technical training

3.1 Overview of training

Technical training on the use of the 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 DSS. The feedback will be included in the further development and refinement of the DSS and is of great value for the project.

The technical training targets stakeholders from different organisations, and provided 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 provided from the Chao Phraya Basin. The training sessions will reflect the developed functionality within the 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 DSS.

Objective

The objective of the technical training is to:

- Enhance the stakeholders understanding of the developed DSS
- Provide the stakeholders with an opportunity to give feedback on the functionality of the DSS
- Refine the development of the 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 DSS, and how the output from the 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 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 Thailand focused on staff from the water utilities (Provincial Waterworks Authority and Metropolitan Waterworks Authority) and institutes engaged in analysing and planning for the impacts of climate change (at a national level); e.g. Hydro and Agro Informatics Institute, Royal irrigation Department, Thai Meteorological Department, etc. (see Annex 3 for full participant list).

3.2 Technical training

From November 24-26, 2015, the FDMT project held a 3 day technical training with support from CapNet and the Hydro and Agro Informatics Institute (HAII). The training was held at the Sukosol Hotel, Bangkok, Thailand. The 3 days gave participants a first impression of the DSS in which they could test the functionality of the different components and provide feedback which will be useful in further developing the DSS.

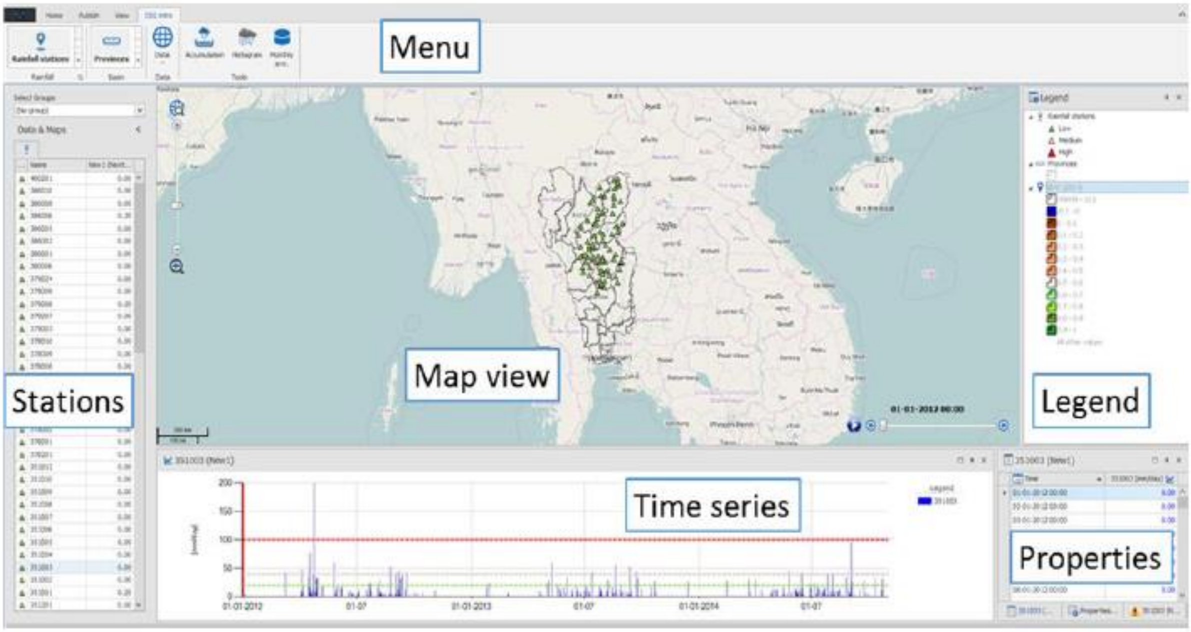
Day 1. Project overview, DSS platform and QGIS
Tuesday the 24th of November 2015

Project overview and the DSS platform
There is ongoing developments of selected functionality within the DSS. At this point, the developments are focusing on the:

- Platform and tools for the DSS
- Drought management
- Support for Water Safety Planning (WSP)
- Seasonal forecasting
- Indicator builder tool

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 the location of rainfall stations, information on the station and a time series of rainfall data for that station or combination of stations. It enables you to calculate monthly average rainfall, along with other functions depending on the data.



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 will 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.

Introduction to QGIS
Why use GIS?

- 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. The tutorial also explained, in brief, how to deal with netCDF files and how to calculate zonal statistics.

