Inception report

Final

FLOOD & DROUGHT MANAGEMENT TOOLS

Inception report

Final

Project manager	Click here to enter text.
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Executive Summary

Background

The ‘Flood and Drought Management Tool’ 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 aims at 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 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.

Based on these issues, the project is designed to develop a methodology for basins, which uses tools and decision support systems that will allow the integration of information on floods and droughts. The project will develop technical tools to support flood and drought planning processes which, previously, may not have fully exploited the information available. The project also aims to develop an approach and tools that work both on a transboundary level and the local level. GEF International Waters projects have planning methods which focus at the transboundary level. However, decisions made at the regional level (basin) and the local level need to be linked to plans at a larger scale. The project will address this aspect of inter-level communication by providing tools for both scales within a single DSS.

The DSS being developed will be a piece of software containing various technical functionality in the form of ‘tools’. The DSS will be tested and applied in 3 different 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 and the project will support planning activities related to TDA/SAP, IWRM or WSP, but will not embrace all activities within the planning methods.

Stakeholders

Basin organisations are the key stakeholders in the project, and are the organisations relevant for the TDA/SAP approach as this is based on a transboundary planning context. Urban water utilities are involved as a main stakeholder and potential end-user in the project. One of the objectives will be to support their WSPs with technical tools enhancing the outcome of the WSP process.

The project has engaged with a large number of stakeholders during the inception phase, and other potential end-users for the project have been identified, for example: electricity companies operating multipurpose reservoirs, irrigation departments or managers operating large irrigation schemes and environmental organisations or departments in need of tools for evaluating flood and drought issues and potential mitigation measures in the short- or long-term.

	Volta Basin	Lake Victoria Basin	Chao Phraya Basin
Basin scale	Volta Basin Authority (VBA)	Lake Victoria Basin Commission (LVBC)	Hydro and Agro Informatics Institute (HAII)
Local scale	ONEA Ghana Water	National Water Uganda, Jinja KIWASCO MWAUWASA	Metropolitan Waterworks Provincial Waterworks Authority
Other scale	Electricity companies, irrigation and environmental agencies or departments, catchment organisations and other interested parties		

Project stakeholders

Stakeholder meetings

The project started officially in June 2014 and had a 6 month inception phase during which the executing agencies (DHI and IWA) held a series of stakeholder consultations in each pilot basin. These consultations were aimed at gaining an understanding of how the project can improve water planning in the three basins, in order to formulate a detailed project description for the inception meeting. The meetings were also used to determine which stakeholders were interested in actively engaging with the project. The findings from the stakeholder meetings will be used to form the design of the methodologies and the development of the DSS.

Result Framework and Strategic Areas

The project results framework is divided into 5 components each describing a phase in the project. The project components are:

Component 0 – Inception phase	Introducing the project to stakeholders; identifying gaps and needs around flood and drought planning
Component 1 – Development of methodologies	Development of 6 methodologies with tools in a decision support system, which increase the at increasing understanding of flood and drought dynamics and impacts at transboundary and local levels
Component 2 – Validation and testing at basin-wide level	Application of the methodologies in the 3 pilot basins to provide the opportunity for integration of flood and drought information into basin level planning
Component 3 –	Application of the methodologies in the 3 pilot basins to provide the opportunity for

Validation and testing at local level	integration of flood and drought information into local level planning (urban water utilities)
Component 4 - Capacity building and dissemination	Learning package developed to provide training and information within and beyond the pilot basins; and project outputs communicated and disseminated to inform global dialogue on water security and adaptation to climate variability and change

The experience from the inception phase and especially from the stakeholder consultations in the three pilot basins has enabled a further clarification of the overall project objective. The project will focus on three key strategy areas which cut across the above results framework:

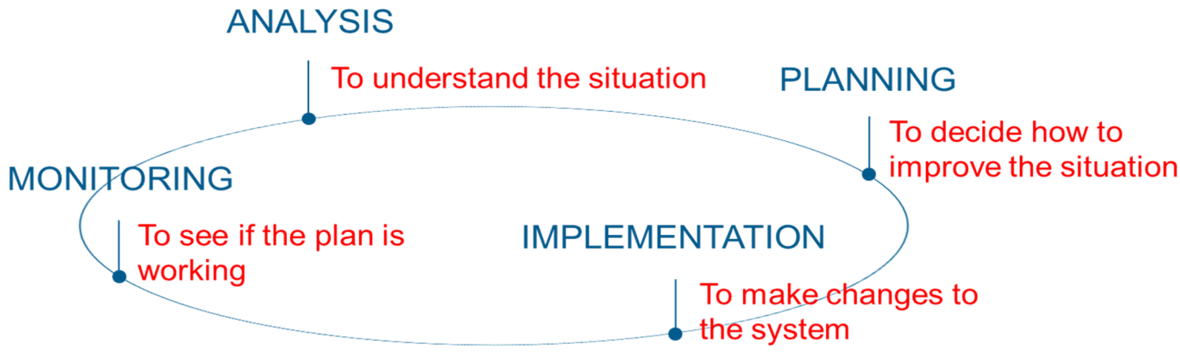
1. **Based on the adopted planning approach, to design and validate specific methodologies (at least 6) to address a variety of flood and drought applications at basin and local scale.**
2. **Development of a Decision Support System (DSS) which will support key processes within the methodologies at basin and local scale. The DSS will be available without charge to all GEF basins.**
3. **Stakeholder involvement throughout the development of the methodologies and the DSS and dissemination of findings.**

Planning types supported

Water resource planning at basin and local scale includes many different activities, stakeholders and issues. This project will focus on short- to long-term planning, while real-time operation and forecasting will not be part of the project. Short- to long-term planning is divided here into two distinct types of planning: operational and strategic planning. Operational planning is short term planning (weeks to a few years) with the objective of reducing impacts without investing in new infrastructure. Strategic planning is planning based on a vision or objective covering a longer time period. This will typically include investments in infrastructure to cope with future changes. Floods and droughts should be distinct phenomena because of different characteristics and typically different management. Therefore, operational and strategic planning is further divided into drought management and flood management.

Planning approach

The three planning methods of WSP, IWRM and TDA/SAP were analysed and used to develop and adopt a general 4-stage planning approach for the project. Activities within the IWRM, TDA/SAP and WSP methods were mapped and analysed. Similarities and overlaps in the content of the three specific planning methods were evaluated and grouped into the 4 overall planning components: Analysis, Planning, Implementation and Monitoring.



Planning cycle adopted by the project

Planning methodologies

The DSS will be based on the adopted planning approach, but the functionality will be designed and validated against specific flood and drought applications.

The exact applications are not yet defined and will be defined based on stakeholder input and requirements from the existing planning methods. The start of the process to identify the potential application areas for validation of the DSS will be undertaken in meetings in connection with the inception meeting, where a number of potential application areas for DSS validation will be identified. The project will select 6-8 application areas covering flood and drought planning issues on basin and local scale. For each application area a detailed step-by-step description of the application will be made, this will be referred to as a methodology, and will be used to test and validate the DSS on specific applications. The methodologies will be specific step-by-step list of activities to address a specific flood or drought application within a defined application area.

The aim will be to have at least one methodology which combines both flood and drought issues and at least one methodology combining local and basin scales within the selection. However, it will be limited by the nature of the work being undertaken by the stakeholders. The selection of methodologies will also include both operational and strategic planning applications and methodologies linked to TDA/SAP and WSP activities. The developed methodologies will be closely linked with the adopted planning approach.

The project will develop both an idealised methodology for each application area, and a locally-adjusted version based on a practical implementation in the pilot basins. The idealised methodology could be used as a global template for applying the DSS on a specific case, while the implemented version will serve as a validation of an actual use of the DSS on a specific case.

The application area for DSS validation could be a specific application, done by the stakeholder, where the functionality of the DSS will be tested and validated, or a number of workshops for in-depth training and testing of the DSS functionality. The selection of application areas for DSS validation as applications or workshops will be based on availability of information and resources at the stakeholders.

DSS

The linkage between the planning activities within the DSS and the existing planning methods such as TDA/SAP, IWRM and WSP, is done through the planning approach, and the functionality of the DSS will be addressed by specific tools located in one of the 4 planning stages according to how the tools should be used in a planning context.

The user interface for the DSS will be designed to ensure a flexible and user friendly system based on existing planning methods. At the same time the DSS will be designed so that it can be used for different applications, users and scales.

The developed DSS will support existing planning methods with focus on operational and strategic planning, by applying technical software tools within a planning DSS. The DSS will not embrace the whole planning methodology, but rather support a number of the activities which are part of it.

The implemented methods and tools will be selected during the process of selecting and consolidating the potential application areas for DSS validation, which will be done in close dialogue with the main stakeholders in the project.

Main deliverables

The main deliverable from the project will be a DSS, capable of providing support to decision-makers for short- and long-term planning related to flood and drought issues.

The DSS software will contain a number of technical tools. The exact tools which will be developed cannot be defined at this stage as this will require the assessment of the potential application areas for DSS validation to identify and prioritise, in collaboration with the stakeholders, the most relevant tools for development.

The concrete deliverables from the project will be:

- Planning approach linked to existing planning methods (reported)
    - Description of the general planning approach based on a 4-stage planning cycle. The planning approach is linked to the IWRM, TDA/SAP and WSP methods.
- Methodologies for how to apply the DSS in a planning context (reported)
    - The development of the methodologies (at least 6) will be based on potential application areas for the DSS each aiming at testing and validating DSS functionality within flood and drought related planning.
    - The potential application areas for the DSS will be defined based on the feedback from the stakeholders during the inception meeting, and will cover flood and drought planning issues at the basin and local scale.
    - The project will develop both an idealised methodology for application areas for validation of the DSS, and a locally-adjusted version based on a practical implementation in the pilot basins. The idealised methodology could be used as a global template for applying the DSS on a specific

flood and drought issue, while the implemented version will serve as a validation of an actual use of the DSS on a specific local context.

- DSS software containing tools for supporting technical activities within flood and drought planning (software delivered)
    - The DSS (containing tools) will be delivered as a piece of software to be used freely by all GEF basins.
    - The DSS will be validated based on the selected potential application areas for the DSS
- Strategic recommendations for inclusion of the information from the DSS in existing planning methods at basin and local level
- Training and capacity building documentation for stakeholders within the pilot basins, other GEF and non-GEF basins to apply the DSS and integrate information into planning processes
    - Recommendations and lessons learned for applying the planning methodology.
    - Technical specifications and manuals for the consolidated DSS.
    - Documents and presentations for training modules
- Communication strategy, and communication materials to disseminate project outputs and outcomes
    - Documentation of the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders.
    - Materials for global dissemination through IW LEARN
    - Materials for international water events

Project Framework

Component	Outcome	Output
Component 0: Project Preparation (includes all PPG outcomes and outputs), and Inception Activities	**Outcome 0.1:** Enhanced focus and effectiveness of final project design achieved through the assessment of current practices in addressing flood and drought impacts as part of planning processes in transboundary basins, including the TDA-SAP process **Outcome 0.2:** Identification during project preparation of three transboundary basins for participatory development and pilot testing of the new methodology and tools, ensures timely inception and smooth project implementation	**Output 0.1.1:** Reports containing review of GEF portfolio, case studies, mapping and assessment of current decision making processes, highlighting strengths, weaknesses and any gaps identified (including those related to data and information) **Output 0.2.1:** Selection of three pilot basins and 1-2 learning basins based on a review of all river/lake basins object of foundational GEF IW projects including the TDA-SAP process **Output 0.2.2:** Project inception with the participation of GEF Project Agencies and of Pilot Basin representatives
Component 1: Development of Methodology and Tools	**Outcome 1.1:** Methodologies with tools aimed at increasing understanding of flood and drought dynamics and impacts at transboundary and local levels and including enhancement of commonly used decision support systems, fully developed jointly with pilot basins stakeholders.	**Output 1.1:** At least 6 methodologies with tools adopting a basin and local approach, including enhancements for decision support systems, that would allow the integration of flood and drought issues into (i) the TDA-SAP GEF IW or equivalent processes, and (ii) IWRM plans and Water Safety plans
Component 2: Validation and testing at basin-wide level	**Outcome 2.1:** Application of the methodologies at the basin level (at least 3) using DSS tools in the three pilot basins enables the integration of flood and drought issues into the IWRM, TDA-SAP and other planning processes.	**Output 2.1.1:** Strategic recommendations for inclusion of flood and droughts issues in IWRM, TDA/SAP, and other basin planning methods in the 3 selected pilot basins.
Component 3: Validation and testing at local level	**Outcome 3.1:** Application of the methodologies at lower administrative levels using DSS tools in the three pilot basins enables the integration of flood and drought issues into local level planning (e.g. water safety planning) for water suppliers and regulators, (agro) industries and urban area managers to consider options for increased resilience and	**Output 3.1.1:** Recommendations for inclusion of flood and droughts issues in Water Safety, and other local planning methods in the 3 selected pilot basins with integration of urban and (agro-) industrial water users' perspectives and realities.

	preparedness to F&D within broader basin context with an emphasis on vulnerable groups affected by water related shocks.	
Component 4 Capacity building and dissemination	**Outcome 4.1:** Experience and know how gained through the project is made available within the GEF system and beyond. **Outcome 4.2:** Global dialogue on water security and adaptation to climate variability and change enriched by the dissemination of project outcomes.	**Output 4.1.1:** Learning package including technical specifications of the DSS and training materials for the application of the new methodologies with DSS tools is tested in 2-3 trainings with basin officials, utility and industry management and operational staff, and representatives from civil society with 15-30 people per training. **Output 4.1.2:** Output and feedback from the awareness workshops **Output 4.2.1:** Communication approach developed to disseminate flood and drought methodology within pilot basins, GEF basins, and to other relevant end users**.** **Output 4.2.2:** 2-3 Experience Notes and other documents and audio-visual materials produced for IW LEARN dissemination mechanisms and website. **Output 4.2.3:** Development of materials (4-5) developed and disseminated at major water events: WWF, Water Week, GEF IWC 7/8/9, and IWA Conferences.

Acronyms and Abbreviations

DHI	DHI – Water and Environment
DRB	Danube River Basin
DSS	Decision Support Systems
DWR	Department of Water Resources
GEF	Global Environment Facility
GWP	Global Water Partnership
HAII	Hydro and Agro Informatics Institute
ICDPR	International Commission for Protection of Danube River
INBO	International Network of Basin Organisations
IUCN	International Union for the Conservation of Nature
IW	International Waters
IWA	International Water Association
KIWASCO	Kisumu Water and Sewerage Company
LVBC	Lake Victoria Basin Commission
MCA	Multi-Criteria Analysis
MWA	Metropolitan Waterworks Authority
MWAUWASA	Mwanza Urban Water Supply and Sanitation Authority
NBI	Nile Basin Initiative
RID	Royal Irrigation Department
SAP	Strategic Action Plan
SONABEL	Société Nationale d'électricité du Burkina
SONEB	La Société Nationale des Eaux du Bénin
TDA	Transboundary Diagnostic Analysis
TMD	Thai Meteorological Department
UN	United Nations
UNEP	United Nations Environment Programme
VBA	Volta Basin Authority
WMO	World Meteorological Organisation
WRIS	Water Resources Information System
WSP	Water Safety Plan

1 Introduction and Background

The Flood and Drought Management Tool project is funded by the Global Environment Facility (GEF) International Waters (IW) and implemented by UNEP, with IWA and DHI as the executing agencies. The project aims at 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 Resource 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 Decision Support System.

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.

Based on these issues, the project is designed to develop a methodology for basins, which uses tools and decision support systems that will allow the integration of information on floods and droughts in planning processes. The project will develop technical tools to support flood and drought planning processes which, previously, may not have fully exploited the information available. The project also aims to develop an approach and tools that work both on a transboundary level and the local level. GEF International Waters projects have planning methods which focus at the transboundary level. However, decisions made at the regional level (basin) and the local level need to be linked to plans at a larger scale. The project will address this aspect of inter-level communication by providing tools for both scales within a single DSS.

The DSS being developed will be a piece of software containing various technical functionality in ‘tools’. The DSS will be tested and applied in 3 different 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 so that methods can be applied to other basins. The aim is to develop an approach that interfaces with existing planning practices and the project will support planning activities related to TDA/SAP, IWRM or WSP, but will not embrace all activities within the planning methods.

The DSS will be flexible: it will not contain a fixed workflow but support different planning activities and there will be the ability to link to different model types (MIKE models and WEAP as default). It will also be based on an open platform solution, meaning basin authorities, national authorities, utilities, etc. can further develop the DSS and tools after the completion of the project. The usability of the DSS software is key to ensure that it is relevant and useful to planning activities. The project will also ensure that the DSS software is user-friendly.

It is important to note that the Flood and Drought Management Tool project will not collect data or develop new models, but will focus on the development of tools within a DSS for supporting planning, while the validation and testing of the methodologies and tools will be done using existing information and models. The project will not develop new plans within the pilot basins, but support the use of the DSS in ongoing planning processes.

1.1 Background and History of the Project

The project rationale is based on the recognition that climatic variability and change is being increasingly experienced in the form of more frequent, severe and less predictable flood and drought events. There is a growing sense of urgency among countries, basin organisations and other end users, such as utilities, of the need to build resilience towards flood and drought events as an integral part of the management of water resources. The growing risks related to hydrologic uncertainty are magnified in transboundary contexts, where cooperation among countries is essential to any coping strategy.

Consequently, the IW focal area of the GEF 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. In its focal area strategy, GEF IW is emphasising the need to address the multiple priority stresses – including floods and droughts – impacting transboundary basins, through a multi-country cooperative effort that would enable the needed coordinated mitigation response. As recommended by the GEF, such multi-country efforts should be informed by, and start with a basin-wide Transboundary Diagnostic Analysis (TDA), including consideration of increased climatic variability and change, in particular floods and droughts. Hence the need for a science based methodological approach to integrate floods and droughts in this analysis. In more general terms, there is a need for a technically and economically feasible and scientifically sound way to help land, water and urban area managers to integrate the information on flood and drought events into different scales of planning processes including Integrated Water Resources Management (IWRM) plans at the basin level and Water Safety Plans (WSP) at the local level.

1.2 Planning

The overall project aim is to support planning at transboundary and local scales, and there are a number of existing planning methods used for water management, where the Integrated Water Resources Management (IWRM) approach is adopted. For this project, the focus is on supporting activities within the 3 existing planning methods: Transboundary Diagnostic Analysis/Strategic Action Plan (TDA/SAP) developed by the Global Environment Facility (GEF), Integrated Water Resources Management (IWRM) and Water Safety Planning (WSP) recommended in the WHO drinking water guidelines. These methods are described in more detail in Section 4.

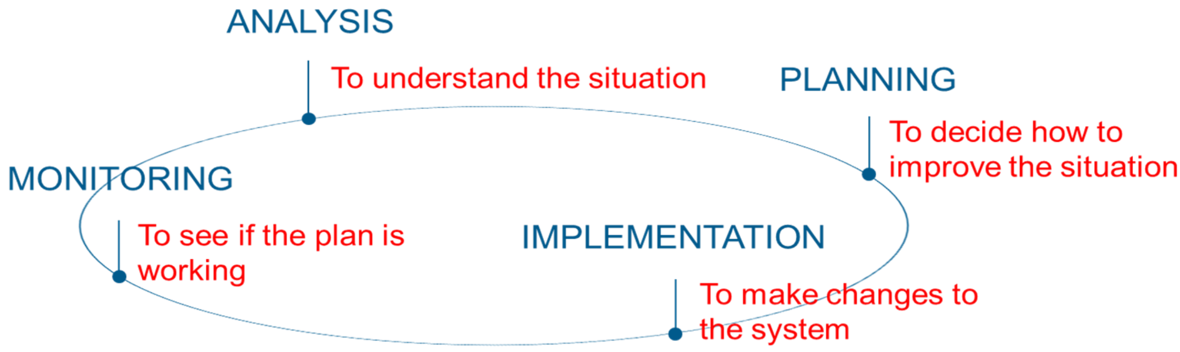


Figure 1-1 Planning cycle adopted by the project

Even though there are many different planning methods in use, the main structure of a planning cycle is often similar. The planning cycle is defined here in 4 general planning stages: Analysis, Planning, Implementation and Monitoring. These stages can be recognised in components of the IWRM, TDA/SAP and WSP methodologies and this approach will be used to link them. The stages are shown in Figure 1-1 and described in more detail in Section 4.

1.3 Project Inception Phase

The Flood and Drought Management Tools project initiated an inception phase from May 2014 to November 2014. During this time a series of stakeholder consultation meetings were carried out by DHI and IWA in the Volta Basin, Lake Victoria Basin and Chao Phraya Basin in Thailand. These consultations were aimed at gaining an understanding of how the project can improve water planning in the 3 basins, in order to formulate a detailed project description for the inception meeting. The meetings were also to determine which stakeholders were interested in actively engaging with the project. A summary of these meetings is available in section 3.

The objectives of these consultations included:

- Key stakeholders understand and endorse the objective of the project
- To understand issues the key stakeholders are facing during water planning, focusing on issues related to climate change, floods and droughts
- To understand the methods/processes which the basin organisations and utilities go through during planning, and tools they currently use in planning
- To identify other projects or initiatives of importance for the project with respect to knowledge or relevant information
- To gather feedback on the proposed approach for the project

1.4 Project Joint Stakeholder Workshop

The project joint stakeholder inception phase workshop for the Flood and Drought Management Tools project took place in Bangkok, Thailand from Sunday 23rd November 2014 to Monday 24th November 2014. The first day was a field visit followed by a second day inception meeting for the project. A number of individual meetings were also held. This was intended as the official inception meeting, however, due to unforeseen circumstances the official meeting had to be postponed, and will take place in March 2015 as an inception/steering committee meeting where the inception report will be approved including any changes and updates to the project workplan and budget. This meeting in March 2015 will not duplicate the meeting in November 2014, and will include the basin representatives only – HAII, LVBC and VBA.

Nonetheless, the joint stakeholder inception workshop included key representatives from the 3 basins (Volta, Lake Victoria and Chao Phraya), as well as additional stakeholders from the Chao Phraya, as the meeting is being held in Bangkok. The meeting provided an opportunity for all stakeholders and project partners to become familiar with the revisions to the project components, i.e. objectives, activities and deliverables, etc. The meeting enabled the representatives to contribute / comment on the relevant project components to help fine-tune the project. Cooperation arrangements with the key representatives were discussed during the inception meeting, clearly defining each party’s roles and responsibilities. This will be approved at the official inception/project steering committee meeting in March 2015.

It should be noted that project implementation will continue after the joint stakeholder inception workshop based on the Project Document and guided by the draft inception report. The agenda from the joint stakeholder inception workshop is in Annex A.

2 Intervention Strategy

The goal of the project is defined as contributing to the global efforts being made to maintain acceptable levels of societal and ecosystem sustainability vis-a-vis growing climatic uncertainty and unpredictability. The overall objective of the project is to improve the ability of land, water and urban area managers operating in transboundary river basins to recognise and address, as part of the TDA/SAP, IWRM plans and WSP processes, the implications of flood and drought events. The components, outcomes, outputs and activities to deliver on the project goal and overall objective are outlined in section 8.

The experience from the inception phase, and especially from the stakeholder consultations in the 3 pilot basins, has enabled a further clarification of the overall project objective. The project will focus on three key strategy areas which cut across the results framework:

1. **Based on the adopted planning approach, to design and validate of specific methodologies (at least 6) to address a variety of flood and drought applications at basin and local scale.**
2. **Development of a Decision Support System (DSS) which will support key processes within the methodologies at basin and local scale. The DSS will be available without charge to all GEF basins.**
3. **Stakeholder involvement throughout the development of the methodologies and the DSS and dissemination of findings.**

Further information regarding the background work, direction and progress towards the three key strategy areas is found in Section 5, 6 and 7 respectively.

Figure 2-1 Project intervention strategy in three key strategy areas

2.1 Definitions

One of the outputs from the project will be software to support decisions within planning with a focus on floods and droughts, referred to as a Decision Support System (DSS). This DSS will contain a number of tools with different functionality. The software is therefore understood as the 'DSS' and the functionality as 'tools'.

The planning approach describes the overall 4-stage planning cycle in Figure 1-1. The term 'methodologies' refers to specific step-by-step list of activities to address a specific flood or drought application. For example, this could be a specific methodology for 'seasonal drought management at catchment level'. The developed methodologies will be closely linked with the adopted planning approach. The approach, DSS and step-by-step methodologies must be globally applicable, but will be tested, adjusted and validated against potential application areas for the DSS. This will show how the DSS and the associated tools could be used to support specific planning activities related to floods and droughts.

2.2 Three key strategy areas

The three key strategy areas are outlined in greater detail below:

1. **Based on the adopted planning approach, to design and validate of specific methodologies (at least 6) to address a variety of flood and drought applications at basin and local scale.**

    - The planning methodologies will be compatible with activities within TDA/SAP, IWRM and WSP and will include methodologies for both basin and local scale.
    - The specific planning methodologies to be developed will depend on interest of stakeholders and availability of information.
    - The planning methodologies will focus on flood and drought issues. Flood and drought issues are interpreted as issues related to excess of water or water deficit, and not only extreme events.
    - The developed planning methodologies will embrace short-, medium- and long-term planning (structural and non-structural planning), on time scales of a few weeks to many years. Day to day and real-time operation will be outside the scope of the project.
    - There will be an emphasis on technical tools to support the planning process. Issues related to institutional, organisational, and political or policy issues will not be addressed in detail by this project.
    - The planning methodologies will be validated and consolidated in the three pilot basins through validation of the DSS on potential application areas.

2. **Development of a Decision Support System (DSS) that will support key processes within the planning methodologies at basin and local scale and will be available without charge to all GEF basins.**

    - There will be a recognisable linkage to planning activities within TDA/SAP, IWRM and WSP used at basin and local scale.

    - The developed DSS will support key processes within the planning methodologies, with technical tools, but will not address all activities in a complete planning cycle. Hence, there might be activities not covered by technical tools.

    - The main focus will be on flexibility and usability, as the final DSS is to be used in multiple contexts and to address various issues. This is also important because it will be used by various types of stakeholders with varying levels of capacity to exploit technical tools.

    - Key tools will be implemented in the DSS in the 3 pilot basins. The developed tools will be available for all users of the developed DSS.

    - The developed DSS will be based on an open platform, enabling users to further develop the DSS by adding tools, methods and model adapters after the closure of the project.

3. **Stakeholder involvement throughout the development of the methodologies and the DSS and dissemination of findings.**

    - The project is focusing on working with basin organisations at basin scale and water utilities at the local scale.

    - The developed DSS may also be applied, where appropriate, for other water organisations such as electricity companies, irrigation departments or environmental organisations responsible for planning at basin or local scale. Some of these organisations may be included in the consolidation and testing phase of the DSS, where appropriate.

    - The project will undertake stakeholder consultations with the aim of increasing the awareness and understanding of flood and drought planning issues.

    - The planning methodologies will be consolidated and adjusted with input from key stakeholders.

    - The DSS will be validated and tested through potential application areas (based on applications or workshops) in close dialogue with the main stakeholders in the project.

    - There will be training and capacity building activities.

    - There will be dissemination of the findings.

Table 2-1 Summary of project strategy areas

Design specific methodologies (at least 6)	Develop a DSS containing tools	Involve stakeholders
• At least one methodology **addressing TDA/SAP** • At least one **addressing WSP** • Covering **basin** and **local** scale • Focus on **flood and drought** planning • Covering **short**- and **long-term** planning • An emphasis on **technical tools** to support the planning process	• **Linkage** to planning activities within TDA/SAP, IWRM and WSP • Support **key processes** in flood and drought planning • Focus on **flexibility** and **usability** • Based on a **freely available open platform**	• Working with **basin organizations**, **water utilities** and **other interested** parties • **Consultation** for our awareness and understanding • **Consolidation of the planning methodology** with stakeholders • **Validation and testing** of the DSS on potential application areas • **Training and capacity building** activities

2.3 Definition of flood and drought

Flood and drought issues are interpreted not only as extreme events but mainly as issues related to excess of water or water deficit.

2.3.1 Definition of drought

Drought could be defined as water supplies being “substantially below” of what is usually experienced for that place and time. What is considered “substantially below” is rather arbitrary and depends on the location and on what features of a drought cause the most stress or loss[1].

Droughts are typically classified in four different categories: meteorological, agricultural, hydrological, or socioeconomic. The first three (meteorological, agricultural and hydrological) describe drought as a physical phenomenon while the last (socioeconomic) defines drought as a mismatch between water supply and demand, also referred to as water scarcity, that causes socioeconomic and environmental

[1] Loucks, P. D. and van Beek, E., 2005. *Water Resources Systems Planning and Management*. Paris: UNESCO.

impacts[2]. Water availability is closely connected to rainfall and physical characteristics, but also to changes in land use, water quality, legislation etc. Water demand depends on the natural and socioeconomic system and its development. It should be noted that water shortages or socioeconomic droughts can be caused by physical phenomena such as climate variability and extremes but also by socioeconomic developments affecting water demand.

This project deals with operational and strategic drought management focusing especially on socio-economic and environmental impacts. Hence the understanding of droughts in the planning context is related to water scarcity in accordance with the socioeconomic drought definition (difference between water availability and water demand). In other words, the project understands drought management as water systems management that aims at mitigating water shortages. The key parameters in water scarcity are the identification and management of the available water and the demand for the same water.

The definition of drought, used in the project, is water shortage which has significant impacts and can be related either to climate variability, extremes or increasing demand. In many cases the term drought is used by countries to describe water shortages that are not caused by rare extreme events but related to climate variability or socioeconomic changes. It is due to the significant impacts that the term 'drought' is used and it is for the same reason (significant impacts) that the project will focus on these types of events.

2.3.2 Definition of flood

Floods are natural events defined as unusual surpluses or excesses of water resulting in higher than usual water levels. The definition of a flood depends on the definition of unusual water levels, and when a specific water level causes damage or impacts in a specific area.

Floods results from short-duration highly intense rainfall events, long duration low intensity rainfall, snowmelts, failure or dams or levees or a combination of these conditions. In undisturbed conditions floods are a natural event occurring with regular intervals. Human interventions as land use changes could change the intervals or frequency by which the floods occur.

One common definition of a flood event is using the return period, also known as a recurrence interval (sometimes repeat interval) as an estimate of the likelihood of an event. It is a statistical measurement typically based on historic data denoting the average recurrence interval over an extended period of time, and is usually used for risk analysis (e.g. to decide whether a project should be allowed to go forward in a zone of a certain risk, or to design structures to withstand an event with a certain return period). Many water structures are designed to withstand a flood event defined by a specific return period, e.g. a 50 year event.

One of the challenges from using a probabilistic definition as a return period in designing mitigation measures against flood events is that changes in climate and land use could change the recurrence interval of floods and thereby the magnitude of a

[2] Source: National Drought Mitigation Center, University of Nebraska-Lincoln, U.S.A., http://drought.unl.edu/DroughtBasics/TypesofDrought.aspx

specific return event. The result is that a 50 year return period defined from historical data, might not be valid anymore in the future. Hence changes to climate and land use are important parameters to include when including floods in long term planning.

The definition of a flood, used in the project, is a high flow event that has significant impacts. Such events might be caused by climate variability in combination with anthropogenic factors or by very rarely occurring extreme flows. Flood management supported by the DSS is therefore not looking at any particular return period of event but more generally on management of dangerously high flows.

2.4 Types of planning addressed in the project

Water resource planning at basin and local scale includes many different activities, stakeholders and issues. This project will focus on short- to long-term planning, while real-time operation and forecasting will not be part of the project. Short- to long-term planning is divided here into two distinct types of planning: operational and strategic planning. Floods and droughts ought to be distinct phenomena because of different characteristics and typically different management. Therefore, operational and strategic planning is further divided into drought management and flood management. A brief description of how they will be supported in the DSS is included in the following sections.

2.4.1 Operational planning (short- to medium-term planning)

Operational planning, or management, is planning within a short- to medium-term (from weeks to few years), where the objective is to evaluate and reduce flood and drought impacts, without investing in new infrastructure. The aim is to optimise or improve the current water system, and reduce impacts from known issues. One example could be the development of a water allocation plan for dry season management of water from multi-purpose reservoirs based on information from a seasonal forecast. Operational planning does not include investments in new infrastructure such as reservoirs, channels or other investments that might be planned for a longer and strategic time horizon. These investments would be considered in strategic planning.

The project may support operational planning with respect to:

- Analysis of the current situation (identification of issues and understanding the situation)
- Evaluation of seasonal changes in water availability and demand considering anthropogenic factors and uncertainty in climate variability.
- Development and selection of indicators to describe the status under different scenarios and to evaluate the potential plans.
- Development of plans for reducing or solving the issues within a medium-term time horizon (weeks to a few years), without use of structural investments.
- Development and selection of indicators to evaluate the potential plans.
- Linkage between plans and numerical models (models developed outside the DSS) for the evaluation of the impact of the proposed plan/operation.

- Optimisation and evaluation of plans using decision-making methods. There will potentially be linkage to economic and socio-economic issues through specific indices.
- Dissemination of results for increased stakeholder and public awareness during the implementation of the selected plan.
- Monitoring of the effectiveness of the plan through specific indicators.

The supported activities will be linked with activities within TDA/SAP, IWRM or WSP. The focus will be on planning for the reduction of impacts related to floods and droughts.

Short-term operational drought management looks as operational measures to mitigate water shortage. The definition of drought is water shortage which has significant impacts and can be related either to climate variability, extremes or increasing demand. This type of planning would typically include the operation of current infrastructure and not consider the development of new infrastructure or longer term changes.

Short-term operational flood management looks as operational measures to mitigate flood risk. The definition of a flood is a high flow event that has significant impacts. High flow events are not defined by any particular return period but more generally as dangerously high flows. This type of planning would typically include the operation of current infrastructure and not consider the development of new infrastructure or longer term changes.

The previously defined understanding of operational flood and drought management in this project implies operational water systems management facing challenges of flow uncertainty, climate variability and extremes.

2.4.2 Strategic planning (long-term strategic planning)

Strategic planning is planning based on a vision or objective covering a longer time period, and will typically include investments in infrastructure to cope with current and future climate, land-use, water demand, etc. Operational planning mainly focusses on optimising the current situation or system while strategic planning will focus on how to solve emerging issues within a longer timeframe. Strategic planning involves a higher degree of uncertainty related to technical aspects of water supply and demand (changes in climate, water demand etc.), but also has stronger dependencies on socio-economic trends and political preferences. These aspects which are not *directly* related to water supply and demand are outside the scope of this project, but might be included through indicators.

The project may support components within strategic planning related to the following:

- Analysis of the current situation to form a baseline assessment (understand the situation and issues)
- Evaluation of changes to water availability and demand in the future considering projections of future climate and climate variability, population development, socio-economic development, land-use change and related uncertainties.

- Development and selection of indicators to describe the status under different scenarios and to evaluate the potential plans.
- Development of plans for fulfilling objectives or visions for the future.
- Linkage between the developed plans and numerical models (models to be developed outside of the DSS) for the evaluation of the impact of the proposed plan.
- Methods for evaluating the robustness of the plans using decision methods such as multi-criteria analysis or robust decision-making. There may be linkage to socio-economic issues through some indicators.
- Dissemination of results for increased stakeholder and public awareness during the implementation of the selected plan.
- Monitoring of the effectiveness of the plan through specific indices.

The project will focus on the technical aspects of strategic planning, but will potentially provide linkages to methods and indices which include socio-economic issues. The main focus will be on drought and flood related issues, and how to reduce the impacts taking into account changes in climate, land-use and water demand. The supported activities will be linked with activities within TDA/SAP, IWRM or WSP. The focus will be on planning for the reduction of impacts related to flood and drought.

Long-term strategic drought planning looks at the same drought events as the short term drought management but over longer timescales which are affected by changes in climate variability and the large uncertainties associated with future projections of climate change, population development and socioeconomic development etc. This type of planning would typically include consideration of new infrastructure and land management for example rather than simply the operation of current infrastructure.

Long-term strategic flood planning looks at the same type of flood events as the short term flood management but over a longer timescale which are affected by changes in climate variability and the large uncertainties associated with future projections of climate change, population development and economic development etc. This type of planning would typically include consideration of new infrastructure and land management for example rather than simply the operation of current infrastructure.

The previously defined understanding of strategic flood and drought management in this project implies strategic water systems management facing challenges of flow uncertainty, climate variability and extremes.

The planning activities potentially supported by the DSS for both operational and strategic planning are summarised in Figure 2-2.

Operational planning (short- to medium-term)	Strategic planning (long-term)
• **Analysis of the current situation**	• **Analysis of the current situation** to form a baseline assessment
• **Evaluation of seasonal changes** in water availability and demand	• **Evaluation of future changes** to water availability and demand
• **Development of plans** to address issues within a time horizon of months to years, without use of structural measures	• **Development of plans** for fulfilling objectives or visions for the future
• **Development and selection of indicators** to evaluate the potential plans	• **Development and selection of indicators** to evaluate the potential plans
• **Linkage between plans and numerical models** for the evaluation of the impact of the proposed plan/operation	• **Linkage between plans and numerical models** for the evaluation of the impact of the proposed plan
• **Optimisation and evaluation of plans** using decision methods	• **Methods for evaluating the robustness of the plans** using decision methods
• **Dissemination of results** for increased stakeholder participation	• **Dissemination of results** for increased stakeholder participation
• **Monitoring of the effectiveness** of the plan through specific indices	• **Monitoring of the effectiveness** of the plan through specific indices

Figure 2-2 Overview of planning activities which the DSS may support

2.4.3 Planning components not covered in the project

The project will not be able to support all planning activities related to the TDA/SAP, IWRM or WSP methods. Based on feedback from the stakeholder visits, available resources and the time-frame of the project, the following components will not be included in the project:

- The project will support key planning activities related to TDA/SAP, IWRM or WSP, but will not embrace all activities within the planning methods. The focus will be on supporting key activities within the planning methods containing a few key tools of high value for the stakeholders in the project. The flexibility of the DSS will ensure that further development and extension of the DSS could be done outside of the project.

