Directorate of Water Resources Management
Ministry of Water and Environment
Uganda

National Water Resources Strategy

October 2014

Table of Contents

Indhold

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AU	African Union
CBO	Community Based Organization
CMO	Catchment Management Organization
DEA	Directorate of Environment Affairs
DEO	District Environmental Officer
DOM	Department of Meteorology
DP	Development Partners
DWD	Directorate of Water Development
DWO	District Water Officer
DWRM	Directorate of Water Resources Management
DWSCC	District Water and Sanitation Coordination Committee
DWSCG	District Water Supply and Sanitation Conditional Grants
EAC	East African Community
EHD	Environmental Health Division
EIA	Environmental Impact Assessment
ENR	Environment and Natural Resources
FAO	Food and Agriculture Organization of the United Nations
GCM	Global Circulation Model
GDP	Gross Domestic Product
GNI	Gross National Income
GoU	Government of Uganda
GWP	Global Water Partnership
IGAD	Intergovernmental Authority on Development
INWRMP	Inland Water Resources Management Program
IRWR	internally Renewable Water Resources
IWRM	Integrated Water Resources Management
JAF	Joint Assessment Framework
JSR	Joint Sector Review
JWESSP	Joint Water and Environment Sector Support Programme
KCCA	Kampala Capital City Authority
LHP	Large Hydropower Project
LVBC	Lake Victoria Basin Commission
LVFO	Lake Victoria Fisheries Organization
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MCA	Multi Criteria Analysis
MEMD	Ministry of Energy and Mineral Development
MFPED	Ministry of Finance, Planning, and Economic Development
MGLSD	Ministry of Gender, Labour and Social Development
MoH	Ministry of Health
MoES	Ministry of Education and Sports
MoFA	Ministry of Foreign Affairs

MoLG	Ministry of Local Government
MoWT	Ministry of Works and Transport
MTTI	Ministry of Trade, Tourism and Industries
MTWA	Ministry of Tourism, Wildlife, and Antiquities
MWE	Ministry of Water and Environment
NWRA	National Water Resources Assessment
NAADS	National Agricultural Advisory Services
NBI	Nile Basin Initiative
NDP	National Development Plan
NEMA	National Environmental Management Authority
NFA	National Forest Authority
NFRRI	National Fisheries Resources Research Institute
NGO	Non Governmental Organization
NPA	National Planning Authority
NWSC	National Water and Sewerage Cooperation
PES	Payment for Ecosystem Functions
PEAP	Poverty Eradication Action Plan
PEPD	Petroleum Exploration and Production Department
PIN	Penalty Infringement Notice
PPP	Purchasing Power Parity
PWO	Private Water Operators
SCMO	Sub-catchment Management Organization
SEZ	Special Economic Zone
SHP	Small Hydropower Project
SIP	Sector Investment Plan
SWAP	Sector Wide Approach
TSU	Technical Support Units
UBOS	Uganda Bureau of Statistics
UIA	Uganda Investment Authority
UIRI	Uganda Industrial Research Institute
UNDP	United Nations Development Programme
UNRA	Uganda National Roads Authority
UO	Umbrella Organizations
UWA	Uganda Wildlife Authority
UWASET	Uganda Water and Sanitation Network
WB	World Bank
WESWG	Water and Environment Sector Working Group
WfP	Water for Production
WMO	
WPC	Water Policy Committee
WSDF	Water and Sanitation Development Facility
WSS	Water Supply and Sanitation
WTTC	World Travel and Tourism Council
WMZ	Water Management Zone
WRM	Water Resources Management
WUC	Water User Committee

Executive Summary

Introduction

Fresh water is a finite and vulnerable resource that is essential to sustain life, development, and the environment. The current water resources situation in Uganda is characterized by overall water supply exceeding demand. Nevertheless, significant differences in water availability exist across the country,and considerable parts of Uganda – including in the cattle corridor – experience occasional water shortages. Further, localized water deficits occur in a number of places (hotspots), but no large scale conflicts between water using sectors have been reported. The chemical quality of the freshwater system is generally good but bacterial contamination of both surface and groundwater is widespread while the water quality risks of future development are large and need to be addressed.

Uganda's water resources have been recognized as a key driver for socio-economic transformation. Sectors with development opportunities related to water resources include: agriculture (irrigation/supplementary irrigation), livestock, fisheries, aquaculture, hydropower, industry, water transportation/navigation, mining and oil production, and tourism. It is anticipated that water demand in the productive sectors will increase significantly.

Further, large volumes of water are needed to sustain the extensive wetland areas and the associated aquatic ecosystems, while the supply of clean and safe water in adequate amounts to a growing population is among the highest priority goals in the country.

Climate change, watershed degradation, urbanization, extreme events (floods, low flows, droughts) , pollution and water quality risks, the water-energy-food nexus, and international competition for water are putting additional pressure on Uganda's water resources.

Within this context, the Directorate of Water Resources Management (DWRM) has developed a national water resources strategy. It aims to maximize the beneficial use of the water resources and support the productive sectors to achieve their respective objectives, while ensuring environmental integrity and taking into account the transboundary context.

Approach to Development of the Strategy

The principal steps involved in the strategy formulation process are outlined in the table below.

CONTEXT	
1	Description of the role of water in national development: a concise and mostly qualitative assessment of the linkages between economic development and access to adequate quantities of water of good quality; a separation has been made between: 1) water for people, 2) water for productive purposes, and 3) water for ecosystem goods and services.

2	Identification and listing of the relevant national development objectives and sector strategies, and an assessment in outline of their main implications on the nation's water resources and its management.
CURRENT WATER RESOURCES ISSUES AND CHALLENGES	
3	Preparation of baseline information on the status of Uganda's water resources, and of an analysis of the current water resources issues and challenges and their implications for managing the country's water resources. Most of this activity had been implemented in the National Water Resources Assessment (NWRA 2012).
4	Description of the existing water governance framework (policy, legal, and institutional elements), and an assessment of the adequacy of this framework to address the existing water resources challenges.
ANTICIPATED WATER RESOURCES ISSUES AND CHALLENGES	
5	Identification and screening of the development options in the respective water-related productive sectors.
6	Preparation of four water resources development scenarios based on the national development objectives and sector strategies (step 2) and the development options (step 5). The scenarios ranged from moderate to intensive development in the 2040 time horizon.
7	Use of a water resources accounting model (MIKE BASIN) and a Multi-Criteria-Analysis (MCA) to analyze the implications (e.g. environmental, economic, hydrologic, etc) of the respective development scenarios. When combined with Step 3 & 4, this analysis resulted in a comprehensive assessment of the current and anticipated water resources issues and challenges in Uganda that had to be addressed in the strategy.
STRATEGY DEVELOPMENT	
8	Through a consultative process with key stakeholders, a Vision for the nation's water resources for 2040 was developed, while the associated set of concrete objectives was defined.
9	Key strategic outputs and actions were developed that aimed to reach the vision and objectives defined in Step 8, while addressing the existing and anticipated water resources issues and challenges identified in Step 7.
10	Preparation of a prioritization framework for implementing the actions and reaching the strategic outputs.

The strategy development process was anchored in four workshops in order to ensure adequate stakeholder consultation:

Workshop 1: Setting the Scene (organized 8-9 February 2012) – this event aimed at internalizing the outcome of the National Water Resources Assessment (NWRA) and revisited the policy objectives and sector analysis presented in the National Development Plan (NDP) 2010/11-2014/15.

Workshop 2: Vision and Objectives (organized on 15-16 January 2013) – the workshop developed a Vision for the nation's water resources for 2040 and defined the associated set of concrete objectives.

Workshop 3: Road Map towards Vision and Objectives (organized on 27 March 2013) – this event identified relevant strategic outputs and actions, and developed a low resolution roadmap to reach the Vision for Uganda's water resources defined in workshop 2.

Workshop 4: Consolidating the Strategy (organized on 11-12 December 2013) - the workshop reviewed the draft strategy through facilitated stakeholder discussions.

Over 45 sector stakeholders and experts participated in the events, representing institutions that included KCCA, Local Government, MAAIF, Ministry of Finance, MEMD, MTWA, NFA, PEPD, various departments of MWE, as well as the Water Management Zones. Also present were representatives from GWP, World Bank, and international consultancy firms.

In addition to the above, a wide range of organizations and individuals have been consulted in the strategy development process.

Vision and Principle Objectives

In workshop 2 (see above) a Vision for managing and developing the nation's water resources up to 2040 was developed together with an associated set of principal objectives.

The Vision for water resources management in Uganda for 2040 is:

"Water resources management in Uganda is effective in contributing to economic and social development and maintaining environmental services."

The vision is broken down in the following 3 principal objectives:

1. Ensure sustainable and equitable allocation and provision of waterof appropriate quantity and quality.

2. Mitigate the effects of extreme climatic events.

3. Strengthening the water governance framework.

Key Water Resources Issues, Strategic Outputs and Actions

An overview of the key existing and anticipated water resources issues in Uganda, and the strategic outputs and actions designed to address these issues, is presented in the table below.

Principle Objective 1: Ensure sustainable and equitable allocation and provision of water of appropriate quantity and quality

WATER RESOURCES AVAILABILITY FOR USE

Overview and Key Issues	Strategic Output	Strategic Actions
With substantial rainfall and surface and groundwater resources, overall water resources in Uganda presently exceed demand; nevertheless, the country is experiencing recurrent drought events and local water shortages.	Beneficial use of the available water resources in key sectors enhanced	Improve domestic water supply from a combination of surface and groundwater sources, and rainwater harvesting (also see Management of Water Quality)
Future requirements for domestic water supply will grow substantially; domestic water use in 2040 is estimated at 485 mcm/yr and 532 mcm/yr for rural and urban areas respectively, which compares to the Internally Renewable Water Resources (IRWR) of 15.6 bcm/yr, and can thus be met		Prepare and implement catchment management plans, starting with priority catchments
The sustainable groundwater potential is estimated at 5.7 bcm/year; current groundwater use is low and mostly for domestic water supply; groundwater demand projections for 2030 (for domestic and livestock water supply only) estimate use of about 15% of the sustainable groundwater potential; hence there is significant potential for development of groundwater resources for productive purposes.		Develop high-value water projectsin accordance with IWRM principles; this includes the hydropower facilities on the Nile and oil development, which do not conflict with other water uses
Water demand for oil production can be met at all times and does not affect Nile flows; environmental and water quality risks associated with oil production are high.		Develop irrigation potential in phases subject to better information on affected wetlands and in accordance with IWRM principles(also see Management of Water Quality)
Full development of wetland and upland irrigation potential results in a decline in the Nile flow to South Sudan of 65 m3/s corresponding to around 5.4% of the original flow, and an average decrease in hydropower production of about 3%;However, irrigation development may substantially alter local hydrologic conditions and have large adverse impacts on local wetlands, local ecosystem functions, fisheries, and tourism. Short and mid-term industrial water demand is low and can generally be met through a combination of ground and surface water sources; the same applies to water demand for the mining sector.		Continue engagement with Nile partners on equitable use of the Nile waters and their benefits
There are inadequate watering facilities along the livestock migration routes; storage volume of some facilities is low; conflicts over water points occur at the peak of the		

dry season; nevertheless, livestock water demand can generally be met through a combination of ground and surface water sources.

There are very significant regional differences in rainfall and specific runoff; it implies that Uganda's water resources need to planned and managed in a spatial context.

All surface water is transboundary in nature; the dependency ratio – i.e. that part of the renewable water resources originating outside the country – is about 69%. Hence water resources management in Uganda has to be coordinated with the upstream and downstream riparians.

MANAGEMENT OF WATER QUALITY

Overview and Key Issues	Strategic Output	Strategic Actions
Poor sanitation has led to widespread bacterial contamination of surface water and drinking water sources, resulting in health risks and increased costs for water treatment.	Wholesome drinking water sources safeguarded and the quality of surface and groundwater bodies kept within limits defined by water quality objectives	Establish proper sanitation facilities and protected drinking water sources for rural and urban populations
Excessive amounts of nutrients from non-point sources are reaching the water bodies (eutrophication); soil erosion, however, is mostly a localized problem; the application of soil and water conservation measures in the country is very limited.		Reduce the amounts of point and non-point pollutants reaching the surface and groundwater water bodies
Aquaculture will become increasingly important; increasing pollution is associated with the rapid expansion of aquaculture, in particular cage culture at semi-industrial scale; the consumptive water use of aquaculture is small and can generally be met.		Reduce the risk of environmental damage and water quality deterioration from oil exploitation
The water quality implications of industrial pollution, urbanization, and oil exploration are still limited and local, but potentially large;the same applies for agricultural modernization.		Promote conservation and wise use of wetland resources
Wetlands play a crucial role throughout the country in capturing sediment and maintaining water quality.		Protect environmental flows in rivers
Difficulty in maintaining the minimum requirements of ecosystems to water flows and water quality (environmental flows) is an issue.		Develop water quality objectives
Inadequate water quality management is an issue requiring development of water quality objectives and emission standards as well as intensified water quality monitoring.		Further develop water quality monitoring and assessment capacity
		Enforce and monitor compliance with water quality standards and source protection guidelines

INTEGRATED LAND AND WATER MANAGEMENT		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
Poor land management practices – mainly in agriculture – has led to widespread soil and land degradation, which causes depletion of water resources and is a primary cause of non-point pollution. In spite of the substantial irrigation potential, rainfed agriculture will remain the primary form of agriculture in the country;poor agricultural practices have a major adverse impact on the state of the water resources; farmers are reluctant to adopt improved farming practices unless they see direct evidence of higher yields and associated higher household income. Deforestation and degradation of forests and wetlands results in lower level of ecosystem services as well as shifts in the hydrologic regime because of lower water retention in the catchment, and subsequent higher flood and drought risks. Wetlands cover over 10% of Uganda's land area and perform valuable ecosystem functions and other roles; high population growth combined with agricultural land scarcity is driving wetland encroachment. Mismanagement of suspended sediment. Water for environment is a key productive use (primarily eco-tourism), and may become one of the most economically important water uses. Landslides regularly occur in mountainous areas in Eastern and Western Uganda due to steep slopes, soil type, land use, and high precipitation. Mandated institutions have not effectively enforced compliance with water legislation and regulations due to capacity constraints.	Catchments effectively managed Ecosystem delivery of goods and services that protect water resources sustained or enhanced	Integrate land management into catchment management plans Promote appropriate agricultural practices Develop and apply incentives to improve adoption of sustainable land management practices Promote better understanding of the intrinsic relationship between water and land management, and the inter-linkages of the agriculture and water sectors Prepare land degradation and vulnerability maps, starting with selected hotspots Implement targeted interventions in priority areas (hotspots) Promote sustainable forest management , and conservation and wise use of wetland resources (see management of water quality) Protect riverbanks and lakeshores Promote incentives for sustaining ecosystem goods and services Strengthen enforcement and compliance functions in relation to water resources protection

WATER DEMAND MANAGEMENT		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
Presently no large scale conflicts between water using sectors have been reported although occasional water shortages are experienced at local level. Consumptive water use is set to increase significantly because of ongoing population growth, and socio-economic development including industrialization, irrigation development, and oil production; nevertheless, no water shortages are anticipated at national level; by contrast, competition for raw water is expected at local scales. It indicates that Uganda needs to encourage more efficient use of its water resources (which concerns a no-regret measure) and justifies the development of a demand management strategy. Establishing a water conservation culture and allocating water resources to high-value activities is a lengthy process that can be fraught with political difficulties when established water rights are challenged or historic and socio-cultural use patterns are subjected to change.	End-use efficiencies increased Water resources allocated to higher value economic activities	Raise awareness about the importance of water conservation Ensure compliance to abstraction permits through monitoring Develop water pricing policies that encourage efficient water use Set water use efficiency standards Encourage adoption of water efficient technologies Develop a set of standard tools for estimating the economic value of water for various development options for use at national, catchment or local level

WATER RESOURCES INFORMATION, PLANNING, AND CAPACITY

Overview and Key Issues	Strategic Output	Strategic Actions
There is insufficient knowledge of surface and ground water resources, in particular at local level**;** hence informed water resources managementat local level - where most shortages are expected - is currently not possible. A number of analysis tools exists, but not at lower level and not integrated; models at catchment level are mostly absent. Coordinated operation of the cascade of (future) hydropower facilities along the Nile in Uganda to optimize hydropower production and meet other system objectives will require a dedicated decisions support system, which is currently absent. Data acquisition has declined since its peak in the 1970s; budgetary constraints combined with high incidences of vandalism have conspired to reduce the network coverage; the current groundwater monitoring network is grossly inadequate. The directorate has only few trained staff that can maintain the databases and models, and can perform model runs and water resources analysis	Water Information System (WIS) established and operational at WMZ and national level General water resources knowledge base expanded and integrated into the Water Information System (institutional and human capacity aspects are discussed in 6.3.3)	Rationalize and modernize the hydrometric monitoring network for surface and groundwater, and water quality Prepare a harmonized and integrated water resources data management system Develop modeling and analysis tools, integrated into the WIS Prepare information dissemination mechanisms including visualization and web-publishing tools Establish cooperation with partners for the acquisition and/or development of various spatial and non-spatial data sets Initiate development of important information sets

Principal objective 2: Mitigate the effects of extreme climate events

REDUCE VULNERABILITY TO WARMER CLIMATE CONDITIONS

Overview and Key Issues	Strategic Output	Strategic Actions
There is overwhelming evidence of a warming trend of the Earth's atmosphere and a gradual increase of temperature in Uganda is anticipated in the coming decades; uncertainties remain over the magnitude and speed of future temperature increase; changes in precipitation are still unknown; climate variability is expected to increase. Uganda is highly vulnerable to the impacts of a warming climate owing to a multiplicity of factors, such as the generally high evaporation rates that accentuates periodic agricultural droughts, combined with the large rural population that depends for its livelihood on rainfed agriculture or (semi) pastoralism. Climate change risks are not yet fully mapped. While rainfall in large parts of the country is sufficient to grow a crop, once every five years all crops experience a moisture deficit; for most crops, however, the deficit is less than 100 mm (in a 20% drought year); global warming will lead to higher evapotranspiration rates while climate variability is increasing; hence drought risk for rainfed agriculture will increase Rising temperatures will increase water losses from reservoirs and wetlands. Because of generally low specific runoff in large parts of the country, increasing the amount of rainfall that is captured for productive use may change local hydrologic conditions but will not substantially reduce the Internal Renewable Water Resources (IRWR) or associated Nile flows.	Reduced vulnerability to warmer climate conditions	Prepare climate change vulnerability and risk maps at national and catchment level Develop effective drought preparedness plans at national and catchment level Strengthen cooperation mechanisms with MAAIF and other partners on integrated land and water management (see 6.1.3) Expand water storage capacity Improve seasonal climate outlook

REDUCE VULNERABILITY TO MORE SEVERE RAINSTORMS

Overview and Key Issues	Strategic Output	Strategic Actions
Rising temperatures are predicted to increase the intensity of extreme weather events; a higher frequency of more severe rainstorms will result in more flash floods and larger flooding events, more soil and stream-bank erosion, and increase the risk of contamination of storm and flood-waters with human waste. Urban flooding risks are mounting because of 1) rapidly expanding build-up areas, 2) development in low-lying areas or drained marshlands because of land scarcity in urban areas, and 3) rudimentary urban drainage systems that are designed to evacuate water quickly rather than temporarily storing it The risk of dam failure increases with more intense rainstorms and consequent higher runoff volumes and (flash) floods. The indirect damage from flood events can be significant and include the outbreak of water-borne diseases such as cholera., (effective flood protection of the floodplain is discussed in paragraph 6.2.4)	Reduced vulnerability to more severe rainstorms	Improve catchment management practices Strengthen urban planning and management of storm-water runoff Promote measures to improve dam safety, taking into consideration more intense rainstorms Improve and elevate sanitation facilities in the floodplain and flood prone areas Review flood frequency curves and adjust these to more intense rainstorms and flood events

REDUCE VULNERABILITY TO INCREASED HYDROLOGIC VARIABILITY		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
Rising global temperatures are predicted to increase the intensity of extreme weather events, which is expected to amplify the variability of the hydrologic regime of the rivers, streams, and lakes in Uganda. Of particular interest to Uganda is the increased hydrologic variability of Lake Victoria, which could have a large impact on Uganda's economy because of the direct correlation with Nile flows and associated hydropower production. Climate change may equally increase the hydrologic variability of the other (smaller) river and lake systems in Uganda; their vulnerability and possible adaptation and mitigation measures need to be considered on a case-by-case basis and need to be included in the catchment management plans.	Preparedness for higher variability of lake levels achieved	Establish capacity to monitor long-term climate trends Establish capacity for climate change impact assessment, with special attention to Lake Victoria Inform and support policy dialogue on the implications of climatic change on Lake Victoria

EFFECTIVE FLOOD MANAGEMENT IN THE FLOODPLAINS

Overview and Key Issues	Strategic Output	Strategic Actions
The areas in Uganda most affected by floods are the low-lying areas at the foothills of Mount Elgon and the Rwenzori's that are part of the original floodplain;floodplains in Uganda are generally attractive sites for agricultural activities and various types of developmentinundation of the floodplain is a natural event that occurs periodically and cannot be prevented. Flooding typically does not extend far beyond the original floodplain; large wetlands play an important detention role in mitigating flood impacts; water levels in the floodplains tend to rise slowly, allowing people and livestock to evacuate safely to higher dry grounds. Floodplain encroachment is contributing to the severity of recent flood events; floods causes infrastructure and livelihood damages, and cause the spread of water-borne diseases. Land use of the floodplains needs to be well regulated in order to allow productive use while accommodating periodic inundation. Flash floods occur in a number of regions (including Karamoja).	Effective flood management achieved	Prepare flood mitigation and prevention plans in the context of the entire river basin Develop floodplain zoning and reach community buy-in Protect the upland catchments Protect and manage wetlands Review and strengthen hydro-meteorological monitoring capacity Establish flood forecasting and early-warning systems Develop flood-related disaster management plans

Principle Objective 3: Strengthening the water governance framework

ENHANCE POLICY, LEGAL & INSTITUTIONAL FRAMEWORK FOR WATER RESOURCESAVAILABILITY FOR USE		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
The Water policy gives the first priority to domestic demands & allocation of water uses. The membership of the WPC does not include all the key sectors relevant to water resources management. Institutional reforms have been made to shift the responsibility of water resources management from the DWD to DWRM thus separating water regulatory functions from water development functions. However, there is no autonomous body to regulate the use and development of water resources. The WMZ & sub-catchment structures have been established to promote water management at the lowest applicable level. The Water Policy and Act do not adequately provide for the adequate financing and the attainment of economic benefits from the water resource management. The Water Act does not provide for transboundary watercourses. There is limited coordination of projects, plans, programmes of all water resources projects. There is no effective system for information sharing. There are no comprehensive training opportunities for water law and policy.	Effective regulation of water use.	Strengthen measures for regulating water use allocations to all sectors (including priority high value projects). Strengthen the membership of WPC to include all other relevant sectors such as wildlife, forests, land, wetlands & tourism. Establish an autonomous water resources management authority that separates the water resource management function from the service delivery function. Strengthen measures for regulating water use and management at catchment or lower levels. Improved institutional support to WMZ to ensure their requisite capacity to fulfil the responsibilities at zone levels. Strengthen measures for improving water use efficiency (water harvesting and storage, utilization technologies, etc). Harmonize legal mandates (Land Act, Wildlife Act, Forestry and Tree Planting Act, Pubic health Act, etc). Harmonize institutional mandates and

	operational mandates (WPC, DWD & DWRM, MAAIF, DEA, NEMA Vs DWRM, NWSC etc.) Harmonize water legislation with international law principles. Strengthen measures for attracting funding to the water sector (e.g. establish and operationalize innovation financing mechanisms such as PES, Polluter Pays Principle, revising water tariffs). Strengthen systems of projects, plans & programmes coordination, monitoring & evaluation. Strengthen the systems of information sharing. Strengthen outreach programmes for water resources management.

ENHANCE POLICY, LEGAL FRAMEWORK FOR MANAGEMENT OF WATER QUALITY		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
The Water Act & regulations require polluters to take actions to prevent contamination of surface and groundwater. However, there is limited & uncoordinated enforcement of the laws. Both the Water Act and National Environment Act contain provisions relating to pollution control,which need to be harmonised. The Water Act & regulations do not provide adequate regulation for non-pointsources of pollution, pollution from municipal waste, andwaste discharge to groundwater. There is still a problem of ensuring compliance with waste discharge permits especially in cases of big polluters and powerful enterprises. This is caused by lack of water quality monitoring equipment, very limited access to laboratory facilities, and shortage of qualified staff in water discharge control at district level and lack of agreed standards on water quality standards countrywide. Data and information on surface and groundwater quality is limited. There is an uncoordinated or fragmented approach of waste disposal management into the water bodies. Water quality control and does not adequately address the question of sustainable environmental protection in water resource management.	As above.	As above.

