REPUBLIC OF UGANDA

MINISTRY OF WATER AND ENVIRONMENT

DIRECTORATE OF WATER RESOURCES MANAGEMENT

Uganda Catchment Management Planning Guidelines

APRIL 2014

Proposed Revisions September 2017

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List of Acronyms and Abbreviations

CBO	Community Based Organization
CMC	Catchment Management Committee
CMO	Catchment Management Organization
CP	Catchment Planning or Plan
CTC	Catchment Technical Committee
DEM	Digital elevation model
DSS	Decision support system
DWD	Directorate for Water Development
DWO	District Water Office (Officer)
DWRM	Directorate of Water Resource Management
GIS	Geographical information system
EIA	Environmental Impact assessment
EQO	Environmental quality objectives
IWRM	Integrated water resource management
ICP	Integrated catchment plan
JSR	Joint Sector Review
MDGs	Millennium Development Goals
LAC	Limits of acceptable change
MoAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoEMD	Ministry of Energy and Mineral Development
MoLG	Ministry of Local Government
MoTTI	Ministry of Trade, Tourism and Industry
MTEF	Medium Term Expenditure Framework
MWE	Ministry of Water and Environment
NDP	National Development Plan
NEMA	National Environmental Management Authority
NFA	National Forest Authority
NGO	Non-governmental organization
NWP	National Water Policy
SSEA	Strategic social and environmental assessment
SWAT	Soil and Water Assessment Tool
TSU	Technical Support Unit
UGX	Ugandan Shillings
UWASNET	Uganda Water and Sanitation Network
WAC	WMZ Advisory Committee
WEAP	Water Evaluation and Planning system
WfP	Water for Production
WHO	World Health Organization
WMZ	Water Management Zone
WSDF	Water Supply Development Facility

Acknowledgements

These guidelines were prepared by the Directorate of Water Resource Management of the Ministry of Water and Environment with technical support of the World Bank (2014 edition) and Expertise France (2017 edition). Input and guidance was gratefully received from various DWRM staff at the centre and in the Water Management Zones, key stakeholders involved in catchment-based water resources management activities and many other people and organisations who took part in the consultation process. Financial support for preparation and printing of the documents was provided by the World Bank.

Foreword

Although water resources management is central level function, it has been realized that effective planning and management of water resources needs to be carried out at the lowest appropriate level and based on hydrological catchments or basins. This has been the driving force behind the concept of Water Management Zones (WMZs). A number of operational level water resources management functions will be undertaken at WMZ level to improve efficiency and effectiveness in performing these functions while responding to stakeholder needs and challenges in timely manner.

At present all four WMZs – Victoria, Albert, Kyoga and Upper Nile – are formally established but need consolidation and operational strengthening. One of the focal areas of work of the WMZs is the preparation of Catchment Management Plans, with effective stakeholder participation, in priority catchments of the country. WMZs will have a key role in coordinating the preparation of catchment management plans.

Planning provides the mechanism for learning about the physical, social, economic and environmental conditions and characteristics of the catchment, about people's aspirations and needs, about potential development opportunities and about problems, risks and threats that need to be addressed. Considering that comprehensive planning at the catchment or river basin level had not been done in Uganda before, it was found necessary to develop guidelines to provide a common framework for catchment planning to guide WMZ teams and other stakeholders; provide the planning teams an overview of the catchment planning process and the outcomes they are seeking; help to create awareness and understanding of the catchment planning process and its value in supporting sustainable, equitable and more rapid economic growth and livelihoods. These guidelines should provide a framework within which the WMZ teams and other stakeholders will refine and develop in detail their approach according to the needs and conditions in the respective catchments. I am confident that these guidelines will revolutionalise the way the country is developing and managing its water and related resources for sustainable socio-economic development.

I do hope that implementation of these guidelines will be done very closely between and among the various agencies and departments of government, the WMZ teams and other relevant stakeholders at regional and local levels so that the necessary expertise available in various agencies is utilized to prepare the catchment management plans that respond to the needs and aspirations of the stakeholders.

I wish therefore to congratulate the Directorate of Water Resources Management of the Ministry of Water and Environment for coordinating the development of these guidelines which I am sure will be updated and revised as experiences are gained on the ground. I wish also to thank the World Bank for the strategic technical guidance and financial support provided that led to preparation of these guidelines.

Prof. Ephraim Kamuntu

Minister of Water and Environment

Policy framework for integrated catchment planning

1. In Uganda, identification and planning of water development programs and projects has traditionally been done at the central level by the concerned lead sector departments. This has generally been done on a project by project basis targeting areas where demand has been expressed to authorities (for safe drinking water or water for livestock, for example) or where opportunities have been identified from field reconnaissance or maps such as water storage sites or irrigation development areas. In this way Uganda has made notable progress on achieving the MDGs for access to safe drinking water (exceeding 60% in both rural and urban areas).
2. However, progress on water development for other economically important sectors has been slow. Only a very small area of irrigated agriculture has been developed in this way (about 15,000 ha out of a potential of 200,000 ha or more) and, while many small-scale water storages have been built, few (only about 23%) are currently found to be functioning. Meanwhile declining water quality threatens water supplies and ecosystems because of unregulated discharge of wastewater, and over development and excessive use of water is resulting in increased water scarcity and conflict.
3. Nevertheless, in the 2010-2014 National Development Plan (MoFED 2009) the Government has set ambitious goals for infrastructure development in general and water infrastructure in particular including water storage and conveyance systems for irrigated agriculture, livestock and fisheries as well as hydropower. Participatory water resource planning based on an integrated water management approach could relieve emerging conflicts and water scarcities, and accelerate development of water infrastructure that is more sustainable and the productive.

WATER POLICY FRAMEWORK

4. Water policy in Uganda has been based on the integrated water resource management (IWRM) approach since the Water Action Plan in 1995, the Water Policy in 1999 and the Water Act Cap 152. The 2005 Water Sector Reform Study and the 2006 Joint Sector Review (JSR) both recommended the implementation of IWRM at the catchment level. The National Water Policy provides an overall policy framework and defines the Government's policy objective as:

   > "*To manage and develop the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs of the present and future generations and with the full participation of all stakeholders*".

5. The National Water Policy (NWP) promotes an integrated approach to the management of the water resources in ways that are sustainable and most beneficial to the country. The approach is based on the continuing recognition of the social value of water, while at the same time giving much more attention to its economic value and to the importance of the participation of stakeholders in its management and development.

CLIMATE CHANGE AND CLIMATE CHANGE MAINSTREAMING

6. Climate Change Policy in Uganda is laid out in the Uganda National Climate Change Policy (Ministry of Water and Environment, 2012). This policy is intended to guide all climate change activities and interventions in the country. The goal of the policy is to ensure a harmonised and coordinated approach towards a climate-resilient and low-carbon development path for sustainable development in Uganda. The overarching objective of the policy is to ensure that all stakeholders address climate change impacts and their causes through appropriate measures, while promoting sustainable development and a green economy. Not surprisingly, the guiding policy principles reflect many of the key guiding principles of Integrated Water Resources Management (IWRM):
   - Mainstreaming and coordinated response to climate change
   - Communicating effectively and promoting participatory approaches
   - Promoting community-based approaches to adaptation

- Devoting adequate attention to capacity development and institutional set-ups
- Devoting adequate attention to technology needs, development and transfer
- Identifying, developing and influencing financing mechanisms
- Providing a credible delivery structure

7. The policy provides both adaptation and mitigation priorities by sector. The key challenges faced by the most vulnerable sectors and the priorities for ensuring that climate change adaptation concerns are mainstreamed in the development of these sectors are provided in the Policy.

8. Adaptation priorities for the Water Sector recognise the main challenges of the "combined effects of climate change, population growth and environmental degradation", which "will lead to competing demands for water. Water stress challenges are already being felt in most parts of the country, especially in the cattle corridor, which receives less rain naturally". The Policy recognizes the importance of these Catchment Management Planning Guidelines, the preparation of which was underway at the time of publication of the National Climate Change Policy. The policy priority for the Water Sector is stated as "To support on-going efforts to ensure that climate change concerns are integrated into national efforts for sustainable and long-term conservation, access and effective utilisation and management of water resources". The Policy provides specific strategies for tackling this sectoral policy priority will include the following:

   - Promote and encourage water harvesting and efficient water utilisation among individuals, households, institutions and sectors
   - Promote and strengthen the conservation and protection against degradation of watersheds, water catchment areas, river banks and water bodies
   - Promote Integrated Water Resources Management (including underground water resources), including contingency planning for extreme events such as floods and drought
   - Support on-going efforts to ensure that climate change concerns are integrated into national efforts for sustainable and long-term conservation, access and effective utilisation and management of water resources
   - Ensure that all guidelines for infrastructure/hydraulic works (i.e., water for production, piped water supply schemes and conditional grants guidelines for support to point sources protection) mainstream climate change
   - Improve and strengthen transboundary cooperation regarding water resources management
   - Support institutional and human capacity building in water resource use, development and management
   - Strengthen water resource monitoring networks and flood warning systems

   Once again, it is interesting to note that many of these specific strategies strongly reflect existing IWRM strategies. Of particular note is the need to strengthen water resource monitoring networks and flood warning systems. Although not specifically stated in the Policy, the importance of collecting data that can inform on climate change trends and impacts of particular importance (e.g. rainfall intensity etc.)

   For other water-related sectors, the Policy priorities and associated specific strategies for tackling them, are summarised in Annex A.

9. As stated in the Policy, like adaptation to climate change, mitigation of greenhouse gas emissions in Uganda also requires a series of coordinated policy responses that are either sector-specific or cross-cutting in nature. The policy includes a summary of challenges associated with wetlands in Uganda:

   - Wetlands emit substantial quantities of GHG, even more so when reclaimed on a large scale such as for rice growing in Eastern Uganda
   - The enormous biomass (living and dead) in wetlands and their high productivity suggest an important function of wetlands in the mitigation of GHG emission
   - Much interest is directed towards their role in the carbon balance, in terms of production of carbon dioxide and methane when conserved and even more significant emission of GHG when reclaimed or drained
   - Saving wetlands will therefore help to reduce GHG emission overall
   - There is heavy encroachment of the country's wetlands by developers

- Political interference has often hampered the enforcement of laws and regulations to protect the wetlands under the current policy framework for wetland protection
- In some cases, waste from various sources is directed into wetlands and the ecosystem is destroyed
- There is rampant illegal draining and filling of wetlands, which causes flooding and increased GHG emissions
- As the population increases, both the rich and poor are increasingly pushed to derive livelihoods from wetlands, including through reclamation for agriculture, vegetables and other industrial and commercial purposes
- These losses of wetlands are accompanied by large quantities of GHG emissions

The policy priority for addressing these challenges is stated as follows " to promote a balance between conservation and sustainable use of wetlands to reduce GHG emissions". Specific strategies include the following:

- Demarcate wetlands and mandate their conservation in watershed areas
- Ensure that only sustainable economic activities are carried out within wetlands
- Reclaim wetlands where possible

10. Guidelines for the Integration of Climate Change in Sector plans and budgets (Climate Change Department, MWE, 2015) have been prepared by the Climate Change Department (see Para 20). These guidelines provide highlights of the approaches that can be used to mainstream climate change in sector plans and budgets. The guidelines are designed to provide different sectors with approaches on how to:

- Carry out impact and vulnerability assessments
- Identify opportunities and entry points for integration of climate change mitigation and adaptation measures
- Propose options for integrating climate change adaptation and mitigation into the policy formulation process, financing, implementation and evaluation at national, local and community levels
- Assist to improve resilience

This useful set of guidelines provides a set of basic steps for the integration of climate change in Sector Plans and Budgets. The steps are summarised in the following figure.

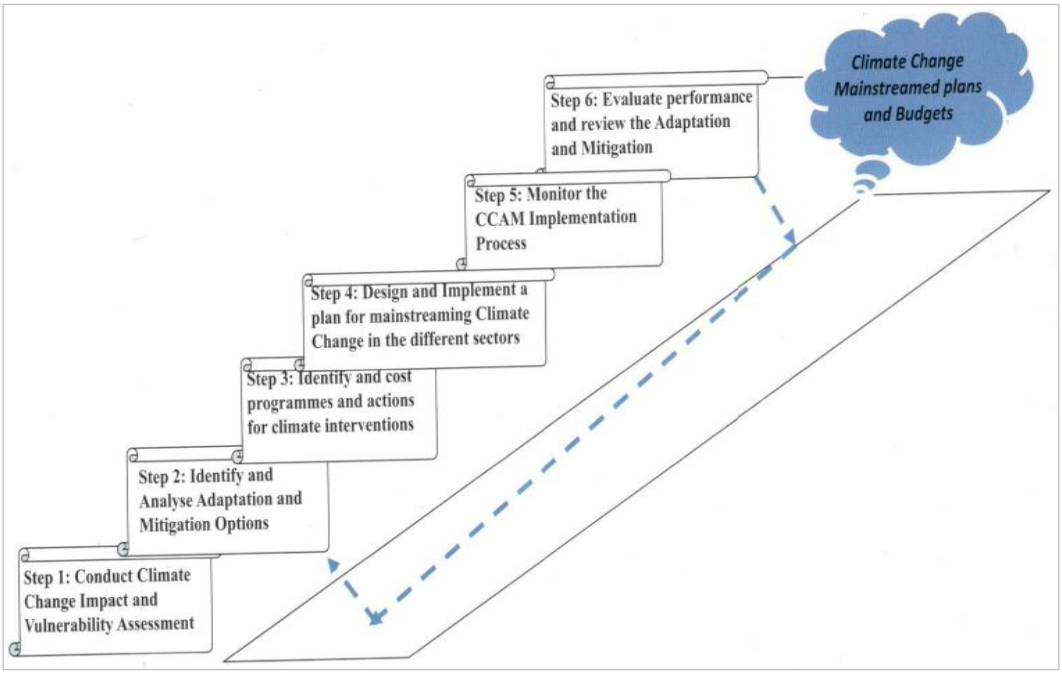

Figure 1: Steps for the integration of climate change in Sector Plans and Budgets (CCDept)

DECONCENTRATION OF IWRM PROCESSES TO THE CATCHMENT LEVEL

11. The Ministry agreed in the 2006 JSR to pilot participatory IWRM in at least one catchment. A pilot was undertaken in the Rwizi Catchment and based on this experience and the lessons learned, the strategy to roll out IWRM at the catchment level was developed. Catchment level IWRM should enable not only more effective water management but also accelerated development and sustainable water use. However, how it is implemented is decisive in achieving this policy objective.

12. Based on a pilot catchment planning program in the Rwizi Basin, DWRM and the Ministry adopted a strategy (DWRM 2008) to "deconcentrate IWRM"– that is, rather than executing all the responsibilities and functions associated with IWRM (Figure 2) at the central level within the body of the Directorate of Water Resources Management (DWRM), these functions would wholly or in part be executed by new units within DWRM that are located in newly defined regions or zones closer to stakeholders and district local governments.

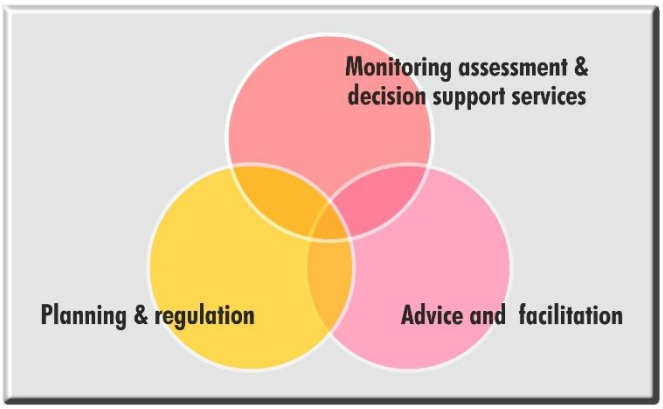

Figure 2: Core IWRM Functions

13. DWRM would retain day-to-day responsibility for policy and legislation, national water strategy, coordination at the central level, transboundary waters and technical backstopping of the zonal offices particularly in the development and testing of new technologies (for example, new analytical tools, models, information management systems, etc.). However, DWRM's main IWRM functions

– including water planning, water allocation, water quantity and quality monitoring and regulation – would now be carried out at the regional and river basin or catchment level with central oversight and guidance. This initiative brings these IWRM functions closer to stakeholders (farmers, townspeople, local government officials, businessmen, etc.). Doing so tends to increase the focus onto real problems, to improve the analytical underpinnings (for example, hydrologic analysis and water resource assessment, multi- sector water balance) of programs and projects and provides an opportunity for stakeholders to participate in the formulation of plans and the development of new water infrastructure.

14. To implement this policy, DWRM has created four regional units called Water Management Zones (WMZs). These WMZs are a part of DWRM but they are located at four regional headquarters as shown in Figure 3. DWRM's intention is for the WMZs to carry out many of its IWRM functions, including planning, monitoring, water allocation and water regulation. Taking responsibility for and executing these functions is expected to be a gradual process in which the WMZ staff gradually takes on greater responsibility as their capacity is enhanced.

Institutional framework for integrated catchment planning

ESTABLISHMENT OF WATER MANAGEMENT ZONES (WMZS)

15. The 2006 recommendation of the JSR was to implement IWRM at the catchment level without defining exactly what constitutes a catchment. Regardless, the aim is to move implementation of DWRM's IWRM functions closer to stakeholders and to the physical realities on the ground – to create new units under its guidance and supervision that are regionally based and responsible for carrying out IWRM functions at the catchment level. These new units are the Water Management Zones (WMZs). The major river basins in Uganda are depicted in Figure 3. As a practical matter it was decided to limit the number of WMZs to four as detailed in Table 1.

Figure 3: Uganda's eight main river basins and the four Water Management Zones (WMZs)

Table 1: Summary of the WMZ Catchments

Zone	Area (km^2)
Upper Nile	50,000
Kyoga	58,000

Victoria	78,100
Albert	45,000
TOTAL	231,100

16. It is evident from Figure 3 that the catchments can be quite complex and generally consist of several distinct but connected sub-catchments and micro-catchments. Each catchment is thus a multilevel water or hydrologic system consisting of integral hydrologic units at each level.

WMZ FUNCTIONS AND ROLES

17. Broadly speaking the goal of the WMZ team, and its primary role, is to facilitate sustainable development of water resources for the economic and social benefit of the people in the catchment, and to implement the water management measures needed to protect and conserve the catchment and its water resources, ensure sustainability and reduce or resolve conflicts over resource use.

18. To achieve this goal and fulfil these roles, The WMZ team will assume the following functions

- Prepare zonal and catchment water development and management strategies and plans
- Develop, maintain and expand the zonal and catchment knowledge database and information system, prepare knowledge products, and disseminate data and information including maps to support CMO and WMZ functions and facilitate catchment water management and development
- Promote awareness and understanding of integrated and sustainable water management and development among stakeholders in the zone and catchment, present Government water policy, water conservation and protection values, the role and importance of the CMOs in ensuring sustainable and equitable access to water
- Establish, support and facilitate an institutional framework for effective stakeholder participation in catchment management and development planning and plan implementation including training and capacity building of stakeholders
- Carry out holistic water resource assessments, estimate current water use and project future water demand, prepare water balances, and simulate and analyse integrated water use and infrastructure operations
- Design, install, and operate a modern zonal and catchment water monitoring system for hydrologic and meteorological data on groundwater and surface water including data collection, storage and analysis and dissemination
- Design, install, and operate a modern zonal and catchment water quality monitoring system, and operate and maintain a regional water quality laboratory
- Regulate water allocation, water use, and infrastructure operations in accordance with the agreed and adopted water management plan, administer the water permitting system, and monitor and enforce compliance with regulations including the implementation of environmental management plans and project plans
- Review project proposals for water development and water use, water use permit applications, proposals for modification of regulations or prior permits, and environmental impact assessments (EIAs) in the zone and catchment
- Contribute to and support the formulation of new and revised regulations and laws, and national water development and management plans and strategies, and support Uganda participation in transboundary water resource forums and implementation of agreements
- Coordinate, facilitate and support the activities of central sector departments and agencies, regional and district level officers, NGOs and donor partners within zone and catchment, including activities such as investment in water development at the zonal and catchment level, project planning and project preparation studies
- Guide and facilitate the continuing role and function of the CMOs in the implementation of the catchment management and development plan

CLIMATE CHANGE DEPARTMENT AND OTHER CLIMATE CHANGE INSTITUTIONS

19. In terms of the various sectoral regulatory frameworks in place in Uganda, the disaster

preparedness and management and the health and environment (NEMA) sectors make provisions to tackle climate change. In addition, the forest, land, water and energy sectors' regulatory frameworks are compatible with the climate change policy.

20. In terms of the institutional set-up, different roles will be played by various institutional structures, and a national coordination function was assigned to the Climate Change Unit. This has now been strengthened and upgraded to the level of a governmental department under the Ministry of Water and Environment, making it possible for it to conduct business with the various cross-sectoral and sectoral departments involved in the implementation of the policy. The main functions of the Climate Change Department (CCD) include:
    - Acting as an information clearing house on climate change concerns
    - Providing policy and strategic advice on climate change
    - Supporting communication and outreach on climate change
    - Ensuring the integration of climate change concerns into overall national planning through coordination with the relevant ministries, departments and governmental agencies
    - Providing secretarial services to the National Climate Change Policy Committee, the National Climate Change Advisory Committee and the CDM-Designated National Authority
    - Monitoring the implementation of the Climate Change Policy and its Implementation Strategy
    - Serving as the National Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC)
    - It is very important that a dialogue is started with the CCD right from CMP study inception. The CCD is in a position to provide advice and support and may even be able to facilitate access to financial support.

PARTICIPATION OF CATCHMENT STAKEHOLDERS

21. The effective participation of catchment stakeholders is central to the IWRM approach. The operational environment of the WMZ team, in terms of stakeholders in the use, development and management of water resources in the catchment, is summarized in Figure 4.

22. Above the WMZ at the central level is DWRM, the line departments in MWE (water supply, water development and environment) and the line departments in the other concerned sector ministries especially agriculture, livestock, fisheries, hydropower and tourism that are responsible for investment projects and programs in the WMZ catchments.

23. At the regional or WMZ level there a wide variety of organizations active in water resources development. These organizations are important potential partners whose technical and financial support needs to be mobilized for the success for both the preparation and implementation of catchment plans. These include NGOs and international partners working within the zone and the regional entities set up by the water supply sector, the WSDF and the TSUs, the NWSC.

24. At the catchment level and especially at the sub-catchment, district and county levels, there are a bewildering array of officials, offices, and organizations as well as programs and projects that are of direct concern to the WMZ planning team and who have

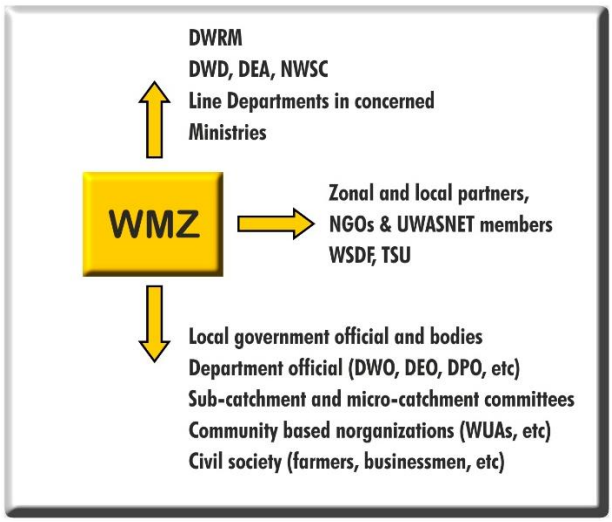

Figure 4: The complex realm of the WMZ

important interests in the work of the WMZ and the catchment management plan.

25. The WMZ planning team has several purposes in proactively engaging national, regional and catchment stakeholders. Among these are:

    (a) To raise awareness and promote greater understanding and appreciation of the catchment water resource system, its potential and its limits, and of the value and work of the WMZ team in preparing an integrated management plan for these valuable resources;

    (b) To facilitate greater "buy-in" or commitment on the part of catchment stakeholders to the plans for water management and development in the catchment that are ultimately agreed;

    (c) To create continuing mechanisms and processes that are accepted by water users and other key stakeholders (e.g., local government) and institutionalized within the catchment for conflict resolution, water regulation and enforcement, and other water management measures.

26. The scope of stakeholder participation in integrated catchment water resources planning in terms of the nature or manner of their involvement and the goals and methods of the planning team (du Toit *et al* 2010) is outlined in Table 2.

Table 2: The nature of stakeholder participation

GOAL	To provide stakeholders with balanced information to assist them in understanding the problem, opportunities, threats, solutions and options	To obtain stakeholder feedback on analysis, options and decisions	To work directly with stakeholders throughout the process to ensure that public concerns are consistently understood and considered	To partner with stakeholders in each aspect of the decision-making process including the development of alternatives and the identification of preferred solutions
PROMISE	To ensure people are informed	To inform, to listen and to acknowledge concerns and aspirations, provide feedback on how stakeholder input influenced decisions	To work with stakeholders to ensure that concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how stakeholder input influenced decisions)	To look to stakeholders for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible
TECHNIQUES	▪ Fact sheets ▪ Web sites ▪ Open-forums ▪ Press releases ▪ Videos for TV ▪ Advertisements ▪ Media	▪ Public comment ▪ Focus groups ▪ Surveys ▪ Circulars ▪ Email	▪ Workshops ▪ Face-to-face meetings ▪ Discussion groups ▪ Sector meetings	▪ Forums ▪ CMO – multiple stakeholder meetings ▪ Consensus building meetings ▪ Participatory decision making

THE CATCHMENT MANAGEMENT ORGANIZATIONS (CMOS)

Facilitating a collaborative process

27. The process of preparing and adopting an integrated catchment management plan is one that is almost by definition a collaborative process (Table 2). A plan that is prepared in isolation might

be technically sound but neither viable or implementable because the stakeholders most affected by the plan's recommendations do not accept the recommendation or do not believe their interests are taken into consideration or are protected. Management actions or instruments that are not accepted by stakeholders are not complied with. Similarly, infrastructure that is not accepted by stakeholders is often abandoned and becomes dysfunctional.

28. During plan preparation, stakeholders need some kind of institutional framework within which to operate for them to consider the process as legitimate. Moreover, since catchment plans, especially water management measures, take some time to implement and the plan itself will be reviewed and revised from time to time, an institutional framework for this continuing process over time is needed. The existing structures at the district level could serve this purpose but none have sufficient spatial scope or jurisdiction.

Establishing and supporting a new institutional framework

29. It is the responsibility of the WMZ to establish and support the new institutional framework at the catchment level – the Catchment Management Organization (CMO) - that builds on and utilizes to the maximum practicable extent, existing structures and relationships (MWE 2010). The overall structure of the CMO and related forums and advisory bodies is shown in Figure 5. The CMO constitutes the most involved and collaborative stakeholder group; the advisory committees are consultative.

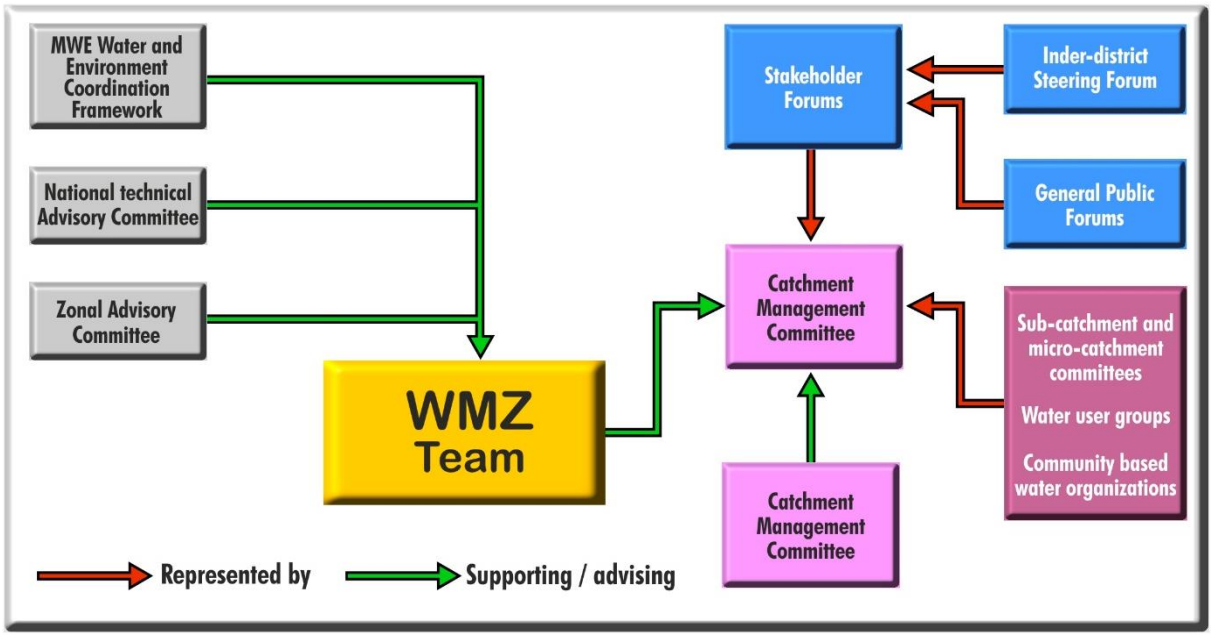

Figure 5: The Catchment Management Organizations (CMOs) and related stakeholder forums and advisory committees

30. The WMZ has to make sure that the CMCs are formed and up and running. It has an important role to play at the beginning in ensuring that CMC understands its role and that it is capacitated to play its part in the catchment planning process. The WMZ will be able to rely on support from a number of national or zona-level organisations including the ministerial water and environment coordination network.

31. It is important to stress that the CMC is a representative body. As indicated in Figure 5, it represents various stakeholder forums including the inter-district steering forum and a range of water-related user groups and committees. These various groups will have representation on the CMCs. It is vitally important that the full range of key stakeholders as shown in Figure 5 are involved from the outset and the CMC is as complete as possible.