- The project will support short- to long-term planning, but will not support real-time operation. This includes real-time flood forecasting, or optimisation of daily operation within reservoirs or irrigation schemes. The developed system might, however, contain links to other systems capable of real-time operation and forecasting.

- Water quality issues are a key concern within planning in many areas, and could be linked to flood and drought events. Due to limited resources and prioritisation the project will not include water quality issues in the DSS, but the framework will be developed so water quality could be included after the closure of the project.

- Issues related to socio-economic changes, institutional and political issues are all very relevant for planning, and will in many cases have a huge impact on the outcome of the planning. The project will include these issues through indices and other available information where possible, but the main focus will be on technical tools supporting technical parts of the planning process.

- The developed DSS will support flood and drought management, but not emergency response to extreme flood and drought events. The reason is that emergency response involves actions and activities not included in the three supported planning methods (TDA/SAP, IWRM and WSP).
- The project will not include detailed assessments of urban planning, as the level of information needed for proper assessments of urban issues will not be available in the selected basins. The project might include simple solutions as rapid flood assessment or other methods supported by the available data.
- The project will not collect data or develop new models, but will focus on the development of a generic DSS for supporting planning. The validation and testing of the methodology will be done using existing information and models.
- The project will not develop new plans within the pilot basins, but validate and test the DSS on ongoing planning processes within the pilot basins.

2.5 Potential Stakeholders

Basin organisations are the key stakeholders in the project, and are the organisations relevant for the TDA/SAP approach as this is based on a transboundary planning context. The project will develop the DSS with the needs of the basin organisations in mind. Basin organisations are normally involved in the TDA/SAP method in the beginning of a 10 to 15 year planning cycle, and as this process is mainly donor driven, the method seems to be somewhat disconnected with the more frequent planning activities at the basin organisations. The project will, in close dialogue with the basin organisations, look at tools or methods to further strengthen the linkage between basin and local catchment scale planning. Basin organisations are mainly focusing on long-term strategic planning, but a stronger linkage with planning activities at catchment or local level could provide an important linkage between operational and strategic planning for basin organisations. This linkage is mainly an institutional issue but will be supported where possible with technical tools which function at the different spatial scales.

The project is aware of the fact that the TDA/SAP process has been ongoing in some of the basins, primarily Volta and Lake Victoria, making it difficult to test the tools directly in a TDA/SAP process. Nevertheless, the project will utilise their experience from the previous TDA/SAP process in the development of the. Such experience will be valuable in defining tools and functionality that were missing during the previous TDA/SAP process.

Water utilities are involved as a main stakeholder and potential end-user in the project. One of the objectives will be to support the WSP with technical tools enhancing the outcome of the WSP process. The water utilities in the three pilot basins operate under very different conditions: some are operators (not performing actual planning) while others are water owners and responsible for planning of the water abstraction. Flood and drought planning is very relevant to many water utilities as they are required to undertake activities such as the evaluation of water availability, conjunctive use of surface and groundwater, careful monitoring and dissemination of results and decisions. The project will focus on some of these areas.

The project has engaged with a large number of stakeholders during the inception phase, and other potential end-users for the project have been identified. These could be:

- Electricity companies operating multipurpose reservoirs. The DSS could address the need for tools for optimising the water allocation between different sectors during water scarcity (operational planning). Such potential end-users in both Volta and Chao Phraya have been identified.

- Irrigation departments or managers operating large irrigation schemes. The DSS could address a need for better planning based on seasonal forecasts of water availability and demand (operational planning). Such potential end-users in both Volta and Chao Phraya have been identified.

- Environmental organisations or departments in need of tools for evaluating flood and drought issues and potential mitigation measures in the short- or long-term. Potential end-users in Lake Victoria have been identified.

The project has, through the stakeholder meetings, presented the project for a wide range of stakeholders. The intention is to involve relevant stakeholders in the consolidation and testing of the methodology, thereby introducing stakeholders, other than the basin organisations and water utilities, to the DSS and addressing the needs beyond those of water utilities and basin organisation. During the consultation meetings, not all stakeholders were available or identified. The intention of the project is to connect with these stakeholders during the next visits scheduled in 2015. Furthermore, as the project progress, more stakeholders will be identified and their needs taken into consideration. However, it is important to stress that while the project will look to address issues of all relevant stakeholders, the project will work in different capacities with the identified stakeholders.

	Volta Basin	Lake Victoria Basin	Chao Phraya Basin
Basin scale	Volta Basin Authority (VBA)	Lake Victoria Basin Commission (LVBC)	Hydro and Agro Informatics Institute (HAII)
Local scale	ONEA Ghana Water	National Water Uganda, Jinja KIWASCO MWAUWASA	Metropolitan Waterworks Provincial Waterworks Authority
Other scale	Electricity companies, irrigation and environmental agencies or departments, catchment organisations and other interested parties		

Figure 2-3 Overview of potential stakeholders in the project

2.6 Deliverables from Intervention Strategy

The main deliverable from the project will be a DSS, capable of providing support to decision-makers for short- and long-term planning related to flood and drought issues.

The DSS software will contain a number of technical tools. The exact tools which will be developed cannot be defined at this stage as this will be based on an assessment of the selected application areas for validation of the DSS. From initial stakeholder consultations it is expected that the tools will be related to the following areas:

- Data management and visualisation
- Remote sensing
- Future changes (climate, land use and population changes)
- Decision-making methods
- Optimisation
- Evaluation of plans

The exact tools that will be developed will be defined within the first year of the project.

A number of specific application areas for validation of the DSS will be selected based on the stakeholder feedback during the inception meeting. They will form the basis for developing specific methodologies describing how the planning approach (4-stage) should be applied in more detail with a step-by-step methodology. These methodologies (at least 6) will cover a variety of flood and drought applications and a variety of temporal and spatial scales.

The application areas for validation of the DSS could be a specific application, done by the stakeholder, where the functionality of the DSS will be tested and validated, or a number of workshops for in-depth training and testing of the DSS functionality. The selection as applications or workshops will be based on availability of information and resources at the stakeholders.

For each application area, an idealised methodology for addressing the issue will be first developed. This can be used as a general global template for addressing more global or regional issue (for example basin-wide flood risk management). With stakeholders, the methodology will be adjusted to be locally relevant based on the practical implementation limitations. The locally-adjusted methodology will be tested, revised and implemented on a specific application areas. This will serve as the validation of the DSS.

The concrete deliverables from the project will be:

- Planning approach linked to existing planning methods (reported)
    - Description of the general planning approach based on a 4-stage planning cycle. The planning approach is linked to the IWRM, TDA/SAP and WSP methods. The planning approach was defined during the inception phase and is described in section 4.
- Methodologies for how to apply the DSS in a planning context (reported)
    - The development of the methodologies (at least 6) will be based on application areas for validation of the DSS each aiming at testing and validating DSS functionality within flood and drought related planning.
    - The application areas will be defined based on the feedback from the stakeholders during the inception meeting, and will cover flood and drought planning issues at a basin and local scale.
    - The project will develop both an idealised methodology for each application area, and a locally-adjusted version based on a practical implementation in the pilot basins. The idealised methodology could be

used as a global template for applying the DSS on a specific flood and drought issue, while the implemented version will serve as a validation of an actual use of the DSS on a specific local context.

- DSS software containing tools for supporting technical activities within flood and drought planning (software delivered)
    - The DSS (containing tools) will be delivered as a piece of software to be used by all GEF basins.
    - The DSS will be validated based on the selected application areas
- Strategic recommendations for inclusion of the information from the DSS in existing planning methods at the basin and local level
- Training and capacity building documentation for stakeholders within the pilot basins, other GEF and non-GEF basins to apply the DSS and integrate information into planning processes
    - Recommendations and lessons learned for applying the planning methodology.
    - Technical specifications and manuals for the consolidated DSS.
    - Documents and presentations for training modules
- Communication strategy, and communication materials to disseminate project outputs and outcomes
    - Documentation of the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders.
    - Materials for global dissemination through IW LEARN
    - Materials for international water events

2.7 Benefits of the proposed planning DSS

The objective is to develop a DSS supporting decision-makers (both managers and technical staff) with technical activities within flood and drought planning. The DSS will contain tools supporting the technical part of the planning process, but also providing planning managers with reports, summaries or other information used in the decision-making process for flood and drought management planning. Therefore, the DSS should support both the technical activities, performed by the technical staff, but also be able to provide valuable information to the management during a decision-making process. Figure 2-4 illustrates how the DSS fits into the process of flood and drought planning.

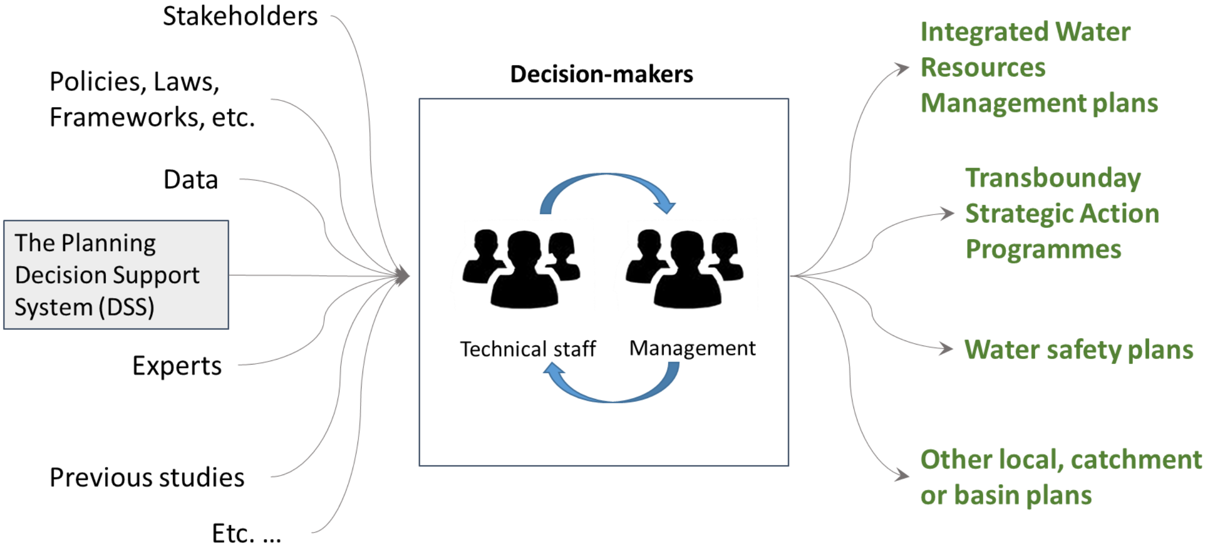


Figure 2-4 Schematic of how the planning DSS fits into Flood and Drought planning

Some of the envisaged benefits of the planning DSS are:

- Facilitating the inclusion of a scientific approach to decision-making for more transparent and scientifically-sound planning decisions
- Facilitating access to technical information for the technical staff working with planning
- Facilitating the use of high-end technical tools for supporting the technical activities within flood and drought planning
- Providing non-technical decision-makers with an informative overview of the planning process, and supporting this with key information
- Offering tools to visualise and communicate information (within organisations, departments and ,if needed, with other stakeholders) to ensure that the highest possible value is extracted from local information
- Offering the opportunity to store and organise data to ensure that valuable information is used in decision-making and stored for future use
- Development of indicators to summarise and disseminate information about basin or system status in a simple and understandable way to facilitate a general understanding of the issues in and status of the basin
- Facilitating the generation of figures and tables for reporting and dissemination activities

3 Findings from stakeholder meetings

This section describes the findings from the stakeholder meetings in the Volta, Lake Victoria and Chao Phraya Basins.

The project started officially in June 2014 and had a 6 month inception phase during which the executing agencies (DHI and IWA) held a series of stakeholder consultations in each basin. These consultations were aimed at gaining an understanding of how the project can improve water planning in the 3 basins, in order to formulate a detailed project description for the inception meeting. The meetings were also an opportunity to determine which stakeholders were interested in actively engaging with the project.

The objectives of these consultations included:

- Key stakeholders understand and endorse the objective of the flood and drought project
- To understand issues the key stakeholders are facing during water planning, focusing on issues related to climate change, floods and droughts
- To understand the methods/processes which the basin organisations and utilities go through during planning, and tools they currently use in planning
- To identify other projects or initiatives that the project can work with that could potentially support the issue of data collection and fill in knowledge gaps of the basin
- To gather feedback on the proposed planning approach for the flood and drought project

3.1 Volta basin

The project held meetings with the following stakeholders in the Volta Basin from August 21th – 29th, 2014:

Organisation	Country	Main Responsibility	Interaction with the Project
Volta Basin Authority (VBA) http://www.abv-volta.org/	Basin organisation	Transboundary watershed management organisation promoting implementation of integrated water resources management	Key stakeholder. Knowledge of WRIS, and leading organisation in the TDA/SAP process.

West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) https://icg4wascal.icg.kfa-juelich.de/	West Africa organisation	Strengthens the research infrastructure and capacity in West Africa related to climate change	Knowledge on climate models and hydraulic models for flood and drought. The project should engage with WASCAL.
Economic Community of West African States (ECOWAS) http://www.wrcu.ecowas.int/	West Africa	WRCC is the technical department within the ECOWAS framework of coordination and monitoring of water resources within West Africa.	Disseminate results and information through ECOWAS as its well connected to the countries.
National Office for Water and Sanitation (ONEA) http://www.oneabf.com/	Burkina Faso	The National Office for Water and Sanitation (ONEA) is the state company responsible for drinking water and sanitation services	Further collaboration on tools for water availability and water budget.
International Union for the Conservation of Nature (IUCN) http://www.iucn.org/fr/propos/union/secretariat/bureaux/paco/	Burkina Faso	Conservation NGO which has worked with VBA on water governances	Keep informed of the project.
Global Water Partnership (GWP) http://www.gwp.org/	West Africa	The Global Water Partnership (GWP) is an international network open to all organisations working for better water security.	Further coordination with GWP-WMO on the Integrated Drought Management programme. Initiate contact to WMO.
National Committee for Emergency Assistance and Rehabilitation (CONASUR)	Burkina Faso	CONASUR is in charge of the implementation of rehabilitation programmes following periods of crisis (including flood and drought).	Providing information on historical floods and related damage.
Ghana Water Company Limited (GW) http://www.gwcl.com.gh/	Ghana	A state-owned limited liability company responsible for planning and development of water supply systems in urban communities	Need further discussions to understand coordination.
National Disaster and Management Organisation (NADMO) http://www.nadmo.gov.gh/	Ghana	Government agency that is responsible for the management of disasters as well as other emergencies	Keep informed of the project.

National Disaster and Management Organisation (CREW project) http://crewghana.wordpress.com/	Ghana	Project aims to build capacities within the country to reduce disaster risk by putting in place an integrated early warning system that is both scientific and people-centred	Might produce relevant information for the project
Hydrological Services Department (HSD) http://www.mwrwh.gov.gh/	Ghana	Responsibility for monitoring all rivers and surface water bodies in Ghana, providing engineering consultancy services in hydrology, water resources, drainage engineering, sewerage engineering, coastal engineering and related fields. Under the Ministry of Water Resources, Works and Housing	Provide real time system and surface water information. Tools for evaluating the impact from Bagre dam.
Water Resource Commission (WRC) http://wrc-gh.org/en/	Ghana	Mandate is to regulate and manage Ghana's Water Resources and co-ordinate government policies in relation to them. Under the Ministry of Water Resources, Works and Housing	Responsible for catchment planning. Need for a follow up visit.
Ghana Irrigation Development Authority (IDA) http://www.gida.gov.gh/	Ghana	Formulate, develop and implement irrigation and drainage plans for all year round agriculture production in Ghana. Under the Ministry of Food and Agriculture	Collaboration on tools for water demand and allocation (AquaCrop or CropWat).
Environmental Protection Agency (EPA) http://www.epa.gov.gh/	Ghana	Agency under the Ministry of Environment, Science Technology and Innovation dedicated to continuously improving and conserving the country's environment.	Follow up visit with the climate and remote sensing group at EPA, to discuss collaboration.

3.1.1 Summary of the findings from the stakeholder meetings

The project will work with the Volta Basin Authority (VBA) at the transboundary level. VBA will act as advisors in defining and specifying functionality of the DSS. Much of the information that will be needed in the decision support system, to be developed by the project, will need to come from national level organisations. In Burkina Faso, the water management authority is the General Directorate of Water Resource (DGRE) and Permanent Secretariat of the Action Plan for Integrated Water Resource Management (SP-PAGIRE), the water basins agencies of Nakanbé (AEN) and Mouhoun (AEM). In

Ghana, the responsible organisation is the Water Resource Commission. The project will also engage with the other four countries in the Volta Basin through the VBA.

Although the Volta basin contains six countries, the project will concentrate on Burkina Faso and Ghana. This is mainly due to the limited resources of the project, and the fact that these two countries occupy around 85% of the basin. The remaining countries will indirectly be included through VBA and ECOWAS in their coordinating role in the basin. In addition, the project will hold annual meetings in the basin which will invite the participation of the member states and relevant stakeholders (each with 1 representative) for a 2-3 day workshop. The workshop will focus on the progress and implementation of the DSS. For example, in 2015, the project aims to hold an awareness workshop for decision makers that will explain and demonstrate the importance of a DSS and the data being used for analysis, and the relevance of this project to managing floods and droughts.

At the country level, other key agencies that the project will engage with, to gather information and develop capacity (which means taking part in relevant training sessions and workshops during the project) will include the Hydrological Services Department (Ghana) and the Environmental Protection Agency (Ghana). There will also be exchange of information with the National Disaster agencies in the basin countries, especially to gather historical data of floods and understand how the DSS can contribute to improve long-term planning to prepare for flood and drought events.

The project also will test the DSS with end users. The focus will be on urban areas, which in the Volta Basin, are predominantly in Ghana and Burkina Faso. The utilities in Ghana and Burkina Faso are the Ghana Water Company Ltd and the National Office for Water and Sanitation (ONEA), respectively. Other possible end users include the Ghana Irrigation Development Authority, who demonstrated strong interest in the project.

At the regional level, the project will work closely with ECOWAS for dissemination and collection of information as ECOWAS is well connected with the relevant countries. There is the potential opportunity for the DSS to be applied in other basins in the region.

There is a great need for improved communication between various institutions (across borders as well), in particular with the sharing of data. Data in itself is also lacking, and what data is available should be viewed with reservation, as this is not often reliable or validated.

There is the opportunity for the project to support the integration of information from different organisations and work with the various stakeholders to improve their capacity to plan better for flood and drought events at their respective levels. The project also provides a unique opportunity to ensure collaboration and knowledge sharing between institutions and across scales (catchment to water utility).

3.1.2 Key findings from Volta

The key findings from the Volta basin are:

- VBA is the key stakeholder and responsible for basin planning
- At the regional level ONEA, Ghana Water, AEN and AEM (Burkina Faso), EPA (Ghana), Hydrological Services Department (Ghana) and Ghana Irrigation Development Authority (Ghana) will be relevant for the project
- Water availability and assessment of water budgets is an important issue
- Evaluation of flood impact from reservoir releases are critical for Ghana
- Use of remote sensing data to be applied as few data are available
- Data availability and sharing between the countries are critical

3.2 Lake Victoria basin

The project had consultations with the following stakeholders in the Lake Victoria Basin from September 15th to 19th, 2014.

Organisation	Country	Main responsibility	Interaction with the Project
Lake Victoria Basin Commission (LVBC) www.lvbcom.org/	Basin organisation	Coordinates the various interventions on the Lake and its Basin; and serving as a centre for promotion of investments and information sharing among the various stakeholders.	Key stakeholder. WRIS knowledge, but currently no models or DSS.
Nile Basin Initiative (NBI) www.nilebasin.org	Basin organisation	A regional intergovernmental partnership that seeks to develop the River Nile in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security	Extensive knowledge of DSS will be included as a learning basin.
Directorate of Water Resources Management, Ministry of Water and Environment, Uganda http://www.mwe.go.ug	Uganda	Set national policies and standards, managing and regulating water resources and determining priorities for water development and management	To be kept informed
National Environment Management Authority, Kenya www.nema.go.ke	Kenya	A government parastatal established to regulate environment issues.	Responsible for environmental regulation

Lake Victoria Basin Water Board http://www.maji.go.tz/basins/nine.php	Tanzania (Basin organisation)	There are 9 water basins for the purposes of water resources administration and management.	Follow up meeting required
Mwanza Urban Water Supply & Sanitation Authority http://www.mwauwasa.org/	Tanzania	Autonomous - government owned-operating authority providing reliable and safe drinking water to Mwanza City, and disposal of wastewater.	Planning experience, mainly focusing on the inlet location.
National Water & Sewerage Corporation http://www.nwsc.co.ug/	Uganda	A public utility company 100% owned by the Government of Uganda, providing water and sanitation services in urban areas.	The project will collaborate with the office in Jinja. Specific requests for flood and drought support. Interested in WRIS and identification of hot spots. Mainly WQ focus.
Ministry of Water, Tanzania http://maji.go.tz/	Tanzania	Ministry responsible for sustainable management and development of water resources for social and economic development in Tanzania	To be kept informed
WHO www.who.int	Tanzania	Related to the project – Developing guidance on Climate-resilience water safety planning	To be kept informed
Water Resource Management Authority http://www.wrma.or.ke/	Kenya	The Water Resource Management Authority (WRMA) is a state corporation leading on water resources management. It has regional offices based on drainage basins (catchment areas), and Water Resource User Associations (WRUAs) at the local level.	To be kept informed
Kisumu Water and Sewerage Company Limited http://www.kiwasco.co.ke/	Kenya	KIWASCO is a subsidiary company of the Municipal Council of Kisumu with the objective of providing water and sewerage services which generates sufficient revenue to sustain operations.	Operator and does not perform planning. Need to coordinate with NEMA

Water Action Group	Kenya	WAG is a community based entity; affording the consumers a voice on matters pertaining to water access, quality/safety, affordability etc.	To be kept informed
Lake Victoria Water Services Board http://www.lvswaterboard.go.ke/	Kenya	Lake Victoria South Water Services Board is a State Corporation which provides water and sanitation services in their area of jurisdiction.	Need follow up meeting

3.2.1 Summary of the findings from the stakeholder meetings in Lake Victoria

The project will work with the Lake Victoria Basin Commission (LVBC) at the transboundary level. LVBC will act as advisors in defining and specifying functionality of the DSS. However, close collaboration with Nile Basin Initiative (NBI), at the basin level, and the catchment organisation at the country level is needed as many of the planning events need collaboration at both basin and catchment scale (with some input from the NBI who have valuable experience and insight into the process of developing a DSS for the Nile River Basin). However, much of the information that will be needed in the DSS to be developed by the project will need to come from national level organisations. The project will also work with LVBC to disseminate information to their member countries within the basin, as this institution is the relevant connection between the countries.

Although the Lake Victoria basin spans over five countries, the project will concentrate on Kenya, Uganda and Tanzania. This is mainly due to the limited resources in the project, and the fact that these three countries make up roughly 80% of the catchment area. The remaining countries – Rwanda and Burundi which collectively contribute to about 33% of the inflow to Lake Victoria – will indirectly be included through LVBC as they hold a coordinating role across basin countries. In addition, the project will hold annual meetings in the basin which will invite the participation of the member states and relevant stakeholders (each with 1 representative) for a 2-3 day workshop. The workshop will focus on the progress and implementation of the DSS. For example, in 2015, the project aims to hold an awareness workshop for decision makers that will explain and demonstrate the importance of a DSS and the data being used for analysis, and the relevance of this project to managing floods and droughts.

At the country level, the project will engage with a variety of water resources management agencies to gather information and develop capacity, which means taking part in relevant training sessions and workshops during the project. In Kenya, this includes the Water Resource Management Authority, specifically the Lake Victoria South Regional office; the National Environment Management Authority. In Tanzania, agencies that the project will engage with include the Lake Victoria Basin Water Board and potentially the National Environment Management Committee. In Uganda, agencies include the Directorate of Water Resources Management, Ministry of Water and Environment, and potentially the National Environment Management Authority. These agencies can provide the project with relevant historical data on floods and drought events, which can help develop an understanding of how the DSS can contribute to improved long term planning to prepare for floods and droughts.

The project will also test the DSS with a main water utility end-user and will engage with water utilities in the basin in knowledge sharing. The utilities in Kenya, Uganda and Tanzania are Kisumu Water and Sewerage Company (KIWASCO), National Water and Sewerage Corporation (NWSC) and Mwanza Urban Water Supply & Sanitation Authority (MWAUWASA) respectively. The Water Services Boards in Kenya are responsible for management of water supply and sanitation across a region, thus the Lake Victoria Services Boards (North and South) will be consulted. The Water Action Group (Kisumu) also expressed interest in the project and can provide a link to local consumers.

There are regional areas within the basin with flood and drought events, but these are mainly local issues. One of the key issues is water quality, where especially the spread of water hyacinth and continued pollution of the water is of concern to the water utilities.

There is a great need for improved communication between various institutions (across borders as well), in particular with the sharing of data and access to data. Data in itself is also lacking, and what data is available should be viewed with reservation, as this is not often reliable or validated.

There is the opportunity for the project to support the technical integration of information from different organisations, and work with the various stakeholders to improve on their capacity to plan better for flood and drought events at their respective levels. However, the degree of information sharing depends wholly on the willingness of stakeholders and the project can only provide the technical tools to facilitate it. The project also provides a unique opportunity to ensure collaboration and knowledge sharing between institutions and across scales (catchment to water utility).

3.2.2 Key findings from Lake Victoria

The key findings from Lake Victoria are:

- LVBC is the key stakeholder
- NBI will be attached to the project as a learning basin
- At basin level there is a need for a usable DSS with an intuitive work flow
- The water utilities at Kisumu, Jinja and Mwanza will be included in the project, and efforts will be made to develop functionality supporting the ongoing WSP work.

- Water quality is a key issue in Lake Victoria, but will not be addressed in detail in the project
- Strong interest in getting the WRIS system implemented within the planned DSS
- Request for improved usability in the DSS (experience from NBI DSS is that it is not used in the countries)
- GIS functionality and data integration is a key requirement from many local stakeholders
- Planning at basin and catchments level need to be coordinated
- Utilisation of the existing models could be the foundation for planning

3.3 Chao Phraya basin (Thailand)

The project had consultations with the following stakeholders in the Chao Phraya Basin from October 6-10th, 2014:

Organisation	Main responsibility	Interaction with the project
Hydro and Agro Informatics Institute (HAII) http://www.haii.or.th/	Advisor for agricultural and water resources management	Basin representative (key stakeholder). Strong knowledge of DSS and modelling
Royal Irrigation department (RID) www.rid.go.th/eng/	Irrigation planning and management within Thailand	Knowledge of models, real time systems and planning. Strong stakeholder in Chao Phraya
Electricity Generating Authority Thailand (EGAT) www.egat.co.th/en/	Hydropower generation and water allocation from the main reservoirs	Responsible for reservoir releases. Dry and wet season planning. Potential end user for the project.
Thailand Water Resources Association http://www.dwr.go.th/twra/main.htm	Local NGO promoting river basin organisations	To be kept informed
Department of Water Resources (DWR) www.dwr.go.th/	Responsible for basin commissions, as well as surface water resource	To be kept informed.
K water http://english.kwater.or.kr/	Korean consultancy company involved in water projects in Thailand	No ongoing projects. To be kept informed.
Metropolitan Waterworks Authority (MWA) http://www.mwa.co.th/ewtadmin/ewt/mwa_internet_eng/main.php?filename=index	Water supply for Bangkok	Utility end-user with strong technical capabilities.
Geo-informatics and space technology development Agency (GISTDA)	Data supplier to Thai government institutions for remote sensing data	Remote sensing provider.

http://www.gistda.or.th/gistda_n/en/		
Asian Disaster Preparedness Centre (ADPC) http://www.adpc.net/igo/	Non-government consultancy and research institute	Climate modelling and some knowledge of hydraulic models.
Thai Metrological Department (TMD) http://www.tmd.go.th/en/	Meteorological data, forecast and climate projections	Climate data provider. Climate modelling capabilities.
Stockholm Environmental Institute (SEI) http://www.sei-international.org	Non-government consultancy and research institute	WEAP developer. The project will look at weAdapt.
CWEIR, King Mongkut's university of Technology	Academic Institute with expertise on DSS development and knowledge of models	DSS development and knowledge of models. Close collaboration with RID.
International Union for Conservation of Nature http://www.iucn.org/about/union/secretariat/offices/asia/asia_where_work/thailand/	Work with government and local stakeholders	Contact with local stakeholders. To be kept informed.
Provincial Water Authority http://en.pwa.co.th/	Water supply for provinces outside of Bangkok	Utility end-user. Follow up needed.

3.3.1 Summary of the findings from the stakeholder meetings

The Chao Phraya basin is the largest in Thailand and has both flood and drought issues. The main reservoirs in the basin are the Bhumiphol and Sirikit dam (control approximately 22% of the flow). The Yom and Wang tributary rivers are unregulated. At the basin level, floods and droughts are the main issues. Drought planning is critical for water allocation between hydropower generation and irrigation, where surface water and the water storage within reservoirs are the main water source. Flooding is also of high concern, however there are numerous projects addressing floods in the basin. Long-term planning is being undertaken through the development of a new Water Master Plan for water management in all 25 basins in Thailand which addresses floods, droughts and water quality. The development of the master plan is being conducted through 5 working groups.

- Working group 1 – North and Central Thailand (led by RID)
- Working group 2 – North East and Southern Thailand (led by the Department of Water Resources - DWR)
- Working group 3 – Information management (led by HAII)
- Working group 4 – Policy and regulation (Led by National Economic and Social Development Board)
- Working group 5 – Public Relations (Public Relations Department)

The master plan is taking climate change into account.

Basin committees do exist in each of the 25 basins, however they have very little capacity and institutional structure. The Department of Water Resource is responsible for the 25 committees.

The project will focus on the Chao Phraya Basin, but will consider the inclusion of Bang Pakong basin on the recommendation of RID. The Bang Pakong basin has industrial areas affected by flooding, and upstream areas affected by drought. Salinity is also a main issue in this basin. One of the key concerns in including this basin is the lack of available data as few studies have been conducted focusing on this basin.

The climate in Chao Phraya is divided clearly into a wet and dry season. Wet and dry season planning is conducted in regular meetings between the key governmental institutions. The meetings address the flood and drought situation, early warnings and, in particular, possible control decisions. RID is chairing the meetings for dry season planning and HAII the meetings for wet season planning.

The project will work with the Hydro and Agro Informatics Institute (HAII) at the basin level. HAII is the lead organisation for the Water Data Centre, and has extensive experience with DSS, modelling and real time systems. They also have a key role in data integration in Thailand, which is part of what the DSS will aim to achieve.

RID is a key stakeholder in the Chao Phraya basin, and is responsible for the irrigation planning, and planning the dry season water allocation together with the Electricity Generating Authority of Thailand (EGAT). RID has recently completed a project with JICA on the development of a real-time flood forecasting system for Chao Phraya.

EGAT is responsible for energy production in Thailand including hydropower generation. They undertake wet and dry season planning with respect to water allocation from the main reservoirs. This planning is carried out in consultation with wet and dry season planning committees. EGAT has strong technical capabilities with respect to modelling (MIKE 11 and NAM), and could potentially be one of the end users for the flood and drought DSS.

It should be noted that each of the organisations involved in water management in the Chao Phraya have a network to collect information, so there is considerable replication in the system. While data is available, access to information and identifying the best quality data will be a big challenge.

The project will also test the DSS with end users focusing on water utilities, namely Metropolitan Water Authority (MWA) and the Provincial Water Authority (PWA). MWA is responsible for water services in Bangkok, Nonthaburi Province, and Samut Prakan Province. MWA provides water supply using two raw water resources: the Chao Phraya River and the Mae Klong River. PWA is responsible for the production of clean water supplies in 74 provinces throughout Thailand (except Bangkok, Samut Prakan and Nonthaburi). PWA has a total of 233 water utilities scattered throughout the country. Both utilities have started implementing water safety planning. More detailed follow up is needed to determine the level of engagement with each of the utilities depending on information need and interest.

Other government stakeholders that have been informed of the project and will be involved depending on their interest. These include DWR, the Thai Meteorological Department (TMD), and the Geo-informatics and space technology development Agency (GISTDA). DWR is specifically responsible for management of water outside of the irrigated areas and generally do not operate large infrastructure. TMD runs regular projects on climate scenarios and undertakes seasonal forecasting. GISTDA has remote sensing data collected via satellites and is interested in integrating hydrological information to provide better information for water management.

Additional stakeholders that the project will aim to actively collaborate with include the Stockholm Environmental Institute (SEI) and the Asian Disaster Preparedness Centre (ADPC). SEI is the developer of the Water Evaluation and Planning System (WEAP) which could potentially be a tool within the DSS (http://www.weap21.org/). ADPC has several projects on climate risk management and has worked on climate forecasting, as such, there is potential scope for use of the DSS information in their activities. In addition, they carry out training courses so collaboration in capacity building activities can be explored.

There is a great need for improved communication between various institutions, in particular with the sharing of data. The project provides the opportunity for integration of information from different organisations and work with the various stakeholders to improve on their capacity to plan better for flood and drought events at their respective levels. The project also provides a unique opportunity to ensure collaboration and knowledge sharing between institutions and across scales (catchment to water utility).

3.3.2 Key findings from Chao Phraya

The key findings from Chao Phraya are:

- HAII is the key stakeholder in the Chao Phraya basin
- Royal irrigation Department (RID) and Electricity Generating Authority Thailand (EGAT) are stakeholders the project will work closely with on the basin scale while MWA and PWA will be engaged in the project in relation to defining functionality supporting the WSP and climate resilience.
- Drought management is a key issue in Chao Phraya
- Water allocation from reservoirs are the key to drought management
- Long-term planning using climate and land use changes could be important areas for the project
- Data are available although there are sharing issues

3.4 Other stakeholder consultations

The project team had consultations with other stakeholders than the ones in the three basins during the inception phase. This includes Danube basin and Nile basin as the learning basins, and Global Water Partnership (GWP), and International Association of Water Supply Companies in the Danube River Catchment Area (IAWD) as stakeholders of interest for the project.

3.4.1 Danube basin

The Danube basin is identified within the project document as a learning basin in the project, where the intention is that the project should utilise the experience and knowledge that the basin has with planning, and at the same time use the basin actively in the project execution.

The project team had a meeting with the secretariat from International Commission for Protection of Danube River (ICPDR) in Vienna in September 2014. The main outcome of the meeting was:

- The project team will be able to learn from ICPDR by getting access to all published plans and information
- The Danube basin contains 14 countries, covers a huge area and includes a number of complex issues, and the project will not be able to focus on the whole basin
- ICPDR proposed to look at a smaller part of the Danube basin, e.g. the Tisza basin, for evaluation and implementation of the proposed DSS. The project has been in contact with the Tisza basin, and as they are just starting the local basin committee they are not able to work with the project at the current stage.

To further present and introduce the project within the Danube basin the project team presented the project at the 40th Danube River Bain Management expert group meeting in Munich during 31st of October 2014. The result was contacts with the Tisza basin group, and with the flood management group within ICPDR.

3.4.2 Nile Basin Initiative

Nile Basin Initiative (NBI) has considerable experience with DSS, and the project has a strong interest in actively collaborating with NBI to utilise their experience in water resource planning and investment decisions. The project team has a consultation with NBI, in Entebbe during September 2014, and NBI is invited to the inception meeting in November 2014 and Steering Committee meeting in March 2015 to further discuss the collaboration between NBI and the project.

NBI have also suggested the organisation of awareness workshops as these provide the project with a good opportunity to inform stakeholders, in particular decision-makers, on the application and value of the DSS. The project intends to utilise the experience from NBI on organising and disseminating the outcome of awareness workshops focusing on how to use technical tools in planning.

3.4.3 GWP and WMO

The project team had consultation with the Global Water Partnership (GWP) at their regional office in Burkina Faso as part of the stakeholder consultations in the Volta basin. One of the outcomes from the consultation was a direct contact with the programmes manager of the Integrated Drought Management Programme (IDMP) from World Meteorological Organisation (WMO). The project team had a meeting with WMO during Stockholm Water Week, and later a Skype call in October 2014. The main outcomes from the meetings were as follows:

- Aim for collaboration on a demonstration project in Burkina Faso. IDMP will provide key finding from their inception meeting for the West Africa programme during taking place during the first quarter of 2015.The project will discuss this further with GWP at a meeting in Ouagadougou during February 2015.
- Aim for collaboration on drought management. This will be further discussed during a meeting in Sri Lanka during January 2015.

- Exchange of knowledge and information between the IDMP and the project during the coming years.

3.4.4 IAWD

The International Association of Waterworks in the Danube Catchment Area (IAWD) is concerned with improving and safeguarding the water quality of the Danube and its tributaries. IAWD encourages all measures and attempts directed at avoiding and eliminating all contamination of, and hazards to, the raw water quality in order to ensure reliable drinking water supply.

IAWD have expressed their interest in the project, and are keen on collaborating at future events, share their experiences and knowledge and learn from the knowledge and experience gained in the project.

There is an array of knowledge and experience that the project can draw from IAWD in order to address end user (i.e. utilities) needs at both the local and regional level, in particular with water quality as this element will be addressed to a certain extent, but will not be a focus within the F&DMT project. As an association, IAWD has an established wealth of contacts in the Danube region, which can prove of great value as the project develops. Their awareness of the need to increase cooperation across national borders to protect water resources is in line with the transboundary context of the project. The establishment of IAWD was a reaction to the increasing need for co-operation across national borders to protect water resources. Much of the work they partake in; i.e. developing a unified, internationally agreed monitoring and analysis programme on water quality, establishing financial platforms to support a number of subprojects to enhance the efficiency of water utilities and their capacity to supply water of WHO standards and their continuous exchange of experience for public benefit, are certainly elements of great value to the project.