ENHANCE POLICY, LEGAL & INSTITUTIONAL FRAMEWORK FOR INTEGRATED LAND AND WATER MANAGEMENT		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
The management of water resources is inextricably linkedwith the management of land. However, there is limited integration of land and water management. The Water Act &the Water (Resources) Regulations requirethat the holder of a permit shall not cause or allow any water to be polluted; prevent damage to the source from which water is taken or to which water is discharged after use; take precautions to ensure that no activities on the land where water is used result in the accumulation of any substance which may render water less fit for the purpose for which it may be reasonably used. The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations of 2000 (No. 3 of 2000) restricts aquaculturein wetlands. The existing legal provisions do not clearly define water rights of local governments & privately owned facilities within water authority controlled services. There are no provisions for requiring land owners to save water.	As above.	As above.

ENHANCE POLICY, LEGAL & INSTITUTIONAL FRAMEWORK FOR WATER DEMAND MANAGEMENT		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
The management of water resources is inextricably linkedwith the management of land and vegetation since the latterdetermines to a large extent the quality and quantity of theavailable water resources.	As above.	As above.

ENHANCE POLICY, LEGAL & INSTIUTIONAL FRAMEWORK FOR WATER RESOURCES INFORMATION, PLANNING, AND CAPACITY		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
The Water Policy obliges the Government to collect and disseminate data for public knowledge, awareness, and socio-economic development. It imposes a duty on the Directorate of Water Development to collect, monitor and disseminate data on groundwater and water quality. The Water Act instructs the Minister responsible for water to require the Water Policy Committee to coordinate the preparation, revision, and keeping up-to-date of a comprehensive action plan for the investigation, use, control, protection, management and administration of water for the nation. Data required for water resources situation description is scattered in different departments, is of poor quality, has many gaps& difficult to obtain. Water resources data are kept by relevant line ministries, with no mechanisms for pooling or coordination. Yet, such information is critical in order to make plans and informed decisions, including technological choices.	As above.	As above.

STRENGTHEN POLICY, LEGAL & INSTITUTIONAL FRAMEWORK FOR FLOOD MANAGEMENT OF THE FLOODPLAINS		
Overview and Key Issues	**Strategic Output**	**Strategic Actions**
The Water Policy recognizes that changes in vegetation and in cultivation practices may lead to land degradation, soil erosion and siltation of water bodies, and may affect the hydrology and the water balance with the risk of inducing unfavourable microclimatic changes (droughts and floods) and desertification trends. However, it does not provide strategies for assessment and management of flood risks. There is no effective legal & institutional framework for flood control and drought management. There is lack of coherent and comprehensive drought and flood risk mitigation plans and preparedness.	Enhance legal and institutional framework for flood management.	As above.

The policy, legal and institutional framework for addressing higher variabilities in hydrological parameters and the effects of warming can be accommodated within the Water Policy, the Water Act, the Environmental Act and the DWRM and strategic public sector partners.

Implementing the strategy

Resource constraints require that a strategic prioritization is made in order to implement the actions and subsequently achieve the outputs.

Strategy implementation in the Ugandan context has several dimensions. Two key dimensions are:

- *Implementation of those strategies and the associated* actions that makes DWRM able to manage and control the water resources and their use, conservation and protection*.*
- *Implementation of those strategies and associated* actions which support program and project implementation in water-dependent sectors*, recognizing that water is a cross-sectoral commodity.*

Prioritization is often done following a selected set of criteria. Ideally the selection of criteria takes place in a stakeholder consultation and priority setting is to a certain degree a subjective process. For a realistic illustration the 20 outputs have been rated according to:

- *Importance*
- *Urgency*
- *Impact*
- *Effort*
- *Risk*

and finally scrutinized for their dependencies on each other (see main strategy report). The result of the rating is given in the table below. It should be noted that the policy, legal, institutional, and coordination aspects are not included in this table.

Score	**Projects / programs**
12	*3: Catchments effectively managed* *6: Water resources allocated to higher value economic activities* *7: Water information system (WIS) established and operational at WMZ and national level* *8: General water resources knowledge base expanded and integrated into a water information system*
11	*1: Available water resources used in line with Uganda's Water Policy* *2: Drinking water sources safeguarded and the quality of water bodies kept within limits defined by water quality* *4: Ecosystem delivery of goods and services that protect water resources sustained or enhanced* *19: Improved levels and sustainability of funding for water resources management* *20: CMOs and SCMOs able to cover preparation of catchment management plans and in*

	the longer term also a significant part of their operational and development funds
9	*11: Preparedness for higher variability of lake levels achieved* *9: Reduced vulnerability to warmer climate conditions achieved* *10: Reduced vulnerability to more severe rainstorms achieved* *12: Effective flood management achieved*
6	*5: End-use efficiencies increased*

Although there is a certain degree of subjectivity represented in the above table, it still shows some significant tendencies. The highest priorities are appearing in a group of projects /programs which deals with effective management in catchments and provision of an adequate information base. An almost equally high priority is attached to finding ways to increase revenues from water resources allocations in order to finance the improvements in water resources management. Projects / programs dealing with climate change adaptation come out at the lower end of the priorities. In other words, one would recommend DWRM to increase revenue, establish the system upon which rational decisions can be made also for the water sector as well as for water-dependent sectors, emphasize de-concentration of management to catchment levels and then embark on important but less urgent projects /programs.

1 Introduction

1.1 Background and Objective

Fresh water is a finite and vulnerable resource that is essential to sustain life, development, and the environment.Uganda's water resources are quite abundant with a mean annual rainfall of around 1200 mm, the River Nile with a flow exceeding 25 km3 per year, and large combined active storage capacity in Lakes Victoria, Albert, Edward, and Kyoga.

The current water resources situation in Uganda is characterized by overall water supply exceeding demand. Nevertheless, significant differences in water availability exist across the country,and considerable parts of Uganda – including in the cattle corridor – experience occasional water shortages. Further, localized water deficits occur in a number of places (hotspots), but no large scale conflicts between water using sectors have been reported.

Uganda's water resources have been recognized as a key opportunity for socio-economic transformation. Sectors with development opportunities related to water resources include: agriculture (irrigation/supplementary irrigation), livestock, fisheries, aquaculture, hydropower, industrial development, water transportation/navigation, mining and oils production, and tourism. It is anticipated that water demand in the productive sectors will increase significantly.

Further, large volumes of water are needed to sustain the extensive wetland areas and aquatic ecosystems, while the supply of clean and safe water to a growing population is among the highest priority issues in the country.

Climate change, watershed degradation, urbanization, extreme events (floods, low flows, droughts) , pollution and water quality risks, the water-energy-food nexus, and international competition for water are putting additional pressure on Uganda's water resources.

Within this context, the overall policy objective of the Government of Uganda is:

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

The Directorate of Water Resources Management (DWRM) is responsible for management and long-term planning of the water resources in Uganda. In this capacity, DWRM has developed a national water resources strategy. It aims to maximize the beneficial use of the water resources and support the productive sectors to achieve their respective objectives, while ensuring environmental integrity and taking into account the transboundary context.

1.2 Approach to Development of the Strategy

The strategy takes its starting point in the present situation. It then describes a set of actions set in time to reach a future vision for Uganda's water resources, while taking into account the contextual environment formed by the natural resource base, the climate, the regional and transboundary setting, the overall water governance framework, and the respective development plans of the water-related sectors. The vision supports Uganda's overall long-term development objectives, which aredescribed in "Vision 2040" – the most recent policy document guiding the country's long-term development. This process is schematically presented in Figure 1.1. In line with "Vision 2040", the horizon year of the national water resources strategy has been set to 2040.

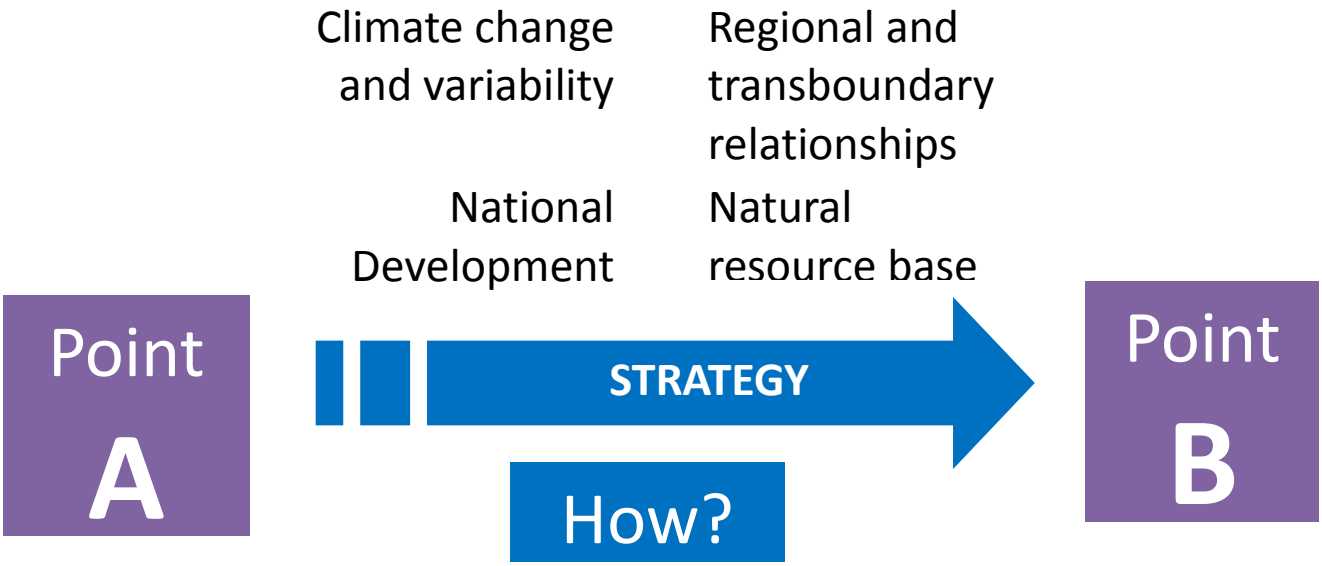

Figure 1.1:The strategy development process

The principle steps involved in the strategy formulation process are outlined in Table 1.1. The table also indicates where these steps have been discussed in this report.

Table 1.1: Overview of the strategy development steps

STEP	DESCRIPTION	CHAPTER/ PARAGRAPH
	CONTEXT	
1	Describe the role of water in national development: prepare a concise and mostly qualitative assessment of the linkages between economic development and access to adequate quantities of water of good quality; differentiate between: 1) water for people, 2) water for productive purposes, and 3) water for ecosystem goods and services.	2
2	Identify and list the relevant national development objectives and sector strategies, and assess in outline their main implications on the nation's water resources and its management.	3.1
3	List and briefly discuss the guiding principles that govern the management of Uganda's water resources.	3.3
	CURRENT WATER RESOURCES ISSUES AND CHALLENGES	
4	Prepare baseline information on the status of Uganda's water resources, and make an analysis of the current water resources issues and challenges and their implications for managing the country's water resources. Most of this task has been implemented in the National Water Resources Assessment (NWRA 2012). The NWRA study, however, did not cover the water governance framework.	4.1
5	Describe the existing water governance framework (policy, legal, and institutional elements), and assess the adequacy of this framework to address the existing water resources challenges.	4.2
	ANTICIPATED WATER RESOURCES ISSUES AND CHALLENGES	
6	Identify and screen the development options in the respective water-related productive sectors.	separate report
7	Based on the national development objectives and sector strategies (step 2) and the development options (step 6), prepare four water resources development scenarios. The scenarios will range from moderate to	4.3

	intensive development in the 2040 time horizon.	
8	Use a water resources accounting model (MIKE BASIN) and a Multi-Criteria-Analysis (MCA) to analyze the implications (e.g. environmental, economic, hydrologic, etc) of the respective development scenarios. When combined with Step 4 & 5, this analysis results is a comprehensive assessment of the current and anticipated water resources issues and challenges in Uganda that need to be addressed in the strategy.	4.3 and Annex 3
STRATEGY DEVELOPMENT		
9	Through a consultative process with key stakeholders, develop a Vision for the nation's water resources for 2040 and define the associated set of concrete objectives.	5
10	Prepare key strategic outputs and actions to reach the vision and objectives defined in Step 9. Most of these actions will address the existing and anticipated water resources issues and challenges identified in Step 8. This activity will also describe who will implement the actions and with what resources, and provide a monitoring and evaluation framework.	6
12	Prepare a prioritization framework for implementing the actions and reaching the strategic outputs. In order to address anticipated institutional and financial resource constraints, implementable actions will be prioritized in the short, medium, and long-term.	7

The strategy development process was anchored around four workshops in order to ensure adequate stakeholder consultation:

Workshop 1: Setting the Scene (organized 8-9 February 2012) – this event aimed at internalizing the outcome of the National Water Resources Assessment (NWRA) and revisited the policy objectives and sector analysis presented in the National Development Plan (NDP) 2010/11-2014/15.

Workshop 2: Vision and Objectives (organized on 15-16 January 2013) – the workshop developed a Vision for the nation's water resources for 2040 and defined the associated set of concrete objectives.

Workshop 3: Road Map towards Vision and Objectives (organized on 27 March 2013) – this event identified relevant strategic outputs and actions, and developed a low resolution roadmap to reach the Vision for Uganda's water resources defined in workshop 2.

Workshop 4: Consolidating the Strategy (organized on 11-12 December 2013)- the workshop reviewed the draft strategy through facilitated stakeholder discussions.

Over 45 sector stakeholders and experts participated in the events, representing institutions that included KCCA, Local Government, MAAIF, Ministry of Finance, MEMD, MTWA, NFA, PEPD, various departments of MWE, as well as the Water Management Zones. Also present were representatives from GWP, World Bank, and international consultancy firms.

In addition to the above, a wide range of organizations and individuals have been consulted in the strategy development process.

2 Role of Water in National Development

This chapter will describe in outline the role of water in national development. It will introduce the reader to the main water-depending sectors, and discuss their contribution to GDP, employment, and export. This is followed by a brief and mostly qualitative discussion of the key characteristics of each sector, and how its performance is related to access to water resources and impacts the national economy.

2.1 Macro-economic Context

While the last 25 years has seen sustained economic growth, the Gross National Income (GNI) of Uganda is still low and stands at 1,124 US$ per capita (2011, measured in PPP$). According to the latest estimate (UNDP 2012), some 29% of the population lives on less than 1.25 US$ per day.

The human development index has seen a steady rise since the early 1990s as a result of important economic reforms, civil peace, and development programs implemented by the government. Population growth remains high and total population is projected to surpass 60 million by 2030 [UNPD – medium projection]. It will put unprecedented pressure on land and water resources. In spite of rapid urbanization, most of Uganda's population - some 79% - is still expected to live in rural areas by 2030, although Vision 2040 is targeting a 60% urban population by 2040.

Services are now the main driver of growth, contributing 52% of growth (2008) compared to 32% in 1992 [Uganda WAS, p.2]. Still, agriculture remains the largest employer. The sector is also responsible for providing food security for the country, emphasizing the importance of rural development and agricultural modernization.

There are direct linkages between economic development and access to adequate quantities of water of good quality. Fresh water is an essential input in the production of goods and services, and limited or unreliable access will adversely affect economic growth. In Uganda the main water depending sectors include: agriculture, fisheries, livestock, tourism, hydropower (energy), oil production, and mining. Table 2.1 presents the contribution of these sectors to the national economy.

Table 2.1: Sector contribution to GDP, employment, and export

Sector	% sector contribution to GDP(2011/12)	Total number of people employed 2009/10 (000)	Export value 2011 (million US$)
Water supply	3.3	8	
Crops	14.6		920.3
Livestock	2.0		34.7
Total agriculture	16.6	8,800	955.0
Fishery	3.1	94	136.2
Energy [1]	1.2	11	
Tourism	4.0[2]	225[3]	773[4]
Mining & quarrying	0.4	48	100.3

Sources of information: NDP 2010/11-2014/15, Statistical Abstract 2012 UBOS, Uganda National Household Survey 2009/10, State of the Environment 2010 NEMA

[1] Electricity supply by national utility including hydropower and thermal power
[2] 2011 estimate by World Travel &Tourism Council (WTTC). This is the direct estimate and does not include indirect and induced impacts.
[3] 2011 estimate by WTTC
[4] 2010 estimate by WB: Uganda, Migration and Remittances Fact Book 2011

Table 2.1shows that the economic sectors directly dependent on the water resources represent some 28% of gross domestic product (GDP), provide around 9.2 million jobs (corresponding to 71% of all employment in Uganda), and generate export value of around 1,965 million US$ (corresponding to around two thirds of all export from Uganda). Agriculture is the largest water-related contributor to the economy measured in GDP contribution, employment and export value, followed by tourism.

It is noted that not all water using sectors are included in Table 2.1. The contribution to the national economy from sectors such as manufacturing and processing industry, aquaculture, marine transportation, and environment could not be estimated due to insufficient statistical data. Neither the emerging and important oil sector is included. However, with an anticipated peak production of 180,000 barrels per day, the oil sector is expected to be an important source of economic activity, job creation, and economic growth. It implies that the state of Uganda's water resources impacts an even higher proportion of the national economy, and accentuates the importance of sound water resources management.

2.2 Water for People

Access to clean and safe water is a prerequisite for a healthy population and has a direct impact on the quality of life, labor productivity, and economic development of the country. The National Water Policy gives first priority to domestic water supply, and so does the National Poverty Eradication Plan (PEAP), whichhas categorized water supply and sanitation among the highest priority issues. The national urban water coverage was estimated at 66% in 2008 while the coverage in rural districts (2009) ranged from 24% to 100% with a national average of 66% (NWRA 2012). The national targets for water supply and sanitation coverage in urban areas are 100% safe water coverage and 100% sanitation coverage by

2015, with 80-90% effective use and functionality of facilities. In rural areas the targets are 77% safe water coverage and 95% sanitation coverage by 2015, with 80-90% effective use and functionality of facilities.

Household water purposes include drinking water, bathing, cooking, and sanitation. Basic water consumption rates have been estimated at 20.8 and 44.8 liters per person per day for rural and urban areas respectively (NWRA 2012), but specific water consumption rates in areas without private connections can be significantly lower.Water consumption rates are expected to rise with economic growth and improved access. Total water use for domestic purposes will further increase because of population growth.

2.3 Water for Productive Purposes

Water is an essential input into many production processes and for agricultural activities. In Uganda, water for production refers to development and utilization of water resources for productive use in irrigation, livestock, aquaculture, fisheries, hydropower, processing and manufacturing industries, mining, oil production and other commercial uses. These sectors are briefly discussed in Table 2.2.

Table 2.2: Water for production in Uganda

Sector	Sector description
Irrigation	Agricultural droughts occur frequently in Uganda and periodic moisture deficits at critical points for crop growth are among the principle reasons for low crop yields. Irrigation provides reliable water supply for crop production and is key to increasing agricultural yields, and thus supports improved standards of living in rural areas. The total acreage under consolidated irrigation is small and estimated at some 10,000 ha. In addition, an estimated 53,350 ha are under informal irrigation for rice cultivation on wetland fringes, mainly in Eastern Uganda(NWRA 2012). The National Irrigation Master Plan (2010 – 2035) has identified 294,000 ha of potential irrigated area that can be developed without need for water storage facilities. The overall majority of this area concerns managed wetlands. In addition, the plan has identified potential upland irrigation that does require development of water storage and delivery facilities. No specific locations have been indicated. Rather, the upland potential is estimated as a percentage (10%) of existing cultivated land. The potential irrigated area exceeds 500,000 ha and the sub sector, therefore, has the potential to make an important contribution to food security, rural development, and economic growth.
Livestock	Uganda's natural environment provides good grazing areas for livestock.The sector contributes some 15% to the agricultural economy, and includes a cattle herd of 11.4 million in 2008 with an increasing trend. It has high potential for domestic and export marketing of dairy, meat, hides, skins, and leather.

	The performance of the sector is negatively affected by multiple factors including poor animal husbandry practices, high diseases burden, low level of adaptation of exotic breeds, and insufficient facilities to ensure drinking water for the animals during the dry season and periodic droughts. While over 1,000 water facilities for livestock production were constructed in the last 50 years, the majority has heavily silted or was breached, and is no longer fulfilling their purpose (NWRA 2012). Increasing sector productivity will support rural development and contribute to food security.
Fisheries	Fish production in Uganda peaked at 330,000 ton but has seen a gradual decline since 2008. Revenue from fish export is significant. Fishery represents a non-consumptive water use. Key sector requirements include maintaining aquatic habitats, maintaining surface area of shallow lakes, and sustaining river flows to keep ecosystems healthy and abate upstream pollution (NWRA 2012). Increasing sector productivity will support rural development and contribute to food security.
Aquaculture	Aquaculture production in Uganda has grown exponentially over the last 10 years, with an annual growth rate of over 300%. With high demand for fish – both for local markets and for export - production growth is expected to continue. The vast majority of aquaculture production comes from low and semi-intensive ponds, minor lakes, and communal dams. Only 8% is produced at industrial scale, but this segment is growing rapidly. Pollution is a main concern. Increasing sector productivity will support rural development and contribute to food security.
Hydropower	Hydropower potential in Uganda is estimated at 4500 MW, mainly through large facilities on the Nile system. Only 630 MW is currently operational. Water use is non-consumptive. Hydropower development will alleviate a key constraint to economic development in Uganda (i.e. grossly inadequate supply of electricity).
Industry	Uganda is pursuing a strategy of industrialization that will require dependable water supply and adequate pollution control.There is currently no reliable data on water used by individual industries, but industrial water demand is currently small (NWRA 2012). Sector demand is expected to increase substantially with economic growth, but no reliable projections for future industrial water demand exist. Industrial development will provide employment and generate economic growth.

Tourism	Game parks and wildlife reserves are among the most important tourist destinations in Uganda. Requirements in terms of water resources are mainly non-consumptive and concerned with preservation of natural scenic spots such as lakeshores, rivers, and water falls (e.g. Murchison Falls). There are a number of specific water-related tourist attractions including white-water rafting along the Victoria Nile, and sport fishing on the major lakes and rivers. Tourism will provide employment in rural areas and generate economic growth.
Mining	Commercial viable reserves of over 27 minerals have been found and will be developed. Apart from Kilembe copper – which is a large scale operation – the sector consists of a few medium scale mining units (in particular gold) and many smaller quarrying units.Water is mainly used for drilling and processing. No reliable estimate exists of water use in the mining sector, but consumptive water use is distributed and most probably small. Water quality concerns are more pertinent and potentially large. Goldmine waste includes byproducts such as mercury and heavy metals, while cyanide is used in leaching gold from ore. Development of the mining sector will provide employment and generate economic growth.
Oil production	Commercially viable oil deposits have been discovered in the Albertine Graben in western Uganda. Peak production is estimated at 180,000 barrels per day. A refinery of the same capacity is planned in Hoima. Fresh water plays an integral part in many operating processes in the petroleum industry. For example, water is widely used in cooling systems, for heating and crude washing, and to maintain pressure in oil reservoirs. While water is typically recycled and used multiple times (for instance in closed-loop processing systems), most water eventually returns to the environment and needs to be treated and cleaned before discharge so as not to pollute the environment. Maximum consumptive water use for oil production in the Albertine Graben during peak production is estimated at 36.5 mcm/year (Annex 2). The oil sector will contribute to job creation and economic growth.

2.4 Water for EcosystemGoods and Services

Uganda has many unique aquatic and terrestrial ecosystems, and water resources are an integral part of a complex and varied landscape that comprises 1) large wetland areas that cover some 11% of Uganda's land area, 2) the Nile system that includes the equatorial lakes Victoria, Kyoga, Albert, Edward, and George, 3) some 160 minor lakes, and 4) extensive river systems draining into the Nile.

The following environmental goods and services accrue from water resources:

a) Aquatic ecosystems (lakes, rivers, ponds) are important habitats for aquatic biodiversity.
b) Water and/or hydrological cycles play an important role in climate modulation.
c) Aquatic habitats, especially wetlands, play an important role in flood control, pollution control and purifying waste water, maintaining dry season flows, and groundwater replenishment.

In addition, economic development in Uganda is closely linked to the ability of the environmental and natural resource base to provide a variety of goods and services, and sustain these into the future. Environmental degradation entails high economic costs such as declining fish catch and expenditures for water treatmentand curative health care, re-settlement of environmental refugees, flood control, and restoration of degraded ecosystems. It would also adversely impact on the important tourism sector in the country.