Day 2. WSP and drought management in the DSS
Wednesday the 25th of November 2015

The developed DSS allows you to both view data but also analyse data. By clicking on a station (if this data set has been put into the system) you can get the monthly average rainfall. This can be done for as many stations as you want in one chart.

System and data visualisation and analysis in the DSS consists of:

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

You are also able to add additional tools to the system and there is no limit to the number of tools that can be added. This is to ensure flexibility enabling users to customise the platform for their specific needs.

Currently, data input has not been done, but it is easy to import data into the system. The next training course will have a focus on importing data sets (in different data formats). In the next phase of development, the transfer of data from QGIS and the DSS will be worked on to make the process easier.

Even though different systems are used in the basin, the DSS platform can accommodate this. So long as there is some data, this can be put in the system. Inputting data can be atomised by importing a script into the system, but this would need to be done by an IT person.

More than one parameter from one station can be presented. More than two needs to be explored. These parameters can also be visualised in excel to have a different view.

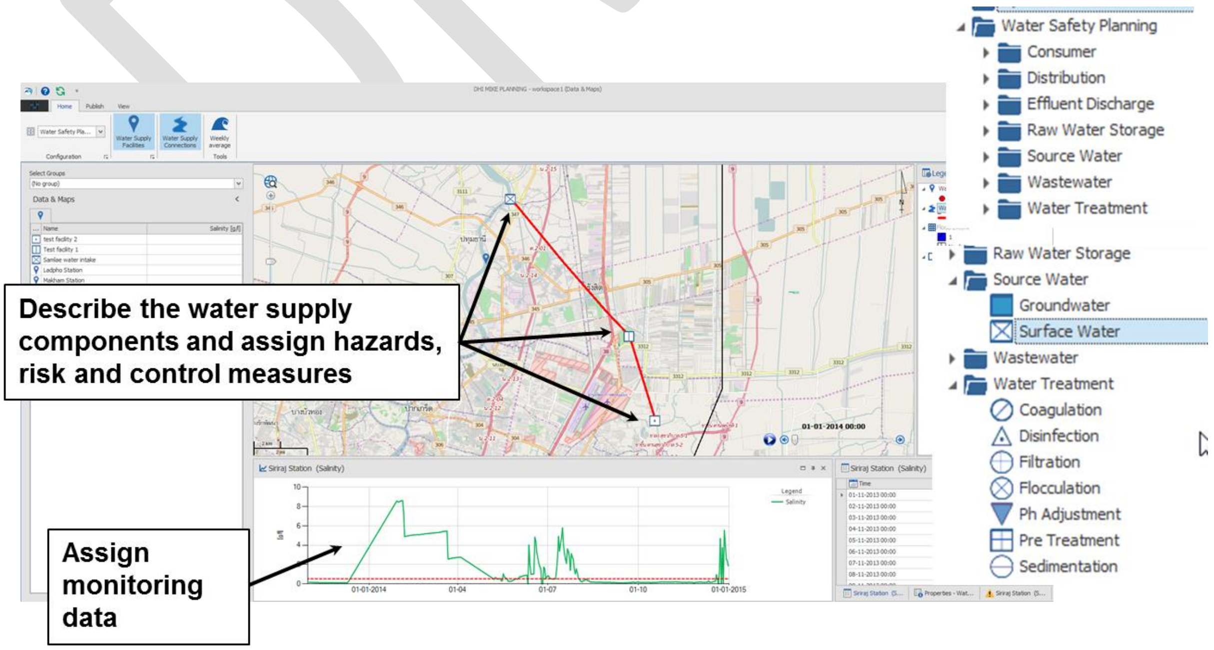
You can also have the system database on a central server to which you log on. Furthermore you can create different types of users who have different access rights (different levels). These levels can be modified to suit the needs of the organisation.

WSP in the DSS
Technical tools are being developed to support some of the WSP modules, however in different capacities. Module, 2, 3, 4 and 6 will be fully supported. Module 7, 10 and 11 will be partly supported (but as the DSS develops, these modules will be fully supported as well). Module 5, 8 and 9 are not supported as the project does not see any technical tools that can be integrated into the system to support upgrading, and management and communication of the WSP implementation. The overall idea is to digitalise the WSP process for utilities. This will help when utilities need to make updates to their plan.

The 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.).



Exercises 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.

Feedback form the WSP session will be used to further develop the WSP component of the DSS platform. Users are the experts and know what they need, so they can indicate how outputs should be visualised or reported. More work on linking WSP to flood and drought information is being done and improvements are expected on the reporting capability.