Furthermore, there is room for collaboration and knowledge exchange with regards to capacity development. IAWD's commitment to the "Danube Region Water Supply and Wastewater Sector Capacity Building Program" is a point of entry in terms of dissemination of training material developed in the project, not to mention the input that can be provided in their own trainings at the local level, but also the regional level.

3.5 Compiled findings for implementation in the project

The stakeholder meetings in Volta, Lake Victoria and Chao Phraya took place during the period 20 August to 11 October 2014, and a total of 40 stakeholder consultations where done during this period.

The consultations showed that planning is performed in all the 3 basins, but the issues, information, scales, procedures and collaboration between organisations differ significantly between the visited basins and also between stakeholders within a given basin.

In the Chao Phraya basin, there has been much focus on flood management and forecasting since the flood event in 2011. This initiated a number of projects focusing on improving the quality of flood warning, and the procedures for water allocation (reservoir operation) during the wet season. Dry season planning has not received the same amount of attention, as floods in Thailand, and is an area where the project could collaborate with relevant organisations, in order to improve the management or planning of water allocation. The key institutes in Thailand will be Hydro and Agro Informatics Institute (HAII), Royal Irrigation Department (RID) and Electricity Generating Authority Thailand (EGAT). HAII will be the key stakeholder due to their role as a lead institute in the Water Data Centre, and due to their technical capabilities and knowledge of DSS and models. Royal Irrigation Department, is the key organisation with respect to water allocation during the dry season, and are very interested in working together with the project in order to develop and test new methodologies for dry season planning. Electricity Generating Authority Thailand (EGAT) is responsible for the hydropower generation, and the releases from the large reservoirs. They currently do planning, and water allocation for irrigation and hydropower is already a key concern in the planning process. This, combined with the fact that they have operational models in place, makes EGAT a likely end-user for the project. The project will also test the DSS with a main water utility end-user and will engage with water utilities in the basin in knowledge sharing. The utilities operating in Chao Phraya are Metropolitan Water Authority (MWA) and the Provincial Water Authority (PWA).

The Volta basin is a transboundary basin but the project will mainly focus on Burkina Faso and Ghana. The issues in Burkina Faso and Ghana differ. The eastern part of Burkina Faso mainly suffers from drought issues and has a need for an overview of the available water resource. The western part of Burkina Faso and most of Ghana are affected by releases and conditions in the large reservoirs. The project will work with the National Office for Water and Sanitation (ONEA) on getting a better overview of the water resources and producing reliable water budgets, especially for the dry season planning. For the lower part of the basin, the main focus will be on floods, especially in connection with releases from the large reservoirs (Bagre dam). Special attention will be given to the irrigation side, where estimation of crop water demand will be valuable to have for dry season planning. The key stakeholder will be Volta Basin Authority (VBA), as they operate at the basin level, and is the main organisation dealing with transboundary issues. In Ghana the project will work together with Environmental Protection Agency (EPA), Ghana Irrigation Development Authority (IDA) and Hydrological Services Department (HSD). Collaboration with Ghana Water Company Limited will be further developed during a follow up visit.

The Lake Victoria basin is also a transboundary basin, where the lake plays a key role with respect to water availability and hydropower generation. The main issues in the Lake Victoria basin are related to water quality in the lake, where the main sources are non-point pollution in the basin. In parts of the basin, flood and drought events are severe, but are mainly related to catchment planning. The project will work with the Lake Victoria Basin Commission (LVBC) as the key stakeholder, while the Nile Basin Initiative (NBI) will have an important role as a learning basin. The project will also test the DSS with a main water utility end-user and will engage with water utilities in the basin in knowledge sharing. The utilities in Kenya, Uganda and Tanzania are Kisumu Water and Sewerage Company (KIWASCO), National Water and Sewerage Corporation (NWSC) and Mwanza Urban Water Supply & Sanitation Authority (MWAUWASA) respectively.

3.5.1 Key findings in relation to the implementation in the project

The stakeholder meetings in the 3 pilot basins, and the learning basins (Danube and Nile Basin), have yielded very valuable results. Based on the feedback from the meetings, the project will have the following prioritised focus areas:

1. Usability – the variation in technical level, issues, data, etc., is so great, that the DSS needs to be able to adapt to the local workflows and methods. Usability is one of the key focus areas in the project.
2. Flexibility – The Flood & Drought Management Tools project will not be able to deliver a complete planning system embracing all the issues and requirements. It will be required that the final DSS is flexible and it should be possible to add methods, tools, models, etc. after the closure of the project.
3. Key tools – The Flood & Drought Management Tools project will focus on development of a few key tools, implementation of a number of existing tools, and a simple implementation of a number of other tools.

The key findings from the stakeholder meetings in the 3 basins are briefly described in the following sections.

Planning is diverse

The main objective with the project is to develop tools to support planning at a transboundary and local level. Planning is performed by many different organisations at different scales to solve different issues. The process is formalised by the use of some of the existing planning methods, such as IWRM, TDA/SAP or WSP, but in many cases, planning is also done outside of these formalised processes.

Tools or DSS to support planning need to facilitate the wide range of users and need to be able to incorporate local requirements, and methods. It is not possible to make a fixed methodology, which includes all planning activities on a global scale; therefore, the project will focus on some selected planning activities or applications.

Usability is a key issue

A key indicator for the success of the project is how the final deliverables are used; therefore, usability is one of the key concerns. This requires close collaboration between the project team and the stakeholders during the project components, where the methodologies are developed and consolidated, and during the validation and application of the DSS.

The 3 pilot basins and the learning basins cover a variety of issues, locations and stakeholders, but one of the main outcomes from the stakeholder meetings is that usability is a key issue, and usability is of higher concern than specific technical tools.

Data or information availability is a common issue

Availability of information or data is a common problem in all the pilot basins. In some areas where information is available, sharing of the information is problematic. These issues are outside the scope of this project, as the project will not be able to collect new information, but it is an important boundary condition when defining the methodologies. One possible solution will be to focus on global data and the use of remote sensing data; these are data sources that, to some extent, are freely available.

Collaboration between organisations or stakeholders is important

Collaboration between organisations and stakeholders are very important during any planning event. The experience from the 3 pilot basins is that many of the decisions are done during meetings or consultations. The Flood and Drought Management tool project needs to emphasise the consultation process within planning, and address this in the final deliverables. This could be through implementation of tools or methods for facilitating meetings or consultations. Examples of this could be implementation of the Delphi method, e-mail and document libraries, blogs, etc.

Flood and drought issues are relevant in a planning context

Flood and drought are the key issues when dealing with short-, medium- or long-term planning. Issues related to flood and drought affects many parts of society through hydrological issues, agriculture, industry and socio-economic issues. The project will mainly focus on the impacts related to water resources, agriculture, and industrial, while the socio-economic impacts will be addressed through the use of indicators.

Key technical tools

The project will develop specific tools related to the specific issues the project has encountered in the 3 pilot basins, but the main emphasis will be on usability and flexibility compared to development of a pure toolbox.

4 The overall planning approach

The overall aim of the project is to design a technical Decision Support System (DSS) based on a general planning methodology which links to planning methods in TDA/SAP, IWRM plans and Water Safety Plan (WSP) processes. In order to integrate the different planning methods in one system a general approach, which encompasses the existing planning methods, has been adopted.

4.1 Existing planning methods within water management

The structure of IWRM, TDA/SAP and WSP planning processes are briefly presented in the following sections.

4.1.1 Integrated Water Resources Management (IWRM)

Integrated water resources management (IWRM) has been defined by the Global Water Partnership (GWP) as "a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".

IWRM rests upon 3 principles that together act as the overall framework:

- Social equity
- Economic efficiency
- Ecological sustainability

IWRM plans generally work at the basin scale. IWRM is a holistic, integrative, participatory and systematic approach compared to the traditional technocratic, supply-oriented, top-down approach. Hence, the IWRM process should be seen as a transition from traditional water management to a demand-oriented, multi-sectoral approach to integrated water resources management. Since the World Summit on Sustainable Development in Johannesburg 2002, national water policy is supposed to be mainstreamed into IWRM action plans.

In summary the IWRM planning process consists of a status analysis, the derivation of an Action Plan, its implementation on the highest political level with full stakeholder acceptance, and monitoring and evaluation of the progress; see Figure 4-1 for schematic view of an IWRM process.

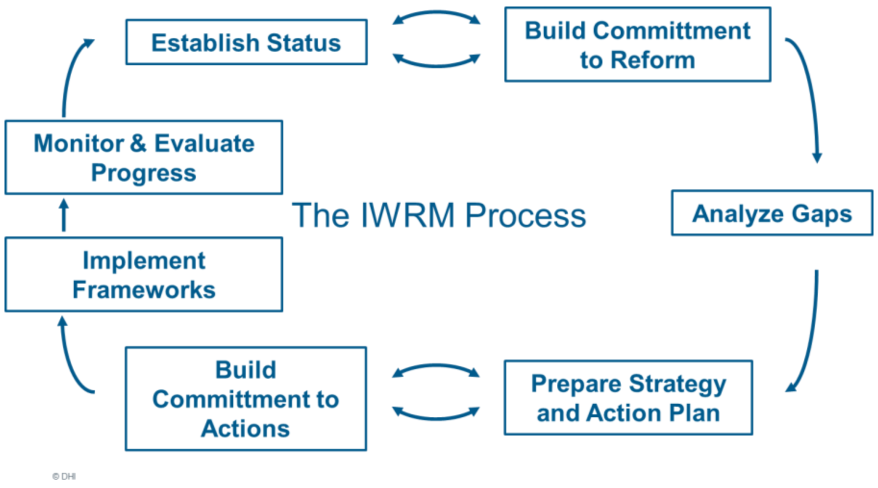


Figure 4-1 The IWRM planning process

The main output of IWRM is a portfolio of actions (action sheets) which are supposed to be adopted by the relevant authorities and stakeholders. Status reports and information systems are other outputs as well as the definition and description of monitoring indicators. Furthermore, capacity building, promoting stakeholder cooperation and creating or supporting key institutions represent other outputs of the IWRM process.

4.1.2 Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP)

The Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) procedure has been implemented by GEF since 1996. The objective is to enable countries to collectively manage their transboundary water basins. TDA/SAP is used in transboundary basins and in both river basins and large marine ecosystems.

The TDA and the first part of the SAP is an analytical and technical process, where the last part of the SAP is mainly a political process. A schematic representation of the TDA/SAP workflow is presented in Figure 4-2.The TDA refers to an analysis stage and the SAP is a planning phase. There is also an implementation phase referred to as 'Project investments'. There is however no specific name for the monitoring and evaluation phase in the workflow.

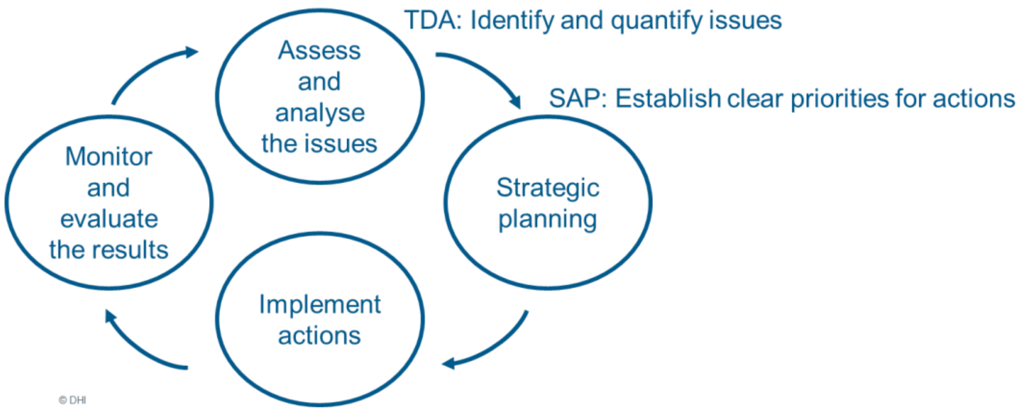


Figure 4-2 TDA/SAP planning process

The TDA provides an analysis of the state of the basin's environment as well as the root causes for its degradation using the best available verified scientific information.

The TDA is a pure analytical component that identifies and analyses the transboundary problems, their impacts and causes. A solution for the problems is not specified in this process. The main objectives of the TDA are as follows:

- Identify and prioritise transboundary problems
- Gather and analyse information
- Analyse root causes for each problem

The SAP is a negotiated policy document that should be endorsed at the highest level of all relevant sectors. It establishes clear priorities for actions to resolve priority problems identified in the TDA. The main objectives of the SAP are as follows:

- Clear priority for actions
- Linkage with the issues identified in the TDA
- Collaborative process involving the countries within the basin

The main output of the TDA/SAP process is an action plan that links issues with actions, priorities and implementation.

4.1.3 Water Safety Planning (WSP)

Water Safety Planning (WSP) is recommended in the WHO drinking water guidelines as a “risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer”. WSP is done by water utilities, and the main objective of WSP is to consistently ensure the safety and acceptability of drinking water supply. WSP are mainly focusing on the water quality and the hazards connected to it.

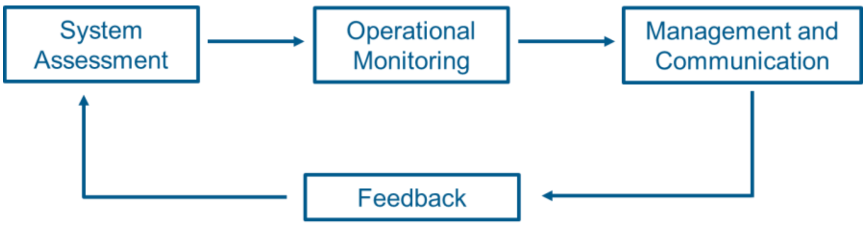


Figure 4-3 WSP planning process

The WSP approach should be seen as a risk assessment and management tool in order to guarantee safe drinking water supply. The main aspects of the approach are:

- describing the water supply system
- identifying hazards and risks
- determining effective control measures
- establishing management and communication programs
- monitoring the WSP, and revise it if necessary

A WSP is a method that should ensure that procedures within the water utility are controlled in such a way that hazards are excluded or controlled to ensure a safe drinking water supply from the catchment to the consumer.

4.2 The adopted 4-stage planning approach

The 3 planning methods of WSP, IWRM and TDA/SAP were analysed and used to develop a general 4-stage planning approach for the project. Activities within the IWRM, TDA/SAP and WSP methods were mapped and analysed. Similarities and overlaps in the content of the 3 specific planning methods were evaluated and grouped into the 4 overall planning components: Analysis, Planning, Implementation and Monitoring.

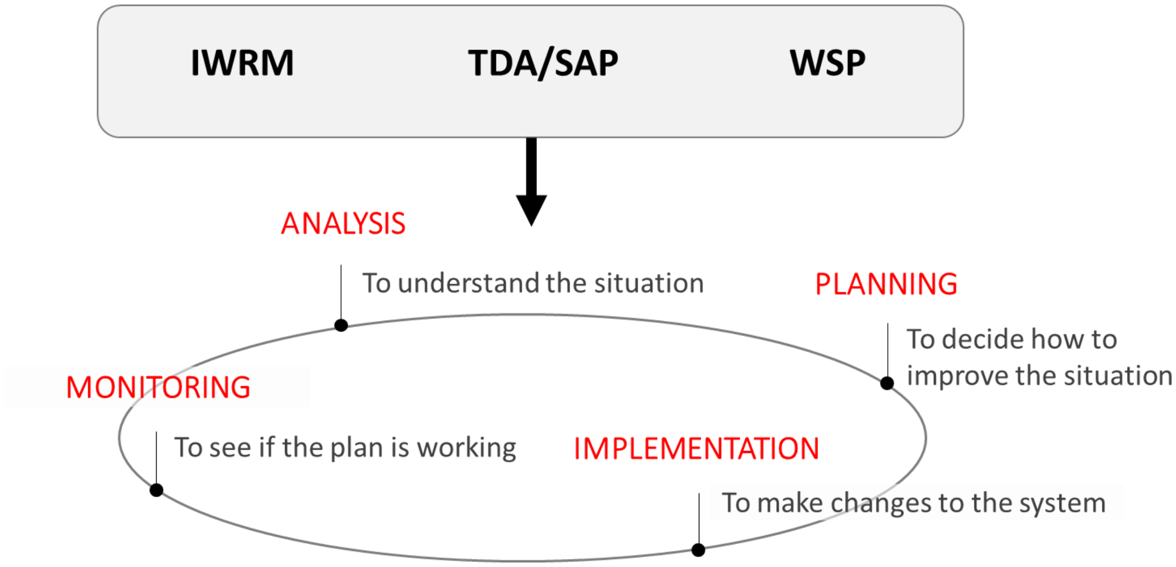


Figure 4-4 Overall planning methodology/approach developed from analysis of IWRM, TDA/SAP and WSP planning cycles

1. Analysis	2. Planning	3. Implementation	4. Monitoring
Identify priority water issues and their causes to focus efforts in improving the situation	Make a targeted plan to address priority issues under current and future conditions	Carry out activities identified in plan to achieve an improved situation	Monitor changes to evaluate whether plan remains valid or if new issues are arising
• Data collection • Mapping the system • Data analysis • Identify priority problems • Cause and effect analysis • Sensitivity analysis • Status report • ...	• Define vision and objectives • List of potential ideas • List of alternative plans • Evaluation of plans • Selection of a plan • Monitoring/evaluation plan • An implementation plan • ...	• Funding • Coordination of people • Budget management • Implementation of monitoring plan • ...	• Collection of monitoring information • Evaluation of changes to the system • Identification of effectiveness of plan • ...

Figure 4-5 Objective and Activities/Outputs associated with the four planning stages.

4.2.1 Analysis stage

The objective of this stage is to identify the issues / challenges and their underlying causes.

Potential activities which would be undertaken in this stage include:

- **Data collection and analysis**, which may include the collection of relevant data or information and analyse this or other information to enable an overview of the area. Analysis could include average maps, indicators, trends in the data, calculation of relevant indicators, etc. From the data analysis, the user should gain an understanding of the area and the main issues in the system.
- **Mapping of the system** - this broadly refers to the collation of information about the basin or water supply network and visualisation of the information to get an overview of the system.
- **Identification of issues** is a critical part of the planning process, and might be done through workshops or other methods. The identified issues will be the target in the planning stage.
- **The causes of the issues** might be identified through an analysis of the cause and effect relationships relating to the identified issues to understand the drivers of problems to understand how to improve the situation.
- **Sensitivity analysis** or identification of leverage points of the system is important to understand the key vulnerabilities of the current system, for example under changes to climate or water demand.
- **Reporting** activities related to the analysis stage are important for dissemination of the findings.

The exact activities, which stakeholders undertake as part of this stage, will depend on the specific application and objectives of the plan.

4.2.2 Planning stage

The objective of this stage is to define and evaluate plans for solving the identified issues.

Potential activities which would be undertaken in this stage include:

- **Definition of visions and objectives**, which is the starting point in the planning stage. Definition of clear success or failure criteria related to the overall vision of the plan. This clear definition of the aims of the plans will allow alternative strategies to be evaluated and compared, looking at their performance against the objectives.
- **Potential ideas**. Once clear aims and measureable objectives have been defined a long list of potential ideas to address them may be put together – this might be through workshops. The potential ideas should cover all possible solutions as ideas should not be excluded at this point.
- **Alternative plans**. The initial ideas must then be developed into a number of concrete viable plans, where each plan defines one possible solution to the identified issues and fulfilling the vision and objectives.

- **Evaluation and selection of plans**. The alternative plans may then be tested and compared. This could be done using a water resources or flood model to simulate the expected effects of the different plans under different climate and water demand scenarios. The performance of the plans must be summarised (probably using indicators) and decision methods used to select a preferred plan for implementation or for further refinement.

- **Monitoring and implementation plan**. Once a preferred plan is agreed upon an implementation plan must be prepared and a plan to monitor and evaluate the impacts of the new plan to enable it to be adjusted where appropriate.

Again, the exact activities that stakeholders undertake, as part of this stage, will depend on the specific application and objectives of the plan.

4.2.3 Implementation stage

The objective of the implementation stage is to implement the selected plan. Some potential main activities in the implementation stage include getting funding, managing people, budgeting and ensuring the monitoring is being undertaken. Many of these activities are standard project management activities rather than specific flood and drought activities and for this reason it is not envisaged that the project will focus on this stage but will provide tools that can facilitate implementation of selected plans.

4.2.4 Monitoring stage

The objective of the monitoring stage is to evaluate the effectiveness of the implemented plan, and decide whether it should be revised. Some potential key activities in the monitoring stage include collecting the monitoring information and using it to calculate relevant indicators to describe the status of the basin and to compare against objectives of the plan. It may also contain activities to investigate the reasons for success of failure of the plan to allow a re-analysis of the problem and alterations to the plan to improve performance.

5 Design of methodologies for specific flood and drought applications

The project aim has been divided into 3 key strategy areas as described in Section 2. In this section the first key strategy area is discussed:

1. **Based on the adopted planning approach, to design and validate of specific methodologies (at least 6) to address a variety of flood and drought applications at basin and local scale.**

The first key strategy area is outlined in Figure 5-1 and discussed in more detail in section 2.

Design specific methodologies (at least 6)	Develop a DSS containing tools	Involve stakeholders
• At least one methodology **addressing TDA/SAP** • At least one **addressing WSP** • Covering **basin** and **local** scale • Focus on **flood and drought** planning • Covering **short**- and **long-term** planning • An emphasis on **technical tools** to support the planning process	• **Linkage** to planning activities within TDA/SAP, IWRM and WSP • Support **key processes** in flood and drought planning • Focus on **flexibility** and **usability** • Based on a **freely available open platform**	• Working with **basin organizations, water utilities** and **other interested** parties • **Consultation** for our awareness and understanding • **Consolidation of the planning methodology** with stakeholders • **Validation and testing** of the DSS on potential application areas • **Training and capacity building** activities

Figure 5-1 Summary of project strategy areas for the design of the planning methodologies

The project has adopted an overall planning approach (4 stages), described in section 4.2, which provides the linkage with the existing planning methods (IWRM, TDA/SAP and WSP). The DSS will be based on the adopted planning approach, but the functionality will be designed and validated against specific flood and drought applications.

The exact applications are not yet defined and will be defined based on application areas for validation of the DSS which will be identified with stakeholders. The start of the process to identify the application areas will be undertaken in meetings in connection with the inception meeting, where a number of application areas will be identified. The project will select 6-8 application areas covering flood and drought planning issues at the basin and local scale. For each a detailed step-by-step description of the application will be made, this will be referred to as a methodology, and will be used to test and validate the DSS on specific applications. The methodologies will be a specific step-by-step list of activities to address a specific flood or drought application within a defined application area for the DSS.

The choice of application areas and hence the methodologies to be developed will depend on stakeholder interest and availability of information. However, it will be ensured that amongst the 6-8 methodologies developed, at least one methodology for the following types of applications will be included:

- Drought planning at local scale
- Flood planning at local scale
- Drought planning at basin scale
- Flood planning at basin scale

The aim will be to have at least one methodology which combines both flood and drought issues and at least one methodology combining local and basin scales within the selection. However, it will be limited to a degree by the nature of the work being undertaken by the stakeholders. The selection of methodologies will also include both operational and strategic planning applications and methodologies linked to TDA/SAP and WSP activities. The developed methodologies will be closely linked with the adopted planning approach.

The DSS and these specific step-by-step methodologies will be validated against potential application areas, which will show how the DSS and the associated tools could be used to support specific planning activities related to floods and droughts. The application areas will form the validation and test of the DSS on actual cases within the 3 pilot basins.

The project will develop both an idealised methodology for each application area, and a locally-adjusted version based on a practical implementation in the pilot basins. The idealised methodology could be used as a global template for applying the DSS on a specific case, while the implemented version will serve as a validation of an actual use of the DSS on a specific case.

Examples of areas where a methodology could be developed and used for testing the DSS are:

- **Data availability**. The planning is limited by the available data, where the DSS could propose and link to other data sources as remote sensing data.
- **Dry season planning**. Water allocation from reservoirs to irrigation and hydropower or other sectors. The DSS could apply tools for optimising the water allocation with respect to a specified objective.
- **Flood response planning**. Development of flood action plans. The DSS could apply tools for including climate change and other human interventions, and linkage with existing models for evaluating the hydrological impact and flood mitigation measures.
- **Basin planning**. Development of TDA/SAP or catchment management plans. The DSS could apply tools for evaluating different future scenarios, assisting the water planners in selecting a robust and resilient plan, and providing tools for disseminating the results.

6 Development of a planning DSS

The project aim has been divided into 3 strategy areas as described in Section 2. In this section, the second key strategy area is discussed:

2. **Development of a Decision Support System (DSS) which will support key processes within the methodologies at basin and local scale. The DSS will be available without charge to all GEF basins.**

Design specific methodologies (at least 6)	Develop a DSS containing tools	Involve stakeholders
• At least one methodology addressing TDA/SAP • At least one addressing WSP • Covering basin and local scale • Focus on flood and drought planning • Covering short- and long-term planning • An emphasis on technical tools to support the planning process	• **Linkage** to planning activities within TDA/SAP, IWRM and WSP • Support **key processes** in flood and drought planning • Focus on **flexibility** and **usability** • Based on a **freely available open platform**	• Working with **basin organizations**, **water utilities** and **other interested** parties • **Consultation** for our awareness and understanding • **Consolidation of the planning methodology** with stakeholders • **Validation and testing** of the DSS on potential application areas • **Training and capacity building** activities

Figure 6-1 Summary of project strategy areas for the DSS development

6.1 Linkage to planning activities within TDA/SAP, IWRM and WSP used at basin and local scale

The linkage between the planning activities within the DSS and the existing planning methods, such as TDA/SAP, IWRM and WSP, is done through the planning approach introduced in Section 4. The functionality of the DSS will be addressed by specific tools located in one of the four planning stages according to how the tools should be used in a planning context.

The workspace concept, see 6.2.2 for description, will ensure that the DSS is tailored towards the specific methodology for a specific stakeholder working on developing a specific plan.

6.2 Flexibility and usability of the DSS

Flexibility and usability of the DSS is a key objective as the final DSS is to be used within various local contexts, to address various issues, by various types of stakeholders with varying levels of capacity to exploit technical tools.

6.2.1 User interface

The user interface is the framework from where users will work with the DSS, and is the platform connecting the tools with the activities within the planning methods. The user interface of the DSS should comply with the following key criteria:

Key criteria for the User Interface of the DSS

- *Usability*
    - Intuitive and graphical user interface
    - Workspace concept for adapting specific user requirements
- *Technical description*
    - *Scientifically sound approach based on adapting existing planning methods*
    - *Implementation of a few key tools*
- *Flexibility*
    - *Open platform (adapters, scripting, etc.)*
    - *Options for adding tools, methods, etc.*

The user interface for the DSS should be designed so it makes a flexible and user friendly system based on existing planning methods. At the same time it should be ensured that the DSS could be used for different applications, users and scales. These criteria will be accomplished using a workspace concept, see 6.2.2 for description.

A preliminary design of the user interface is developed as this helps the process of defining the final DSS. The key features in the user interface are (see Figure 6-2):

1. Tabs for planning components (changes the toolbar)
    a. **Home**: start page for the planning DSS
    b. **Analysis**: Understand the situation and assess the issues and causes
    c. **Planning**: Define and evaluate a plan to improve the situation
    d. **Implementation**: Implement the selected plan
    e. **Monitoring**: Monitor the effectiveness of the implemented plan
2. GIS view (same view in all planning components)
    a. Present data, indicators, models, etc.
3. Table and input view
    a. Tabular data view and input view
4. Visualisation views
    a. Visualisation of time series, plots, etc.

See Figure 6-2 Overall UI concept for an illustration of the overall user interface concept.

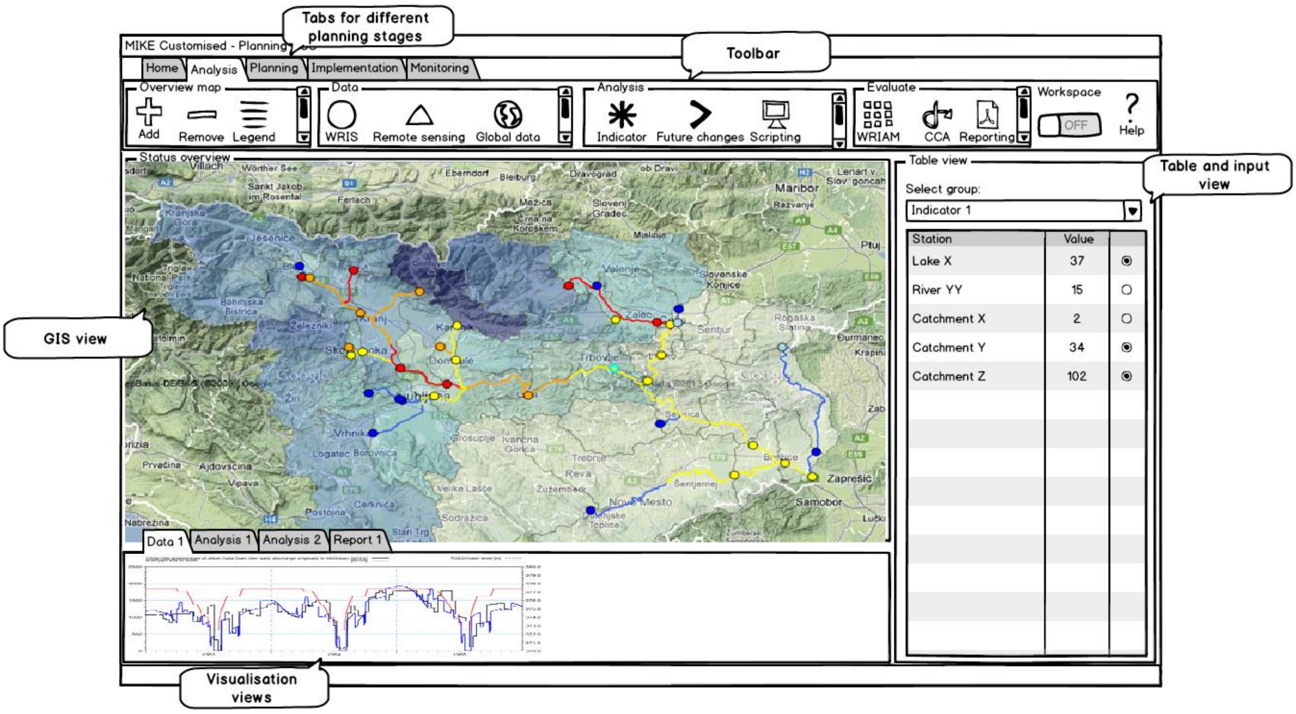


Figure 6-2 Overall UI concept

Mock-ups for each of the planning components are shown in Annex G.

6.2.2 Usability

One of the key criteria for the DSS is flexibility to cope with the diverse users and applications within planning.

In order to tailor the DSS towards the specific user, a workspace concept is introduced in the DSS.

1. A workspace is a number of pre-configured tools matching the requirements for a specific planning event. This could be:
   a. TDA/SAP workspace for a basin organisation
   b. WSP workspace for a water utility
   c. Baseline assessment workspace for a catchment organisation
2. A workspace is preconfigured by technical staff with knowledge of the DSS platform and how the tools are configured
   a. The workspace will be used to pre-configure some of the more advanced tools as the configuration of these tools will not be possible from the user interface. The available workspaces configuration (tools, GIS view, tables, etc.) could be done by a consultant, or it could be workspaces used in previous planning events.
   b. Model adapters providing the linkage between the DSS and the models is one example of a tool the user will not be able to configure from the user interface.

3. The workspace will also be used to save the history or description of how a specific planning event was carried out. One example could be the 2005 – 2010 plan where all the data, tools and indicators used are stored in a specific workspace. By browsing through the workspaces, users will be able to see how the planning was done. Figure 6-3 illustrates an example of how the workspace selection and definition could look.

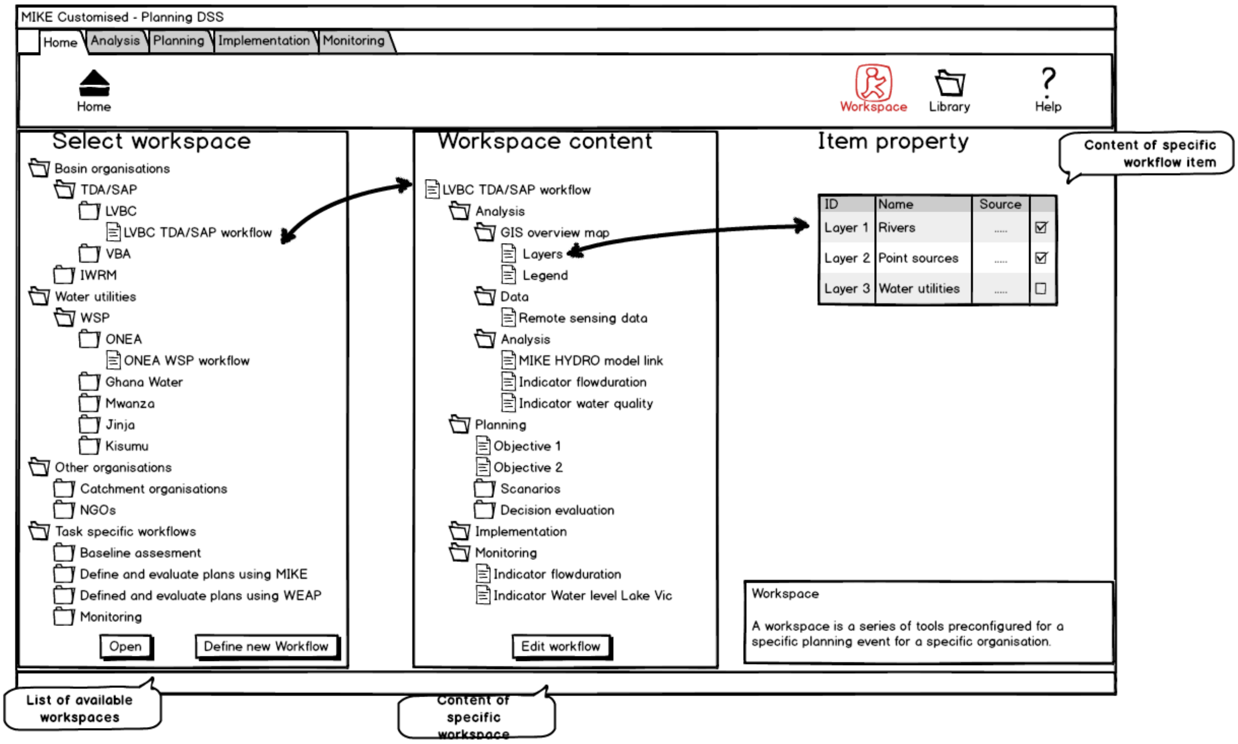


Figure 6-3 Workspace selection and definition

Figure 6-3 also shows an example of how the selection of a workspace could work within the user interface. It would contain the following:

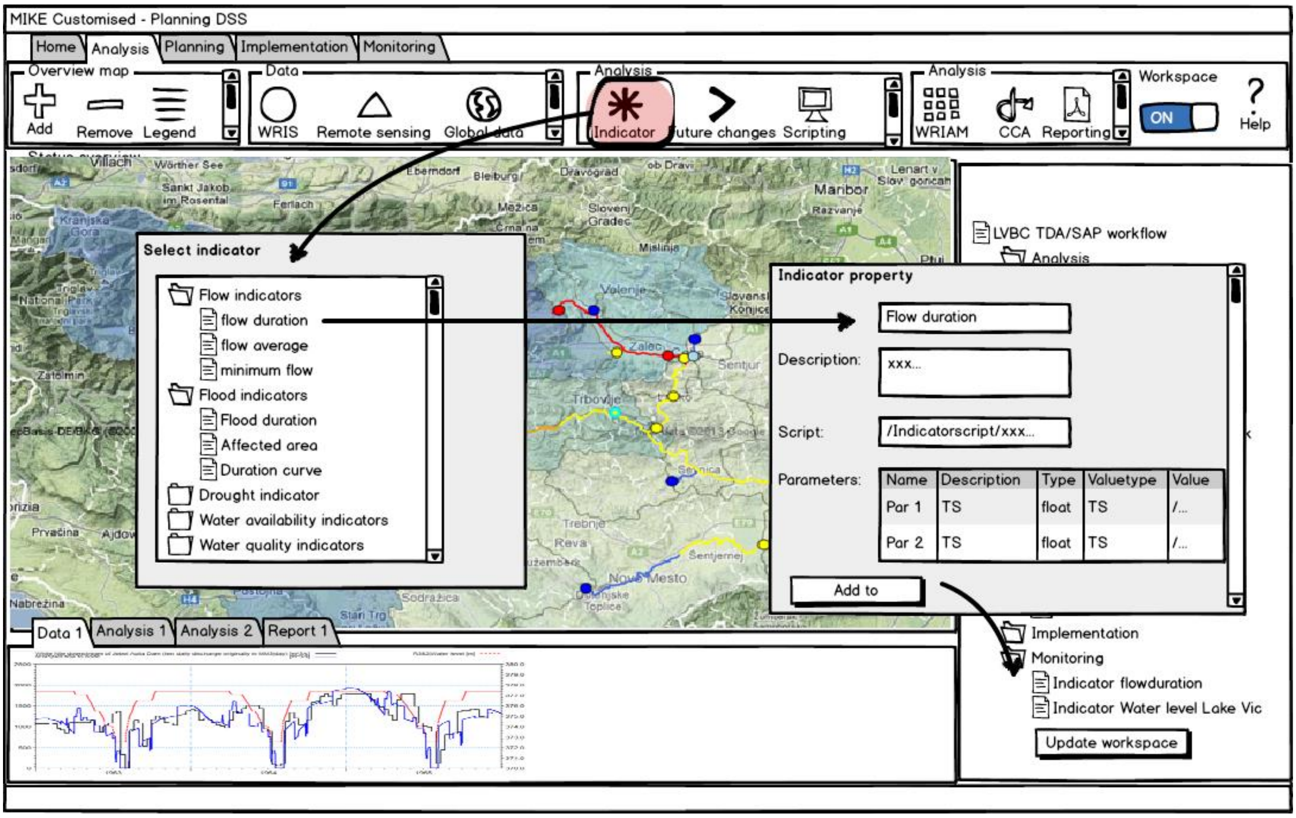


Figure 6-4 Example of workspace integration with tools

Figure 6-4 illustrates how the workspace is integrated with the tools:

6.3 Key processes or focus areas

The developed DSS will support existing planning methods with focus on operational and strategic planning, by applying technical software tools within a planning DSS. The DSS will not embrace the whole planning methodology, but rather support a number of the activities which are part of it.