32. The core of the CMO consists of two connected and complimentary committees:

- The Catchment Management Committee (CMC)

The CMC will play two key roles:

⇒ Planning: the CMC will represent all stakeholders in collaborating with the WMZ team at each step of the planning process, especially in expressing the catchment development vision, deciding on the planning objectives and key issues, identifying options and considering alternative scenarios. The draft final catchment plan will be agreed with the CMC;

⇒ Implementation: the CMC will play steering role for the implementation of the catchment plan. The membership of the CMC would include representatives of all key stakeholder groups in the catchment including the political and technical leadership of the various administrative units in the catchment. This is the most important stakeholder group and the WMZ will need to take considerable care including wide consultations to select and mobilize candidates some of whom will have to be motivated. The CMC would meet frequently, perhaps every month, during the latter stages of the planning process.

As indicated in Figure 5, the Catchment Management Committee (CMC) is at the centre of the whole process. At the end of the process it is the CMC that approves the Catchment Management Plan (CMP) so they have to be involved throughout the process. Ideally, the CMC should be in place before the formal work on drawing up the CMP begins. All catchments should be included in catchment management plans so the CMCs can be formed as soon as possible, even if they are relatively inactive initially (especially if funds are not available).

- The Catchment Technical Committee (CTC)

The CTC is the technical arm of the CMO. The committee has several functions: to bring technical experience and knowledge of the sector programs and projects in the catchment to the planning process; to take responsibility for operationalizing and in some cases implementing programs and projects in the agreed plan; and to oversee and foster inter-district cooperation during the implementation phase. Membership would include the representatives of the line departments at district (or zonal level) and heads of the district service departments (there are typically multiple districts in a catchment).

The Catchment technical committee should be put in place at the same time as the CMC. As the CMC's technical advisor, it should include members with the capacity and experience to provide useful support. Typically, these should be technical specialists from the line departments at the district or zonal level. It should also include representation from the district natural resources management committees. The CTC will bring both technical support and knowledge on sectoral and district development priorities.

33. To extend the reach of the WMZ planning team and ensure the broadest possible and practicable participation, an informal and *ad hoc* **stakeholder forum** and possibly **general public forums** will be established. The general public forums are meetings of the general public organized to promote awareness and understanding of what the WMZ is doing and what are the issues and opportunities in the catchment. The stakeholder forum is a more targeted forum that would most often be organized at the catchment or sub-catchment level to enhance and broaden the spatial scope of communications and ensure that catchment stakeholders are fully aware and can participate in the catchment planning work.

34. The **Inter-district Steering Forum** brings together the chairpersons of district and urban councils, the district water and sanitation committees and the district environment committees, the respective chief administrative officers, important leaders of business and private sector groups including farmer organizations, fisherman and livestock associations, etc. This is an important group since it is essential for the WMZ planning team to ensure that key issues within and across districts are addressed. Local government is likely to play a major role in implementing the catchment plan including and beyond the provision of water and sanitation services. Hence, the Inter-district Steering Forum has both an important political role and a substantive role in the preparation and implementation of the catchment plan. In general, its role might include:

- Enact and enforce, in the context of local government laws and regulations, policies, ordinances and bye-laws related to IWRM and wise use and sustainable management of water and environmental resources;
- Participate actively in the development and implementation of catchment management plans for the river/lake basins;

- Promote integrated planning in management of land, water and environmental resources; promote and facilitate the mainstreaming of IWRM into district and town development plans, district environmental action plans, poverty eradication action plans, district water development plans and other relevant plans;
- Carry out monitoring and evaluation of IWRM activities in their respective areas;
- Raise public awareness within their jurisdictions on water and environmental issues;
- Encourage and increase stakeholder participation in the integrated management of water resources; and
- In collaboration with the WMZ team and DWRM, resolve conflicts related to use of the water resources.

35. The **WMZ Advisory Committee (WAC)** brings together the regional and national partners. One of the most important functions of this committee is to ensure that the catchment planning process internalizes the plans, projects and priorities of the various line departments and their regional units, and to provide guidance to the WMZ team on sector policy, strategies and priorities. The NGOs have experience working at catchment and sub-catchment level on a wide range of programs and the aim is to facilitate the integration of this experience into the catchment planning process.

Support for the CMO

36. The roles and functions of the catchment CMO including its various constituent committees and forums cannot be sustained without support from the WMZ, the Ministry, the concerned local governments located in the catchment, and the stakeholders and water users. However, neither the nature nor the magnitude of the continuing long term support needs is yet known mainly because the process of establishing and activating the CMOs is only now beginning. The same could be said for the WMZs. It seems unlikely, for example, that the initial staffing plan for the WMZs will be adequate over the longer term, and hence their operating budgets can be expected to rise not only to accommodate additional staff but also the requirements for the catchment planning and implementation process.

37. The Ministry will have to design a sustainable financing plan in the context of the MTEF of the Ministry for both the WMZs and the CMOs. In doing so there are some major policy issues to resolve, including whether and to what extent the beneficiaries should contribute to the cost of water resources management, specifically their catchment management and development plan, the modalities for beneficiary payment for services and benefits, and whether and how the costs can or should be shared among level of Government.

38. For the time being both the cost of the WMZ, the CMOs and the catchment planning process are borne by the Ministry and DWRM through the budget process (DWRM 2008). Support for the CMOs for the time being must come through the WMZ's. This support will be in several forms, for example:
    - Information, especially knowledge products such as maps and charts, that inform stakeholders;
    - Technical guidance and support, generally based on presentations of the results of planning analysis in terms and in forms that are readily understood by laymen;
    - Secretariat services such as organization, scheduling, meeting services (venues, etc), and documents (including videos, slides, reports, etc);
    - Training and capacity building of CMO members and participants, including the initial mobilization and organization of the CMO;
    - Logistical support including travel and meeting costs.

39. The basic or core concept of the CMO, including its role and function, is sufficiently established at present to launch the process of catchment planning in each of the zones. Nevertheless, the issues and questions outlined and suggested above will become more urgent as the process progresses. Most urgent are:
    - The legal framework for both the WMZ and the CMO, especially the CMC and CTC; The revision of the Water Act and the regulations currently (September 2017) under development will provide the legala basis for the CMCs and will also enable them to hold funds.

- The authority and powers of the WMZ and the CMO constituent committees; these aspects will also be clarified by early 2018 once the proposed specific regulation on catchment-based resources management has been drafted. This will provide clear functions and roles of the CMOs
- The short and long term financing plan for catchment water resources management and development; there is a proposal under consideration aimed at introducing a levy on new water infrastructure. This level of this levy has not been finalised but could be significant and sufficient to support vital catchment protection requirements.

40. The DWRM has these issues high on its agenda.

SUB-CATCHMENT MANAGEMENT ORGANIZATIONS

41. There are several situations that could arise that suggest the establishment of a formal or informal catchment management organization or forum at the sub-catchment or micro-catchment level. Examples include areas where substantial land, forest or wetland degradation has occurred, irrigation command areas (decentralized community based programs or centralized developments), community based water supply development, or multipurpose water storages. Groups could be mobilized at this level to support both planning as well as plan implementation. But note that the effort to engage and mobilize the community at this level is issue driven, that is, the WMZ would undertake this initiative where it will directly support the planning and implementation process. For example, where the issue of land degradation driven by poor farming practices or deforestation for fuelwood is important, there will be an absolute necessity to involve this type of stakeholder forum at the micro or sub-catchment level. Where a catchment management plan is for a small upland catchment it is likely that a large proportion of the CMC will be from formal or informal catchment management organizations or forums at the sub-catchment or micro-catchment level.

42. There are several important reasons for the WMZ to look seriously at the needs for the mobilization of stakeholders at this level:

(a) It is a way to make IWRM and integrated catchment planning more equitable by ensuring that a broader range of stakeholders is brought into the process;

(b) Where there are already water use conflicts or there is high potential for such conflicts, it will be essential for the WMZ planning team to create mechanisms by which it can facilitate the resolution of these conflicts by stakeholders to the extent possible;

(c) Some problem such as land and forest degradation require significant changes in behaviour on the part of stakeholders including taking actions to mitigate these problems – as pointed out in Chapter 6, mobilization of the community and involving them in the planning and implementation is an essential part of finding and implementing solutions.

(d) The approach at the sub-catchment and micro-catchment level should be to use existing county and parish and village level organizations (formal and informal), associations and groups.

Purpose and aim of these guidelines

43. Where does a WMZ team wanting to take on its delegated responsibilities begin? The team needs a framework within which to implement the IWRM functions (Figure 2), and this framework typically consists of a strategy *or* ***integrated water management and development plan*** for each of the catchments delineated in its zone.

44. Planning provides the vehicle for learning about the physical, social, economic and environmental conditions and characteristics of the catchment, about people's aspirations and needs, about potential development opportunities and about problems, risks and threats that need to be addressed. Since this type of comprehensive planning at the catchment or river basin level had not been done in Uganda before, the need for guidelines or a road map was recognized. The broad aim of these guidelines is to:

- Provide a common framework for the WMZ planning teams and other stakeholders;
- Provide the WMZ planning teams and other stakeholders an overview of the catchment planning process and the outcomes they are seeking;
- Help to create awareness and understanding of the catchment planning process and its value in supporting sustainable, equitable and more rapid economic growth and livelihoods.

45. These guidelines are not intended to be a detailed manual for water resources planning at the catchment level. They are a framework within which the WMZ team and other stakeholders will refine and develop in detail their approach according to the needs and conditions in their catchment. The purpose is to:

- Inform the WMZ planning team and other stakeholders on the scope of the catchment planning process;
- To provide a common policy and institutional framework for catchment planning;
- To provide a strategy and guidance on stakeholder participation;
- To provide a generalized step-by-step process that can be applied flexibly to take into account realities on the ground, yet would yield a plan that is technically and economically sound and in which the stakeholders in the catchment have been substantially involved in its preparation;
- To provide guidance on different approaches that can be used to implement various steps and activities in the planning process;
- To help the planning team design its workplan and schedule its activities.

46. These guidelines are a "living document." They will continue to be refined and strengthened based on experience and lessons learned from ongoing catchment planning activities.

47. These guidelines assume a close working relationship between the central level DWRM departments and the WMZ teams. In the early years of its implementation, this relationship will be critical, particularly for the transfer of GIS technology, development of the knowledge base and the transfer of data, the acquisition and testing of models and building modelling capacity.

Key issues and challenges for integrated catchment planning

ISSUES THAT WILL TYPICALLY CONFRONT THE WMZ PLANNING TEAM

48. **Scale**. At what scale, or level of detail is the planning exercise to be carried out? This is an important consideration. For large catchments with major rivers and either existing or potential large-scale abstraction works for irrigation, hydropower or other purposes, the focus may be different than for small catchments where the issues may be more focussed on "localised" problems such as the availability of water in streams during the dry season or localised competition for water and other natural resources.

    Given that the CMC has a central role in guiding the development of the plan, the composition of this body should reflect the scale and the issues that the Plan will have to address. If the composition is representative of the issues and scale the focus of the Plan is more likely to be appropriate.

49. **Choice of models and tools.** As with scale, the choice of the appropriate models should be issue-driven. Where the main issues concern the choice between different options of hydropower and irrigation schemes and whether there is enough water remaining for potable water supply to various centres, a water balance/allocation and optimisation model may be the most appropriate. Where the focus is on underlining the benefit of watershed management investments, a rainfall-runoff model that show the benefits of improved land-use practices may be the priority.

50. The catchment is a natural system of land, water, and ecosystems, and the catchment management plan will have many aspects that address the problems of protecting, conserving and managing that natural system. But it also much more than a natural system; it is also a unique social and economic system dependent upon the exploitation of the natural system of the catchment. This enlarges and expands the context and range of problems that are addressed in the catchment management plan. Among the many roles and functions of the WMZ team summarized in the previous sections, the implementation of three highlight the complexity and range of issues with which the WMZ team will typically have to address:

    - Development of water for economic and social development – people will want access to more reliable water supply, better sanitation, reliable water for livestock in the dry season, water for irrigation and to improve crop production, water for aquaculture, water for environmental services especially in wetlands, and they will want their present access to water for these activities protected and improved;
    - Protection of the resource base that supports these economic and social benefits - many of these activities, singly and in combination, can result in adverse impacts on the catchment itself and on the water resource base of the catchment including impacts on groundwater recharge, stream flow, flood flows, soil erosion etc.;
    - Conservation of the catchments resources will involve measures to ensure that water uses do not waste or diminish the resource, as for example, discharge of wastewater and pollutants into the catchment.

51. Specific examples of these issues were identified in a survey of all 17 catchments undertaken (COWI 2009) to help set priorities and to identify some of the key issues as seen by catchment stakeholders. Some issues are unique to a particular catchment – an example being the high risk of adverse impacts of oil exploration and development in the Lake Albert Eastern Catchment and in the Lake Edward Catchment. But others occur frequently and in nearly all catchments. The latter include:

    - Resource use conflicts – actual and potential; that is, presently or in the near future – this issue was identified by stakeholders in every priority catchment;
    - Lack of operational management and appropriate regulation of multiple uses in the same catchments (irrigation, hydropower);
    - Lack of enforcement of water regulations, particularly the discharge of untreated wastewater and harmful pollution;
    - Catchment and river bank degradation, particularly where there is sand and gravel mining, but also in areas where population pressure and urbanization, deforestation, and extension of

cropland are resulting in land degradation, increased erosion, and siltation of rives, reservoirs and water bodies;

- Very limited hydro-meteorological monitoring with major gaps that are a hinder to water development and management;
- Lack of coherent and comprehensive drought and flood risk mitigation plans and preparedness;
- Conservation and management of wetland water management and environmental services.

52. There are also several overarching issues that are most easily seen from a distance. These include:
    - The need to increase resilience to climate variability and change – the high annual average precipitation masks high seasonal and inter-annual variability that is manifested in frequent rainfall shortages that depress yields and productivity;
    - Deteriorating water quality, especially the threats this poses for domestic and livestock water use and for the numerous lakes found in the WMZs;
    - The need to prioritize and channel investment in ways and directions that ensure maximum and sustainable benefits to stakeholders from the water resources in each catchment.
    - None of these issues can be addressed in isolation or completely from the perspective of a single sector or department, but at present there is no overall basin or catchment natural resource planning in Uganda that could guide both the departments and water users.

53. This is the fundamental rationale for approaching catchment water resources development and management with an integrated approach. Holistic and integrated water resource plans that take into account the physical, economic, social and environmental resources in a catchment and that are based on the long term vision and short term concerns of stakeholders provide an appropriate framework for effective management and regulation of water resources. Equally important, they provide a framework for priority setting and investment on the part of sector authorities that ensures strong stakeholder awareness and partnership.

LESSONS LEARNED FROM COMPLETED CATCHMENT MANAGEMENT PLANS

Rwizi Catchment Pilot

54. The Rwizi catchment pilot offered the opportunity to capture a number of important lessons that should guide the WMZ teams (DWRM 2009). These included:

    (a) A coordinator of IWRM, located within the catchment, is essential for successful implementation of IWRM – this suggests that at least one member of the WMZ team would need to be appointed “team leader or coordinator” for each catchment. That person is the visible point of contact within the WMZ for all stakeholders in that catchment;

    (b) Cooperation is easier amongst Districts with a common factor such as shared culture and historical ties – this lesson highlights the importance of the WMZ team quickly developing an understanding of the social and cultural landscape of each catchment and taking that into account in the planning process;

    (c) Data required for water resources situation description is scattered, of poor quality, has many gaps, difficult to obtain – this will be a major challenge in which DWRM and the NWA team must play an important role to solve the associate problem; it also underscores the principal that an adopted plan is not “the plan forever”, that the plan is a living document that has to be revisited as knowledge grows and conditions change;

    (d) Use of existing structures within the catchment complemented by a few new structures gets IWRM up and running much faster than introducing new structures – hence, in a way similar to the social and cultural issues, the WMZ team needs to map the formal and informal institutional landscape of the catchment, and mitigate whenever possible harmful competition; The WMZ needs to avoid redundant organizations and meetings, and cumbersome procedures;

    (e) Another important lesson from the Rwizi pilot is the need for the WMZ team to be able to effectively explain the purpose and scope of the proposed catchment planning program including how it is being funded, how plan proposals will be funded and implemented, and

what the long-term requirements are for plan implementation. None of the stakeholders has been involved in such an exercise before and the process is likely to result in water management plans (water allocations, land use behaviours, regulations, etc) that ask them or require them to take various actions – not all of which are what they may be thinking at the outset.

Other Lessons Learned

55. As part of the process to update these Guidelines, the DWRM carried out a review of the lessons learned from the preparation of around 15 catchment management plans prepared since the publication of the first edition of the Guidelines. The main points are highlighted below and explicitly relate to practitioners' experience in using and applying the first Edition of the Guidelines. It should be stressed that the general experience in using the guidelines has been very good. Many of the recommendations have been incorporated into these revised guidelines:

(a) **Scale**: Guidelines are focussed on larger catchments and the development of larger infrastructure. The use of non-process-oriented water balance and/or optimisation models such as Mike Hydro or WEAP are not really useful for smaller catchments where actions at the smaller scale (in micro-catchments for example), such as watershed management, tackling degradation hotspots needs to be better taken into account in the options analysis.

(b) **Stakeholders' structures**: The institutional structure for stakeholders as set out in the guidelines is not clear in terms of roles and timing and the general engagement strategy. There are issues around sustainability, funding and legal status

(c) **Communications**: More detail on the specific role of the communication strategy is required

(d) **District development plans / other sectors**: the relationship of catchment management plans with district development plans should be clearer. There is a need to link better with lower level structures and their plans (WUAs and CEAPs)

(e) **Modelling, DSS and knowledge base**: There are question marks over the choice of appropriate modelling tools. This relates to the question of scale. For issues related to watershed management and resultant impacts, there is a need for other modelling tools.

(f) **Strategic framework, SSEA and options analysis**: Linkages between these different parts are not clear. How the SSEA is to be carried out can be confusing.

(g) **Local expertise / knowledge**: There is a need for local expertise on the planning team building the catchment management plan. There is also a need to make more use of indigenous knowledge and practices.

(h) **Groundwater:** Groundwater does not receive adequate coverage in the water resources planning analysis (Section 2.1). Once again, this is probably linked to the issue of scale since groundwater is not generally seen as a resource that can be shared and transferred around the basin. However, the role of groundwater at the micro-catchment level is critical.

(i) **Conflict Management**: Not adequately covered or stressed in the Guidelines.

(j) **Advocacy and Capacity Building**: Capacity building is not stressed adequately with respect to some stakeholders, especially CMCs.

GUIDELINES FOR INTEGRATED CATCHMENT PLANNING

OVERVIEW OF THE MAIN STEPS

56. The schematic diagram in Figure 6 outlines the planning process as a series of steps each of which contain varying numbers of tasks. The steps and tasks are sometimes iterative and often interdependent. Each of these steps and the task they comprise are discussed in this section. It bears repeating that these steps provide the framework within which the WMZ team and other stakeholders will refine and develop in detail their approach according to the needs and conditions in their catchment. They are not meant to be followed mechanically, but rather to provide guidance on the catchment management planning process. As experience is gained in undertaking catchment management planning in Uganda, these guidelines will be refined to reflect lessons learned.

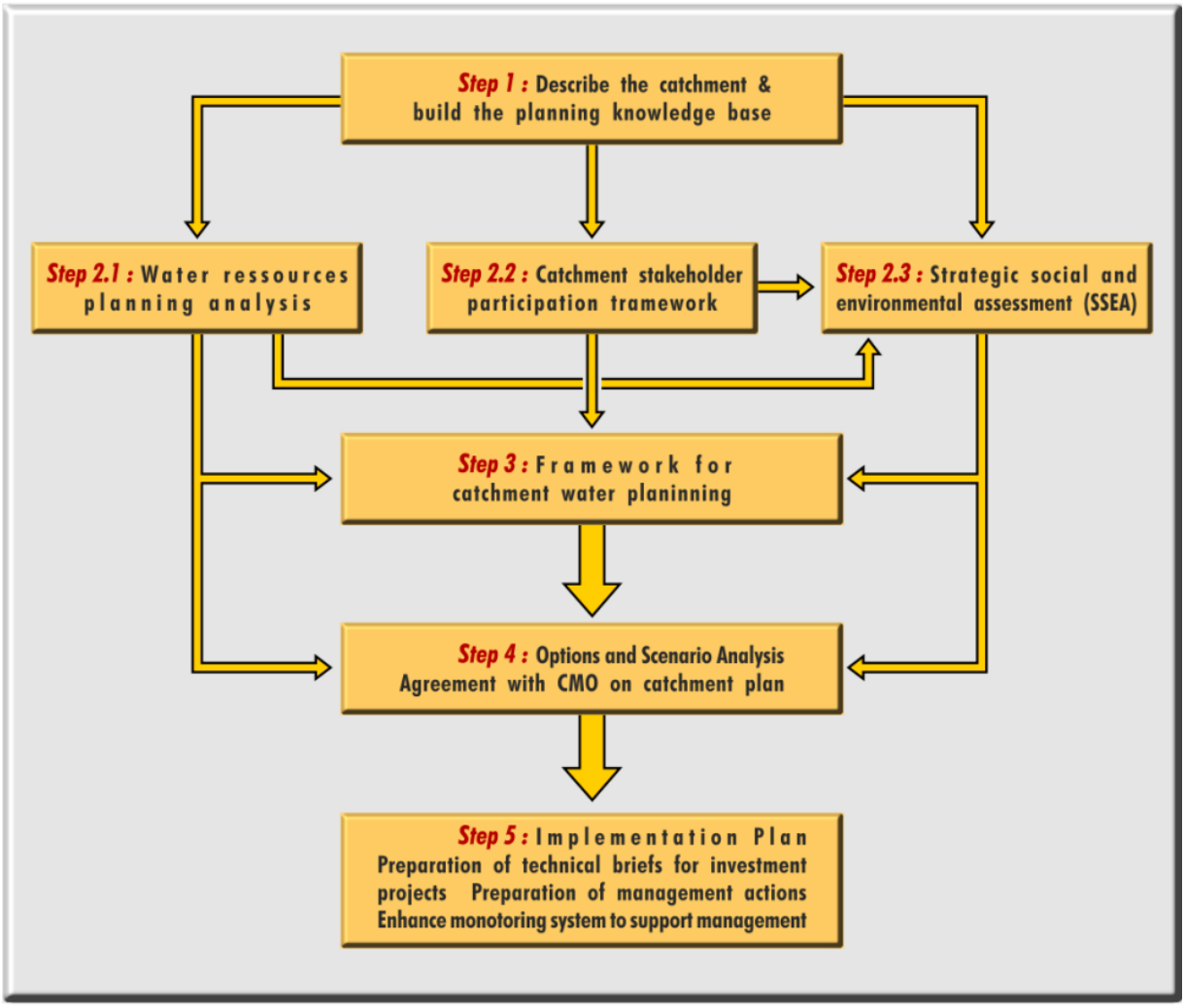

Figure 6: Overview of the catchment management planning process

Collecting the right information

57. ***Step 1*** establishes the *information foundation* on which the remainder of the planning process rests. The aim is delineate and describe the catchment and to compile and organize the data and information – *the knowledge base* - that is needed to support the planning process. Since the spatial

qualities of much of the relevant data are critical to the planning process, it is also necessary to establish and operationalize a GIS system for the zone with the support of the DWRM GIS Centre.

58. The importance of **scoping** is to be stressed here. It is important that work carried out under Step 1 is focussed, which means keeping in mind what the information is to be used for. It is not the purpose of knowledge base to describe everything about the catchment, but rather to understand the issues, challenges and threats and to appreciate the opportunities. At the same time, the water resources modelling and SSEA will require certain information and it is important that it is well-defined before extensive field work is undertaken.

Analysis and Assessment

59. ***Step 2*** involves three interrelated steps implemented more or less in parallel:
    - In ***Step 2.1*** the analytical framework for planning analysis in the catchment is established and operationalized including catchment hydrologic and water system simulation models. Analysis in this step includes a water resource assessment and water balance. At the Step 2.1 stage this will represent the baseline or current situation, but the models should be configured so that they can be used to inform the Options and Scenario Analysis under Step 4.
    - In ***Step 2.2*** the framework for the participation of stakeholders in the preparation of the catchment plan is established and operationalized – stakeholders are identified, mapped and mobilized; the CMO is created and membership identified and motivated; and the program to inform, train and operationalize the CMO is designed and implemented;
    - ***Step 2.3*** is the critical strategic social and environmental assessment (SSEA) in which the key vulnerabilities in the catchment are identified, and linkages, cumulative impacts and options for mitigation are assessed. Since the SSEA process is participatory, this step must be planned and carried out in close coordination with Step 2.2. The SSEA also depends on outputs from the water resources modelling which will provide key outputs on cumulative impacts. As indicated in Figure 6, the SSEA will also play a key role when comparing options under Step 5.

60. ***Step 3*** establishes the framework for catchment water planning. This highly participatory step includes four tasks as outlined below. This is the first and one of the most important and substantive inputs to the planning process by the CMC and the CTC.
    - Present to the CMC and CTC an overview of the catchment; the major issues, problems, trends; and the opportunities and options identified by the WMZ planning team in Step 1 and Step 2;
    - Review and agree with the CMC and CTC on planning objectives and indicators – this is a critical task since these objectives and the corresponding indicators will guide the formulation and evaluation of options and scenarios;
    - Review and agree with the CMC and CTC on the major issues, problems and trends in the catchment that need to be addressed by the catchment plan. This would include the aspirations and needs for water expressed by stakeholders;
    - Review and agree with the CMC and CTC on the range and scope of options to be considered – what stakeholders want done and what does the planning team see as being needed.

61. ***Step 4*** consists of the analysis (using the tools developed and operationalized in Step 2.1 and Step 2.3) of options and scenarios within the framework for planning developed in Step 3. This step is iterative and interactive. It will be challenging for the CMC and CTC to follow the reasoning if the presentation is too complex. Hence, the WMZ planning team needs to carefully walk the CMC and CTC through the process and results in order to foster good understanding and a consensus draft catchment plan.

62. ***Step 5*** consists of a series of tasks that prepare the agreed draft catchment plan for implementation, including its review and approval by MWE. It also includes the development of the monitoring and evaluation system and a framework for adaptive management.

The WMZ will need a communications strategy

63. MWE has developed a water resources management communications strategy that is designed to:
    - Ensure that communication within the MWE is well coordinated, effectively managed and responsive to the diverse information needs of the people of Uganda;

- Provide mechanisms for provision of timely, accurate, clear, objective and complete information on Government policies, programs, services and initiatives related to water resources management to Ugandans;
- Provide a framework to enable MWE to communicate openly with the public on water resources management policies, programs, services and initiatives;
- Ensure that all stakeholders involved in water resources planning, development and overall management collaborate with each other and communicate with the public.

64. Even a cursory review of the guidelines suggests that effective communications with a wide range of stakeholders from government officials to members of civil society is important and will be necessary. Hence it will be useful as a part of Step 2.2 in the planning process (see the next section) to develop a specific communication strategy and program for the WMZs.

STEP 1: DESCRIBING THE CATCHMENT AND BUILDING THE KNOWLEDGE BASE FOR PLANNING

STEP 1.1: DELINEATING THE CATCHMENT AND SUB-CATCHMENT BOUNDARIES

65. All WMZ planning teams face the same problem at the beginning – how to develop and organize a basic understanding and picture of its catchments. Figure 7 illustrates the delineation of two catchments in Kyoga WMZ. The process generally begins with gathering and studying ***all available maps*** of the catchment areas including in particular topographic maps. Where maps are old or out of date or have significant gaps, ***remote sensing imagery*** should be obtained.

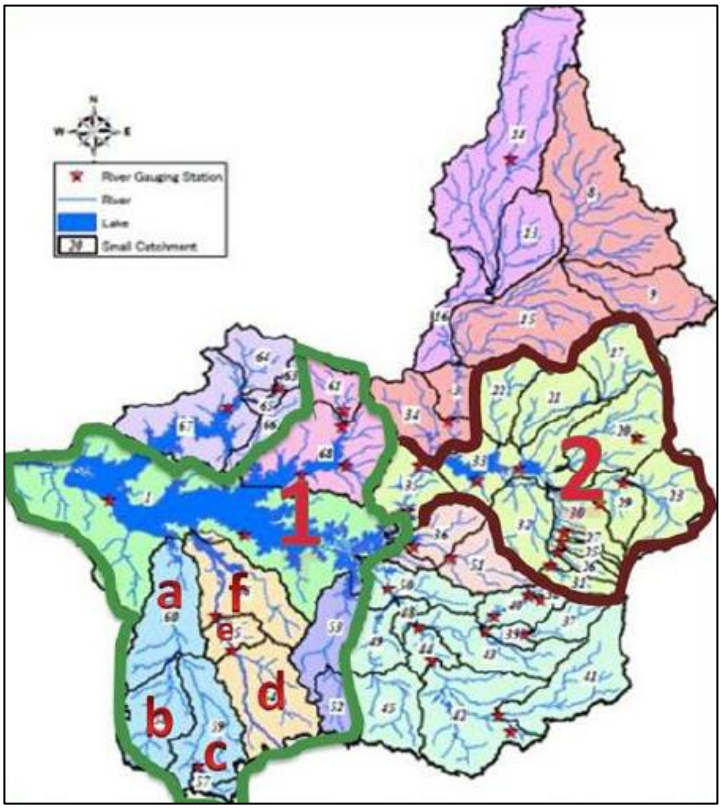

Figure 7: Delineation of two catchments in the Kyoga WMZ

66. Even a cursory examination of Figure 3 and Figure 7 suggests that each of these catchments is complex from a hydrologic perspective and require the delineation and analysis of several sub-catchments to understand the whole catchment. Catchment 1 is the Lake Kyoga catchment – distinct from its three primary upstream catchments but including several smaller catchments that directly flow in to the lake.