Environmental resources in Uganda are under increasing pressure from a combination of both natural and man-made factors. Wetlands are being drained for agriculture, rangelands are over-exploited through overgrazing, and forests are being lost because of encroachment and high needs for wood fuels. These land-use changes modify the hydrological patterns and intensify the hydrologic extremes (floods and low flows). Climate change and over-exploitation of water resources exacerbate this trend. There are a number of locations in Uganda, such as the cattle corridor, where water demand already exceeds availability in the dry season.

While many factors, such as water quality, sediments, food-supply and biotic interactions, are important determinants of healthy aquatic ecosystems, an overarching master variable is the flow regime. Environmental flows refer to the current flow regime that sustains ecosystem services provision at an agreed upon level. Social, economic, and political factors determine this acceptable level, which may vary between river basins. In highly developed river basins, lower levels of ecosystem services may be acceptable while in near-pristine catchments of high environmental value high level of ecosystem services provision must be maintained.

3 Strategy Formulation Context

Chapter 3 will appreciate the key factors that direct the management and development of Uganda's water resources, but which are outside the influence and responsibility of DWRM. These external factors include Uganda's overall development objectives, and the specific objectives and strategies of the respective productive sectors. It also includes the transboundary context.

The chapter ends with a discussion of the 'guiding principles'. It is recognized that strictly speaking these are not part of the external context, but rather represent a set of fundamental and established principles that govern the management of Uganda's water resources. In this capacity they will be taken into consideration when developing the strategy.

3.1 National Development Objectives and Strategies

3.1.1 Uganda Vision 2040

Uganda's vision is: '**a transformed society from a peasant to a modern and prosperous country within 30 years**' [Vision 2040, p.4]. Vision 2040 represents the country's long-term perspective development plan and is based on the GoU adoption of the Comprehensive National Development Planning Framework policy. It provides for the development of a 30 year vision implemented through: a) three 10-year plans, b) six 5-year National Development Plans (NDP), c) sector specific master and investment plans (SIPs), d) local government development plans, and e) annual plans and budgets. A framework for implementing Vision 2040 is presented in Figure 3.1below.

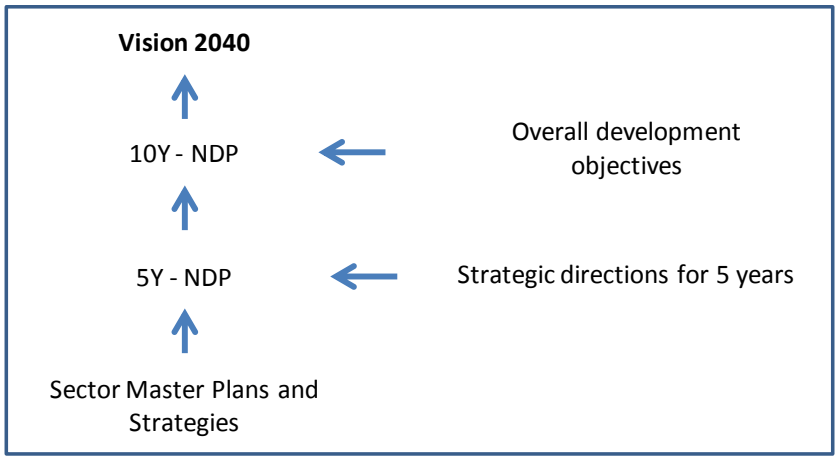

Figure 3.1: Implementing Vision 2040

Selected Vision 2040 targets related to the water sector are presented in Table 3.1below.

Table 3.1: Selected Vision 2040 targets [Vision 2040, p.5]

No.	Development Indicator		Baseline 2010	Target 2040
4	Sectoral Composition of GDP (%)	Agriculture	22.4	10
		Industry	26.5	31
		Services	51.2	58
5	Labor force distribution (%)	Agriculture	65.6	31
		Industry	7.6	26
		Services	26.8	43
14	Electricity consumption per capita (kWh/yr)		75	3668
15	% population with access to electricity		11	80
16	Water consumption per capita (l/day)		26	100
17	% population with access to safe piped water		15	100
21	% urbanization		13	60
31	Forest cover (% land area)		15	24
32	Wetland cover (% of total area)		8	13

Vision 2040 specifically recognizes Uganda's water resources as a key opportunity for socio-economic transformation. Sectors with development opportunities related to water resources include: agriculture (irrigation/supplementary irrigation), livestock, fisheries, aquaculture, hydropower, industrial development, water transportation/navigation, and tourism.

The main implications of Vision 2040 for the water resources strategy are described in Table 3.2.

Table 3.2: Water-related Vision 2040 objectives and projections, and implications for the water resources strategy

Water supply	Vision 2040: access to safe piped water for 100% of the population, water consumption per capita at 100 l/day; 60% urban population; WR strategy implications: increase supply of clean and safe water to urban and rural population; ensure protection of water sources;strengthen integrated catchment based planning, development, and management of water resources; enhanced regulation of water use to prevent water shortages and/or conflicts; reduce wasteful use of clean water and encourage water efficiency
Urbanization	Vision 2040: 60% urban population WR strategy implications: increase investments in bulk water supply and treatment; increase urban sewerage coverage and waste water treatment; improve urban

	drainage and prevent and/or mitigate the impacts of urban flooding and polluted runoff

Table 3.2: Water-related Vision 2040 objectives and projections, and implications for the water resources strategy (continuation)

Ecosystem management and pollution prevention	Vision 2040: …efforts will be undertaken to attain a green and clean environment with no water pollution …... Uganda will take urgent measures to protect natural resources and ensure their future sustainability [250, p. 61]. Efforts will be made to restore ecosystems (wetlands, forests, range lands) by undertaking (re)forestation, promoting participation of the population in tree planting, and enhancing private investment in forestry…. and adoption of green agriculture practices [252, p. 61]. Restoration of degraded wetlands, hill tops, rangelands and other fragile ecosystem will be achieved through catchment–based systems, gazetting of vital wetlands for increased protection and use, and monitoring and inspecting restoration of ecosystems (wetlands, forests, catchments) [253, p. 61]. WR strategy implications: increase sanitation coverage; expand pollution and water quality monitoring; compliance monitoring and enforcement of regulations on waste and effluent discharge; strengthen integrated catchment based planning, development, and management of water resources; prepare for possible climate change
Hydropower	Vision 2040: Government will develop all the hydro-power potential; this will include small, mini, and large hydropower plants [154, p. 41]. WR strategy implications: develop appropriate release policies that optimize power production while taking into account environmental integrity and other productive water uses including agriculture; increase water use efficiency; implement measures to mitigate the possible effects of climate change on electricity generation; develop effective drought management plans; prepare for possible climate change;
Agriculture	Government will facilitate the construction of large and small-scale irrigation schemes. In addition, livestock watering activities will be constructed…. In addition to facilitating fisheries, emphasis will be on aqua culture…..[160, p. 42] Promote commercial agriculture……which will require sustainable use of water resources for irrigation; bulk water transfer systems will be built to cover long distances… to provide water for multi-purpose use;….; to mitigate local scale shortages large and medium water reservoirs will be developed [155, p. 41]. WR strategy implications: provide water for irrigation development; encourage improved soil and land management in rainfed areas; provide safe water for livestock watering; control pollution and ensure environmental integrity; strengthen integrated catchment based planning, development, and management of water

	resources; design effective drought management measures; prepare for possible climate change

Table 3.2: Water-related Vision 2040 objectives and projections, and implications for the water resources strategy (continuation)	
Tourism	The country's main tourism potential lies in nature-based tourism. It presents the country with numerous opportunities to stimulate economic growth, and Uganda aims to be within the top-five tourist destinations in Africa [120, page 35]. WR strategy implications: maintain the natural water bodies and scenic spots that provide tourist destinations; strengthen integrated catchment based planning, development, and management of water resources that gives due prominence to maintaining environmental integrity; pollution prevention
Mining and oil Sector	Commercial viable reserves of over 27 minerals have been found and will be developed, including iron ore (Kabale, Kisoro), copper (Kilembe, where a local smelter will be build), gold (Tira, Mubende-Kiboga, South Western Uganda, Moroto), phosphates (Tororo), limestone and pozollana for cement (Tororo and Kasese), and tin (South Western Uganda) [76, p 24]. Commercially viable oil and gas deposits in the Albertine Graben will be developed; a total of 3.4 billion barrels of oil equivalent have been discovered (with 40% of the Albertan Graben explored); a refinery in Hoima will ensure value addition [83, page 26]. WR strategy implications: ensure sufficient and reliable water supply to the mining and oil sector; regulation of water use; pollution prevention, and associated compliance monitoring and enforcement of regulation
Industry	Government will pursue the strategy of industrialization [item 21, p.6]; sector-specific cluster-based industrial zones will be developed, and Special Economic Zones (SEZ) set up [97, page 29]. Four regional cities will be established: Gulu, Mbale, Mbarara and Arua. Other strategic cities will include; Hoima (oil), Nakasongola (industrial), Fort Portal (tourism), Moroto (mining) and Jinja (industrial). [203, p. 50]. WR strategy implications: ensure sufficient and reliable water supply; strengthen integrated catchment based planning, development, and management of water resources; pollution prevention; regulation of water use; increase water use efficiency; compliance monitoring and enforcement of regulations
Marine transportation/ navigation	To reduce the cost of transportation and increase connectivity, efforts will be geared towards increasing the volume of passenger and cargo traffic by marine transport. Government will establish navigable routes and put in place adequate marine infrastructure [175, p. 46].

	WR strategy implications: maintain the water level of navigable water bodies within a predetermined range, or encourage investment in more flexible docking facilities

3.1.2 National Development Plan 2010 – 2014

Within the framework provided by Vision 2040, the National Development Plan (NDP) stipulates Uganda's medium term development priorities and implementation strategies.Compared to Vision 2040, the sector objectives, strategies, and interventions in the NDP are more concrete and detailed, and the discussion in this paragraph therefore complementsTable 3.2.

NDP 2010-2014's theme is "Growth, Employment, and Socio-Economic Transformation for Prosperity". It includes eight general development objectives - five of which are directly affected by the water sector. Table 3.3 summarizes the role of the water sector in reaching the NDP objectives. The main economic implications are also reported, as adopted from Uganda Water Assistance Strategy (World Bank, 2011, page 7). It is noted that many water issues are cross-cutting, while there is an obvious link to Table 3.2.

Table 3.3: Overall supporting role of the Water Sector in achieving NDP 2010-2014

Objective: Uplift household standards of living	
Increase supply of clean and safe water to people	To improve health and (indirectly) household standards of living
Investments in sanitation and hygiene	To improve general health and reduce water treatment costs
Investments in flood protection	To reduce water borne diseases and loss of lives, crops, livestock, and property
Provide water for irrigation development, and support improved soil and water management in rainfed areas; increase livestock water supply	To support rural development and improve standards of living in rural areas
Objective: Enhance the quality and availability of gainful employment	
Ensure sufficient and reliable water supply to the industrial, mining, oil, and service sectors	To provide employment and generate economic growth
Optimize hydropower production through appropriate water release policies	To alleviate a key constraint to economic development in Uganda (i.e. grossly inadequate supply of electricity)
Maintain the natural water bodies and scenic	To facilitate development of the tourist sector,

spots to provide tourist destinations	which is a key foreign revenue earner and employment provider
Objective: Improve the stock and quality of infrastructure	
Provide up-to-date water resources data for improved hydraulic design of infrastructure	To optimize design, reduce maintenance expenses, minimize risk of failure and damage, and increase the lifespan of infrastructure
Address flood and climate change risk with regard to the road network, hydropower facilities, dams, and other public infrastructure	See above
Objective: Develop and optimally exploit the national resources base and ensure environmental and economic sustainability	
Strengthen capacity for IWRM	To ensure food security, rural development, provide employment, and generate economic growth
Objective: Strengthen good governance and improve human security	
Implement a de-concentrated and participatory approach to water resources management	To help consolidate good governance in the water related sectors
Ensure equitable allocation of water between communities and sectors	To minimize competition and possible conflicts
Participate in transboundary water programs (such as the Nile Basin Initiative and the Lake Victoria Basin Commission)	To ensure Uganda's water security

Annex 1 presents a detailed list of selected objectives, strategies, and interventions for the water-related sectors and sub-sectors included in NDP 2010-2014. These elements will be included as required in the Water Resources Strategy to ensure alignment with the NDP and Vision 2040.

3.1.3 Sector Plans and Strategies

Development of Vision 2040 and NDP 2010-2014 has taken into consideration most master- and investment plans relevant to the water sector. The objectives and actions included in these plans will therefore not be repeated in this paragraph. The notable exception is the National Irrigation Master Plan for Uganda (2010 – 2035). Table 3.4below summarizes the main objectives and interventions of this plan.

Table 3.4: National Irrigation Master Plan for Uganda (2010 – 2035) *Main objectives, projections, interventions, and implications for water resources management*	
Objectives and interventions	Implications for water resources management
Subsidiary objective 1: Irrigated agriculture contributing to poverty alleviation in Uganda as a result of farmer-managed small scale schemes, and best practice service delivery	Supply of water of adequate quantity and quality for irrigation development
Subsidiary objective 2: Irrigated agriculture contributing to economic growth in Uganda as a result of an enabling investment environment and the profitable investment in irrigated crop production, value addition and/or service provision	As above
Irrigation Potential: "Type A land" which lies close to surface water resources on which agricultural water can be managed without the need for storage. "Type A land" potential has been estimated to total some 295,000 ha (approximately 24,000 ha of which will be upland, and the balance managed wetlands)	strengthen integrated catchment based planning, development, and management of water resources; regulate water use; assess and mitigate environmental consequences; maintain ecosystem functions; maintain hydrologic functions of wetlands
Irrigation Potential: "Type B land" which does not lie close to surface water resources or which cannot be fully developed in the absence of storage facilities and/or feeder systems. No specific locations have been indicated. Rather, the "Type B" potential is estimated as a percentage (10%) of existing cultivated land.	strengthen integrated catchment based planning, development, and management of water resources; prepare detailed catchment management plans; regulate conjunctive groundwater and surface water use; drought risk management
The greater part of the public investments (around 75%) are targeted at the traditional emerging farmer.	

3.2 The Transboundary Context

Virtually all of Uganda lies within the Nile drainage area. Only a small part of Karamoja drains into the Lake Turkana basin. Uganda is both an upstream and downstream riparian, and a number of Nile tributaries and lakes are shared with neighboring countries. These include Kagera, Semliki, Sio-Malaba-Malakisi, Albert Nile, and the lakes Victoria, Edward, and Albert.

The Nile, which by some measures is the longest river in the world, drains about 10% of the African continent and is shared by eleven countries: Burundi, Democratic Republic of Congo, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, South Sudan, Tanzania, and Uganda (fig 3.2).

The international conventions concerned with fresh water are discussed in paragraph 4.3.3, while the international river basin organizations in Uganda are covered in paragraph 4.3.4.

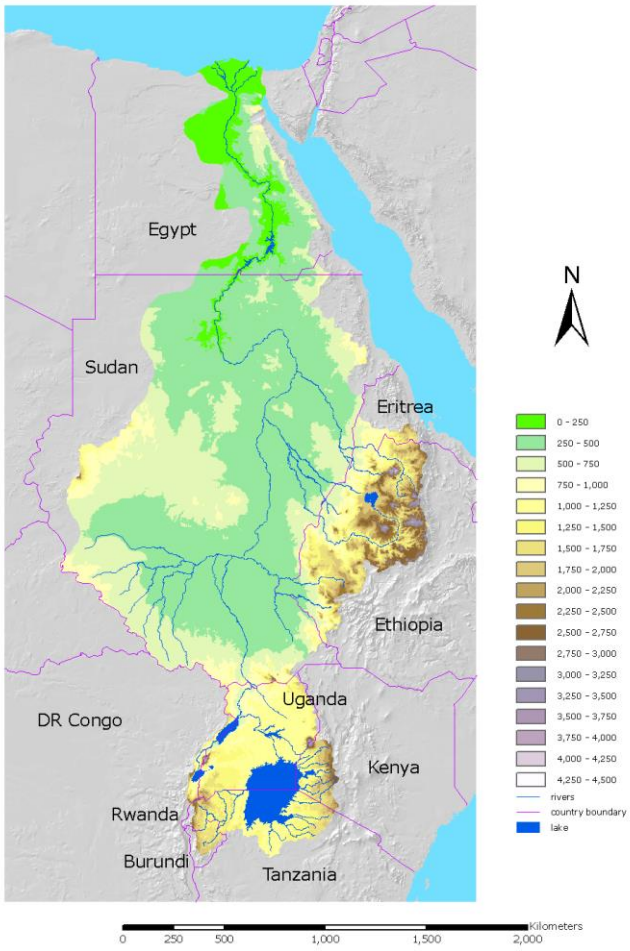

Figure 3.2: The Nile Basin

3.2.1 Lake Victoria

Lake Victoria is shared by Kenya (6%), Tanzania (49%), and Uganda (45%) and its drainage basin also includes parts of Burundi and Rwanda. There are concerns about eutrophication and pollution in the lake. Coastal towns and cities discharge untreated sewages into the lake, while soil erosion caused by deforestation and poor farming methods is increasing sediment loads in the rivers flowing into the lake.

The key features that determine the hydrology of the lake include the high contribution (85%) of over-lake rainfall to total lake inflow. This suggests that lake levels and the long-term outflow will be highly sensitive to climatic change. The operational policies of the Kiira and Nalubaale hydropower stations at Jinja control the outflow from the lake and effectively limit lake level fluctuations to a relatively narrow band of some 3 m, giving Lake Victoria a live storage volume of over 200 km^3. This attenuates seasonal and annual variability in lake inflows and has led to a relatively stable outflow down the Nile.

The outflow from Lake Victoria has been determined by the 'agreed curve', which represents the natural outflow, based on a ten-day average flow of the Victoria Nile at Ripon Falls prior to the construction of the Owen Falls Dam, as a function of lake level. Consumptive water use by the Lake Victoria riparians will impact on Victoria Nile flows and hydropower production along the river.

3.2.2 The White Nile

Of particular interest to Uganda is the hydrology of the White Nile. The relatively stable outflow of Lake Victoria (see above) is modified by its passage through Lakes Kyoga and Albert but it remains steady with little seasonal variation. Just below the South Sudanese border, the river is joined by the Aswa, a seasonal river whose basin is almost exclusively in Uganda, and some other streams known as The Torrents. They provide a seasonal component to the steady flow of the Bahr el Jebel, as the river is known in South Sudan.

The Sudd and Bahr el Ghazal swamps are vast wetland areas in South Sudan where evaporation from the flooded lands vastly exceeds rainfall. The hydrology of the wetland areas is not well understood but it is estimated that Sudd outflow is about half its inflow. Consumptive water use in Uganda and the upstream riparians, therefore, will only partly translate into reduced Nile flows below the Sudd.

3.2.3 Implications of the Transboundary Context

Because Uganda is both an upstream and downstream riparian state, and all of its territory is part of transboundary basins, the country has in effect no exclusive control over its water resources. Uganda, therefore, has to coordinate the management and development of its water resources with the co-riparians. At the same time, Uganda needs to ensure that its interests are taken into consideration by the upper Lake Victoria states when they develop and manage their Lake Victoria basin water resources. The principles governing and sharing international water (see paragraph 4.3.4), and regional water programs such as NBI and LVBC (see paragraph 4.3.4) provide an obviousframework for such coordination.

3.3 Guiding Principles

The guiding principles form a set of fundamental principles or established precedents according to which the water resources in Uganda are managed. They are based on the overall principles (Dublin – Rio process, and Agenda 21) at the foundation of Integrated Water Resources Management (IWRM), which has been adopted by the great majority of nations worldwide including Uganda, and which are represented in the revised National Water Policy (draft, March 2013).

Table 3.5 presents the guiding principles that will direct the development of the national water resources strategy.

Table 3.5: Specific guidelines directing the development of the national water resources strategy

Enabling environment	Institutional development	Management, planning and prioritization
• Good Governance principles recognized (transparency, participation, openness, inclusiveness, accountability) • Legislation to support policy • Local level custodians of water resources acknowledged in legislation • Regulatory controls only in response to need and at enforceable levels • Regulatory controls combined with economic incentives	• Key institutions comply to the tenets of Good Governance • Cross-sectoral coordination mechanism with DWRM as the lead agency • Integrated approaches to project development • Management functions delegated to lowest appropriate level – local organizations mandated in legislation and adequately resourced • Private sector involvement • Women's participation • Water resources management capacities at all levels • WMZs as an important step towards de-concentration of water resources management	• Catchments adopted as the most appropriate management unit, rather than using administrative boundaries • Holistic approach to water resources management, development, and use • Domestic demands to have first priority • Allocation to other productive uses (agriculture, industry, hydropower, etc.) continues to recognize the social and environmental value of water but also emphasizes its economic value • Economic incentives applied with regulatory instruments to encourage water use efficiency and avoid water wastage and pollution • Ensure stakeholder participation in management, planning, and prioritization; all plans to be assessed for cross-sectoral and social impacts • Sustainability and efficiency use to be a key element in planning • Links between upstream and downstream users recognized • Water quality and land-use links recognized, and water quality and environmental management integrated • Wetlands to be recognized as an integral part of water resources systems • Prevent pollution at source and "polluter pays" principle recognized • Regional cooperation for the shared water resources • Water resources management based on reliable data and sound science • Interventions need to focus on no-regret or low-regret actions, non-structural actions, and demand management

4 The National Water Resources Challenges

This chapter prepares an inventory of the current and anticipated water-resources and water-governance issues and challenges that need to be addressed in the strategy. It is based on: 1) the findings of the National Water Resources Assessment (NWRA 2012), 2) an analysis of the water governance framework specifically conducted for this project, and 3) a water resources development scenario exercise.

Four water resources development scenarios have been prepared that support achieving Uganda's overall development objectives. They range from moderate to intensive development in the 2040 time frame. The implications (e.g. hydrological, environmental, economic, etc.) of implementing these scenarios have been analyzed through a water-resources modeling exercise and a multi-criteria analysis, and will be discussed in the last paragraph of this chapter.

4.1 Main Features of the Water Resources in Uganda

4.1.1 Climate

A detailed description of the state and characteristics of Uganda's water resources is presented in the National Water Resources Assessment (NWRA, 2012). Paragraphs 4.1.1 – 4.1.4 in this report summarize the main features of the water resources in Uganda.

Most of Uganda experiences two rainy seasonswith heavy rains from March to May, and lighter rains from October to December. Only the north experiencesonly one rainy season in the summer months (May to October) but it is more pronounced. Mean annual rainfall over Uganda is about 1200 mm, but is subject to pronounced temporal and spatial variability. Average annual rainfall ranges from 1800 mm around the shores of Lake Victoria to below 600 mm in some parts of the Karamoja region (figure 4.1). The reliability of rainfall generally declines towards the north but it increases in areas in close proximity to Lake Victoria and the mountainous areas.

High evaporation rates have a marked effect on Uganda's hydrology and use of its water resources. Potential evaporation rates in most of the country (75%) range from 1350 - 1750 mm/year. Annual rainfall exceeds potential evaporation in only about 10% of the land area, although the annual rain deficit in most of the country outside the cattle corridor it less than 400 mm (fig 4.2). High rates of evaporation reduce runoff, groundwater recharge and dry season flows, while they increase drought risks.

The climate of Uganda ranges from arid to humid (Thornthwaite Climate Classification, based on data from 1960 – 1990), demonstrating the climatic variability of the country. Most of Uganda (67%) is classified as 'dry sub-humid' and is characterized by a moderate water surplus during the rainy seasons,

while water deficits occur during the dry season. About 20% of the country, mostly in the north-east and parts of the Rift Valley, is classified as 'semi-arid' while a few small and isolated spots in Karamoja are classified as 'arid.' Arid and semi-arid zones are generally more suited as rangelands. The remaining 13% of Uganda is classified as either 'humid' or 'moist sub-humid.' These conditions prevail around the shores of Lake Victoria, in the mountainous regions in the country (Mt. Elgon and the Rwenzori), in the Kabale region, and close to the Congolese border in West Nile.