The implemented methods and tools will be selected during the process of selecting and consolidating the application areas, which will be done in close dialogue with the main stakeholders in the project. Based on the response from the stakeholder consultations, during the inception phase, some of the key areas the project will focus on were identified as:

- Flood
- Drought
- Decision methods
- Future changes
- Remote sensing

Each of the above areas are briefly described in the following sections, and a more detailed description can be found in Annex H, I, J, K and L.

6.3.1 Flood

Floods are a key issue in the project as understanding and planning for the impacts and risks of floods is critical for decision making, planning and appropriate flood related responses.

The definition of a flood, used in the project, is a high flow event that has significant impacts. Such events might be caused by climate variability in combination with anthropogenic factors or by very rarely occurring extreme flows. Flood management supported by the DSS is therefore not looking at any particular return period of event but more generally on management of dangerously high flows.

The objective with flood implementation is to provide decision makers with information to improve the planning for floods with respect to operational and long-term strategic planning.

- The *analysis* part might consist of tools for evaluating the baseline condition and the main issues and causes. The main tools for the analysis part could be linkage between observations, models and selected indicators, where the indicators will give the decision makers the information on the current status.
- The *planning* stage allows decision makers to envisage alternative solutions in order to improve the current situation. The DSS could support the evaluation of various mitigation measures under various scenarios (current and future conditions) and evaluate their effectiveness (with the use of models not included in the DSS). Hydraulic and water allocation models could provide the linkage between the developed plans and the evaluated results, where the targets and criteria will be defined based on indicators.
- The *implementation* of the selected plan, as such, will not be part of the DSS; nevertheless dissemination tools will be available to support the implementation of plans.
- In order to *monitor* the effectiveness of flood measures, flood indices are used. These indices will be specific to the local conditions and the available information. See Annex E for a list of potential flood indices.

6.3.2 Drought

Droughts are a key issue in the project as understanding of the impacts and severity of droughts is critical for decision making, planning and appropriate drought related responses.

This project deals with operational and strategic drought management focusing especially on socioeconomic and environmental impacts. Hence the understanding of droughts in the planning context is related to water scarcity in accordance with the socioeconomic drought definition (difference between water availability and water demand). In other words, the project understands drought management as water systems management that aims at mitigating water shortages. The key parameters in water scarcity are the identification and management of the available water and the demand for the same water.

The definition of drought, used in the project, is water shortage which has significant impacts and can be related either to climate variability, extremes or increasing demand. In many cases the term drought is used by countries to describe water shortages that are not caused by rare extreme events but related to climate variability or socioeconomic changes. It is due to the significant impacts that the term ‘drought’ is used and it is for the same reason (significant impacts) that the project will focus on these types of events.

The objective with drought implementation is to provide decision makers with information to improve the planning and management of drought with respect to operational and long-term strategic planning.

- The *analysis* part might consist of tools for evaluating the baseline condition and the main issues and causes. Water allocation models (e.g. MIKE HYDRO or WEAP models) could be used to define and evaluate scenarios with drought issues and measures. Moreover climate, land use and population change are key parameters that can be included into the analysis. The *analysis* tools can be used for estimating the water demand and usage both for the urban and rural part, as well as for irrigation and industrial usage.

- The *planning* stage allows decision makers to envisage alternative solutions in order to improve the current situation. The DSS is able to encompass various mitigation measures under various long-term or short term scenarios and evaluate their effectiveness. Other potential planning applications could be:

    - Seasonal forecasting taking either the historical events into consideration or using actual climatically forecast of the seasonal climate or

    - Prioritisation of the different water sectors, during dry season.

    - Drought mitigation measures such as reduce NRW, artificial recharge, irrigation efficiency, crop selection etc.

    - Strategies for crop management during drought periods.

    - Conjunctive use of groundwater and surface water.

- The *implementation* of the selected plan, as such, will not be part of the DSS; nevertheless dissemination tools will be available to support the implementation of plans.

- In order to *monitor* the severity of droughts as well as the effectiveness of the implementation of plans, drought indices are used. At the basin scale, remote sensing indicators – even with a coarse resolution – are preferred since they offer uniform information across the basin where ground data might not be available for all countries or available in different forms. See Annex F for a list of potential drought indices.

6.3.3 Decision methods

Decision making is a central part of planning. Its main use in planning is to decide between which of the various alternative plans to follow in order to meet a specific objective. It is typically very complex to select the best plan, as there are many priorities and objectives that need to be addressed.

The objective with implementing decision methods is to provide methods from where stakeholders are able to select the plan or scenario that provides a robust and resilient option for solving the issues and fulfilling the objective. There are a number of approaches to decision analysis or decision making which can be investigated such as scenario analysis, multi-criteria analysis and robust decision making.

The project will evaluate which decision methods are relevant for the stakeholders involved in the project. The focus will be on usability and communicational aspects as successful decision making includes decisions being accepted by many stakeholders.

The implementation of decision methods will focus on different activities all within the planning stage of the project planning methodology / approach.

- Planning stage where activities, such as defining various plans and evaluating them using scenario analysis and multi-criteria analysis or other approaches, can be supported. Other applications may include decision making tools for use with deeply uncertain futures such as robust decision making.

6.3.4 Future changes

Future changes drive long-term changes in water demand and availability and consequently need to be considered in strategic planning for the reduction of flood and drought risk. Future changes covers climate and land use changes, which is an essential part of strategic or long-term planning.

The future change implementation of the project will address strategic planning only.

- The *analysis* stage might be supported by tools to access and process climate projection data at least for the relevant variables to estimate water demand and availability (temperature, precipitation and evapotranspiration). Support for land use change, population growth, economic development and technological development projections may also be developed. Mapping capabilities might provide an overview of future changes on the basin scale and statistical downscaling methods might be implemented. Links between projections and existing models, and the management of many scenarios might be supported.

- The *Planning* stage might be supported by linking the range of outcomes of the future change analysis to decision making methods in order to derive long-term plans for the reduction of flood and drought risk that are robust to a wide range of future outcomes.

- The *Implementation* stage might be supported by dissemination tools in order to raise awareness of the impact of future changes on flood and drought risk and to support long-term adaptation plans.

- The *Monitoring* stage might be supported by indicator tools that allow the evaluation of effectiveness and robustness of strategic plans. Indicator tools allow the ‘real’ scenario to be monitored and compared to the previously-estimated future scenarios in order to allow adjustment of future change estimates.

6.3.5 Remote sensing

In many parts of the world ground-based monitoring networks of hydrological variables produce inadequate time series records, and in almost all areas there is a lack of spatial coverage of such networks. These gaps in temporal and spatial information can be partly addressed by using global datasets of ground observations and/or remotely-sensed datasets to supplement the locally available information.

The objective is to improve the density and quality of data coverage in areas with few or no data by making remote sensing information more readily available to stakeholders.

Remote sensing and global data can be used in various stages of the planning process:

- *Analysis* stage where the focus might be on using remote sensing data or global products for providing an overview and for calculation of indices. The project might focus on: Importing and visualising remote sensing data
- *Planning* stage where remote sensing data may provide data to be used in the developed plans, and could be input data for any models, which are used to evaluate different plans. The project will focus on: Supplementing ground-gauged rainfall and evaporation information with satellite products or using SRTM topographic information as input to hydrological or hydraulic models. Linkage between remote sensing data and water resource or hydraulic models
- The *implementation* of the selected plan, as such, will not be part of the DSS; nevertheless dissemination tools will be available to support the implementation of plans.
- The *monitoring* stage where remote sensing data could be used to monitor the status of the basin. Remote sensing data could be used for calculation of indices; e.g. flood monitoring product or a drought severity index, or possibly a product for monitoring crop yields.

7 Stakeholder involvement

The project aim has been divided into three strategy areas as described in Section 2. In this section, the third key strategy area is discussed:

3. **Stakeholder involvement throughout the development of the methodologies and the DSS and dissemination of findings.**

The DSS will contain tools supporting the technical part of the planning process, but there will be many activities taking place around the DSS, where the main objective for the DSS is to support these processes. This could be to use the DSS to facilitate information leading to decisions, or the dissemination of results to other stakeholders in a planning situation. This will be addressed in the planning process component of the DSS, where the main activities will be centred on the stakeholders.

An important element here is capacity development through training and workshops (e.g. awareness workshops). The project will engage with key stakeholders, addressing the application of the DSS. Furthermore looking at the usability and functionality, ensuring that through stakeholder engagement, the needs of those within the basin can be addressed through the developed tools. NBI will be actively engaged in the process of defining the content of these workshops.

As the stakeholders in the project are crucial for the development and implementation of the DSS, and the key activities are:

- Stakeholder consultations for our awareness and understanding of their issues
- Consolidation of methodology across basins during the inception meeting
- Development and consolidation of the planning methodology in close collaboration with the stakeholders
- Validation and testing in the pilot basins
- Training and capacity building ensuring the sustainability of the DSS

Figure 7-1 Summary of project strategy areas for the stakeholder involvement

The project will work with stakeholders across all 3 basins. The key stakeholders are the basin organisations for transboundary planning and water utilities for local scale planning. Other organisations such as electricity companies, irrigation and environmental agencies and catchment organisation will provide an important role in testing and validating the DSS at different scales, and provide the linkage between basin and local scale planning.

Furthermore, the project will engage with the sub-regional level through the basin organisation. This is especially the case in Lake Victoria. This is the case because most of the technical work, at basin level, is done by catchment organisations or external consultants. Their knowledge and expertise will be used in the project and sub-regional organisation can be involved in trainings on the use of the DSS developed. Sub-regional decision makers will only be invited to the final training sessions due to financial constraints, but will be kept informed on the progress though the project.

The main stakeholders in the project are shown in Figure 7-2.

	Volta Basin	Lake Victoria Basin	Chao Phraya Basin
Basin scale	Volta Basin Authority (VBA)	Lake Victoria Basin Commission (LVBC)	Hydro and Agro Informatics Institute (HAII)
Local scale	ONEA Ghana Water	National Water Uganda, Jinja KIWASCO MWAUWASA	Metropolitan Waterworks Provincial Waterworks Authority
Other scale	Electricity companies, irrigation and environmental agencies or departments, catchment organisations and other interested parties		

Figure 7-2 Stakeholders in the project

7.1 Stakeholder involvement, roles and responsibilities

The involvement and roles of each of the stakeholders will be discussed during the inception meeting, where meetings between the project team and each of the main stakeholders will detail the involvement and roles across the duration of the project.

Some of the overall activities with respect to stakeholder involvement will be:

- Stakeholder consultations (inception phase)
    - Presentation and introduction of the project
    - Discussion of the stakeholders challenges and needs in relation to the project
- Inception meeting
    - Presentation and consolidation of planning approach

- Initial definition of application areas for DSS validation to be used to develop the methodologies
- Planning of the involvement and responsibilities for the coming year

- Consolidation of methodologies (project component 1)
  - The consolidation of the methodologies through application areas and design of the DSS will be done in close collaboration with the stakeholders. There will be a number of face-to-face meetings and Skype meetings. This input from stakeholders will provide verification of the project approach and additional guidance on how to develop the methodologies. The objective will be to ensure that the developed methodologies can be applied by the individual stakeholders.
- Validation and testing of the DSS (project component 2 and 3)
  - Validation and testing of the DSS at both basin and local level. The application of the methodologies is to be undertaken with users at the basin and local (e.g. utility or catchment) level. The aim is to ensure ownership of the process and ensure that the idealised methodologies are adaptable to different contexts.
  - The validation and testing requires identification of actual planning activities which could be used to validate and further develop the methodologies.
- Production and application of training materials; and communicating and disseminating project information (project component 4)
  - This will incorporate end user experiences and recommendations based on practical application of the DSS.
  - Participation in relevant workshops and trainings. For example, in 2015, the project aims to hold an awareness workshop for decision makers that will explain and demonstrate the importance of a DSS and the data being used for analysis, and the relevance of this project to managing floods and droughts.
  - The dissemination will be undertaken in partnership with “champions” within the basin, for example, through presentations at international and regional events.

The stakeholder involvement will be discussed with each stakeholder during the joint stakeholder inception meeting, and further discussions will be undertaken during the annual steering committee meetings. The aim is to involve the stakeholders based on individual needs and resources.

The intention of the project is not to place any financial burdens on stakeholders involved. However, it is important to understand that as funds are limited, therefore the project is limited to covering direct costs (e.g. logistics) related to meetings with partners and the PMU. This would also apply to participation in workshops organised (and the associated costs for these workshops) by the project.

Memorandum of Understanding (MoUs) will be developed with each stakeholder as required to facilitate project implementation.

7.1.1 Application areas

Validation of the DSS functionality on actual applications is important for the ability to apply the DSS in basins outside the selected pilot basins. The project will identify a number of application areas for testing and validating the DSS, therefore ensuring that the developed DSS is able to assist the stakeholders with solving their key challenges within planning.

The application areas covers specific applications, identified and executed by the stakeholder, where the functionality of the DSS will be tested and validated, or a number of workshops for in-depth training and testing of the DSS functionality. The selection as applications or workshops will be based on availability of information and resources at the stakeholders.

As one of the project key areas is to develop, technical tools for supporting the TDA/SAP and WSP methods, these will be included specifically in the application areas. This ensures that the final DSS will be validated against its ability to support both TDA/SAP and WSP and the other key planning challenges identified during the stakeholder consultations. This will also enable the project to provide tools that can be used in different contexts and scales, besides the ones tested in the project.

The key planning challenges for each of the stakeholders will be identified during the inception meeting. The focus will be on challenges that are relevant for the stakeholder with respect to operational or strategic planning, and challenges that could be used for validating the developed DSS. For example, tools developed and tested with basin organisations could focus on data management and visualisation, operational use of remote sensing data and water balance tools, tools for divining indicators, tools for communicating results. These all depend on the needs which vary across stakeholders, as priorities are different.

The application areas will be used to design the functionality within the DSS (includes data requirements and tools). The functionality will be consolidated with the stakeholder, and validated on the application area through the stakeholders. The actual validation of the DSS on a selected application area could be carried out by the stakeholder / partner institution with close support from the project team or could be a number of workshops where the developed DSS functionality will be tested and validated with the stakeholders and at the same time provide in-depth training in the application of the DSS.

The project will develop 1-2 application areas within each basin, and they will form the validation of the DSS. The outcome of the DSS validation on a selected application area (data requirements and tools) will be shared with all the stakeholders and made available for everyone to apply.

There will be a range of application areas covering both basin and local applications. All the application areas will be linked to activities within WSP and TDA/SAP methods.

The validated and tested DSS functionality within the selected application areas will form the final validation of the DSS, and would ensure that the DSS is capable of assisting the stakeholder in solving the selected challenge. The application areas could also be used for defining a workspace in the DSS, describing how to solve a specific challenge.

The content of the application will vary depending on whether they are based on actual applications or a workshop. The following table provides and overview:

DSS validation based on actual application	DSS validation based on a workshop
Focus on actual application or issue, identified by the stakeholder	Focus on general issue related to basin or local planning
Functionality in DSS to be developed and tested based on need/requirements for the application	Functionality to be developed by DHI/IWA based on stakeholder interaction
DSS functionality to be used by the stakeholder on the actual application	
In-depth training and feedback on the DSS functionality during a yearly workshop	
Workshop to focus on the use of the DSS on the selected application area (application)	Training to focus on specific modules within WSP or TDA/SAP, using data from the stakeholders
Feedback from the yearly workshop to be included in the development	

The yearly workshops will be the focal point for interactions between the stakeholders and the project team, and where the formal feedback from the DSS development will be collected and incorporated into the project. Due to the limited funds in the project there will be a limitation on the number of stakeholder staff participating in the workshops and the associated costs:

- The yearly workshops will be initiated in the 2nd half of 2015 in each of the three pilot basins
- The duration is expected to be 1 week
- Basin organisations and water utilities will usually be present at the same workshop
    - The first and last day will contain common sessions with basin organisations and water utilities, while there will be 3 days with specific activities for basin organisations or water utilities
    - There may be some cases where there are separate workshops if the subject is only relevant to one group of stakeholders, however other stakeholders will be asked if they wish to attend (e.g. Developing Climate Resilient Water Safety Plans)
- There will be a limitation on the number of staff and costs covered by the meetings. This will be announced prior to each workshop.

7.1.2 Process of identifying potential application areas for DSS validation

The process of identifying and utilising the application areas for DSS validation involves:

1. **Stakeholder meeting** - Identification of activities where the project will support the planning effort. The focus will be on activities that are relevant for the stakeholder with respect to operational or strategic planning, and could be used for validating the developed DSS.

2. **Evaluation** - The project team will evaluate the feedback from all the different stakeholders and ensure that they cover as many of the potential issues within flood and drought planning as possible, and based on this, 1-2 potential application areas will be developed for each pilot basin. During this process the project team will decide if the DSS validation within a selected application area will be done based on applications or a number of workshops. The selection will be based on the available resources and information at the stakeholders. The aim will be to have a combination of applications and workshops.

3. **Ideal workflow** - The project team will evaluate each potential application area and propose how an idealised workflow, including data and tools, could be implemented in the DSS.

4. **Consolidation** - The proposed workflow will be evaluated and consolidated with the stakeholder, ensuring that it is in line with the actual needs and requirements.

5. **Software development** - The DSS tools will be developed to support the agreed workflow

6. **Yearly workshops** - The DSS will be tested and validated on each of the selected application areas, based on an actual case within the pilot basins or training during workshops. The stakeholder will do the actual implementation of the consolidated workflow (using an actual application, or during training sessions at the workshop), and produce the intended output, while the project team will assist in using the DSS and the developed tools.

The validated and tested DSS based on a selection of application areas will form the final validation of the DSS, and would ensure that the DSS is capable of assisting the stakeholder in solving the selected issue. This could also be used for defining a workspace in the DSS, describing how to solve a specific issue.

7.1.3 Learning Basins

The project consists of 3 pilot basins used to validate and test the developed methodology and the DSS. There are also 2 learning basins in the project where the objective is to utilise the experience from the learning basin, and share this knowledge with the stakeholders in the 3 pilot basins.

For the learning basin this is an opportunity to influence the project, and the development of the tools and DSS which is part of the project outcome. The learning basins will be invited as part of the annual meetings, and will be kept updated throughout the project. There are no financial or other obligations attached to being a learning basin.

Danube basin

The Danube basin is identified within the project document as a learning basin. The project team had consultations with The International Commission for the Protection of the Danube River (ICPDR) and the International Association of Waterworks in the Danube Catchment Area (IAWD) during the inception period.

ICPDR is an International Organisation consisting of 14 cooperating states. Since its establishment in 1998, the ICPDR has grown into one of the largest and most active international bodies of river basin management expertise in Europe. The ICPDR deals not only with the Danube itself, but also with the whole Danube River Basin, which includes its tributaries and ground water resources.

The project team will engage with Danube basin through ICPDR in the following way:

- Information sharing and knowledge exchange trough existing and developed basin plans
- Engage the Tisza basin, a sub-basin within the Danube basin, for the possibility to use the Tisza basin for validation and testing of the methodology and the DSS.

IAWD is concerned with improving and safeguarding the water quality of the Danube and its tributaries. The organisation is a potential entry point in terms of dissemination of training material developed in the project, not to mention, the input that can be provided in their trainings at the local level, but also the regional level. However, specific collaboration will be defined as the project progresses.

Nile basin

The project has engaged Nile Basin Initiative (NBI) during the inception phase, as NBI has extensive experience and knowledge of using and applying DSS in the countries within the Nile basin.

The Nile Basin Initiative (NBI) is a regional inter-governmental partnership led by 10 Nile riparian countries, namely Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda. NBI provides riparian countries with information sharing as well as joint planning and management of water and related resources in the Nile Basin.

The project team will engage with Nile basin through NBI in the following way:

- Knowledge sharing on application and use of DSS within the Nile basin
- Knowledge sharing on usability requirements for a DSS
- The involvement of NBI will be further detailed during the inception meeting

7.1.4 Global stakeholders

The project has, during the inception period, engaged with a number of global stakeholders to collaborate on issues with the objective of improving the project.

The UNEP-DHI Partnership: Centre on Water and Environment (UNEP-DHI) is dedicated to improving management of freshwater resources from the local to the global level. The Centre is hosted by DHI and draws upon the expertise of DHI and external partners to provide technical support for UNEP's activities related to freshwater. UNEP-DHI has been actively involved in the preparation and design of the project and intends to continue collaborating with the project throughout its lifetime, with emphasis on capacity development, technology transfer, application of tools and creating synergies with basin scale and global activities.

Integrated Drought Management Programme (IDMP): World Meteorological Organisation (WMO) and Global Water Partnership (GWP) are executing the Integrated Drought Management Programme (IDMP). The aim of IDMP is to "*To support stakeholders at all levels by providing policy and management guidance and by sharing* *scientific information, knowledge and best practices for Integrated Drought Management".* The objective with the IDMP is aligned with the objective of focusing on drought management as one of the focus areas, and the project will engage with WMO and GWP during the duration of the project.

Associated Programme on Flood Management (APFM): The Associated Programme on Flood Management (APFM) is a joint initiative of the World Meteorological Organisation (WMO) and the Global Water Partnership (GWP). The APFM facilitates the dialogue to governmental agencies and provides a platform for guidance on flood management policy, strategy and institutional development. The programme's objective is to promote the concept of Integrated Flood Management (IFM) as a new approach in dealing and living with floods. The objective with the APFM is aligned with the objective of focusing on flood management as one of the focus areas, and the project will engage with WMO and GWP during the duration of the project.

8 Overall Workplan, Activities and Budget including Annual Workplan 2014-2015

The project framework is divided into 5 components each describing a phase in the project. The project components are:

- Component 0 – Inception phase
- Component 1 – Development of methodologies
- Component 2 – Validation and testing at basin-wide level
- Component 3 – Validation and testing at local level
- Component 4 - Capacity building and dissemination

Each of the project components are described in details in the following sections.

Each component section also provides information on the detailed Annual workplan covering activities until the end of 2015. The main focus during this period will be:

- **Inception phase** (component 0).
- **Development of Methodology** (component 1)

Component 0 and will be completed before Q3 (first quarter of 2015).

Under component 2, 3 and 4, several activities will be initiated during the latter part of 2015 but the deliverables for these activities will be after the end of 2015.

The main deliverables for the end of 2015 are:

- Inception report. Draft version ready for the inception meeting and final version by 21st of January 2015.
- Report of the inception meeting
- Description of planning approach and consolidated idealised planning methodologies (middle of 2015)
- Software development plan (2015)
- Document on gender and social dimension in flood and drought management (2015)
- Communications strategy (March 2015)
- Project website (August 2014)
- Project factsheet in English, French and Thai (October 2014)

The outputs from components 2 and 3 will be documented as part of the deliverables due in 2016.

8.1 Component 0 – Preparation and Inception Activities

All activities in component 0 relate to the project preparation phase and inception period and will be completed by Q3 (first quarter of 2015).

8.1.1 Description of Outcomes, Outputs and Activities – Component 0

***Outcome 0.1: Enhanced focus and effectiveness of final project design achieved through the assessment of current practices in addressing flood and drought impacts as part of planning* processes in transboundary basins, including the TDA-SAP process**

Output 0.1.1: Reports containing review of GEF portfolio, case studies, mapping and assessment of current decision making processes, highlighting strengths, weaknesses and any gaps identified (including those related to data and information)

These outputs and outcome were completed during the project preparation phase from June 2012 to December 2013.

Outcome 0.2: Identification during project preparation of three transboundary basins for participatory development and pilot testing of the new methodology and tools, ensures timely inception and smooth project implementation

Output 0.2.1: Selection of three pilot basins and 1-2 learning basins based on a review of all river/lake basins object of foundational GEF IW projects including the TDA-SAP process

Activities

Activity 1: Stakeholder consultations in each pilot (3 basins) and learning basins (2 basins) to provide awareness of the project, provide further input, and verify the methodology so it is relevant for end users

- Identify 15-30 participants to participate in each stakeholder consultation, which will be a mix of focus groups and key informant interviews
- Organise meetings in each pilot basin with relevant stakeholders, if possible in conjunction with planned events (e.g. IWA conferences). There will be an emphasis on identifying existing flood and drought planning and response processes to identify gaps that the DSS can address.
- During stakeholder consultations identify impacts on vulnerable groups affected by water related shocks.
- Summarise discussions in stakeholders consultations into a report which provide end user verification and additional guidance to floods and drought methodology

This activity will produce a series of stakeholder reports (Deliverable 1), and key points will be incorporated into the inception report (Deliverable 2).

Activity 2: Development of planning approach for integration of flood and drought components for DSS systems

- Describe impacts/issues/consequences of floods and droughts in a transboundary basin context (what are the problems to be solved)
- Identify flood and drought indices (indications that there is a problem), the means these can be monitored or predicted, and the data and analytical tools required
- Outline a planning approach , which can accommodate flood and drought situations considering technical, economic and environmental aspects (including risks and consequences)
- Prepare a description of overall planning approach for application of the flood and drought DSS components for use at stakeholder consultations

This activity will contribute towards the content of the inception report (Deliverable 2).

Output 0.2.2: Project inception with the participation of GEF Project Agencies and of Pilot Basin representatives

Activities

Activity 3: Convening key stakeholders to participate in inception meeting and project steering committee

- Preparation of inception meeting agenda and organisation of logistics
- Preparation of material for participants

This activity will produce an inception meeting report which details the discussion during the inception meeting. (Deliverable 3)

8.1.2 Deliverables component 0:

1. Stakeholder meeting reports
2. Inception report clarifying the project objective, work plan and budget.
3. Inception meeting report

8.1.3 Description and justification of changes

The activities in the inception phase have been changed according to what has been achieved during the stakeholder consultations. The main changes are:

- An overall planning approach has been developed during the inception phase based on the stakeholder consultations. The overall planning approach will be adopted and methodologies will be developed for step by step description of implementation of planning activities in the DSS.
- Impacts on vulnerable groups were included in the inception phase as this activity was closely related to the stakeholder consultations.

8.1.4 Annual workplan – component 0

By Q2 (November 2014), the project had undertook detailed stakeholder consultations in each of the pilot basins, as well as initial discussions with the Danube and Nile learning basins. Details of these consultations are provided in section 4, and the in-depth reports are available as separate documents. The inception report and the inception meeting report will be delivered by Q3 (March 2015).

8.2 Component 1 – Development of Methodologies

8.2.1 Description of Outcomes, Outputs and Activities – Component 1

Outcome 1.1: Methodologies with tools aimed at increasing understanding of flood and drought dynamics and impacts at transboundary and local levels and including enhancement of commonly used decision support systems, fully developed jointly with pilot basins stakeholders.

Output 1.1: At least 6 methodologies with tools adopting a basin and local approach, including enhancements for decision support systems, that would allow the integration of flood and drought issues into (i) the TDA-SAP GEF IW or equivalent processes, and (ii) IWRM plans and Water Safety plans

Activities

Activity 1: Needs assessment with respect to flood and drought issues (based on the stakeholder consultations)

- Key findings with respect to implementation of flood and drought in planning
- Identification of key issues relevant for the project

This activity will compile experience from stakeholder consultations which will be used to inform the project methodology (Deliverable 1).

Activity 2: Assessment of the gender and social dimensions in flood and drought management

- Consultations and stakeholder involvement in flood prone areas within pilot basins
- Identify water relevant gender indicators being adopted and monitored by countries, if any.
- Identify impacts of droughts on men and women/girls, including hygiene, and analyse options for diversified livelihood support for women during droughts.

This activity will compile knowledge of gender issues in flood and drought planning which will be presented as a briefing on the gender and social dimension in flood and drought management (Deliverable 3).

Activity 3: Methodologies for including flood and drought in planning

- Describe idealised methodologies for including floods and drought issues into existing planning methods

- Collect and analyse evidence of how flood and drought issues are affecting the pilot basins
- Inventory of previous and existing initiatives related to floods and drought issues and taking contact to those that may be relevant for cooperation/lessons learnt including GWP/WMO
- Develop idealised methodologies for DSS components for flood and drought issues in a planning context

This activity will develop planning methodologies for including flood and droughts into planning and will be incorporated into the consolidated idealised planning methodologies Deliverable 1).

Activity 4: Methodologies for including future change (climate and land use change) in planning

- Describe idealised methodologies for including future change (climate and land use changes) into existing planning methods
- Collect and analyse evidence of how future changes (climate and land use changes) are affecting the pilot basins
- Inventory of previous and existing initiatives related to climate change and taking contact to those that may be relevant for cooperation/lessons learnt including World Bank supported initiatives such as WB GAMS
- Develop idealised methodology for DSS components for future change including global climate change impacts in a planning context

This activity will develop in planning methodologies for including future changes into planning and will be part of the consolidated idealised planning methodologies (Deliverable 1).

Activity 5: Develop and consolidate methodologies to apply DSSs in TDA/SAP, IWRM and WSP

- Develop a methodologies for flood and drought with respect to DSS components
- Demonstrate the use of DSS with representatives from basin organisations, urban water utilities and relevant industries to resolve typical hot-spot issues in planning processes
- Consolidate stakeholder input to idealised methodologies
- Establish and consult with international experts to define guideline materials needed for incorporating flood and drought methodologies into planning processes

This activity will develop bring together the various components of the activities under outcome 1.1. To create the consolidated planning methodologies (Deliverable 1).

Activity 6: Develop DSS which integrates flood and drought management decisions in water resources management planning

- Develop functionality of DSS to be applicable for basin organisations to improve planning for management of flood and drought risk in each of the pilot basins. The process will be developed in collaboration with users, experts and partners, as well as relevant civil society to ensure vulnerable localities impacted by floods and droughts.

- Develop functionality of DSS to be applicable for water utilities to improve planning for management of flood and drought risk in each of the pilot basins. The process will be developed in collaboration with users, experts and partners, as well as relevant civil society to ensure vulnerable localities impacted by floods and droughts.

- Prepare a detailed design of flood and drought DSS components

- Consolidate stakeholder input to methodologies to DSS

- Prepare a software development plan

- Initiate software development

This activity will be undertaken to create a consolidated detailed description of the planning methodologies and initiated software development (Deliverable 2).

8.2.2 Deliverables component 1:

1. Document with description of consolidated idealised planning methodologies
2. Document with software development plan
3. Document on gender and social dimension in flood and drought management

8.2.3 Description and justification of changes

Component 1 (Development of methodologies) has been changed so it reflects the workflow in the activities during the development of the methodologies. The changes are:

- Needs assessment based on the stakeholder consultations and the comments from the inception meeting. This is a critical activity as it focuses the methodology on the stakeholder needs.

- Activities have been adjusted to reflect that the project will develop a number of methodologies aiming at testing and validating the DSS within specific planning activities. The methodologies in component 1 will be based on an idealised solution, and will be validated and tested in component 2 and 3.

- The changes in component 1 reflect the need for a more consistent flow in the development of the methodology.

8.2.4 Annual workplan - component 1

All the activities within component 1 will be completed during 2015. See section 8.2 for a detailed description.

8.3 Component 2 – Validation and testing at basin-wide level

8.3.1 Description of Outcomes, Outputs and Activities – Component 2

Outcome 2.1: Application of the methodologies at the basin level (at least 3) using DSS tools in the three pilot basins enables the integration of flood and drought issues into the IWRM, TDA-SAP and other planning processes.

Output 2.1.1: Strategic recommendations for inclusion of flood and droughts issues in IWRM, TDA/SAP, and other basin planning methods in the 3 selected pilot basins.

Activities

Activity 1: Establish working environment for application of methodologies with DSS tools in pilot basins

- Plan application in pilot basins together with project partners (responsibilities, data sharing agreement, workplan etc. for application)
- Transboundary basin and national water managers who are specifically involved in responding to water related risks provide guidance to identify and select specific areas for application. Involvement of relevant civil society to ensure that areas selected take into account vulnerable areas impacted by floods and droughts. The relevant civil society representatives will be identified during the stakeholder consultations

The aim of this activity is to define and establish the working environment for the validation and testing, and the information developed will be included in the documentation describing the application of the developed DSS at basin level (Deliverable 1).

Activity 2: Apply flood and drought Components in a DSS for TDA/SAP, IWRM in selected basins

- Apply the DSS in within each of the pilot basins in collaboration with the key stakeholder.
- In cooperation with transboundary basins and national water managers demonstrate the applicability and usefulness of the DSS in planning across the three pilot basins. Simultaneously provide training on the application of the flood and drought DSS to end users including basin officials (transboundary and national), and urban managers from water utilities and industry.

This activity will validate and test the DSS at the basin level, and the findings will be included in the documentation describing the application of the developed DSS at basin level (Deliverable 1).

Activity 3: Recommend policy and strategy for flood and drought in consultation with stakeholders

- With transboundary basins and national water managers involved in the application, prepare strategic recommendations for inclusion of flood and droughts consideration in IWRM, TDA/SAP and other basin-wide land and water plans in selected basin

- Develop documentation of the process to provide basin specific guidance on how to use information from the floods and drought components of a DSS in developing recommendations for planning.

This activity provides recommendations for how to include information from the applied DSS in existing planning methods (Deliverable 2).

8.3.2 Deliverables component 2:

1. Document describing the application of the developed DSS at basin level. This includes recommendations and lessons learned for applying the planning methodology.

2. Document with strategic recommendations for inclusion of the DSS in existing planning methods at basin level

8.3.3 Description and justification of changes

There are no major changes to component 2.

8.3.4 Annual workplan – Component 2

For component 2 it will only be activity 2.1 (Establish working environment for application of methodology with DSS tools in pilot basins) which will be finalised during 2015. The remaining activities will to some extent be initiated during 2015, but not finalised. See section 8.3 for a detailed description.

8.4 Component 3 – Validation and testing at the local level

8.4.1 Description of Outcomes, Outputs and Activities – Component 3

Outcome 3.1: Application of the methodologies (at least 3) at lower administrative levels using DSS tools in the three pilot basins enables the integration of flood and drought issues into local level planning (e.g. water safety planning) for water suppliers and regulators, (agro) industries and urban area managers to consider options for increased resilience and preparedness to F&D within broader basin context with an emphasis on vulnerable groups affected by water related shocks.

Output 3.1.1: Strategic recommendations for inclusion of flood and droughts issues in Water Safety, and other local planning methods in the 3 selected pilot basins with integration of urban and (agro-) industrial water users' perspectives and realities.

Activities

Activity 1: Establish working environment for application of methodologies with water utility end users with DSS tools in the 3 pilot basins

- With guidance from basin representatives and urban water managers, identify at least 3 water utilities (one in each basin) that will test application of DSS information in local level planning (e.g. water safety planning).Plan application in pilot basins together with project partners (responsibilities, data sharing agreement, workplan, etc. for application)

- Catchment managers who are specifically involved in responding to water related risks provide guidance to identify and select specific areas for application. Involvement of relevant civil society to ensure that areas selected take into account vulnerable areas impacted by floods and droughts. The relevant civil society representatives will be identified during the stakeholder consultations

This activity will establish the working environment for the validation and testing of the DSS with utilities. All findings will be incorporated into documentation describing the application of the developed DSS at local level (Deliverable 1).

Activity 2: Apply flood and drought components in a DSS to contribute towards utility level planning (e.g. water safety planning) in selected basins

- Apply the DSS in within each of the pilot basins in collaboration with the key stakeholder. Apply a suitable model to test at least one urban area/catchment within each of the 3 pilot basins with the ultimate purpose of improving the resilience and preparedness through appropriate planning and implementation of mitigating measures. Simultaneously provide training on application of the downscaled methodology during implementation with water utility and industry representatives.

- Incorporate recommendations from application of flood and drought methodology into planning processes (e.g. WSP)

This activity covers the process of validation and testing of the DSS of the DSS with utilities. All findings will be incorporated into documentation describing the application of the developed DSS at local level (Deliverable 1).

Activity 3: Recommend policy and strategy for flood and drought in consultation with stakeholders

- Establish critical factors (e.g. water levels) for water safety and urban drainage at the selected test areas/catchments and assess impacts, risks and frequencies

- Incorporate recommendations from application of flood and drought methodologies into planning processes (e.g. WSP)

- Recommendations for updated plans, including investments, for utility water safety and, urban drainage and socio-economic urban areas vulnerable to flood and drought incorporating basin level constraints and outlooks

This activity will provide recommendations for inclusion of the outputs of the applied DSS in existing planning methods (e.g. WSP). The recommendations will be included in a briefing note for the pilot basin utilities (Deliverable 2).

8.4.2 Deliverables component 3:

1. Document describing the application of the developed DSS at local level. This includes recommendations and lessons learned for applying the planning methodology.

2. Document with strategic recommendations for inclusion of the DSS in existing planning methods at local level

8.4.3 Description and justification of changes

Component 3 (Validation and testing at local level) has been changed so it reflects the activities in component 2. The justification is that the validation and testing at basin and local level will be done simultaneously, as this enables synergy between the stakeholders at basin and local level.

8.4.4 Annual Workplan – Component 3

For component 3, only activity 3.1 (Establish working environment for application of methodology with DSS tools in pilot basins) will be completed during 2015. The remaining activities will to some extent be initiated during 2015, but not finalised.