67. Sub-catchment a-b-c in Figure 7 constitutes one such sub-catchment, and sub-catchment d-e-f constitutes a second (note that they do not join but flow into the lake separately). The delineation of catchments was established for the purpose of developing a water system simulation model for the whole Lake Kyoga basin (JICA 2010). The delineation in Figure 7 is not what the planning team needs initially, but it is a good model of how one might begin. Just as in Figure 7, the planning team can begin by sketching the boundaries of watersheds of the river network, and then further refining this as a greater understanding is gained of the sub-catchments. Initially the team is trying to identify not only the network and the sub-catchment boundaries but also to locate and identify how and for what purpose people in the catchment are using water and, in general, the status and spatial distribution of the catchments natural resources. The level of detail at this stage may be much greater than that which the team will use to model the catchment and these activities.

68. But how detailed should the exercise be? For example, in Figure 7 sub-catchments d, c and f can obviously be further subdivided into two sub-catchments. Note that in Figure 7 there are few gauging stations (shown faintly by small red stars). Hence for modelling the catchment, many sub-catchments were combined or lumped together. At this point the team is trying to learn about the land, people, the resource base including the sensitive environmental as assets, existing water use and other infrastructure, the major issues and problems, and what plans and development proposals exist in the sub-catchments. Later these data can be combined in ways that are convenient for modelling the catchment, but at the beginning that is not what is driving the process.

69. There is obviously a hierarchy of catchments and sub-catchments, but these guidelines are

deliberately vague about giving separate names (other than sub-catchment and micro-catchment) to all the various levels. It is not necessary if the planning team focuses on the connectivity of the various sub-units and their relation to these other units (the team can of course give them real names as opposed to a generic or categorical name as it wishes or finds helpful).

70. How fine the delineation is made depends on whether the new sub-units convey important information about hydrology, people, water demand and use, or infrastructure options, etc, and to what extent this information can be taken into account given the **scale** of the catchment management plan. Where the catchment management plan is being developed for a larger catchment plan it will not be possible to plan in detail all the required actions at the micro-catchment level. However, if actions addressing issues such as land degradation and the need for watershed management are relevant to the overall plan, it is important that smaller catchments are delineated, even if they are lumped together for parts of the analysis such as water balance and optimisation modelling.

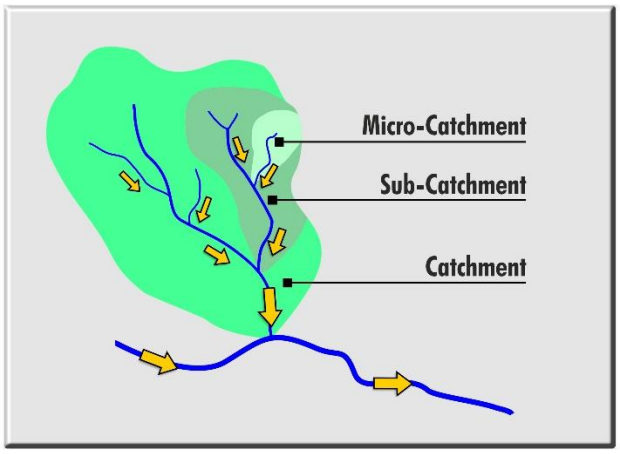

Figure 8: Catchments, sub-catchments and micro-catchments

71. It may not be realistic for large-scale plans to provide action plans for each micro-catchment, but they should at least i) address the issues, ii) provide for remedial actions in the form of pilot demonstration projects covering some micro-catchments and iii) develop a plan for scaling up. These three actions will at least require that micro-catchments are delineated, even if they are aggregated for basinwide modelling tasks and other considerations.

72. This characteristic of multilevel interconnectedness of sub-catchments is demonstrated in the schematic diagram in Figure 8. Water users in the different connected sub-catchments are using a common shared resource – what one group does or plans to do with water affects what upstream and downstream groups may do or plan to do with water. This principal applies to both groundwater and surface water. The effects of heavy upstream use of groundwater on dry season flows downstream are an example of how the use of surface water and groundwater are connected both spatially and temporally.

STEP 1.2: DEVELOPING A CATCHMENT INFORMATION MANAGEMENT SYSTEM

73. The planning team has to have a way of organizing and manipulating the information and data it will compile for the catchment and each of the sub-catchments. Hence the second step is to begin building a spatial database that can be used to support consultation and collaboration with stakeholders and planning analysis.

74. In collaboration with the DWRM GIS Centre, each WMZ will develop a ***GIS spatial information system***. The GIS will include the ***digital elevation model*** (DEM) used in the NWA (or an updated or improved version) to provide a topographic base which can be used to delineate sub-catchment boundaries. The DWRM GIS Centre will provide technical support and backup, provide training, provide existing shape files from its library, and help the WMZ team to acquire new data files.

75. The first and one of the most powerful applications of the GIS should be the preparation of several thematic maps that can be used to inform stakeholders and to collect and document information including opinions that stakeholders can provide to the WMZ planning team.

76. The use of new technologies – especially ***remote sensing*** – to gather spatial information and data needs to be piloted by the WMZs**.** Not only are many new satellites available and accessible but also data from satellites can be found free on the internet.

STEP 1.3: BUILDING THE CATCHMENT KNOWLEDGE BASE

Critical role of the knowledge base

77. Without good data and information, no real planning can be done and no informed decisions taken. Hence, at the beginning an important task is to collect, compile, and organize data needed to support the planning process. The GIS is the tool need to organize most of this data, but other software such as excel will also be needed.

78. The broad term "knowledge base" refers to the whole body of data and information that is generally needed to support the planning and decision-making process (see Annex E for an initial list of the types of data and information). The knowledge base may consist of all types of data and information including hardcopies or reports and maps as well as data in digital form. Moreover, as the planning process proceeds new data will be added to the knowledge base.

79. The knowledge base should be organized and implemented in a manner that facilitates wide access to the data and provides a focal point for water-related data and information in the Water Management Zone, with data collected by various national and other agencies being collated in the knowledge base. This suggests that there needs to be a seamless and mutually supportive interface between the zonal and national water information systems. In addition to the queries, analysis, the information and maps would be used to generate various knowledge products such as atlases, state of the Basin reports, etc.

What data are needed for the catchment knowledge base? The importance of scoping

80. Preliminary answers to this question can be obtained by focusing on key questions that need to be answered by the knowledge base, that is, **what are the questions and issues that will drive the planning process and what data and information will be needed in order to answer these questions?** This is the role of a scoping exercise which should be carried out before too much effort is expended in the field. At the zonal and catchment level these questions might include:

- What is the status of the resource base - Surface and groundwater availability? Seasonal patterns? Storage-yield relationships? What is the frequency and magnitude of droughts and floods? Are there threats to water quality?
- What are estimated water demands at different points in time in the future (domestic use, irrigation, industrial use, hydropower, environmental, in-stream, etc. uses) and trends?
- What is baseline for the planning objectives and indicators?
- What is the existing water regulation and monitoring infrastructure? Data? Reliability? Gaps?
- What options are there for further developing and regulating the resource base and what are their economic, environmental, and social implications?

81. A tentative list of data that might be compiled and used in preparing a catchment plan is given in Annex E. Also included in Annex E are the sources of data in Uganda and elsewhere. This list includes potential sources of climate data for future "under climate change" conditions.

82. When compiling the list of data, including spatial datasets, it is important to identify the shortcomings or gaps, especially where action could be taken to address these shortcomings during implementation of the plan. This should include, but not be limited to:

- Collection of climate, especially precipitation data. In consideration of anticipated climate change, all new precipitation gauges should measure rainfall intensity (eg automatic tipping bucket). It is important to improve monitoring in source areas.
- Surface and groundwater gauging stations.

83. Among the ***physical spatial data*** to be compiled initially are the stream network, water bodies including lakes, reservoirs and tanks; groundwater boreholes and dug wells; identification and location of important existing infrastructure (roads (all types), bridges, dams, diversions, pumps, canals, hydro-met stations); villages, towns and urban areas; industries; commercial farms; mines; forests; protected areas and parks; important touristic assets; and wetlands; soils, land cover and land use.

84. An important part of the spatial data base is the ***district and country administrative boundaries***. A large amount of important ***social and economic data*** are compiled and reported by district

and its sub-units. These data, including for example population and related census data, can be compiled into the WMZ GIS system as attributes of the district and other units.

85. ***Lakes, ponds and wetlands*** play an important role in the hydrology of a catchment, support specific water uses, and represent a special water management challenge. Lakes in particular are fragile, have a very long retention time, mix slowly and have a very long recovery time from shocks such as pollution discharges. Along with lakes, wetlands are one of the most ubiquitous features of the Uganda landscape. Together these two features represent most of the manageable water storage in the country. Hence in compiling this initial picture of the catchment, the WMZ team should pay particular attention identifying, locating and describing lakes, ponds, and wetlands as key parts of the catchment water system.

86. ***A computer model or paper map is no substitute for field reconnaissance***, i.e., for traveling throughout a catchment to see the many ways in which water is used, to observe the factors that govern the hydrology of the catchment such as soils, land cover, slope, land use and the stream network. This also provides an important opportunity for initial discussions with stakeholders – not necessarily through formal gatherings but primarily impromptu discussions in the field with local people. This is also an opportunity to assess land-use changes, especially the expansion of agriculture and to obtain an appreciation of the timeline associated with these changes. In some cases, these changes may be both large and relatively recent and highly significant in terms of observed changes to the hydrological regime (baseflow, floods, groundwater recharge etc.).

STEP 1.4: PEPARE A SCHEMATIC DIAGRAM OF THE CATCHMENT

87. The fourth step, undertaken in parallel with the above, is to develop ***a schematic diagram of the*** catchment. This process is demonstrated in Figure 9 which represents existing and potential developments in the Mpologoma sub-catchment of the Kyoga Lake basin. Such a schematic diagram can be sketched quickly from the study of the maps and reports on studies that may have been done previously.

88. The schematic diagram describes the stream network as a series of links and nodes (connections) and includes all existing and proposed water uses and water infrastructure. The schematic diagram in Figure 9 shows all the existing demand centres, abstraction and return flow details for 2 sub-catchments in the Mpologoma catchment. When building this network it is advisable to take into consideration both existing and possible future developments, even those that may n=be in competition for the same water. This could include dams and reservoirs, hydropower developments, irrigation and water supply schemes and any water abstractions and return flows. It can also take into account the need to meet environmental flow requirements. When it comes to looking at alternative development options in Step 4, the modeller will be able to “switch on or off” those future developments that are to be included or not, in the option being investigated.

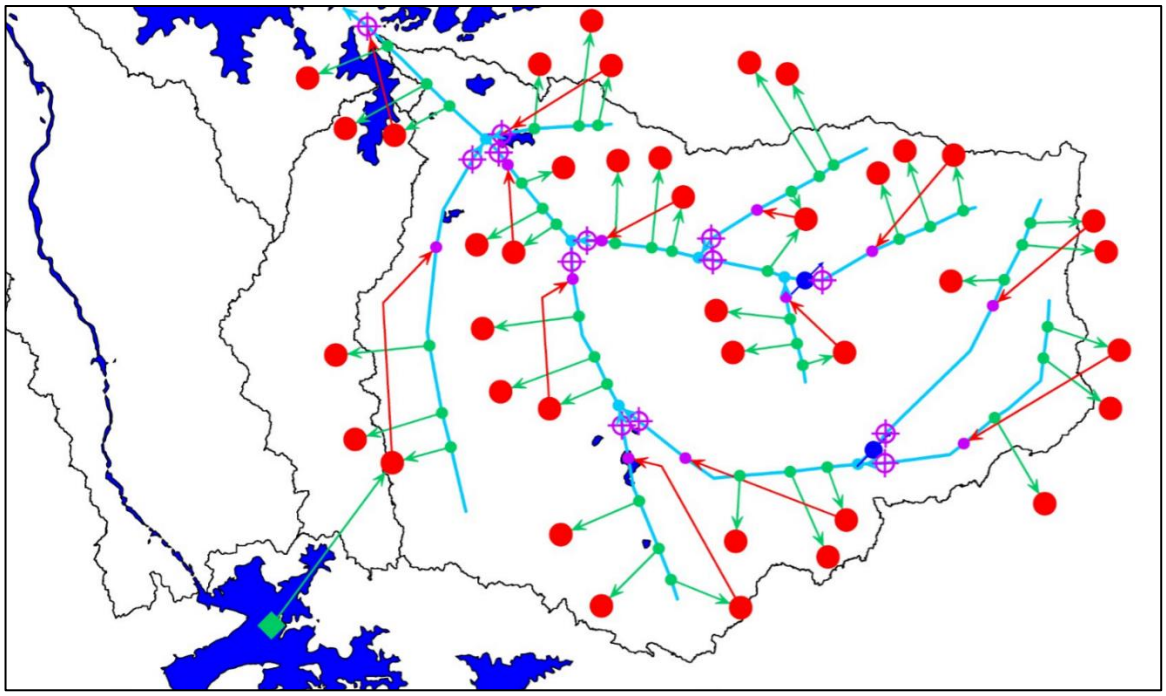

Figure 9: Schematic water resources / demand flow in the Mpologoma catchment (elaborated with WEAP)

STEP 2 WATER SOURCE ASSESSMENTS AND STAKEHOLDER PARTICIPATION

STEP 2.1 WATER RESOURCE PLANNING ANALYSIS

Task 2.1.1: Analytical Tools for Planning and Water Resources Management

89. Integrated catchment planning generally requires a set of analytical tools including water system models to undertake water balance studies and scenario analysis. Together with the Knowledge base these tools form the core of a decision support system (DSS). Annex D briefly describes the basic analytical tools that are typically needed in a water resource planning decision support system.

90. Since publication of the first edition of these Guidelines, the Nile Basin Decision Support System (DSS) has been developed by the NBI. It is a comprehensive analytic framework designed to meet the requirements of complex water resources planning. It provides diverse tool sets for data processing, modelling, scenario management, benefit-cost analysis, optimization and multi-criteria decision making. It also offers tools for integrating environmental, social and economic objectives, thus facilitating multi-sector water resources planning at river basin level. Member states have been provided with a number of licences which give free access to the tools. Details are available through the DSS portal http://nbdss.nilebasin.org/support/home. An important addition to the models mentioned in the first edition of these guidelines is the NAM rainfall-runoff model.

Decide on the decisions that may need to be supported

91. An important step in developing a decision support system (DSS) for water resource planning and water operations is to define the range and nature of the decisions that may be needed and to use this information to determine the characteristics and elements of the decision support system that will be required to support these decisions. This is an important topic to discuss, possibly on more than one occasion, with stakeholders.

92. The requirements to support these decisions may be as simple as a map (often the case with a micro-catchment) or as complicated as a mathematical model of the water system – the point being that the DSS is likely to be made up of a number of very different tools using the information in the knowledge basin in different ways to support different kinds of decisions. Experience suggests that these tools and the connections be kept as simple and transparent as possible while meeting the particular decision needs and requirements.

93. The planning team will have its own view of what the issues are and what decisions may be needed based on its reconnaissance of the catchment and analysis of the data in the knowledge base. Nevertheless, the team should hold discussions with stakeholders to define the basin operating, management and investment decisions to be supported by the DSS. Some examples include:

- Decisions relating to investments that could impact flow patterns, water balances, water quantity and water quality, including irrigated agriculture developments, other growth- related developments (e.g. floriculture/greenhouses, tanneries, agro-industrial processing plants, etc.), and other consumptive water use developments;
- Decisions relating to water storage and flow control investments and corresponding coordinated system operations to meet various objectives (e.g. hydropower, irrigation and drought mitigation, flood mitigation and prevention, lake level regulation, environmental flow regimes, etc.);
- Decisions concerning investments for pollution and waste water management, fisheries management, navigation, recreation and tourism, and environmental conservation and enhancement;
- Decisions relating to optimal, equitable and coordinated operation Shire River hydropower schemes, irrigated agriculture schemes and environmental flow control; and future projected surface and/or subsurface water control and withdrawal schemes, to be generated in the context of routine annual/seasonal, monthly/weekly and/or daily/sub-daily operational planning;
- Decisions relating to the generation of operating rules and guidelines future water infrastructure to achieve various objectives;

- Decisions concerning appropriate water control and use during periods of crisis, including drought flow apportionment and allocation priorities, distributions and schedules at times of shortage, and flood flow retentions and/or diversions at times of excess, together with the nature and timing of key contingency plan actions in the event of emergencies.

Select the water system modelling tools

94. Annex D provides a quick summary of the types of tools typically used in catchment planning along with the kinds of tasks that can be done with them. The focus initially should not be on this model or that model, but on what the team needs or wants to do, that is, focus first on questions such as:
    - what results do we need?
    - what kind of analysis do we need to do to get those results?
    - what data do we have?

95. The final question is, then, what models could one use to address these questions with the data available (remembering that one needs to look beyond what is available in MWE, that is, to the internet and sources of public domain and remotely sensed data). The ease with which the models can be operationalized, the level amount of training required, and the intuitive nature of the interfaces are important considerations.

96. The National Water Resources Assessment (NWRA) prepared by DWRM utilized the MIKE BASIN[1] water system simulation model to carry out the analytical tasks in the water assessment including analysis of rainfall-runoff relationships, data gap filling, determination of water availability and the water balance. This model, developed by DHI, has been discontinued but replaced by MIKE Hydro, which is included in the NBI DSS.

97. The NWRA simulation model should not be used for analysis in a particular catchment without an assessment of its suitability in its present form. The findings of Step 1 are likely to **result in a much more detailed definition of the catchment in terms of sub-catchments than was used in the NWRA, which has a much more coarse representation**. This will result in the need to use a more refined and detailed model for the catchment under study. In some cases DWRM may suggest and provide support for the use of a different model such as the hydrologic model SWAT (Soil and Water Assessment Tool)[2] or NAM (see Paragraph 42) or a different system simulation model such as the WEAP model (Water Evaluation and Planning system)[3]. This is an area on intense collaboration between the WMZ teams and DWRM central level departments including the early organization and implementation of specific applied training.

98. NAM. The NAM model is a deterministic, lumped (catchment is looked upon as a single unit with average values of parameters) and conceptual Rainfall-runoff model. It can present the **processes that take place in the surface zone storage, root zone storage and the ground water storage**. This is important if there is a need to understand the impacts of changes in land use and/or vegetation cover which could typically result from improved land management practices. In addition, it contains provision to deal with snow melt and Irrigation schemes. Applications related to the NAM include:
    - Runoff forecasts taking into consideration the status of the surface and groundwater storage zones
    - Extension of runoff series
    - Estimate effects of Climate Change, for instance on stream flow"

    Further detail on the NAM model is provided I Annex D.

Task 2.1.2: Assessment of Baseline Water Resources Availability

99. A key step in catchment water planning is a determination of the characteristics of water availability and the balance of water available with estimates of present and future water use and demand. An estimate of the spatial and temporal characteristics of the catchments water resources, combined with trends in potential water use, provides a picture of what issues may arise in meeting people's need for water, what opportunities appear to be available for development, and

[1] www.mikebydhi.com/Products/WaterResources.aspx
[2] www.**swatmodel**.tamu.edu
[3] www.**weap**21.org

what actions may be required to manage water resources to ensure that conflict does not overtake opportunity. The present NWRA, which was also based on modelling catchments, provides a useful guide to the WMZs in formulating its approaches to implementing Step 2.1.

100. The water resources assessment will describe the current status of water resources in the catchment at different spatial and time scales taking into account the constraints and opportunities in different sub-basins and catchments, including the risks of extreme events (floods and droughts). The assessment will include a description of rainfall and streamflow variability and as well as evaporation. The assessment will be based on a detailed review of all available hydrologic and meteorological records and the use of suitable methods for filling data gaps. A key part of the modelling work will include the calibration of a "rainfall-runoff model" for key points in the catchment where runoff records are available.

Consideration of climate change

101. This calibrated rainfall-runoff model will be used to generate runoff series for the same key points, using climate-change affected datasets rather than historical rainfall. The results will be that two sets of catchment and sub-catchment hydrology are generated, one reflecting historic conditions, and one reflecting conditions under climate change. The process is summarised in Figure 10. Details of the approach are provided in Annex C.

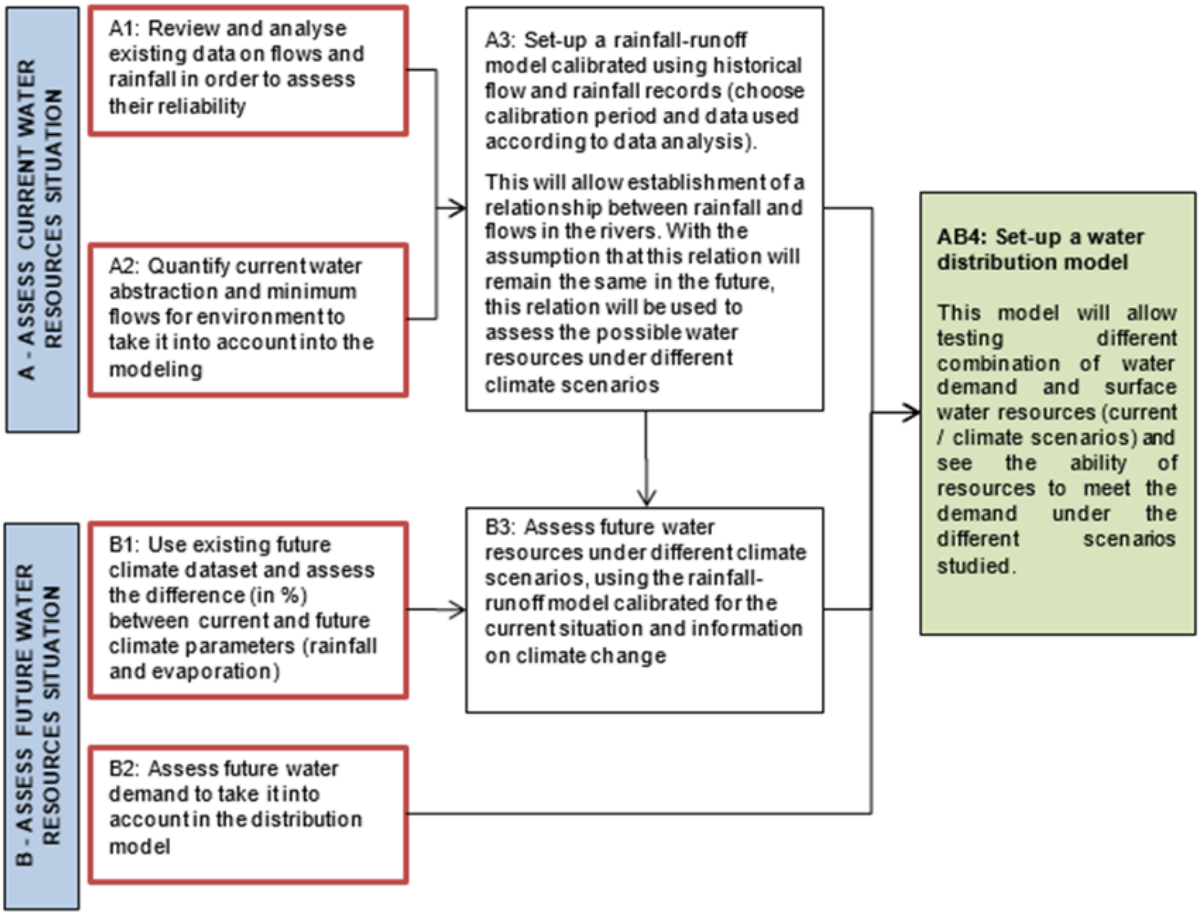

Figure 10: Consideration of climate change approach

102. The knowledge base, Step 1, should provide data on topography, geology and hydrogeology, land cover and land use and other parameters necessary to estimate runoff from un-gauged watersheds and catchments.

Groundwater availability and mapping

103. Groundwater is an important source of water for drinking, livestock, agriculture and industry in nearly all catchments in Uganda. Hence the assessment of the groundwater availability, including its location and characteristics such as the type, depth and extent of aquifers, comparative well

development and operating costs, and sustainable yield, are an important part of establishing the context and basis for an integrated catchment plan.

104. The WMZ team should prepare detailed groundwater availability maps initially by district but wherever possible by sub-district. These maps are used by district local government to plan and carry out the development of new drinking water supplies and to approve the location of other major water uses that require groundwater supplies.

105. The initial data and information for this mapping will come from the analysis done as part of the NWRA. In the long run these data will prove inadequate, especially where groundwater development is intense, for example because of population growth or large increases in other uses such as agriculture or mining. In areas where these preliminary data suggest conditions are favourable for groundwater development for domestic, livestock, agriculture and industrial water use, the WMZ in collaboration with central level DWRM departments should prepare and implement a program of groundwater investigation and possibly detailed modelling to improve the estimates of groundwater availability and development potential.

Surface water availability & the environmental flow regime

106. The surface water assessment determines the ***amount of water available as streamflow*** in time and space. This is not the amount of water available for future use. The amount of existing use must be taken into account, as well as the amount of streamflow that is needed to maintain critical season flows for water quality management (reserving adequate capacity to assimilate pollution discharges), for environmental and ecological requirements (in rivers, lakes and wetlands), and to protect water off-takes that depend on river water levels to function. The streamflow net of existing use and critical season flow requirements is the amount that is available for future development.

107. Critical season flows depend to a large extent (if not completely) on discharge from groundwater. Hence in those catchments or sub-catchments where groundwater development is large the consequent effect on critical season flow should be taken into account in determining the streamflow available for development.

108. Note that the determination of critical season flow requirements should take into account the views of stakeholders through consultation with the CMO, CTC and the WAC. Because of the present lack of data and tested analytical tools for this purpose in Uganda, determination of critical season flow requirements might be called in part the “how much is enough” problem, whose resolution will require the WMZs to undertake wide ranging consultations.

Rainfall and streamflow extremes

109. Knowledge of rainfall and ***streamflow extremes*** is also an important input to the catchment planning process. The characteristics of extremely high rainfall and streamflows that are the cause of floods, and extremely low rainfall and streamflows that contribute to drought conditions need to be analyzed since in most catchments these adverse conditions will be among the issues to be addressed in the planning process.

110. It is generally accepted that the magnitude and frequency of floods will increase under conditions of climate change. As yet, there are insufficient data to quantify these changes. However, then likely increased risk should be taken into consideration. It is also important to check with the Climate Change Department on the availability of any new studies or analyses.

111. The assessment of ***flood risks*** should include the mapping of areas with significant flood risk and an investigation and mapping of the causes of flooding. Flooding will always occur in a river valley because the channel is never large enough to accommodate extreme rainfall events, but this naturally occurring flooding can and often is exacerbated by changes in land use upstream (for example, deforestation, poor cultivation practice, soil and land cover degradation, stream channel degradation) that increase the amount of runoff and the degree (depth, duration, extent) of flooding. Where data are adequate, upstream measures to mitigate flooding should be modelled to estimate their potential effects and benefits.

112. In sub-catchments where streamflow records are available and adequate the frequency and magnitude of flood flow or discharge can be estimated. The aim is to identify and map areas affected by floods of different frequency. These are areas with different degrees of flood risk - for example, areas flooded once in four years, or ten years or fifty years.

113. Unfortunately, in many sub-catchments the streamflow records may be unavailable or inadequate for this type of analysis. In these cases the flood affected areas in each sub-catchment should be mapped by means of field reconnaissance and consultation with local people to identify indirect evidence of flooding (such as change in vegetation, topography, or flood marks) and by interview and discussion with people living in potentially flood affected areas. In these cases, the WMZ team would not have an estimate of actual risk, but it would be able to identify how the flood affected areas are presently occupied (dwellings, other buildings, pasture, cropland, orchards, etc), and it would be able to survey people in the affected areas to obtain information on past flood losses and possibly their frequency. This will give a good picture of overall flood risk in the absence of streamflow records, and enable a useful discussion with stakeholders on alternative measures to mitigate these risks and losses.

114. ***Droughts*** are difficult to define and hence to assess. There is no single universally accepted definition of a drought because a drought, unlike a flood, is not a distinct event. A drought is often the result of many complex factors, and there is often no well-defined starting or end point. Furthermore, the impacts of a drought vary among different water users and sectors of economic and social activity, making the definition of a drought specific to particular affected groups.

115. The most commonly used drought definitions are based on meteorological, agricultural, hydrological, and socioeconomic considerations.

    (a) A *meteorological drought* often refers to a period of lower-than-normal precipitation duration and/or intensity. These periods can be identified, for example, by comparing actual recorded monthly rainfall with the long-term average monthly rainfall.

    (b) An *agricultural drought* occurs when there is inadequate soil moisture to meet the needs of a particular crop at any given time. This is a significant risk in Uganda since rainfall is highly variable. Even though overall seasonal rainfall in a particular year is average or near average there may be a deficit in months or portions of months that are critical for crop growth and yield. The occurrence of rainfall deficits was analyzed extensively in the NWRA.

    (c) A *hydrological drought* refers to deficiencies in the availability of surface and groundwater supplies. This is the type of drought evident when streamflow records or records of groundwater levels are analyzed. More often, ex-post indications of a hydrologic drought are extremely low water levels in boreholes or pumps failing to operate, water levels in rivers are too low for diversions to operate, or streamflow volume is insufficient.

    (d) A *socio-economic drought* may occur when physical water shortages start to affect the health, well-being, and quality of life of the people, or when the drought affects the supply and demand of the production of goods and services.

116. The WMZ planning team should undertake an analysis of the meteorological and hydrologic records to estimate the nature of droughts in the catchment. Where records are inadequate or absent, the WMZ team should survey stakeholders, including especially extension officials and farmers, to assess the different manifestations of drought.

117. The use of a “with climate change hydrology” in the water resources modelling will already have provided good insight into impacts on low flows, although this may be limited according to the time step being used. If a monthly time step is used, this will usually be sufficient to have goo insight into the impacts on dry season flows.