WSP Asia Network
The WSP Asia Network was launched to strengthen network outreach to promote the WSP approach in the Asia region.

WSP is a broad model that needs to be contextualised for your specific situation. The WSP portal provides a platform to share information on WSP practices, which people can view and use (adapt) for their conditions. The portal does not have a record of water bodies, but the portal enables you to engage in a forum or dialogue in search for certain solutions to a problem.

Participants found a WSP Network useful to provide information about WSP. However, information should not only be in text form as language becomes a constraining factor. Furthermore, identifying key words or grouping experiences (e.g. separate the raw water by surface water or groundwater) would improve on the usability of the WSP portal. The portal provides access to best practices and experiences and a more complete list from various regions will come in the near future. The portal relies on the contribution of those implementing WSP to share their experiences.

An important aspect of WSP, and any other planning approach, is integrating information and knowledge across institutions (information sharing mechanisms). The portal can provide such a mechanism. WSP is something that utilities are doing, however, it is important that all institutions within the system work together in order to understand how the activities of others affect the water (quality and quantity), as this impacts the capacity of the utility to supply water.

Metropolitan Waterworks Authority (MWA)'s WSP development and implementation
WSP came into focus after the flood crisis in 2011.

MWA has prepared short- and long-term plans for drought management.

The short-term plan is taking water upstream of where they currently take water to ensure better quality water. Salinity is another issue that arises from drought. The extent of saline intrusion is being monitored, and when it enters the system there is nothing that can be done to treat, but they have a plan to warn the community of any issue regarding this. If there is low water in Chao Phraya, they cannot dilutee the water (high concentration of contaminants) so the treatment systems are prepared for this.

The long-term plan is to increase the capacity of the wastewater treatment by about 10%.

Provincial Waterworks Authority (PWA)'s WSP implementation
PWA has 10 branches and has 34 operation units. Form the head office it is difficult to deal with the drought issue, so they use their reginal branches.

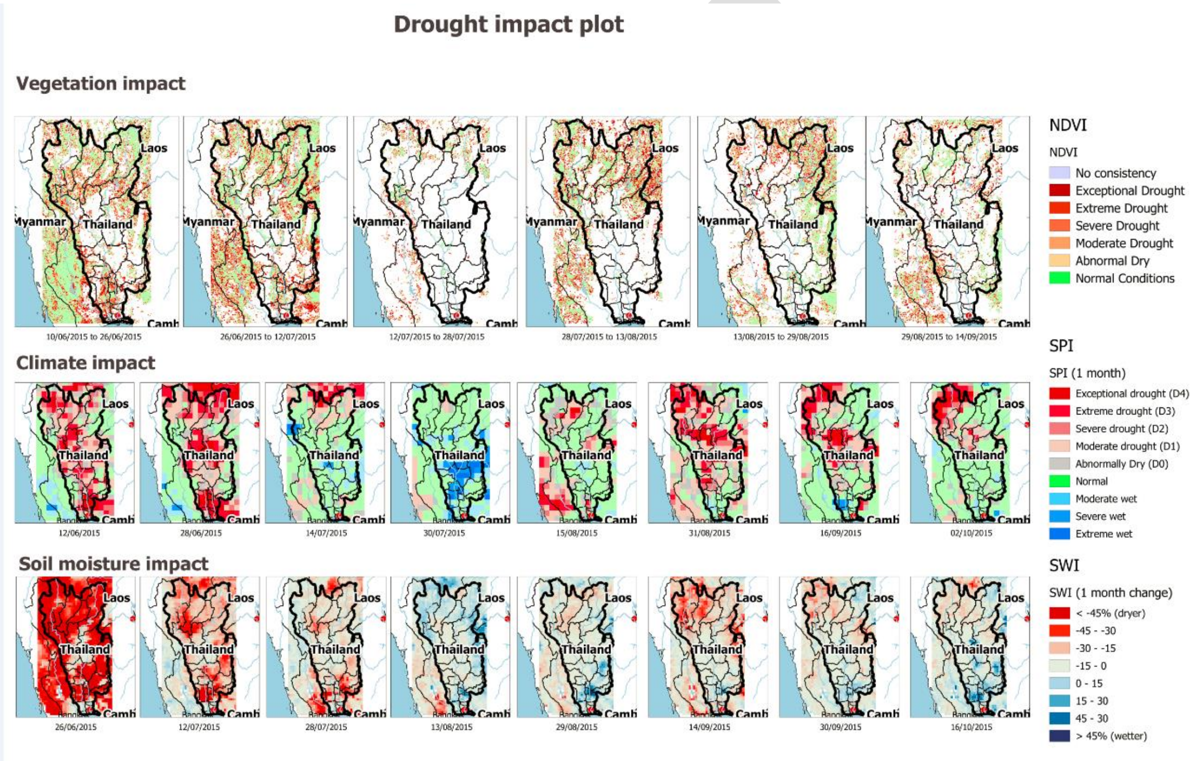
People need to understand WSP in order to implement it. This is sometimes a challenge they face. The technologies for utility units that are used are different. Some places have high technology, but other smaller units may have low-tech approaches. This brings a challenge in implementing and carrying out WSP.