8.5 Component 4 – Capacity Building and Dissemination

8.5.1 Description of Outcomes, Outputs and Activities – Component 4

Outcome 4.1: Experience and know-how gained through the project is made available within the GEF system and beyond.

Output 4.1.1: Learning package including technical specifications of the DSS and training materials for the application of the new methodologies with DSS tools is tested in 2-3 trainings with basin officials, utility and industry management and operational staff, and representatives from civil society with 15-30 people per training.

Activities

Activity 1 Prepare technical specifications, manuals, guidance and training materials for users in the 3 pilot basins focusing on capacity building in the pilot basins

- Identify potential basin, water utility and industry users' levels of knowledge and establish their need for knowledge and training. This includes those involved in the development of the DSS tool and additional users who would apply the tool and use the outputs.

- Preparation of technical specifications and user manuals enabling professional level staff to apply the methodology and models within different planning processes. Material will include system manuals, approaches, methodologies and demos.

- Confirm applicability of guidance material on a number of selected trainees in the pilot basins

This activity will focus on the development of manuals and guidance material for initial use in the 3 pilot basins and beyond (Deliverable 1).

Activity 2: Awareness workshops on DSS with decision makers

- Develop awareness raising workshop material based on experience from NBI.
- Identify participants in each basin, such as Commissioners and Senior Advisors, to take part in the workshops.
- Implement workshops with the aim of developing a better understanding of the usefulness of DSS and how the outputs can be applied effectively
- Develop and implement follow up mechanisms to continue to engage decision maker

Activity 3: Prepare training module on application of flood and drought methodological approach from basin to end user for inclusion in existing training courses

- Development of module that contains information on flood and drought methodological approach in catchment and end user context.
- Testing of module in 2-3 existing IWRM (could be through involvement in one of the CAPNET trainings) and WSP trainings to build the capacity of end users (basin representatives, water utility and industry users) in understanding the DSS application and use of the results in planning

This activity will develop and test training modules on the application of flood and drought methodological approach in existing training courses (Deliverable 2).

Outcome 4.2: Global dialogue on water security and adaptation to climate variability and change enriched by the dissemination of project outcomes.

Output 4.2.1: Communication approach developed to disseminate flood and drought methodology within pilot basins, GEF basins, and to other relevant end users.

Activity 4: Document the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders

- Document the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders
- Collect and collate information from the pilot basins through various media - video, blogs, interviews, focus groups, etc.

This activity will provide a communications roadmap to create public awareness of the developed DSS to different stakeholder groups (Deliverable 3).

Output 4.2.2: 2-3 Experience Notes and other documents and audio-visual materials produced for IW LEARN dissemination mechanisms and website.

Activity 5: Audio-visuals, documents and other materials for global dissemination with an emphasis on IW LEARN

- Analyse IW LEARN mechanisms and their requirements to materials in order to streamline it with the existing materials and to make it accessible on a global scale
- Prepare and adjust materials on the methodology and the application to meet the requirements of IW LEARN
- Identify other dissemination channels in order to reach out broadly including development of project website
- Participation in IW LEARN events

This activity will aim to develop materials and enable global dissemination through IW LEARN (Deliverable 4).

Output 4.2.3: Development of materials (4-5) developed and disseminated at major water events: WWF, Water Week, GEF IWC 7/8/9, and IWA Conferences.

Activity 6: Prepare brochures, leaflets, CDs and materials suitable for water events

- Identify water events scheduled for the near future and where the methodology would be a relevant topic for presentation
- Prepare presentation material tailor-made to water events (pamphlets, posters, etc.)

This activity produces materials for international water events (Deliverable 5).

Activity 7: Organisation of and participation in international conferences and workshops for the dissemination of methodological approaches and technical solutions across networks

- Organisation and facilitation of workshops at key events including (but not limited to):
    - IWA World Water Congress (Lisbon (Portugal), September 2014 // Brisbane (Australia), September 2016),
    - IWA Development Congress (Jordan) October 2014)
    - IWA Conference on Water, Energy and Climate (TBD)
- Support key stakeholders to attend and present at international events

This activity will support the involvement of project stakeholders in relevant international events (Deliverable 5).

8.5.2 Deliverables component 4:

1. Technical specifications and manuals for the consolidated DSS.
2. Report on output and feedback from the awareness workshops
3. Documents and presentations for training modules
4. Document describing the communication of the project deliverable to external stakeholders

5. Materials for global dissemination through IW LEARN
6. Materials for international water events

8.5.3 Description and justification of changes

This component has been updated so that capacity building and dissemination are two separate outcomes. The communications strategy development has been moved to this component under outcome 4.2, and will provide a roadmap to create public awareness of the developed DSS to different stakeholder groups.

8.5.4 Annual Workplan – Component 4

The communication roadmap will be completed by mid-2015. Technical specifications and user manuals will be developed in parallel with the methodologies in Component 1 so that professional staff will have the necessary information for application of the DSS and interpreting the outputs, and will be completed in the final quarter of 2015. Apart from trainings (output 4.1.1, Activity 2); all other component activities will be started in 2015 but will be developed throughout the project. This includes communication material, involvement in events, and engagement with IW-LEARN. See section 8.5 for a detailed description.

8.6 Updates to Budget

The updated joint IWA/DHI GEF Project budget is fully developed in Annex D over a 4-year period (funds for the project are restricted to this timeframe. The project is aware of the benefits of additional funds for the maintenance after the closure of the project; however this will require a conversation with the executing agency, UNEP and funding institution, GEF). The main budget components and costs are summarised in the following table:

UNEP Budget Components	**COSTS (US$)**		
	Original budget (GEF)	**Revised budget (GEF)**	**Co-finance**
Personnel Component Project personnel, including PMU cost, Consultants for developing training material, missions travels	3,731,668	3,599,753	14,774,367
Subcontractor Component Supporting agencies/institutions			
Training Component National and regional training courses	208,810	328,212	2,533,611
Equipment and Premises Expendable equipment, Non-expandable equipment, Premises costs	10,640	10,640	396,055
Miscellaneous Component Operation and maintenance of equipment, Reporting costs (printing and publishing), Communication costs, Project evaluation[3]	138,882	151,396	4,760,809

[3] Does not include project evaluation costs of 85,000 (UNEP funds)

Total Budget	4,090,000	4,090,000	22,464,842

8.6.1 IWA

The revised budget is attached as Annex D. The overall budget remains unchanged. There have been changes between the components to reflect the new workplan where IWA activities are more concentrated in component 3 and 4. IWA does not play a large role in component 1, however the stakeholder meetings (form component 0) are included here as this was the case in the original budget. The yearly distribution within all budget lines has changed because of the start of the project was in mid-2014.

Personnel

- Reduced from 1,273,668 USD to 1,187,753 USD. This change is mainly due to a decrease in travel expenses and a reduction in costs for consultants despite the additional consultancy focusing on gender issues.
- Communications strategy and material have been concentrated in component 4 which is has resulted in a decrease in component 3 and an increase in component 4
- Distribution within the 4 project years are changed to reflect the project activities

Training

- The training budget from IWA has increased from 208,810 USD to 288,212 USD.
- This includes all stakeholder travel for meetings, conference and trainings. The budget has been distributed across components with a decrease in component 1 (revised cost of stakeholder meetings), and an increase in the other components to cover the cost of stakeholder meetings
- Training cases are more evenly distributed across the years to allow for continuous stakeholder engagement and capacity building

Equipment and Premises

- No change

Miscellaneous

- The website cost has been removed (13,300 USD), and has been added to personnel
- The website removal is also reflected in the components and year distribution

8.6.2 DHI

The revised budget is attached as Annex D. The overall budget sum remains unchanged, but 42,000 USD has been moved from travel expenses to staff expenses, as this better reflects the project activities. The yearly distribution within all budget lines has been changed, to reflect the expected distribution within the 4 years of the project.

The changes to the DHI part of the budget include:

- Travel expenses
  - Budget sum reduced from 297,000 to 255,000 USD. (42,000 USD moved to staff expenses).
  - Distribution within the 4 project years are changed to reflect the project activities
- Staff expenses
  - Budget sum increased from 2,155,000 to 2,157,000 USD (42,000 USD added from travel expenses, and 40,000 USD moved to training expenses).
  - Distribution within the 4 project years are changed to reflect the project activities
- Training
  - 40,000 USD has been allocated for training costs
- Administration
  - The budget sum remains the same, but the distribution within the 4 project years are changed to reflect the project activities

Equipment and Premises

- No change

Miscellaneous

- No change

8.7 Overview of Annual budget - 2014-2015

During the inception/PSC meeting the detailed work of the project in 2014-2015 will be presented together with the budget and key milestones of this first year and a half of the project. An overview of the 2014-2015 budget is provided below for each organisation, with more details available in Annex D.

UNEP Budget Components	DHI (USD)	IWA (USD)	TOTAL
Personnel Component Project personnel, including PMU cost, Consultants for developing training material, missions travels	**1,072,000**	**359,747**	**1,431,747**
Subcontractor Component Supporting agencies/institutions			**0**
Training Component National and regional training courses	**10,000**	**78,254**	**88,254**
Equipment and Premises Expendable equipment, Non-expandable equipment, Premises		**3,990**	**3,990**

costs			
Miscellaneous Component Operation and maintenance of equipment, Reporting costs (printing and publishing), Communication costs, Project evaluation	**8000**	**21,148**	**29,148**
Total Budget	**1,090,000**	**463,139**	**1,553,139**

8.8 Co-financing

Project co-financing has been committed from various stakeholders including Executing Agencies, the Implementing Agency, and stakeholders in both pilot and learning basins. Commitment from stakeholders has been made through the submission of respective co-finance letters to UNEP which ensure the provision of these funds throughout the duration of the project. The cash and in kind co-financing will complement the GEF funded activities as per the project's budget.

The following table indicates the co-financing committed per stakeholder and amount.

Organisation	**Amount (USD)**
Implementing agency	
UNEP	733,000
Executing agencies	
DHI	11,277,000
IWA	2,919,842
Other stakeholders	
UNEP DHI	100,000
Volta Basin Authority	3,785,000
Lake Victoria Basin Commission	3,000,000
International Commission for the Protection of the Danube River (ICPDR)	650,000
TOTAL	**22,464,842**

9 Project Coordination and communication

9.1 Institutional framework and Implementation Arrangements

The Institutional Framework and Implementation Arrangements are shown schematically in the figure below. The Implementing agency of the Project is UNEP, while DHI and the International Water Association (IWA) are joint executing partners. On CEO endorsement of the project, a single, three-party Project Cooperation Agreement (PCA) was signed between DHI and IWA for delivery of the project. The PCA outlines the roles and responsibilities of the each of the agencies (UNEP, DHI, IWA) during project implementation.

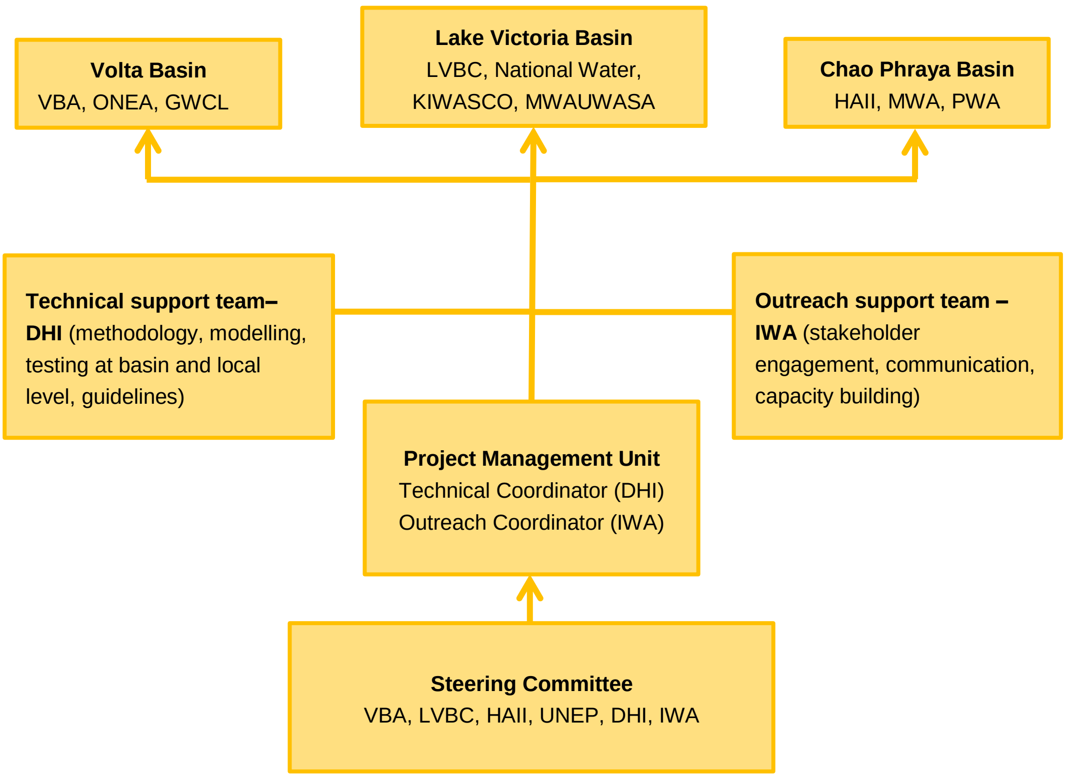


Figure 9-1 The Institutional Framework and Implementation Arrangements

9.2 Roles and Responsibilities

9.2.1 PSC

The Project Steering Committee (PSC) or Steering Committee (SC) is composed of representatives of the implementing and executing agencies (UNEP, DHI, IWA), and of the pilot basin organisations. These representatives are from LVBC, VBA and HAII. The SC will set its own operational procedures and approve its own Terms of Reference. It will meet at least once a year and thereafter as frequently as the SC itself deems necessary. The SC will review the project budget and work programs and provides feedback and policy guidance to the Project Management Unit (PMU) on such matters. Funding for SC business will be covered by the project.

The SC is responsible for providing general oversight of the execution of the Project and will ensure that all inputs and activities agreed upon in the project document are adequately prepared and implemented. In particular, it will:

- Provide overall guidance to the PMU in the execution of the project;
- Ensure that all project activities and outputs are in accordance with the project document;
- Identify, agree and facilitate any multi-country activities that would assist with the execution of activities or meeting project objectives; and
- Facilitate the dissemination of relevant project findings and recommendations globally.

Terms of Reference

The SC shall operate on the basis of consensus to:

- Provide direction, and strategic guidance to the Project Management Unit (PMU) regarding project implementation and execution of agreed activities over the entire period of the project including the establishment of timelines and milestones for provision of agreed outputs;
- Review and approve the annual work programme and budget for project execution ensuring that these remain focused on the project overall goal and objective;
- Facilitate co-operation and co-ordination among the participating institutions, organisations and agencies particularly in transboundary environmental issues and cross component issues;
- Review and evaluate progress in project implementation and execution, and provide guidance to the PMU and core partners regarding areas for improvement, paying particular attention to:
    - progress in implementation of the various project components;
    - the monitoring and evaluation plan of the project;
    - the quality of outputs produced;
    - the sustainability of the project outcomes; and
    - the replicability of actions recommended by the project; assist in soliciting wide support for the project;
- Assist UNEP and the PMU in soliciting wide support for the project and raising such additional co-financing as may be required from time to time;
- In order to enhance dissemination of project results and recommendations, the SC should review and monitor:

    - stakeholder buy-in to the project during implementation (by review of the Monitoring and Evaluation survey reports);
    - whether results reach intended targets; and
    - the risks of failure;

- Provide feedback on Project Implementation Review (PIR) reports as needed and approve progress on the results framework presented at each SC meeting;

- Consider and approve such recommendations as shall be presented to the Committee by the PMU and the all stakeholders regarding project execution;

- Review and approve the outline of, and subsequently the final reports arising from the project, including conclusions and recommendations particularly focusing on quality of outputs, and the information dissemination strategy, including its utility by potential users; and

- Agree at their first meeting:

    1. The membership, meeting arrangements and terms of reference of the committee as prepared in draft in this document; and
    2. The rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the committee.

The full ToR for the SC can be found in Annex N.

9.2.2 Project Management Unit

Owing to the specialised nature of the flood and drought modelling methodologies, the project executing agencies, DHI and IWA, have seconded existing project staff to the project to form the Project Management Unit (PMU). The PMU includes a technical coordinator from DHI and an outreach coordinator from IWA who hold weekly management meetings. The PMU will carry out the day-to-day administration of the Project and are responsible to the SC for the project activities, financial accountability, staff welfare and discipline, etc. All communications must be copied to both coordinators. Essentially the overall coordination and operation of the project is handled by the PMU, while the SC provides the PMU with strategic guidance on implementation.

The PMU will provide the SC with a draft budget review and work plan in sufficient time prior to the annual SC meeting. In terms of regular administrative reporting, the PMU will provide produce joint technical reports to UNEP management. The PMU will also assist UNEP in preparing the annual Project Implementation Review. Finally there will be a number of management, monitoring and evaluation activities that will be planned and supported by the PMU, including a midterm and final evaluation. The IWA and DHI coordinators will communicate separately to UNEP to provide their financial reports.

The PMU taps into resources in IWA and DHI to support the delivery of the project. The coordinators are employees of DHI and IWA and are tasked to coordinate the project, oversee the progress and quality of work and report to the SC.

The DHI technical coordinator works with a technical support team in DHI to develop and implement the DSS. Whereas, the IWA outreach coordinator works with staff within IWA (outreach support team) on relevant tasks such as the design and operation of the website, for the organisation of consultation and outreach conferences, workshops, and special events and for the production of dissemination materials and publications. These content support teams from IWA and DHI will report directly to the PMU. The coordinators from DHI and IWA report to their respective line managers. If there are any issues around management, then the managers from IWA and DHI are the first line of consultation.

The DHI technical coordinator will coordinate the inputs from the technical team developing the DSS in DHI (Component 1 & 2), whereas the IWA outreach coordinator will coordinate the stakeholder engagement, communication and dissemination (Component 3 & 4). Within both components there are activities which are undertaken jointly, so close cooperation is required. For example, in component 0, there is a stakeholder consultation at the project inception to incorporate end user needs into the DSS. The project management unit will have regular update meetings to enable smooth coordination of project inputs and outputs. They will also be responsible for semi-annual reporting, communication with partners and the UNEP task manager.

Permanent focal points in the pilot basins (basin facilitators) will be selected among existing staff within the executing agencies that are present in the region. IWA will have staff in each of the pilot basins, and (potentially) the learning basins. These staff will have the role of relationship building and to facilitate that the basin visits from the coordinators and technical support teams are productive. The basin facilitators will report directly to the PMU. The PMU will liaise with these contact points to organise meetings, identify stakeholders and implement actions on the ground assisted by short term DHI and IWA staff. DHI will have direct contact with the key stakeholders, but keeping the focal points copied in any communication as they will be in a good position to further support continued cooperation.

Terms of Reference

Project Management Unit (PMU)

Responsible for the successful implementation project, the PMU will be, where required, guided by the decisions of the SC, to support the implementation of project outputs through the following tasks:

- Program management (financial, logistical, monitoring and strategic) particularly;
- Assistance in networking with Basin Teams and all participating countries;
- Coordination and oversight of the work carried out by project partners;
- Assistance in implementing basin pilots through guidance and administrative support;
- Maintenance of project information archives – photos, video, documents, outputs, etc.;
- Appropriate dissemination and publication of materials and outputs from the project; Capturing lessons learned and disseminating them in appropriate formats (project website and links to IW:LEARN, etc.);

- Coordination with the other GEF and non-GEF programs and activities to ensure relevant linkages are made between water projects;
- Coordination with other international, multilateral and bilateral activities among participating countries related to the implementation of the project, including sourcing additional funding to ensure future sustainability of project interventions;
- Financial reports will be provided separately by DHI and IWA, but there will be joint technical reports from the PMU.

The PMU shall consist of the following officers:

- Partners Focal Points – Technical coordinator (DHI) and Outreach coordinator (IWA)
- Administrative and support staff as required from DHI and IWA

9.3 Communication strategy

As part of Component 4, a communications roadmap to guide external and internal communications will be developed. The approach is described in this inception report; however a separate communications strategy document will be produced and updated throughout the project.

The project communications strategy is intended to guide project participants' communications, both internally and externally: thus, it should be considered a framework reference not only for communication products related to the project, but also more widely for all communications, including the way project advisors communicate with the partners, the way the project communicates with GEF, the public etc. The communication strategy is a living document, as it will need to be updated as stakeholders' perceptions, positions and commitment to the project will change over time.

The strategy will also provide guidance for the documentation of the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders.

9.3.1 Communication goals and objectives

The GEF project rationale is based on the recognition that climatic variability and change is being increasingly experienced in the form of more frequent, severe and less predictable floods and drought events. The highlighted phrases in this statement help point towards the overarching communications objectives: There is ***a growing sense of urgency*** among countries, basin organisations and other end users such as utilities of the ***need to build resilience*** towards floods and droughts as an integral part of the management of water resources. The growing risks related to hydrologic uncertainty are magnified in transboundary contexts, where ***cooperation among countries is essential*** to any coping strategy.

The objective of the project is to improve the ability of land, water and urban area managers operating in transboundary river basins to ***recognise and address the***

implications of the increased frequency, magnitude and unpredictability of flood and drought events.

This suggests the priorities are to communicate:

- The urgency of the situation (stating the need for the project);
- Identified need to build resilience (outlining the solution required);
- That cooperation amongst countries is essential (stakeholders and their desired attitude identified, FDM&T project positioned as 'bridge' connecting them);
- Water managers ***recognise and address the implications*** (concrete outcome identified, goal set.).

These goals and objectives will be revisited as the project develops and highlighted at each project steering committee meeting.

A series of tools to develop the communications strategy are outlined in Annex M. These will be to draft the internal and external project communications strategy before the end of Year 1 of the project, which will be continuously updated at regular intervals.

9.3.2 Key messages

Several draft key project messages have been developed reflecting the intervention strategy in Section 2.

Key message: Future changes (climate change, land use changes) are altering weather and water patterns around the world, causing increased floods in some areas and shortages and drought in others

- Floods and droughts are increasingly common, more severe and less predictable, increasingly large numbers of people globally need to adapt their lives to this reality
- We need to plan better to prevent and prepare for the expected negative impact on human welfare, ecosystems and economies
- Through the development of decision support system (DSS)(which integrates data and information in a usable interface) , the project will improve the ability to address the increased frequency, magnitude and unpredictability of flood and drought events

Key message: Better water management planning from local to transboundary level will build resilience to floods and droughts

- Joint stakeholder development of tools for improved flood and drought planning ensures improved use of information planning
- Integration of data through a Decision Support System provides consolidated information for flood and drought decision making and planning at basin and local scale

- Cooperation and information sharing between governments, agencies, institutes, organisations, within countries and across borders and at different levels, leads to better planning and reduced impact of severe flood and drought events

Key message: There is a growing urgency among countries, basin organisations and water end-users, such as utilities, of the need to build resilience towards floods and droughts as an integral part of different planning processes including integrated water resource management, water safety planning, and Transboundary Diagnostic Analyses (TDA) and Strategic Action Plans (SAP).

- The risks and impacts of flood and drought are magnified in transboundary river basins when two or more countries share a water source
- Uncertainty and lack of information dramatically increases flood and drought impacts risks for countries and their negative impacts on people, ecosystems and economies, the project is a bridge between countries to mitigate these impacts
- Enabling river basin managers and water utilities to access and share accurate information catalyses cooperation, helps planning, builds resilience to future floods and droughts, and protects water resources

Key message: Building resilience to severe adverse impacts from floods and droughts requires cooperation amongst countries

- There is a lack of available information, planning and coordination within countries or across national borders in transboundary river basins
- Understanding and planning around the risks of floods and droughts is critical for decision makers to plan appropriate responses
- The project will integrate existing information on flood and drought into planning and analysis processes at different scales to allow land, water and urban area managers to better prepare for water-related risks

Key message: Climate change is only one factor impacting floods and droughts, governments and planners must consider all factors to deliver resilient solutions

- Population growth, economic development, urbanisation, technology developments and changing land use all influence water availability and flood risk
- The Decision Support Systems is a key tool for understanding flood and drought vulnerability from a climate change perspective, and aims to improve management and decision making to reduce risks and mitigate the consequences
- The Decision Support System will aid in the estimation of future water demand and availability, as well as decision making and planning for extreme weather events

9.3.3 Communication channels

The project will be communicated through a mix of direct and indirect channels, and will disseminate information to each audience based on the level of commitment and influence (see Annex M), what their involvement/engagement with the project is, and what media they typically consume. These will include:

Third party media: We will target key political and financial media in the partner countries, to raise awareness of the project and influence government/inter-governmental stakeholders this way.

The IWA media team will also reach out to carefully selected, key scientific journals and environmental periodicals, to highlight the benefits of our efforts, with a view to greater support/interest and uptake of the flood and drought planning tools being developed.

Direct communications: Creations of a set of materials – fliers, internal Q&A, presentations, web materials, etc. – that we can use in direct engagement with key stakeholders. These can be further classified along political/financial/environmental areas.

Special interest groups: we will use events and group discussions (both online and offline) with special interest groups like IWA membership, Specialist Groups, young water professionals, utilities member associations in partner countries and so on, to disseminate information about the project on an ongoing basis.

In addition, there are some communications channels unique to this project, including IW LEARN http://iwlearn.net/.

9.3.4 Communication materials

In order to support this communications strategy, a set of core materials will need to be created at the outset, and supplemented in following phases of project delivery.

Communications materials	Audiences	Timeline - TBC
Project fact sheet (v1) available in English, French and Thai	Stakeholders in pilot basins; interested organisations in other basins (Danube, Nile) and at the global level; Water and climate professionals, institutions and networks	August 2014
Project fact sheet available in French	Stakeholders in pilot basins; interested organisations in other basins (Danube, Nile) and at the global level; Water and climate professionals, institutions and networks	September 2014
Project fact sheet available in Thai	Stakeholders in pilot basins; interested organisations in other basins (Danube, Nile) and at the global level; Water and climate professionals, institutions and networks	October 2014
Websites: F&DMT website launched through IW –LEARN http://fdmt.iwlearn.org/ Project also highlighted on IWA website	Web audience connected to GEF projects; Water and climate professionals, institutions and networks	Started July 2014 updated periodically
Media pack: Including project factsheet as	Third party media identified as key to influencing relevant audiences	Q3 – March 2015

above, key spokespeople for the project, broad timeline for the project, announcement press release in each pilot basin (to be developed in collaboration with basin partners)		
Audio-visuals: Photos and/or video from each pilot basin to be curated/created to support media pack. All AV material needs to be centrally stored and made available to project teams in all three countries	As above	Q3 – March 2015
Project Q&A	For internal as well as external use	Q2 – Dec 2014
Offline communications (via international and regional events, specialist groups, conferences etc.)	Water and climate professionals, institutions and networks	Q2 onwards
Social media: IWA and DHI channels	IWA and DHI Membership, partners, academia, scientists, public sector professionals	Q2 onwards
Communications materials	Audiences	Timeline - **TBC**
Project fact sheet (v1) available in English, French and Thai	Stakeholders in pilot basins; interested organisations in other basins (Danube, Nile) and at the global level; Water and climate professionals, institutions and networks	August 2014
Project fact sheet available in French	Stakeholders in pilot basins; interested organisations in other basins (Danube, Nile) and at the global level; Water and climate professionals, institutions and networks	September 2014
Project fact sheet available in Thai	Stakeholders in pilot basins; interested organisations in other basins (Danube, Nile) and at the global level; Water and climate professionals, institutions and networks	October 2014
Websites: Project website launched through IW:LEARN http://fdmt.iwlearn.org/ Project also highlighted on IWA website	Web audience connected to GEF projects; Water and climate professionals, institutions and networks	Started July 2014 updated periodically
Media pack: Including project factsheet as above, key spokespeople for the project, broad timeline for the project, announcement press release in each pilot basin (to be developed in collaboration with basin partners)	Third party media identified as key to influencing relevant audiences	Q3 – March 2015
Audio-visuals: Photos and/or video from each pilot basin to be curated/created to support media pack. All AV material needs to be centrally stored and made available to project teams in all three countries	As above	Q3 – March 2015

Project Q&A	For internal as well as external use	Q2 – Dec 2014
Offline communications (via international and regional events, specialist groups, conferences, etc.)	Water and climate professionals, institutions and networks	Q2 onwards
Social media: IWA and DHI channels	IWA and DHI Membership, partners, academia, scientists, public sector professionals	Q2 onwards

10 Monitoring and Evaluation

An introduction on GEF monitoring and evaluation (M&E) requirements, the review of process, stages and requirements of the GEF M&E process will be provided together with information about GEF and UNEP project implementation responsibilities during the inception/steering committee meeting.

Information on basic principles of project monitoring, adaptive management, project budget, and evaluation system will be provided. A focus will be on the details of project implementation during 2014-15 (first year and a half), as well as management arrangements.

According to GEF funding agreements the purpose and outcomes of the approved project cannot be revised without clearance from GEF Secretariat. Any required changes or additions to the project outputs or activities should be documented and will be presented to the Steering Committee in their next meeting for approval.

10.1 GEF Monitoring and Evaluation requirements

The project will follow UNEP standard monitoring, reporting and evaluation processes and procedures. Substantive and financial project reporting requirements are in Appendix 8 of the project document. Reporting requirements and templates are an integral part of the UNEP legal instrument to be signed by the executing agency and UNEP.

The project M&E plan is consistent with the GEF Monitoring and Evaluation policy. The Project Results Framework presented in Appendix B includes SMART indicators for each expected outcome as well as mid-term and end-of-project targets. These indicators along with the key deliverables and benchmarks included in Appendix 6 of the project document will be the main tools for assessing project implementation progress and whether project results are being achieved. The means of verification and the costs associated with obtaining the information to track the indicators are in Appendix 7 of the project document, and an overview is provided below. Other M&E related costs are also presented in the Costed M&E Plan and are fully integrated in the overall project budget.

The M&E plan will be reviewed and revised as necessary during the project inception workshop to ensure project stakeholders understand their roles and responsibilities vis-à-vis project monitoring and evaluation. Indicators and their means of verification may also be fine-tuned at the inception workshop. Day-to-day project monitoring is the responsibility of the project management team but other project partners will have responsibilities to collect specific information to track the indicators. It is the responsibility of the PMU to inform UNEP of any delays or difficulties faced during implementation so that the appropriate support or corrective measures can be adopted in a timely fashion.

The project Steering Committee will receive periodic reports on progress and will make recommendations to UNEP concerning the need to revise any aspects of the Results Framework or the M&E plan. Project oversight to ensure that the project meets UNEP and GEF policies and procedures is the responsibility to the Task Manager in UNEP-GEF. The Task Manager will also review the quality of draft project outputs, provide feedback to the project partners, and establish peer review procedures to ensure adequate quality of scientific and technical outputs and publications.

Type of M&E activity	Responsible Parties	Time frame
Inception Workshop *Including confirmation of logframe at basin and global levels and development of gender disaggregated indicators as appropriate.*	PMU	Within first two months of project start up
Inception Report	PMU and Executing Agencies UNEP DEPI	Immediately following workshop
Measurements of Means of Verification for Project Progress and Performance (measured on an annual basis)	PMU External consultants when required Executing Agencies	Annually
APR and PIR	PMU and Executing Agencies UNEP DEPI	Annually
TPR and TPR report	Government Counterparts Project team UNEP-GEF	Every year, upon receipt of APR
Steering Committee Meetings	PMU Project Steering Committee UNEP DEPI Executing Agencies	Following Project Inception and subsequently at least once a year
Quarterly Progress Reports	PMU	Quarterly
Mid Term Evaluation	PMU UNEP EOU External Consultants	At mid-term.
Final External Evaluation	PMU UNEP EOU External Consultants	At the end of project implementation
Terminal Report	PMU	At least one month before the end of the project
Lessons learned	PMU External Consultants as required	Yearly
Audit	PMU External Auditor UNEP DEPI	Yearly
Total Indicative Cost - *Excluding project team staff time and UNEP staff and travel expenses*		85,000 USD

Project supervision will take an adaptive management approach. The PMU will develop a project supervision plan at the inception of the project that will be communicated to the project partners during the inception workshop. The emphasis of the PMU supervision will be on outcome monitoring but without neglecting project financial management and implementation monitoring. Progress vis-à-vis delivering the agreed project global environmental benefits will be assessed with the Steering Committee at agreed intervals. Project risks and assumptions will be regularly monitored both by project partners and UNEP. Risk assessment and rating is an integral part of the Project Implementation Review (PIR). The quality of project monitoring and evaluation will also be reviewed and rated as part of the PIR. Key financial parameters will be monitored quarterly to ensure cost-effective use of financial resources.

An independent terminal evaluation will take place at the end of project implementation, and the process will be managed by UNEP's Evaluation Office. The terminal evaluation (TE) will provide an independent assessment of project performance (in terms of relevance, effectiveness and efficiency), and determine the likelihood of impact and sustainability. It will have two primary purposes: (i) to provide evidence of results to meet accountability requirements, and (ii) to promote learning, feedback, and knowledge sharing through results and lessons learned among UNEP, the GEF and the executing partners. A review of the quality of the evaluation report will be submitted along with the report to the GEF Evaluation Office not later than 6 months after the operational completion of the project.

11 Conclusions and next steps

The Flood & Drought Management Tools project defines a need to develop a methodology that works both on a transboundary level and the local level. GEF projects tend to look just at the transboundary level. Lately there has been a push to put emphasis on end users, such as utilities. Decision made at the regional level (basin) and the local level needs to be linked, the project looks to also address this aspect of inter-level communication. The methodology being developed will be an open source progamme, meaning basin authorities, national authorities, utilities, etc., can freely take up the methodology and further develop to enhance their planning experience. The methodology will be flexible, i.e. stakeholders can develop their own indicators, are free to decide which models to use, pull experiences from other basins, etc.

It is important to note that the project will not collect data, however, tools will be put in place to assist stakeholders in monitoring the status of their basin. The project will utilise existing models such and not develop something new, we are not in a position to develop new models to facilitate data generation. What the project will produce is a tool that will assist basin level organisation and end users (i.e. utilities) in their planning processes in the likelihood of a flood and drought events.

The stakeholder meetings have helped identify other projects or initiatives that the project can work with that could potentially undertake data collection and knowledge gaps of the basin. This project/tool provides the framework to bring such data together and make it accessible. However, a one-size-fits-all concept does not work due to varying capacities and resource. A combination of remote sensing and available data on the ground will be considered, to tailor to the situation of the country.

The joint stakeholder inception meeting – November 23rd and 24th, 2014 is an opportunity for the different basin and utility representatives to become familiar with each other and understand the project methodology and overall approach. The discussion from this meeting will be invaluable in completing the inception period and provide clear items for approval during the inception/steering committee meeting.

Conclusions and next steps will be elaborated based on the discussion during the joint stakeholder inception meeting – November 23rd and 24th, 2014 and the inception/steering committee meeting – March 2015.

ANNEX

Annex A. Draft meeting agenda – Joint Stakeholder Inception Meeting

Day 1 – Sunday 23rd November 2014 - Technical Tour in Ayutthaya

Time	Item
08:00	Pick up at hotel
9.30 -10:30	Arrive at the Fine arts department regional office, Ayutthaya
	Welcome message by the Flood & Drought project team
	Presentation “Ayutthaya after the Flood” by Dr. Surajate Boonya-aroonnate (HAII)
10.30 - 10:45	Break
10.45 - 12:00	Visiting flood affected area, historical canals and mitigation structures within Ayutthaya Historical Park
12.00 – 13:30	Lunch
13.30 -16:00	Visiting flood management & mitigation structures
	Historical flood retarding basin (Tung Makhamyong)
	Proposed flood bypass channel by JICA
	HAII weather & flood monitoring stations
16.00	Travel back to Bangkok
17.30	Arrive at hotel

Day 2 – Monday 24th November, 2014 - Inception meeting

Chair: UNEP

Time	Item	Responsible
09:00 - 09:15	Opening and Welcoming Address	HAII UNEP
09:15 – 09:30	Introductions	All
09:30-09:45	Review of agenda Overview of project and governance structure	IWA
9:45 – 10:00	Presentation by VBA on status and main issues within the Volta basin	VBA
10:00 – 10:15	Presentation by LVBC on status and main issues within Lake Victoria Basin	LVBC
10:15 – 10:30	Presentation by HAII on status and main issues within the Chao Phraya basin	HAII
10:30 – 10:45	Q&A	UNEP
10:30-11:00	*BREAK*	
10:45 - 11:00		
11:00 – 11:15	Summary of findings from stakeholder consultations	IWA
11:15 – 11:45	Project methodology - Intervention strategy - Presentation of proposed design and development of DSS	DHI
11:45 – 12:00	Q&A	UNEP
12:00 - 14:00	*LUNCH*	
14:00 – 14:30	Component 1 and 2 - Overview of project components and deliverables - Includes review of the full project work plan - Annual workplan and budget	DHI
14:30 – 15:00	Component 3 and 4 - Overview of project components and	IWA

	deliverables - Includes review of the full project work plan - Annual workplan and budget	
15:00 – 15:30	Stakeholder roles and responsibilities (DHI)	DHI
15:30 – 15:45	Q&A	UNEP
15:45 - 16:00	***BREAK***	
16:00 - 16:45	Discussion and Q&A	IWA/DHI
16:45 - 17:00	Final wrap up and closing remarks (all)	UNEP

Annex B. Results Framework

Project Objective				
The objective of the project is to improve the ability of land, water and urban area managers operating in transboundary river basins to recognise and address, as part of the TDA-SAP, IWRM and water safety planning processes, the implications of the increased frequency, magnitude and unpredictability of flood and drought events.				
Objectively Verifiable Indicators			**Means of Verification**	**Assumptions**
Indicator	**Baseline**	**Target**		
DSS software containing tools for supporting technical activities within flood and drought planning, to recognise and address the impacts and the transboundary implications of floods and droughts on human livelihoods, economic activities, and ecosystems. Based on a planning approach linked to the IWRM, TDA/SAP and WSP methods. Functionality validated and verified on at least 6 application areas in the 3 basins.	GEF client countries, transboundary basin organisations, and end users including water suppliers, regulators, and industries, lack adequate guidance and tools for addressing the impacts and the transboundary implications of the changing frequency and magnitude of floods and droughts.	A flexible methodological approach with DSS tools addressing stakeholder priorities, especially the impact on end users, is fully developed and tested in three pilot basins.	Delivered and tested DSS software and training documentation, supporting existing planning methods on basin and local scale, applied and validated in the three pilot basins.	Present available tools for short and long term planning with respect to flood and droughts, at basin and local scale and the inclusion in existing planning methods are presently lacking, and the project will allow the development of a flexible, generic methodological approach; potential basin end-users are interested and able to engage in the process.