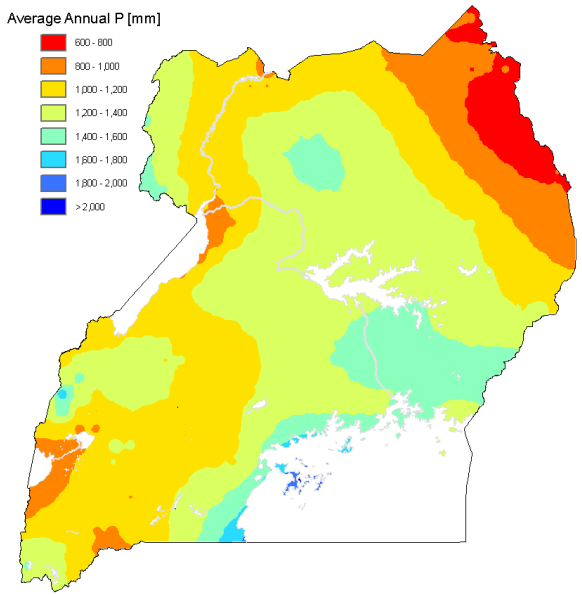

Figure 4.1: Mean annual rainfall

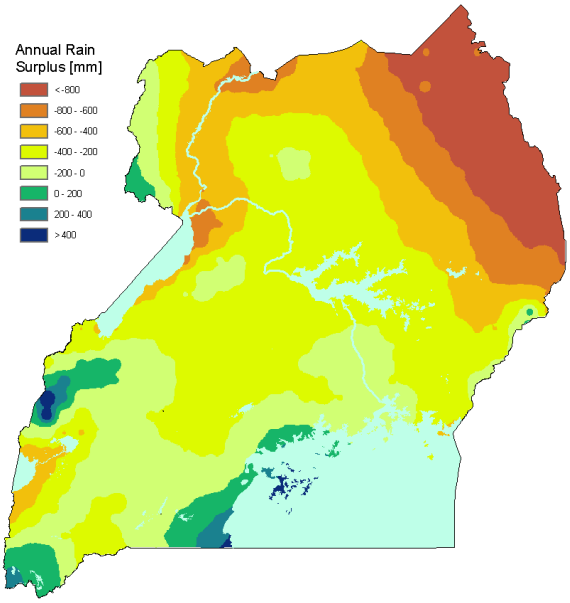

Figure 4.2: Main annual rain surplus/deficit

4.1.2 Hydrology

Uganda is situated on a continental plateau between the eastern and western arms of the African Rift Valley. High mountains rise on both the eastern and western borders. The plateau has an average altitude of 1300m above sea level andhas a relatively flat topography characterised by flat-topped hills and broad swamp-filled valleys. The extensive wetland areas in the country (11% of total land surface) have a marked effect on Uganda's hydrology.

Virtually all of the country lies within the Nile drainage area, apart from a small area in the easternpart of Karamoja, which drains into the Lake Turkana basin.

Uganda exhibits a high variation in specific runoff and the associated catchment runoff coefficient (fig 4.3 and 4.4). Very low values are reported from the Lake Kyoga area, in the Katonga and Bukora catchments, and in the Albert Nile valley. High runoff coefficients are only observed in south-western Uganda, West Nile, and the Mt. Elgon region. The spread in specific runoff is caused by geographic factors such as wetlands and mountains, and also reflects the pattern of the annual rain deficit.

The low average specific runoff in a large part of Uganda is a determining factor in the country's hydrology. It is partly attributed to the close balance between rainfall and evaporation losses and thehigh evaporation losses from the extensive wetland areas.

The Nile regime in Uganda is dominated by the equatorial lakes. Lake Victoria is the single largest contributor to the Nile flow and runoff from the catchments downstream of the lake is relatively small compared to the outflow from Lake Victoria. Evaporation losses from Lake Kyoga, Lake Albert, Lake Edward, and Lake George are significant and exceed direct rainfall on their surfaces, resulting in a substantial combined net loss of water fromthe Nile system.

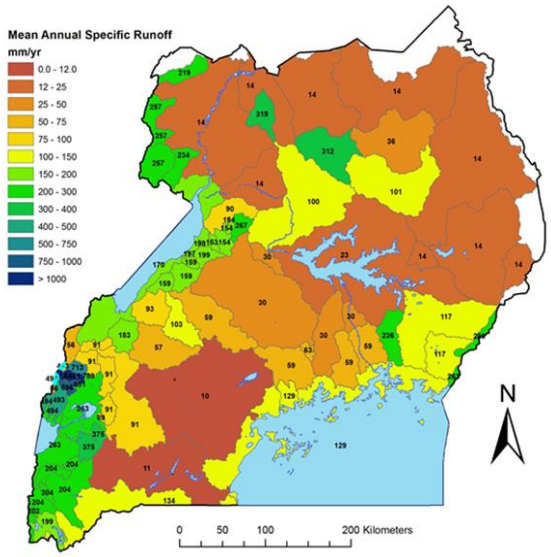

Figure 4.3: Specific runoff

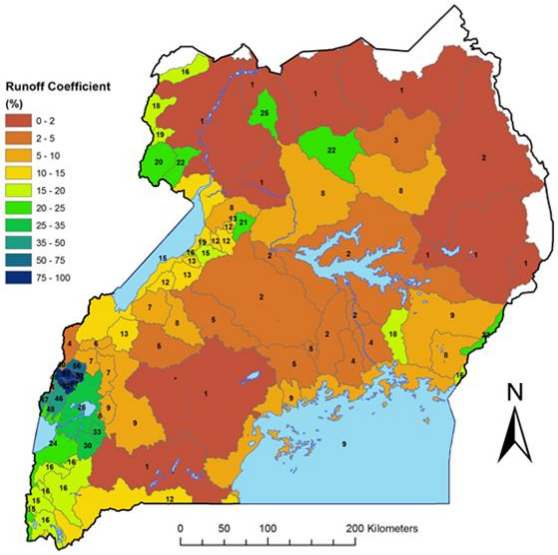

Figure 4.4: Runoff coefficient

4.1.3 Water Resources Utilization

The renewable water resources in Uganda comprise of an internal and external component. Total renewable water resources amount to 43.3 km3/yr. A proportion of 69% originates outside the country. Hence the internal renewable water resources (IRWR) in Uganda, i.e. the average annual river flow generated from precipitation over the country but excluding the impact of the major lakes, amounts to15.6 km3/yr.The present utilization rate of the IRWR is low (2.8%), which is partly attributed to the limited area under irrigation in Uganda.

Uganda's groundwater resources are substantial in relation to the available surface water (if Victoria Nile flows are not considered). The estimated quantity of renewable groundwater generally exceeds the projected demand for domestic water supply in non-NWSC areas by a considerable margin and the sustainable utilization rate projected to the year 2030 is below 15% in most districts (fig 4.5 and 4.6). It is recognized, however, that local shortages may arise, particularly in areas with a high population density. Local shortages may also arise as a result of water quality considerations.

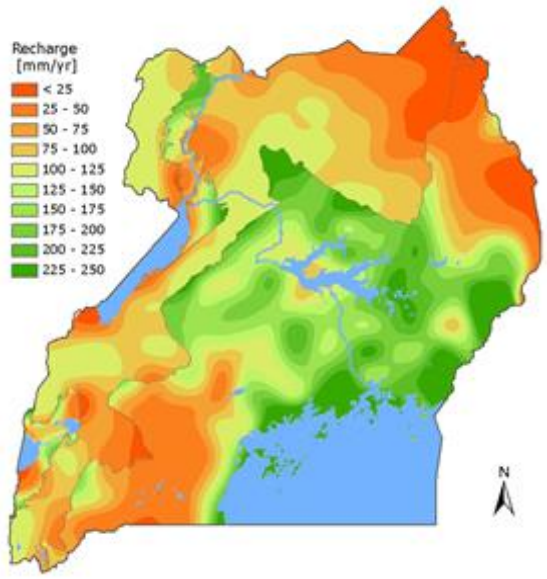

Figure 4.5: Estimated groundwater recharge (mm)

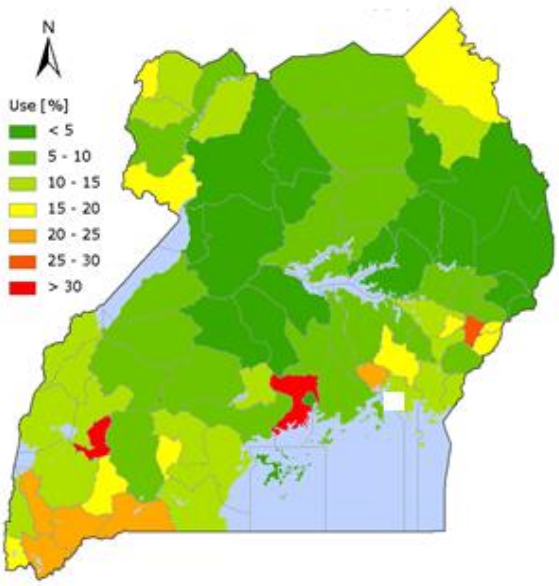

Figure 4.6: Sustainable rates of groundwater utilization per district, projected to 2030

In their natural state, the quality of surface and groundwater in Uganda is generally good. However, poor sanitation has led to bacterial contamination of both groundwater and surface water. In many places the concentrations of bacteria are so high that even bathing is not recommended and could even be dangerous. Further, eutrophication resulting from excessive quantities of nutrients reaching water bodies can cause algal blooms in all lakes that may lead to oxygen deficits and fish kills, or promote the excessive growth of weeds such as water hyacinth.

4.1.4 Aquatic Ecosystem Goods and Services

Wetlands in Uganda cover about 11% of the land area of the country. They include areas of seasonally flooded grassland, swamp forest, permanently flooded papyrus and grass swamp, and upland bog. Wetlands, as well as other ecosystems, provide a wide range of valuable services to the people of Uganda, including supply of water, fish production, water purification, scenic beauty and climate change resilience (buffers against extreme events such as floods and droughts).

In Uganda, it is estimated that approximately 5 million people depend directly on wetlands for their water supply needs, valued at US$ 25 million per year (MFPED 2010). Additionally, the water purification service of healthy wetlands is crucial to public health in Uganda, where 30 percent of rural households lack adequate sanitation facilities (MWE 2010) and where water-related diseases (e.g. diarrhoea) accounted directly for 8 percent of deaths in 2002.

The ecosystem goods and services provided by wetlands also support subsistence and commercial incomes. For instance, many people make a living out of selling clay bricks and pots; papyrus products; medicinal plants; fisheries and crafts.

It is estimated that about 30 per cent of the original wetlands area has been converted to other uses. The rate of conversion varies and ranges from as high as 53.8 percent in the Lake Victoria drainage basin to as low as 14.3 percent in the Lake Albert drainage basin (WMD 2011). The reason for wide spread encroachment includes rice cultivation, dairy farming, industrial development, urban settlement, brick-making, sugar-cane plantation, floriculture and horticulture.

4.1.5 The Prospect of Climate Change

There is overwhelming scientific evidence of a warming trend in the earth's temperature, and consensus about the movement towards intensified extreme events such as floods and droughts.

Many efforts have been made at understanding and predicting the future climate over the equatorial plateau. The climate models give contradicting and wide-ranging results. While a warming trend is common in all models, some predict a drier and others a wetter climate, depending on which global circulation model (GCM) is used. The low resolution of the GCMs makes it difficult to predict regional and local weather patterns.

While the direction and magnitude of change in rainfall is yet unclear, anecdotal evidence suggests an increase in the temporal variability of rainfall in Uganda in recent years. It has been reported that the rainy season has become shorter and more intense, and subject to erratic onset and cessation, making it very difficult for farmers to plan the farming calendar. It has not been possible, however, to verify these reports at this point in time and determine significant long-term trends in rainfall patterns in Uganda because of insufficient data.

Likely impacts of the continuing warming trend because of climate change include:

i. Higher evaporation and consequent increased losses from reservoirs and lakes;
ii. Higher evapotranspiration rates and rising crop water requirements;
iii. A consequent increase in demand for irrigation water, and an increased vulnerability of rainfed agriculture to drought;
iv. An exacerbation of desertification in drier regions such as Karamoja, which are apt to lose more moisture if the weather is hotter; it will possibly increase wind erosion, lead to further land degradation, and pose a threat to the pastoralist lifestyle that dominates the semi-arid zones;
v. Hotter and longer dry periods which will increase drought risks, especially in drier regions;
vi. Increased variation in precipitation and risk of moisture deficit at critical stages of crop growth; this could jeopardize agricultural production in rainfed areas, with subsequent consequences for food security and standards of living in rural areas;
vii. Higher frequency and intensity of severe rainstorms that will lead to increased flood risk and storm damage, also in urban areas;
viii. Higher water temperatures, which increase algal productivity and reduce oxygen dissolution, among other effects.

Lake Victoria water levels and White Nile flows are particularly sensitive to climate change. The principal components of the Lake Victoria water balance are over-lake rainfall (82-85% of total inflow) and lake evaporation (75-78% of total outflow). This makes Lake Victoria very sensitive to changes in precipitation and temperature, as demonstrated by the large inter-annual fluctuation of historic net basin supply (fig 4.7). While the general warming trend of the global climate would lead to an increase of the evaporation rate, its possible impact on the rain regime on the equatorial plateau is uncertain. Thus, the impact of climatechange on lake levels and the resulting Victoria Nile flows is uncertain. Thisapplies both to the magnitude and direction of a possible change. Changes in Lake Victoria outflow will first of all impact hydropower production on the Victoria and Kyoga Nile. It would also affect the extent and seasonal fluctuation of the Sudd wetlands in South Sudan.

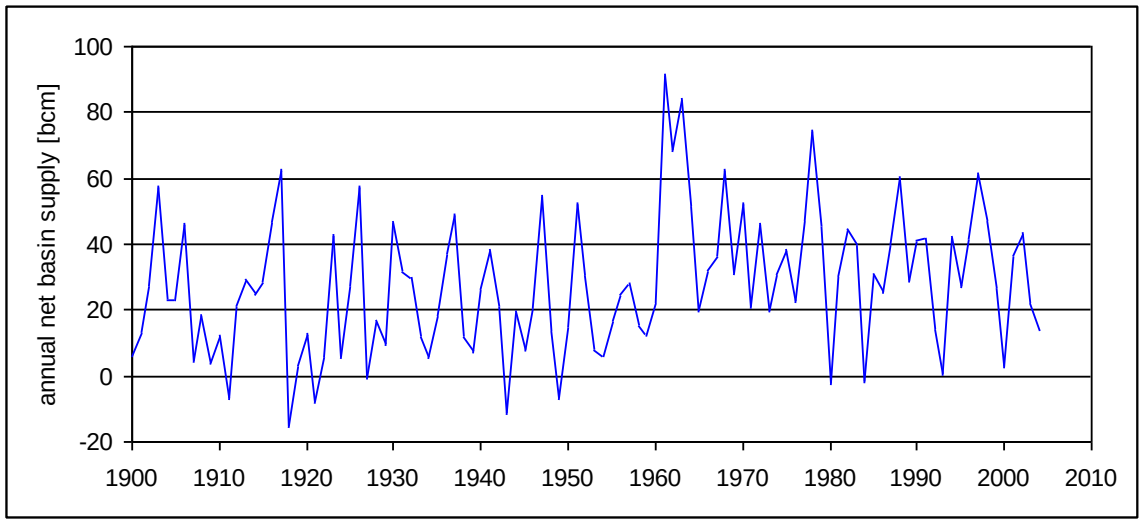

Figure 4.7: Historic net-basin supply of Lake Victoria

A number of factors make Uganda particularly sensitive to global warming. Key socio-economic factors are:

- the large rural population who derive their livelihood and food security from rainfed agriculture;
- a high dependency on hydropower for energy;
- a rapidly growing population that is putting unprecedented pressure on the natural resource base.

4.2 Key Water Resources Issues and their Implications

Thisparagraph presents in table format the key issues identified in the National Water Resources Assessment accompanied by a concise discussion of their implication.

Water Resources Issues	Implications
DOMESTIC WATER SUPPLY	
Future requirements for domestic water supply will grow substantially, but will still be at low service level; total domestic water use is estimated at 650 mcm/year by 2030, which can be met from a combination of ground and surface water sources.	Domestic water supply needs can be fully met with proper investment planning, implementation and operation, and integrated management of water resources;
SURFACE WATER	
The specific runoff is generally low in spite of substantial rainfall; in large parts of the country, the runoff coefficient is less than 5%	Rain-use efficiency is very low; Only a minor proportion of rainfall reaches the Nile system; Increasing the amount of rainfall that is captured for productive use may change local hydrologic conditions but will not substantially reduce the Internal Renewable Water Resources (IRWR) or associated Nile flows;
There are very significant regional differences in rainfall and specific runoff	Uganda's water resources need to planned and managed in a spatial context
All surface water is transboundary in nature; the dependency ratio – i.e. that part of the renewable water resources originating outside the country – is about 69%.	Water resources management in Uganda has to be coordinated with the upstream and downstream riparians
There is insufficient knowledge of surface water resources, in particular at local level	Informed water resources management at local level - where most shortages are expected - is currently not possible
Poor sanitation has led to widespread bacterial contamination of surface water and protected drinking water sources	Health risks and increased costs for water treatment
The water quality implications of industrial pollution, urbanization, and oil exploration are still limited and local, but potentially large;the same applies for agricultural modernization and aquaculture development	Proper and timely regulation, and associated enforcement, can prevent/mitigate the negative impacts on water quality from emerging pollution sources

Water Resources Issues	Implications
SURFACE WATER (continuation)	
Excessive amounts of nutrients from non-point sources are reaching the water bodies (eutrophication); soil erosion, however, is mostly a localized problem	Land and water resources need to be managed jointly; improve participatory and integrated watershed management; protect forests and reverse deforestation
GROUNDWATER	
The sustainable groundwater potential is estimated at 5.7 bcm/year; current groundwater use is very low, and mostly for domestic water supply; groundwater demand projections for 2030 (for domestic and livestock water supply only) estimate use of about 15% of the sustainable groundwater potential	There is significant potential for development of groundwater resources for productive purposes (such as supplementary irrigation, livestock water supply, aquaculture, etc.)
There is inadequate information on local availability of groundwater	Informed ground water management at local level is currently not possible
Groundwater quality is generally acceptable although contamination is increasingly observed in selected areas, particularly due to fecal matter	Ground water generally safe for domestic water supply
ENVIRONMENT	
Wetlands cover over 10% of Uganda's land area and perform valuable ecosystem functions and other roles (seasonal grazing area, flood control); high population growth combined with agricultural land scarcity is driving wetland encroachment, which is increasing; wetlands have not been classified as a function of their ecological importance and key functions	Wetlands need to be preserved; however, since some level of wetland conversion seems inevitable, there is need to control this process; there is not enough information about individual wetlands to assess the implications of wetland development projects
Tourism (primarily eco-tourism) is growing rapidly and contributed 9.2% of GDP in 2008 (includes both direct and indirect contribution); Occasional insufficient dry-season flows in some rivers to maintain environmental integrity.	Water for environment is a key productive use, and may become one of the most economically important water uses

Water Resources Issues	Implications
AGRICULTURE	
Potential irrigation area (excl. supplementary irrigation) is small relative to the area under rainfed cultivation	Rainfed agriculture will remain the primary form of agriculture in the country and critical to food security and rural livelihoods
In 90% of Uganda, potential evaporation exceeds average annual rainfall; once every five years all crops experience a moisture deficit; global warming will lead to higher evapotranspiration rates while climate variability is increasing	(periodic) water scarcity in Uganda is at plot level; while rainfall in large parts of the country is sufficient to grow a crop, rainfed agriculture is subject to regular drought risks;low-cost drought mitigation measures are needed that can be adopted incrementally
In 50% of Uganda, the average annual rain deficit is below 400 mm; for most crops the moisture deficit in a 20% drought year (once every five years) is less than 100 mm;	Simple drought mitigation measures such as soil restoration, water harvesting, or supplementary irrigation can be effective for shallow droughts for most crops
LIVESTOCK	
There are inadequate drinking water facilities along the animal migration routes; storage volume of some facilities is low; conflicts over water points occur at the peak of the dry season	There is need for more facilities for provision of water for livestock; bulk water transfer may be needed to replenish storage facilities with inadequate volume
There is insufficient pasture in the dry season and low productivity of range lands; conflicts over grazing areas occur at the peak of the dry season	Need for improved management of livestock; there is a need to maintain seasonal wetlands and flood plains that are essential grazing areas
AQUACULTURE	
Aquaculture will become increasingly important; increasing pollution is associated with the rapid expansion of aquaculture, in particular cage culture at semi-industrial scale	Increasing water quality risks

Water Resources Issues	Implications
HYDROPOWER	
Lake Victoria is the principal reservoir for the cascade of (potential) hydropower facilities	lake hydrologic regime and release policies determine energy production in Uganda;
Hydropower production is sensitive to mid-term climate variability and output decreases during periodic hydrologic droughts; hydropower production will reduce significantly in case of drier hydrologic conditions of Lake Victoria because of climate change	Climate change could have a major impact on power production in Uganda
Small hydropower potential is about 210 MW, but likely seasonal	Most small hydropower needs to be connected to the grid and does not constitute a stand-alone solution to local power shortages
FLOODS	
Most flood affected areas are the low lying areas at the foothills of Mount Elgon and the Rwenzoris that are part of the original floodplain; floodplain encroachment is contributing to the severity of recent flood events; floods causes infrastructure and livelihood damages; flood waters, however, typically rise slowly, allowing villagers and livestock to move safely to higher dry ground; flash floods occur in a number of regions (including Karamoja)	Land use of the floodplains needs to be well regulated in order to allow productive use while accommodating periodic inundation
Large wetlands play an important detention role in mitigating flood impacts	Loss of strategic wetlands will increase flood risk and damage
Landslides regularly occur in mountainous areas in Eastern and Western Uganda due to steep slopes, soil type, land use, and high precipitation	There is need for integrated land and water management
Urbanization is increasingly leading to flash floods, in particular in built-up areas in Kampala	Increased health risks and storm water damage in urban areas
CLIMATE CHANGE	
Temperatures will rise while changes in precipitation are still unknown; it will affect the hydrologic conditions of lake systems and wetlands; more variability of the climatic parameters	Prepare for higher evapotranspiration and higher temperatures, and a more variable climate than historically recorded;there is a need to better understand the climate risks

4.3 Policy, Legal, and Institutional Framework

The principal policy and legal framework for the water resources in Uganda comprises of: the Water Action Plan (1994), the Water Policy (1999); the Water Act (Cap 152), the (Water Resources) Regulations S.1 No. 152-1 and the Water (Waste Discharge) Regulations, S.1 No 152-4. However, there are sectoral policies, legislation and regulations such as those related to oil and gas, mining, agriculture, transport, fisheries, wildlife, environment, forestry, public health, etc that contribute towards or have implications on water resources management.

At institutional landscape level, responsibility for water resources management is vested in the Ministry of Water and Environment (MoWE) and National Water Policy Committee. Other government ministries and agencies as well as districts have mandates over some aspects of water resources management. The MoWE and other ministries and lead agencies and districts collaborate with private sector, NGOs/CSO and research institutions in water resource management. Trans-boundary aspects of water resources management in Uganda is arranged through international cooperation framework such as the East African Community (EAC), Nile Basin Initiative (NBI), African Union (AU) and Inter-Governmental Authority on Development (IGAD).

Since 1994, there have been significant reforms in policy, legal and institutional frameworks. The reforms have taken into account specific issues of water resources management. This section describes an overview of the current policy, legal and institutional framework for water resources management.

4.3.1 Water Resources Management Policies

4.3.1.1 The National Water Policy (1999)

The National Water Policy (NWP), adopted in 1999, provides the overall policy framework for water resources management and development in Uganda. Its objective is "*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 with the full participation of the stakeholders*"

With regards to development of the National Water Strategy, the following policy principles and objectives are considered:

a) Policy principles

The guiding principles for water resources management contained in National Water Policy are:

i. freshwater as a finite and vulnerable resource, essential to sustain life, development and the environment,
ii. management of water resources at the lowest appropriate levels,
iii. the role of Government as an enabler in a participatory, demand-driven approach to development,
iv. the recognition of water as a social and economic good,

v. the integration of water and land use management,
vi. the essential role of women in the provision, management and safeguarding of water,
vii. the important role of the private sector in water management.

b) Policy objectives

The Objective is to *"Manage and develop the water re-sources 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 with the full participation of all stakeholders.*

In order to ensure the Uganda achieves the above objective, the National Water Strategy will seek toaddress the following aspects of water resources management as derived from the policy objective:

i. Recognition of water as key resources for Uganda's social and economic development.
ii. Strategies and actions that ensure an integrated and sustainable use and management of Uganda's water resources at all levels.
iii. Recognition and application of principles of Integrated Water Resources Management
iv. Deepening the de-concentration of water resources management approach (Catchment based Water Resources Management - CbWRM)
v. Public-Private Partnerships for WRM in order to enhance the participation of the private sector in monitoring and management of the resources in the form of self monitoring of permit conditions and payment of ecosystems services.
vi. Capacities for in-country training of water resources managers.