Drought management in the DSS
Tools integrated in the 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 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 situations; e.g. drought classification. For example, 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 form normal to exceptional drought).



The information obtained can be used for operational drought reporting. Participants highlighted a number of recommendations and observations:

- Have the report in the local language.
- Describe the drought using one general index rather than through 3 indices (TRMM, SWI and NDVI).
- There is time lag between SWI and TRMM.
- Use rain data with evaporation in analysis of the drought situation.

AquaCrop has also been integrated into the system. The crop water productivity model estimates the crop yield or crop water demand under given conditions. The environmental conditions are specified by the user as input:

- 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.).

By altering the input, the expected crop production and yield can be simulated for different environmental conditions. By characterising the drought situation for a certain period this information can be used to study and model the impact on yield and crop water demand under various climate change scenarios.

Dr. Winai Chaowiwat from the Hydro and Agro Informatics Institute (HAII) explained how HAII are developing a similar model to study the water situation in Thailand for crop production. The Agricultural Water Demand Estimation Model (AWADEM) was inspired by WUSMO, which initiated the water use simulation in Thailand and CropWat, from FAO. More work will be done to validate and improve the model and visualise the outputs.

The work that is being done by HAII is an example of a model that can be integrated within the DSS platform.

Participants evaluated the drought status by analysing data. The reporting capability offered by the DDS platform was also discussed.

Day 3. Planning DSS, seasonal forecasting and indicators
Thursday the 26th of November 2015

Seasonal forecasting
Seasonal forecasting is based on a global clime model, updated every 5 days, 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 and months (information needed for the drought indices) or to analyse crop production.

Currently there is no advanced system in the DSS platform, but this will be developed later on using NCEP – CFS v2 and to have the workflow form download to reporting fully automated on the platform

HAII has experience with seasonal forecasting. SIMIdx is used as a method that successfully predicts (rainfall) forecast for Thailand. They have used this method to forecast for the year 2016.

Participants worked on probabilistic forecasting to indicate where there is rainfall below or above normal. 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 DSS to operationalise – downloading forecasting to processing, extracting relevant time series and generating products, and reporting and dissemination.

Indicators in planning

Indicators are an important part of planning, a means by which data can be combined and interpreted to make decisions; establish the status of an issue to which you can make choices to plan for or respond to the issue. It is a way to collate complex data into a simple interpretation of a state and pressure (e.g. drought or flood status). For drought, using NDVI will provide you with a status of the extremity of drought. This classification of the state of extremity can be used to plan or respond.

There are a lot of indicators to choose from for planning. Good indicators are those that are relevant to the issue, easy to understand, gives information on the current status (and the status in relation to historical change) and based on data that is available.

- Driving force - describes what causes the issue to change
- Pressure - describes the environmental pressure
- State - the current status of the issue
- Impact - describes impacts from any changes
- Response - describes how to respond to the changes

Participants were asked to identify indicators they are currently using at their organisations (see Annex 2):

- (Radar) Rainfall (e.g. duration of rainfall)
- Reservoir water level
- Runoff
- Accumulated Inflow
- Stream flow level
- (Raw) Water quality (dissolved oxygen, biological oxygen demand, sedimentation, salinity, turbidity, nitrate level, phosphate level)
- NDWI (Normalised Different Water Index)
- NDVI (Normalised Different Vegetation Index)
- SST (Sea Surface Temperature)
- API (Anticipated Precipitation Index)
- LST (Land Surface Temperature)
- Pressure (in distribution system)
- Water demand
- Population density
- Slope/topography
- Reservoir capacity
- SPI (Stream Power Index)
- SWI (Soil Water Index)
- Water management policies
- Land use policies
- Legislation

The exercise is a good way to standardise the understanding of indicator as well as to identify the main issues organisation face and identify the issues that are most important. The DDS platform will link to a web based tool (Water Indicator Builder) that is being developed to