Component 1 Development of methodology and tools					
	Objectively Verifiable Indicators			Means of Verification	Assumptions
	Indicator	Baseline	Target		
Outcome 1.1 Methodologies with tools aimed at increasing understanding of flood and drought dynamics and impacts at transboundary and local levels and including enhancement of commonly used decision support systems, fully developed jointly with pilot basins stakeholders.	Reports and recommendations for how to apply the DSS in a planning context. Clear direction for the development and application of the DSS to accommodate basin and local stakeholders' concerns.	Lack of tools and methodologies integrating climate and land use changes into existing planning methods (including TDA/SAP, IWRM planning and WSP). Baseline: 0	Developed methodological approach, through stakeholder consultation for on the ground application in the 3 pilot basins and with at least 3 basin end-users (basin organisations), and 3 local end-users (water supply utilities) in the pilot basins. Midterm target: Global applicable methodology to be applied with TDA/SAP and WSP planning developed with stakeholders in the 3 pilot basins End of project target: Methodological approach validated and tested within the three pilot basins.	Description (reported) of how to apply the DSS in a planning context, based on at least 6 application areas used for testing and validating the functionality within flood and drought related planning. Description of idealised version for global application and locally adjusted version based on practical implementation in the pilot basins. Software development plan.	Presently existing and accessible information, knowledge, monitoring systems and modeling tools will allow the development of a broadly applicable methodological approach.
Output 1.1: At least 6 step by step methodologies with tools adopting a basin and local approach, including enhancements for decision support systems, that would allow the integration of flood and drought issues into (i) the	At least 6 step by step methodologies describing how the DSS could be applied in a planning context, specifically TDA/SAP, WSP and IWRM implementation.	Lack of existing integrated methodologies Baseline: 0	6 step by step methodologies developed across the 3 pilot basins with a variety of end users. Methodologies have clear descriptions of development and application of the DSS	Reports for planning approach and application of DSS validation within selected application areas which include: • Description of consolidated idealised planning methodologies • Description of the applied	Available information and knowledge will allow for the development of a methodological approach. Stakeholders unwilling to engage and recognise

TDA-SAP GEF IW or equivalent processes, and (ii) IWRM plans and (iii) Water Safety plans	Description of idealised and locally adjusted version based on practical implementation. Reported planning approach linking DSS with existing planning methods.		based on the planning requirements (from TDA/SAP, IWRM planning and WSP) and feedback from the stakeholders. Midterm target: Global applicable methodology to be applied within TDA/SAP and WSP planning. End of project target: Methodological approach validated and tested within the three pilot basins.	application in the pilot basins. Including workplan, data requirement and objective • Software development plan • Gender and social dimension in flood and drought management • Feedback and comments from stakeholders, project steering committee and project review group	the need for technical planning tools. Data owners, including the private sector, unwilling to share available information.

Component 2 Validation and testing at basin-wide level					
	Objectively Verifiable Indicators			**Means of Verification**	**Assumptions**
	Indicator	**Baseline**	**Target**		
Outcome 2.1 Application of the [step by step methodologies] at the basin level using DSS tools in the three pilot basins enables the integration of flood and drought issues into the IWRM, TDA-SAP and other planning processes.	Management options and recommendations formulated for managing floods and droughts in planning (TDA/SAP, IWRM) across the 3 pilot basins.	Floods and droughts issues currently not integrated into TDA/SAP, WSP and other planning processes.	Application of the DSS at basin level and recommendations for integrating floods and droughts in TDA/SAP and IWRM plans developed in 3 pilot basins.	Report describing the application of the DSS at basin level, this includes lessons learned from the DSS validation within a potential application area. Strategic recommendations for inclusion of the DSS in existing planning methods at basin level.	Governments of the participating countries and key stakeholders convinced of the importance of addressing floods and droughts as part of the TDA/SAP and IWRM processes, will cooperate actively to the refinement,

		Baseline: 0	Midterm target: DSS applied and validated in the three pilot basins. End of project target: Validated DSS available for application in other basins	Evaluation of the DSS functionality presented and discussed at workshops at basin level.	experimentation and testing of the new methodological approach.
Output 2.1: Strategic recommendations for inclusion of flood and droughts consideration in IWRM, TDA/SAP, WSP and other basin land and water planning tools in the 3 selected pilot basins.	Report describing the application of the DSS at basin level, through the DSS validation on selected application areas, including strategic recommendations for inclusion of floods and droughts considerations in TDA/SAP, WSP and IWRM. Report outlining evaluation of DSS validation on selected application areas at the basin level through project review group	Recommendations for how to incorporate information on floods and droughts from DSS in existing planning methods are lacking. Baseline: 0	Strategic recommendations for application and the DSS use of information on floods and droughts in existing planning methods including TDA/SAP and IWRM planning in 3 pilot basins. Midterm target: Strategic recommendations based on feedback from project stakeholders in the 3 pilot basins and learning basins. End of project target: Strategic recommendations ready for dissemination to a wider range of basin stakeholders.	Reports from application at basin scale including: • Description of the application of the developed DSS at basin level, including recommendations and lessons learned. • Strategic recommendations for inclusion of the DSS in existing planning methods at basin level • Evaluation of the DSS validation at basin level • Software package with DSS for application at basin level • Feedback and comments from stakeholders, project steering committee and project review group	Stakeholders recognise the need for use of technical tools in existing planning methods at basin and trans-boundary level.

Component 3 Validation and testing at local level					
	Objectively Verifiable Indicators			**Means of Verification**	**Assumptions**
	Indicator	**Baseline**	**Target**		
Outcome 3.1 Application of the step by	Water Safety Plans and other land and	Present approaches to WSP and supply	At least 3 end users (e.g. a utility) within the 3	Report describing the application of the DSS at local level, this	Stakeholders in pilot basins, including those in

step methodologies at lower administrative levels using DSS tools in the three pilot basins enables the integration of flood and drought issues into local level planning (e.g. water safety planning) for water suppliers and regulators, (agro) industries and urban area managers to consider options for increased resilience and preparedness to F&D within broader basin context with an emphasis on vulnerable groups affected by water related shocks.	water planning instruments developed by key stakeholders in identified sites within pilot basins, incorporate the findings and guidance on flood and drought management in a basin (transboundary if applicable) context derived from the application of the developed basin-wide methodological approach.	planning adopted by water suppliers and regulators, cities and industries, are generally fragmented, not integral to basin management, and do not focus on floods and droughts issues and their transboundary implications. Baseline: 0	project pilot basins integrate the project findings and recommendations into land and water planning instruments while cooperating with stakeholders in the wider basin. Midterm target: DSS applied and validated at the water utilities within the three pilot basins. End of project target: Validated DSS available for application at water utilities outside of the pilot basins	includes lessons learned from the DSS validation on selected application areas. Strategic recommendations for inclusion of the DSS in existing planning methods at local level. Evaluation of the DSS validation on selected application areas presented and discussed at workshops at local level.	urban areas including utilities and industries, will participate in project activities, cooperate with basin organisations and governmental bodies, and engage in reforming their water safety plans and other planning instruments.
Output 3.1: Recommendations for inclusion of flood and drought issues in WSP and other local planning methods in the 3 pilot basins with integration of urban and (agro-) industrial water users' perspectives and realities.	Report with recommendations describing the application of the DSS at local level, through the DSS validation on selected application areas; this includes lessons learned from the DSS validation. Report outlining evaluation of the DSS validation at the local level through project review group	Recommendations for how to incorporate on floods and droughts from a DSS in existing planning methods for water utilities and other utilities at local and urban level are lacking. Baseline: 0	Strategic recommendations for application and the DSS use of information on floods and droughts in existing planning methods at the local level with at least 3 end users (utilities across the 3 pilot basins Midterm target: Strategic recommendations based on feedback from at least 3 end users (utilities across the 3 pilot basins.	Reports from application at local scale including: • Application of the developed DSS at local level. This includes recommendations and lessons learned for applying the planning methodology • Strategic recommendations for inclusion of the DSS in existing planning methods at local level • Evaluation of the DSS validation at local level • Software package with DSS for application at local level • Feedback and comments from stakeholders, project	Stakeholders recognise the need for use of technical tools in existing planning methods at the local level.

			End of project target: Strategic recommendations disseminated to a wider range of water utilities	steering committee and project review group	

Component 4 Capacity building and dissemination					
	Objectively Verifiable Indicators			**Means of Verification**	**Assumptions**
	Indicator	**Baseline**	**Target**		
Outcome 4.1 Experience and know how gained through the project is made available within the GEF system and beyond.	A learning package including technical specifications and training materials for the application of the new methodological approach, integrating the results of consultations and of its testing in pilot basins.	Land, water and urban managers, and key stakeholders lack access to approaches and tools and guidance on the modalities of their application. Baseline: 0	Broadly applicable training and technology transfer package, developed with the contribution of key stakeholders and decision makers in all pilot basin. Midterm target: Training material developed and used by project stakeholders across the 3 pilot basins End of project target: Training material applicable for use outside of the pilot basins.	Technology Transfer Report, providing evidence of (i) the participation of decision makers and other stakeholders to the capacity building activities, (ii) their positive evaluation of the activities effectiveness, and (iii) their contribution to the finalisation of the technology transfer package.	The project's implementing and executing agencies are able to facilitate and foster the engagement of, and cooperation among the complex set of actors involved in floods and droughts management.
Output 4.1.1: Learning package including technical specifications and	A learning package including technical specifications and	Insufficient training material and understanding of the	Training package developed and applied (at least 2-3 trainings	Technical specification and manuals for the consolidated DSS. Documentations and	The project's implementing and executing agencies

training materials for the application of the new methodology with DSS tools is tested in 2-3 trainings with basin officials, utility and industry management and operational staff, and representatives from civil society with 15-30 people per training.	training materials for the application of the new methodological approach, integrating the results of consultations and of its testing in pilot basins.	application of methodologies for DSS to improve flood and drought management across a variety of basins Baseline: 0	with 15-30 people) for different types of stakeholders across basins. 2-3 awareness raising workshops for decision makers across pilot basins which also include neighbouring basins Midterm target: Training package developed and applied in awareness workshops within the 3 pilot basins. End of project target: Training package applicable for use outside of the pilot basins.	presentations for the training modules and awareness raising workshops	are able to facilitate and foster the engagement of, and cooperation among the complex set of actors involved in floods and droughts management.
Outcome 4.2 Global dialogue on water security and climate resilience enriched by the dissemination of and awareness raising on project outcomes.	Communication materials and messages developed by the project feature prominently at the WWF, Water Week, GEF IWC 8/9, and IWA Conferences and other major water events.	The GEF IW Strategies and the international discourse on water policy lack focus on the transboundary implications of the increased frequency of extreme climatic events. Baseline: 0	Future GEF Strategies, and global water processes show adherence to the approach developed by the project. Midterm target: Information on the project methodology is disseminated through IW LEARN	Number of Experience Notes and other documents and audio-visual materials produced for project and IW LEARN dissemination mechanisms and website. GEF foundational projects adopt the application of the new methodological approach as part of the TDA-SAP process, and implementation of IWRM.	There is sufficient interest and understanding of the applicability of the DSS for improving flood and drought management planning from basin to local level

			End of project target: The DSS and methodologies are incorporated into GEF materials (e.g. through IW LEARN)		
Output 4.2.1: Communication approach developed to disseminate flood and drought methodology within pilot basins, GEF basins, and to other relevant end users.	Communication strategy guides application of project outputs and provides roadmap for promotion and disseminations	Lack of systematic and applicable communication products explaining the necessity of have a scientifically sound approach for incorporating flood and drought management into planning	Communication strategy which can be used to communicate project outputs through various media at global, basin and local level Midterm target: Project communication strategy used across 3 pilot basins to communicate project actions and outputs End of project target: Key messages and communication products are incorporated into stakeholder communication approaches	Published communication strategy Series of communication outputs - reports, videos, blogs, disseminated and promoted through various media	As above
Output 4.2.2: 2-3 Experience Notes and other documents and audio-visual materials produced for IW LEARN dissemination mechanisms and website.	Material developed for IW LEARN is referred to within GEF IW projects and other basins (beyond GEF)	The GEF IW Strategies and the international discourse on water policy lack focus on the transboundary implications of the increased frequency of extreme climatic events.	Future GEF Strategies, and global water processes show adherence to the approach developed by the project. Midterm target: Information on the	Communication material promoting use of project outputs specifically for IW LEARN	As above

			project methodology is disseminated through IW LEARN End of project target: The DSS and methodologies are incorporated into GEF materials (e.g. through IW LEARN)		
Output 4.2.3: Communication materials (4-5) developed for and participation in major water events: WWF, Water Week, GEF IWC 8/9, and IWA Conferences.	Communication material developed is used in a variety of traditional and non-traditional media to promote and disseminate project outputs	Lack of clear information on the application and use of DSS for flood and drought management at basin and local level	Reference of project tools and methodologies (as part of the DSS) in 1-2 basins/localities beyond the project Midterm target: Project information is shared at least 1 event in each basin and 1 event at the global level End of project target: Project outputs are referenced by stakeholders beyond the pilot basins	Communication material promoting use of project outputs	As above

Component 1 Development of methodology and tools	
Activities	**Objectively verifiable indicators**
Activity 1: Needs assessment with respect to flood and drought issues (based on the stakeholder consultations)	Inception report
Task 1: Key findings with respect to implementation of flood and drought in planning	As above
Task 2: Identification of key issues relevant for the project	As above
Activity 2: Assessment of the gender and social dimensions in flood and drought management	Document on gender and social dimensions in flood and drought management
Task 1: Consultations and stakeholder involvement in flood prone areas within pilot basins	As above
Task 2: Identify water relevant gender indicators being adopted and monitored by countries, if any	As above
Task 3: Identify impacts of droughts on men and women/girls, including hygiene, and analyze options for diversified livelihood support for women during droughts	As above
Activity 3: Methodologies for including flood and drought in planning	Report describing the consolidated idealised step by step methodologies
Task 1: Describe idealised methodologies for including floods and drought issues into existing planning methods	As above
Task 2: Collect and analyse evidence of how flood and drought issues are affecting the pilot basins	As above
Task 3: Inventory of previous and existing initiatives related to floods and drought issues and taking contact to those that may be relevant for cooperation/lessons learnt including GWP/WMO	As above

Task 4: Develop idealised methodologies for DSS components for flood and drought issues in a planning context	As above
Activity 4: Methodologies for including future change (climate and land use change) in planning	Report describing the consolidated idealised step by step methodologies
Task 1: Describe idealised methodologies for including future change (climate and land use changes) into existing planning methods	As above
Task 2: Collect and analyse evidence of how future changes (climate and land use changes) are affecting the pilot basins	As above
Task 3: Inventory of previous and existing initiatives related to climate change and taking contact to those that may be relevant for cooperation/lessons learnt including World Bank supported initiatives such as WB GAMS	As above
Task 4: Develop idealised methodology for DSS components for future change including global climate change impacts in a planning context	As above
Activity 5: Develop and consolidate methodologies to apply DSSs in TDA/SAP, IWRM and WSP	Report describing the consolidated idealised step by step methodologies
Task 1: Develop a methodologies for flood and drought with respect to DSS components	As above
Task 2: Demonstrate the use of DSS with representatives from basin organisations, urban water utilities and relevant industries to resolve typical hot-spot issues in planning processes	As above
Task 3: Consolidate stakeholder input to idealised methodologies	As above
Task 4: Establish and consult with international experts to define guideline materials needed for incorporating flood and drought methodologies into planning processes	As above
Activity 6: Develop DSS which integrates flood and drought management decisions in water resources management planning	Software development plan

Task 1: Develop functionality of DSS to be applicable for basin organisations to improve planning for management of flood and drought risk in each of the pilot basins. The process will be developed in collaboration with users, experts and partners, as well as relevant civil society to ensure vulnerable localities impacted by floods and droughts.	As above
Task 2: Develop functionality of DSS to be applicable for water utilities to improve planning for management of flood and drought risk in each of the pilot basins. The process will be developed in collaboration with users, experts and partners, as well as relevant civil society to ensure vulnerable localities impacted by floods and droughts.	As above
Task 3: Prepare a detailed design of flood and drought DSS components	As above
Task 4: Consolidate stakeholder input to methodologies to DSS	Described in a separate note connected to the software development plan
Task 5: Prepare a software development plan	As above
Task 6: Initiate software development	As above

Component 2 Validation and testing at basin-wide level

Activities	Objectively verifiable indicators
Activity 1: Establish working environment for application of methodologies with DSS tools in pilot basins	Document describing the application of the developed DSS at basin level. This includes recommendations and lessons learned for applying the planning methodology
Task 1: Plan application in pilot basins together with project partners (responsibilities, data sharing agreement, workplan etc. for application)	As above

Task 2: Transboundary basin and national water managers who are specifically involved in responding to water related risks provide guidance to identify and select specific areas for application. Involvement of relevant civil society to ensure that areas selected take into account vulnerable areas impacted by floods and droughts. The relevant civil society representatives will be identified during the stakeholder consultations	As above
Activity 2: Apply flood and drought Components in a DSS for TDA/SAP, IWRM in selected basins	Document describing the application of the developed DSS at basin level. This includes recommendations and lessons learned for applying the planning methodology
Task 1: Apply the DSS in within each of the pilot basins in collaboration with the key stakeholder	As above
Task 2 In cooperation with transboundary basins and national water managers demonstrate the applicability and usefulness of the DSS in planning across the three pilot basins. Simultaneously provide training on the application of the flood and drought DSS to end users including basin officials (transboundary and national), and urban managers from water utilities and industry.	As above
Activity 3: Recommend policy and strategy for flood and drought in consultation with stakeholders	Document with strategic recommendations for inclusion of the DSS in existing planning methods at basin level
Task 1: With transboundary basins and national water managers involved in the application, prepare strategic recommendations for inclusion of flood and droughts consideration in IWRM, TDA/SAP and other basin-wide land and water plans in selected basin	As above
Task 2: Develop documentation of the process to provide basin specific guidance on how to use information from the floods and drought components of a DSS in developing recommendations for planning	As above

Component 3 Validation and testing at local level

Activities	Objectively verifiable indicators
Activity 1: Establish working environment for application of methodologies with water utility end users with DSS tools in the 3 pilot basins	Document describing the application of the developed DSS at local level. This includes recommendations and lessons learned for applying the planning methodology

Task 1: With guidance from basin representatives and urban water managers, identify at least 3 water utilities (one in each basin) that will test application of DSS information in local level planning (e.g. water safety planning).Plan application in pilot basins together with project partners (responsibilities, data sharing agreement, workplan etc for application)	As above
Task 2: Catchment managers who are specifically involved in responding to water related risks provide guidance to identify and select specific areas for application. Involvement of relevant civil society to ensure that areas selected take into account vulnerable areas impacted by floods and droughts. The relevant civil society representatives will be identified during the stakeholder consultations	As above
Activity 2: Apply flood and drought components in a DSS to contribute towards utility level planning (e.g. water safety planning) in selected basins	Document describing the application of the developed DSS at local level. This includes recommendations and lessons learned for applying the planning methodology
Task 1: Apply the DSS in within each of the pilot basins in collaboration with the key stakeholder. Apply a suitable model to test at least one urban area/catchment within each of the 3 pilot basins with the ultimate purpose of improving the resilience and preparedness through appropriate planning and implementation of mitigating measures. Simultaneously provide training on application of the downscaled methodology during implementation with water utility and industry representatives.	As above
Task 2 Incorporate recommendations from application of flood and drought methodology into planning processes (e.g. WSP)	As above
Activity 3: Recommend policy and strategy for flood and drought in consultation with stakeholders	Document with strategic recommendations for inclusion of the DSS in existing planning methods at local level
Task 1: Establish critical factors (e.g. water levels) for water safety and urban drainage at the selected test areas/catchments and assess impacts, risks and frequencies	As above
Task 2: Incorporate recommendations from application of flood and drought methodologies into planning processes (e.g. WSP)	As above
Task 3: Recommendations for updated plans, including investments, for utility water safety and, urban drainage and socio-economic urban areas vulnerable to flood and drought incorporating basin level constraints and outlooks	As above

Component 4 Capacity building and dissemination

Activities	Objectively verifiable indicators
Activity 1: Prepare technical specifications, manuals, guidance and training materials for users in the 3 pilot basins focusing on capacity building in the pilot basin	Technical manuals and specifications for the consolidated DSS
Task 1: Identify potential basin, water utility and industry users' levels of knowledge and establish their need for knowledge and training. This includes those involved in the development of the DSS tool and additional users who would apply the tool and use the outputs	Document with need assessment
Task 2: Preparation of technical specifications and user manuals enabling professional level staff to apply the methodology and models within different planning processes. Material will include system manuals, approaches, methodologies and demos.	Technical manuals and specifications for the consolidated DSS
Task 3: Confirm applicability of guidance material on a number of selected trainees in the pilot basins	Feedback from selected trainees
Activity 2: Awareness workshops on DSS with decision makers	Report on output and feedback from the awareness workshops
Task 1: Develop awareness raising workshop material based on experience from NBI	Workshop materials
Task 2: Identify participants in each basins such as Commissioners and Senior Advisors to take part in the workshop	List of participants for the workshops
Task 3: Implement workshops with the aim of developing a better understanding of the usefulness of DSS and how the outputs can be applied effectively	Minutes from workshops
Task 4: Develop and implement follow up mechanisms to continue to engage decision makers	Report
Activity 3: Prepare training module on application of flood and drought methodological approach from basin to end user for inclusion in existing training courses	Training module including presentations

Task 1: Development of module that contains information on flood and drought methodological approach in catchment and end user context.	As above
Task 2 Testing of module in 2-3 existing IWRM (could be through involvement in one of the CAPNET trainings) and WSP trainings to build the capacity of end users (basin representatives, water utility and industry users) in understanding the DSS application and use of the results in planning	Feedback from training
Activity 1: Document the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders	As above
Task 1: Document the design and implementation process of flood and drought methodology in pilot basins to be communicated to a wide range of stakeholders	As above
Task 2: Collect and collate information from the pilot basins through various media - video, blogs, interviews, focus groups, etc.	As above
Activity 1: Audiovisuals, documents and other materials for global dissemination with an emphasis on IW LEARN	Delivered materials for global dissemination of the results
Task 1: Analyse IW LEARN mechanisms and their requirements to materials in order to streamline it with the existing materials and to make it accessible on a global scale	As above
Task 2: Prepare and adjust materials on the methodology and the application to meet the requirements of IW LEARN	As above
Task 3: Identify other dissemination channels in order to reach out broadly including development of project website	As above
Task 4: Participation in IW LEARN events	As above
Activity 1: Prepare brochures, leaflets, CDs and materials suitable for water events	Delivered materials
Task 1: Identify water events scheduled for the near future and where the methodology would be a relevant topic for presentation	List of relevant events

Task 2: Prepare presentation material tailor-made to water events (pamphlets, CDs, posters etc)	Presentations and papers from events
Activity 2: Organisation of and participation in international conferences and workshops for the dissemination of methodological approaches and technical solutions across networks	Proceedings and media references to papers, posters and presentations in conferences and workshops
Task 1: Organisation and facilitation of workshops at key events including (but not limited to): ○ IWA World Water Congress (Lisbon (Portugal), September 2014 // Brisbane (Australia), September 2016), ○ IWA Development Congress (Jordan) October 2014) ○ IWA Conference on Water, Energy and Climate (TBD)"	As above
Task 2: Support key stakeholders to attend and present at international events	As above; blogs, interviews articles outlining involvement in event and project

Annex C. Project Workplan

Annex D. Project Budget

Annex E. Flood indices

Indicator name	Short Description	References
Flow and Flood indicators		
Average Monthly runoff	Average monthly runoff values are an indicator of seasonal runoff patterns. This indicator could be estimated using estimates of runoff.	ATEAM, 2004
Maximum Monthly Runoff (flood runoff)	The maximum monthly runoff is considered an indicator of flood risk. This indicator could be estimated using estimates of runoff.	ATEAM, 2004
Intra-annual flow (Max/Min)	Intra-annual max/min is defined as the ratio of the maximum average monthly flow to the minimum average monthly flow.	Vorosmarty et al. 2005
Flash Flood Potential Index (FFPI)	The goal of the FFPI is to quantitatively describe a given sub-basin's risk of flash flooding based on its inherent, static characteristics such as slope, land cover, land use and soil type/texture	http://www.crh.noaa.gov/dmx/?n=ffpi_dmx
Flood Vulnerability Index (FVI)	Flood vulnerability for river basins using 11 indicators.	Conner and Hiroki, 2005
Integrated Flood Vulnerability Index (Vul)	Integrated Flood Vulnerability index.	Sebalh 2010

Annex F. Drought Indices

Indicator name	Short Description	References
Climate-based Indicators		
CMI	The Climate Moisture Index (CMI) is an aggregate measure of potential water availability imposed solely by climate. It is the ratio of annual average precipitation to annual average precipitation.	Willmott and Feddema, 1992
CMI CV	Coefficient of Variation (CV) Index for the climate moisture index (CMI) is a statistical measure of variability in the ratio of plant water demand to precipitation. It is useful for identifying regions with highly variable climates as potentially vulnerable to periodic water stress and/or scarcity.	Vorosmarty et al. 2005
Palmer Drought Severity Index (PDSI)	The PDSI is a meteorological drought index and responds to weather conditions that have been abnormally dry or abnormally wet.	Palmer, 1965, Alley, W. M., 1984.
Monthly average changes in precipitation, temperature, and streamflow for each decade between 2000 and 2100	Monthly average changes in precipitation and temperature can be computed for any decade between 2000 and 2100	Strzepek and McClusky, 2006, Dyszynski (2010)
Standardised Precipitation Index (SPI)	The SPI is designed to quantify the precipitation deficit for multiple time scales (3-, 6-, 12-, 24-, and 48-months) time scales, based on the long-term precipitation records.	McKee et al. (1993)

Drought and Water Stress indicator		
Annual runoff exceeded in nine year out of ten (drought runoff)	The annual runoff exceeded in nine years out of ten is considered an indicator of drought.	ATEAM, 2004
Future probability of historical 10-year drought	The frequency at which a drought that had occurred once every 10 years historically might be expected to occur in the future.	ECA Working Group, 2009
Number of human lives impacted by drought	This indicator is defined in terms the number of individuals affected by different drought probabilities.	ECA Working Group, 2009
Local Relative Water Use Index	The Local Relative Water Use Index is defined as the ratio of local domestic, industrial, and agricultural water withdrawals to locally generated runoff.	Vorosmarty et al. 2005
Dry Season Flow Index	Water supply on a river basin during the dry season, calculated by dividing the volume of runoff by population, with water stress based on 1700 m^3/person/year. The dry season is defined as the four consecutive months with lowest cumulative runoff.	Revenga et al. 2000
Flow Duration Curves	The flow duration curve is the percentage of time that flow in a stream is likely to equal or exceed some specified value of interest. For example, the percentage of time river flow can be expected to exceed a specified design flow of some specified value or the discharge of the stream that occurs or is exceeded some percentage of the time.	Vogel, R. M. and N. M. Fennessey, 1994; Refsgaard and Knudsen, 1996
Surface Water Supply Index (SWSI)	The Surface Water Supply Index (SWSI) was developed to complement the Palmer Index as an indicator of surface water conditions in which mountain snowpack is a major	Shafer and Dezman (1982)

	component	
Reclamation Drought Index (RDI)	The RDI differs from the SWSI in that it builds a temperature based demand components and duration into the index. The RDI's main strength is its ability to account for both climate and water supply factors.	
Extreme values analysis of annual or partial duration series	Extreme value analysis (EVA) deals with determining the probability of events (droughts) that are more extreme than any observed prior	Madsen, H. & Rosbjerg, D. (1995)
Water Stress Index	The Water Stress Index sometimes referred to as the Falkenmark indicator is defined as the number of people per 10^6 m^3 water supply per year. A threshold value of 1700 m^3/person/year is widely below which water stress is likely to occur. A threshold of 1000 m^3/person/year is used as a threshold for water scarcity. This is a "benchmark indicator" that has been accepted by the World Bank	Falkenmark and Lindh, 1974; Falkenmark and Widstrand, 1992;Vorosmarty et al. 2005
Water Reuse Index	The Water Reuse Index is defined as the sum of local domestic, industrial, and agricultural water withdrawals plus all upstream withdrawals divided by the sum of locally generated runoff and all upstream runoff.	Vorosmarty et al. 2005
Water Availability Index (WAI)	The water availability index relates current water availability to historical availability during periods of drought by measuring the deviation from normal rainfall over the prior four months.	
Socio-economic and Sector indicators		
Basic Human Water Requirement	The Basic Human Water Requirement is a minimum amount of water needed for drinking, hygiene, food preparation, and sanitation. It does not include water needed for food production (e.g., irrigation). Vorosmarty	Gleick, 1996; Vorosmarty et al. 2005

	suggests a minimum of 50 L/person/day.	
Social Water Stress Index	Integrates the "adaptive capacity" which depends on wealth, education opportunities and political participation as represented by the UNDP Human Development Index (HDI) with the Falkenmark indicator.	Ohlsson 2000
Water Poverty Index	The Water Poverty Index is defined as the ratio of the amount of available renewable water to the amount required to cover the food production and household uses of one person in one year under prevailing climatic conditions.	Sullivan 2002; Vorosmarty et al. 2005
Watershed Sustainability Index	The Water Sustainable Index incorporates hydrology, environment, human life and policy as the average of a simple score between (0-1) for each of these contributions based on stakeholder assessments.	Chavez and Alipaz (2007)
Drought impacted area	The Drought-Impacted Area is defined as an agricultural area that experiences a yield loss of more than 30% as a result of insufficient water.	ECA Working Group, 2009
Drought covered area	The Drought-covered Area as an agricultural area that experiences a yield loss of more than 10% as a result of insufficient water.	ECA Working Group, 2009
Ratio of drought-impacted area to drought-covered area	The ECA Working Group defined the ratio of drought-impacted area to drought-covered area as an indicator of vulnerability.	ECA Working Group, 2009
Average annual agricultural value lost	Average annual agricultural value lost is used as an indicator of drought vulnerability	ECA Working Group, 2009
Annual agricultural value loss exceedance	This indicator is represented by a plot of expected annual loss as a function of drought severity return period.	ECA Working Group, 2009

curves		
Changes in standard deviation of year-to-year agricultural GDP growth rates	The impact of climate change on the standard deviation of GDP growth rates in the agriculture sector was estimated	World Bank EACC, 2010; Dyszynski (2010)
Livestock yields and production values	ECA Working Group methodology for estimating climate impacts on livestock yields in Mali. First livestock yields were estimated then the economic impact of yield losses was then estimated.	ECA Working Group, 2009
Total cost of hydropower shortages	The sum of unavoidable economic losses due to power outages, costs of replacement power from thermal sources, and costs associated with the use of temporary diesel generators.	ECA Working Group, 2009
Costs of supplies need to meet additional demands	Estimated future demands under climate change conditions and made estimates of costs to meet demands.	Kirschen/UNFCC, 2007, UNEP ADAPT Cost
Benefits and costs of climate change and adaptation as percentage of GDP	The World Bank study “Economics of Adaptation to Climate Change” (EACC) estimated benefits and costs of adaptation as a percentage of GDP.	World Bank EACC, 2010; Dyszynski (2010)
Effect of droughts on government expenditure on food	Records of expenditure by the Ethiopian government on vulnerability and food security (VFS) during extreme droughts were also used to develop a statistical model of the correlation between climate drivers and Ethiopian VFS expenditures	World Bank EACC, 2010; Dyszynski (2010)

Annex G. User interface (mockup) of the different planning components

The next sections will briefly describe the content of the Home, Analysis, Planning, Implementation and Monitoring sections, with respect to UI and the key tools.

G.1 Home component

The Home components is the start page when initiating the Planning DSS. The start page contains the following features:

- GIS view showing key indicators
- News box
- Calendar components

Mock-up of the Home component is shown on Figure 11-1.

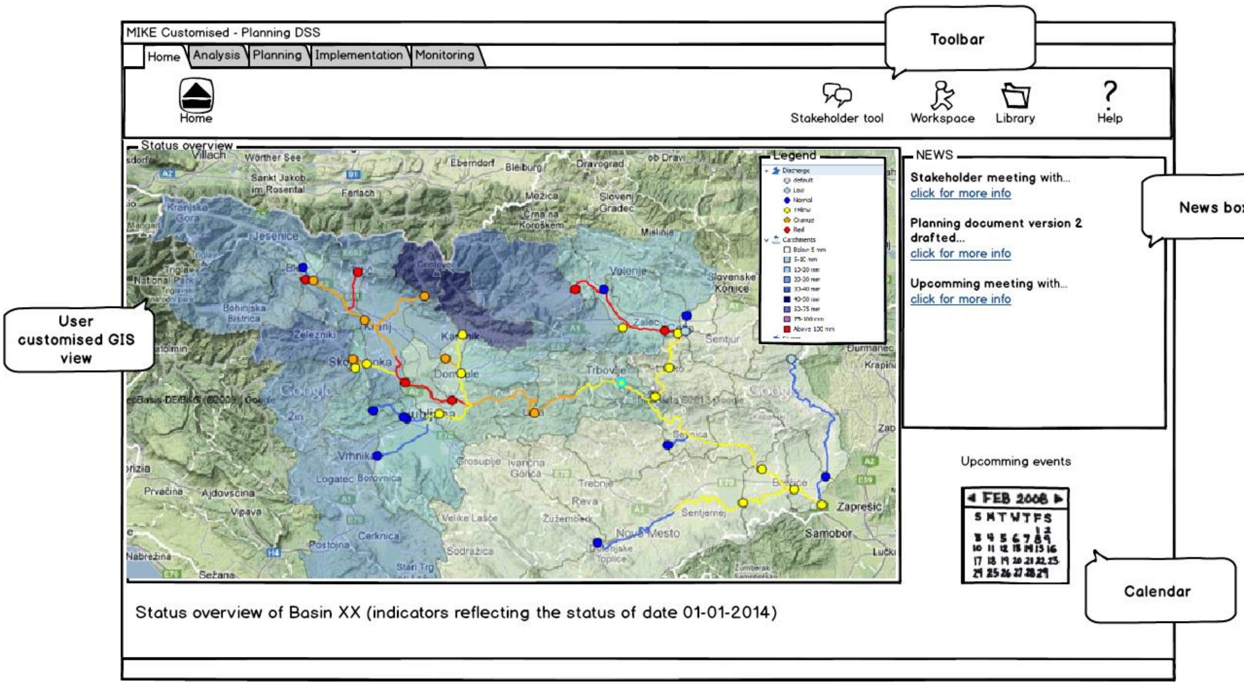


Figure 11-1 Overview of Home component

The key tools will be:

Tool	Function	Type
Workspace tool	Option for selecting a workspace with pre-configured tools tailored towards specific applications and users (see section 6.2.2 for detailed description)	New tool
Library	Document library for handling documents etc.	Existing tool
Stakeholder tools	Tools for enabling stakeholder communication (not defined yet)	New tool
Help	Help function	Existing tool

G.2 Analysis component

The objective of the analysis component is to evaluate the current situation and identify issues and causes to be addressed in the planning.

The main features in the analysis component will be:

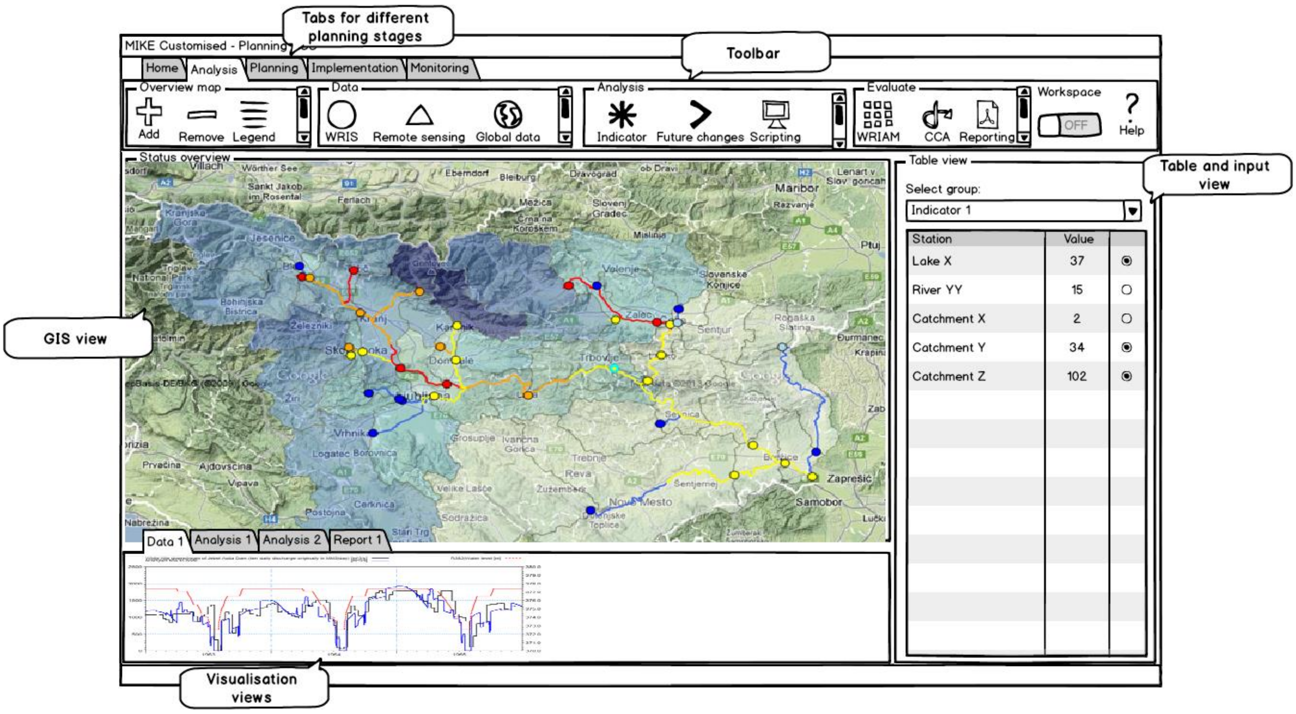


Figure 11-2 Overview of Analysis component

The key tools will be:

Tool	Function

GIS tools	Add or remove GIS layers from the map
WRIS	Link to the WRIS tool. Option for transferring data from WRIS to the Planning DSS
Remote sensing	Smooth integration of remote sensing data in the planning DSS
Global data	Link to global data (public available data)
Indicator	Specify indicators
Future changes	Apply climate projections and land use changes.
Scripting	Scripting interface
WRIAM	WRIAM tool
CCA	Cause Chain Analysis tool
Report	Reporting tool

G.3 Planning component

The Planning component is where the user defines scenarios, and evaluate the scenarios for selecting the final scenario to implement. Figure 11-3 illustrates a mock-up of the planning component.