4.3.1.2 Sectoral Policies

a) The National Environment Management Policy, 1994

The National Environment Management Policy is the over-all policy for environmental management and coordination of environmental actions in Uganda. Its goal is to *promote of sustainable economic and social development that enhances environmental quality without compromising the ability of future generations to meet own needs*.

The following environmental management guiding principles that relate to water resources conservation and management will be considered in the Water Resources Strategy:

i. Sustainable management and development of the water resources in a coordinated and integrated manner so as to provide water of acceptable quality for all social and economic needs;
ii. Watershed management to control, conservation and regulation of the water balance in the catchment regions and water courses;
iii. Participatory water resources management at all levels;
iv. Monitoring and evaluating performance and outcomes /impacts of water policies, programs and projects;
v. Application of water management guidelines;

vi. Water resources planning for both surface and groundwater;
vii. Equitable and sustainable allocation of water for meeting ample quantities and good quality water for domestic, industrial, energy, and agricultural;
viii. Integrated Water Resources Management (IWRM).

b) The National Policy for the Conservation and Management of Wetlands Resources, 1995

The overall aim of the Policy is to *promote the conservation of Uganda's wetlands in order to sustain their ecological and socio-economic functions for the present and future well being of the people*. The policy provides for sustainable water supply and effluent treatment as core functions of wetlands. It requires that any wetland serving as a source of water supply or receiving effluent, as part of a designatedservice to any human settlement be declared a fully protected wetland from anyencroachment, drainage or modification.

Further, the policy recognises that wetland resources form an integral part of the environment and their conservation must be pursued in the context of an interaction between conservation and the overall development strategies and activities and wetland conservation would be achieved through a co-ordinated and co-operative approach involving all the concerned people and organisations in the country, including the local communities.

In this regards, the following aspects of wetlands functions and management requirements in relation to water resources management will be addressed in the Water Resources Strategy:

i. Flood and storm water control;
ii. Pollution control/management of pollutants and sediments/water purification;
iii. Water retention and discharge functions that sustain water availability;
iv. Options for wise use of wetland resources that do not affect the ecological function of the wetlands.

c) The Uganda National Land Policy, 2013

The goal of the Policy is: "*to ensure an efficient, equitable and optimal utilization and management of Uganda's land resources for poverty reduction, wealth creation and overall socio-economic development.* The policy provides principles and strategies on the natural resources and environmental management. It requires Government to ensure that all land use practices conform to land use plans and the principles of sound environmental management, including biodiversity preservation, soil and water protection, conservation and sustainable land management. One of the strategies for the policy is to mobilize communities and assist them to develop and implement actions or strategies for sound land management.

The following land policy measures relating to water resources management will be considered in the Water Strategy:

- ✓ Develop programs for the restoration of waste disposal sites, polluted watercourses, provide special protection for fragile ecosystem, including unique and sensitive biodiversity colonies, like hill tops, wetlands, water catchment areas, lake-shores and river banks;

- ✓ Compensation for all land owners whose land stretches into designated wetlands, hilltops, water catchment areas, lake shores, river banks and other sensitive eco-systems who acquired title before the coming into force of the 1995 Constitution and discontinue the alienation of designated wetlands, hilltops, water catchment areas, lake shores, river banks and other sensitive eco-systems by enforcing legislation, regulations, guidelines and standards;

- ✓ Integrated national and district level land use planning that compliments catchment management planning and IWRM principles, over-all.

d) The National Fisheries Policy, 2004

The overall goal of the policy is to *ensure increased and sustainable fish production and utilization by properly managing capture fisheries, promoting aquaculture and reducing post harvest losses*.
The following policy objectives and strategies relate to water resources management: i) co-operating with neighbouring states on the management of shared water bodies ii) supporting and participating in bilateral and regional processes and institutions for the management of shared water bodies, iii) initiate and encourage stocking programmes to improve fisheries diversity and productivity of the water bodies with fish from the same waters; iv) encourage involvement of communities in restocking andmanagement of fish stocks in water reservoirs and minor lakes; v) encourage Local Government implement stocking programmes in dams, reservoirs and small waterbodies with participation of the communities; vi) Strengtheninginstitutional arrangements for safeguarding national interests in international waters.

The Water resources strategy will consider the following aspects of the fisheries policy: monitoring and regulating likely effects of aquaculture and cage fish farmingon water quality.

e) The National Forestry Policy, 2001

The main goal of the policy is to *establish an integrated forest sector that achieves sustainable increases in the economic, social and environmental benefits from forests and trees by all the people of Uganda, especially the poor and vulnerable*. The Policy provides policy directives on watershed management and soil conservation. It requires that watershed protection forests will be established, rehabilitated and conserved. It further commits the government to promote the rehabilitation and conservation of forests that will protect the soil and water in the country's key watersheds and river systems.

The Water Strategy willconsider the following forestry policy issues related to water resources management:

i. Watershed/catchment forest management;

ii. Development and implementation of Catchment management plans.

f) National Oil and Gas Policy for Uganda, 2008

The goal of this policy is to *ensure that the use the country's oil and gas resources contribute to early achievement of poverty eradication and create lasting value to society.*With respect to water (and environment) management, the policy requires protection of the environment and conservation of biodiversity form oil and gas activities. It imposes the responsibility of the oil companies to protect the environment where they work or any areas in the country impacted by their operations. The Policy requires government to ensure that oil and gas activities are undertaken in a manner that conserves the environment and biodiversity and also to put in place legislation for regulating and monitor compliance of with environmental standards.

Further, the Policy commits governmentto support control measures against the release of hazardous gases, chemical wastes and spills into the atmosphere, water bodies, aquifers and soils which will ensure that water remains safe for animals, fish and human consumption.

The Water resource strategy will consider the following Oil and gas policy issues related to water resources management:

i. Regulation and monitoring of likely pollution and impacts of pollution on surface and ground water;
ii. Compliance with Water Use Regulations through securing water abstraction permits and complying with permit conditions;
iii. Management Oil wastes and their disposal.

g) The Energy Policy for Uganda, 2002

The main goal of the Policy is *to meet the energy needs of the Ugandan population for social and economic development in an environmentally sustainable manner*. The Energy policy prioritises development of renewable energy, including increasing hydropower generation to approximately 4,000MW by 2040. The energy policy recognises linkages between the energy sector and the other sectors including economy, environment, water resources, agriculture, forestry, industry, health, transport, education, decentralisation and land use.

The Water Strategy will consider the following policy aspects relating to water resources management:

i. Providing , on sustainable basis, adequate quantities of water for hydropower generation;
ii. Regulating and monitoring water use for hydropower generation.

h) The Uganda Wildlife Policy, 1999

The overall aim of the Policy is to *promote the long term conservation of the country's wildlife and biodiversity in a cost effective manner which maximises the benefits to the people of Uganda*. The policy recognises management of water bodies within wildlife protected areas as wildlife/biodiversity habitat and tourism attraction.

The Water Strategy will consider the following policy aspects relating to water resources management:

i. Regulating water based tourisms activities;
ii. Monitoring likely effects of tourism activities on water quality.

i) The Mining Policy of Uganda, 2000

The goal of the Policy is to *develop the mineral sector, for it to contribute significantly to sustainable national economic and social growth by creating gainful employment and providing alternative source of income particularly for the rural population in Uganda.* One of the objectives of the policy is to minimise and mitigate the adverse social and environmental impacts of mineral exploitation. It requires the Government to ensure that there is compliance with the existing laws and regulations on the environment and the protection of human health and safety. Further, the policy requires government to strengthen the environmental monitoring unit of the lead ministry, carry out sensitisation of the society on the impact of mining on environment, promote the application of environmentally friendly technologies and methods in mineral exploitation, ensure health and safety regulations in all stages of mineral development through regulations and education and undertake responsibility for the cleanup operations of past negative mining environmental impacts.

The Water Strategy will consider the following policy aspects relating to water resources management:

i. Monitoring likely water pollution from mining operations;
ii. Collaborating with lead ministry in planning and promoting mining technologies and approaches which cause minimal harm on hydrological systems.

j) The National Health Policy, 2010

The overall objective of health sector policy is to *reduce mortality, morbidity and fertility, and the disparities therein.* It requires the Government to address the increasing burden of disease resulting from water borne diseases associated with safe and clean water, hygiene and environmental sanitation.

The Water Resources Strategy will consider the following policy aspects relating to water resources management:

i. Increasing access to adequate clean and safe water for domestic use;
ii. Awareness about water sanitation, hygiene and waste management;
iii. Improved sanitation facilities and waste management facilities.

k) The Uganda Gender Policy, 2007

The Policy objective is to establish a clear framework for identification,implementation and coordination of interventions designed to achievegender equality and women's empowerment in Uganda. The policy recognizes therole of women and youth in access and use of water at household levels. It anchors the importance of gender responsiveness in terms of planning, implementation and management of water and sanitation initiatives.

The Water Strategy will consider the following policy aspects relating to water resources management:

i. Gender mainstreaming in water access and sanitation facilities.

l) The Uganda Tourism Policy, 2003

The policy objective is Tourism development should be based on a wide participation of Ugandan and foreign investors and it should form the basis for protection of the environment including financial support for developing national parks and protected areas. Tourism development must be socially and culturally acceptable. The policy aim to ensure that tourism becomes a future vehicle for poverty reduction. The policy recognizes the importance of water based tourist attractions such scenery, sport fishing, *bunjee* jumping, water rafting, etc.

The Water Strategy will consider the following policy aspects relating to water resources management:

i. Regulating water use for tourism;
ii. Monitoring likely pollution associated with tourism.

4.3.2 Water Resources Management Legal Framework

Uganda has up to-date legislation for regulating water resources management and utilization. The Constitution of Republic of Uganda is the supreme law while the Water Act cap 152 is the principal law for water. TheWater Resources Regulations (S 152-1) and The Water (waste discharge) Regulations (S 152-4)provide for water use and management of waste water respectively. In additional, sectoral legislation on environment, wildlife, forestry, mining, energy, oil and gas, transport, Public health, fisheries, etc make specific water resources use and management provisional.

The key legislation and Regulations are as elaborated in sections here under.

4.3.2.1 The Constitution of Uganda (amended 2005)

The Constitution of the Republic of Uganda makes provision for natural resources of which water forms an integral part. Article 237 imposed the duty on the central government or local government to hold natural resources such as lakes and rivers in trust for the people of Uganda. As a trustee government only has power to regulate use of these resources in form of concessions, licenses or permits.

Principle XIII –XXVII of the Constitution imposes obligations on the central government to manage water resources. The central government is required to take all practical measures to promote good water management systems at all levels and promote sustainable development and public awareness of the need to manage land, air and water resources in a balanced and sustainable manner for the present and future generations, and utilization of natural resources in such a way as to meet the development and environmental needs of present and future generations. Under Article 39 every Ugandan has a right to a clean and healthy environment.

The Constitution provides the broad legal and policy framework within which all water sector legislation, policies and institutional framework for water resources management are developed. Several Acts have been passed to provide a legal framework for directing development efforts towards achieving the national objectives set out in the Constitution.

The Water Strategy will consider the following aspects of water resources management in accordance with the Constitutional provisions:

- Ensuring the central government and local government implement the public trust doctrine in regulation and management of water resources;
- Promoting sustainable water use and participation by stakeholders;
- Ensuring the principle of clean and healthy environment so as to control water pollution control;
- Strengthening legal and policy framework as well as water resources development strategies and plans so as achieve sustainable water management.

4.3.2.2 The Water Act Cap 152 and Regulations

4.3.2.2.1 The Water Act Cap 152

The Water Act cap 152 is the principal law for the management of water resources in Uganda. The Act provides for the use, protection and management of water resources and supply; and, also provides for the constitution of water and sewerage authorities and facilitates the devolution of water and sewerage undertakings.

Notable among the objectives of this Act are the promotion of rational management and use of waters of Uganda; promoting the provision of clean and safe sufficient water supply to domestic purposes to all persons; allowing orderly development and use of water resources for purposes other than domestic (such as livestock watering, irrigation, agriculture, industrial, commercial and mining purposes, hydroelectric power generation, preservation of flora and fauna etc) in ways which minimize harmful effect to the environment; and the control of pollution and promoting safe storage, treatment, discharge and disposal of waste which may pollute water or otherwise harm the environment and human health. It also provides for penalties for offenders.

The Act establishes Water Policy Committee (WPC as an inter-sectoral body, whose function is to advise the Minister responsible for Water on various aspects of water resource management which include among others coordination the preparation and revision of water action plan.

The Water Resources Strategy is therefore a planning and management tool to implement the Water Act by the sector institutions in collaboration with the stakeholders and partners.

4.3.2.2.2 Water Regulations

The principal water regulations are the Water Resources Regulations S 152-1 and Water (waste discharge) Regulations, S 152-4

a) The Water Resources Regulations S 152-1

These regulations define procedures of application and regulation of water abstraction permits. Under the Regulations a person who occupies or intends to occupy any land wishes to construct, own, occupy or control any works on or adjacent to land on or adjacent to which there is a motorised water pump which, whether temporarily or permanently, pumps water from a borehole
or waterway; there is weir, dam, tank or other work capable of diverting or impounding an inflow of more than 400 cubic meters in any period of twenty-four hours or there are works for non consumptive uses requires to acquire a permit.

b) The Water (waste discharge) Regulations, S 152-4

These regulations provides for the establishment of standards for effluent or waste before discharge into water or on land, prohibition on the discharge of effluent or waste, and the requirement for waste discharge permits. They impose an obligation for every industry, establishment or holder of a waste discharge permit to install anti-pollution equipment for the treatment of effluent or waste discharge emanating from the industry. They provide for sampling of effluent and wastewater analysis by environmental inspectors and waste discharge fees which are a basis for the polluter-pays principle.

There have been reforms that affect the implementation of the Water Act and Regulations. These reforms were established administratively and the Water Act and the regulations are being reviewed to legalize the operations of the Directorate of Water Resources Management.

Regulations are also being drafted legalize the operation of water management zones; regulate rain harvesting and dams safety.

The Water Resources Strategy, building on the strength of these legislations and Regulations will seek to address the following areas of weak performance:

i. Regulating water use/abstraction, waste water and effluent discharge;
ii. Planning for water resource use and management;
iii. Harmonized institutional mandates and better performance (MoWE, WPC, DWRM, DWD NWSC);
iv. Coordination of water resources management and development by strengthening the involvement of NGOs, civil society, umbrella organisations and private sector.

4.3.2.3 The National Environment Act Cap 153 and Environmental Regulations

4.3.2.3.1 The National Environment Act Cap 153

This Act provides for sustainable management of the environment, establishment of the National Environment Management Authority as a coordinating, monitoring and supervisory body for that purpose. It provides the framework for coordinated and sound management of the environment including environmental impact assessment of water resources related projects and setting water quality and effluent standards. The Act thus plays an important role in the management of water resources in the following aspects: approval of EIA in consultation with the lead agency; establishment of water quality standards in consultation with the lead agency; issuing guidelines for the management of environment of lakes and rivers; protection of banks of rivers and shores of lakes in Uganda from human activities that will adversely affect the rivers and the lakes, regulation of pollution of land or water.

The implications of the Act for the Water Resources Strategy are that NEMA and DWRM have to collaborate to ensure that standards for water quality are ensured and maintained. Therefore, the Water Resources Strategy will provide measures for strengthening institutional collaboration between NEMA and water sector institutions and stakeholders in realizing the above mentioned provisions in the Environment Act.

4.3.2.3.2 The Environment Regulations

(a) The National Environment (Standards for Discharge of Effluents into Water or on Land) Regulations, SI 153-3

The Regulation addresses discharge of effluents on to land or water. It sets the maximum permissible limits for effluent or waste water before it is dischargedinto water or on land. The Regulations empower the Executive Director or a person authorised by him or her to issue guidelines and recommend the method of treatment of effluent for industries or establishments so as to ensure assimilation by the water or land into which the effluent is discharged. They also impose a general obligation on every industry or establishment shall install at its premises, antipollution equipment for the treatment of effluent and chemical discharge emanating from the industry or establishment.

(b) The National Environment (Delegation of Waste Water Discharge Functions) Instrument S.1 No. 153-4.

The Regulations address delegated function of regulating discharge of waste water from industries to from NEMA to the Director, DWD. The National Environment Act requires that that an operator of a plant undertakes pre-treatment of effluent before discharge into any water in accordance with the Act and the National Environment (Standards for Discharge of Effluent into Water or on Land) Regulations.

(c) The National Environment (Waste Management) Regulations, S 153-2

The Regulationsaddress the management of solid wastes. These Regulations apply to all categories of hazardous and nonhazardous waste; to the storage and disposal of hazardous waste and its movement into and out of Uganda and) to all waste disposal facilities, landfills, sanitary fills and incinerators. The Regulation require a person licensed to own or operate a waste treatment plant or disposal site to ensure that the waste treatment plant or disposal site is a radius of at least
one thousand metres away from a residential or commercial area and from water sources; the waste treatment plant or disposal site is enclosed and secure from scavengers and the waste treatment or disposal site has hazard and safety signs.

(d) The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations, SI 153-5

These regulations provide for the management of wetlands, lake shores and river banks, ensuring water catchment conservation, sustainable utilization and conservation of resources involved, promoting the integration of wise use of resources, and prevent and control of pollution and degrading activities. It also provides for a mandatory environmental impact assessment for developments within wetlands, lake shores or river banks likely to have significant environmental impacts, as well as annual environmental audits. It also provides for application procedures for permits for regulated activities in these protected areas, defines regulated activities, wetlands of international importance, and names rivers and lakes for which buffer zones of up to 100 m and 200m respectively are mandatory.

(e) The Environment Impact Assessment Regulations, Statutory Instrument 153—1

The regulations apply to all project of out of character with its surroundings or any structure of a scale not in keeping with its surroundings or major changes in land use. Thus they require that no developer shall implement a project for which environmental impact assessment is required under the Act and under these Regulations unless the environmental impact assessment has been concluded in accordance with the Regulations. The regulations require that in case a project affect water, that the lead agency for shall make written comments on the project brief and transmit them to the executive director of NEMA within fourteen working days of receiving it and where the lead agency fails to make comments and transmit them to the executive director within the period specified in the executive director may proceed to consider the project brief. They also provide that an environmental impact study shall be conducted in accordance with terms of reference developed by the developer in consultation with the NEMA and the lead agency. The Lead Agency is also required to make comments on the EIS and transmits them back to the ED within thirty working days of receiving the environmental impact statement.

(f) The National Environment (Hilly and Mountainous Areas Management) Regulations, SI 153-6

These Regulations aim at facilitating sustainable utilization and conservation of resources in mountainous and hilly areas by and for the benefit of the people and communities living in the area and

promoting the integration of wise use of resources in mountainous and hilly areas into the local and national management of natural resources for socio-economic development.

The Regulations require that that occupiers of land in mountainous and hilly areas observe the carrying capacity of the land; carry out soil conservation measures, utilize underground and surface water catchments areas and use available technologies to minimize significant risks to the ecological and landscape aspects and maintain vegetation cover as may be determined by an Agricultural Extension Officer. The hilly areas and mountains in Uganda are known for their catchment values and are a source of numerous rivers and streams, and whose land covers degradation and soil erosion is having a siltation impact on these rivers.

The Water Resources Strategy will aim at proposing measures for strengthening:

i. Effectiveness of delegated function, including the functional role of DWD and DWM in the delegated responsibilities;
ii. Capacity for enforcement and compliance monitoring, including data management (collection, analysis, sharing);
iii. Compliance assistance (and incentives for compliance/disincentives for non compliance e.g., punitive measures);
iv. Institutional collaboration in enforcement, monitoring and reporting;
v. Institutional participation in reviewing and approving EIAs.

4.3.2.3.3 The Local Governments (Kampala City Council) (Solid Waste Management) Ordinance S I 243—21

The Ordinance was made under sections 38 and 40 of the Local Government Act. This Ordinance applies to all areas of the district, including private premises, Government-owned properties and council properties. It requires that disposal of refuse on the ground shall be by controlled sanitary landfill method. It also requires that no person other than the council shall operate or maintain a sanitary landfill without a permit issued by the council or otherwise than in accordance with this Ordinance and any other written law in force. The applicant to operate a sanitary landfill shall be accompanied by a plan showing the following among other things depth to ground water and proximity to surface water or drainage courses. It requires that a landfill operator to prevent the pollution of surface or groundwater and prevent or eliminate any public nuisance on the premises.
A landfill operator is required to provide at the premises adequate water supply.

The Water Resources Strategy will aim at proposing measures for strengthening:

i. Capacity for controlling and monitoring likely pollution from landfills.

4.3.2.4 The Local Government Act Cap 243

The Local Governments Act defines roles for different levels of government in provision and management of water and sanitation related activities. The Act stipulates that provision of water for domestic use and maintenance of facilities is a role of Local Governments in liaison with the Ministry responsible for Water Affairs. The Act empowers the different levels of government to plan and implement development interventions according to identified local priorities.

Part 2 of the Second Schedule to the Act prescribes the functions of Government that the District Councils are responsible for. The following are the functions relevant to water resource management are: forests, wetlands, environment, sanitation and protection of streams/river banks and lakeshore.

Part 3 of the Second Schedule to the Local Governments Act, prescribes the functions for which the Urban Councils are responsible. Some of the functions relevant to water resource management are: providing sanitary services and providing water services outside the jurisdiction of National Water and Sewerage Corporation.

Under part 4 of the Schedule, the District councils may devolve services and functions to the Lower Local governments including the protection of wetlands, the protection and maintenance of local water resources and any other functions the District may delegate. It is not clear how many districts have formally devolved these functions.

The Water Resources Strategy will seek to strengthen the mandate of Districts Authorities, Urban Authorities and lower Councils, in the following priority areas:

i. Enforcement and monitoring compliance of delegated mandates;
ii. Enacting ordinances and bylaws for regulating water related uses;
iii. Increasing access to clean and safe water and sanitation facilities;
iv. Participation in IWRM/Catchment based Water Resources Management;
v. Participation in national level policy planning and implementation processes.

4.3.2.5 The Kampala Capital City Act, 2010

The Act establishes the Kampala Capital City Authority (KCCA) as the governing body of the city. KCCA is mandated among other things to construct and maintain major drains, developing Physical Development Plan for the Capital City and themetropolitan area and provide safe water and sanitation in the communities. The division Urban Councils are mandated among other things to manage public health and environment.

The Water Resources Strategy will include measures for strengthening institutional collaboration between KCCA and water sector institutions in the following mandates:

a. City Urban planning for water supply and waste water treatment;

b. Management of sources or causes of pollution including management of sewer, storm water and other non-point sources of pollution e.g., motor garages and vehicle washing bays.

4.3.2.6 The Land Act Cap 227

The Land Act provides for the tenure, ownership and management of land. It requires a person who owns or occupies land to manage and utilize the land in accordance with the environmental laws and other laws including the Water Act. It provides that the Government or a local government shall hold in trust for the people and protect natural lakes, rivers, ground water, natural ponds, natural streams, wetlands, forest reserves, national parks and any other land reserved for ecological and touristic purposes for the common good of the citizens of Uganda and thus the Government or a local government shall not lease out or otherwise alienate any natural resource. The two governments may grant concessions or licenses or permits in respect of a natural resource. It restricts all rights in the water of any natural spring, river, stream, watercourse, pond, or lake on or under land, whether alienated or un-alienated to the Government. Thus no such water shall be obstructed, dammed, diverted, polluted or otherwise interfered with, directly or indirectly, except in pursuance of permission in writing granted by the Minister responsible for water or natural resources in accordance with the Water Act. However, the Act allows reasonable use by occupier or owner of a piece of land, of water for domestic and small-scale agricultural purposes.

The Water Resources Strategy will provide measures for strengthening collaboration between MHLUD and water sector institutions the following priorities:

a. Physical Planning;
b. Integrated land use planning and management.

4.3.2.7 The Uganda Wildlife Act Cap 200

The Act provides for sustainable management of wildlife, to consolidate the law relating to wildlife management, establish a coordinating, monitoring and supervisory body for that purpose (Uganda Wildlife Authority- UWA) whose principal function is to ensure sustainable management of wildlife resources in Uganda.Further the Actprovides for declaration of an area of land or water a Wildlife Conservation Area. The latter provision has important implication for the Water Act in reference to use of water resources in Uganda.

The Water Resources Strategy will provide measures for strengthening institutional collaboration between lead ministry and UWA in the following priority water resources management issues:

a. Management of water resources for biodiversity purposes;
b. Management for water resources to promote water based tourism;
c. Monitoring likely effects of water based tourism on water quality;
d. Access/use of water resources within wildlife protected areas;

e. Management of watershed/catchment designated Wildlife Conservation areas (forested national parks).