- Assist users in selecting relevant indicators based on a specific issue
- To be used as a learning tool for basin or catchment organisations/other users
    - Providing starting point via default indicator framework that can be adjusted and complemented to match user needs

- Providing online tool for stakeholders to share their indicator configurations with others

- To be used as a tool for storing indicator information to support design of decision support systems (DSS)

3.3 Next steps (Q1 and Q2 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:

- Technical training in Lake Victoria during January 26th to 29th
- Technical training in Volta during February 8th to 12th
- Finalise WSP support
- 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

English version

Tuesday the 24th of November 2015	
Time	**Title**
09.00 – 09.30	Welcome and presentation of the objective with the technical training
09:30 – 11:00	**Session 1: Project overview**
11.00 – 12.30	**Session 2: QGIS basic**
12.30 – 13.30	**Lunch**
13.30 – 14.30	**Session 2: QGIS basic - continued**
14.30 – 16.15	**Session 3: QGIS project functionality**
16.15 – 16.30	Discussion and wrap up

Wednesday the 25th of November 2015 (Track 1: Water utilities)	
Time	**Title**
09.00 – 09.30	Questions based on experience from day 1
09:30 – 09:50	**WSP Asia Network**
09.50 – 10.10	**Presentation by MWA**
10:10 – 10:20	**Presentation by PWA**
10.30 – 12.30	**Session 4: Introduction to DSS**
12.30 – 13.30	**Lunch**
13.30 – 15.30	**Session 5: WSP in the DSS**
15.45 – 16.30	Discussion and wrap up

Wednesday the 25th of November 2015 (Track 2: Other stakeholders)	
Time	**Title**
09.00 – 09.30	Questions based on experience from day 1
09.30 – 12.00	**Session 4: Introduction to DSS**
12.00 – 12.30	**Session 5: Drought status**
12.30 – 13.30	**Lunch**
13.30 – 15.00	**Session 5: Drought status - continued**
15.00 – 16.30	**Session 6: crop model**
16.30 – 17.00	Discussion and wrap up

Thursday the 26th of November 2015 (all stakeholders)	
Time	**Title**
09.00 – 9.30	Questions based on experience from the previous day
09.30 – 11.00	**Session7 - Data in DSS**
11.15 – 12.30	**Session8 - Seasonal forecast**
12.30 – 13.30	**Lunch**
13.30 – 14.45	**Session8 - Seasonal forecast - continued**
14.45 – 15.45	**Session9 - Indicators**
15.45 – 16.30	Discussion and wrap up

Thai version

วันอังคาร 24 พฤศจิกายน พ.ศ. 2558	
เวลา	**รายละเอียด**
09.00 – 09.30	กล่าวต้อนรับและนำเสนอวัตถุประสงค์ของการฝึกอบรมทางเทคนิค
9:30 – 11:00	**วาระที่** 1: **บรรยายสรุปเกี่ยวกับโครงการ**
11.00 – 12.30	**วาระที่ 2: พื้นฐานของ QGIS**
12.30 – 13.30	**พักรับประทานอาหารกลางวัน**

13.30 – 14.30	**วาระที่ 2: พื้นฐานของ QGIS basic –** ต่อ
14.30 – 16.15	**วาระที่ 3: ฟังก์ชั่นการทำงานของ QGIS สำหรับโครงการ**
16.15 – 16.30	แลกเปลี่ยนความเห็นและสรุป

วันพุธ 25 พฤศจิกายน พ.ศ. 2558 (ส่วนที่ 1: ระบบผลิตน้ำประปา)	
เวลา	**รายละเอียด**
09.00 – 09.30	**คำถามจากการฝึกอบรมวันที่** 1
09:30 – 09:50	**เครือข่าย** WSP **ในเอเชีย**
09.50 – 10.10	**การบรรยายจากการประปานครหลวง**
10:10 – 10:20	**การบรรยายจากการประปาส่วนภูมิภาค**
10.30 – 12.30	**วาระที่** 4: **แนะนำระบบสนับสนุนการตัดสินใจ (**DSS**)**
12.30 – 13.30	**พักรับประทานอาหารกลางวัน**
13.30 – 15.30	**วาระที่** 5: WSP **ในระบบสนับสนุนการตัดสินใจ**
15.45 – 16.30	**แลกเปลี่ยนความเห็นและสรุป**