Water quality assessment

118. The aim of a water quality assessment is twofold: first, to determine if the quality of the surface water and groundwater available in the catchment is suitable for the different present and future uses; and second, to determine the present status of surface and groundwater in terms of their capacity to absorb additional pollution without reaching an unacceptable degree of degradation. Note that what can be absorbed in the future and the capacity to recover is very different for a river, a lake or a groundwater reservoir.

119. The paucity of data on water quality is going to make it very difficult for the WMZ team to identify specific problem areas. Some data on the quality of drinking water supplies may be available and useful. Regardless, the WMZ team is likely to find these issues to be high on list of priorities of many stakeholders. Using what little data may be available and anecdotal evidence from stakeholders and planning team field reconnaissance, the WMZ team should develop a map of

problem areas and threats that can be discussed with the CMO and WAC and could form the basis for the design of a program of increased monitoring.

Task 2.1.3: Projection of Future Water Use

120. The basic objective of this task is to forecast future water use in the catchment. To do this, the WMZ planning team needs to identify all the sectors and types of water use in the catchment and the factors that will influence future water use by these activities. It may also be necessary to identify new categories of water use and forecast their level of water use.

121. Water uses or activities can be consumptive (agriculture) or non-consumptive (domestic, navigation, fisheries); they can adversely (wastewater, storm drainage) or positively (wetlands, land management) affect water quality and quantity. Consumptive uses clearly reduce the stock of water available in the catchment, but non-consumptive uses can have important impacts on the spatial and temporal patterns of water availability including importantly water quality.

122. The general categories of water use are listed below. Together with water use, the level and characteristics of wastewater generation and discharge into the catchment should be estimated.
    - Agriculture - rainfed, recession, irrigated (centralized, decentralized)
    - Domestic water supply – rural, urban; Industry; urbanization and settlement expansion
    - Livestock; Fisheries – commercial, subsistence
    - Navigation
    - Wetlands, forests, grazing land, protected areas, parks
    - Hydropower
    - Tourism – ecological, cultural
    - Environmental assets and services – recreation, livelihoods
    - Sand and gravel mining, other extractive mines and ore processing

123. The estimates of future water use depend on a number of assumptions including factors such as population growth rates, rates of urbanization, trends in agriculture practices (crop choices), rates of reforestation, etc. Estimates of these trends are generally maintained by the sector ministries, the Ministry of Finance and Economic Development (MoFED), and the Uganda Bureau of Statistics (UBOS). Major international organizations such as the United Nations and the World Bank also provide important planning estimates and forecasts that are sometimes considered more apolitical than other sources. With the assistance of DWRM, the WMZ planning team will systematically collect data from the line ministries, MoFED and UBOS on these factors, trends and estimates. Typically at an early stage in the planning process the DWRM in collaboration with the WMZ planning teams would agree on the estimates to be used in the planning process. The assumptions and methodologies used to arrive at the estimates should be understood and accepted by the planning team.

124. While there is considerable uncertainty over the sign and magnitude of precipitation under climate change conditions, it is universally accepted that temperatures will increase. If cropping choices and patterns remain the same, then the crop water requirements will increase as a result of increased evapotranspiration. However, the potential impact of climate change (especially temperature) on agriculture practices (crop choices) should be taken into account. It is worth looking carefully at this issue in the light of climate change which will result in the shifting of agro-ecological zones and hence in crop choices.

125. While the consumptive use of water by agriculture tends to be an order of magnitude greater than any other use, consumptive use is not the only factor that will influence the shape and content of the basin plan. In the economic sectors such as agriculture, hydropower, fisheries, livestock and tourism the factors that influence and govern production are the key to understanding and determining the impact (benefits) of changes in water allocation and water use. In general the WMZ planning team will seek to:
    - Identify and analyse the spatial characteristics of existing and potential future activity;
    - Identify the parameters that describe the activity in terms of water quantity, quality or ecological impact (for example, the parameters that determine crop water consumption - crop water use -

domestic water supply, wastewater, hydropower diversion, etc), as well as the production models in each of these sectors;

- The current level or magnitude of these activities, including production in the economic sectors;
- Estimates of future water use, discharge or consumption at different points in time;
- Future values of these impacts or characteristics based on alternative future scenarios and development paths.

Task 2.1.4: Water Balance – Comparing Water Resource Use and Demand

126. Among other things, the catchment plan is based on a sustainable balance of water supply and water demand that optimizes the achievement of the planning objectives. Hence, one of the first planning outcomes to discuss with stakeholders is the picture of how water supply and demand compare based on the results of the water balance analyses. When this comparison is made over time (out to the end of the planning time horizon), surpluses suggest opportunities for increased water productive use, while deficits suggest that the plan will need to include measures to improve water use efficiency, manage water demand or use, or better manage supply. There may also be a need for measures to improve the condition of the watershed if degradation has had a negative impact on the availability of water through reduced groundwater recharge or dry-season stream flows.

127. The gap analysis is likely to differ spatially within the catchment and among aquifers, lakes and rivers. The aim is to identify the areas with the most critical gaps and the most promising opportunities. In the context of agreed planning objectives, the gap analysis along with other identified issues provides an opportunity for the initial identification of development options and management measures with the CMO and the WAC.

STEP 2.2: FRAMEWORK FOR STAKEHOLDER PARTICIPATION

128. Table 3 outlines the technical tasks and the corresponding stakeholder engagement activities that correspond to each of the Steps in the Guidelines for Catchment Management Planning.

Table 3: Stakeholder engagement in integrated catchment planning

Step 1: Describe the catchment and build the knowledge base	▪ Define catchment and sub-catchments; compile and organize the knowledge base ▪ Develop knowledge products – thematic maps, charts, posters, newspaper articles, videos and presentations	▪ Inform the public and key stakeholders about the work of the WMZ and the catchment planning process ▪ Increase public awareness to motivate participation
Step 2 & 3: Stakeholder engagement and the SSEA	▪ Stakeholder identification and mapping ▪ Terms of reference for stakeholder organizations ▪ Mobilize CMO membership ▪ Design CMO consultation programs including preparation of training and information materials ▪ Carry out strategic social and environmental assessment of the catchment	▪ Inform all catchment stakeholders about the ICP program and the WMZ by preparing and disseminating knowledge products ▪ Form WAC and consult with members ▪ Meet with and consult with district local government officials and district level technical officials in all the catchment districts to increase awareness of ICP and the role of CMO ▪ Involve district local government officials and district level technical officials in nomination of potential members of the CMO ▪ Promote membership in the CMC and CTC ▪ Begin formation of CMC and CTC
Step 4: The planning	▪ Prepare a summary catchment situation report to present to the	▪ Collaborate with the CMC and CTC to develop a future vision of the

framework- Objectives, issues, and options	CMOs including maps and charts ▪ Collaborate with the CMO to prepare the catchment planning framework – ▪ Future vision of the catchment ▪ objectives, criteria and indicators; ▪ major issues and problems in the catchment; ▪ identification of options including those proposed by central line departments and regional officials	catchment and decide on the objectives, criteria and indicators that will guide planning ▪ Collaborate with the CMC and the CTC to review the results of the SSEA and the gap analysis, and to identify the specific needs, issues and problems that will be the focus of planning ▪ Hold one or more stakeholder forums to gather feedback and ideas from a broad spectrum of stakeholders on the planning framework. ▪ Consult with the WAC and the inter-district officials forum on the planning framework
Step 5 through 8: **Acquire and test tools & carry out water resource assessment, water demand and water balance studies**	▪ Acquire models, carry out training, operationalize models (adapt, calibrate and verify) ▪ Carry out water resources assessment ▪ Carry out water balance assessment and gap analysis	▪ Review the modelling approach and intermediate results with the CMC and the CTC ▪ Demonstrate the need and value of the models with examples from the analysis in the catchment
Step 9: Preparing an agreed catchment plan and an implementation plan	▪ Analysis of individual options: estimate of costs and benefits; O&M requirements; ownership and institutional arrangements; policy and regulatory requirements; monitoring ▪ Simulation of catchment scenarios with combinations of options ▪ Multi-criteria evaluation of scenarios ▪ Formulation of alternative plans	▪ Collaborate with the CMC and the CTC on the results of scenario simulation and the multi- criteria evaluation ▪ Consult with the WAC and the Inter-district forum on the simulation results and multi- criteria evaluation ▪ Facilitate a consensus among CMC and CTC members on the agreed plan (including priorities and sequencing)
Step 10: Project preparation and implementation	▪ Prepare a technical brief including specifications and cost estimate for each priority investment project or program to be implemented and submit to DWRM for review, determination of implementation modality and funding ▪ Prepare program to upgrade monitoring network (SW, GW) to meet the needs of the water management and regulatory measures in the agreed plan ▪ Prepare and submit proposals for projects and programs to be implemented though district local government	▪ Consult the members of the WAC on the modalities for implementation of the projects and programs in the agreed plan ▪ Collaborate with DWRM to develop process and procedures to facilitate preparation and funding of implementation

Task 2.2.1: Stakeholder Identification and Mapping

129. The WMZ planning team must engage with three groups of stakeholders:

(a) The CMO – namely the CMC and the CTC – and any sub-catchment committees that are formed including those formed under the Water Source Protection Guidelines – These are the most important because they have an executive function to agree on and adopt a catchment plan (in which the CTC advises the CMC);

(b) The WAC which brings together regional non-governmental partners as well as regional and central representatives of the line departments – Among other things this group should provide the WMZ planning team critical guidance on problems and workable solutions and technical advice and assistance on carrying out the various planning tasks;

(c) The inter-district forum of district local government officials and the broader stakeholder forum that brings together self-identified representatives of the many parts of civil society – The inter-district forum is important because the WMZ planning team will want its members, some of whom may be on the CMC, to see the agreed plan as a positive development that they will support through their various mechanisms. Both of these forums should provide important feedback to the WMZ planning team. It is also important to bear in mind that District Government is responsible for the production of District Management Plans and that any catchment plans produced must be coherent with the district development plans developed for the districts within the catchment AND vice versa. This requires the buy-in of the District Council.

130. Table 4 outlines a generalized stakeholder mapping for national, regional and catchment level stakeholders that the WMZ planning team will engage. The WMZ would prepare a specific detailed table for the national and regional or zonal level while the WMZ planning team would prepare such a table for the catchment. These detailed tables would utilize the general categories of stakeholders in Table 4 to identify specific entities.

Table 4: Generalized stakeholder mapping for the WMZ

	Organizations with a direct Public and private interest in IWRM outcomes and/or that are able to provide support	Public and private sector organizations including NGO and private voluntary organization	Organized groups centered or focused on specific locations or issues in the catchment	Individuals in the catchment or region representing themselves rather than organized groups
WMZ – National Level	▪ Development partners ▪ Government departments, agencies ▪ Parastatals (NWSC, UFA, etc) ▪ Universities and research centers ▪ Media	▪ National and international NGOs ▪ Business Assoc. ▪ Private sector including financial institutions	▪ Association of common interest and concern (environmental groups)	▪
WMZ – Regional Level	▪ Local government officials and bodies – land boards, councils, and various service departments ▪ Water utilities and community based water boards or companies ▪ Ministry district and regional officers including DWO,DEO,DPO and their associated committees ▪ NGOs ▪ Agricultural research centers	▪	▪ Association of common interest and concern (environmental groups) ▪ Community based organizations - water users, farmers, fisherman, pastoralists, etc. ▪ Schools	▪ Business owners ▪ Land owners ▪ Commercial farmers ▪ Tourism operators

Task 2.2.2: Mobilize the Membership of the CMOs and Advisory Groups

131. Mobilisation of the CMOs and advisory groups includes the following activities

- Prepare brief Terms of Reference for each of the stakeholder organization – define their objectives, roles and functions, relationship with WMZ and other stakeholder organizations, expected outcomes of their participation;
- Prepare briefing materials to inform stakeholders and potential CMO members about the WMZ, the Catchment Plan and the catchment planning process, explaining the role that stakeholders will have;
- Consult with the regional and inter-district advisory groups to identify potential CMO members;
- Mobilize the CMC and CTC membership.

Task 2.2.3: Design the CMO Program of Meetings and Activities

132. The task of planning and managing the effective participation of catchment stakeholders is a complicated one. There are at least five, and possibly more, entities whose participation has to be planned and managed.

- The CMC, and possibly several sub-catchment committees;
- The CTC;
- The Inter-district Steering Forum;
- A regional advisory committee; and

- One or more General Public Forums covering different parts of particularly complicated or non-homogenous

133. It is apparent from Table 3 that the agenda for discussion with and input from the various stakeholder groups changes as the planning program progresses. At each step the planning team may need to inform stakeholders, consult with stakeholders to obtain feedback or input, involve stakeholders directly in the process carried out at that step, or collaborate to make decisions, as in deciding on what the catchment plan will contain. Moreover, depending on the goal of the interaction with and participation of the stakeholders, the method of interaction and the techniques used may also change.

Communications Strategy

134. The Communications Strategy is summarised in Table 5.

Table 5: Stakeholder participation spectrum - the how and why of participation

GOAL	To provide stakeholders with balanced information to assist them in understanding the problem, opportunities, threats, solutions and options	To obtain stakeholder feedback on analysis, options and decisions	To work directly with stakeholders throughout the process to ensure that public concerns are consistently understood and considered	To partner with stakeholders in each aspect of the decision-making process including the development of alternatives and the identification of preferred solutions
PROMISE	To ensure people are informed	To inform, to listen and to acknowledge concerns and aspirations, provide feedback on how stakeholder input influenced decisions	To work with stakeholders to ensure that concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how stakeholder input influenced decisions)	To look to stakeholders for direct advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible
TECHNIQUES	▪ Fact sheets ▪ Web sites ▪ Open-forums ▪ Press releases ▪ Videos for TV ▪ Advertisements ▪ Media	▪ Public comment ▪ Focus groups ▪ Surveys ▪ Circulars ▪ Email	▪ Workshops ▪ Face-to-face meetings ▪ Discussion groups ▪ Sector meetings	▪ Forums ▪ CMO – multiple stakeholder meetings ▪ Consensus building meetings ▪ Participatory decision making

135. At the beginning it is not possible to know the detailed agenda for all the meetings and activities throughout the whole process. The initial design of the program should schedule a series of meetings and activities – specifying at least in general terms the type of meeting, participants, timing, venue, objectives, and materials required, and outcomes sought - that extends over the entire period of the planning program. Details will only be known confidently for the initial steps, for example Steps 1 and 2. Hence as the program moves forward, at each step the details should be worked out and the schedule finalized for the next series of meetings and activities.

136. Everyone on the planning team needs to monitor this schedule. As outlined in Figure 6 there is a strong and continuous interaction between the so called technical steps (5 through 8) and Steps 2, 3, and 4. Nearly everyone will participate in most stakeholder meetings either to ask questions seeking new information or to provide information (including maps and charts depicting conditions on the ground and results of the ongoing planning analysis) and inform (train) stakeholders.

STEP 2.3: STRATEGIC SOCIAL AND ENVIRONMENTAL ASSESSMENT (SSEA)

Cumulative Impacts of a development programme

137. The potential adverse consequences of development, and the fragility of many economically and socially important natural assets, are well recognized in Uganda (though possibly in some cases not effectively taken into account). In these circumstances it has become good practice to provide objective information to decision makers about the social and environmental consequences of developments by undertaking an environmental and social assessment of some kind. Environmental assessments are most commonly undertaken for single projects (when they are usually termed environmental impact assessments or EIAs), but in the case of integrated catchment planning there are and will be many projects (e.g., water supply, storage, irrigation, tourism, water transfer schemes etc) within the catchment and these are likely to differ from one another in terms of outcomes and impacts. Moreover, developments have been taking place in different parts of the catchment over many years, but typically little is known about the current ***cumulative impact*** of these separate developments, which could be substantial even if the impact of each individual activity is small.

138. Of course it is not possible to conduct an EIA of each of the various projects that might ultimately be found in the plan. From the planning analysis done during Step 1 and from initial discussions with stakeholders, the WMZ planning team should have a very good idea of the universe of possible options to be considered. An EIA cannot be done for each of these. Instead, what is needed is a process by which one can assess at a strategic level what the major social and environmental issues are in the catchment today and what the potential issues are in the future that the plan should foresee and attempt to mitigate, taking into account the resource base, development opportunity, and the goals and direction that stakeholders desire.

139. This process is known as a strategic social and environmental assessment (SSEA). An SSEA is a formal process of systematic analysis of the social and environmental impacts of development policies, plans, programs and other proposed strategic actions. **The SSEA is focused on the "big picture" – what has been the cumulative impact of water resource development and use in the catchment up to today, and what may be the impact in the future**. This is the sense of the term "strategic" – the issues and impacts that may influence how well the catchment plan achieves the planning goals and objectives. A good example is an option or a group of options that is likely to produce high economic value but is not sustainable and hence the country's goal of sustainable growth cannot be achieved by this option or approach. Looking ahead in time and across the catchment by means of an SSEA is a way of avoiding these outcomes.

Broad understanding for discussion with stakeholders

140. The SSEA seeks to identify the major social and environmental issues and problems at an early stage in the planning process so that consideration of these issues are given equal weight and attention with other issues and needs, expanding the range of options and alternatives to be considered. The primary objectives of the catchment SSEA are:

    (a) identify (at a strategic level) the most vulnerable social systems and communities, institutional systems, areas of natural habitat and sites of national heritage that are most likely to be affected by current and likely future development, and associated infrastructure;

    (b) identify the important environmental issues resulting from the current and expected future main land-use and development activities in the sub-basin and the impacts these already have and will likely have on other economic activities, the environment, and socio-economic development.

141. The results and findings of the SSEA should be widely shared with stakeholders and thoroughly discussed with the CMC, CTC, the stakeholder forum and the WAC. The aim should be to improve awareness of the nature and significance of social and environmental issues in the catchment, to help stakeholders understand the potential implications of these issues and cumulative impacts, and to integrate them into the planning framework. Because GIS is a powerful communication tool, the data gathered during the SSEA study and the findings of the study should be compiled in the GIS in order to develop maps and other information products to inform stakeholders and facilitate discussion.

Task 2.3.1: Assessment of Land Use and Development in the Catchment

142. This step includes a number of concurrent activities, including a description of current and expected new activities (e.g. plans, programs and projects, as well as informal activities) in the catchment,

an assessment of the vulnerable components of the environment and society, the availability/status of international and local safeguards, and the stakeholders and partners who will need/want to be part of the SSEA process. This information needs to quantified as much as possible and depicted on maps, graphs, etc.

Understanding the forces and dynamics in the catchment

143. When conducting an SSEA of a large and complex area that supports multiple development sectors as well as traditional land use, the broader forces that determine how the area may evolve in the foreseeable future need to be appreciated. This requires the construction of at least three scenarios that could become reality in a 10-15 year time horizon, depending on how external and internal factors play out.

144. Macro-economic issues, market trends relevant to Uganda, the zone and the catchment, business opportunities and other regional and global trends (opening of agriculture export markets for example), as well as an understanding of internal opportunities and constraints, provide a useful background for analysis of sustainable development options for the catchment and their social and environmental implications. Table 6 provides some examples of global, regional, national and local level factors that could affect future development trajectories in a catchment.

Table 6: Stakeholder participation spectrum - the how and why of participation

Global factors	Regional factors	National factors	Local factors
▪ Economic crisis in Europe and USA – may suppress tourism and export markets ▪ Growth of Chinese and other emerging economies may improve viability of some mines ▪ Climate change may reduce prospects for rainfed cropping and increased parasites may threaten livestock health ▪ Rising oil prices will increase transport costs, with negative impacts on the formal agriculture sector and tourism	▪ Political instability in surrounding countries may affect tourism negatively, and may result in an influx of refugees that will place increased pressure on social infrastructure and local communities (including increased crime, STDs, etc.) ▪ Alternatively, peace and prosperity in neighbouring countries may improve the regional economic environment, and result in more cross-border trade. This may increase heavy-vehicle road traffic and spread of STDs	▪ National policies, plans and programs (e.g. food security, energy self sufficiency, economic liberalization, decentralization, etc.) will all likely have an effect on the way the sub-basin will develop – these PPPs need to be well understood ▪ A decision (hypothetical) to upgrade all airports and increase regional flights will likely stimulate economic growth and tourism ▪ Allocation of sufficient funding to economic sectors (e.g. mining, tourism, manufacturing, agriculture) will likely have a spin-off in the sub-basin	▪ Local health factors (e.g. HIV and AIDS) may limit growth potential ▪ Under investment in physical and service infrastructure (e.g. roads, communication, power supply and hotels) will likely limit future growth potential in almost all sectors (adequate investment obviously has opposite effect!) ▪ Competency (or otherwise) at local authority level will likely affect competiveness of the area to attract and maintain investments. ▪ Trends in ecosystem health will affect viability of most sectors that rely on resources such as water, fish, etc.

145. It is not possible to complete step 1 until step 2 has also been concluded, because constructing scenarios requires an understanding of both past trends, current situation and then the analysis of possible futures as described above. Therefore, steps 1 and 2 are not sequential, but **concurrent**.

Current and expected new developments

146. This step requires an inventory of all existing and planned new activities[4]. Fundamental to this is an understanding of how various development sectors operate, including process requirements, waste, water and power requirements, need for labour, skills and expertise, markets, and (if applicable) closure plans, rehabilitation and environmental restoration. At the very least, there must be an accurate assessment of the following in the case of each major project/sector:
    - How much water and power will be used and where it is/will likely come from
    - How many employees and service providers are/will be required (and where they might come from – or already live in nearby villages)
    - Profile of employees so one can have an idea of income levels, family size, whether employees live as 'migrants' or with their families, number of school-going children, sex and age profiles, levels of education, etc.
    - What chemicals are/likely to be used in the various industries, where will they are/will be obtained and how they are/will be transported, stored and disposed of
    - How much waste is/will be generated and how this is/will be managed,
    - What infrastructure will be developed (roads, housing, sewerage systems, pipelines, fences, recreation facilities, power lines, schools, clinics, waste disposal sites, storage and packing facilities, etc.)
    - The phases of the various projects, including anticipated closure (if applicable)
    - The plans for funding the implementation of environmental and social safeguards and closure
    - The existence/planned environmental and social consultants (or in-house team) which the projects use/will use to help them monitor environmental and social impacts and management throughout the life of mine (and beyond if appropriate)
147. Given that many of the impacts in the area are generated by informal activities (e.g. mixed farming and artisanal fisheries), it may be necessary to make an aggregated assessment of the impacts based on expert opinion, or possibly glean information from existing reports.

Task 2.3.2: Assessment of the Vulnerable Environments in the Catchment

148. The receiving environment includes social, ecological, infrastructure, institutional, economic and other components. It is important for the SSEA to consider developments in the context of the following:
    - Assessment of the protected natural and heritage areas which are/will be affected by current land use and proposed new developments – their status, their objectives and their existing/emerging management plans
    - The current and likely future demands on labour, water, land, power and other critical resources
    - As noted earlier, the combination of many activities will likely result in strains on various types of infrastructure and social services, as well as on the physical environment. These include:
    - Housing
    - Health facilities
    - Transport
    - Education facilities
    - Public administration (institutions)
    - Impacts of project-specific and cumulative water abstraction on environment
    - Impacts of project-specific and accumulative development on environment: species, communities, and sensitive landscapes

Task 2.3.3: Design a Stakeholder Participation programm for the SSEA

149. Effective stakeholder engagement in – and independent review of – an SSEA are critical ingredients in assuring its quality. To be successful, an SSEA requires commitment from a variety of stakeholders, e.g. politicians, senior management, government officials from all interested and affected departments, community representatives and non-governmental

[4] Activities means developments, such as mining, hydropower, agriculture, tourism, etc.

organizations. Thus, a **credible public participation process is fundamental to this SSEA**.

150. This step builds on Step 2 and is essentially a part of the program worked out in Step 2.3. The SSEA stakeholder participation involves planning on how stakeholders will be engaged throughout the SSEA process and beyond. As in Step 2.3, the program design will specify who will participate, what methods will be used to engage them, and whether there will either be information provision, consultation or negotiation with them (or a combination of all three).

Determination of Environmental Quality (sustainability) Objectives

151. The formulation of sustainability or environmental quality objectives (EQOs) is important because it provides clear statements of intent and indicates the desired direction for the WMZ or catchment. EQOs thus provide a methodological 'yardstick' against which the positive or negative effects of the various land-use types (and different projects) can be tested. These objectives also guide the SSEA process in terms of the level of detail and type of information or data that is required. The EQOs and limits of acceptable change (LACs) should be agreed upon by key stakeholders in the SSEA process.

152. The EQOs can be derived from various sources such as National Development Plan documents, National HIV/AIDS and education strategies, Water Management Strategies, WHO standards, local development parameters, Biodiversity Strategy and Action Plan, State of the Environment Reporting system, etc.

153. EQOs should also reflect the extremes of environmental quality (biophysical, social, sense of place, etc.) beyond which society would find further change unacceptable. An inherent aspect of setting EQOs is determining thresholds or limits of acceptable change (LACs), which are defined as the point at which irreversible or serious damage could occur. Thus, EQOs are a combination between a desired common future, as well as a limit on what negative impacts would be allowed.

154. Given the time and other resource limitations, it might not initially be possible to set LACs based on 'high scientific confidence'. Instead, public opinion and best available expert knowledge might have to suffice until such time as more data become available. Thus, LACs may be adjusted as knowledge improves. When defining the EQOs there are several considerations that must be taken into account, e.g. the EQO should focus on the desired outcome, be clear and concise, be both ambitious and realistic, be measurable, and be compatible with each other.

155. Some examples of EQO topics may be:

- Economic diversification and value-adding
- Efficient use of land (e.g. optimal livelihood options and economic returns)
- Efficient water use (as above)
- Capacity building (e.g. government agencies, service providers, employees, civil society, etc.)
- "Wellness" and health targets (a basket of social parameters)
- Acceptable water quality
- Maintaining (or enhancing) ecological integrity
- Protection of heritage resources
- Improved social and physical infrastructure.

Task 2.3.4: Assessment of Linkages, Cumulative Impacts and Options

156. An assessment of cumulative impacts is the crux of the matter. The WMZ planning team and the catchment stakeholders must fully understand how all the different activities, both on their own and in combination, will impact (either positively or negatively) upon the environment and the social conditions in the catchment. There is no single best method to assess the cumulative impacts, possible linkages between activities and the adverse effects, so approaches should be selected based on the issues at stake and the nature activities.

Assessment Tools – pivotal role of water resources modelling tools

157. The tools for this assessment include:

- Water resources modelling tools (see Paras XXX and Para XX below)
- Use of GIS (particularly mapping of trends and vulnerable areas)

- Cost-benefit analysis
- Causal loop or causal chain analyses to determine the main pathways of impacts;
- Linkage diagrams, which try to plot the main positive and negative links between causes and effects and which highlight unintended consequences and cumulative impacts (positive and negative)
- Comparative risk assessment, etc.

158. Water resources modelling tools, as already introduced, are central to the SSEA. Water balance and optimisation models are often well-suited to providing an assessment of cumulative impacts of various combinations of developments

Establishing an SSEA Analytical Framework

159. In this case, using a matrix to test the cumulative impacts of various sectors against sensitive environmental aspects might be a good way to obtain an initial overview, followed by the drawing of linkage diagrams so that intended and unintended consequences of actions may be understood. Key cumulative impacts could be negative:
    - Unsustainable water and land-use (with resultant opportunity costs and loss of livelihood options)
    - Pollution of water resources (as above)
    - Social tension (including undermining of local cultures and governance systems)
    - Increase in diseases
    - Strain on social services and infrastructure (hospitals, clinics, schools, crime prevention)
    - Deterioration of and/or congestion of physical infrastructure (e.g. roads, municipal facilities, communication networks)
    - Loss of biodiversity, habitats and ecological integrity
    - Damage to heritage resources
    - Visual impacts and loss of sense of place (resulting in loss of tourism potential)
160. There are also positive impacts to be identified, including:
    - Economic stimulation
    - Socio-economic improvements
    - Skills and capacity development
    - New and/or improved social and physical infrastructure.
161. The assessment of cumulative impacts is essentially a continuation of step 2, where an understanding of the receiving environment was obtained. Having done this, the impacts can be assessed. Once the impacts are understood, the SSEA must propose measures as to how they can be avoided/mitigated (or enhanced if they are positive impacts), in a similar way as is done in standard project-level EIA process. The main difference is that avoidance/mitigation/enhancement measures must take into account the desired future state of the WMZ or catchment. A key value of an SSEA (as compared to a project-level EIA) is that the SSEA may have greater scope in proposing alternative ways of achieving desired outcomes than those already articulated by existing development proponents. Also, the avoidance/mitigation/enhancement measures will be broad-brush initially, gradually becoming more detailed as one moves closer to project-level activities.

The Mitigation Hierarchy

162. In all cases, addressing negative impacts must follow a hierarchy of: impact avoidance, mitigation (e.g. rehabilitation and restoration), offsets and, as a last resort, financial compensation. This concept is illustrated for the issue of biodiversity in Figure 11, and is at the heart of the SSEA approach which is "upstream"[5] in nature.