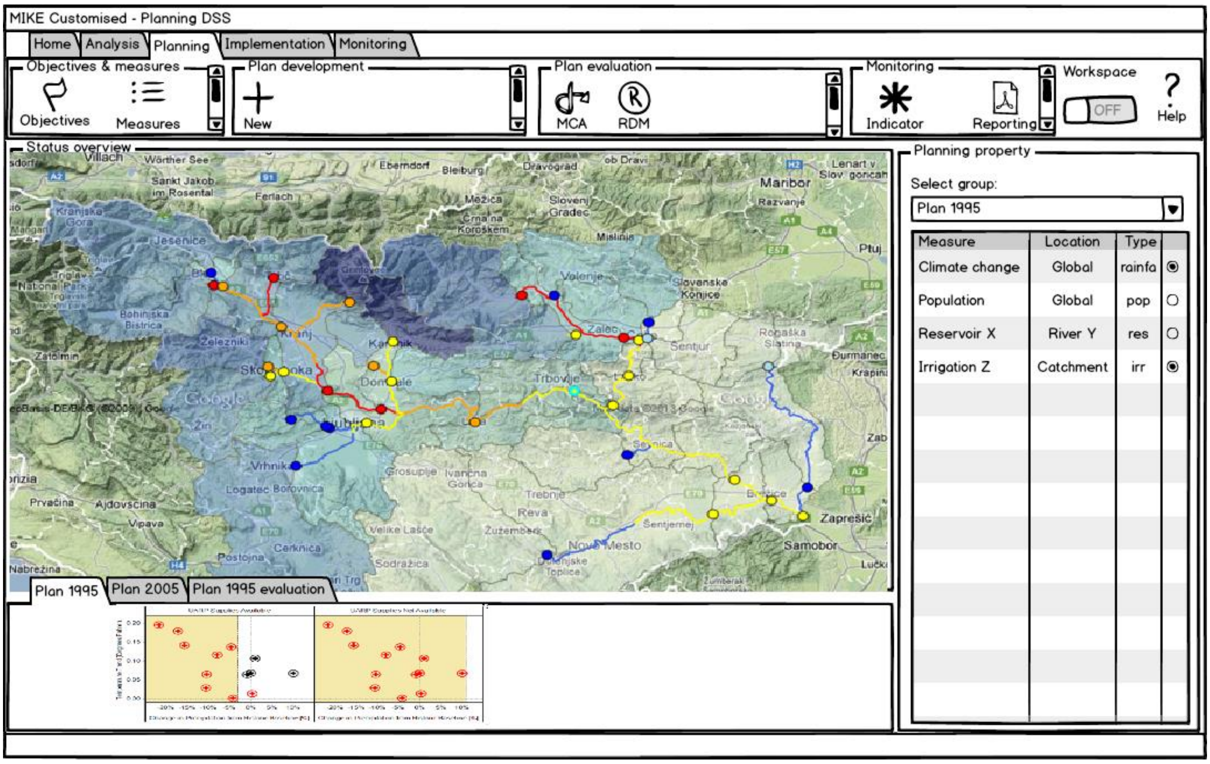


Figure 11-3 Overview of Planning component

The key tools will be:

Tool	Function
Define objectives	Preconfigured spreadsheet for defining planning objectives
Define measures	Select measures to be used. Should be linked with the define scenario tool.
Define scenario	Define scenarios using the pre-configured model adapter
MCA	Evaluate scenarios using MCA
RDM	Evaluate scenarios using RDM
Indicator	Specify indicators
Reporting	Reporting tool

G.4 Implementation component

The implementation component is where the user plans how the implementation of the selected plan should be. Figure 11-4 illustrates a mock-up of the implementation component.

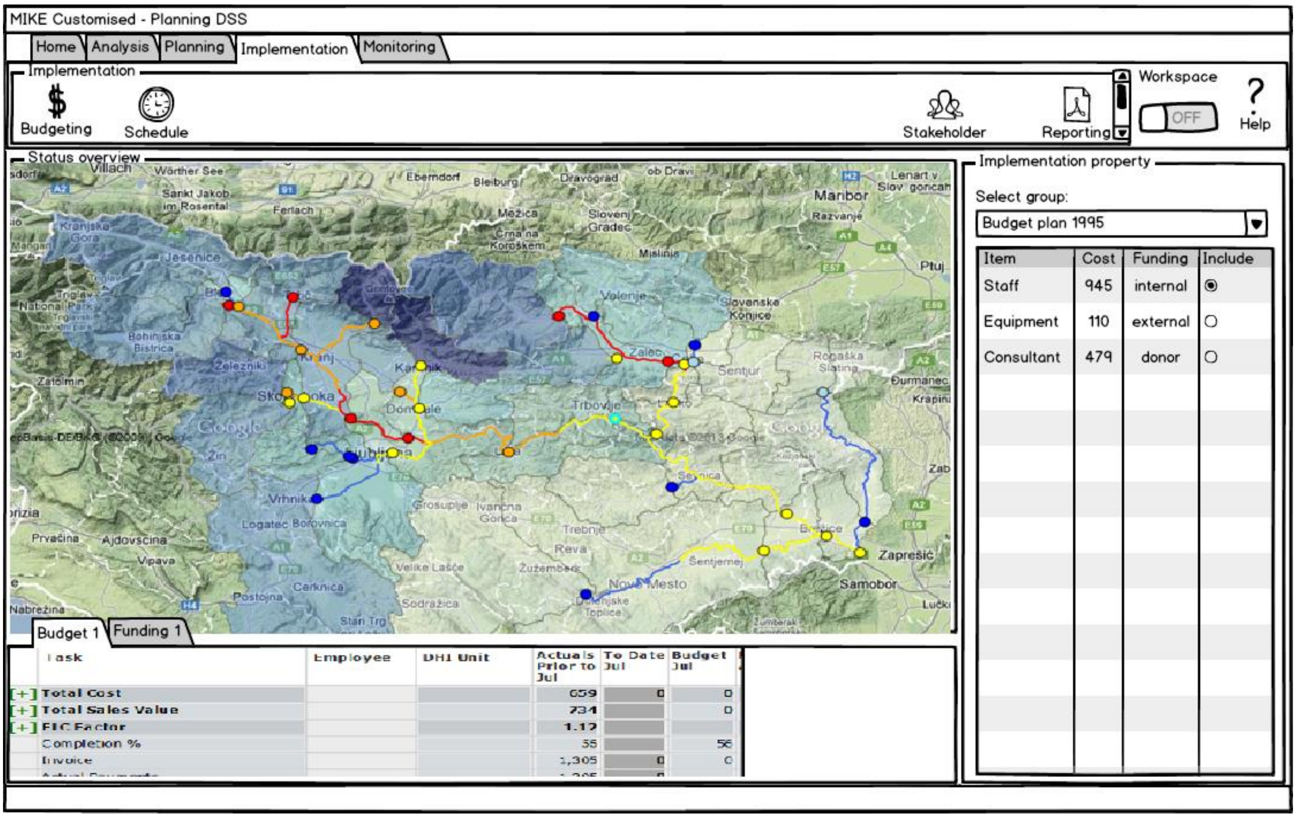


Figure 11-4 Overview of Implementation component

The key tools will be:

Tool	Function
Schedule	Simple spreadsheet tool for project scheduling
Budgeting	Simple spreadsheet tool for budgeting
Stakeholder tools	Tools for enabling stakeholder communication (not defined yet)
Reporting	Reporting tool

G.5 Monitoring component

The objective of the monitoring component is to evaluate the effectiveness of the implemented plan, and to evaluate if the plan is sustainable or if it should be revised. Figure 11-5 illustrates a mock-up of the planning component.

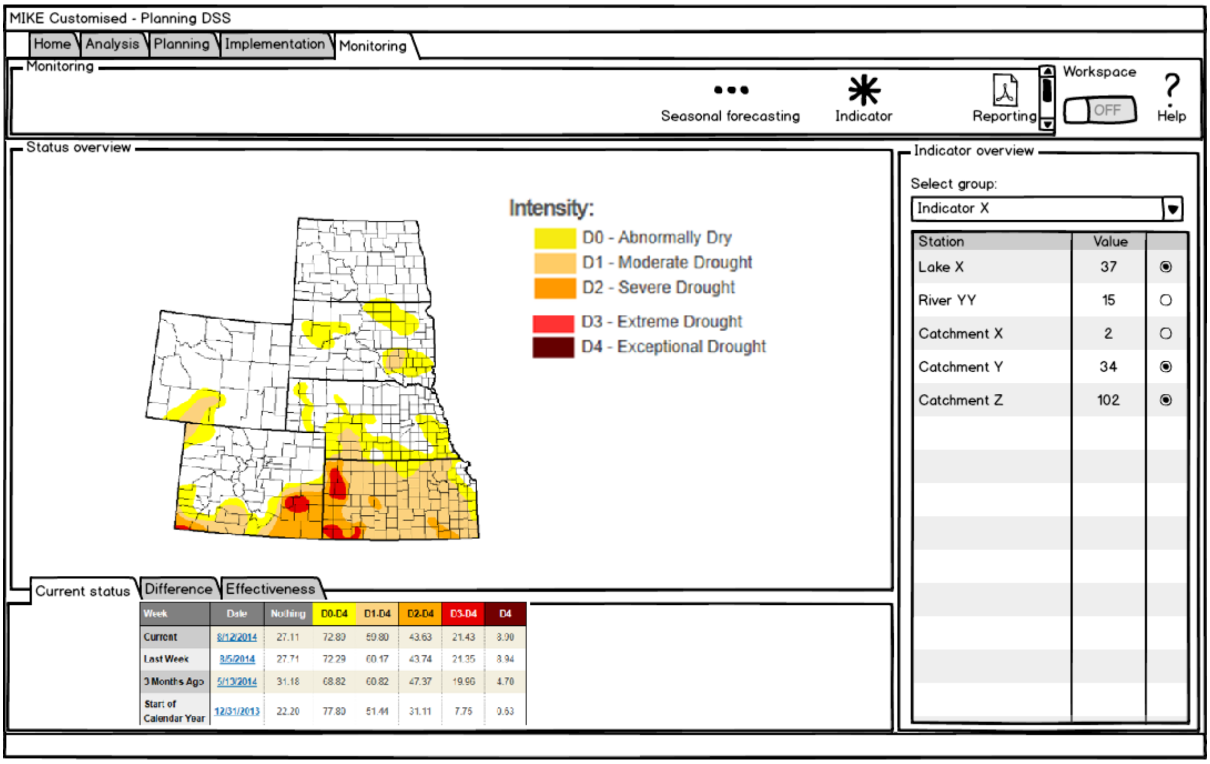


Figure 11-5 Overview of Monitoring component

The key tools will be:

Tool	Function
Seasonal forecasting tool	Tool for seasonal forecasting (this tool could also be in the planning component)

Indicator	Specify indicators
Reporting	Reporting tool

Annex H. Floods as a key focus area

Flood plains have through time been a preferred place for human settlement and socio-economic development because of their proximity to rivers, guaranteeing rich soils, abundant water supplies and means of transport. Floods play an important role in such areas in maintaining the ecological and natural functions of rivers: they may replenish wetlands, recharge groundwater and support fisheries and agriculture systems thereby supporting livelihoods of people.

However, floods also represent a significant risk to communities, when people and their activities are exposed to flooding without considering the potential negative impacts. Floods can produce severe adverse impacts on the economy and people's safety. Mega cities and important economic activities (e.g. agriculture and industries) for national economies have been located in flood plains despite the awareness of the detrimental impacts of flood. In fact, every year many countries around the globe face serious floods and major damages, and large populations have to adapt their life to such conditions.

As for many other types of integrated water resources management and planning, there is a need for tools, which can assist in the specific requirements of controlling and alleviating the impacts of floods including providing early warning of unexpected flood events. Such tools must recognise and help in solving important pressure – impact relationships such as:

- A river basin is dynamic over time and space, and there is often a series of interactions between water, soil/sediment and pollutants/nutrient to take into account;
- Population growth and increased economic activities in floodplains increase vulnerability to flooding;
- High level of investment in floodplains, and the lack of alternative land in many countries, means that abandoning flood-prone areas is not a viable option for flood damage reduction;
- Changes in land use across the basin affect runoff and the probability of a flood of a given magnitude;
- Changes in the intensity and duration of precipitation patterns as a result of climate change can increase flash floods and seasonal floods.

Decision Support Systems for flood management and planning are required for the use of policy makers and flood practitioners to guide the operational procedures of basin flood management and planning. This involves early warning systems to be operated in real-time, operational planning on a short or seasonal scale and strategic planning on long term taking variability in land use, population and climate into account

H.1 Defining flood

Floods are natural events defined as unusual surpluses or excesses of water resulting in higher than usual water levels. The definition of a flood depends on the definition of unusual water levels, and when a specific water level causes damage or impacts a specific area.

Floods results from short-duration highly intense rainfall events, long duration low intensity rainfall, snowmelts, failure or dams or levees or a combination of these conditions. In undisturbed conditions floods are an natural event occurring with regular intervals. Human interventions as land use changes could change the intervals or frequency by which the floods occur.

One common definition of a flood event is using the return period, also known as a recurrence interval (sometimes repeat interval) as an estimate of the likelihood of an event. It is a statistical measurement typically based on historic data denoting the average recurrence interval over an extended period of time, and is usually used for risk analysis (e.g. to decide whether a project should be allowed to go forward in a zone of a certain risk, or to design structures to withstand an event with a certain return period). Many water structures are designed to withstand a flood event defined by a specific return period, e.g. a 50 year event.

One of the challenges from using a probabilistic definition as a return period in a designing mitigation measures against flood events is that changes in climate and land use could change the recurrence interval of floods and thereby the magnitude of a specific return event. The result is that a 50 year return period defined from historical data, might not be valid as a prediction of a future 50 year return period. Hence changes to climate and land use are important parameters to include when including floods in long term planning.

H.2 Flood management and mitigation

Flood risk management is defined as all activities that aim at sustaining or improving the capability of a basin or area to cope with floods. Risk is defined as a function of flood probability and impact. The objective is to reduce the risk of floods and mitigate the consequences.

Flood mitigation can be divided into structural and non-structural measures. Structural measures consist of investment and development of new water infrastructure as dams, channels etc. to reduce the impact from floods. Non-structural measures consists of mitigation measures without investing in new infrastructure, such as: planning, policies, awareness, flood forecasting and warning systems, training, capacity building etc.

The implementation of non-structural measures are also linked with the need to improve the decision making process for flood protection, so that investments can be allocated in a more optimal way. For this purpose the introduction of indices for flood vulnerability is one of the key tools, for improving the flood management and decision making.

Indicators or indices will be one of the means for identifying, managing and planning for flood events and reduce the risk and likelihood of impact, and will be a key tool in the DSS. A list of potential flood indicators are shown in Annex A.

H.3 Objective with flood implementation

Floods are a key issue in the Flood & Drought Management Tools project, as understanding and planning of the impacts and risks of floods is critical for decision making, planning and appropriate flood related responses.

The objective with flood implementation is to provide decision makers with information to improve the planning and managing for floods with respect to operational and long term strategic planning.

Operational planning: the objective is to reduce the risk and likelihood of flood without investing in new or modified water structures. The key components will be:

- Baseline assessment identifying current flood impact, and the hydrological and economic flood risk using different indicators.
- Optimisation of water release and diversion for reducing the flood risk.
- Monitoring using different flood indicators.
- Result dissemination for increased awareness

Strategic planning: the objective is to reduce the risk and likelihood of floods, taking changes of climate and land use into account, balancing cost and effectiveness. The key components will be:

- Baseline assessment identifying current flood impact, and the hydrological and economic flood risk using different indicators.
- Development of future plans for mitigation flood issues taking changes to climate and land use into account. Structural measures as reservoirs, wetlands, land use changes etc. could be included in the plans.
- Evaluation of the plans using decision methods as multi criteria analysis or robust decision methods for a robust and flood resilient management
- Monitoring of the effectiveness using flood specific indicators

H.4 Specific implementation of flood

Tools addressing floods are developed in a DDS framework. In order to follow the planning process already in use at the basin level and in local organisations the tools are categorised according the four planning stages. A description of the flood implementation in each of the planning stages are shown in the following sections.

H.4.1 Analysis stage

The aim of the analysis stage is to identify priorities of water resources issues to focus the effort on. The main focus will be on assessment of the current flood risk with respect to economical and socio-economic impact. The *analysis* part will consist of tools for evaluating the baseline condition and the main issues and causes.

Available observation will be used in connection with flood models as simple water allocation models (e.g. MIKE HYDRO or WEAP) or more sophisticated hydraulic models as MIKE 11, to evaluate the current conditions. The main tools for the analysis part will be linkage between observations, models and selected indicators, where the indicators will give the decision makers the information on the current status.

H.4.2 Planning stage

The *planning* stage allows decision makers to envisage alternative solutions in order to improve the current situation. The DSS is able to encompass various scenarios and evaluate their effectiveness. This includes generation of scenarios using different flood mitigation measures, during changing climate conditions.

For operational planning the focus will be on optimisation of the current system, while the strategic and long term planning will include generation of scenarios using different flood mitigation measures (structural or non-structural) including changes to climate and land use.

Hydraulic and water allocation models will provide the linkage between the developed plans and the evaluated results, where the targets and criteria will be defined based on indicators.

H.4.3 Implementation stage

The *implementation* of the selected plan as such will not be part of the DSS, nevertheless dissemination tools will be available to support the implementation of plans.

H.4.4 Monitoring stage

In order to monitor the effectiveness of flood measures, flood indices are used. These indices will be specific to the local conditions and the available information. See Annex E for a list of potential flood indices.

It could be note that the monitoring stage could provide links to real time flood forecasting systems, for monitoring on a short time frame (3-5 days), but real time flood forecasting systems are seen as being outside of the project where the focus is on operational and strategic planning.

Annex I. Drought as a key focus area

Similar to flooding, drought is an equally important issue for integrated water resources management and planning as well as environmental protection. Climatic variability in time and space may cause periods with low rainfall and runoff insufficient to sustain the normal requirements for water for basic human needs as well as agricultural and industrial production. Unsustainable water management, including over-exploitation and water pollution, as well as predicted climate change effects in droughts, could result in severe impacts on nature and communities, which can have significant impacts on the national economy in many countries.

Drought differs from many other natural disasters in its slowness of onset and its commonly lengthy duration and possible spatial difference between the deficiency of precipitation itself and the occurrence of drought. Although it is a natural hasard, drought may to be aggravated by climate change in many regions.

Decision Support Systems (DSS) for drought planning and management should provide the decision makers with an effective and systematic means of assessing drought conditions and the future outlook, developing mitigation actions and programs that reduce in advance the effects of drought, and developing response options to minimise economic stress, environmental losses, and social hardship during drought. They may consider the following elements:

- **Services and system overview** (a general description of the registered services for water allocation to which drought management applies, the infrastructure for supplying water and the current and future demands);
- **Evaluation** of the potential for the strategic utilisation of **groundwater resources**, less impacted by climatic fluctuations, including utilisation of deeper aquifers, storage of flood waters and of treated wastewaters, and the full development of the potentialities in terms of drought mitigation offered by conjunctive surface and groundwater management.
- **Assessment of available water sources** (identification and assessing the available water sources including possible future and emergency sources). Such an assessment may address the historic performance of the existing source(s) of supply and consider the quantity of water available, the water quality and any impacts of climatic effects.
- **System operational and management strategies** (addressing consumption patterns by the various categories of water users in the community, for example, residential, commercial, industrial, irrigation, stock and domestic, irrigation and other), the location of those users and identify strategies that can be implemented to minimise the detrimental social and economic impacts of the drought and water shortages on the community. It may specify the trigger points adopted for the imposition of restrictions in order to minimise the social and economic impacts on the individual communities, who is responsible for managing drought and the organisational structure for implementation of the strategy.

I.1 Types of drought

Drought could be defined as when water supplies are “substantially below” what is usually experienced for that place and time. Just what is considered “substantially below" is rather arbitrary and, depending on the location and what features of a drought cause the most stress or loss (Water Resources Systems Planning and Management, UNESCO 2005).

Droughts are typically classified in four different categories: meteorological, agricultural, hydrological, or socioeconomic. Meteorological drought is defined as deviation of rainfall compared to normal conditions. Agriculture drought occurs when the sustainability of the crop development is affected, leading to reduced crop yields. Definitions of hydrological drought are often referring to hydrological condition of the surface hydrology, which could be a period when stream flow has fallen below a given threshold. The last category of droughts is the societal and economic impacts.

All these definitions encompass the concept of water scarcity where water availability is insufficient to meet water demand. Water availability is closely connected to rainfall, but also to changes in land use, water quality, legislation etc. However it is important to bear in mind that water shortages related to drought must be considered as relative and not as absolute conditions.

This project is focusing on the drought aspect in water resources planning, where drought in a planning context is related to water scarcity (difference between water availability and water demand). The key parameters in water scarcity is the identification and management of the available water and the demand for the same water.

I.2 Drought indices

Defining a drought condition relates to identifying the beginning, length and degree of severity of the drought. One of the issues with defining a drought event is that at its beginning, the duration and severity of the drought will be unknown.

The main tools for defining a drought event are different drought indices, as they can help identifying when a drought is starting and the severity. There are many existing indices, all developed and used for different purposes. It should be noted that no drought index is perfect for all situations, and in most cases, several indices will be used to evaluate a drought event.

Drought management depends on indices to detect drought conditions, and thresholds to activate drought responses.

The most commonly applied drought index includes the Standardised Precipitation Index (SPI), the Palmer Drought Severity Index (PDSI) and Deciles due to their simplicity. One of the outcomes form "The Lincoln Declaration on Drought Indices" were that the use of SPI should be encouraged as an index to characterise meteorological droughts.

Some of the key issues in connection with drought indices:

- they are only a tool for analysing and identifying droughts
- Their dissemination should be kept simple.
- They need to be evaluated based on the local conditions.

A list of potential drought indices are shown in Annex F.

I.3 Drought Early Warning Systems

A Drought Early Warning System (DEWS) is a system allowing for:

1. Early drought detection (by forecast or observation)
2. Improves the response time towards drought
3. Trigger actions within drought plan

DEWS is more than just drought prediction as a DEWS ideally should contain both a forecast component, early detection tools and monitoring products (in the form of indicators).

Drought Early Warning Systems are a critical part of drought management as they link early detection, with response and actions, hence provide the link between the drought plan and the observations. Some of the key components of a DEWS:

- Monitoring and Forecasting
- Access to timely data (including impacts) and value added information
- Synthesis/analysis of data used to —trigger or set actions within a drought plan
- Tools for decision makers
- Efficient dissemination/communication tools
- Drought risk planning
- Education and Awareness

I.4 Drought mitigation

The impacts of drought can be reduced through the use of drought mitigation measures. In a planning context this would be actions in the drought plan, triggered by threshold values in the selected indices.

Conjunctive use of water relates to the combined use of ground and surface water, and could be one potential drought mitigation measure. Due to the combined water source, higher water reliability can be achieved. Conjunctive use therefore functions as a buffer for periods of water scarcity. The idea is to use surface water when the water table is high and change to groundwater when the water table is low. Conjunctive use of water could be one of the mitigation solutions for climate impacts and increased frequency and severity of droughts.

Drought mitigation measures could be implemented on different levels from basin to catchment to local level, with the objective of minimising the impact of long lasting droughts on the ecosystem and the society. Some of the relevant adaptation measures for drought events might be:

- Careful integrated management of the water resource on the river basin scale (e. g. multi-sectorial reservoir management)
- Artificial recharge to the groundwater during periods with sufficient water

- Increase the water use efficiency in the system (e.g. irrigation system)
- Restrictions of water usage in general (swimming pools, gardens, etc.)

I.5 Objective with drought implementation

Droughts are a key issue in the Flood & Drought Management Tools project, as understanding of the impacts and severity of droughts, is critical for decision making, planning and appropriate drought related responses. The ideal objective would be inclusion of drought monitoring tools with the ability to provide an early warning of the droughts onset, determine drought severity and spatial extent, and convey that information to decision-making (The Lincoln Declaration on Drought Indices).

The objective with drought implementation is to provide decision makers with information to improve the planning and managing for drought with respect to operational and long term strategic planning.

Operational planning: the objective is to reduce the risk and likelihood of drought without investing in new or modified water structures. The key components will be:

- Baseline assessment estimating the water demand, availability and usage both for the urban and rural part, as well as for irrigation and industrial usage. The economic impact will be included through specific indices.
- Optimise the operation and allocation of water resources during dry seasons
- Monitor the status and risk of droughts using selected indices
- Result dissemination for increased awareness

Strategic planning: the objective is to reduce the risk and likelihood of droughts taking changes of climate and land use into account, balancing cost and effectiveness. The key components will be:

- Baseline assessment estimating the water demand, availability and usage both for the urban and rural part, as well as for irrigation and industrial usage. The economic impact will be included through specific indices.
- Develop plans that are robust towards drought events, taking climate and land use changes into account. Structural measures as reservoirs, irrigation schemes, channels etc. could be included in the plans.
- Develop and evaluate plans that are robust towards drought events, taking climate and land use changes into account
- Monitor the severity of droughts as well as the effectiveness of the implementation of plans

I.6 Specific implementation

Tools addressing droughts are developed in a DDS framework. In order to follow the planning process already in use at the basin level and in local organisations the tools are categorised according the four planning stages. A detailed description of the drought implementation in each of the planning stages are shown in the following sections.

I.6.1 Analysis stage

The aim of the *analysis* stage is to identify priorities of water resources issues to focus effort on. The DSS is developed based on stakeholder needs, and the main focus will be on evaluation of water availability with respect to both surface and groundwater sources, and water demand from the different sectors. The *analysis* part will consist of tools for evaluating the baseline condition and the main issues and causes.

Water allocation models (e.g. MIKE HYDRO or WEAP models) will be used to define and evaluate scenarios. These could serve as basis to assess the availability and usage of water at the basin or local level. Models are useful to identify hydrological impacts, and with respect to drought by calculating water allocation based on water demand and available water. Moreover climate, land use and population change are key parameters that can be included into the analysis. The *analysis* tools can be used for estimating the water demand and usage both for the urban and rural part, as well as for irrigation and industrial usage.

I.6.2 Planning stage

The *planning* stage allows decision makers to envisage alternative solutions in order to improve the current situation. The DSS is able to encompass various scenarios and evaluate their effectiveness. This includes generation of scenarios using different drought mitigation measures, during changing climate conditions.

For the **operational planning** focus will be on:

- Seasonal forecast taking either the historical events into consideration or using actual climatically forecast of the seasonal climate.
- Prioritisation of the different water sectors, during dry season. This could be with multi-purpose reservoir operations strategies or optimisation.
- Drought mitigation measures such as; reduce NRW, artificial recharge, irrigation efficiency, crop selection etc.
- Strategies for crop management during drought periods.

For the **strategic planning** focus will be on:

- Long-term climate projections in connection with projected changes in land use and water demand.
- Development of plans for prioritisation of the different water sectors, during dry seasons, linked with economical and socio-economical indices.
- Strategies for crop management, including improved irrigation management and strategies.
- Application of drought mitigation measures such as; reduce NRW, artificial recharge, irrigation efficiency, crop selection etc.

- Conjunctive use of groundwater and surface water are critical for drought management and tools for evaluating the available water resource and utilisation of groundwater and surface water.
- Evaluation of plans and linkage with crop models (e.g. CropWat) or water resource models (e.g. MIKE HYDRO or WEAP).

The objective is to develop plans that are robust towards drought events, taking climate and land use changes into account.

I.6.3 Implementation stage

The *implementation* of the selected plan as such will not be part of the DSS, nevertheless dissemination tools will be available to support the implementation of plans.

I.6.4 Monitoring stage

In order to monitor the severity of droughts as well as the effectiveness of the implementation of plans, drought indices are used. At the basin scale, remote sensing indicators – even with a coarse resolution – are preferred since they offer uniform information across the basin where ground data might not be available for all countries or available in different forms. Moreover the general fact that in some transboundary basin there is not real-time climatic monitoring network emphasises the need to base the monitoring on Global Climate Circulation Models (GCCM) as well as remote sensing products.

There is not a single drought index that is able to measure the severity of droughts. Nevertheless the Standardised Precipitation Index (SPI) appears useful for application in developing countries because of its limited data requirements and relative simplicity of calculation. As with many other rainfall-only indices, the SPI is more suited to monitor meteorological and hydrological droughts than agricultural droughts.

Focus will also be on indices complementary to the SPI, not based only on precipitation but also on other climate variables. An index based on the evapotranspiration, which plays an important role in the crop development, is also essential for monitoring droughts.

In addition, the DSS could be complemented with a methodology that merges a monitoring and seasonal forecasting of precipitation for droughts monitoring on a regional scale. Additionally this methodology could be extended and applied to composite indices given the availability of monitoring data.

Annex J. Future changes as a key focus area

The issues of flood and drought can be seen, from a broad perspective, as an excess or lack of water. In the case of droughts, this lack of water is the result of a mismatch between water availability and demand. Agricultural and socioeconomic droughts are induced by water demand exceeding water availability for a relatively long time period. Water availability depends among others on rainfall and runoff, groundwater recharge and flow controlling infrastructure. Water demand is usually divided into the sectors of domestic, industrial and agricultural water demand, and water supply requirements for ecosystems. Consequently, water availability depends on climatic conditions, water controlling infrastructure and land use while water demand can be derived from the population size, economic and technological development, land use and ecosystem requirements. Floods, on the other hand, are most affected by an increased ‘availability’ of water or a change in the short term patterns of rainfall. However, land use changes (which often are the result of changes in population and economy) also impact flooding issues as they might lead to additional runoff or greater flood damages.

Floods and droughts might be caused by short to mid-term events such as climate variability and operation of reservoirs. Flood and drought risk is also subject to long-term change, brought about by long-term changes in the factors such as climate change, land-use change, changes in economy, population and technological development.

The fifth Assessment Report of the Intergovernmental Panel on Climate Change reaffirms the existence and severity of future climate change. It names the increase in intensity and frequency of climatic extreme events, specifically flood and drought events, as one of the most pronounced impacts on society. However, climate change is not the only future change and may not be the change having the largest impact on plans for the reduction of flood and drought risk. In the last decades, the world has experienced unprecedented population growth and, in some regions, economic growth has put a stress on water resources, especially in those regions already suffering from water scarcity. Future land-use changes are another factor which may influence both water availability and flood risk.

In the following section we refer to future changes as drivers to long-term changes in water demand and availability, specifically climate change, land use change, population growth, economic and technological development. Figure illustrates the interrelation between these future changes and the issue droughts.

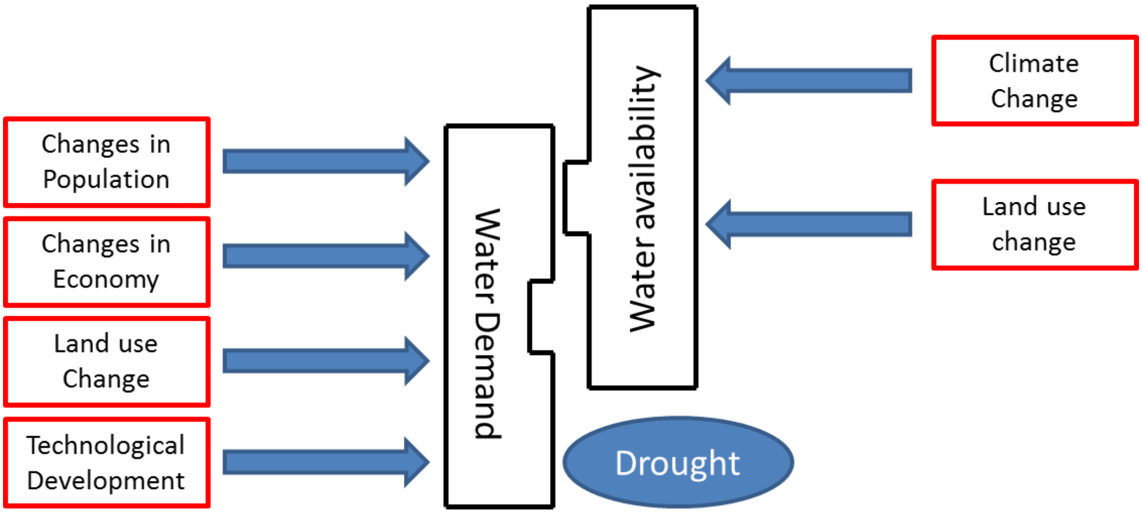


Figure 11-6 Future changes as drivers to long-term changes in water demand and availability. The diagram indicates that, for this project, drought can be regarded as a mismatch between water demand and availability.

Due to the long-term nature and significance of future changes, it is essential to include the impact of such changes in strategic planning for the reduction of flood and drought risk. Long-term projections are usually used to derive estimates for future changes. Such estimates are inherently uncertain because of the unpredictability of the long-term future. This uncertainty is also referred to as deep uncertainty because it cannot be quantified with probability distributions. Uncertainty in global climate models (GCM), climate forcing scenarios (SRES or RCP), regional climate models (RCM) or statistical downscaling are some sources of uncertainty in long-term climate projections.

The aim is to support policy and decision makers in defining long-term plans for flood and drought management which are robust towards any outcome of future changes.

J.1 Types of future changes

In this project we understand future changes as drivers to long-term changes in water demand and availability. In particular, we divide future changes into three categories: climate change, socioeconomic change consisting of population growth, economic development and technological development, and land use change. In the following sections we describe the available data and which assumptions are commonly used in order to estimate these future changes.

J.1.1 Climate Change

All climate change adaptation plans must rely on some projection of the future climate. For the purpose of this project, we will focus on climate variables which are relevant for changes in water demand and availability: temperature, precipitation and evapotranspiration.

Climate models are commonly used to project climate variables into the future. The IPCC develops emission scenarios, so-called climate forcing scenarios, which are used to force global climate models. There are two generations of climate forcing models: SRES scenarios and RCP scenarios. SRES scenarios were the first generation of climate forcing scenarios. They represent narratives of demographic, social, economic, technological and environmental development. Based on the narrative, global greenhouse gas emissions and the corresponding increase in global surface temperature are projected. Representative concentration pathways (RCPs) are the new generation of climate forcing scenarios. Instead of projecting a certain development of the society they assume pathways of radiative forcing. For example the scenario RCP4.5 leads to a radiative forcing of 4.5 W/m2 at stabilisation after 2100. Many different societal developments could lead to such a radiative forcing and hence the RCP scenarios provide a wider range of possible futures. Global climate models (GCMs) are physical based models which are forced by climate forcing scenarios and model climate variables for the entire globe on daily time steps and a relatively coarse grid (usually 100x100km). Sub-grid processes are modelled by physical parameterisations. 44 different GCMs were developed of several modelling groups as part of the intercomparison study (CIMP5) for input to the 5th Assessment Report of the IPCC. The GCM data can be retrieved from the IPCC homepage: www.ipcc-data.org (see Figure for a sample map).

GCMs have too coarse spatial resolution for most climate adaptation purposes. Several modelling groups around the globe engaged in large research initiatives in order to develop regional climate models (RCM) for different regional domains, e. g. Europe, Africa. These models take GCMs as boundary conditions and have spatial resolutions between 11 and 50 km. The most recent research initiative is the CORDEX project which provides global coordination of regional climate models. The aim is to cover all continents with RCMs at a spatial resolution of at least 50 km. For Africa these RCM outputs can be accessed for example via the data node cordexesg.dmi.dk and the node cordex-ea.climate.go.kr provides RCM data for the domain of East Asia including Thailand. Prior to CORDEX, the ENSEMBLES project engaged in developing RCM data at a spatial resolution between 25 and 50 km for Europe and Africa. Besides these sources of climate projection data, local research institutes or government departments such as meteorological institutes may have additional climate model data. Data from ENSEMBLES, CORDEX or the IPCC are freely available but there might be limitations with respect to commercial use. Within this project, we will focus only on data that are available for commercial use.