วันพุธ 25 พฤศจิกายน พ.ศ. 2558 (ส่วนที่ 2: ผู้มีส่วนได้ส่วนเสียอื่นๆ)	
เวลา	**รายละเอียด**
09.00 – 09.30	**คำถามจากการฝึกอบรมวันที่** 1
9.30 – 12.00	**วาระที่ 4: แนะนำระบบสนับสนุนการตัดสินใจ** (**DSS**)
12.00 – 12.30	**วาระที่ 5: สถานการณ์ภัยแล้ง**
12.30 – 13.30	**พักรับประทานอาหารกลางวัน**
13.30 – 15.00	**วาระที่ 5: สถานการณ์ภัยแล้ง – ต่อ**
15.00 – 16.30	**วาระที่ 6: แบบจำลองการเพาะปลูก**
16.30 – 17.00	แลกเปลี่ยนความเห็นและสรุป

วันพฤหัสบดี 25 พฤศจิกายน พ.ศ. 2558 (all stakeholders)	
เวลา	**รายละเอียด**
9.00 – 9.30	**คำถามจากการฝึกอบรมวันที่** 2
9.30 – 11.00	**วาระที่ 7 – ข้อมูลในระบบสนับสนุนการตัดสินใจ**
11.15 – 12.30	**วาระที่ 8 - การคาดการณ์ตามฤดูกาล**
12.30 – 13.30	**พักรับประทานอาหารกลางวัน**
13.30 – 14.45	**วาระที่** 8 – **การคาดการณ์ตามฤดูกาล – ต่อ**
14.45 – 15.45	**วาระที่ 9 - ดัชนีชี้วัด**
15.45 – 16.30	แลกเปลี่ยนความเห็นและสรุป

Annex 2 – Indicator exercise notes

Issue	Driver	Pressure	State	Impact	Response
Group 1 - Others					
Flood					
Drought					
Water quality					
Indicators 1. Reservoir water level - EGAT 2. NDWI (Normalised Different Water Index) - GISTDA 3. Accumulated Inflow – EGAT 4. Stream flow level – ALL 5. Rainfall (e.g. duration of rainfall) – ALL 6. Radar Rainfall – BMA 7. NDVI (Normalised Different Vegetation Index) 8. SST (Sea Surface Temperature) – GISTDA, TMD (IOD, ENSO, POD) 9. Water Quality – BMA, EGAT 10. API (Anticipated Precipitation Index) 11. LST (Land Surface Temperature) – GISTDA Flood issue – 5, 1-4, 8 (Priority) Drought issue – 5, 1-3, 8 (Priority), 7					
Group 2 - Others					
Flood	Land cover change	Forest decreasing	Flood area; water level	Damage; flooded area	Reservoir operation
Flood and drought	Land cover change	Water demand +; population density +; slope/topography	NDVI; reservoir capacity; runoff? Can also use SPI and SWI	Runoff; water quality; sedimentation (≠); Salinity (D)	Water management; policies; land use policy; legislation
Group 3 - WSP					
Drought					
Raw water quality					
Flood					
Drought – interest is in raw water Raw water quality – management in the use of chlorine to treat water (they look at DO, BOD, Salinity, turbidity Flood – issue with high turbidity – when there is high turbidity the water quality is poor need to add more chlorine into the system PWA (not MWA) will measure Nitrate and Phosphate in reservoir because of agricultural area Pressure in the distribution system, in particular at the end of the pipe, they need to control the pressure from the head to keep the tail water with enough pressure Additional indicators: - Try to manage the algae - reduce the amount of the production – especially during the dry season when water levels are low --- this indicates and issue with sand filter, then would need to backwash					
Group 4 - WSP					
Water level					
Water quality					
Amount of water and water level and water quality issue – impacts the amount of water that can be used. If they release the water and not enough there are issues with salinity Water level – if it is too high, then salinity is also high Water quality – pneumonia in the water (to check what is good or bad) – if they measure that they will know how good or bad the water is					