[5] "upstream" is used in the sense of early or before, not in the hydrological sense of the word

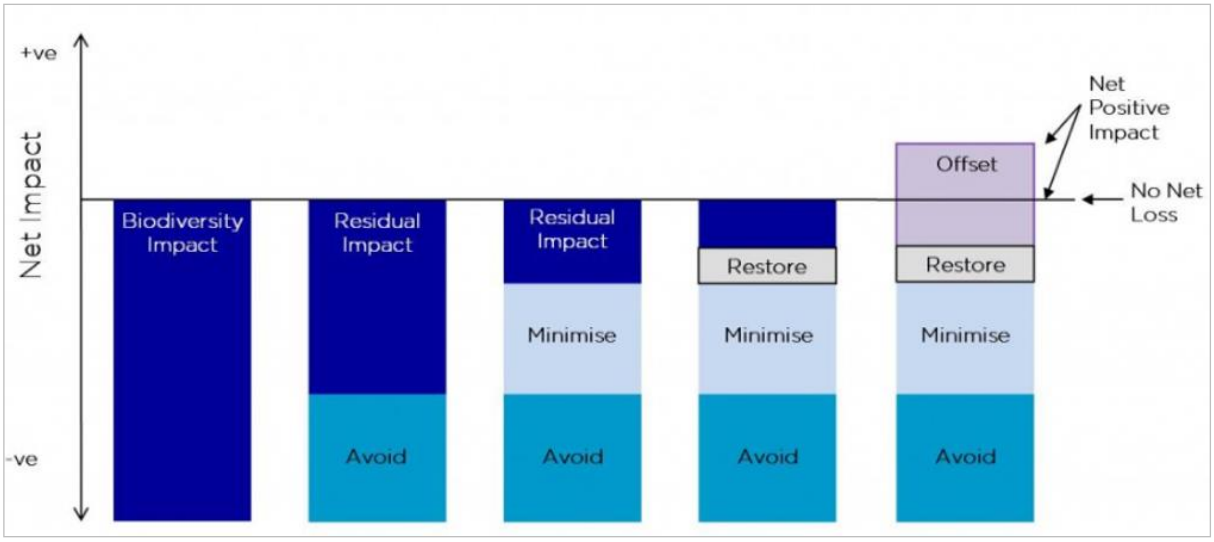

Figure 11: The Mitigation hierarchy is central to the SSEA concept

Task 2.3.5: SSEA Guidance Framework

163. Because the SSEA provides important guidance for the preparation of the catchment plan and for future project planning and development it is important to bring together the findings, conclusions, and recommendations of the SSEA process into an SSEA guidance framework. The framework might contain the following elements:

- **Sub-Basin overview** – A brief (<10 pages) and well-illustrated (maps, graphs, statistics) overview of history, land-use, geography, socio-economy, demographics, biodiversity, water resources, physical infrastructure and climate of the sub-Basin. This should emphasize trends rather than just provide a snap-shot in time (e.g. land degradation over past 10 years…..)
- **Forces and dynamics of the catchment** – A brief (<10 pages) and well-illustrated (maps, graphs, statistics) overview of external and internal factors that shape current and especially future development options.
- Scenarios – A description of the scenarios used to conduct the analysis.
- A quick summary SSEA approach and methodology:
- Overview of SSEA approach, assumptions, limitations and constraints
- SSEA methodology
- Stakeholder engagement, thematic analyses, use of GIS, assessment of linkages and cumulative effects, construction of scenarios
- Legal, policy and institutional context (overview)
- Cumulative effects and analysis of alternatives
- Social structures, livelihoods and access to resources, human health, gender issues, tenure and community wellness
- Towns and settlements
- Transport and communications infrastructure
- Institutional functioning and governance
- Water resources
- Energy supply
- Recreation and tourism
- Biodiversity and ecological integrity
- Archaeological heritage
- Macroeconomics
- Linkages, antagonisms and synergies

- Strategic social and environmental management plan (SSEMP) with EQOs and indicators
- Conclusions and Recommendations

164. The SSEA guidance framework should also summarize the existing regulatory framework in the country for environmental management. A number of laws, policies, standards and guidelines exist both in Uganda and internationally to guide development. Decision makers need a good understanding of what these are, how they relate to each other and the implications for Uganda's local and international commitments. Much of this information exists in the various documents, but it needs to be synthesized in the SSEA.

165. Based on the previous steps, the SSEA should be able to provide recommendations on what could be done to make current and future developments more environmentally and socially acceptable and beneficial. From this, it is clear that the team required to conduct the SSEA is much more than the usual consortium of environmentalists. One needs a social scientist, agriculture expert, water resources management specialist, environmentalist and biodiversity expert, archaeologist, health expert, tourism specialist, and economist on the team.

166. Once the assessment of cumulative impacts is complete, it will be possible to design a framework within which the individual and cumulative impacts relating to the development activities could be better managed. This framework could be regarded as a "Strategic Social Environmental Management Plan" (SSEMP), which sets the actions that all the developers could follow and contribute to.

STEP 3: FRAMEWORK FOR CATCHMENT PLANNING

167. With the CMO in place and functioning (Step 2.2) and the water balance (Step 2.1) and the SSEA (Step 2.3) completed the basis for developing with the stakeholders a framework for planning is established. This is an important step in the planning process because it provides the framework in term of objectives, issues and options that drive the planning process in Step 4 & 5.

168. Developing the framework begins with a thorough briefing of the CMO (mainly the CMC and CTC) on the catchment's natural resources, their status, the water balance, the opportunities for development, and the potential constraints and limitations as they have emerged from the study and analysis carried out in Steps 1 and 2. The findings with respect to climate change trends should also be clearly understood by the CMO at this stage. This provides a basis for agreeing on the key results of this Step:

- An agreed set of planning objectives, criteria and indicators – this will be the framework for evaluating projects and plans;
- The results of a strategic social and environmental assessment –the major environmental and sustainability issues that need to be addressed in the catchment;
- A preliminary view of the major water resource management and economic development issues in the basin and possible options and interventions.

169. Overarching these is the stakeholders' vision of the catchment in the future. Since they are only beginning to see themselves and their surroundings (farm, district, town or village, etc.) as a part of a "catchment", the catchment vision expressed by a group of stakeholders is initially most likely to be the sum of what they envisage for their immediate surroundings. When they see these brought together in a catchment context it helps the stakeholders to begin to see the implications of being a part of a "catchment". The WMZ planning team should facilitate a brainstorming session – and likely several – with the CMC and CTC to develop a vision statement for the catchment, using this occasion to build greater understanding of IWRM and catchment planning.

STEP 3.1: SUMMARY OVERVIEW OF THE CATCHMENT AND SUB-CATCHMENTS

170. This is a quick summary mainly in visual form (maps, videos, charts, etc.) of what the WMZ planning team has learned about the people, land, water and other natural resources in the catchment, what activities are going on that benefit from and impact upon the catchment's water resources, and what the planning team and the stakeholders think the needs and issues will be in the future.

STEP 3.2: DEVELOPING PLANNING OBJECTIVES AND INDICATORS

171. It is surprisingly easy for a planning team to become lost in the details of the various technical activities that need to be carried out. In other words, the team could easily lose sight of the objectives and outcomes it is supposed to achieve through the planning process. In this case the team ends up with a plan that may be fine technically except it does not necessarily do, or do well enough, what the team set out to do.

172. Hence it is very important for the WMZ planning team and the CMO to go through a process together to agree on the specific objectives and outcomes that the catchment plan should aim to achieve. No single objective will sufficient to cover all the goals the stakeholders may share. There will be multiple goals and objectives (criteria). In discussing the goals of the catchment plan with various stakeholders one is like to hear objectives such as sustainability, equity, economic growth, food security and poverty reduction. Climate and short term weather resilience are also important goals.

173. It is necessary for the planning team to develop objectives that are consistent with these goals, but also to provide a more operational framework for the evaluation of alternatives. Table 7 provides an indicative list possible goals and objectives. This table or version of it is a useful way to begin the discussion of planning objectives and outcomes with the CMO, while being very careful with the use of difficult to understand jargon or words that few people in the catchment are familiar with. Of great importance is column 3 in Table 7 – the indicators or metrics by which achievement towards an objective is measured. These – along with the objectives – must be unique and measurable.

Table 7: Goal, Objectives (criteria) and indicators

Economic Development	▪ Sustainable economic growth ▪ Increased farm income ▪ Increased energy production ▪ Poverty alleviation	▪ Agricultural Benefits ▪ Hydropower Benefits ▪ Flood Damages ▪ Drought Protection (reliability of supply) ▪ Benefits to priority regions and sectors
Social Development	▪ Water supply and sanitation provision ▪ Reduction in threat of water borne disease ▪ Increased employment opportunities ▪ Minimize resettlement	▪ Drinking water supply and sanitation coverage ▪ Additional jobs created/income increases expected ▪ Expected resettlement from proposed investments
Environmental Sustainability	▪ Minimize adverse project impacts ▪ Minimum flow provision ▪ Biodiversity protection	▪ Area inundated/impacted by projects that is environmentally sensitive ▪ Flow at sensitive environmental stretches ▪ Benefits to sensitive habitats
Implementability (with filter for technical environmental and social feasibility or risk)	▪ Minimize adverse project impacts ▪ Minimum flow provision ▪ Biodiversity protection	▪ Financial Requirements & Financial Rate of Return ▪ Economic Rate of Return (Econ Anal outputs) ▪ Stakeholder views on acceptability (rating

174. Annex I provides an example of a multi-criteria framework and tool. Figure 12 is an example of a multi-criteria evaluation framework that is currently being used in a water resource planning program in Sri Lanka to evaluate river basin development scenarios (not so different from what should be done in a catchment). The Sri Lankan planning team began by building a table like Figure 12, went through a process of consultation with stakeholders at the district and central policy levels, and then converted the last column of its version of Table 7 into an operational framework for evaluating multiple scenarios as shown in Figure 12.

Scenario Name		Mundeni Aru_Scenario_D	Mundeni Aru_Scenario_t3	Mundeni Aru_Scenario_t3	Mundeni Aru_Scenario_t3
Reference scenario (Base line):	Unit	u_Scenario_A	u_Scenario_A	u_Scenario_A	u_Scenario_A
Economic Development					
Net Ecomnomic Annual Benefits:	**Mill SLR**	**367**	**550**	**400**	**367**
NetAgricultural Annual Benefits	Mill SLR	(40)	100	50	244
Net Industrial Annual Benefits	Mill SLR	4	300	100	20
Net Hydropower Annual Benefits	Mill SLR	-	50	50	3
Net Domestic Annual Benefits	Mill SLR	404	100	200	100
Contribution to National Rice Production Target	%	(0)	2.0	2.0	2.0
Financial Viability					
Total Investment	Mill SLR	3,000	2,000	4,000	3,000
Net Present Value	Mill SLR	200	2,000	400	300
Internal Rate of Return	%	0	7.30	3.00	5.00
Social Development					
Increase in employment	Jobs	(200)	50,000	10,000	30,000
Resettlement Needed	Persons	-	500	500	3,000
Rise in Income Levels	SLR/year	27	20,000	2,000	27
% of total Benefits in Post War Zones	%	10	20	50	70
% of total Benefits in dry zone	%	60	60	50	70
Environmental Sustainability					
% Affected rivers Violating Target	%	-	-	20	10
Total length of reaches violating flow target	Km	-	-	100	20
Average Modification in classes	-	1	1.0	1.5	1.1

Figure 12: An example of a multi-criteria analysis (SLR is Sr Lanka Rupees)

175. Note in Figure 12 that the goal of "environmental sustainability" is explicitly defined as three objectives that measure how river flow regimes are affected and whether there is an acceptable change in river (water quality) classification. The first two objective were the subject of extensive debate because the country lacked the data or policies needed to establish environment flow requirements (EFRs) on any other basis. The third objective was highly subjective because of the lack of water quality data, a situation that prevails in Uganda as well. The critical point is not the sophistication or lack thereof of the methodology of measuring these indicators; the critical point is to debate and agree on a set of "environmental quality objectives" for the catchment in collaboration with stakeholders. Regardless of how well they can be measured or assessed today, data will improve in the future and having adopted these objectives establishes the intent to ensure that these will not be allowed to cross a threshold or limit of acceptable change. For the time being public opinion and objective and best available expert opinion may be the only means establish these limits.

Comparing the proposed catchment planning objectives and the NDP objectives

176. The National Development Plan (NDP) is the country's road map to prosperity, and the NDP objectives represent the development and management agenda for each of the line ministries in the government, including MWE. Hence, the aim in establishing catchment planning objectives is to develop a set of objectives for the catchment plan that are consonant with the NDP objectives and lead to achievement of the goals of stakeholders in the catchment. The catchment plan objectives might be expressed differently from the NDP objectives, or as is more likely, they may be expressed more directly and explicitly. There might also be additional objectives that are not mentioned in the NDP but are considered important by the catchment stakeholders. In this sense the NDP objectives provide an overarching framework for the catchment level objectives.

177. The theme of the National Development Plan (NDP), the country's development strategy over the next five years (2010-15) is to realize the country's vision of growth, employment and socio-

economic transformation for prosperity. The plan is the first in a series of six plans intended to transform Uganda over thirty years into a modern and prosperous economy. Promoting the ***inclusive and sustainable growth*** that is enshrined in the NDP requires ***sustainable exploitation*** of development opportunities, including agriculture and natural resources. Water can be both a positive force – providing productive input to agriculture, industry, energy and tourism, and sustaining human and environmental health – as well as a destructive one – to which the devastating consequences of floods and droughts can attest.

178. A growing Ugandan economy and population will require more water in the future**.** Since many parts of Uganda will experience increasing water scarcity, water resources must also be used more productively and efficiently than at present. The Uganda NDP reflects this need by placing emphasis on productive investment in water for agriculture, fisheries, livestock, hydropower (and possibly thermal power), drinking water, and industry including agro-processing. However, increasing pressures on the water and natural resource base mean that Uganda's natural resources, including wetlands and forests, are being degraded at an alarming rate. Each of the NDP objectives is discussed in Table 8 in terms of the ways in which the elements of an integrated catchment plan could support their achievement.

Table 8: Integrated catchment planning and the achievement of the NDP objectives

NDP Objective: Uplift household standards of living

- Effective development and management of water sources can increase the supply of clean and safe water to people and livestock, thereby reducing morbidity and mortality from water-borne diseases including cholera, typhoid and hepatitis B. This will lead to improved health and household standards of living.
- Effective flood management can also make a contribution, as risks of water-borne diseases increase significantly during flood periods.
- The problem of poor sanitation and hygiene exacts the highest toll on the poorest segments of society in both rural and urban areas. Investing in sanitation could bring substantial returns and reduce costs in other sectors, including the curative health sector
- Agricultural development for growth (e.g. irrigation development and commercial agriculture) and for poverty reduction (e.g. improved soil and water management in rain-fed areas) is critically dependent on availability of reliable water resources.
- NDP Objective: Enhance the quality and availability of gainful employment
- Ensuring sufficient and reliable supplies of water to be used as a raw material for processing, cooling, cleaning, blending, etc. in many types of manufacturing and processing industries (especially agro-processing and pharmaceutical sectors), as well as in mining and service sectors, can stimulate the growth of businesses, and employment.
- Protection of aquatic ecosystems and natural water bodies ensures that they can be used for recreation/tourism and various forms of self-employment including horticulture, food vending, etc.

NDP Objective: Improving stock and quality of economic infrastructure

- Climate variability and frequent floods and droughts have severe consequences for the country's economic infrastructure, disrupting the road network and leading to shortfalls in drinking water supply and hydroelectric power.
- In the longer run, hydrologic uncertainty acts as a disincentive to growth-enhancing investments.
- Addressing these risks through flood preparedness and management can help maintain the stock and quality of Uganda's infrastructure
- IWRM initiatives can ensure that there is accurate and up-to-date water resources data that can facilitate the planning of population centers and major infrastructure like road and rail networks and water piers/ports.

NDP Objective: Develop efficient, innovative and internationally competitive industries

- A key 'binding constraint' to Ugandan industrial growth is the poor supply of electricity, yet development of the main source of electricity in the country, i.e., hydropower, is not keeping up with demand.
- Hydropower is the least cost energy expansion path for Uganda,
- Future expansion of small and large hydropower capacity is planned.
- Strengthening water quality regulations will provide an incentive for industries to adopt international best-practices while also reducing water pollution and thereby providing spill-over effects into other water-dependent sectors.

NDP Objective: Develop and optimally exploit the national resources base and ensure environmental and economic sustainability

- Water and catchment management initiatives can be tailored to ensure sustainable exploitation of natural resources.
- Environmental and economic sustainability can be enhanced through water source protection and effective implementation of Uganda's environmental laws and regulations.

NDP Objective: Strengthen good governance and improve human security

- A participatory and multi-stakeholder approach to water resources management can help to consolidate good governance in water-related sectors.
- Equitable allocation of water between communities and sectors (e.g. drinking, livestock rearing, industry, etc.) can minimize competition and conflicts between communities and sectors.

STEP 3.3: IDENTIFYING AND SUMMARIZING THE MAJOR PLANNING ISSUES AND OPTIONS

179. In the course of carrying out the tasks in Chapter 4 and preparing the Catchment Situation Report, the planning team will have recognized numerous problems and issues that warrant study and further investigation and that should perhaps be resolved in the catchment plan. These might include water shortages or the need for expanded supply not only for drinking but also for livestock and agriculture, forest, land and soil degradation including soil erosion evident from the field observation or stakeholder reports of silted tanks and river channels and progressive gully development, and areas of with high flood plain development including housing and other land uses that are at risk of economic loss.

180. If the WMZ planning team has been diligent in placing data concerning these issues and problems into the GIS (no matter how limited the data) it should be able to present a picture of the spatial distribution, location and extent of these problems in a series of readily understood maps. These maps provide an excellent tool to stimulate discussion among stakeholders in the various forums and in the CMC and CTC on what they see as the key problems related to water and development in their catchment or sub-catchment. Sometimes the problems or issues will be expressed as something that needed such as a borehole or a weir or a tank, other times as a problem to be fixed such as a degraded stream channel, polluted water or conflict among water users in a sub-catchment. The issues are thus generally a combination of problems to be fixed or improved and options or investments to be undertaken. In response to the problems and issues, one can think of a catchment plan as a body of actions to provide for:
    - Protection of the resource
    - Use and development of the resource
    - Conservation of the resource
    - Monitoring of the resource and building knowledge of the resource
    - Management (to ensure the agreed goals and objectives are achieved)
    - Regulation, particularly where scarcity or water quality degradation are issues

181. Overlaying these stakeholder views on what should be done are the proposals of the various central or district level line department and agencies including for example, water for agriculture, water for livestock, land management, hydropower development, drinking water supplies for villages, towns and cities, wetland restoration and reforestation, mines and industrial developments, expansion of aquaculture. These proposals can also be mapped using the planning team's GIS. In fact an overlay of the three sources of information on problems and issues – the planning team's own reconnaissance, the stakeholders and the line departments and agencies – would present not only a comprehensive picture but also one that would no doubt stimulate intense discussion among stakeholders including the members of the WAC.

182. The WMZ planning team would now need to sift through all of these proposals and suggestions to identify two types of options
    - Those that involve some type of investment to conserve, store, divert, extract, protect, convey or carry or otherwise control water for productive purposes (including domestic drinking water);
    - Those that involve management actions including water allocation, water use and wastewater discharge regulation including operating rules for storages, permitting, monitoring and measuring water, empowering user groups, facilitating and supporting actions by others

such as district councils or inter-district mechanisms, or water demand management initiatives such as promoting changes in crops or cropping patterns, improving efficiency or water deficit management.

183. It is important to emphasise that while the planning may be strategic in nature, **Localized action is part of strategic thinking**. A concern that emerged on several occasions during discussions with stakeholders was the risk that catchment plans, because they are supposed to be strategic in nature, do not attempt to include the micro-level IWRM-style interventions that are so critical to a sustainable approach to water resources and related natural resources management. If stakeholders are to be involved in the identification of issues and needs, it is important that the resultant Plan presents appropriate solutions, not just the planning and prioritizing of large-scale water resources development options. One way of dealing with this is to present a "programme "of local level interventions in the form of demonstration projects, which when taken to scale represent real basinwide solutions to some of the key challenges. This concept is very important for the mainstreaming of climate change since it is those communities, subsistence farmers etc., whose livelihoods are most intertwined with climate variability and the status of natural resources, who are most vulnerable to climate change. Mainstreaming localized sustainable land and water management practices into catchment plans is a key part of climate mainstreaming. The Plan should include a coherent plan of action for taking to scale. The action of replication and taking to scale should be clearly expressed as an action in catchment Management Plans. In this way, the strategic element is brought to the fore.

184. A list of generic options of the first type is given in Annex G. These include:

- Surface water storage dams and reservoirs of various sizes for single and multiple purposes
- Rainwater harvesting (off-farms) including check dams and small valley tanks for soil and water conservation including groundwater recharge management
- Bulk water supply (storage, diversion, conveyance) for various purposes including irrigated agriculture, aquaculture, livestock etc.
- Introduction of new irrigation technology (low pressure pipe conveyance, small scale sprinkler, drip and bubbler water application, etc.) generally to improve efficiency and productivity
- Power generation, generally mini and micro scale
- Drinking water supply and distribution
- Flood risk management
- Land management to reduce erosion and runoff, increase soil moisture storage, improve groundwater recharge
- Water source protection

STEP 3.4: OPTIONS FOR CATCHMENT AND SOURCE PROTECTION

185. The objective of environmental sustainability encompasses the concepts of managing, conserving and protecting the catchment itself, and hence its natural resources including land and water resources as well as taking actions to sustain beneficial development of those resources. Hence among the issues discussed and reviewed with stakeholders in Task 3.3 should be the status of the catchment and existing and proposed development, their present or potential vulnerability, and the threats that may be present or may arise in the future. The focus of this discussion would typically be on specific sub- or micro-catchments where the problems and issues are most severe.

186. There are many possible causes for the degradation of sub- or micro-catchment areas but in Uganda poverty, food insecurity and exceptionally high population growth have been the prime drivers of the expansion of agriculture into more marginal and vulnerable areas, deforestation, encroachment into wetlands, degradation of soils and land cover, and excessive erosion. This ever increasing degradation of catchment natural resources undermines livelihoods thereby increasing poverty, reinforces low productivity and food insecurity, and threatens existing development of water for, e.g., drinking water and hydropower production, and increases flood and drought risk. It also has important effects on the catchments downstream (externalities) because this degradation changes the hydrology of the catchment, altering seasonal streamflow and groundwater recharge, and filling downstream channels and water bodies with silt and sediment.

187. From the strategic perspective of Task 3.2, achieving economic, social and environmental objectives in these catchment areas requires putting in place measures (options) to reverse this degradation by managing the catchment. In this sense managing the catchment means managing the hydrologic and ecological processes in the catchment to prevent degradation, conserve water, protect water sources and in general to prevent the loss of values important for local livelihoods, especially the loss of water resources and other natural and environmental services.

188. Note, however, that one cannot focus only on these important externalities. The problem is not just, for example, to improve land management or restore forest cover but also to alleviate poverty and food insecurity and strengthen livelihoods in the affected catchment area. That is the stakeholder's "stake". They are unlikely to be interested in reducing catchment degradation to the benefit of downstream water users and water sources unless they are substantial beneficiaries as well.

189. While it is fairly obvious technically how to implement most of the actions in a catchment plan, for example boreholes, small dams, weirs, etc., it is much less obvious how one undertakes to beneficially manage land use in a catchment since, for example, it involves significant changes in behaviours and assumption of risks by the inhabitants (who are likely to be very risk averse) as well as physical interventions. The overall catchment planning process is able to define what needs to be done and where it needs to be done, but in the case of these measures a very intensive and localized planning process in each sub-or micro-catchment must be undertaken to define what is to be done, to mobilize people and local community based organizations to support implementation, and to implement and monitor the agreed measures.

190. These problems are commonly approached from two different perspectives;

- First is the integrated catchment management approach outlined in these guidelines; that is, the preparation of integrated sub- or micro-catchment plans in collaboration with stakeholders in these catchment areas that seek to eliminate the adverse externalities and facilitate the economic, social and environmental development of the sub- or micro-catchment as discussed in Task 3.2. The generic measures or options that might typically be found in such sub- or micro-catchment plans are outlined in Annex G.
- Second is from the perspective of downstream water users whose source of water is threatened by these externalities; this perspective is referred to as source protection for which separate guidelines have been prepared. This is somewhat narrower than the more comprehensive integrated catchment management approach because the scope of the objective is much more limited in practice. The generic measures or options typically used in source protection plans are outlined in Annex H.

191. Since adoption and implementation of these measures, especially those summarized in Annex G, influence the hydrology of the catchment – and hence the water balance and the efficacy of some downstream options and possibly the overall plan – the options for catchment management and source protection that have been adopted need to be added to the development options discussed with the CMO in Task 3.3 as a part of the Option and Scenario Analysis in Step 4.

STEP 4: OPTION AND SCENARIO ANALYSIS

192. Having decided on the specific or particular portfolio or universe of options and interventions for the catchment, the WMZ planning team should carry out the analysis described below.

STEP 4.1: PRELIMINARY CONCEPTUAL DESIGN OF OPTIONS

193. First, the team should prepare a preliminary or conceptual design of each option to determine its main specification and characteristics. Small scale and repetitive infrastructure would use standard layouts and designs adapted to each circumstance.

194. The purpose is to enable a preliminary estimate of its costs including operation, maintenance and construction cost. The design specifications should include its operating characteristics (flow rate, volume, time pattern, energy use) and outputs (area or number of people served, production, etc.).

195. The operating characteristics and outputs will be used to estimate the economic benefits of implementing the option. The modality of operation and maintenance should be specified including who will have this responsibility and what measures and actions need to be undertaken to ensure these critical responsibilities are fulfilled (legal requirements, training, funding, etc.).

196. Since many of the options can be found in the portfolio of planned or completed projects lying with the sector departments (water for production in MWE, for example), layouts, design criteria, and cost and benefits should exist.

STEP 4.2: INTEGRATED ANALYSIS OF POTENTIAL DEVELOPMENT OPTIONS

197. One of the fundamental advantages and benefits of the integrated and analytical approach to catchment planning is the ability to test the sustainability and compatibility of a larger number of different types of development options and management actions simultaneously. This will be done by the WMZ planning team using the water system simulation model adopted for the catchment as discussed in Chapter 3.

198. Hence, the need indicated in Step 9.1 for information on the technical specifications and operating characteristics of the various options. These data are needed for the model to be able to simulate the function and output of the option simultaneously with the others that are assumed to be implemented under the scenario being considered. However, note that there are two broad types of options – investment or physical options as outlined in Annex F, and management actions. The latter are also included in the model runs by identifying the result or outcome of the management action and modelling that outcome. For example, some management actions will affect the way reservoirs are operated or water is diverted, others will affect the hydrology of the sub-catchment by changing land use.

    A ***scenario*** is a combination of assumptions about the options in place (which options are possible or assumed to be implemented), external factors that influence their performance (climate, economic conditions, etc.), projections or forecasts of the future (population growth rate, urbanization rate, agricultural productivity, water use or demand rates, economic parameters, etc.), and government policy affecting either selection or performance (priority, funding, regulations, institutional arrangements, etc.). Hence what the WMZ planning team is simulating and studying in (b) is a series of scenarios.

199. The ***comparison and assessment of scenarios*** should be done in the context of the multi-criteria evaluation framework discussed above in section 5.3. Assuming a particular scenario is feasible (it does not use more water than is available, or violate other thresholds or limits, for example, level of pollution discharge) the model should estimate the value of each of the multi-criteria indicators based on the simulation of the scenario. This is the context for the discussion of what is better or almost as good, or not good at all – it is the objectives and indicators the WMZ planning team and the CMO have set for the plan.

200. The work done in earlier steps means that there can now be two sets of hydrology (long time series of daily or monthly discharge data at key points around the basin. These are used as inputs to the “water system simulation model”. One hydrology set will correspond to the naturalized hydrology based on historic observations. The other hydrology will correspond to naturalized hydrology as calculated from the climate change data.

201. If there are time and resources available each one of the different development scenarios can be investigated under without climate change and with climate change. This is the best approach because it may be that one scenario will be more climate change resilient than another, which may lead to its selection. If time and resources are limited, it is recommended that all scenarios are run using the "without climate change" hydrology and then the most favourable two scenarios run again using the "with climate change" hydrology.

STEP 4.3: INVOLVING THE CMO AND CTC IN THE EVALUATION OF SCENARIOS

202. The challenge for the WMZ planning team at this point is to ***organize and present these results*** to the CTC and the CMC in a manner that is readily understood and promotes and facilitates productive discussion of these scenarios as the heart or core of alternative catchment plans. Options and scenarios that drop out of the analysis should be highlighted and explained. Stakeholders should be able to identify how their issues and proposed options or actions have been addressed or dropped, and in the latter case receive a good explanation of why (including the possibility that their concerns and proposals have been addressed in a new or different way). The first round of discussion would typically lead to a request for the WMZ planning team to analysis with the model several variations on the scenarios analyzed in the first round.

STEP 4.4: THE CONSENSUS DRAFT CATCHMENT PLAN

203. As it works through the evaluation of each of the scenarios with the CMC and CTC, the WMZ planning team needs to be thinking ahead as to what should constitute the catchment management plan in the sense of its form, substance, etc.

204. The team might first ask, if this is to be an integrated catchment management plan what might constitute an "integrated plan" (as opposed to something else). What qualities would it have? Then, it might reflect on whether both of the earlier steps and its own thinking include these characteristics. For example:

- Is it participatory? Did all stakeholders have a say at each step of the planning and decision making process?
- Are all sectors and users are considered, in the present and the future?
- Is the scope of the objectives (and indicators) appropriate? Do they include the following factors:
  - Economic (growth and incomes, poverty, food security)
  - Social (equity, health)
  - Environmental (sustainability, conservation and enhancement of environmental services)
- Does the Plan encompasses conservation and protection of the resource, the catchment, and the hydrologic system?
- Does the scope of the planning process include the assessment of resources and system analysis of water supply and water demand; surface water and groundwater; and flood and drought risk management?

205. The above questions help to review the adequacy of the process on one level. But it is also useful to have a checklist at this point in the process of what the broad generic elements of the catchment plan would include. The following might constitute the beginnings of such a checklist, which could be detailed further:

- It presents an understanding the natural resource base and people of the catchment their economic and livelihood activities
- It consists of two interrelated plans –
  - water development or investment - infrastructure, enabling water use to achieve stakeholder objectives; and
  - water (and catchment) management – water allocation, permitting, regulation, operations
- It presents and discusses a water balance (surface water and groundwater), including the factors that govern or control the water balance. It presents a proposed allocation of water when and where limits to water use or development exist?
- It facilitates development of water resources to achieve stakeholder objectives by proposing projects and programs, and by proposing priorities

- It presents a plan for monitoring, regulation and permitting
  - Shows where water in the catchment needs to be measured in order to manage it;
  - Indicates what will be the rules for all stakeholders that enable equitable and sustainable water use
- Proposes measures to protect and conserve the natural resources of the catchment
  - Answers the question - Is the future sustainable? From the standpoint of the catchment hydrology? Water allocation and use? The environmental objectives? The economic and social objectives?
  - Demonstrates how should the catchment's resources be managed to ensure the long term viability of the plan.