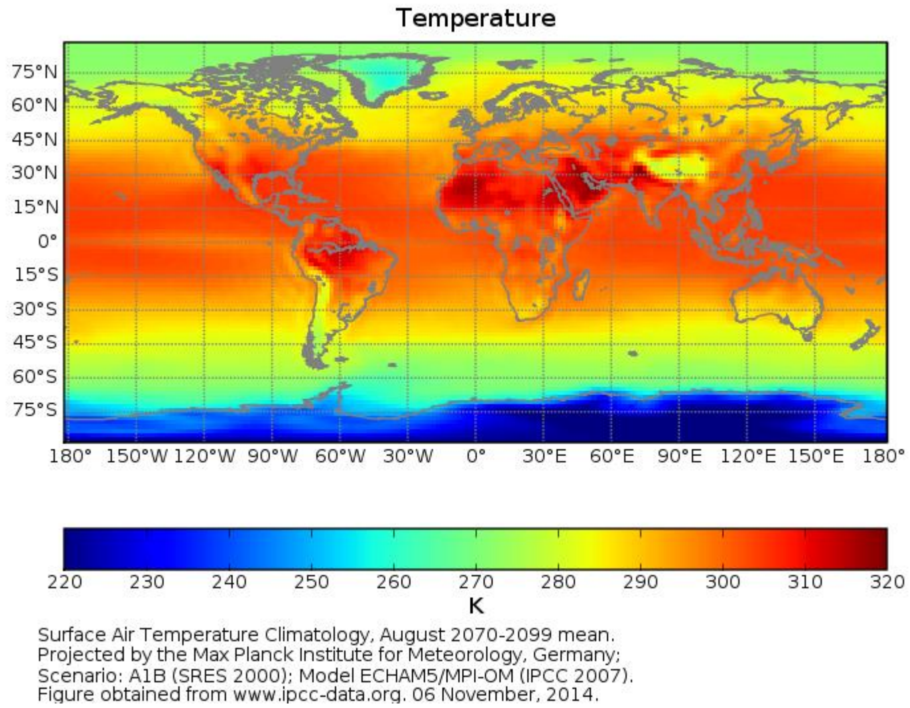


Figure 11-7 Sample GCM output from the IPCC homepage (www.ipcc-data.org). Monthly mean temperature in August based on the period 2070-2099.

For climate adaptation on the local scale such as the urban scale the resolution of RCMs is still too coarse. Therefore, statistical downscaling of GCM or RCM data is often used for climate adaptation studies and impact assessments for local scales. Statistical downscaling methods use statistical methods to link point observations to large-scale climate model outputs. As a consequence they can transfer the projected climate change by the large-scale climate models to the local scale. Commonly used statistical downscaling methods are for example the delta change factor, the quantile-quantile and the perturbed quantile method.

J.1.2 Population growth, economic development and technological development

Population growth, economic development and technological development are covered as drivers for long-term changes in water demand. In some cases, long-term changes in water demand due to these drivers might be more pronounced and pressing for flood and drought management than climate change. Population growth increases water demand across sectors whereas technological development may decrease the water consumption per capita. Economic development increases total water demand in the sense that water consuming industrial production increases. However, economic growth goes usually along with technological development and higher average education decreasing water consumption intensities in the domestic, industrial and agricultural sector. For future scenario analysis with hydrological models, assumptions on technological development and economic growth can be used together with the projected population growth to estimate future water demand. As an example, the World Bank data portal provides population estimates and projections up to 2050 for approximately 200 countries (data.worldbank.org).

J.1.3 Land-use change

Land-use change is a broad term which incorporates various phenomena, e. g. changes in CO2 emissions and uptake, changes in irrigation area extent and changes in the runoff coefficient. For the purpose of this project, we will focus on land use changes which drive long-term changes in water demand and availability. In particular, this involves surface changes affecting the runoff ratio, the increase of irrigation schemes and changes in crop pattern. As an example, deforestation increases the runoff coefficient and thereby the flood risk. Different crop patterns or the increase of the irrigation area affects the agricultural water demand and also the runoff coefficient. Land use changes of these types are anthropogenic and hence information on long-term land use projections will have to be derived locally by governmental departments and decision makers. The impacts of land-use changes can be simulated by hydrological models and the results of such models (developed outside of this project) can be used in the planning DSS.

J.2 Objective

Future changes drive long-term changes in water demand and availability and consequently need to be considered in strategic planning for the reduction of flood and drought risk. Meetings with various stakeholders in the pilot basins showed that quantitative estimates of future changes are rarely used to support strategic planning. Obstacles are access and processing of data and the linkage to hydrological models capable of providing estimates on long-term changes in water demand and availability. Another challenge is to deal with the deep uncertainty related to estimates of future changes in the context of decision making.

It should be emphasised, that the purpose of the project is not to generate new projections of future changes or to create new hydrological models but to better utilise existing data and models. The Planning DSS aims at providing a user-friendly method for accessing and processing data on future changes and linking the results to hydrological models in order to facilitate the estimation of future water demand and availability. As a result, a wide range of future scenarios will be available as input to decision making methods for deriving long-term plans which are robust to a wide range of future outcomes.

The future change implementation of the project will address strategic planning following the division of the planning components analysis, planning, implementation and monitoring. Specifically, the objectives are:

- Analysis:
  - Estimation of future water demand and availability on the basin scale and the local scale as well as large and small time scales based on existing future change data and hydrological models.
- Planning:
  - Provide a wide range of future scenarios as input to decision making methods in order to develop long-term plans which are robust towards future changes.
- Implementation:
  - Dissemination to raise public awareness about the effect of future changes on flood and drought risk and support the implementation of strategic plans.
- Monitoring:
  - Evaluation of the effectiveness and robustness of strategic plans

J.3 Implementation

The information on and understanding the role of future changes is crucial for making effective long-term plans for the reduction of flood and drought risk. The project will combine tools in the Planning DSS to estimate future water demand and availability and provide a proxy of the uncertainty of these estimates. Success and failure of plans depends often on the endorsement of all the relevant stakeholders. Therefore, it is of highest priority to the development of the Planning DSS that the methods and outputs of the tools are transparent, easy-to-understand and user friendly. As an example, this is considered more important than implementing sophisticated statistical downscaling methods into the DSS.

The future change implementation will also lean on the experiences made with respect to long-term planning and climate change adaptation in the two learning basins, the Danube River Basin and the Nile River Basin. The Nile Basin Initiative (NBI) already employs GCM projections and water allocation models within in their DSS to estimate future water demand and availability. The International Commission for the Protection of the Danube River processed and analysed water related impacts of climate change and developed climate change adaptation strategies[4].

There are initiatives that collect and process information and data on climate, water demand and availability projections. One effort is the weAdapt platform (weadapt.org) that gathers high-quality information on climate change adaptation and provides a space for practitioners and researchers to share experiences and lessons learnt. The Water Risk Atlas of the World Resources Institute (www.wri.org/our-work/project/aqueduct/aqueduct-atlas) is another example worth mentioning. The atlas provides indicator information on current and projected water risk for the global scale and selected river basins. The Planning DSS might consider linking up with such initiatives in order to provide a complete background on water-related impacts of future change and to prevent replication of efforts.

J.3.1 Specific Implementation

The specific future change implementation in the project will follow the division of the four planning stages: Analysis, Planning, Implementation and Monitoring. The following sections outline the specific implementation of future change tools in the Planning DSS.

J.3.1.1 Analysis

- Tools to access and process climate projection data at least for the relevant variables to estimate water demand and availability (temperature, precipitation and evapotranspiration)
- Tools to access and process projections or assumptions on land use change, population growth, economic development and technological development
- Tools to link up with other initiatives providing overview and indicators for water-related future changes such as weAdapt and the Water Risk Atlas.
- Mapping tools to provide an overview of future changes on the basin scale

[4] *ICPDR Strategy on Adaptation to Climate Change*, 2012. International Commission for the Protection of the Danube River, Vienna.

- Statistical downscaling methods to provide an estimate of future changes on the rural or urban scale. Statistical downscaling methods such as the delta change factor, quantile-quantile and perturbed quantile method will be implemented.
- Seamless link between processed data on future changes and water allocation models such as MIKE HYDRO and WEAP in order to estimate the impact of future changes on future water demand and availability. The outcome will be a wide range of possible flood and drought scenarios.
- Tools to provide a proxy and visualise the uncertainty related to estimates of future flood and drought risk.

J.3.1.2 Planning

- Tools to link the range of outcomes of the future change analysis to decision making methods in order to derive long-term plans for the reduction of flood and drought risk that are robust to any outcome of the future.

J.3.1.3 Implementation

- Dissemination tools in order to raise awareness of the impact of future changes on flood and drought risk and to support long-term adaptation plans.

J.3.1.4 Monitoring

- Indicator tools that allow the evaluation of effectiveness and robustness of strategic plans.
- Indicator tools that monitor the ‘real’ scenario compared to estimated future scenarios in order to allow adjustment of future change estimates.

Annex K. Decision methods as a key focus area

Decision making is a central part of planning. Its main use in planning is to decide between which of various alternative plans to follow in order to meet a specific objective. It is typically very complex to select the best plan, as there are many priorities and objectives that need to be addressed.

An organised and quantified approach to decision making is useful to:

- Provide support to the decision makers
- Facilitate reaching an agreement between many stakeholders
- Justify the expense of choosing a particular alternative over another one.

However, there will always be subjective elements to decision making in determining what the definition of success or failure of a plan is, and in choosing the range of future scenarios to investigate and the types of plans which will be evaluated.

Decisions should reflect the values and priorities of the plan, thus it is important to have a clear aim and objectives to support good decision making. Furthermore, decisions will always be taken with discussion between stakeholders and the judgment those making the decisions.

Plans for the future

Future events and the future water management situation are influenced by two types of factors: those which we can change and those which are outside of our sphere of influence. In this case the first type relates to the

1. The interventions/plans put in place by decision makers now and in the future. Here called 'plans or alternatives'.
2. The future climate, the future population size and demographic, the future economic situation etc. Here called 'scenarios'.

Uncertainty

Future scenarios of climate and population and economic scenarios are very uncertain. Although there are many different future *projections* of plausible climatic and population futures, it is impossible to *predict* which one will occur. It is even impossible to assign probabilities to certain futures as they are based on such a complex group of uncertain factors. This high uncertainty where probabilities cannot be estimated is called 'Deep Uncertainty' and means that a number of traditional decision making methodologies cannot be used with credibility.

K.1 Methodologies

There are a number of approaches and methodologies used in the various stages of decision analysis which are briefly presented here:

Traditional scenario analysis

The main objective of traditional scenario planning is developing a plan that best prepares for a plausible range of uncertain circumstances. Scenarios are developed through the identification of critical uncertainties and driving forces. The goal is to develop a range of future conditions. Typically, scenarios are treated as equally likely to occur, rather than assigned probabilities as in classic decision analysis. A benefit of traditional scenario planning is that those involved in the planning process do not need to agree on a single future when developing the plan.

Classical decision analysis

Classical decision analysis is based on multiplying the probability of an outcome by the expected benefit or loss of that outcome. This leads to an overall value for each plan which can be ranked to show the best performing plans. Fundamentally, classic decision analysis is used to find a preferred plan with the best value, which often is the lowest expected cost. However, this methodology requires that the probability of certain futures occurring is known and this assumption is invalid for climate change and future population scenarios which are deeply uncertain.

Multi-criteria analysis

Multi-criteria analysis is a way of defining different indicators and combining them based on weights into a single index which can be ranked to show highest performing plans. It can be used as a tool to gain consensus about the how different indicators should be weighted by varying the weights and seeing how it affects the ‘preferred’ plan.

Robust decision making

Robust decision making is an approach to decision making whereby a single plan is evaluated under many future scenarios and then the results are analysed to identify which particular factors in future scenarios cause the plan to fail. This shows the key vulnerabilities of the plan and enables the plan to be modified to be more robust to these situations. It does not involve the analysis of probability.

Adaptive management

Adaptive management is the concept of designing a plan to be adaptive in future. That is, to design inbuilt flexibility into the plan. This is done by deferring some decisions to be taken in the future when more is known or more information has been gathered or uncertainties, for example around cost, are lower. The flexibility may also allow the path to switch to another plan depending on the status in the future. Such future decision points rely on some monitoring of information to inform those future decisions.

K.2 Objectives with implementation of decision methods

Deciding on the plan to implement based on specific issues and objectives are a key area in planning. This is where the measures, cost and potential future impacts are decided.

The objective with implementing decision methods is to provide methods from where stakeholders are able to select the plan or scenario that provides a robust and resilient option for solving the issues and fulfilling the objective.

The decision methods requires processing of information into easily understandable indices, so the complex results observed information or numerical models can be easily interpreted by those involved in decision making.

There is a strong communication element in decision making and a need for support to the communication between the stakeholders involved in the planning process

K.3 Specific implementation

The project will evaluate which decision methods are relevant for the stakeholders involved in the project. The focus will on usability and communicational aspects as successful decision making includes decisions being accepted by many stakeholders.

The implementation of decision methods will focus on different stages, each of them explained in the following:

Define success and failure
This requires a clear definition of when the plan is failing and when it’s a success.

This is the most important stage as without clear goals and clear priorities of the plan, it is impossible to design a good plan evaluate plans, and identify the final plan.

This stage is entirely based on the goals of the organisations involved and their aims and values. Therefore the definition of a successful plan may include such activities such as the review of policies, laws and mandates and discussions in workshops to come to an agreement of a measurable goal.

Design a number of alternative plans
In order to evaluate the best alternative, a number of plans need to be defined.

This stage requires a long list of ideas of actions to be made into a single or number of distinct potential plans for the future which can be evaluated. Plans at this stage should include a reasonable level of detail such as the timing and costs of potential actions.

Evaluate the plans and summarise the performance of these plans under various future scenarios
This stage evaluates the different plans and their performance in relation to defined measures or indices. At this stage the plans are evaluated but the final plan is not selected.

In order to evaluate the plans it is important that they are evaluated under different possible future scenarios, e.g. climate ensembles or different land use scenarios.

Evaluation of a plan could be done using a numerical model for calculating the impact from a specific plan. The performance is then calculated by converting the model results into indices.

Compare results and choose the best plan or choose to modify the plan
This stage evaluates the different indices for the various plans under different scenarios, and decides on the best plan. The best plan could be decided based on a score or the robustness towards a specific objective.

It can be difficult to summarise the performance of different plans to show a clear preferred plan. Previously, classical decision methods used estimates of the probability of different future scenarios to calculate the best choice (based on most likely outcomes and benefits). However, under very uncertain futures with respect to populations and climates, it is difficult to estimate a reasonable probability for each of the future scenarios. Therefore methods which do not focus on probability are preferred, when uncertain future predictions are included.

The project will evaluate if methods like Robust Decision Making could be applied when evaluating plans with uncertain future predictions.

Annex L. Remote Sensing as a key focus area

Strategic planning for the reduction of flood and drought risk and operational planning for the management of flood and drought events require an overview of the study area and analysis of hydrological information. Hydrological information may be required not only as time series or for different time periods (for example rainfall data) but *spatial* information is also important as a) plans often cover a whole basin or area and b) because flood or drought in one specific local area will often be the result of processes occurring in other larger areas (for example rainfall, evaporation, land use in the upstream catchment area).

In many parts of the world ground-based monitoring networks of hydrological variables produce inadequate time series records and in almost all areas there is a lack of spatial coverage of such networks. These gaps in temporal and spatial information can be partly addressed by using global datasets of ground observations and/or remotely-sensed datasets to supplement the locally available information.

There are many global data sets of ground observations or remote sensing products available not only covering many different variables but also covering different regions, with different spatial and temporal resolutions, covering different time periods and with different access rights.

The project will investigate sources of data which offer global, freely available datasets relevant for water resources applications, with focus on those which are available at useful resolutions and with data access for non-academic use.

Remote sensing is the measurement of a variable from a distance and often refers to both datasets from airborne instruments and from satellite-based instruments. There are many different global data products based on processing and combining information from the different instruments aboard the different satellites.

It is important to note that such datasets are ever evolving and in many cases still require much improvement. As a result it is often important to validate such datasets against ground measurements as there may be large errors in the satellite data in some areas.

Some of these global data products have already used ground-gauged data in their algorithms so are called a ‘merged’ product, using both remotely sensed and ground-gauged information.

The project will focus on pre-processed products (that is products which are more or less ready to be used in water planning) which have a more or less global coverage and which are freely available for use.

L.1 Climatic data

Remote sensing products can provide spatial information and time series information for **rainfall**, **evaporation** and **temperature** which are important variables in assessing and managing floods and droughts.

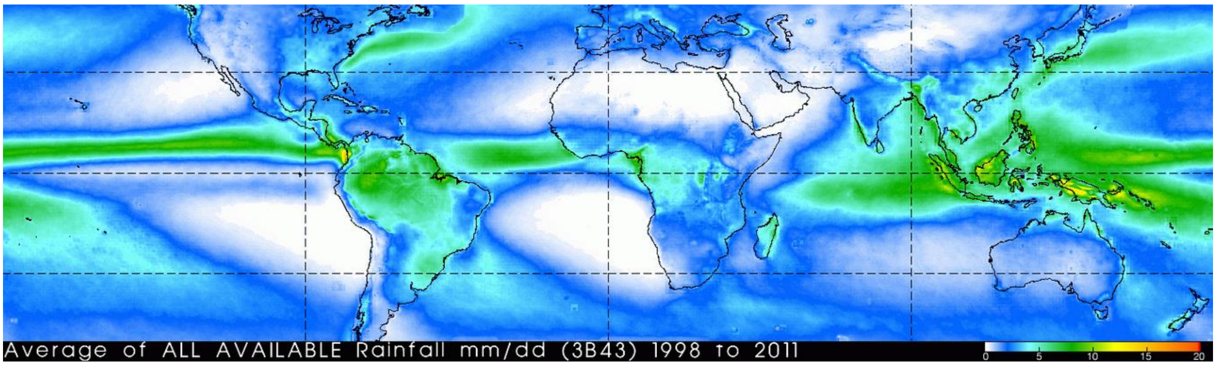


Figure 11-8 Example of average annual rainfall patterns from TRMM satellite data

L.2 Land data

Low-resolution **topographical datasets** are available and are useful for defining basin areas and river path lines and for analysis of the relationships between other variables and elevation. For example it may be important to know how rainfall varies with altitude to estimate rainfall in mountainous areas.

Visible imagery such as google earth images are useful for getting an overview of an area and **land cover** information provides some overview of an area and may also be used to make some assumptions about the hydrological functioning of an area.

Figure 11-9 Visible imagery from Google Earth provides important background information showing variations in landscape, irrigation and population densities for example.

Remote sensing products which show the **extent of flooded areas** are available both for historical periods and in near-real-time. Such data is obviously useful in flood applications. There are also satellite-based **drought indices** available online. However, the accuracy and reliability of these datasets should be investigated.

Table 11-1 List of potentially useful global products for flood and drought planning

Variable	Instrument	Product available (Global, free, pre-processed)
	Ground gauges	GPCC Full Data Reanalysis Version 6.0
	Satellite only	CMORPH (CPC MORPHING TECHNIQUE)
	Merged	TRMM3B42
	Merged	IMERG
	Merged	GPCP

Variable	Instrument	Product available (Global, free, pre-processed)
Evaporation	Satellite	MODIS ET (MODIS Global Terrestrial Evapotranspiration (ET) Product (NASA MOD16A2/A3))
Snow	Satellite	MODIS/Aqua Snow Cover 5-Min L2 Swath 500m, Version 5
	Satellite	AMSR-E/Aqua L3 Global Snow Water Equivalent EASE-Grids, Version 2
Land cover	Satellite	CCI Land Cover Maps
Topography	Satellite	SRTM 90m
	Satellite	SRTM 30m
Visible images	Satellite	Google Earth
Deforestation	Satellite	Global Forest Change 2000–2012
Flood extent	Satellite	MODIS based flood maps
Drought index	Satellite	SPI, SPEI and PDSI
Soil Water Index (SWI)	Satellite	Soil Water Index (SWI) Daily Soil Water Index V2
Crop monitoring	Satellite	FAPAR

L.3 Objectives

Meetings with the various stakeholders of the project have shown that both data availability and the access to data is often a problem. It is, however, important that plans and decisions are based on an informed analysis of flood and drought issues. As a result, remote sensing is considered an important element in supplementing the information available at a local level.

Planning for floods and droughts requires an overview of the area being managed and good information to base decisions on. In many areas there are insufficient ground data to understand the scale or spatial and dynamic nature of flood and drought risk. Remote sensing products can provide useful additional information and are freely available. However, it can be complex and time consuming to attain and extract such information and also to process it to be relevant for specific flood and drought issues.

It must be stressed that such global datasets cannot be simply used directly as the accuracy of such global information can be very variable with large errors in some areas. Local validation of such datasets is imperative which means that ground-gauged measurements are still of vital importance. Furthermore, the study of floods and droughts requires long datasets covering such events in history and remote sensing products typically provide data from around 2000 onwards which limits the extent to which they can be relied upon. However, spatial information or supplementary time series information from the datasets is useful.

The specific objective for the project is to:

Improve the density and quality of data coverage in areas with few or no data by making remote sensing information more readily available to stakeholders.

Specifically, the Floods and Drought project should aim to:

i. Facilitate access to relevant remote sensing data.

ii. Allow analysis and the processing of remote sensing data to make it relevant in flood and drought planning applications.

L.4 Specific implementation

Remote sensing and global data can be used in various stages of the planning process:

Analysis stage - where the focus is on using remote sensing data or global products for providing an overview and for calculation of indices. The project will focus on:

- Import and visualise remote sensing data, to be used as overview or background maps such as google earth images, or land use cover maps which provide general background information for the basin. Also average rainfall and drought patterns could be examples of useful background maps
- QA data and ensure that missing data are correctly dealt with
- Comparing remote sensing/global data with ground-gauged information for validation

Planning stage where remote sensing data may provide data to be used in the developed plans, and could be input data for the models which are used to evaluate different plans. The project will focus on:

- Supplementing ground-gauged rainfall and evaporation information with satellite products or using SRTM topographic information as input to hydrological or hydraulic models
- Linkage between remote sensing data and water resource or hydraulic models

Monitoring stage where remote sensing data could be to monitor the status of the basin.

- Use remote sensing data for calculation of indices, e.g. flood monitoring product or a drought severity index, or possibly a product for monitoring crop yields

Annex M. Communication Toolkit

This toolkit has been designed to help the project team identify targeted communications activities that will help deliver the outcome objectives through identifying the main communications objectives, profiling their audiences/actors, and establishing how one can target them through strategic communications planning. The resulting Communications Strategy is a living document that needs to be consulted, evaluated and updated throughout the project life cycle.

M.1 Understanding Stakeholders

The first step in any project is to understand the 'lay of the land', and get an insight into each of the stakeholders who will influence the project or the outcomes over the entire course of the project: from inception through to achievement of the eventual outcome. There are several tools to doing this, but a combination of the following four exercises can help answer most stakeholder related questions in a concise yet clear way:

a. Understanding the stakeholders (who they are, where do their motivations lie and why they would engage with the project)
b. Mapping on a commitment-influence graph (Using a graphic approach to understand what/how much influence does each stakeholder wield)
c. Identifying the co-relationships between stakeholders, especially to identify focal points for power to influence the outcomes.

Defining Communications Objectives

Set clear outcomes to drive all your communications activity

While project strategies will differ in their detail, the communications objectives will also bolster the organisational strategy by ensuring:

- Stakeholders are clear about the aim of the project;
- Priority areas are understood and acted on, and the influence and impact of the project is recognised;
- How IWA is engaged in the project partnership.

For each project, it is useful to begin by identifying the gaps between the current position in the project environment and the outcome the project aims to achieve. Then gaps can be mapped to prioritise specific communications activities – based on which are most strategically pressing (for example, because the project may need to win over some key stakeholders in order to persuade them then to engage their constituencies).

As stated, the GEF project rationale is based on the recognition that climatic variability and change is being increasingly experienced in the form of more frequent, severe and less predictable floods and drought events. The highlighted phrases in this statement help point towards the overarching communications objectives: There is ***a growing sense of urgency*** among countries, basin organisations and other end users such as utilities of the ***need to build resilience*** towards floods and droughts as an integral part of the management of water resources. The growing risks related to hydrologic uncertainty are magnified in transboundary contexts, where ***cooperation among countries is essential*** to any coping strategy.

The objective of the project is to improve the ability of land, water and urban area managers operating in transboundary river basins to ***recognise and address the implications*** of the increased frequency, magnitude and unpredictability of flood and drought events (F&D).

This suggests the priorities are to communicate:

- The urgency of the situation (stating the need for the project);
- Identified need to build resilience (outlining the solution required);
- That cooperation between and within countries is essential (stakeholders and their desired attitude identified, IWA positioned as 'bridge' connecting them)
- Water managers ***recognise and address the implications*** (concrete outcome identified, goal set.)

Understanding target audiences

Focus and understand your target audiences to maximise impact

The key target audience for the project are the pilot basin organisations (LVB, VBA, HAII), and the selected utilities. However, within this overarching audience smaller sub-groups will be identified to achieve focus and impact towards achieving the overall campaign goals, using audience segmentation. Audience segmentation divides the general audience into groups which share similar characteristics, and have a similar propensity to respond to the project. Segmentation enables:

- Identify and prioritise specific types of audience for the project.
- Gain insight into these audiences – their mind-set, motivations, life circumstances, needs, and barriers to engagement with your campaign.
- Shape project communication outputs to capture their interest, make it meaningful to them.
- Structure messaging, and target communications channels for maximum impact.

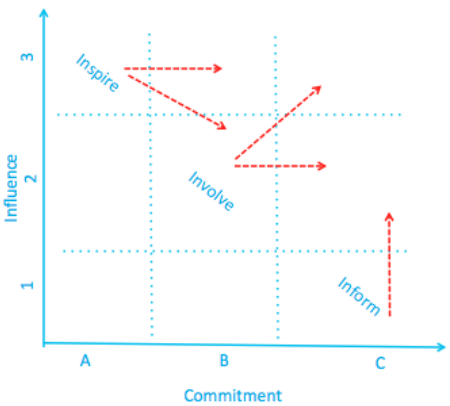
Exercise 1: Understanding the stakeholders

The following exercise provides an example of how to understand the perception of project stakeholders in order to identify the channels that the project can target activities and outputs, whether directly or indirectly. The exercise below will be complete for each project stakeholder.

Stakeholder:	Who has the power to influence the outcomes?
Current View:	Based on stakeholder meetings OR publicly held positions OR intelligence gathered from local partners etc.
Desired Position	Taken from project documentation
What will influence the stakeholder:	Research project, local groups and other stakeholders
Audience	Key stakeholders are often influenced by other parties/ groups, depending on what the decision involves. (For instance, a prime minister may be influenced by his cabinet for some decisions, and by the public for others) – Finding these points of influence will give us our communications audience
Best Channels:	Identify how and where the target audience consumes information, in order to find the best channels to communicate messages to them.

Exercise 2: Stakeholder Mapping

Mapping audiences on a graph of commitment and influence allows us to determine the tone of voice required for communications intended for them. We estimate, for each stakeholder, the level of influence they have on the project environment (along the vertical axis) as well as their commitment towards the project objectives (on the horizontal axis.) Stakeholders' level of commitment, as is usual in projects centred on innovation, ranges from low (requiring an inspiring/convincing tone of communication to win them over) to medium commitment (those already interested, but not entirely convinced of project benefits; they will need to be kept involved so as to secure their conviction) to high commitment (partners who are completely committed to the project, and need to be regularly informed of developments to 'sustain' their interest and commitment.)



Quad. B2: (Mid commitment, mid influence) is occupied by project partners (like utilities, membership bodies and on-side government bodies who need to be kept ***involved*** and ***inspired*** to move towards greater commitment/buy-in, as well as increasing their sphere of influence as they do so, such that they start to act as advocates for the project. This is where the critical mass of our communications effort will be focused, as we communicate more with/via/to these groups.

Quad. A3: These are stakeholders or audiences highly influential in their scope of operations, with either uncertain commitment to the project (i.e. we need to inspire them towards greater cooperation) or outright opposition (as they may not see the value of investment in, or the benefits of the project) This is a critical focus audience for the project, as we will need to address both, direct and indirect communications towards convincing these groups of the project benefits, and move them along the commitment access. Occasionally, there are influential stakeholders that remain unconvinced, in which case we need to find ways to communicate the project in a way that overcomes the negative influence/reduces the risk by countering arguments with evidence-based communications.

Quad. C3: (High commitment, high influence) is occupied by groups of committed project participants, like IWA, DHI and UNEP. We need to keep everyone ***informed*** and ***involved*** at this level, engaging them with frequent updates, exchanges of information, and reports as required.

To keep this communications strategy a live document, we should aim to update this table regularly as our stakeholders and audiences move along our graph based on our engagement with them.

influence >>>	A3	B3	C3 UNEP GEF DHI IWA
	A2	B2 Mwanza Urban Water & Sewerage Authority National Water & Sewerage Corporation Kisumu Water and Sewerage Company Limited National Office for Water and Sanitation (ONEA) Ghana Water Company Limited (GW) Metropolitan Water Authority Provincial Water Authority	C2 LVBC VBA HAII
	A1	B1	C1
Commitment to project >>>			

Through the project lifecycle, as developments affect stakeholders, they will proceed along the commitment influence graph, and the communications tone/objectives for each stakeholder will change accordingly. It is therefore vitally important that we keep the graph continually updated, reviewing each stakeholder's commitment and influence and adjusting the tone of communications with them accordingly.

M.2 Defining Key Messages

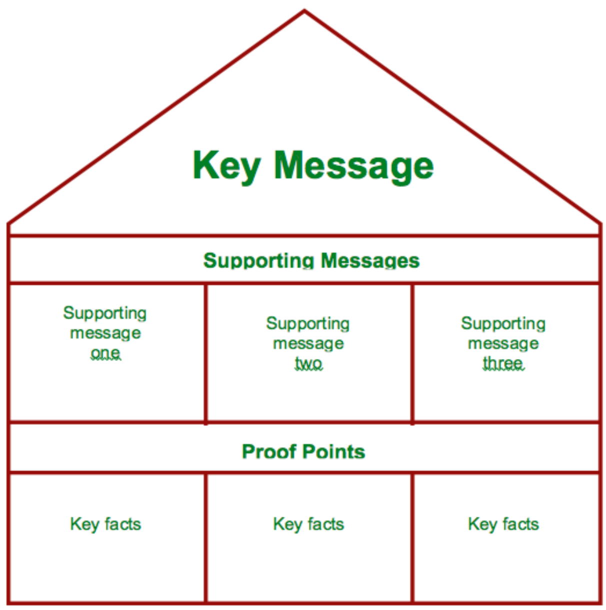
Defining the key messages for each piece of work undertaken by the project makes it easy for all project participants to be guided by, and keep to an agreed communications strategy. While it will never be possible to predict all the messages required to keep each stakeholder informed, inspired or involved in the project, it is important to draw up a comprehensive messaging framework that shapes the project communications.

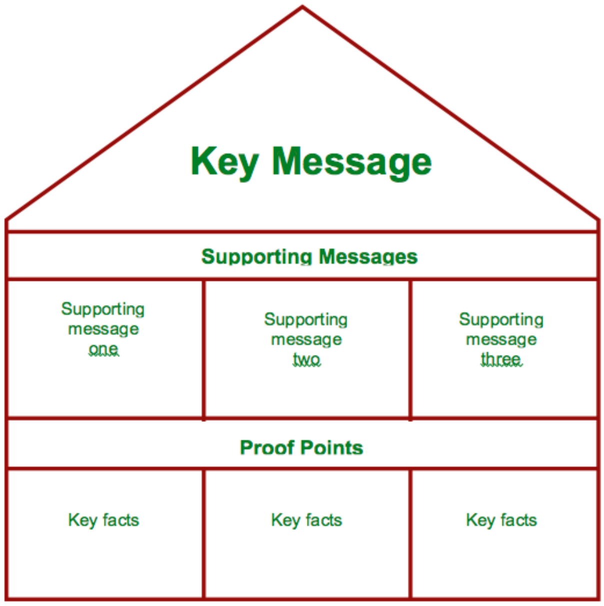
As a first step, it is important to identify the overall message conveyed by the project. The Message House exercise helps teams to break down the project rationale and crystallise the one central theme that perfectly captures the essence of the project. There is **one** key message, backed up by three supporting messages (limiting it to three supporting messages ensures clarity and focus). These supporting messages are then propped up by "proof points"; illustrations, examples or statistics that help provide additional strength to the supporting messages as well as the singular Key Message of the project.

Once the Message House (see below) is completed, and the stakeholders' relationships with each other understood, it is possible to build a more detailed messaging framework that captures what kinds of messages each project participant needs to hear at different stages of the project.

Exercise 3: Message Development House

The message house has been developed to encapsulate the key message for the campaign it is intentionally restrictive so we focus down on the key messages for the campaigns. We start building each message house from the roof with the key message. The supporting messages create three pillars holding the roof up, with the proof points listed beneath these. The draft key messages reflect the intervention strategy in Section 2.





Key message: Better water management planning from local to transboundary levels will build resilience to floods and droughts

Supporting message 1. Joint stakeholder development of tools for improved flood and drought planning reflecting stakeholder ensures improved use of information in flood and drought improvement planning

Supporting message 2. Integration of data through a Decision Support System provides consolidated information for flood and drought applications at basin and local scale

Supporting message 3: Cooperation between agencies, institutes, organisation, etc. (stakeholders) within countries and across borders and at different levels (sharing of information and knowledge) leads to better climate planning.

Exercise four: Messaging framework

Messages for different audiences will be developed based on the level of commitment and influence.

Themes to frame	INFORM	INSPIRE	INVOLVE
Stakeholders			
Political			
Economic			
Technological			
Social			
Ecological/Envir			

Themes to frame	INFORM	INSPIRE	INVOLVE
onmental			

Annex N. Project Steering Committee ToR

The Project Steering Committee (PSC) or Steering Committee (SC) for the UNEP/GEF Project entitled: “Flood and Drought Management Tools” (hereafter referred to F&DMT project) is established under the Project Document as approved by the collaborating institutions and organisations during the project preparation phase as follows:

A specific responsibility of the SC will be to facilitate liaison with the GEF Implementing Agency (UNEP) regarding overall governance of the project. The Steering Committee shall:

- Be the decision making body for the project;
- Provide governance assistance, policy guidance and political support in order to facilitate and catalyse implementation of the project, and to ensure relevant project outcomes;
- Annually review program progress and make managerial and financial recommendations as appropriate, including review, amendment and approval of annual reports, budgets and work plans.

N.1 Membership of the Committee

1. Full members of the SC shall consist of key representatives of the basin participating in the project and external observers. Key representatives are defined as the basin organisation (i.e. VBA, LVBC and HAII). The external observers consist of UNEP-DHI and NBI.
2. In addition the Implementing Agency (UNEP), and the executing agencies (DHI and IWA) and the GEF Secretariat, shall designate individuals to serve as *ex officio* members of the committee.
3. The host organisation will chair the meeting.
4. The SC may agree, by consensus, at the commencement of each meeting to co-opt additional experts as observers or advisors to any meeting or meetings of the Committee or part thereof, as the committee shall deem appropriate.

N.2 Secretariat of the Committee

1. The Project Management Unit (PMU) established by IWA/DHI under authority of the project document shall act as Secretariat for the Committee.
2. The PMU shall act as Secretary to the Committee and as rapporteur for formal meetings of the Committee.

N.3 Meetings of the Committee

1. The PMU acting in its capacity as Secretariat shall convene regular annual meetings of the Project Steering Committee.
2. *Ad hoc* meetings may be convened:
   - When a majority of the Committee members make a request for such a meeting to the PMU; and
   - At the request of the PMU when circumstances demand.

N.4 Terms of Reference

The SC shall operate on the basis of consensus to:

- Provide direction, and strategic guidance to the Project Management Unit (PMU) regarding project implementation and execution of agreed activities over the entire period of the project including the establishment of timelines and milestones for provision of agreed outputs;
- Review and approve the annual work programme and budget for project execution ensuring that these remain focused on the project overall goal and objective;
- Facilitate co-operation and co-ordination among the participating institutions, organisations and agencies particularly in transboundary environmental issues and cross component issues;
- Review and evaluate progress in project implementation and execution, and provide guidance to the PMU and core partners regarding areas for improvement, paying particular attention to:
    - progress in implementation of the various project components;
    - the monitoring and evaluation plan of the project;
    - the quality of outputs produced;
    - the sustainability of the project outcomes; and
    - the replicability of actions recommended by the project; assist in soliciting wide support for the project;
- Assist UNEP and the PMU in soliciting wide support for the project and raising such additional co-financing as may be required from time to time;
- In order to enhance dissemination of project results and recommendations, the SC should review and monitor:
    - stakeholder buy-in to the project during implementation (by review of the Monitoring and Evaluation survey reports);
    - whether results reach intended targets; and
    - the risks of failure;
- Provide feedback on Project Implementation Review (PIR) reports as needed and approve progress on the results framework presented at each SC meeting;
- Consider and approve such recommendations as shall be presented to the Committee by the PMU and the all stakeholders regarding project execution;
- Review and approve the outline of, and subsequently the final reports arising from the project, including conclusions and recommendations particularly focusing on quality of outputs, and the information dissemination strategy, including its utility by potential users; and
- Agree at their first meeting:

1. The membership, meeting arrangements and terms of reference of the committee as prepared in draft in this document; and
2. The rules of procedure, and such standing orders and manner of conducting business as may be considered necessary by the committee.

N.5 Conduct of Committee Business

1. The Committee shall operate and take decisions on the basis of consensus, regarding any matter relating to project execution that has implications for key stakeholders.
2. Where full consensus cannot be achieved in reaching agreement during a full meeting of the Committee, on any matter relating to project execution that has implications for core partners, the Secretariat shall, in consultation with the Committee, facilitate negotiations during the subsequent inter-sessional period with a view to seeking resolution, and will report the results of these negotiations to the Committee members.

N.6 Other Matters

1. Notwithstanding the membership and terms of reference contained in this document the Project Steering Committee shall have the power to amend, from time to time, the membership and terms of reference of the Committee.