4.3.2.8 National Forestry and Tree Planting Act, 2003

The National Forestry and Tree Planting Act (2003) provides for the conservation, sustainable management and development, and use of forests for the benefit of the people of Uganda. The Act Section empowers the Minister to declare a strict nature reserve for the purpose of protecting streams, rivers, lakes, lakeshores, riverbanks or wetlands. It provides that an order declaring a local forest reserve shall be revoked only where soil, slope, or other watershed conditions will not be irreversibly damaged and further provides that the forests shall be developed and managed so as to conserve natural resources, especially soil, air and water quality. In essence, the Act aims at protection the water sources and hydrological function of forests covering water shed/catchments.

The Act empowers a District Council accordance with the Local Governments Act to establish a District Forestry Office and appoint a District Forestry Officer and such other officers whose functions include liaising with the National Forestry Authority and other lead agencies on matters relating to forestry; promoting the planting of trees; undertaking duties involved in the management of local forest reserves; advising and supporting the management of community forests and assisting in the development and provision of advisory services relating to private forests.

The Water Resources Strategy will provide measures for strengthening institutional collaboration between lead ministry, NFA, FSSD and Districts in the following priority water resources management issues:

a. Development and implementation of Catchment management plans;
b. Access/use of water resources within protected forests (Forest reserves);
c. Management of watershed/catchment designated forest reserves.

4.3.2.9 The Public Health Act Cap 281

The Act consolidates the law in the respect of Public health. It place duties on the Urban and local authorities in matters pertaining to public health. It requires every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes, whether the supply is derived from sources within or beyond its district and for purifying any such supply which has become so polluted. It can take measures, including if necessary, proceedings at law, against any person so polluting any such supply or polluting any stream so as to be a nuisance or danger to health.

The Water Resources Strategy will provide measures for strengthening institutional collaboration between lead ministry, Urban Authorities and Local Authorities in the following priority water resources management issues:

a. Water pollution control and management from storm water, waste water, sewer and non-point sources;
b. Development and enforcement of ordinances and bylaws on water use and pollution control;
c. Increasing access to safe and clean water and sanitation facilities.

4.3.2.10 The Fish Act Cap 197

The Act governs the utilization and management of fisheries resources. It controls fishing in the following water bodies' aquarium dam, fish pond and shores. It empowers the Minister by statutory order to declare that all or any specific provisions of the Act relating to licences may not apply to any area or waters of Uganda. The Minister is also empowered in his or her discretion to exempt any person or persons from all or any of the provisions of the Act either generally or in respect of any particular area or waters.

The implications of this Act for the Water Resources Strategy is that there is a need for DWRM collaborate with the Fisheries Department regarding the regulation new fisheries management technologies for example cage fish farming and aquaculture. The Water Resources Strategy will provide measures for:

a. Institutional collaboration in licensing and monitoring compliance of cage fish farming and aquaculture to Water Act, Water Regulations and Water quality Standards;
b. Monitoring likely effects on cage fish farming and aquaculture on water quality.

4.3.2.11 The Mining Act, 2003

The Act provides for the ownership, prospecting and mining of minerals in Uganda. It restricts mining activities in water. The Act provides that all rights in wetlands and in the waters of any spring, stream, river, watercourse, pond or lake on or under public land, are vested in the Government; and no such wetlands or water shall be obstructed, dammed, diverted, polluted or otherwise interfered with, directly or indirectly, except in accordance with the provisions of Part II of the Water Act. It regulates the grant of water rights thus every application for a mineral right shall indicate whether the applicant intends to utilise for prospecting, exploration and mining operations any water existing within the boundaries of his or her mineral right or to utilise any natural source of water existing at the site to which mining products are conveyed for washing to obtain and convey to the area of his or her mineral right from any natural water supply outside the boundaries of the mineral right, such specified volume of water as may be required for the relevant operations or to occupy any land that may be required for the construction of a dam, reservoir or pumping station and for the conveyance of such water to the area where the water is utilised, by means of pipes, duets, flumes, furrows or otherwise, and for such conveyance to

have a right of passageway or to construct any works necessary for the collection, storage or conveyance of such water.

The Water Resources Strategy will provide measures for strengthening collaboration between lead ministry, Department of Geological Surveys, Districts and stakeholders in the following aspects:

i. Processing mining and prospecting licenses where water resources are likely to be involved/affected;
ii. Enforcing mining licence conditions in relation to water, wetlands and drainage systems;
iii. Monitoring pollution from mining operations.

4.3.2.12 The Petroleum Acts

Petroleum exploration, development, production, refining, conversion, transmission and midstream storage is regulated by the Exploration, Development and Production) Act, 2013 and Refining, Conversion, Transmission and Midstream Storage) Act, 2013. The two acts require a licensee to carry out petroleum activities in the licenced area in a proper and safe manner and in accordance with the requirements of the applicable law, regulations and conditions stipulated by lawful authorities and best petroleum industry practices. He or she is also required to take all reasonable steps necessary to secure the safety, health, environment and welfare of personnel engaged in petroleum activities in the licence area including controlling the flow, and preventing the waste or discharge, into the surrounding environment, of petroleum, gas which is not petroleum or water and preventing the escape of any mixture of water or drilling fluid, and petroleum or any other matter.

The Petroleum Authority is mandated to direct a licencee to prevent water or any other matter entering any reservoir through the wells, except when in accordance with properly approved plans and best petroleum industry practices or prevent the pollution of any water well, spring, stream, river, lake or reservoir by the escape of petroleum, water, drilling fluid, chemical additive, gas not being petroleum or any other waste product or effluent.

The Water Resources Strategy will provide measures for:

a. Strengthening collaboration between lead ministry, PEPD, Petroleum Authority, Oil and Gas companies and stakeholders in developing joint management procedures, guidelines and capacities for preventing, monitoring or managing pollution from drill waste water and fluids, oil spills, etc.

b. Providing adequate water for the “high value projects” such as oil refinery and exploration activities.

4.3.2.13 The National Water and Sewerage Corporation Act Cap 317

The Act establishes the NWSC as a water and Sewerage Authority and gives it the mandate to operate and provide water and sewerage services in areas entrusted to it on a sound commercial and viable basis. Presently, NWS operates and provides water and sewerage services for 23 large urban centres across the country including Kampala City.

The Water Resources Strategy will provide measures for:

a. Increasing supply of adequate quantities clean and safe water to all populations, especially, urban population;

b. Institutional collaboration with water sector institutions in waste water/sewer management and pollution control in area sunder NWSC jurisdiction.

4.3.2.14 The Rivers Act Cap 357

The Act regulates dredging in riversand the use of steam vessels onrivers. It requires any person wishing to dredge a river to acquire a licence from theMinister responsible for Water resources. The Act affects such activities on rivers listed in the first schedule including:Aswa,Kafu,Kagera,Katonga,Mayanja, Sezibwa and Nile (portion from Lake Victoria to LakeAlbert). The Act requires the master of every steam vessel on a river to acquire a licence for that vessel.

The Water Resources Strategy will provide measures for strengthening collaboration between DWRM and DWM in:

a. Processing dredging licence;
b. Monitoring likely impact of dredging in riversand the use of steam vessels onrivers in first schedule.

4.3.2.15 The Control of Agricultural Chemicals Act Cap 29

This Act regulates the manufacture, storage, distributionand trade in, use, importation and exportation of, agriculturalchemicals and for other purposes connected therewith. It establishes the Agricultural Chemicals Board and one of the members should be a public officer appointed by the Minister responsible formatters relating to the environment. The Board is charged with ensuring that agricultural chemicals are properly managed throughregistration, labelling, issuance of licences regulating quality and importation.Where an inspector believes on reasonable grounds that this Actor any regulations made under it has or have been contravened, he or she mayseize and detain the agricultural chemicals by means of or in relation towhich he or she believes the contravention was committed. However, the Act does not make strong provisions for disposal of agricultural chemicals.

The Water Resources Strategy will provide measures for strengthening collaboration between Lead Ministry and water sector institutions in:

a. Participation in the Agricultural Chemicals regulatory body (Agricultural Chemical Board);
b. Promoting safe handling, application and disposal of Agricultural Chemicals;
c. Monitoring likely pollution arising from use of agricultural chemicals as one of the non-pointsources of water pollutants.

4.3.2.16 The Inland Water Transport (Control) Act Cap 356

The Act restricts and controls thecarriage of goods andpassengers by water withinUganda.This Act requires any person interested in conveying goods by means of a ship on inlandwaters of Uganda, to apply for a licence. The Act defines the Board as the Transport Licensing Board established by theTraffic and Road Safety Act. The Board is empowered to attach to any licence the condition that certain classes ordescriptions of goods shall or shall not be carried or any other conditions deemed necessary,in public interest.

The Water Resources Strategy will provide measures for strengthening collaboration between Lead Ministry and Transport Licensing Board in:

a. Promoting safe conveying goods by means of a ship on inland waters;
b. Monitoring likely pollution arising from use of water transport vessels.

4.3.3 International Law Requirements and Implications for Water Resources Management in Uganda

There are several international agreements and customary international law principles that have implications for water resources management.

4.3.3.1 Agreements that Uganda Has Signed

(a) The Treaty for the Establishment of the East African Community 1999

The EAC treaty covers five partner States of Kenya, Uganda and Tanzania, Burundi and Rwanda. One of the objectives of the treaty is promotion of a sustainable growth and equitable development of partner States including rational utilization of the region's natural resources and protection of the environment. The treaty provides that States agree take measures to control trans-boundary water pollution arising from developmental activitiesadopt common environmental standards for the control of water pollution arising from urban and industrial development activities and exchange information on water and harmonize their policies and regulations for the sustainable and integrated management of shared natural resources and ecosystems.

The implications of the treaty for the Water Resources Strategy are that Uganda has to strengthen the institutional framework for promoting trans-boundary water resources management, especially, Lake Victoria and its catchment.

(b) The Protocol for Sustainable Development of Lake Victoria Basin 2003

Uganda as signatory of the EAC Treaty also signed the Lake Victoria Protocol. This protocol is a detailed document aimed at sustainable development in Lake Victoria.Sustainable development, management and equitable utilization ofwater resources is one of the areas of co-operation. It requires partner states toprevent pollution at sourceprevention and non-point sources

The implication of this Protocol for the Water Resources Strategy is that Uganda as a signatory to the Protocol is required to enforce measures that require developers of planned activities to prevent pollution, and where prevention is not possible,minimize pollution.

(c) The Convention for the Establishment of the Lake Victoria Fisheries Organization, 1994

Uganda is one of the parties to the Convention. The Convention establishes the Lake Victoria Fisheries Organisation (LVFO) whose main objective is to foster co-operation among the Contracting Parties, harmonize national measures for the sustainable utilization of the living resources of the Lake and to develop and adopt conservation and management measures. To achieve the objectives, the LVFO has the responsibilities to: promote the proper management and optimum utilization of the fisheries and other resources of the Lake; to provide a forum for discussion of the impacts of initiatives dealing with the environment and water quality in the Lake basin and maintain a strong liaison with the existing bodies and programs and provide for the conduct of research concerning the waters of Lake Victoria, including without limitation the quality of such waters, in particular with respect to supporting the living resources of the Lake and the nature, extent and pathways of its pollution and other forms of environmental degradation;

The implication of this Protocol for the Water Resources Strategy is that Uganda is the seat of the LVFO which is important for strengthening its position of management of fisheries resources in Lake Victoria.

4.3.3.2 Agreements that Uganda Has Signed but Not Ratified

(a) The Nile River Basin Cooperative Framework Agreement 2010

Uganda signed the Cooperative Framework Agreement (CFA) on the 14th May 2010. The CFA covers the use, development, protection, conservation and management of the Nile River Basin and its resources. It also establishes an institutional mechanism for cooperation among the Nile Basin States.

The implications of the CFA for the Water Resources Strategy are that it provides opportunities for cooperation, development and sustainable management/utilisation of the water resources of the Nile River Basin for the benefit of all. The ratification of the CFA by Uganda is important because when the

agreement becomes effective, Uganda will host the headquarters of the Commission which puts her in a strategic position to handle the Nile Basin issues.

(b) EAC Protocol on Environment and Natural Resources Management 2006

The Protocol is designed to govern the Partner States in their cooperation in the management of environment and natural resources over areas within their jurisdiction including trans-boundary environment and natural resources. For water management, it requires the Partner States to cooperate in the management of shared water resources.

The implications of the Protocol for the Water Resources Strategy are that it calls for joint management of shared water resources.

4.3.3.3 Agreements that Uganda Has Not Signed

(a) The Convention on the Law of the Non-navigational Uses of International Watercourses, 1997

The UN Watercourses Convention adopted in 1997 is a global legal framework that establishes basic standards and rules for cooperation between watercourse states on the use, management, and protection of international watercourses. As a global legal umbrella, the Convention is important because it seeks to supplement, facilitate, and sustain transboundary water cooperation at all levels. Moreover, some of the provisions of the Convention are already included in regional and bilateral agreements and it also has some linkages with other conventions and international policies that Uganda is a party to. Uganda should consider signing this Convention so as to widen her participation ininternational water law.

4.3.3.4 Customary International Law

Customary international law on water consists of a number of key principles that guide water resources management. These principles are important in the management of transboundary resources. The three most important principles involve the equitable and reasonable allocation of shared watercourses; the obligation to prevent significant harm; and the need for prior notification of works which may affect other riparians sharing international watercourses. The relevant instruments that contain customary international principles are: The Helsinki Rules on the Uses of the Waters of International Rivers, adopted by the International Law Association in 1966. The Seoul Rules on International Groundwaters adopted by the International Law Association in 1986 and the Berlin Rules promulgated by the International Law Association in 2004. These principles should be incorporated in the legal framework of water resources management.

The Water Resources Strategy will provide measures for strengthening Uganda's:

a. Participation in regional/international policy, planning and negotiations processes associated with EAC, AU, NBI, among others;
b. Capacity to meet her obligations to international obligations/regional agreements and protocols;
c. Capacity to benefit from or apply water resources management technologies, information and resources availed through international and regional cooperation.

4.3.4 Institutional Framework for Water Resources Management

The institutional framework for the management of water resources entails management at five levels, namely, 1) national level (centre), 2) district level, 3) water management zone level, 4) catchment level, and 5) community level. The lead institution is the Ministry of Water and Environment (MWE). The Water Policy Committee inter-ministerial and inter-sectoral coordination body advises the Minister of Water and Environment on policy level water resources management and development issues. Several government ministries, agencies, and semi-autonomous or private institutions and NGOs/CSOs are directly or indirectly involved in the management of the water resources. At thecentral government levelwater policies, regulations and water action plans and strategies are formulated, enforced and monitored, while at lower levels (districts, water management zones and catchment management organizations, communities institutions and wateruser organizations) water use and protection interventions are implemented.

Currently, there are several institutions that are mandated to administer water at national, local and community levels (see Figure 4.8).

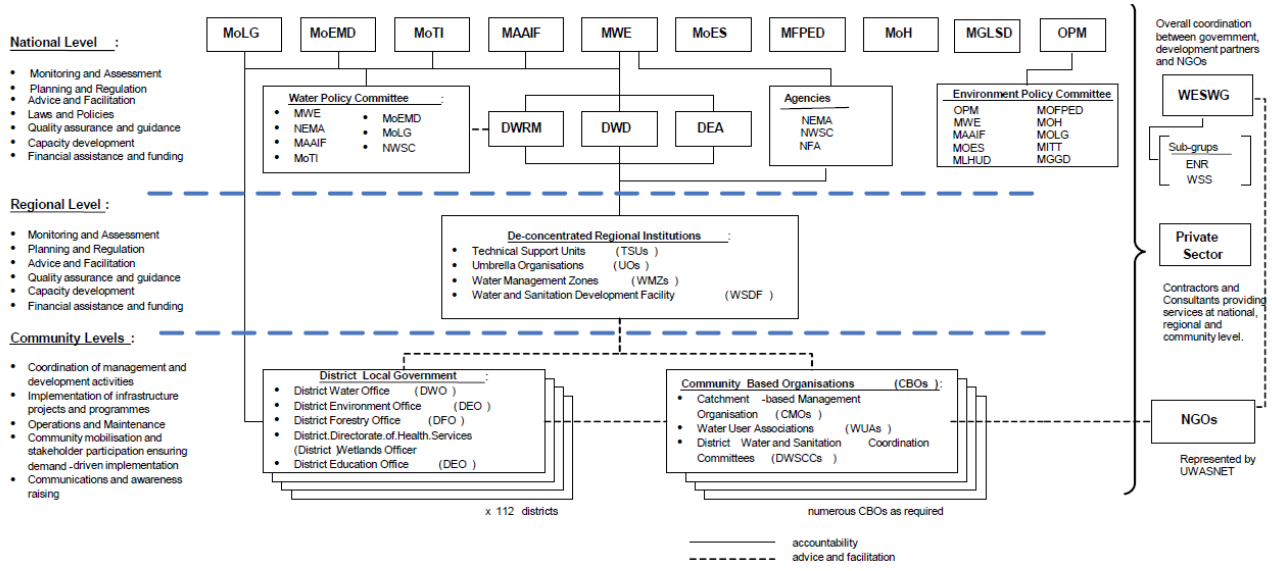

Figure 4.8: Institutional Setup of the Water Sector (November 2012); source JWESSP page 3

4.3.4.1 The Mandates of Central Government Ministries and Agencies

4.3.4.1.1 The Water Policy Committee

The Water Policy Committee (WPC) advises the Minister in charge of water resources on water policy, standards for service delivery, and priorities for water resources management. It also advises on revisions to legislation and regulations for water resources, and also coordinates formulation of international water resources policy.

4.3.4.1.2 The Ministry of Water and Environment

The Ministry of Water and Environment has the overall responsibility for setting national policies and standards, managing and regulating water resources, and determining priorities for water development and management. It also monitors and evaluates sector development programs to keep track of their performance, efficiency, and effectiveness in service delivery.

The Ministry has the following three directorates:

a) *The Directorate of Water Resources Management (DWRM)*

The overall mandate of DWRM is *"To promote andensure rational and sustainable utilization, effective management and safeguard of water resourcesso that there is water of adequate quantity and quality to meet the social welfare and economic developmentneeds of Uganda".*

DWRM comprises three departments namely: Department of Water Resources Monitoring and Assessments, Department of Water Quality Management, and Department of Water Resources Regulation. The latter contains the Trans-boundary Water Resources Management Division which promotes trans-boundary regional cooperation for equitable and reasonable utilization of the shared water resources of the Nile and Lake Victoria basins through active participation in the Nile Basin Initiative (NBI) and the Lake Victoria Basin Commission (LVBC) programmes and activities, as well as other international water resources management programmes.

DWRM is responsible for monitoring, assessing, allocatingand regulating water resources through the issuance of water abstraction and wastewater discharge permits. It also coordinates Uganda's participation in joint management of trans-boundary waters resources and peaceful cooperation with Nile Basin riparian countries. It issues water abstraction permits to the Water Authorities and waste discharge permits for those towns with sewerage,and monitors compliance with the permit conditions. It also provides on demand services related to water quality as the case may be. It may also move in to provide emergency water quality surveillance to guide the operations of water systems during periods of emergency e.g. algal bloom as in Lake Victoria, water hyacinth invasions, epidemics and floods. DWRM at central level does not link with districts directly but links with them through the Water ManagementZones (WMZs).

Some of the water resources management functions of DWRM have been de-concentrated to Water Management Zones (WMZ) as a way of moving closer to the stakeholders. The country has been divided into four WMZs (Victoria, Albert, Kyoga and Upper Nile) based on hydrological basins and this is a regional level top-down framework through which water resources are being managed and developed. Currently, there are four WMZ Offices responsible for the four WMZ. The WMO are managed by DWRM personnel who have been assigned from headquarters and posted to the WMZ level. The WMO offices were established to implement the IWRM and the mandate of DWRM. They are supported by Steering Committees, Technical Advisory Committees, and Catchment Management Committees who provide a steering and coordination role in the implementation of the strategies and plans at the catchment scale.

Within the WMZ there are Catchment Management Organizations (CMOs)which are based on water sub-basins orcatchments. CMOs are organized and managed by the stakeholders, including the local governments and other stakeholders, and form structures for effective management including a Secretariat. They are the local level bottom-up frameworksthrough which stakeholders will participate in water resources management.Districts are the lowest level institutions where implementation of catchment based water resourcesmanagement plans will be implemented.

The CMO are facilitated by DWRM and WMZ levels to get organized but are not a structure of the Ministry of Water and Environment. The WMZ staff offer technical advice and exchange of information and reports, and are members of the CMO and forums.

b) The Directorate of Water Development (DWD)

The DWD is responsible for regulation of water services and for providing the overall technical oversight for the planning, implementation, and supervision of the delivery of urban and rural water and sanitation services across the country, including water for production. It provides capacity development and other support services to Local Governments, Private Operators and other service providers. DWD fulfils its responsibilities through three departments: Urban Water and Sewerage Department; Rural Water Supply and Sanitation Department, and the Water for Production (WfP) Department.

c) The Directorate of Environment Affairs (DEA)

The Directorate of Environment Affairs is responsible for promoting and ensuring rational and sustainable utilization, development and effective management of the environment for socio–economic development of the country. Of special relevance for the water sector is the Meteorology Department, which will be transformed into the Uganda National Metrological Authority established under the Uganda National Meteorological Authority Act 2012. The authority will be responsible for collecting, analyzing, and disseminating meteorological data. Mechanisms for real time data exchange between the Meteorology Department and DWRM should be established to facilitate the latter in its role, particularly on interventions for flood and drought forecasting and early warning systems.

4.3.4.2 Sectoral Ministries Involved in Water Resources Management

The following sectoral ministries play important roles in the water resources management in Uganda:

a) The Office of the Prime Minister is the convener of the Environment Committee which is responsible for harmonizing and coordinating sector policies in relation to environment management and water resources and also disaster management (floods).
b) The Ministry of Health (MoH), in particular the Environmental Health Division (EHD) is the lead agency in hygiene and sanitation promotion and is responsible for providing overall policy and technical oversight for planning, implementation, and supervision of hygiene and sanitation promotion in the country.
c) The Ministry of Education and Sports (MoES) is responsible for planning, implementation management, and monitoring of school sanitation improvements. It also develops human power and raise awareness.
d) The Ministry of Local Government (MoLG) oversees the implementation of Local Government Development Plans that also includes water supplies and improvement of hygiene and sanitation in institutions and public places.
e) The Ministry of Gender, Labour and Social Development (MGLSD) assists the water sector in gender responsive policy development. It also provides employment in water based activities, equity and access to water resources, community development.
f) The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) is responsible for agriculture, "on-farm" activities in respect of irrigation, livestock, and fisheries/aquaculture. It is responsible for regulating agro-pesticides, chemicals and fertilizers and invasive plants and animals.
g) The Ministry of Trade, Industries and Cooperatives (MTIC) is responsible for licensing trade. For example it licenses mineral water processing factories. It also licenses industries in relation to water use and waste management.
h) The Ministry of Energy and Mineral Development (MEMD) is responsible for hydropower generation, mining, and oil and gas exploration and production. It plans for the implementation of hydropower infrastructure in collaboration with DWRM.
i) The Ministry of Works and Transport (MoWT) is responsible for policies and regulation of water transport as well as development.
j) The Ministry of Finance, Planning and Economic Development (MFPED). It is the key Ministry for economic development/macroeconomic development and it is responsible for mobilizing and financing investments in water resources development and management. It is responsible for the development of the National Development Plan and Vision 2040.
k) The Ministry of Foreign Affairs (MoFA) plays a lead role in negotiations over international waters, in particular the use of the Nile waters; in development of trans-boundary projects on Lake Victoria and the Nile with neighboring countries, and in development of institutional frameworks for management of trans-boundary waters.
l) The Ministry of Justice and Constitutional Affairs is responsible for analysis and advise on legal matters pertaining to the country's cooperation with other riparian states.
m) The Ministry of Tourism, Wildlife and Antiquities plays a role in regulating water based tourism.
n) The Ministry of Land, Housing and Urban Development plays role in land use policy and planning, settlement and physical planning.

o) The Ministry responsible for Kampala City is responsible policy/political management of KCCA which include functions of City planning and development.

4.3.4.3 The Mandates of Statutory Bodies

The National Water and Sewerage Corporation (NWSC)

The NWSCis a parastatal under MWE that operates and provides water and sewerage services for 23 large urban centres across the country including Kampala City. It is essentially a Water Authority for providing water and sewerage services in accordance with the Water Act Cap 152 and the subsequent regulations governing water supply and waste disposal.