206. The goal in evaluating different scenarios is to begin selecting the actual options, measures and actions that will constitute the heart of the plan.

207. ***When a consensus emerges or begins to emerge***, the WMZ planning team should consult with the inter-district forum and the WAC on the emerging plan. Feedback from these consultations should then be brought to the CTC and CMC for their consideration. While the CMC has the executive authority to adopt the catchment plan, it is absolutely ***essential that such a plan be supported by key groups and key officials in the catchment community***. Hence the WMZ planning team must work towards a very broad consensus to ensure that implementation will be supported.

STEP 5: MOVING TO IMPLEMENTATION

STEP 5.1: PREPARATION OF THE SUMMARY DRAFT PLAN DOCUMENT

208. An indicative outline of the draft catchment plan document is shown in Figure 13. This is a document that will be widely circulated in draft form for review by DWRM and the Ministry. It should be a concise summary document that provides the key data, findings and recommendations of the planning process and the discussions with the CMC and CTC. Supporting technical data and analysis should be compiled in annexes that can be made available on request during the review process.

209. The consensus draft plan agreed with the CMC is likely to comprise the following elements:

- Infrastructure and project investments (small, medium and large scale) with O&M agreements and plans - investments would be prioritized and sequenced over the planning horizon, perhaps bundled into three- or five-year programs.
- Water supply allocations and water storage operating rules
- Water conservation initiatives (including investments), catchment management measures and water source protection initiatives
- Regulations, standards, and investment proposals to control pollution and improve water quality

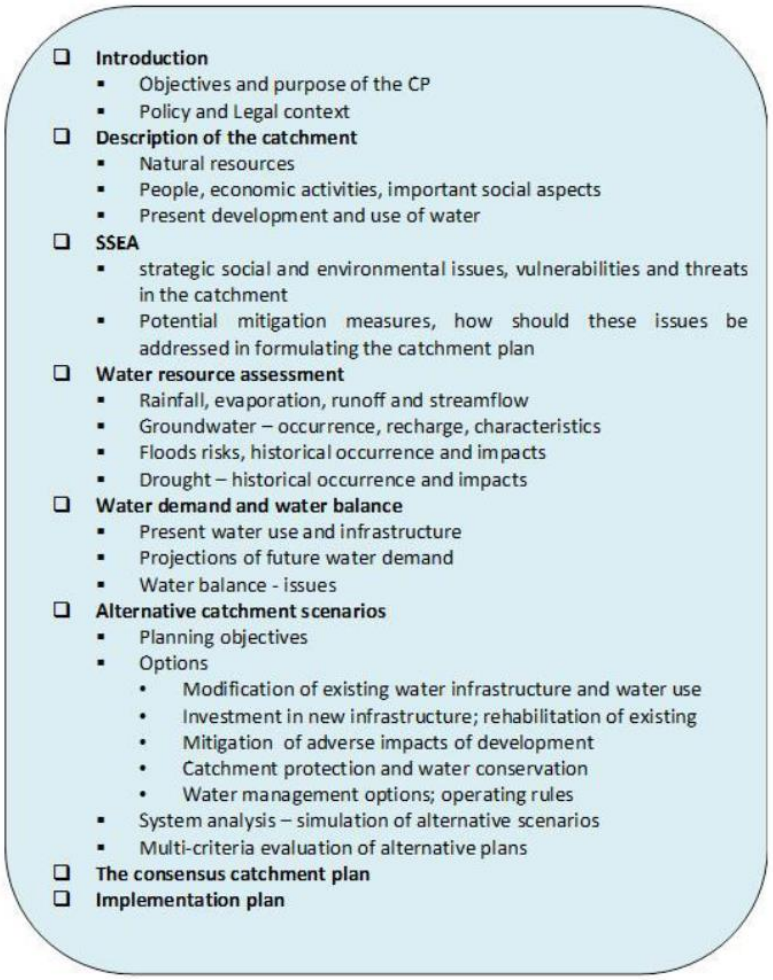

Figure 13: Indicative outline of the Plan document

- Drought and water deficit management actions to enhance drought and water deficit resilience including soil and land cover management, water conservation and water harvesting, water use regulation and mechanisms for adjustment to shortages or deficits
- Flood risk mitigation including flood plain use regulations and flood loss reduction measures
- Measures and incentives to promote improved water use efficiency and productivity Catchment water resources monitoring plan including new or altered hydro-meteorological stations, water quality monitoring stations, regulations on water measurement for major water users
- A program of project preparation activities (pre-feasibility and feasibility studies) for larger scale infrastructure proposals.

STEP 5.2: REVIEW AND ADOPTION OF THE DRAFT CATCHMENT PLAN

210. The goal is to have a final catchment plan that not only is agreed between the WMZ and the

catchment CMO and supported by the other stakeholder groups especially the Inter-district advisory committee (Figure 5), but also has the sanction and support of the Government. This is important for attracting donors and budget allocations to support plan implementation. The final plan, as with the WMZ and the CMC, should have an appropriate legal status. This would facilitate adding elements of the plan to the District Development Plans and to the portfolios of the lead sector departments, and provide a basis for implementing the management actions that constitute a key part of the plan.

211. The process of moving from a draft plan to a final plan, in terms of the relationship between the WMZ, the CMC and the Ministry is shown in Figure 14 and again in Figure 15. Review and adoption of the WMZ-CMC adopted draft plan by the Government will be arranged and managed by DWRM in collaboration with the Water Sector Working Group and the WPC. The instrument of formal Government adoption of the final agreed plan would be issued by the Ministry.

212. The WMZ planning team will present the draft plan to these bodies and provide whatever support is needed to respond to comments, queries and suggestions. This process is likely to be iterative and involve at some point consultation with the CMC and CTC, and possibly other stakeholder groups – in effect building a consensus between MWE, the WMZ and the CMC. The WMZ planning team will also support DWRM's efforts to brief other ministries and the Ministry of Finance and Economic Development on the proposed plan and its benefit. The Ministry would formally adopt the final plan document.

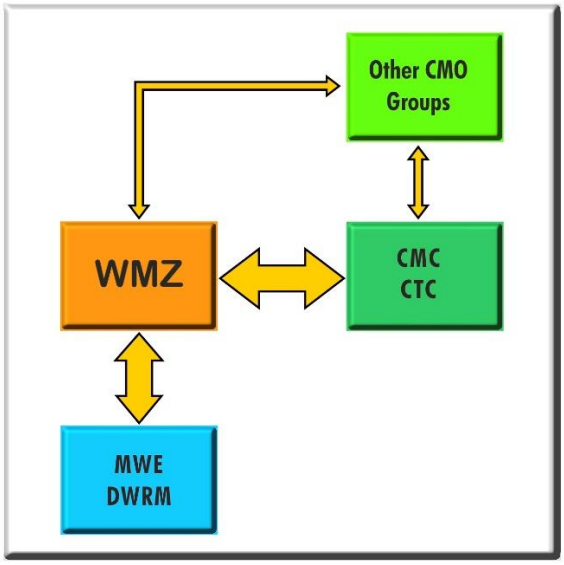

Figure 14: Moving from draft to final catchment management plan

213. The WMZ planning team will present the draft plan to these bodies and provide whatever support is needed to respond to comments, queries and suggestions. This process is likely to be iterative and involve at some point consultation with the CMC and CTC, and possibly other stakeholder groups – in effect building a consensus between MWE, the WMZ and the CMC. The WMZ planning team will also support DWRM's efforts to brief other ministries and the Ministry of Finance and Economic Development on the proposed plan and its benefit. The Ministry would formally adopt the final plan document.

STEP 5.3: PREPARATION OF THE IMPLEMENTATION PLAN

214. There are so many activities and participants in the final catchment plan agreed between the Ministry, the WMZ and the CMC, and formally adopted by the Ministry that a systematic, phased plan for its implementation will be needed. Phasing over time is determined in part by priorities, but also by the availability of funds and implementation capacity (which may have to be created as a part of plan implementation). The implementation plan would include (among other things):

- An action plan - a phased and sequenced plan of action in which the priorities and activities to be undertaken in each phase of plan implementation are clearly identified;

- A plan for the "processing" of each project, program and activity in the action plan – processing typically involves preparation (feasibility study, design, preparation of bills of quantity, tender documents, etc. or other technical activity necessary to implement the activity);
- Identification of who will be responsible for the implementation of each project, program or activity, and what that organization's role will be in relation to the WMZ, the project, and the stakeholder;
- The amount of financing (capital, operating, maintenance) needed, the potential sources of that financing, and identification of who is responsible for securing the financing;
- Identification of changes required in existing policy, laws or regulation to implement the adopted plan; identification of who will be responsible for formulating, preparing and processing those changes;
- A specific, targeted training and capacity building program that is design to directly support the institutions, stakeholders, and beneficiaries of plan implementation.
- Monitoring and evaluation framework. A monitoring and evaluation system or is required to ensure that the various parts of the implementation of the catchment management plan are on track and that they will lead to the desired outcomes, essentially progress towards meeting the strategic objectives and realising the Vision.

215. Table 9 summarizes the role of various institutions in the implementation of the adopted plan.

Table 9: Roles in Catchment Plan Implementation

WMZ	▪ Coordinate all implementation activities ▪ Facilitate and support DWRM coordination of central level implementation and financial resource mobilization ▪ Facilitate implementation of catchment plan projects by central departments ▪ Identify modalities for zonal and catchment level implantation among its public and private sector partners (Figure 15) ▪ Mobilize funds (MTEF, budget, donors, private sector) with the assistance of DWRM for implementation of zonal and catchment level projects ▪ Coordinate, manage and undertake project preparation for zonal and catchment level plan projects ▪ Assess water use permit applications under existing regulations ▪ Facilitate implementation and installation of upgraded and expanded monitoring network and WIS, and operate system within the zone ▪ Monitor hydrologic and meteorological conditions, compliance with regulations, implementation of sub-and micro catchment plans and source protection plans ▪ Support and facilitate the continuing role the CMC and CTC and other stakeholder groups including keeping all stakeholders informed of implementation progress
CMC & CTC	▪ Monitor plan implementation ▪ Promote and facilitate compliance with regulations and permitting system ▪ Facilitate and promote implementation of catchment management and source protection plans ▪ Facilitate inclusion of plan projects and programs into District development plans
MWE - DWRM	▪ Organize and coordinate review of the draft catchment plan and facilitate the Ministry's approval and adoption of the final agreed plan ▪ Organize and coordinate the technical review of plan project proposals and assignment of implementation to the appropriate department ▪ Mobilize funds for plan implementation and WMZ support ▪ Review policy, legal and regulatory revision needs based on plan recommendations and manage the process for updating and revision
MWE - NEMA	▪ Review the environmental regulatory needs (actions, new or revised regulations) based on the adopted final plan ▪ Issue required regulations, notices, and permits in accordance with legal and regulation requirements
MWE – Line	▪ Undertake preparation of projects and investments within their area of responsibility that

departments	are proposed in the adopted final catchment plan (feasibility studies) ▪ Supervise and manage project implementation (designs, tender and procurement, construction) ▪ Operate the completed project in accordance with the permit and operating rules agreed with the WMZ
Line departments in the concerned sector Ministries	▪ Undertake preparation of projects and investments within their area of responsibility that are proposed in the adopted final catchment plan (feasibility studies) ▪ Supervise and manage project implementation (designs, tender documents, procurement, construction) ▪ Operate the completed project in accordance with the permit and operating rules agreed with the WMZ
District government	▪ Facilitate and support implementation of the adopted final catchment plan ▪ Incorporate priority projects and program into the District development plan as appropriate
Donor partners & NGOs	▪ Implement priority projects and program in collaboration with the WMZ and stakeholders in accordance with agreements and Memoranda of Understanding with the WMZ and DWRM
Private sector	▪ Facilitate and support implementation of the adopted final catchment plan

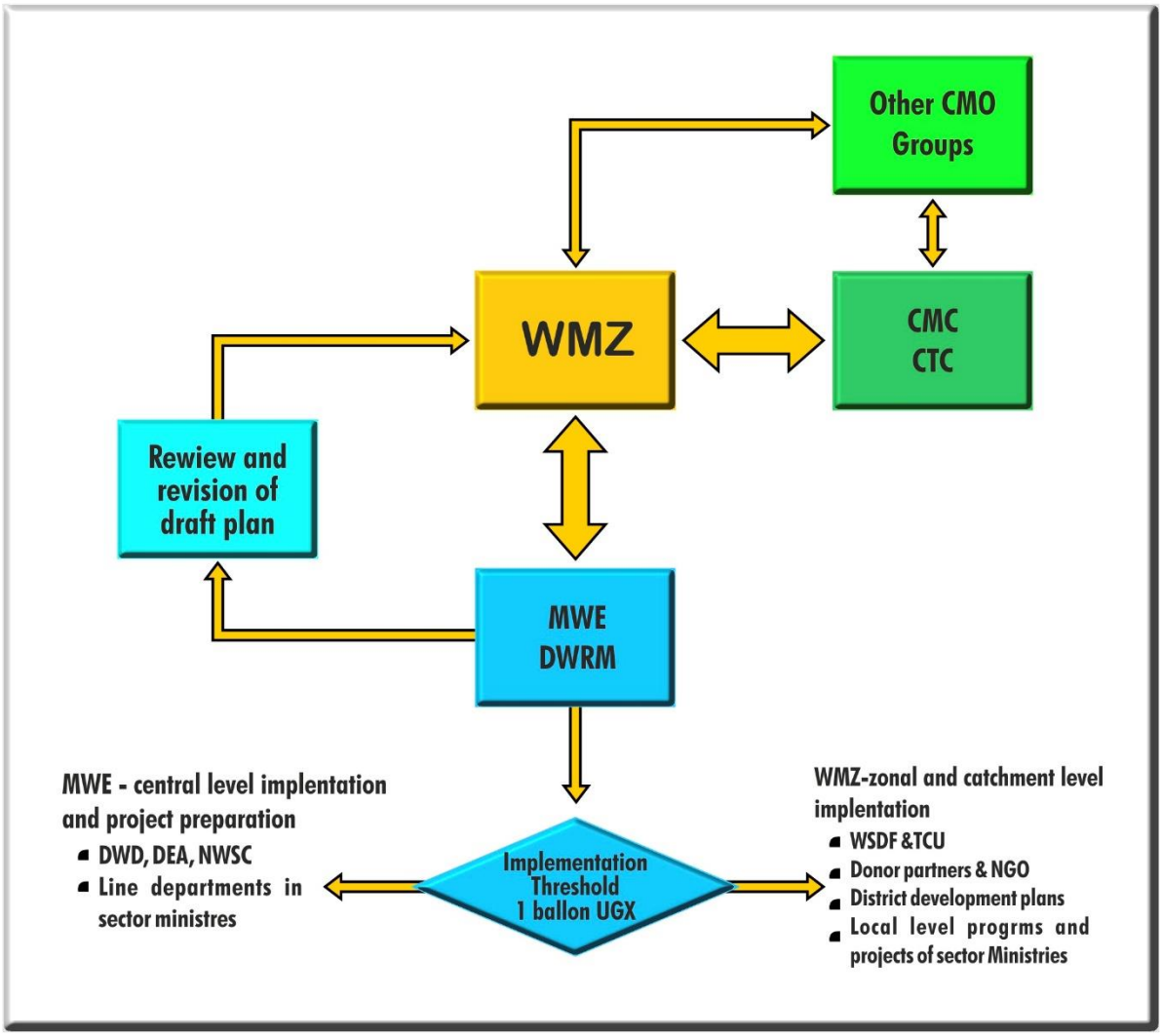

Figure 15: Implementation of the catchment management plan

STEP 5.4: PREPARATION OF THE MONITORING AND EVALMUATION FRAMEWORK

216. Monitoring and evaluation is required to ensure that the various parts of the implementation of the catchment management plan are on track and that they will lead to the desired outcomes, essentially progress towards meeting the strategic objectives and realising the Vision. A monitoring and evaluation system is only effective if the understanding of the desired outcomes is clear and measurable in some way, hence the development of indicators is critical.

217. The overall aim of the monitoring and evaluation tasks can be seen in two distinct parts:

- To develop a monitoring and evaluation framework aimed at tracking progress towards the achievement of the strategic objectives of the catchment management plan and
- To provide feedback on the implementation process in terms of whether actions are being carried out according to the planned timeline and on budget.

There are clearly strong linkages between planning and monitoring and evaluation. Good planning provides the foundation for a robust monitoring and evaluation process. Planning, monitoring and evaluation all have important roles to play in ensuring the monitoring and evaluation is effective and useful and that adaptive management can keep the programme on track towards its desired outcomes

218. The Figure 16 below illustrates how the results-based monitoring and evaluation framework is built during the planning process and takes full cognisance of the programme's vision and related strategic objectives and desired outcomes. If the results are to be achieved, clear indication of these results must be built into the framework. Process-based monitoring and evaluation (sometimes referred to as the traditional approach) is effectively based on whether the planned actions and activities are being carried out as planned. They do not take into account whether these actions are being effective or not.

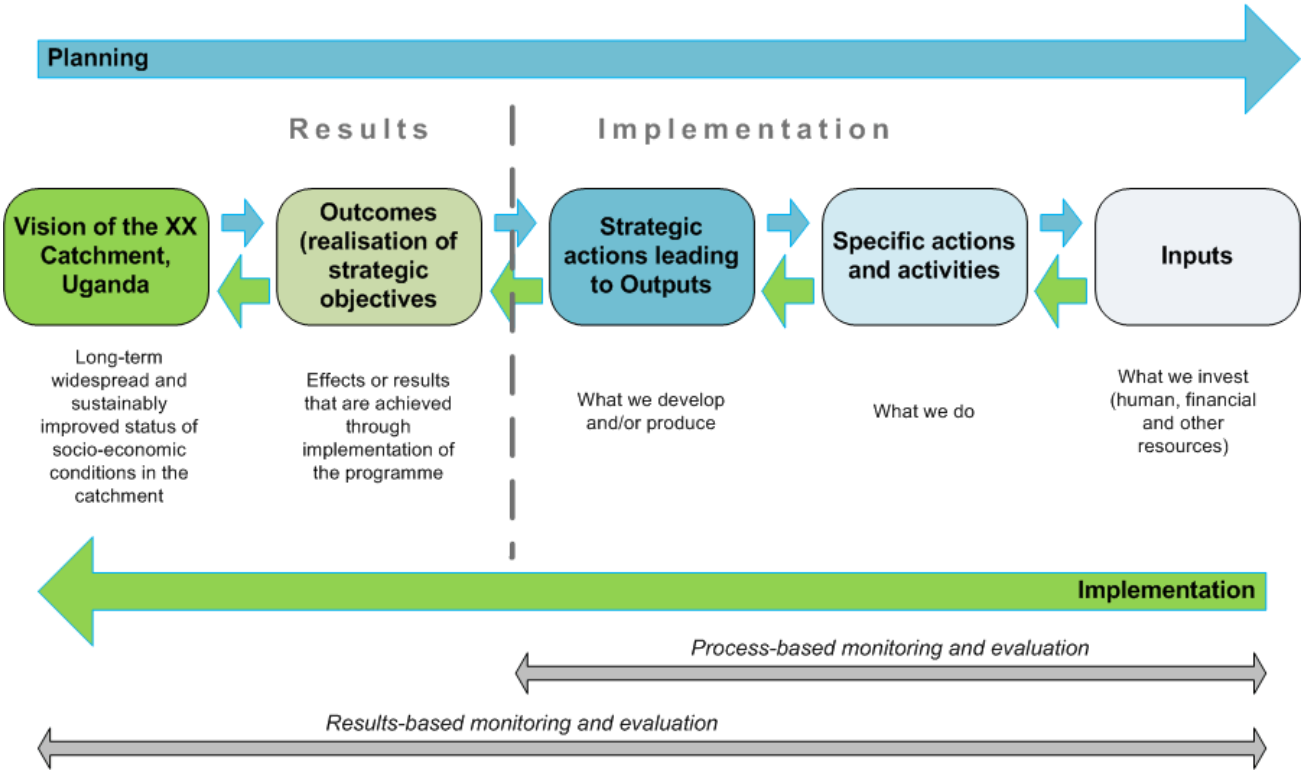

Figure 16: Results-based monitoring covers both planning and implementation (based on UNDP; 2016)

It is worth bearing in mind some key points linking planning, monitoring and adaptive management:

- Without proper planning and clear articulation of intended results, it is not clear what should be monitored and how; hence monitoring cannot be done well.
- Without effective planning (clear results frameworks), the basis for evaluation is weak; hence evaluation cannot be done well.

- Without careful monitoring, the necessary data is not collected; hence evaluation cannot be done well.
- Monitoring is necessary, but not sufficient, for evaluation.
- Monitoring facilitates evaluation, but evaluation uses additional new data collection and different frameworks for analysis.
- Monitoring and evaluation of a programme will often lead to changes in programme plans. This may mean further changing or modifying data collection for monitoring purpose (part of the adaptive management process)

219. As a minimum, the main body of the report should include the logical framework ("logframe") and there should be a Project management Framework included in the Annex J.

220. **Logical Framework**: A logframe is typically presented as a matrix with several columns and rows. While there are many different logframe formats, the NBI logframe is a 3-column matrix that captures the following:
    - The Goal and Objectives of the initiative, and results at all levels (impact, medium-term outcomes, short-term outcomes, outputs)
    - Performance indicators to measure the progress of each result
    - Assumptions and challenges and constraints that may affect achievement of results.
    - For each of the outputs, the main groups of associated activities may be included (the activities do not require indicators).

Results	Indicators	Assumptions and Challenges and constraints
Vision		
Impact	Impact Indicators	Assumptions and Challenges and constraints
Strategic Objective 1:		
Medium-Term Outcomes	Medium-Term Outcome Indicators	Assumptions and Challenges and constraints
1.		
2.		
Strategic Objective 2:		
Medium-Term Outcomes	Medium-Term Outcome Indicators	Assumptions and Challenges and constraints
3.		
4.		

Figure 17: Layout of Logical Framework

An example in the form of an extract from a logframe for a completed catchment management plan is included in Annex J.

221. **Project Management Framework (PMF)**: This is a tool to organize results monitoring and evaluation processes. The PMF links what you will monitor with how you will do it. It is designed at the start of a project, may be updated annually, as required and is used for baseline collection and later for comparison with actual progress. The elements of the PMF are presented in a 9-column matrix like the one shown below.

Level	Results	Performance Indicators	Data Source	Collection Methods	Frequency	Responsible	Data Use	Baseline	Target
Impact									
Medium Term Outcome 1									
Short-Term Outcome 1.1									
Output 1.1.1									
Repeat for all results									

Figure 18: Layout of Project Management Framework

An example in the form of an extract from a project management framework for a completed catchment management plan is included in Annex J.

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Annex A - Sector-specific priorities as per Uganda National Climate Change Policy

The sector-specific priorities for the water-related sectors, as presented in the Uganda National Climate Change Policy (see Section 4.2.1) are provided in this annex by way of extracts.

AGRICULTURE AND LIVESTOCK

Sectoral Context and Challenges

- Uganda depends largely on rain-fed agriculture, making rural livelihoods and food security highly vulnerable to the consequences of climate change and variability
- Climate change in Uganda is expected to severely influence the variability of rainfall and to cause increases in temperature and the potential for evapotranspiration
- Predicted increases in aridity, and hence droughts, will in turn influence agricultural production
- These impacts will negatively affect food availability and supply, therefore impacting food security
- There are currently a number of initiatives to mainstream climate change agricultural policy and practices, including sustainable land management
- Uganda is developing a National Agricultural Policy (NAP), whose major focus is on food security, increased household incomes, improved value chains, increased domestic and international trade, and improved sustainable natural resource management. The food and nutrition policy is intended to ensure that the entire food chain, from production to consumption, is efficiently managed within the overall development strategy, through building capacities at all levels for adequate action to improve household food security. Uganda's agricultural policy is also shaped by the Ministry of Agriculture, Animal Industry and Fisheries' (MAAIF's) Development Strategy and Investment Plan (DSIP) 2010/11–2014/15, whose major goal is agriculture for food and income security. The DSIP renews recognition of the fundamental importance of agriculture to the Ugandan economy and of the central role it has to play in development, economic growth and poverty reduction. The bulk of activities to adapt to climate change in the agricultural sector centres on capacity building

Policy Response

To address these challenges, the GoU will pursue the following policy priorities, building on efforts underway in the Ministry of Agriculture, Animal Industry and Fisheries:

- To promote climate change adaptation strategies that enhance resilient, productive and sustainable agricultural systems
- To promote value addition and improve food storage and management systems in order to ensure food security at all times, as a factor of resilience

Specific strategies for tackling these sectoral policy priorities will include the following:

- Promote and encourage highly adaptive and productive crop varieties and cultivars in drought-prone, flood-prone and rain-fed crop farming systems
- Promote and encourage highly adaptive and productive livestock breeds in communities and commercial areas
- Promote and encourage conservation agriculture and ecologically compatible cropping systems
- Promote sustainable management of rangelands and pastures through integrated rangeland management to avoid land degradation and deforestation

- Promote irrigated agriculture by developing irrigation schemes using sustainable and cost-effective water sources and by encouraging more efficient water use by irrigation production systems
- Promote and encourage increased agricultural production and diversification and improved post-harvest handling, storage and value addition in order to improve food security and increase household incomes
- Support Community-based adaptation strategies through stretched extension services and improved systems for conveying timely climate information to rural populations to enhance the resilience of agricultural systems to the impacts of climate change
- Develop innovative insurance schemes (low-premium micro-insurance policies) and low-interest credit facilities to insure farmers against crop failure due to droughts, pests, floods and other weather-related events
- Promote and encourage indigenous knowledge, along with research and dissemination of innovations that can enhance climate-smart agriculture and food preservation

FISHERIES AND AQUACULTURE

Sectoral Context and Challenges

- Uganda's lakes and rivers are a repository of aquatic resources, which support fisheries
- Aquatic ecosystems are threatened by resource overexploitation, transformation and degradation of habitat, pollution, and now, climate change
- Fish catches and fish stocks are declining, mainly due to over-fishing
- With climate change, reduction in water levels will lead to decline in fish stocks and other aquatic resources. To reverse the decline of the fishing industry, interventions are urgently required to stop illegal activities and to exploit existing opportunities
- Uganda's 2004 National Fisheries Policy recognises the need to develop fisheries in a socially and environmentally sustainable manner and emphasises the protection of aquatic ecosystems to meet the needs of current and future generations. The policy provides guidance on the development of flexible systems of managing, utilising and conserving the country's fisheries
- Under the MAAIF's DSIP, the government focuses on strengthening controls of illegal fishing, promoting and supporting aquaculture and cage farming—especially of tilapia (currently at negligible levels but with clear potential for export to neighbouring countries), and stocking small water bodies, including dams. Emphasis will also be placed on ensuring fish quality at all levels. These focuses need to be further strengthened by the climate change policy

Policy Response

To address these challenges, the GoU will pursue the following priority:

- To strengthen efforts to promote integrated fisheries resource management and improve aquaculture in order to ensure sustainable fisheries production

Specific strategies for tackling these sectoral policy priorities will include the following:

- Promote and encourage the adaptive management of fishing capacity based on climate and environmental forecasts, to protect against extreme events
- Promote sustainable fish farming as a means of economic diversification and to reduce over-fishing in natural water bodies
- Promote and encourage collaborative and participatory management of aquatic ecosystems
- Promote awareness of the climate change–related impacts on fisheries amongst the various stakeholders, such as local communities, resource managers and policy makers
- Provide economic incentives to diversify livelihood options in order to reduce dependence on climate-sensitive fisheries resources
- Promote biological engineering and restoration of stress-tolerant organisms

- Improve and strengthen trans-boundary cooperation regarding fisheries and aquatic ecosystems

TRANSPORT AND WORKS

Sectoral Context and Challenges

- Uganda's transport systems and other infrastructure continue to be built without taking predicted climate change patterns into account
- Climate-related hazards and predicted impacts of climate change threaten vital transport infrastructure such as roads, bridges and rail networks
- The economic cost of the impacts of climate change on infrastructure damage, repairs and reconstructions, though difficult to estimate, is very high.
- Uganda's transport policy aims to promote cheaper, more efficient and more reliable transport services as a means of providing effective support to increased agricultural and industrial production, trade, tourism, and social and administrative services. For all transport projects, Environmental Impact Assessments (EIAs) are prepared in accordance with the Ugandan Guidelines and the latest international standards and environmental criteria, and submitted to the National Environment Management Authority (NEMA) for approval. Although not much has been done to integrate climate change in transport policy, the Ministry of Works and Transport (MoWT) is currently developing a Climate Change Risk Management Strategy for the transport sector

Policy Response

To address these challenges, the GoU will pursue the following priority:

- To strengthen efforts to promote integrated fisheries resource management and improve aquaculture in order to ensure sustainable fisheries production

Specific strategies for tackling these sectoral policy priorities will include the following:

- Integrate climate change into the existing infrastructure risk assessment guidelines and methodology
- Building on work already underway, establish and enforce climate change–resilient standards for transport and infrastructure planning and development through monitoring and reporting systems
- Encourage the integration of climate change into transport and infrastructure development strategies
- Promote and encourage water catchment protection in transport infrastructure development and maintenance
- Climate-proof existing and future infrastructure by conducting geotechnical site investigations (GSIs) to determine whether areas are appropriate or inappropriate for infrastructural development