Annex 3 – Participants

Title	First Name	Represents	Email
Project Management Unit and support staff			
Mr.	Oluf Jessen	DHI	ozj@dhigroup.com
Mr.	Bertrand Richaud	DHI	ber@dhigroup.com
Mr.	Raul Glotzbach	IWA	raul.glotzbach@iwahq.org
Ms.	Katharine Cross	IWA	katharine.cross@iwahq.org
Ms.	Sushmita Madna	IWA	Sushmita.Mandal@iwahq.org
Ms.	Lalita Rammont	IWA	Lalita.Rammont@iwahq.org
Ms	Romaneeya Mather	IWA	romaneeya@hotmail.com
Participants			
Dr.	Sukrit Kirdsaeng	TMD	sukritk@hotmail.com
Mr.	Pattara Sukthawee	TMD	pattaradini@gmail.com
Mr.	Watthanath Sutthichuentrikul	DDPM	scha29@hotmail.com
Mr.	Sarote Thiprut	DDPM	sarotethiprut@gmail.com
Miss	Amraporn Jitprapai	BMA	amjitpp@yahoo.com; amjitpp@gmail.com
Mr.	Visnu Charoen	BMA	visnuc@hotmail.com
Mr.	Sunsern Rueangrit	BMA	sunsernr@gmail.com
Mr.	Pavaris Meebangsai	BMA	Pavaris.m@gmail.com
Ms.	Woranut Chansury	GISTDA	woranut@gistda.or.th
Mr.	Teansiri Moolchan	GISTDA	teansiri@gistda.or.th
Ms.	Chawee Wongprasittiporn	RID	chawee_w@yahoo.com
Mr.	Pakawat Sereeruk	RID	lliivhviill@gmail.com
Mr.	Piyapong Kuekern	RID	Golf.civil.gnk12@gmail.com
Mr.	Kuersak Thathong	RID	kuersak@hotmail.com
Mr.	Siratis Warawatsupparat	RID	siratis.w@gmail.com
Mr.	Amnuaichai Khongdee	RID	mozart_008@yahoo.com
Ms.	Duangrutai Mongkolkeha	RID	duangrutai.fon@gmail.com
Miss	Kanjanawan Nilklud	RID	nilklud@hotmail.com
Ms.	Chatsinee Surasen	MWA	chatsinee.s@mwa.co.th
Mr.	Sangsan Teepyobon	MWA	sangsan.t@mwa.co.th
Mr.	Nipon Leelaruji	MWA	nipon_lee@mwa.co.th
Ms.	Sureerat Putthakosa	MWA	sureerat.p@mwa.co.th
Mr.	Ekkarat Meewassana	MWA	ekkarat.m@mwa.co.th
Miss	Chaweepan Siampliattibun	MWA	chaweepan@yahoo.com
Mr.	Yothin Somsakul	PWA	yothins@hotmail.com
Miss	Rattana Pholitsariyakul	PWA	rattanap@pwa.co.th
Mr.	Sompong Puangtong	PWA	sompongp@pwa.co.th
Ms.	Phimchanok Khachonboon	PWA	phimchanokk@pwa.co.th
Ms.	Pattarada Phonwariyasakun	PWA	pattaradac@pwa.co.th
Mr.	Narin Sasaeng	PWA	narinsa@pwa.co.th
Miss	Miss Varittha Thanasumbin	PWA	varitthat@pwa.co.th
Mr.	Maitree Foitong	EGAT	maitree.f@egat.co.th
Mr.	Ekaphop Thera-oran	EGAT	ekaphop.t@egat.co.th
Mr.	Taratorn Watanapimol	EGAT	taratorn.w@egat.co.th

Title	First Name	Represents	Email
Mr.	Anuchart Tangphoomnapeewong	ONEP	anuchataggie11@gmail.com
Ms.	Juthamas Panitrangsri	ONEP	juthamas-pa@hotmail.com
Ms.	Kawalee Piandee	ONEP	p.gawalee@gmail.com
Mr.	Pichaya Sungsukh	ONEP	
Mr.	Chairoj Jirapattanakiat	NDWC	chairoj.j@mict.go.th
Miss	Sumalee Phungkham	NDWC	fartar@hotmail.com
Mr.	Wachira Surin	RID	wachira_kk@hotmail.com

Annex 4 – Evaluation form

Evaluation of Flood and Drought Management Tools Technical training

Name: **Organisation:**

General	Agree				Disagree
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 (Nov 24th)	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 (Nov 24th)	Agree				Disagree
1. The explanations of how to use QGIS were clear	1	2	3	4	5
2. The training material on how to do the QGIS exercises were clear and comprehensive	1	2	3	4	5
3. From the exercises I feel confident in using QGIS	1	2	3	4	5
4. What could be improved and made clearer?					

FOR WSP group ONLY **WSP in the DSS (Nov 25th)**	Agree				Disagree
1. The discussion on WSP Asia Network was useful	1	2	3	4	5
2. I will engage with the WSP Asia Network in the future	1	2	3	4	5
3. The explanation on how to use WSP in the DSS were clear	1	2	3	4	5
4. The training material on how to use WSP in the DSS were clear and comprehensive	1	2	3	4	5
5. From the exercises I feel confident in using the DSS in relation to WSP	1	2	3	4	5
6. What could be improved and made clearer?					