The National Environment Management Authority (NEMA)

NEMA is a parastatal under MWE responsible for management of the environment in accordance with the National Environment Management Act Cap 153 and its subsidiary regulations. NEMA compliments the efforts of DWRM and DWD in the regulation of water resources management and development especially the regulation of effluent wastes. It has delegated it functions for waste discharge to DWRM. It is responsible for approving developments/EIA, monitoring environmental & water quality, environmental planning, and management of water biodiversity.

National Forestry Authority (NFA)

NFA was established by the National Forestry and Tree Planting Act 8 of 2003. It is responsible for the management of central forest reserves and thus has an important role to play in the management of forested catchment/watershed.

Uganda Wildlife Authority (UWA)

The Uganda Wildlife Authority is established by the Uganda Wildlife Act Cap 200. It is mandated to manage all natural resources in the national parks, game reserves, and wildlife conservation areas. It is therefore important in the management of water based biodiversity and tourism.

Uganda Investment Authority

The Uganda Investment Authority (UIA) is a semi-autonomous government agency established by the Investment Code Act, Cap 92. It operates in partnership with the private sector and Government of Uganda to drive national economic growth and development. It issues investment licenses to investors that have projects that use water resources.

National Planning Authority (NPA)

NPA was established by the NPA Act 15 of 2002. It is mandated to produce comprehensive and integrated development plans for the country elaborated in terms of the perspective vision, and long- and medium-term plans. It is also responsible for overseeing the implementation of the five-year National Development Plan (NDP) and Uganda's new development blueprint dubbed Vision2040. Thus there is need for coordination with NPA to implement the Water Resources Strategy.

National Fisheries Resources Research Institute (NFRRI)

The NFRRI is one of the six Public Agricultural Research Institutes of Uganda established by the National Agricultural Research Act 2005. It is charged with conducting basic and applied research of national and strategic importance in capture fisheries, aquaculture, water environment, socio-economic and Marketing and Information Communication Management and emerging issues in the fisheries sector. It is also required to generate the knowledge based, develop and disseminate fisheries technologies and information for increased but sustainable fish production, conservation of the fisheries genetic resources, water quality and fish habitat, and to develop and manage the research and required linkages with stakeholders in order to enhance the contribution of fisheries research to increased and sustainable fish production and conservation of the natural resource base.

Uganda Industrial Research Institute (UIRI)

UIRI was established by the Uganda Industrial Research Institute Act, 5 of 2006. It is Uganda Government's lead agency for industrialization, established under the auspices of the Ministry of Trade Industry and Cooperatives (MTIC). It is the country's main vehicle for implementing strategies and measures aimed at transforming industry in Uganda. It is responsible for undertaking applied research and to develop and/or acquire appropriate technology in order to create a strong, effective and competitive industrial sector in Uganda. It is therefore important in industrial development strategies related to water resources.

Uganda National Meteorological Authority

The Uganda National Meteorological Authority Act, 2012, established an Authority. One of its functions is to apply meteorology to water resources management. This Authority will play an important role in providing meteorological information for water resources management, and flood and drought predictions and monitoring, and early warning.

4.3.4.4 Mandates of Local Government

District Water Officers (DWO) in the Local Governments are key stakeholders in catchment-based IWRM. Their specific responsibilities include to:

a) Enact and enforce policies, ordinances and bye-laws related to IWRM, and wise use and sustainable management of water and environmental resources;
b) Participate actively in the development and implementation of catchment management plans for the river/lake basins;
c) 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, investment plans, and other relevant plans;
d) Carry out monitoring and evaluation of IWRM activities in their respective areas;
e) Raise public awareness within their jurisdictions on water and environmental issues;
f) Encourage and increase stakeholder participation in the integrated management of water resources;
g) In collaboration with DWRM/WMZ, resolve conflicts related to use of the water resources.

The DWOs ensure that relevant data collected by Water Authorities and private drillers on water levels and quality will feed into the DWRM data bank for planning and monitoring purposes.
The District Environmental Officers (DEOs) ensure wetlands which are important in the water resources management chain are not abused; and that planned and on-going water and sanitation activities meet the requirements of the relevant environmental laws and regulations.

DWO also play a role lobbying district councils for issuance of bye-laws related to appropriate management and conservation of water and environmental resources in the catchment.

4.3.4.5 Public and Private Sector Participation

Water and Sanitation Committees, Water User Groups, and Water User Associations

The Water Act provides for the formation of Water and Sanitation Committees, Water User Groups, and Water User Associations, as local community level organizations, to ensure the sustainability of the water supply and sanitation facilities through proper management, operation and maintenance by the user communities.

Local Communities

Local Communities are responsible for demanding for water supply and sanitation (WSS) facilities, its planning, making cash and in-kind contributions (land, labour, materials etc), and participating in the implementation, operation and maintenance of most rural WSS facilities. Upon construction of a water source, a Water Users Committee (WUC) is usually established to take responsibility for its operation and maintenance.

Communities are also operating and maintaining point sources in peri-urban areas. A Water User Committee is established at each water point. The role of communities should shape demand management as opposed to supply management of water in their respective areas. Communities ideally address their concerns through PO's and WSSB's.

Non Government Organizations (NGOs)/Civil Society Organizations

NGOs and CBOs have important functions in the implementation of IWRM such as activities related to protection of water supplies like maintaining tree or grass cover in the catchment area of water sources, reducing stream pollution and abstractions, resolving conflicts from sharing of water, water supply (for example gravity flow schemes), water harvesting (water conservation and efficient use technologies), awareness, catchment/watershed management, and community mobilization and citizen participation.

Private Sector

The private sector is responsible for the development of mini-hydropower dams and irrigation schemes, and for establishment value addition to water such as mineral water.

4.3.4.6 Institutional Requirements and Implications for Improved Water Resources Management

There are institutional requirements that are necessary for improved water resources management. The major ones include:

a. Establishing/strengthening cross-sectoral coordination mechanisms to link MWE with public bodies that are not traditionally included in water sector activities such as the Ministries of Foreign Affairs, Regional Cooperation, military intelligence sector, and national parliament. One alternative is to expand the current water policy committee to include these bodies and another is to create a separate cross-sectoral committee for trans-boundary water matters.
b. Strengthening the present trans-boundary coordination mechanisms and capacity by building a multidisciplinary team in DWRM including legal expertise.
c. Coordination of the different subsectors in the WMZ. Appropriate mechanisms for coordination which allow for participation of all relevant subsectors including relevant political leaders in the WMZ need to be defined. The gazettment of the WMZs should be accompanied with clear definition of responsibilities and coordination mechanisms between the different actors.

4.3.4.7 Planning and Coordination Mechanisms in the Water Resources Sector

Water resources management is a multi-sectoral activity that requiresjoint planning and coordination. Planning and coordination mechanisms enhance information sharing, keeping stakeholders aware of sector problems, and ensure joint funding.

a) Planning

Planning for water resources has to be done in accordance with the following existing documents:

National Planning documents: Uganda Vision 2040& National Development Plan;
Sector planning documents: Water and Environment Sector Investment Plan (WEISP); National Water Action Plan;
Related Sector/subsector plans: Energy Master Plan, Fisheries Master Plans, Environment Action Plan& Tourism Master Plan, etc.

b) Coordination

Coordination for water resources management has to done with the following institutions:

- *Water Policy Committee;*
- *Top Policy management in MWE;*
- *Directorate and Department levels;*
- *Water and Environment Sector Working Group (WESWG);*
- *Sector Reviews (Joint Sector Reviews, Joint Technical Reviews)*

c) Joint Sector Management and Coordination Tools

The Joint Sector Review (JSR)

The Joint Sector Review (JSR) is a forum for performance assessment, and budget and policy guidance. Presentations and contributions areguided by a Sector Performance Report and a pre-determined themeoriginating from emerging policy issues. The event allows a broadspectrum of stakeholders to get an insight into, discuss, and influence sector developments.

The Joint Assessment Framework (JAF)

The Joint Assessment Framework (JAF) is the framework for the Government of Uganda and Development Partners (DPs)' General Budget Support and Sector Budget Support. The ENR Sub-Sector will use the newly adoptedSector Performance Measurement Framework (Platinum Indicators) to establish baselines and measure progress.

Joint Water and Environment Sector Support Programme

The objective of the JWESSP is to support the water and environment sector to achieve its targets and improve its efficiency through a consistent, harmonised sector programme that is aligned to government objectives, policies and delivery modalities. JWESSP support will thus be fully in line with the goals and targets of the National Development Plan (NDP, 2010/11 to 2014/15), Uganda's overarching national planning framework.The JWESSP will be the core framework for joint support in the context of a Sector-Wide Approach (SWAP) for the Water and Environment Sector. It is the most significant donor support to the water and sanitation sub-sector – with the exception of water supply and sanitation in large towns under the NWSC.It is important to note the proposed Joint Water and EnvironmentSector Support Programme 2013-2018, which for the first time willsupport both sub-sectors within the Ministry's mandate, includingWater, Environment and Climate Change.

d) Stakeholder/Public Participation

The Water and Environment Sector Working Group (WESWG)

The WESWG is a forum that comprises of the Ministry of Water and Environment, line Ministries, development partners, representatives of NGOs and private sector active in the sector and is responsible for sector coordination, monitoring and approving the sector budgets.

Uganda Water and Sanitation Network (UWASNET

NGOs involved in water sector activities have formed a network called Uganda Water and Sanitation Network (UWASNET) for improved coordination of their activities in the water sector. The network also provides a platform for constructive engagement with government and donors in the water sector and serves to promote the sharing of experience between the members.

There are some challenges that that the Water Resources Strategy seeks to address. These include:

a. Comprehensive planning which have implications for capacity (manpower, funding, institutional collaboration, etc.) hence the Strategy being formulated;
b. Adequacy of platforms for stakeholder/public participation. For example UWASNET focuses on water and sanitation issues and not water resources management;
c. Coordination weaknesses.

4.3.4.8 International Institutional Framework for Water Resources Management

Nile Basin Initiative

The Nile BasinInitiative (NBI) is a transitional institutional arrangement responsible for sustainable managementand development of the Nile basin water resources. 98% of Uganda lies within the Nile basinand thus almost all its water resources are part of the Nile. Active participation of Uganda inthe Nile Basin Initiative activities is therefore key to the sustainable management anddevelopment ofUganda's water resources.

East African Community

The Lake Victoria Basin Commission (LVBC) established by a Protocol for Sustainable Development of Lake Victoria Basin of the EAC Treaty is an apex institution of the Community responsible for all the initiatives in the Lake Victoria basin. Active participation of Uganda in the activities of LVBC is key because she controls 45 percent of the lake's surface.

Intergovernmental Government Authority Development (IGAD)

IGAD has developed the Inland Water Resources Management Program (INWRMP) to assist its member states to address the water issues. The INWRMP aims at the strengthening of national and regional capacities and their links to provide water on a sustainable basis. This is an important program since six out of eight of the IGAD countries are riparians to the Nile and Uganda is already participating in the program.

African Union (AU)

AU has specialized Technical Committees to address sectoral issues. In relation to water resources management, AU's Committee on Industry, Science and Technology, Energy, Natural Resources and Environment has an important role to play in the conduct and regulation of trans-boundary water resources relevant to Uganda.

4.4 Key Findings of the Assessment of the Policy, Legal, and Institutional Framework and their Implications

Thisparagraph presents in table format the key water governance issues identified in paragraph 4.3 accompanied by a concise discussion of their implication.

Critical issues	Implications
REGULATION OF WATER USE	
The Water Policy Committee (WPC) does not include all the key stakeholders relevant to water resources management.	Decisions of WPC may not be inclusive of all sectors relevant to water resources.
There is no separation of regulation of water resources management functions from the service delivery functions.	This causes conflicts of interest and does not ensure compliance and guarantee of commercial autonomy.
Four water management zones have been established but their operational effectiveness is limited.	This affects effective water resources management at catchment levels.
Coordination between stakeholders at sub-national level – such as TSUs, WSDFs, UOs and WMZs – is inadequate.	Affects coordination of management of water resources.
There is limited inter-institutional coordination due to ambiguous and overlapping mandates.	Confusion over roles and responsibilities affects water resources management and slows progress in development of water related projects such as irrigation& hydropower projects.
There is no legal and policy framework for effective monitoring of the activities of NGOs and umbrella organizations.	The outputs of NGOs and umbrella organizations are not reflected in the budget performance of the water sector.
There is limited inter-district water resources management.	There is lack of effective policy framework and Implementation mechanisms at the district levels.
No Regulations, Ordinances, and Bye Laws at local government level have been developed.	Trans-district water resources are not properly managed.

Critical issues	Implications
REGULATION OF WATER USE (continuation)	
There is limited capacity to manage water at districts, especially at the newly established districts.	No effective regulation of water resources at the district levels especially in the new districts.
There is no legal & policy framework that balances customary water rights with State rights in case market-based allocation are introduced.	Customary water rights are not recognized in water resources regulation.
There is no strong institutional framework for transboundary water resources management.	This effects management of transboundary water resources and most importantly, the integration of transboundary waters into policies and legislative framework is deficient.
There is limited enforcement of environmental and water laws.	Water resources management is ineffective, potential for over-abstraction and water conflicts, as well as degradation of natural resources.
There is no comprehensive legal framework for groundwater management.	There are no guidelines & regulations for the protection, conservation & rational use of groundwater resources.
There is no comprehensive policy and legal framework for water harvesting & reusing water.	There is limited implementation of water re-use in both urban and rural areas & no developed methods for collection and storage of rain water.
There is no effective institutional & legal framework for dam safety.	No comprehensive provisions for flood control, supervision & monitoring dams.
There is lack of coherent and comprehensive drought and flood risk mitigation plans and preparedness policy & legal framework.	No comprehensive provisions for management of increased demand for water during drought and excessive water during the rainy season.
There are no adequate mechanisms to resolve water conflicts.	Inter-districts disputes are not solved.
The policy & legal framework does not clearly integrate land with water management.	Disjointed land and water resources management & planning.

Critical issues	Implications
WATER QUALITY MANAGEMENT	
There is limited water quality management caused by lack of quality monitoring equipment, very limited access to laboratory facilities, and shortage of qualified staff in water discharge control at district level and lack of agreed standards on water quality standards countrywide.	It is extremely difficult to enforce waste discharge regulations because of the complexity of monitoring especially for the big polluters.
The current waste discharge permit system, which is based on biological oxygen demand (BOD) load alone, is inadequate.	
There is an uncoordinated or fragmented approach of waste disposal management into the water bodies.	
Both the Water Act and National Environment Act contain provisions relating to pollution control, which need to be harmonised.	This causes conflicts and duplication of roles.
The Water Act & regulations do not provide adequate regulation for non-point sources of pollution, pollution from municipal waste and waste discharge to groundwater.	Pollution at non-point sources is not effectively regulated.
WATER RESOURCES INFORMATION PLANNING & CAPACITY	
Data required for water resources situation description is scattered in different departments, is of poor quality, has many gaps & difficult to obtain.	This leads to uncoordinated decision making & planning.
Water resources data is kept by relevant line ministries, with no mechanisms for pooling or coordination. Yet, such information is critical in order to make plans and informed decisions, including technological choices.	Inadequate provisions for data collection and monitoring; hence decision making is not based on accurate information

Critical issues	Implications
WATER SECTOR CAPACITY BUILDING	
Staffing level at DWRM is currently at 40%.	This poses a significant risk for the timely achievement of the water sector targets.
No strong institutions to enhance capacity building & applied research in water resources management.	The experience and skill level of junior and mid-level DWRM staff does generally not match the associated job description; it decreases the operational functionality of DWRM. Adverse impact on applied research in water resources management.
WATER FINANCE AND FUNDING	
There is no strong legal framework for water finance and funding.	Affects revenue collection from water users and implementation of payment for ecosystem services;as a result, there is inadequate funding for water resources management and infrastructure development.
There are no strong provisions to support sustainable management of water demands through pricing and incentives.	Water is regarded as a cheap commodity & this affects sustainable use of water resources.
Water sector funding has remained about the same since 2003/04.	This poses a significant risk of achieving the water sector targets.
PPP is ongoing but needs to be encouraged and strengthened.	There is still limited involvement of the private sector and limited investment opportunities. There is limited facilitation of the private sector's to contribute to achieving WRAP objectives, playing roles in financing and delivery of water supply and sanitation services, irrigation development, and power generation.

4.5 Water Resources Development Scenarios

In addition to the existing water resources issues discussed in the previous paragraphs, the strategy also needs to address water resources challenges that are anticipated and result from Uganda's development objectives (see chapter 3). To this effect, a scenario exercise has been implemented that produced an inventory of future water resources issues in the country,and assessed their hydrologic, environmental, and economic implications. In line with Vision 2040, the horizon year for the scenarioanalysis has been set to 2040.

The water resources development scenarios have taken their point of departure in the development goals of the country stipulated in Vision 2040 and the associated NDP 2010/11-2014/15. Within this context, a comprehensive screening was made of the development and policy options in the water sector in Uganda. A large set of policy documents, sector development plans, thematic studies, etc. were examined. The results of this screening exercise have been reported in a separate report.

Based on the above information, four water resources development scenarios have been developed that support achieving Uganda's overall development objectives. They have been discussed in-depth with DWRM staff, while a wide range of stakeholders have been consulted during the workshop "Road Map towards Vision and Objectives", which was conducted in March 2013. The four scenarios range from moderate to intensive development in the 2040 time frame. Table 4.1presents the principle scenario parameters. An in-depth discussion of the scenario exercise is presented in Annex 3.

Table 4.1: Key scenario parameters

SCENARIO	DESCRIPTION
Baseline	Present situation with existing hydropower (Nalubaale, Kiira, Bujagali), irrigation, and 2013 domestic and livestock water demand
Scenario 0	Baseline, plus 2040 domestic water demand, and water demand for oil production
Scenario 1	Scenario 0, plus full hydropower development (excluding Kalagala and Murchison Falls) as outlined in the Hydropower Masterplan [MEMD 2011]
Scenario 2	Scenario 1, plus full wetland irrigation (Type A) estimated at 247,000 ha
Scenario 3	Scenario 2, plus full upland irrigation (Type B) estimated at 437,000 ha (10% of the rainfed area)

In line with the National Water Policy, domestic water supply was given first priority and the projected domestic water demand for 2040 – with separate urban and rural components disaggregated at district level – has been included in all scenarios. Livestock water demand has also been included in all

scenarios. Livestock numbers are kept at 2012 levels because no projections were available of future developments in the sector, and because shortages of grazing areas are more and more constraining expansion of the livestock sector in terms of absolute numbers (note: not in terms of productivity).

Given the important contribution of the oil sector to the national economy, water demand for the oil sector has also been included in all scenarios. It is noted that estimated water use in the petroleum industry is quite small (Annex 2).

With the above factors kept constant, the main differentiating elements in the scenarios in terms of water resources and economic development were hydropower and irrigation development. Irrigationdevelopment was separated into 1) potential wetland irrigation, and 2) potential upland irrigation.

Water demand for most scenario elements has been disaggregated at district level, and the modeling exercise has looked into their hydrologic implications at both the catchment level and with regard to the Nile system. Only two demand components (i.e. hydropower and oil exploitation) are almost fully concentrated on the Nile system.

It should be noted that environmental flows, transboundary flows, water quality, tourism & wildlife, navigation, industrial water demand, mining, fisheries, aquaculture, and food security have all been considered in the scenario development process. The reader is referred to Annex 3 for a detailed discussion on this subject.

4.6 Implications of the Water Resources Development Scenarios

The implications of realizing the scenarios defined in paragraph 4.5 have been analyzed through a water-resources modeling exercise and a multi-criteria analysis, and the results will be summarized in this paragraph. The reader is referred to Annex 3 for a detailed discussion of the modeling exercise.

The results of the modeling exercise are subject to a number of uncertainties. The three main variables are hydropower, wetland irrigation, and upland irrigation. With regard to hydropower production, there is high confidence about the modeling results – if climate change is not taken into consideration. The cascade of hydropower facilities on the Nile in Uganda are effectively operated as a run-of-the-river system with Lake Victoria serving as the main reservoir and only minor surface water evaporation losses at the respective dam sites. Hydropower production is thus a function of head, discharge, and turbine characteristics, which are all based on available data of acceptable quality.

Regarding wetland irrigation, there is medium to high confidence about the relatively small water losses because 1) highly water-consumptive rice cultivation is substituting highly water-consumptive wetland vegetation, and 2) water losses due to low irrigation efficiencies will return to the river system. On the other hand, the estimated yields are subject to considerable uncertainty since they are dependent on the farming practice.

Also the modeling results regarding upland irrigation are subject to considerable uncertainties both in relation to the water losses as well as the yields. Obviously, water loss is a function of crop type, irrigation practice, and local climate conditions, while yields very depend on farming practices. These issues are discussed in detail in Annex 3.

Table 4.2 presents selected model results. It is followed by a detailed discussion for each sector on the implications of realizing the development scenarios. At appropriate occasions in these discussions, reference is made to Table 4.2.

Table 4.2: Selected model results

Scenario	Hydropower production		Additional irrigation development		L. Kyoga surface area	Nile outflow toSouth Sudan	Flow change at Murchison Falls	
	MW	GWh/yr	Wetland [1000 ha]	Upland [1000 ha]	[km2]	m3/s	Q10 [%]	Q90 [%]
0	376	3,294			3502	1208	-0.01	0.02
1	1842	16,138			3502	1207	0.03	-0.22
2	1828	16,018	247		3488	1195	-0.86	-1.49
3	1782	15,613	247	437	3447	1142	-3.07	-12.28

Domestic Water Supply: The total domestic water demand in 2040 is estimated at485 mcm/yr and 532 mcm/yr for rural and urban areas respectively, which compares to the Internally Renewable Water Resources (IRWR) of 15.6 bcm/yr. Domestic water demand – which is prioritized - can thus generally be met, as reflected in the model results. It is noted that seasonal deficits occur in the Aswa and Kidepo basins if domestic water supply depends on surface water sources alone (without storage), but groundwater development or construction of small and mid-size reservoirs in this region can effectively remedy this situation. Groundwater shortages may arise at local scales in areas with high population density [NWRA 2012]. Nevertheless, a combination of ground and surface water sources can safely secure adequate provision of domestic water supply in Uganda by 2040 (apart from practical challenges related to establishing treatment facilities and delivery systems).

Water quality risks – in particular bacterial contamination of both ground and surface water resulting from inadequate sanitation facilities – are large and need to be addressed. Water quality is also increasingly threatened by emerging pollution sources such as industrial pollution, urbanization, oil exploration, agricultural modernization, and aquaculture development.

Vision 2040 targets 60% urban population by 2040. While this is an ambitious target - given that UNPD estimates 21% urban population by 2030 – it implies a rapid growth of the urban population and will put enormous pressure on city administrators to provide essential services including domestic water supply

and sanitation. The rapidly expanding build-up areas will also increase urban flooding risks and calls for investments in drainage infrastructure and improved stormwater management.

Industrial Water Supply: Industrial water demand is currently small but expected to increase considerably with economic growth. Most industries are concentrated in the Lake Victoria crescent, but industrial activities are also expected to grow in Gulu, Mbale, Mbarara, Arua, and Nakasongola. The economic value of water used in industrial production is generally high, but water quality issues are pertinent and measures need to be implemented to ensure that no polluted effluents reach the water bodies – both surface and groundwater - in the country. No reliable projections exist of industrial water demand in 2040, and it was therefore not possible to include this demand component in the modeling exercise. Nevertheless, in the short and mid-term future – with low industrial water demand – no large-scale water conflicts are anticipated, and water abstraction can be considered on a case-by-case basis subject to standard permitting procedures. It is recommended to review the implications of industrial water demand once the pace and nature of industrial development in the country has become clearer.

Water for Oil and Gas Production: Maximum consumptive water use for oil production in the Albertine Graben during peak production (180,000 barrels per day) is estimated at 36.5 mcm/year (Annex 2). This will be supplied through surface water abstraction from Lake Albert or the Albert Nile, and is small relative to the average annual Albert Nile flows exceeding 30 bcm/yr. The impact on the Nile outflow to South Sudan, therefore, is minor and water abstraction for oil productions does not cause significant harm to the downstream riparians. Given the high economic value of water used for oil production, this consumptive water use has been prioritized. With oil exploration follows the risk of environmental damaging oil spills along the chain of exploration wells to storage and refinery facilities. Environmental and water quality risks are potentially large and need to be adequately addressed.