FORESTRY

Sectoral Context and Challenges

- Uganda is endowed with abundant forest resources, which contribute significantly to environmental sustainability, the economy, community livelihoods and carbon sequestration
- Uganda forestry policy (the 2001 National Forestry Policy and the 2001 National Forestry and Tree Planting Act) makes reference to climate change issues on the commercial forest plantation, forest products processing industries, collaborative forest management, farm forest conservation of forest biodiversity, watershed management, soil conservation and urban forest

- However, the country's forest cover is disappearing at an alarming rate. Major causes of deforestation include clearing for settlements and agriculture, overgrazing, wildfires, charcoal burning, over-exploitation of wood resources for commercial purposes.
- Climate change and intensified land use will exacerbate degradation and desertification, as tree mortality increases with reduced rainfall and the incidences of pest, diseases and forest fires rise
- This will increase the rate of interventions needed in this sector to ensure sustainable forest management

Policy Response

To address these challenges, the GoU will pursue the following priority:

- To ensure the sustainable management of forestry resources so that they can continue to provide global services, including mitigating climate change, while supporting the sustainable development needs of communities and the country

Specific strategies for tackling these sectoral policy priorities will include the following:

- Strengthen the existing national forestry policy to prevent forest degradation.
- Promote intensified and sustained afforestation and reforestation programmes implemented by the government, institutions, households and individuals, the private sector, civil society and multilateral organisations
- Promote alternative energy sources, energy conservation initiatives and efficient biomass energy production and utilisation technologies to reduce biomass consumption
- Encourage agro-forestry, which will enable poor rural households to meet their subsistence and energy needs
- Strengthen existing forestry research and encourage conservation and restoration of forest ecosystems critically threatened by climate change

WETLANDS

Sectoral Context and Challenges

- Uganda is endowed with wetland resources that contribute significantly to environmental sustainability, community livelihoods and carbon sequestration
- The Uganda government has put in place legislation to manage all its natural resources, including wetlands. The Wetland Policy is in line with efforts to address climate change, as it aims to establish principles by which wetland resources can be optimally used now and in the future, to end practices that reduce wetland productivity, to maintain the biological diversity of natural or semi-natural wetlands and to maintain wetland functions and values
- However, the country's wetlands are disappearing at an alarming rate. In 1964, the total area of wetlands was estimated at 32,000 km2 but by 1999, it had decreased to 30,000 km2, about 13% of the total area of Uganda. As of 2005, the wetland cover had been further reduced to 26,308 km2, only 11% of the total land area
- Major drivers of wetland degradation include draining of wetlands for agriculture, urban and industrial expansion, over-harvesting of wetland resources (mainly for construction and handicraft), over-fishing and poor use of wetland catchments leading to siltation of wetlands and rivers
- Climate change and intensified land use will exacerbate wetland degradation, as wetlands will be encroached upon further for farming, and the incidence of wetland fires is likely to rise
- This will increase the rate of interventions needed in this sector to ensure sustainable wetland conservation and restoration

Policy Response

To address these challenges, the GoU will pursue the following priority:

- To promote long-term wetland conservation and restoration of degraded wetlands so that they can continue to provide global services, including mitigating climate change, while supporting the sustainable development needs of communities and the country

Specific strategies for tackling these sectoral policy priorities will include the following:

- Strengthen the existing national wetland policy to prevent wetland degradation and encroachment
- Promote and intensify wetland protection and restoration of degraded wetlands
- Strengthen collaborative and participatory management of wetland resources
- Strengthen existing wetland research and encourage conservation and restoration of ecosystems critically threatened by climate change

BIODIVERSITY AND ECOSYSTEM SERVICES

Sectoral Context and Challenges

- The GoU promotes the conservation and sustainable utilisation of the country's biodiversity, as well as the effective management of its ecosystems
- There are currently a number of initiatives in Uganda to mainstream climate change biodiversity and ecosystem management, including sustainable land management
- The government also promotes equitable sharing of the benefits arising thereof for the wellbeing of the nation
- However, with climate change and increasing human pressure, biodiversity and ecosystems are being rapidly degraded

Policy Response

To address these challenges, the GoU will pursue the following priority:

- To effectively address the challenges posed by climate change impacts on biodiversity and ecosystems, so as to ensure ecosystem health and provision of ecosystem services that are crucial to sustainable and resilient development

Specific strategies for tackling these sectoral policy priorities will include the following:

- Identify biodiversity hotspots where only restricted development should be allowed
- Encourage collaborative management and sustainable use of biodiversity and ecosystems
- Promote valuation and payment for ecosystem services, and streamline other ecosystem benefit-sharing schemes
- Ensure that any human activity within the vicinity of protected areas does not compromise the integrity of the ecosystem
- Strengthen the capacity for monitoring the impacts of climate change on biodiversity, ecosystems and ecosystem services

Annex B - Checklist for building Climate Change in the CMP Process

This checklist is aimed at providing those responsible for, or involved in catchment management planning to ensure that they have taken into account all the recommended climate change mainstreaming requriements. In this way resilience to climate change can already be built in at an early stage in the project planning cycle.

Checklist for building Climate Change in the CMP Process

Subject Area		Action for Climate Change Mainstreaming	Check
1. Project preparation		▪ Consult existing (e.g. Uganda Climate Change Policy, 2012) and latest documentation on climate change in Uganda. ▪ Consult Climate Change Department (CCD) website and meet with CCD officials to brief them on the project and obtain their support.	
2. Building the knowledge base (STEP 1 of catchment planning process)			
2.1	Observed Climate Change trend data	▪ Collect all historic climate data that can be obtained for points in and around the catchment. The most important aim is to have long and as unbroken as possible records. Sometimes the best records may lie outside the catchment boundary but may still be useful. Rainfall records are the most important.	
		▪ Collect global historic (observed and patched) data sets for precipitation. (See Annex E of these Catchment Management Planning Guidelines for sources)	
		▪ Carry out data quality checks (mass duration and statistical tests etc.) on observed sets and correlation analysis with global data sets	
2.2	Future climate datasets	▪ Obtain datasets reflecting climate under conditions of future climate change (see Annex E of these Catchment Management Planning Guidelines for sources)	
2.3	Identify future data collection needs	▪ Based on the analysis of collected data and gaps (spatial and temporal), identify data collection needs for the future that should be incorporated into the CMP	
3. Water resources planning analysis (STEP 2.1. of catchment planning process)			
3.1	Generation of “under climate change conditions” hydrology	▪ The approach and methodology is described in Paragraph 40 of these guidelines, with further details provided in Annex C.	
3.2	Water demand/use under climate change conditions	▪ Make estimates on the impact of climate change on project water demands. These estimates should be used in the “with climate change modelling runs”. In addition to temperature increase, and likely increases in evapotranspiration. It is worth looking carefully at potential shifts of agro-ecological zones and hence in crop choices. (See Paragraph 63 of these guidelines)	
4. Catchment Stakeholder participation framework (STEP 2.2 of the catchment planning process)			
4.1	Common understanding of the climate change concept	▪ It is important that stakeholders have a good understanding of what climate change is and also of the change that has resulted from anthropogenic pressures on natural resources. These points are underlined in Table 3 (Stakeholder engagement in integrated catchment planning) under Paragraph 67 of the Revised Catchment Management Planning Guidelines	

4.2	Localised action as a part of strategic thinking	▪ Even if the planning process is strategic in nature, it is important that proposed interventions include localised action as a part of the strategic thinking. Micro-level IWRM-based interventions aimed at a sustainable approach to water resources and related natural resources management are essential and the overall plan should include clear strategies aimed taking these initiatives to scale. This is covered in Paragraph 118 of the Revised Catchment Management Planning Guidelines.	

Annex C - Mainstreaming climate change into rainfall-runoff modelling and water resources modelling

INTRODUCTION

In the study carried out for the Mpanga catchment, "Study on current and future potential water resources, under different climate scenarios, for the Mpanga River Basin (Uganda) (BRLi, 2015)", a methodology was used to develop a revised hydrology representing the hydrological charactreistics under future climate change affected conditions.

The purpose of this annex is to summarise rhe approach and methodlogy that was use to assess the impact of different climate change scenarios on the water resources of the Mpanga River.

Preparatory work (bibliography) and field reconnaissance were undertaken to get a general understanding of the catchment. This allowed gathering the needed information and knowledge to perform the water resources modelling itself. The results were presented to stakeholders in the catchment in February 2015.The study essentially focused on the impact of climate change on low flows and did not enter into the modelling of climate change impact on floods and peak-flows. This would have required data that was not available (rainfall intensity data under current and future conditions etc.).

The approach and methodology used is such that it could be applied in any catchment around the country.

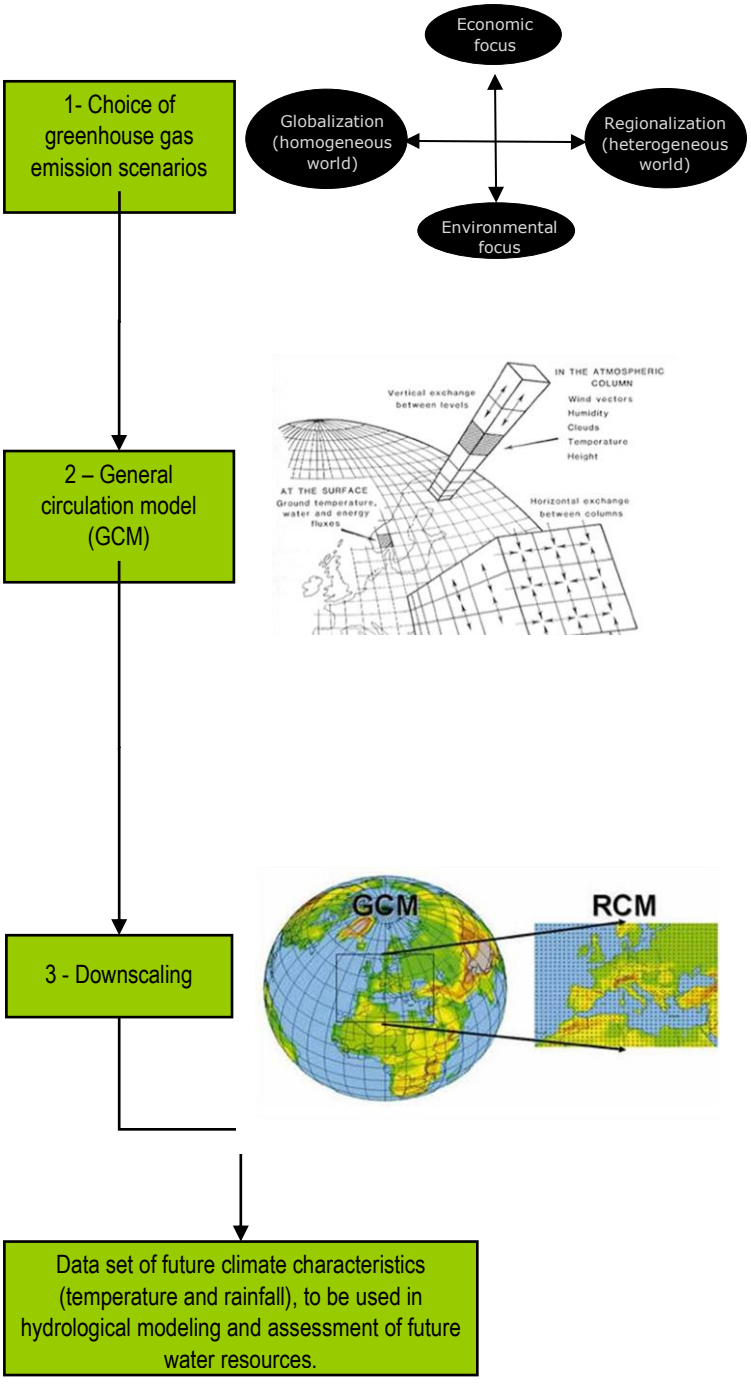
AVAILABLE DATA SETS AND CHOICE OF THE CLIMATE CHANGE SCENARIOS STUDIED.

Generality on climate change modelling

Prediction of future climate depends on many different hypotheses: hypothesis on future greenhouse gases emission; hypothesis on reaction and interaction of physical, atmospheric and climatic parameters etc. The schematic below (BRLi, 2015) shows the main steps of climate change modelling.

A "climate change scenario" is in fact the combination of choices on: the greenhouse gases emission scenario considered, the global circulation model used, and on the downscaling method applied. As shown in the figure below there are many choices and it is important that those involved in catchment management planning are comfortable with how to make choices so that they can take climate change into account in their catchment management plans.

Bearing in mind the objective of the study, the purpose of the climate change modelling was to provide a set of future climate data (especially rainfall and temperature) that could be used to investigate the impacts on water resources in the basin.



There are 40 different emission scenarios, each one making different assumptions for future greenhouse gas pollution, land-use and other driving forces.

There are 22 general circulation models studied by the IPCC. GCM are mathematical representation of the climate and describe how the atmosphere, the oceans, the land, ice, energy from the sun etc. affect each other and Earth's climate. The models divide the earth, ocean and atmosphere into grid. The values of predicted variables (surface pressure, wind, temperature, rainfall…) are calculated at each grid point over time, to predict their future values. Due to the large number of calculation involved and given the current capacities of computers, simulation of the climate can't be done with a high spatial resolution.

Downscaling consist in taking global information on climate response and translating it to a finer spatial scale that is more meaningful in the context of local and regional impacts. Two general approaches are used in downscaling:

- Dynamical downscaling, where a high resolution climate model with a better representation of local terrain simulate climate processes over the region of interest
- Statistical downscaling, where large scale climate features are statistically related to fine scale climate for the region

The advantage of using dynamical downscaling is that a regional model can simulate local fine-scale feedback processes not anticipated with statistical methods. The disadvantage, however, is that the regional models are far more computationally requiring and that the end performance is highly dependent on the quality of the input

Data sets used in the study

The study used two different future climate data sets:

- The "Regional-scale Climate Change Projections of Annual, Seasonal and Monthly Near Surface Temperature and Rainfall in Uganda" (University of Pretoria, Baastel, May 2014) This climate change modelling work was undertaken in the context of the study "Economic Assessment of Climate Change in Uganda" with the objective of generating projections of future temperature and rainfall at regional scale for different greenhouse gas emission scenarios; and to proceed to downscaling in specific regions of Uganda used as case-studies, the Mpanga river basin is one of them.

- The: "Regional Downscaling of Precipitation and Temperature Data for Climate Change Impact Assessment in the Nile Equatorial Lakes (NEL) Region" – University of Stuttgart – 2011) undertaken as a component of the "Tools and guidelines for Climate Change Adaptation Mainstreaming in water Infrastructure development" NELSAP/NBI".

The table below summarizes the main characteristics of the climate change data available in the two studies (in line with normal practice, only a selection of those scenarios has been studied in the case of Mpanga catchment).

Presentation of the climate data sets used in the study on current and future potential water resources under different climate change scenarios in Mpanga catchment

Study	Baastel 2014	NELSAP/NBI 2011
Greenhouse gases emission scenario	2 scenarios from the 5th IPCC assessment (RCP 4.5 and RCP 8.5)	3 scenarios from the 4th IPCC assessment (A1B, A2, B1)
GCM	4 models	2 models
Downscaling	1 downscaling method	Statistical downscaling for 3 different climatic references
Data provided	Seasonal and monthly rainfall and temperature data series	Monthly rainfall data series. For temperature, the study recommends average seasonal temperature evolutions.
Comment	Advantage: uses greenhouse gases emission scenario from the latest released of IPCC assessment (5^{th}) (scenario RCP 4.5 and RCP8.5). Inconvenient: downscaling applied only to a limited number of case study in Uganda and is not available for the entire country.	Advantage: available for the entire country. Inconvenient: use greenhouse gases emission scenario from the 4^{th} IPCC assessment.

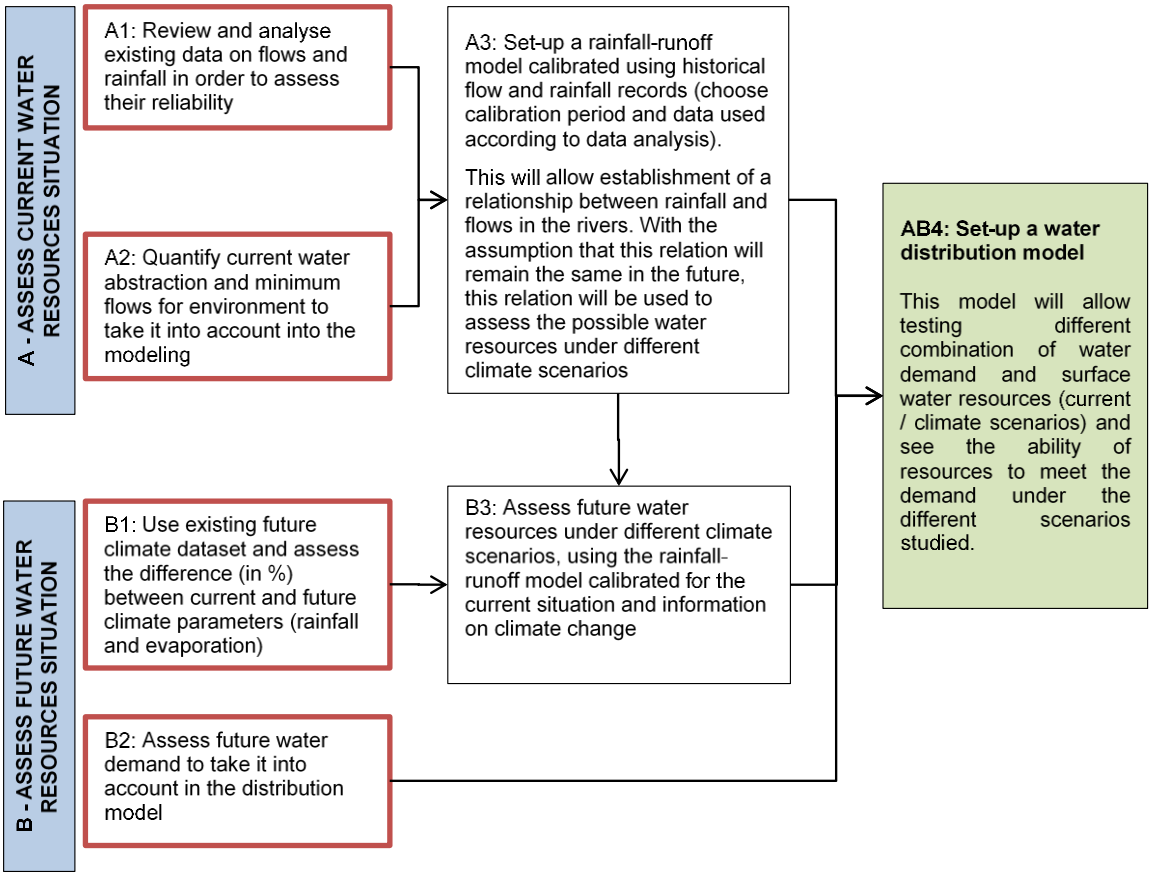
Conclusions on the availability of climate change datasets to be considered for mainstreaming climate change in the CMP guidelines:

The climate change scenarios studied are highly dependent on the data available. Where possible, the selected scenario should allow testing the sensitivity to the main hypothesis of climate change modelling, in particular include different greenhouse gases emission scenarios, and different global circulation models. Testing different downscaling methods can be difficult, as the downscaling is often the steps which limit the availability of data for a certain location.

International user-friendly climate data bases have been developing during the past few years. In particular, the Climate change knowledge Portal (http://sdwebx.worldbank.org/climateportal/index), an initiative from the World Bank, is a central hub of information, data and reports about climate change around the world. It provides easy access to climate change downscaled data series, for any location in the world, for different greenhouse gases emission scenarios (at the moment scenarios of the 4^{th} IPCC assessment), and different GCM. (See http://climatewizard.ciat.cgiar.org/)

METHODOLOGY FOR MODELLING THE IMPACTS OF CLIMATE CHANGE ON WATER RESOURCES

The sketch below summarizes the main steps of the methodology applied in the study.



Main steps of the methodology applied in the study on current and future potential water resources, under different climate scenarios for the Mpanga River catchment (adapted from BRLi, 2015)

Annex D - Analytical Tools for Integrated Catchment Planning

Integrated catchment planning generally requires a set of analytical tools including water system models to undertake water balance studies and scenario analysis. Together with the Knowledge base these tools form the core of a decision support system (DSS). The models in a DSS might include one or more of the following:

RAINFALL-RUNOFF MODELS

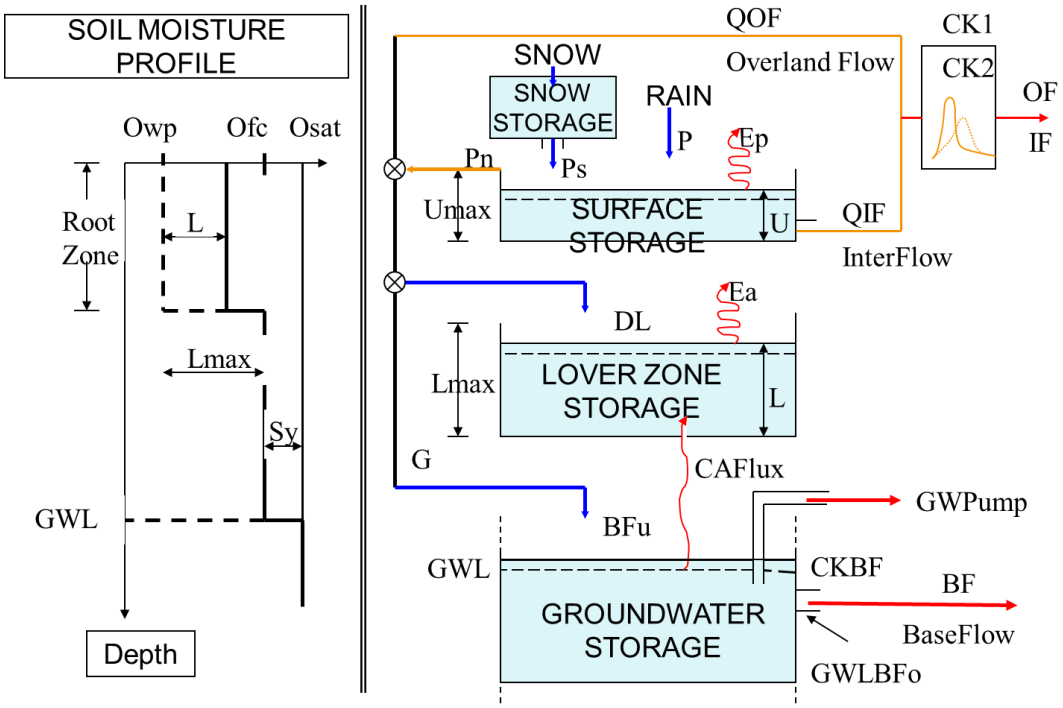
There are several different purposes that a rainfall-runoff model may be used for. These include:

- Understanding the catchment yield, and how this varies in time and space, particularly in response to climate variability
- Estimating the relative contributions of individual sub-catchments to water availability within a larger catchment
- Estimating how this catchment yield and water availability might change over time in response to changes in the catchment, such as development of valley dams, or changes in land-use and land management.

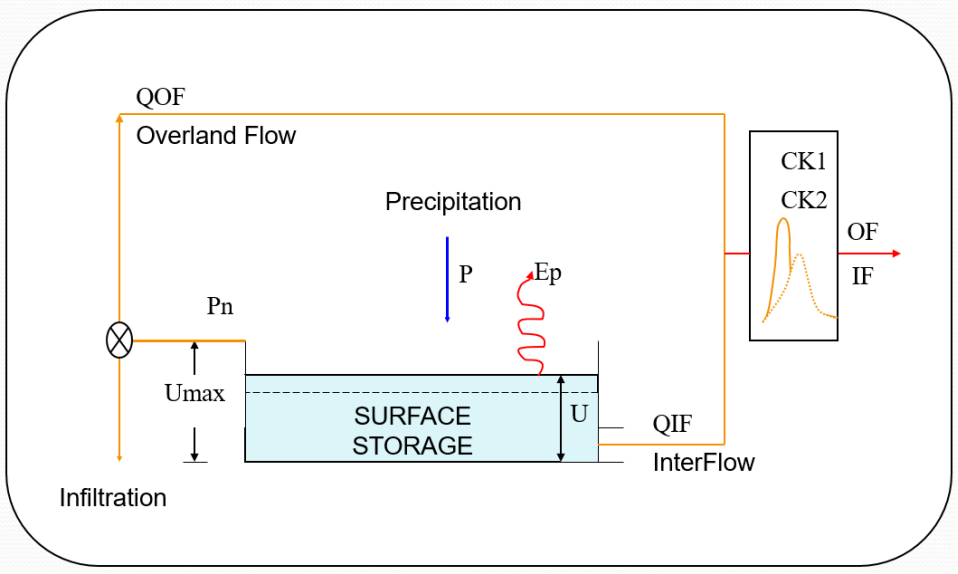
The third of these cases is particularly relevant for the situation in many catchments in Uganda, where changes in land use or land degradation has caused negative changes to the hydrological regime. At the same time, since one of the aims of catchment management will be to improve the condition of the catchment, an improvement in the hydrological regime can be anticipated. It would be useful to be able to estimate these changes and take them into account in the planning process, including the evaluation of options.

Access to the NAM model is available through the NBI DSS portal. It is a deterministic, lumped (catchment is looked upon as a single unit with average values of parameters) and hybrid (mixture of statistical and process-oriented) rainfall-runoff model. It can present the **processes that take place in the surface zone storage, root zone storage and the ground water storage**. This is important if there is a need to understand the impacts of changes in land use and/or vegetation cover which could typically result from improved land management practices. In addition, it contains provision to deal with snow melt and Irrigation schemes. Applications related to the NAM include:

- Runoff forecasts taking into consideration the status of the surface and groundwater storage zones
- Extension of runoff series
- Estimate effects of Climate Change, for instance on stream flow”
- The model structure is shown overleaf:



Structure of the NAM model as described in the NBI DSS



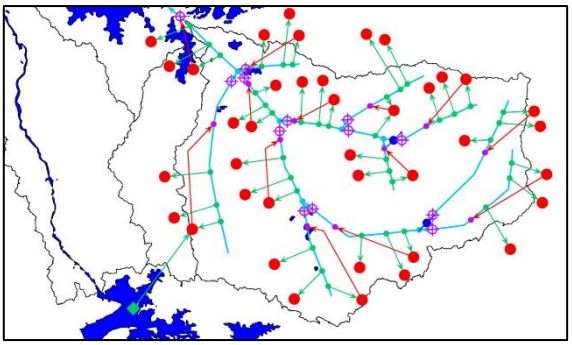
Component of the NAM model for differentiating overland and interflow (baseflow) contributions to catchment runoff as described in the NBI DSS

Access to the NAM model is available through the NBI DSS portal. It is a deterministic, lumped (catchment is looked upon as a single unit with average values of parameters) and conceptual Rainfall-runoff model. It can present the processes that take place in the surface zone storage, root zone storage and the ground water storage.

BASIN WATER SYSTEM SIMULATION MODELS

A basin simulation model typically forms the backbone or core of the decision support system. The model should be capable of accurately simulating the current hydrology and hydraulics of the basin and any or all scenarios for water resource systems development and operation that the stakeholders may wish to investigate.

For modelling purposes the catchment and its sub-catchments will be represented by a network schematic as indicated in the illustration below (the schematic shown here is of Mpologoma catchment). The modelling should allow for easy modifications to the catchment and sub- catchment network representation and analyses of the impacts of potential interventions and developments (e.g. new infrastructure, changes in water allocation and operating rules, revisions to the estimates of the basin hydrology, proposed management and regulatory changes, etc.).



The economic, social and environmental implications of the simulated scenarios are to be computed from database information and from the catchment modelling outputs. The outputs will include a comparison of the hydrologic, economic, social, and environmental criteria (measured with appropriate indicators – see Task 6) of various investment, management and operating scenarios.

Associated tools for output visualization (e.g. using graphical, tabular, schematic, and map-based formats) and statistical analysis, sensitivity analysis, economic and financial analysis (e.g. analysing net present value of streams of benefits and costs associated with each scenario), and scenario comparison and visualization (across environmental, social and economic criteria) will be needed.

BASIN OPTIMIZATION MODELS.

Optimization models are formulated to maximize the net benefits of basin water resources development and management, subject to a variety of constraints (e.g. resource, technology, policy, budget, etc.). The optimization model should employ the same network schematic used in the simulation model to analyse and determine the optimal combination of investment, management and operational actions under various development scenarios. The optimization models would be developed to better understand the system limits and narrow down potential investment choices that could be simulated in detail. The optimization will consider economic, environmental, and social parameters (e.g. as objectives, decision variables or constraints) in scenario analysis to make best use of available information and better aid stakeholder discussions on investment decisions. In this case also, appropriate tools would be developed to visualize, analyse and compare outputs across scenarios.