To be filled in by other stakeholders **Drought status (Nov 25th)**	Agree				Disagree
1. 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
2. The training material on drought status using QGIS were clear and comprehensive	1	2	3	4	5
3. I feel confident on working with drought data in QGIS 4.	1	2	3	4	5
5. The training exercises and material on interpreting drought reports was useful	1	2	3	4	5
6. From the exercises I feel confident in using the DSS in relation to drought management and planning	1	2	3	4	5
7. What could be improved and made clearer?					

Planning DSS (Nov 25th)	Agree				Disagree
1. The presentations to explain the planning DSS was clear 2.	1	2	3	4	5
3. The training material to understand how to use the DSS was clear and comprehensive	1	2	3	4	5
4. I have a good understanding on how to use the DSS 5.	1	2	3	4	5
6. What could be improved and made clearer?					

Use of indicators (Nov 27th)	Agree				Disagree
1. The presentation on indicators was clear	1	2	3	4	5
2. After the exercises I understand how to use the Water Indicator Builder	1	2	3	4	5
3. What could be improved and made clearer?					

Annex 5 – Feedback

Legend:	*Agree*				*Disagree*
	1	*2*	*3*	*4*	*5*

General *n 31*

Questions	**Response**				
	1	**2**	**3**	**4**	**5**
The duration of the course was satisfactory	11	12	4	4	
The time for discussions and group work was sufficient	11	12	5	3	
The time for hands-on exercises was satisfactory	5	17	9		
The support during hands-on training was satisfactory	11	13	5	1	
	38	*54*	*23*	*8*	*0*

Project overview *n 31*

Questions	**Response**				
	1	**2**	**3**	**4**	**5**
I have a good understanding of the Flood and Drought Management Tools project and what it is trying to achieve	4	18	7	1	1
What could be improved and made clearer?	Need time to be familiar witht he project				
	4	*18*	*7*	*1*	*1*

QGIS *n 31*

Questions	**Response**				
	1	**2**	**3**	**4**	**5**
The explanations of how to use QGIS were clear	6	19	5	1	
The training material on how to do the QGIS exercises were clear and comprehensive	4	20	4	3	
From the exercises I feel confident in using QGIS	2	19	7	3	
What could be improved and made clearer?					
	12	*58*	*16*	*7*	*0*

WSP in the DSS *n 16*

Questions	**Response**				
	1	**2**	**3**	**4**	**5**
The discussion on WSP Asia Network was useful	1	8	7		
I will engage with the WSP Asia Network in the future	1	9	5	1	
The explanation on how to use WSP in the DSS were clear	1	7	8		
The training material on how to use WSP in the DSS were clear and comprehensive	1	5	10		

From the exercises I feel confident in using the DSS in relation to WSP	2	6	8		
What could be improved and made clearer?	The training material should put more detail and step-by-step to make it easier to practice by myself. And it will be better if there is vocabulary index because some trainers do not have background knowledge about GIS, methodology, etc.				
	6	*35*	*38*	*1*	*0*

n *15*

Drougth status					
Questions	**Response**				
	1	**2**	**3**	**4**	**5**
The presentation on drought status was clear and has given me a good understanding of the different indices and how they are used	5	10			
The training material on drought status using QGIS were clear and comprehensive	5	9	1		
I feel confident on working with drought data in QGIS	3	5	7		
The training exercises and material on interpreting drought reports was useful	4	9	2		
From the exercises I feel confident in using the DSS in relation to drought management and planning	4	8	3		
What could be improved and made clearer?	Comprehensive hand out needed The drought indices are very useful but it is a new thing for some people. Need more time to understand each idea clearly				
	21	*41*	*13*	*0*	*0*

n *29*

Plannign DSS					
Questions	**Response**				
	1	**2**	**3**	**4**	**5**
The presentations to explain the planning DSS was clear	7	16	5	1	
The training material to understand how to use the DSS was clear and comprehensive	5	17	6	1	
I have a good understanding on how to use the DSS	2	20	6	1	
What could be improved and made clearer?					
	14	*53*	*17*	*3*	*0*

n *30*

Use of indicators					
Questions	**Response**				
	1	**2**	**3**	**4**	**5**
The presentation on indicators was clear	6	17	6	1	

After the exercises I understand how to use the Water Indicator Builder	7	15	8		
What could be improved and made clearer?					
	13	*32*	*14*	*1*	*0*