BASIN MULTI-CRITERIA ANALYSIS TOOLS

A multi-criteria tools is very useful to compare various catchment scenarios (combinations of proposed investments or changed operational practices or management actions – as illustrated in the figure to the left) according to economic, environmental and social consequences defined from the objectives, criteria and indicator framework agreed with stakeholders as a part of the planning framework). The suggested approach (described briefly in Annex I) avoids the necessity of devising weights or other abstract parameterizations to reduce the multiple objectives and criteria typical of river

basin planning to a single metric for each scenario. The approach results in the identification of the typically few objectives that really define the choice between scenarios and allows for the explicit consideration of trade-offs when there are multiple objectives

FUNCTIONAL SPECIFICATIONS OF THE SIMULATION AND OPTIMIZATION MODELS

The Simulation and Optimization Models should have:

- Compatibility with the planning framework developed (Task 2) and ability to answer the questions posed
- Ability to model key processes in the system as indicated in the adjoining table
- Ability to Drag-and-drop objects (sub-basins/watersheds, dam, regional transmission systems, confluence, irrigation systems, hydro-meteorological stations, connections, return flows) to define the water system and interactively add attributes/operating rules, choose scenario options, undertake sensitivity analyses, etc. and visualize and further analyse outputs.
- Ability to select/deselect individual proposed projects in defining scenarios
- Ability to estimate water supply under various scenarios (including climate variability/change) and demands (by location, sector and future scenarios)
- Ability to generate hydrograph and flow time-series at user-defined location
- Ability to estimate/optimize impacts of various operating rules for existing and proposed infrastructure
- Tools to assist with water resources analysis (e.g. time series analysis, synthetic streamflows/data generation)
- Tools to assist with economic analysis of various types of investments (e.g. using streams of costs and multi-purpose benefits to generate net benefits, IRRs)
- Tools to assist with environmental analysis of various types of investments (e.g. inundation of
- forest areas under large storage development scenarios, erosion reduction through different watershed management measures)
- Tools to assist with social analysis of various types of investments (e.g. resettlement, employment generation for different investments based on input data)

Type of Modeling		Description of Outputs
Primary	**Rainfall-runoff modeling**	▪ Estimation of relationships in each watershed (rainfall, runoff, evaporation, losses) ▪ Ability to incorporate climate change rainfall/temperature scenarios
	Water Systems modeling/ Hydrologic routing (the Water "Spine")	▪ Impacts of system storages and abstractions, return flows, losses, inter-basin diversions ▪ Assimilation (for error optimization)
	River-reach/ Hydraulic routing	▪ Generation of levels, inundated areas
	Reservoir operations	▪ Reservoir management
	Agricultural modeling (rainfed, irrigated, flood irrigation, pump schemes)	▪ Crop water requirements, return flows, efficiency, overall water demands, etc.
Supporting (initial versions based on available data)	**Groundwater model**	▪ Application to selected aquifers - expandable
	Economic optimization	▪ Approaches to maximize productivity of water – e.g. reservoir choice and operation and cropping systems to maximize multipurpose benefits
	Sediment modeling	▪ Watershed management scenarios and implications on sedimentation in reservoirs
	Water quality modeling	▪ Approx salinity computation based on flows, sea-level rise, land subsidence in delta

- Tools to estimate impacts of uncertainty of various parameters on selected outputs (e.g. monte-carlo simulation)
- Inclusion of all software required for the knowledge base and modeling/DSS development with licensing (unlimited duration with upgrading potential) required to support use in all three counterpart teams (at least 3 licenses per location = 9 licenses on desktop/laptop) – this allows the Consultant flexibility to develop customized tools or customize off-the-shelf models as appropriate.
- Specific delineation of the spatial and temporal (e.g. daily/monthly) resolution and extent required for various modules
- Further elaboration of the spatial analysis (and use of GIS/remote sensing, including the use of accessible global, regional and national spatial datasets)
- Types of processes to be modelled in this 3-year period (e.g. rainfall-runoff, missing flow estimation, erosion, sediment transport, water quality, groundwater/conjunctive use management, reservoir operations, etc.) for both the simulation and optimization modelling proposed (based on outputs required)
- Development of appropriate user interfaces/workspaces/access at different levels (basic user, advanced user, administrator)
- Appropriate model calibration and validation
- Provision of online help and tutorials; Security arrangements; Logfile for scenario run management
- Ability to store results of different scenarios for comparison

FUNCTIONAL SPECIFICATIONS OF THE MULTI-CRITERIA ANALYTICAL TOOLS

Decisions on investments are seldom made on hydrologic considerations alone, but on a range of objectives, criteria, and indicators and their intersection with the political economy. This set of tools seeks to better inform decisions by choosing a few focused criteria and indicators (Task 2) to compare various scenarios. Hence, the multi-criteria analytical tools developed should have:

- the ability to compare various scenarios from different perspectives (economic, social and environmental) using both quantitative and qualitative indicators (as described in Task 2) by developing *consequence tables* (e.g. indicating consequences to the indicators selected of different scenarios)
- easy-to-use visual, interactive tools for selecting scenarios, criteria, visual comparison (e.g. through color-coding consequence tables and charts/graphs) and saving/retrieval.

Many of these indicators will need to be assessed not only at an overall level, but at administrative and basin/sub-basin levels. Not all these indicators (that are representative of the types of considerations in investment decision making) will be computable using the modelling system. However, they do give an idea about the kinds of outputs that will be expected from the models, knowledge base, and stakeholder interaction. The indicators could be quantitative or normative (e.g. categories from 1-5) in nature depending on data availability and modelling possibilities. All these tools have to be developed in a customized fashion to support each Plan. Local language support (Sinhala, Tamil and English) will need to be provided in the interfaces and outputs of these tools.

Annex E - An initial list of the kinds of data needed for a WMZ Knowledge Base

BIO-PHYSICAL DESCRIPTION OF THE WMZ AND ITS CATCHMENTS

- Topography, DEM
- Existing infrastructure – roads, bridges, water storage, wells and water points, wastewater discharges, treatment plants, surface water diversions and conveyances
- Settlements, villages, towns and cities
- Climate – metrological, hydrologic and water quality records; station location and status,; temperature and evaporation; climate change trends (including global historic climate data sets), future climate datasets
- Land cover, land use, soils
- Forest cover
- Cultivable land, cropped area, irrigated area, typical crops and cropping patterns (commercial, smallholder, subsistence), crop productivity
- Industries, mines and mineral processing
- Water quality classification of streams; main sources of pollution (point and non-points)
- Valley tanks and reservoirs; lakes – size(area, volume); water level records; outlet controls, users
- Livestock and water points; livestock numbers, location
- Fisheries; riverine and floodplain; water bodies including ponds; - production by specie, catch, fisherfolk (numbers, origin)
- Water supply – boreholes, surface water diversion; conveyance and distribution networks
- Flood affected areas
- Geological and hydro-geological maps; groundwater assessments
- Project proposals by relevant Ministries & Departments

MAPPING AND CHARACTERIZATION OF MAJOR ISSUES

- Stream bank degradation
- Significant sources of erosion
- Areas affected by sedimentation
- Water use conflicts; water shortages
- Areas for potential irrigated agriculture
- Areas for fisheries development (capture, aquaculture)
- Areas with potential for enhanced livestock production
- Areas for potential water storage
- Areas needing improved access to safe drinking water supply
- Areas of low water supply reliability
- Areas with degraded water quality
- Areas with high flood risk

SOCIO-ECONOMIC DATA

- Population- numbers; growth rates and trends; spatial distribution
- Inflation and exchange rate trends

- Market prices for agriculture inputs and outputs; costs of materials and construction
- Employment
- District development plans- priorities and expenditures
- Poverty data (numbers, spatial distribution)
- Food availability trends, frequency of shortage

SOURCE OF THESE DATA IN UGANDA

- DWRM
  - Hydrologic records
  - Meteorological records
  - Water quality records
  - GIS lab - layers and shape files
  - National Water Assessment
  - Zonal sub-set of the NWA database
  - Water system simulation (Mikebasin) sub-model (zone, catchments)
  - Hard copies of maps (cadastral, topographic)
  - Satellite imagery
- The Climate Research Unit of East Anglia University
  - Dataset of historical precipitation gridded at 0.50° x 0.50° resolution, on a monthly time step. This grid has been constructed from a total of over 11,800 stations worldwide. This database has the advantage of including long periods of rainfall historical data based on observations (data are available from 1901 to 2012). However on relatively small catchments and where rainfall spatial variability is high, this source of data may not be precise enough.
- Data from Global Precipitation Climatology Centre (GPCC).
  - This Centre, operated by DWD (Germany's National Meteorological Service) under the auspices of the World Meteorological Organization (WMO) avails a full data re-analysis for the period 1901-2010, based on quality controlled data from all stations in GPCC's data base available at the time, with a varying coverage over time. Data set are available at different special resolution, including 0.5°*0.5° . As for the CRU database, GPCC has the advantage of presenting long period of data without gaps.
- Regional-scale Climate Change Projections of Annual, Seasonal and Monthly Near Surface Temperature and Rainfall in Uganda" (University of Pretoria, Baastel, 2014):
  - Two realistic greenhouse gas emission scenarios have been studied under the regional scale Climate Change study: a moderate concentration pathway (RCP 4.5), and a more extreme concentration pathway (RCP 8.5).
  - Four Global circulation Model were considered to generate historical and future climate projection (HadGEM2-ES, EC-EARTH, CNRM-CM5, MPI-ESM-LR, see the Regional scale Climate Change projection study report for more information on these model);and one downscaling method was then applied, to give climate projections at a 0.44°x0.44° grid resolution.
  - Both future rainfall and temperature data have been generated for the whole of Uganda
- Tools and guidelines for climate Change Adaptation" (BRLI, 2013) for NELSAP
  - This includes a future climate modelling study that provides downscaled rainfall data under different climate change scenario at a 0.5°x0.5°grid resolution
- DWD (including WfP)
  - Inventory of towns, and their location and WSS status
  - Planning criteria for small towns (water production rate, losses, UAW)
  - Studies and surveys
  - Project proposals for the catchment (reservoirs and valley tanks, boreholes)
  - Feasibility studies of proposed projects

- NWSC
  - Location and status of urban areas;
  - existing and planned sources of water supply
  - Areas where micro-catchment planning for source protection will be needed
  - Urban water supply planning criteria (water production rate, losses, UAW)
- DEA - Wetland department
  - Surveys and investigations
- Bureau of Statistics
  - Population and demographic data and statistics; 2012 Census
  - Business and industry data and statistics
  - Environment statistics
  - Maps and data archives
  - Economic and financial statistics
- Ministry of Agriculture
  - Agriculture data - cultivated area (rainfed, irrigated) crops, productivity, fertilizer use, soil surveys, research results)
  - Livestock
  - Fisheries
- Ministry of Energy
- National Forest Authority (NFA)
- Ministry of Tourism

Annex F - Typical Investment Options

Indicative Catchment Plan Investment Options Typically Considered in Integrated Catchment action plans		
Option	**Description**	**Indicators**
Valley Tanks	Small water storages used primarily for livestock, groundwater recharge for drinking water and limited irrigation (kitchen gardens)	Volume of water stored (m^3) Estimated livestock served Ha of land irrigated
Dam & reservoir	Generally small dams with limited water storage, but larger than traditional valley tanks able to support a wider range of uses and provide more water in the dry season; possible purposes include water for agriculture, urban and industrial water supply, energy production (micro-hydro, and possibly flood risk reduction.	
Rainwater harvesting (off-farm)	Small dams, ponds and tanks that harvest rainwater runoff used for small scale (decentralized) irrigation, fisheries, and flood management	
Gravity diversion of water (from river or water body) for bulk water supply for multiple purposes (agriculture, drinking, industry, etc.)	Generally low weirs used to divert water bulk water supply) into farmer (group) constructed canals and distribution ditches. These are developed in collaboration with District extension and agriculture development officers who are responsible for agriculture development.	Ha of land Volume of water delivered (m^3)
Pump delivery of water for bulk supply for multiple purposes (agriculture, drinking, industry, etc.)	Pump delivery of bulk irrigation water supplies by as above; includes treadle or similar pumps (shallow groundwater) or small pumps (dug wells, water bodies)	
Water saving irrigation technology	Introduction of low pressure pipe water distribution especially for horticulture or cash crops where water shortages can reduce yields and reduce returns; also introduction of small scale drip (especially for orchard crops) and sprinkler irrigation on a selected basis with private sector participation	
Mini- & micro-hydropower		KWh of energy generated
Solar power for pumps, mills and other village prime mover needs; refrigeration (fisheries)		
New or increased village or settlement drinking water supply (GW)		m^3 per year Number of people provided with access to improved water sources and sanitation serves and hours per day of increased service delivery
New or improved (reliability, volume) bulk water supply for towns or cities		
Protection of village, town and urban water sources		
Flood risk management and preparedness	Flood proofing, measures flood warning and communications, relocation of activities from flood risk zones	Ha of land with reduced flood risk or protected
Drain and waterway improvements	Reconstruction and stabilization of degraded waterways	Ha of land (e.g. forested, area of increased groundwater levels, area sustainably managed or improved)
River bank stabilization	A combination of revetments (stone, gabions) and vegetative planting (trees, shrubs) to stabilize degrading river banks	
Contour bunds	Small raised bunds aligned with the contour to slow or stop surface runoff of rainfall and stop erosion of top soil	
Gulley control	Systems of small structures to stop small stream and gully formation and progressive erosion	
Check dams to manage hill torrents		
Reforestation and aforestation	Tree planting to reestablish forest cover, reduce soil exposure to erosion, reduce runoff rates and increase groundwater recharge	
Wetland restoration	Restoration and improvement of environmental services	

Annex G - Generic Measures Used for Micro- and Sub-catchment Management

Divert / drain runoff & run-on.	Where there is excess water in humid environments, or at the height of the wet seasons in sub- humid conditions, the soil and ground water can become saturated, or the soil's infiltration capacity can be exceeded. Thus safe discharge of surplus water is necessary. This helps avoid leaching of nutrients, soil erosion, or landslides. It can be achieved through the use of graded terraces, cut-off drains and diversion ditches etc.
Impede runoff (slow down runoff).	Uncontrolled runoff causes erosion - and represents a net loss of moisture to plants where rainfall limits. The strategy here is to slow runoff, allowing more time for the water to infiltrate into the soil and reducing the damaging impact of runoff through soil erosion. It is applicable to all climates. This can be accomplished through the use of vegetative strips, earth and stone bunds, terraces etc.
Retain runoff (avoid runoff).	In situations where rainfall limits plant growth, the strategy is to avoid any movement of water on the land in order to encourage rainfall infiltration. Thus water storage is improved within the rooting depth of plants, and groundwater tables are recharged. This is crucial in sub-humid to semi-arid areas. The technologies involved are cross-slope barriers, mulching, vegetative cover, minimum / no tillage etc.
Trap runoff (harvest runoff).	Harvesting runoff water is appropriate where rainfall is insufficient and runoff needs to be concentrated to improve plant performance. Planting pits, half moons etc. can be used. This can also be applied in environments with excess water during wet seasons, followed by water shortage: dams and ponds can further be used for irrigation, flood control or even hydropower generation.
Reduce soil evaporation loss.	Water loss from the soil surface can be reduced through soil cover by mulch and vegetation, windbreaks, shade etc. This is mainly appropriate in drier conditions where evaporation losses can be more than half of the rainfall.
Increased water use efficiency	In conveying and distributing irrigation water as well as applying it in the field. Conveyance and distribution can be improved through well maintained, lined canals and piping systems – and above all avoiding leakages. In the field, reducing evaporation losses can be achieved by using low pressure sprinkler irrigation during the night or early morning, and avoiding irrigation when windy. Additionally, deep seepage of water beyond rooting depth needs to be avoided.
Spread of limited irrigation water over a larger area	Not fully satisfying the crop water requirements i.e. deficit irrigation. It allows achieving considerably higher total crop yields and water use efficiency compared to using water for full irrigation on a smaller area.
Supplementary irrigation	Complement the lack of rain during periods of water deficits, at water-stress sensitivity stages in plant growth. Supplementary irrigation is a key strategy, still underused, for unlocking rainfed yield potential and water productivity / water use efficiency
Water harvesting and improved water storage	Provide for irrigation during times of surplus and using the water for (supplementary) irrigation during times of water stress. Small dams and other storage facilities, which are combined with community level water management, need to be explored as alternatives to large-scale irrigation projects.
Integrated irrigation management	Focus on a broader set of dimensions of irrigated agriculture such as including sustainability. For example, coordinated water management, maximized economic and social welfare, assured equitable access to water and water services, without compromising the sustainability of ecosystems
Improved fallow-systems	The deliberate planting of fast-growing species - usually leguminous - into a fallow for rapid replenishment of soil fertility. These can range from forest to bush, savannas, grass and legume fallows. There are numerous cases showing the importance of nutrient fixing plants planted either in sequence, intercropped or in rotation.
Residue management	A practice that ideally leaves 30 percent or more of the soil surface covered with crop residues after harvest. It requires residue from the previous crop as the main resource (thus burning is discouraged) – it also helps reducing erosion, improving water infiltration and therefore moisture conservation. There are positive impacts also on soil structure and surface water quality.

Application of improved compost and manure	Compost (mainly from plant residues) and manure (from domestic livestock) help to close the nutrient cycle by ensuring that these do not become losses to the system. By building up soil organic material, they help maintain soil structure and health, as well as fertility. Furthermore they are within the reach of the poorest farmers.
Tapping nutrients	This takes place through the roots of trees and other perennial plants when mixed with annual crops (e.g. in agro-forestry systems). Trees act as nutrient pumps: that is they take up nutrients from the deep subsoil below the rooting depth of annual crops and return them to the topsoil in the form of mulch and litter. This enhances the availability of nutrients for annual crops.
Application of inorganic fertilizer	Without a combination of organic matter application and inorganic fertilizer, soil fertility is unlikely to meet production demands: thus the concept of 'Integrated Soil Fertility Management' should be supported. It is possible to substantially increase millet and sorghum yields and profitability by using micro-doses of inorganic fertilizer in combination with techniques that conserve and concentrate soil moisture and organic matter.
Minimum soil disturbance	Manage systems with minimum soil disturbance such as reduced or zero tillage systems leave more biological surface residues, provide environments for enhanced soil biotic activity, and maintain more interconnected pores and better soil aggregates, which are able to withstand raindrop impact (and thus reduce splash erosion). Water can infiltrate more readily and rapidly into the soil with reduced tillage, and this also helps protect the soil from erosion. In addition, organic matter decomposes less rapidly under these systems. Carbon dioxide emissions are thus reduced. No tillage has proven especially useful for maintaining and increasing soil organic matter.

Annex H - Generic Source Protection Measures

Water quality- biological	▪ Ability to close intakes (time of travel information) if pollution or flood event occurs, or is predicted ▪ CLTS Programme to improve sanitation in catchment and reduced open defecation. ▪ Long detention times in reservoirs to allow for natural treatment. ▪ Long detention times in reservoirs to allow for natural treatment. ▪ Regular catchment patrols ▪ Research program to determine types of pathogens present in wild and domesticated animals ▪ Routine plankton monitoring for all reservoirs. ▪ Signage and education ▪ Stock fencing ▪ Stormwater detention measures: overflow detention ponds, swales, improved soil water retention. ▪ Sustainable drainage systems ▪ Water Protection Zone (Exclude public access to land within supply catchment)
Water quality – chemical	▪ Ability to close intakes (time of travel information) if pollution or flood event occurs, or is predicted ▪ Capacity building of farmers on agricultural chemical use and slurry spreading
Water quality - physical	▪ Ability to close intakes (time of travel information) if pollution or flood event occurs, or is predicted ▪ Ensure intake is set at an appropriate depth by changing depth setting (‘floating intake’). ▪ Fire management and protection procedures. Bushfire management policy ▪ Reforestation with native species ▪ Regular catchment patrols ▪ Regular cleaning of area close to intake. ▪ Regular cleaning of screens to reduce clogging and maintain pumping rate ▪ Water Protection Zone (Exclude public access to land within supply catchment)
Water quantity – water flow or level	▪ Eradicate *Eucalyptus* from the sensitive locations in the catchment ▪ Sustainable drainage systems

Annex I - Example of the use of a multi- objective evaluation framework

The table below represents the application of a "Consequence Table" to evaluate alternative scenarios with respect to a set of planning objectives, criteria and measures similar to those shown in Section 2.5.

The DSS is used to determine the value for each measure for each scenario and the resulting value placed in the corresponding cell as shown in the Table. To use the Table, a base case or focus scenario must be chosen. Any scenario may be chosen, and one can easily cycle through the entire set of scenarios one after the other comparing each scenario to all the others. In the Table below Scenario D has been chosen as the Focus Scenario against which all the other scenarios are compared. The underlying model colours the cells for each of the non-focus scenarios according to the scheme shown at the bottom of the Table:

- Red if the value in the cell is significantly worse than the value for the Focus Scenario
- Yellow if the value in the cell is not significantly different than the value for the Focus Scenario, and
- Green if the value in the cell is not significantly different than the value for the Focus Scenario

It is evident from the results shown in the Table that the selected Focus Scenario (D) is superior to all other scenarios in nearly by nearly all measures. The exception is Scenario C.

Scenarios D & C are not significantly different in many respects including agricultural benefits, employment generation, and poverty, public health and food security impact as well as impacts on navigation and biodiversity. They also represent about the same qualities in regard to regional negotiation and political impact (instability). The differences are displayed in the table below:

Results in more of	But less of
▪ Fewer resettled people ▪ Greater protection of cultural sites Lower financial risk ▪ Lower technical risk	▪ Power generation Flood benefits ▪ Water supply benefits ▪ Watershed management ▪ Greenhouse gases credits ▪ Regional interdependence ▪ Regional trade ▪ Growth pole potential

We can now see that the difference between these two scenarios is that one has less risk (C) while the other (D) has larger economic benefits. The trade-off is thus whether to accept more risk for the extra economic benefits. From the Table, these incremental benefits are, something greater than roughly $2+ billion per year. However, note that C involves one dam, and D 4 dams. This suggests, given the long gestation time of these large infrastructure projects, that the incremental benefits from Scenario D may start coming much later than those from C, in which the present worth of these incremental benefits may be smaller than they appear to be and for some stakeholders, particularly those who are risk averse, this might tip the balance in favour of C.

It is fortunate that in this example the differences between the two most favourable Scenarios involved a relatively simple (though not easy) comparison based on similar sets of objectives. It may not always be the case that the arguments can be expressed in such clear and simple terms. Nevertheless, with such a tool, it is much better and much more transparent to carry out the evaluation with all objectives in view rather than to look at indices constructed by weights where the metric becomes quite abstract.

Focus Scenario--> D (B+4 Dams)

Illustrative Template for **Consequence Table** to Evaluate Scenarios

Type	Criteria	Indicator	Preference (H=Higher is better; L=Lower is Better)	Units	Alternative Scenarios				
					A (Base Case)	B (Low Level Dev)	C (B+1Dam)	D (B+4 Dams)	E (B+Basin2)
Economic	Agriculture	Agricultural benefits	H	billion $/year	4.93	5.50	9.00	11.00	7.00
	Power	Power benefits	H	billion $/year	0.50	0.70	0.98	1.36	0.72
	Flood Protection	Expected flood damages	L	billion $/year	0.30	0.28	0.18	0.05	0.26
	Employment	Total new F/T jobs	H	million # jobs	-	0.30	0.50	0.65	0.31
Social	Low Income Effect	Change in no. people above $1/day	H	million # people	-	0.60	1.00	1.30	0.50
	Public Health	Incidence of water related disease	L	billion DALYs	10.00	10.00	9.00	8.00	10.00
	Resettlement	People relocated	L	thousands# people	-	25.00	26.00	125.00	150.00
	Drinking Water	New people with adequate access to safe water	H	additional million # people	-	2.00	3.00	4.00	2.20
	Food Security	Percent of pop with cereal needs met	H	%	0.75	0.77	0.82	0.90	0.78
	Navigation	Navigable river reaches	H	km-months	25,000	25,000	40,000	50,000	30,000
Environmental	Aquatic/wetland biodiv	Area of aquatic habitat	H	thousand sq km	10.00	9.90	9.90	9.90	4.00
	Watershed management	Area of well managed watershed	H	thousand hectares	20.00	50.00	350.00	500.00	60.00
	Water Quality	Water quality index	H	unitless	0.80	0.75	0.85	0.90	0.75
	Saline water intrusion	Flow to Med Sea	H	bcm	13.00	10.00	13.00	14.00	11.00
	Greenhouse gases	GHG emission offset	H	million tonnes/year	-	0.70	7.50	22.00	2.00
	Cultural sites	Sites impacted	L	# sites	-	-	-	2.00	1.00
Regional/ Implementation	Regional Interdependence	Degree of joint ownership and management	H	scale	1.00	1.00	3.00	4.00	1.00
	Regional Trade	Value of bilateral trade	H	billion $/year	1.00	1.00	1.50	3.00	1.00
	Growth Pole Potential	Number of equivalent centres	H	# equiv centres	-	-	1.00	4.00	0.50
	Negotation Space	Total system losses	L	bcm	40.00	43.00	38.00	36.00	42.00
	Financing Risk	Financing Risk Scale	L	scale	1.00	1.00	3.00	4.00	4.00
	Technical Risk	Technical Complexity Scale	L	scale	1.00	1.00	2.00	3.00	3.00
	Political Instability	Conflict Potential/Instability Scale	L	scale	1.00	1.00	1.00	1.00	3.00

Focus Alternative
Significantly Worse Than Focus Alternative
Not Significantly Different to Focus Alternative
Significantly Better Than Focus Alternative

Annex J - Example of Logical Framework and Project management framework for Monitoring and Evaluation

Example of a logical framework taken from the Baro-Akobo-Sobat Integrated Water Resources development and Management Plan (BRLi, 2017)

Achievement of the vision for the basin "A sustainably managed and developed BAS river sub-basin with prosperous, connected, peacefully and mutually co-existing societies."

Strategic objective 1: to contribute to food security, livelihood enhancement, poverty reduction and the protection and conservation of biological resources through stakeholder-driven management of wetlands, watersheds and other important natural resources

Medium-term outcome	Indicators	Assumptions and risks
Poverty is reduced at the local level, with wider impacts following taking to scale	- Average daily income of subsistence/small-holder farmers **(USD/day)** - Undernourished people **(% of children and adults)** - Attendance of children at school **(% with gender disaggregation)**	- Availability of resources (human and financial) - Political stability - Support from government structures and transboundary cooperation
Biological resources (biodiversity and eco services) are protected and conserved at the local level;	- Number of livelihood-based watershed management projects & wetlands protection projects implemented within the sub-basin **(Number of projects)** - Increase in forest surface area in the basin **(ha/annum)** - Increase in wetlands surface area in the basin **(ha/annum)** - Compliance of development projects with Environmental and Social safeguards **(% of projects compliant)**	- Availability of resources (human and financial) - Political stability - Support from government structures and transboundary cooperation
Project planning, implementation, operation and management is led by stakeholders / beneficiaries	- Level of stakeholders and beneficiaries' involvement into projects planning, implementation, operation and management **(qualitative assessment using standardised questionnaire)** - Number (and %) of projects successfully implemented **(number of projects)** - Extent of gender mainstreaming into project planning **(Number of initiatives led by women)**	- Availability of resources (human and financial) - Political stability - Support from government structures and transboundary cooperation

Strategic objective 2: Taking into account the comparative advantages of the different parts of the sub-basin to sustainably develop water resources for hydropower, irrigation, water supply and sanitation and other sectors with the dual aims of reducing poverty within the sub-basin and generating revenue;

Medium-term outcome	Indicators	Assumptions and risks
Large-scale hydropower developed and affordable electricity supplied within the basin and at the national levels	- Hydropower production within the basin and at national level **(GWHrs/annum)** - Population with access to electricity **(% in rural and urban areas, disaggregated by administrative area)**	- Availability of resources (human and financial) - Political stability - Support from government structures and transboundary cooperation
Large-scale irrigation developed and contributing to both food self-sufficiency within the basin and revenue generation	- Large scale irrigation schemes under cultivation in the basin **(ha of land irrigated)** - Share of the production for local consumption and revenue generation **(% for local consumption and % for revenue generation)** - Number of local people employed in large scale irrigation schemes **(Number of people, disaggregated by administrative area)**	- Availability of resources (human and financial) - Political stability - Support from government structures and transboundary cooperation

Example of a Project Management Framework (MPMF) taken from the Baro-Akobo-Sobat Integrated Water Resources Development and Management Plan (BRLi, 2017)

Achievement of the vision for the basin "A sustainably managed and developed BAS river sub-basin with prosperous, connected, peacefully and mutually co-existing societies."

Strategic objective 1: to contribute to food security, livelihood enhancement, poverty reduction and the protection and conservation of biological resources through stakeholder-driven management of wetlands, watersheds and other important natural resources

Medium-term outcome	Indicators	Data source	Data collection methodology	Frequency of data collection	Respon-sibility	Baseline information	Target (25 years - year 2042)	Uses of information
Poverty is reduced at the local level, with wider impacts following taking to scale	Average daily income of small-holder farmers (USD/day) Undernourished people (% of children and adults) Attendance of children to school (% with gender disaggregation)	- Central Statistic Agency of Ethiopia - South Sudan National Bureau of Statistics -Administrative units: Zones, Woredas, Kebeles (Ethiopia); Counties, Bomas, Payams (South Sudan) - Implementing Agencies* * *"Implementing Agencies" refers to the organisations implementing development projects in the sub-basin.*	- Document review - Data collection - Consultation of the implementing agencies - National census	Annually less frequently for national census (5-10 years)	ENTRO	To be established during the implementation of the ST and MT/LT projects for the smallest unit of analysis available for each project.	100% greater improvement than average of no-project areas or average for the Zone/County	- Assess the relevance of the projects - Reframe the projects if necessary: adaptive management to keep the projects on track to reach the desired outcomes
Biological resources (biodiversity and eco services) are protected and conserved at the local level	Number of livelihood based watershed management projects & wetlands protection projects implemented within the sub-basin (Number of projects)	- Ministry of Water, Irrigation and Electricity (Ethiopia) - Ministry of Electricity, Dams, Irrigation and Water Resources (South Sudan) - Ethiopian Environmental Protection Authority - Ministry of Environment (South Sudan) - ENTRO	- Document review - Data collection - Consultation of the Ministries	Annually	ENTRO	No baseline information	No target	Assess the adequacy between the needs in the sub-basin and the projects implemented
	Increase in the forest surface area in the project area (ha/annum)	-Administrative units: Zones, Woreda, Kebeles (Ethiopia); counties, Bomas, Payams (South Sudan) - Implementing Agencies	- Document review - Data collection - Consultation of the implementing agencies	Annually	ENTRO	Ha of forest in the project area: to be established during the implementation of the ST, MT/LT projects for the smallest unit of analysis available for each project.	> 0%	Reframe the projects if necessary: adaptive management to make sure that there are no further losses of forests in the selected areas