Mining: No reliable estimate exists of water demand of the mining sector in 2040, but consumptive water use is distributed and most probably small. Water quality concerns are more pertinent and potentially large. No large-scale water conflicts are anticipated and water abstractions for mining, therefore, can be considered on a case-by-case basis and subject to standard permitting procedures.

Irrigation: A distinction is made between 'Type A'(mostly wetlands) and 'Type B' (upland) irrigation. Given the substantial average rainfall in most of the country, irrigation in Uganda is supplementary, with the exception of possible dry-season irrigation in (semi) arid zones such as Karamoja.

'Type A' irrigation potential has been estimated at 295,000 ha (National Irrigation Master Plan2010 – 2035). These areas lie close to surface water sources and can be developed without need for water storage facilities. The overall majority of these areas concern managed wetlands – only approximately 24,000 ha are in upland areas. The HYDROMET study has identified the approximate location of 247,000 ha of the wetland irrigation potential, which has been included in the MIKE BASIN model as distinct demand nodes for each scheme.

The modeling exercise observed that the impact of wetland irrigation on the Nile flow regime is small to negligible; in case of development of 247,000 haof wetland irrigation, hydropower production will

decline by 1% while the changes in Q_{10} and Q_{90} – which characterize the high and low flow regime, respectively – are also less than 1%; the reduction of the surface area of Lake Kyoga – which may affect fish catch – is around 1%, while Albert Nile outflows toSouth Sudan may be reduced by about 1%. The low impact of wetland irrigation reflects the specific hydrologic conditions of wetlands characterized by high evaporation losses and very high irrigation efficiencies, as irrigation water lost immediately returns to the wetland system. This is particularly the case for Ugandawhere regulations stipulate that only 25% of the total wetland area that can be converted into cultivated land. Thus, at national level, wetland irrigation does not conflict with hydropower production along the Nile or other water uses. It should be noted, however, that wetland development may have large hydrologic and environmental implications at local or catchment level. Each project, therefore, needs to be subjected to a comprehensive impact assessment at the appropriate scale.

In addition to wetland irrigation, the irrigation master plan also identified upland irrigation potential, which requires water storage and delivery facilities and will therefore be more costly in terms of investments. It generally concerns irrigation potential for which no specific location has been identified. Rather, the upland potential is calculated as a percentage (10%) of existing cultivated land corresponding to 437,000 ha (based on an assessment of cultivated land in AFRICOVER).The locations of the potential upland irrigation areasin the MIKE BASIN model are therefore not based on an actual land resource assessment but distributed according to the location of the existing cultivated land.

The modeling exercise observed that full development of the upland irrigation potential would further reduce hydropower production along the Nile by 2%, and reduce the surface area of Lake Kyoga by an additional percent. The decline of water depth of Lake Kyoga is very small and navigation on the lake is therefore not noticeably affected. Q_{90}(flow exceeded 90% of time) at various points along the Nile would decline by up to 12%, while the maximum reduction of Q_{10}(flow exceeded 10% of time) is less than 4%. The relatively low impact of upland irrigation development on Nile flows is primarily explained by the relatively small moisture deficit that needs to be supplemented in most areas. It goes without saying that upland irrigation development can have major impacts on the local flow regime, and should be subjected to a comprehensive hydrological and environmental impact assessment.

The impact of irrigation development on Nile outflow to South Sudan issmall. Development of the full wetland and upland irrigation potential results in a decline of the original flow of 65 m3/s, or about 5.4%. This is reflected in Figure 4.9and Figure 4.10, which present the hydrographs and flow duration curves for the 4 scenarios for the Albert Nile outflow to South Sudan. For more information, the reader is referred to Annex 3 “Water Allocation Modeling and Scenario Analysis of Water Development Options Using MIKE BASIN and MIKE CUSTOMISED”, which has been prepared as part of the water resources strategy development exercise.

It can be concluded that wetland irrigation development as foreseen in Vision 2040 is not conflicting with hydropower generation along the Nile, and does not cause significant harm to the downstream riparians, while exploitation of upland irrigation potential likewise will have a small impact on the hydropower generation as well as on the flow downstream, when viewed on a national basis. It should, however, be noted that the impact will be largest in absolute and relative terms during the drier periods

when the flow is lowest. The impact of consumptive water use in Uganda on the flow to Sudan and Egypt is further reduced by the Sudd swamps in South Sudan.

Hence the real trade-offs between irrigation developmentand alternative water uses or wetland and environmental protectionare at local and catchment level, rather than at national or transboundary level.

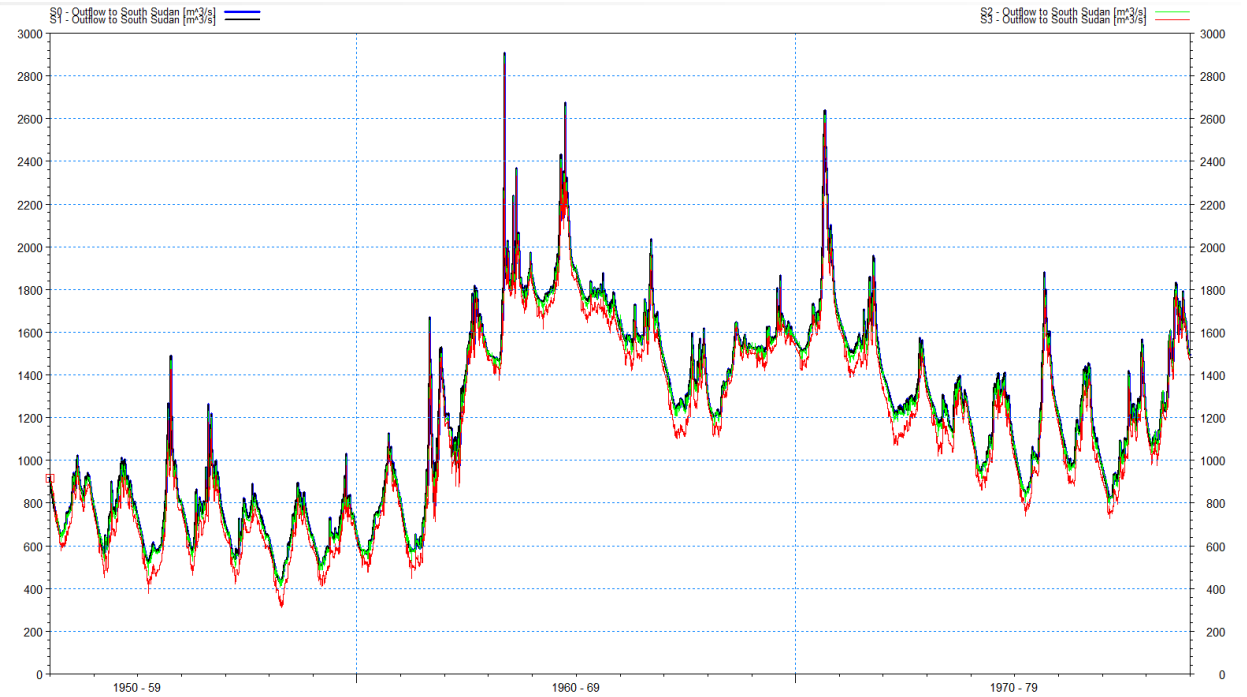

Figure 4.9: hydrographs for the Albert Nile outflow to South Sudan for the four scenarios.

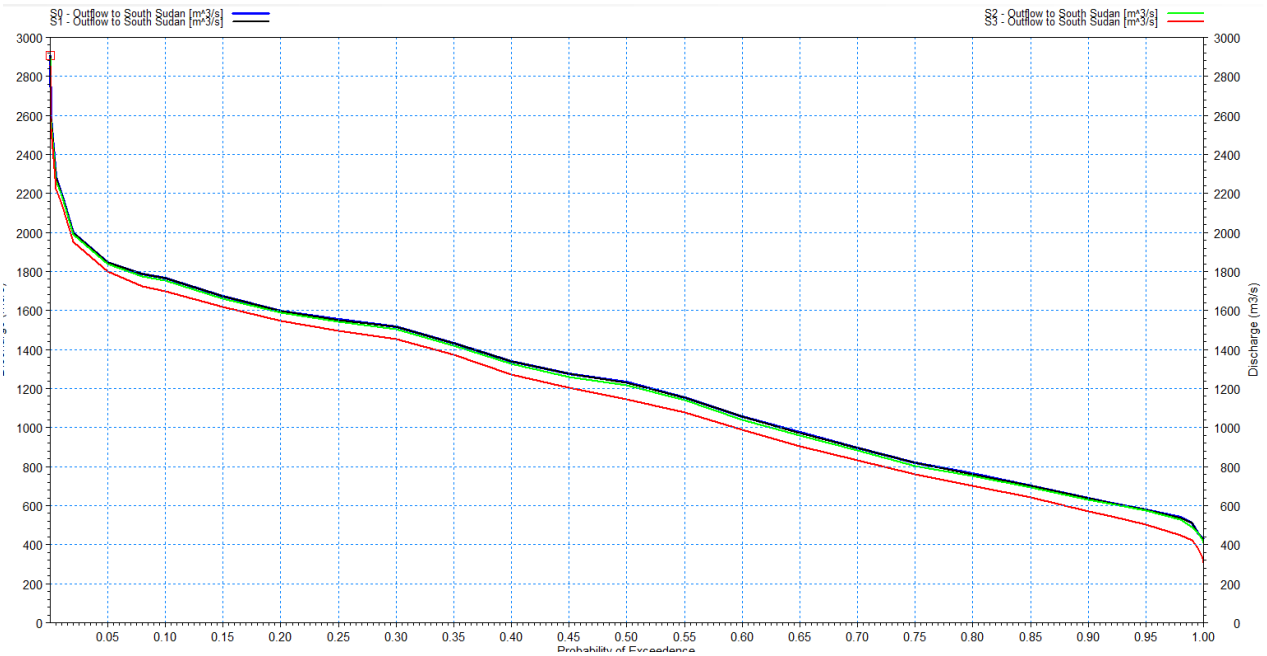

Figure 4.10: Flow duration curves for the Albert Nile outflow to South Sudan for the four scenarios.

Rainfed agriculture: Because the potential irrigation area is small (approximately 10%) relative to the area under rainfed cultivation, agriculture in Uganda by 2040 will remain predominantly rainfed. In about 90% of the country, potential evaporation exceeds average annual precipitation. Furthermore, rainfall is subject to high temporal variability – a situation which may worsen because of climate change. Hence agricultural droughts occur frequently but most incidences of water shortage in the country are at plot and micro-catchment level, with the majority being shallow droughts with a moisture deficit of less than 100 mm during the planting season [NWRA 2012]. It implies that drought mitigation measures at local scales - such as small-scale supplementary irrigation, water harvesting, or increasing the moisture retention capacity of soils – can be very effective. The critical issue, therefore, is to capture and store rainwater at plot and micro catchment level, and increase the productivity of this water through improved farming practices. While technical solutions for this purpose are clear cut and well documented, their uptake requires behavioral change by individual actors to achieve widespread adoption. The water resources implications of improved agricultural practices are generally positive and manifested at catchment level. No negative implications at national level are anticipated.

Hydropower: Hydro-electricity generation along the Nile is not (or only just) conflicting with planned irrigation development (see above) and concerns a non-consumptive water use. Lake Victoria serves as the principal reservoir of the cascade of hydropower facilities along the Nile, whichare essentially operated on a run-of-the-river basis. The reservoirs created by the respective dams are relatively small and the associated evaporation losses are therefore also small. Hence from a water resources perspective all planned large HPP facilities can be established. Furthermore, environmental consequences are limited if release policies mimic the historic flow regime. It should be noted that the right balance has to be found between conserving locations of exceptional scenic beauty (such as Murchison Falls) and maximizing power production. It is also important to note that Nile flows are very

sensitive to changes in the hydrological balance of Lake Victoria. Climate change, therefore, may seriously impact the Nile flow regime and related power generation.

More than 60 Small Hydro Power (SHP) sites with a total potential of about 210 MW have been identified through different studies in Uganda [NWRA 2012]. SHP generation concerns a non-consumptive water use mostly operated on a run-of-the-river basis that does not modify the existing hydrologic regime. Their impact on downstream water resources development, therefore, is minimal. SHP development can be considered on a case-by-case basis subject to standard permitting procedures, and inclusion in the catchment management plans.

Aquaculture: the anticipated rapid growth of the aquaculture sector will increase water quality risks and require effective planning and regulation. The consumptive water use of aquaculture is small and distributed, and can generally be met.

Tourism: Vision 2040 specifically mentions the development of Uganda's nature-based tourism. It requires maintaining natural water bodies and scenic spots, and preserving Uganda's rich biodiversity. This obviously conflicts with developing hydropower facilities at Murchison Falls and Kalagala – which need to be carefully considered. However, irrigation development will pose the largest threat to preserving Uganda's unique aquatic ecosystems and associated touristic value. Both upland and wetland irrigation may have significant impacts on local flow regime, surface area of nearby small lakes, and local aquatic ecosystems. Individual irrigation projects and other water abstractions, therefore, need to be subjected to a comprehensive hydrological, environmental, and socio-economic impact analysis.

Ecosystem goods and services: The provision of ecosystem services such as fish production, water purification, scenic beauty and flow regulation are important to support the developments in other sectors – e.g. tourism and fisheries. Also, the livelihoods of many Ugandans depend, directly or indirectly, on the provision of ecosystem services, in particular those provided by healthy wetlands. However, implementing Vision 2040 may cause a significant reduction in the provision of ecosystem services, mainly due to wetland conversion and irrigation development. The implications may be minimalized by classifying and managing key ecosystems (e.g. seasonal wetlands) according to their value/importance.

Fisheries: the fishery sector requires maintaining lake surface areas and ecosystem functions of water bodies. The environmental impacts of both irrigation and hydropower development on the Nile system – including the lakes Victoria and Kyoga – are limited and will most probably not affect fisheries. By contrast, local water resources development - including irrigation and abstractions for other productive purposes – can have significant impacts on local flow regimes, surface area of small lakes, and local ecosystems, and need to be carefully considered.

Livestock: livestock water demand can generally be met although seasonal deficits are experienced in the Aswa and Kidepo basins if animal drinking water facilities depend on surface water alone. While groundwater can safely provide a substantial part of the livestock drinking water needs in large parts of the country [NWRA 2012], caution is required in the Kaabong and Kotido districts, where respective

utilization rates of 44% and 56% were observed. Both districts have large herds of cattle and therefore require special attention.

A number of districts in the cattle corridor in south-western Uganda also witness high levels of resource use [NWRA 2012]. Nevertheless, combined surface and groundwater sources in these areas will be able to meet livestock water demand although caution is required at local scales.

Marine Transportation: Operating rules of the Kiira and Nalubaale hydro facilities will limit Lake Victoria level fluctuation to a range of 3 m. Harbor facilities need to be adjusted to allow ferries and vessels to operate within this range. This one-time investment should not constitute a real impediment to further developing lake transportation.

The decline of water depth of Lake Kyoga because of irrigation development is expected to be small and navigation on the lake is therefore not noticeably affected.

The most important observations are summarized below:

- Domestic water demand in 2040 can generally be met through a combination of ground and surface water sources, and no supply constraints are anticipated. By contrast, water quality risk – in particular bacterial contamination of water sources, but also from emerging pollution sources – are large and need to be addressed;
- Water demand for oil production can be met at all times and does not affect Nile flows; environmental and water quality risks associated with oil production and processing are high;
- The impact of wetland irrigation development on Nile outflow to South Sudan compared to the present situation is very small;
- Full development of wetland and upland irrigation potential result in a declinein the flow to South Sudan of 65 m3/s corresponding to around 5.4% of the original flow, and an average reduction in hydropower production of about 3%;
- By contrast, irrigation development may alter local hydrologic conditions and may have large adverse impacts on local wetlands, local ecosystem functions, fisheries, and tourism;
- Short and mid-term industrial water demand can generally be met through a combination of ground and surface water sources; no reliable projections exist of industrial water demand in 2040; water quality risks associated with industrialization are high;
- Livestock water demand in 2040 can generally be met through a combination of ground and surface water sources. Supply constraints are anticipated in the Kotido and Kaabong districts, while caution is required in parts of the cattle corridor in South Western Uganda;
- Water quality risks associated with aquaculture are high.

5 Vision and Objectives

Chapter 5 presents the Vision and Objectives for water resources management in Uganda that have been developed through a consultative process with key stakeholders. The vision is the desired future situation with regard to the nation's water resources that the strategy aims to achieve.

5.1 Terminology

This paragraph will define the specific terms used to describe the strategy in the subsequent chapters (see the below table).

Table 5.1: Specific terms used to describe the strategy

Term	Description
Vision	A future ideal situation; the Vision should not be constrained by too many practical/operational considerations but should be the ultimate "wish list".
Objective	The vision will be broken down into a series of high-level objectives (desirable situations); the objectives are assumed to be reached based on achievement of outputs.
Output	A specific and time-bound goal in the process to reach the higher-level objective.
Action	The actual activity required for producing the desired output;an indicator will show progress towards the design; the strategy needs to indicate who will implement the action.
Purpose	A description of the reason for implementing the action.
Action Details	A breakdown of the action into more detailed tasks.
Additional Background Information	Background information and a more detailed analysis of the issues and challenges that the specific action aims to address; this information is intended to provide the context for the proposed action and explain the action details and their purpose.

5.2 Vision and Objectives

A consultative workshop "Vision and Objectives" was organized on 15-16 January 2013 to develop a Vision for managing and developing the nation's water resources up to 2040 and define the associated set of concrete objectives.

Over 45 sector stakeholders and experts participated in the events, representing institutions that included KCCA, Local Government, MAAIF, Ministry of Finance, MEMD, MTWA, NFA, PEPD, various departments of MWE, as well as the Water Management Zones. Also present were representatives from GWP, World Bank, and international consultancy firms.

The Vision for water resources management in Uganda for 2040 is:

"Water resources management in Uganda is effective in contributing to economic and social development and maintaining environmental services."

The vision is broken down in the following 3 principal objectives:

4. Ensure sustainable and equitable allocation and provision of waterof appropriate quantity and quality.

5. Mitigate the effects of extreme climatic events.

6. Strengthening the water governance framework.

5.3 Organization of the Strategy

The strategy is organized according to the three principle objectives: 1) sustainable and equitable allocation and provision of water of appropriate quantity and quality, 2) adapting to the effects of extreme climate events, and 3) strengthening the water governance framework.

The respective outputs and actions aim to achieve the Vision and principle Objectives defined above. In practice this means they have to address the large set of challenges and issues identified in chapter 4. These issues and challenges are of a diverse nature, and need to be clustered and discussed in separate paragraphs.

The outputs and actions, therefore, have been arranged according to distinct categories, as shown in Table 5.2(the paragraph numbers have been included for ease of reference):

Table 5.2:Organization of the strategy	
Paragraph Number	Principle category / sub category
6.1	Ensure sustainable and equitable allocation and provision of waterof appropriate quantity and quality
6.1.1	Water resources availability for use
6.1.2	Protection of water resources
6.1.3	Integrated land and water management
6.1.4	Demand management
6.1.5	Water resources information, planning, and capacity
6.2	Mitigate the effects of extreme climatic events
6.2.1	Prepare for increased hydrologic variability
6.2.2	Prepare for a warmer climate
6.2.3	Prepare for more severe rainstorms
6.2.4	Effective flood management of the floodplain
6.3	Strengthening the water governance framework
6.3.1	Policy and legal framework
6.3.2	Institutions
6.3.3	Coordination Mechanisms
6.3.4	Financing of water resources management

6 Strategies for Water Resources Management and Development

This chapter presents the comprehensive set of strategic outputs and actions required to address the issues and challenges identified in Chapter 4, and reach the Vision defined in Chapter 5.

The chapter is organized according to the two main objectives defined in Chapter 5: 1) sustainable and equitable allocation and provision of water of appropriate quantity and quality, and 2) adapting to the effects of extreme climate events. In addition, a separate paragraph has been added to address issues related to the water governance framework.

At appropriate locations, the reader is presented with additional background information and a more detailed analysis of the identified issues and challenges. This is needed to provide the context for the proposed strategic outputs and actions, and explain the action details and their purpose.

6.1 Sustainable and Equitable Allocation and Provision of Waterof Appropriate Quantity and Quality

6.1.1 Water Resources Availability for Use

With substantial rainfall and plentiful surface and groundwater resources, overall water resources in Uganda presently exceed demand. Nevertheless, the country experiences recurrent drought events and local water shortages, while water demand is set to increase significantly and climate change may intensify periodic drought conditions. Water resources are specifically recognized as having a significant potential role in socio-economic transformation and poverty alleviation. Domestic water supply is given first priority and needs to be met at all times.

Currently, only a small proportion of the irrigation and hydropower potential has been developed, while large development opportunities exists in other water-related sectors of the economy. Key sectors include: agriculture (irrigation and supplementary irrigation), livestock, fisheries, aquaculture, hydropower, industrial development, oil production, mining, water transportation, and tourism.

Vision 2040 represents Uganda's long term development plan (see Chapter 3). The implications on Uganda's water resources of implementing this plan have been reported in paragraph 3.1.1 and summarized at the end of that section.

It should be noted that water availability in Uganda is subject to considerable uncertainty. Climate change may alter Nile flows, rainfall on the catchments, and the hydrologic regime of the river systems. Water allocation plans, therefore, have to take this uncertainty into account and allow for an adequate degree of adaptability.

Key Strategic Outputs and Actions

Output:
Beneficial use of the available water resources enhanced

Actions:

- Improve domestic water supply from a combination of surface and groundwater sources, and rainwater harvesting
- Prepare and implement catchment management plans, starting with priority catchments
- Develop high-value water projects in accordance with IWRM principles
- Develop irrigation potential in phases subject to better information on affected wetlands and in accordance with IWRM principles
- Continue engagement with Nile partners on equitable use of the Nile waters and their benefits

Action: Improve domestic water supply from a combination of surface and groundwater sources, and rainwater harvesting.
Purpose:to provide adequate quantities of clean and safe water to the urban and rural population; a 100% coverage is ultimately anticipated (2030 – 2040).

Action Details:

- Urban areas in close vicinity of Lake Victoria – such as the Entebbe-Kampala-Mukono and Jinja-Iganga corridors – preferably supplied by bulk water pumped from Lake Victoria; groundwater use in this region is limited to large-scale industrial operations and subject to permitting;
- Urban water supply in Mbale and surroundings achieved by Mt. Elgon based gravity systems;
- Other rural and urban areas supplied by a combination of groundwater (boreholes and shallow wells) surface water (protected springs, surface water abstraction), and rainwater harvesting; the local conditions will determine the most appropriate method of water supply;
- Measures implemented to encourage efficient water use and reduce losses in the distribution system in order to reduce capital investment in water treatment facilities, pumping and treatment costs (see 6.1.4).

Water quality issues are discussed in 6.1.2.

Action: Prepare and implement catchment management plans, starting with priority catchments.
Purpose: to plan the use, conservation and protection of water resources at catchment level in a participatory process.

Action Details:

- Identify the principal catchments, which are the basic units for water resources management in the country; this is the task of the respective WMZs and will be based on an assessment of

critical issues and hotspots, while keeping in mind stakeholder involvement and available financial resources; some 20 principal catchments are envisaged;
- Detailed catchment management plans prepared for a number of priority catchments; these could for instance include 1) Kabong and Kotido districts – where livestock water supply constraints are anticipated, 2) lower Lake Kyoga basin – with large irrigation potential and associated challenges with regard to maintaining ecosystem functions, flood control, and wetland protection.

Additional Background Information

The catchment has been adopted as the framework for water resources management in Uganda. It will in many cases reflect the high spatial variability of rainfall and water resources availability and the specific regional and local context of water resources issues and solutions. The catchment management approach also recognizes the drainage basin as the logical unit for integrated land and water management. It acknowledges the importance of stakeholder participation to increase the effectiveness of resources management.

Catchment management plans – at various levels – will allocate the finite water resources in accordance with the Water Policy, the National Development Plan, Vision 2040, and sector objectives, while taking into account the local context and priorities. All water use and abstractions above a certain threshold are regulated. These also include abstractions for the aquaculture, livestock, industrial, small scale hydropower, and mining sector, which are generally small and do not affect flows at the national level. It is important to ensure consistency of the respective catchment plans with plans at the national level that also take into account Nile Basin obligations. De-concentration of water resources management is ongoing with an increasing role of the Water Management Zones and Catchment Management Organizations. In particular, the catchment management plan will play a key role in implementing the water resources strategy, including land management and the water quality elements. Catchment management plans will be developed for priority and hotspot catchments first.

Action: Develop high-value water projects in accordance with IWRM principles(this includes the hydropower facilities on the Nile and oil development, which do not conflict with other water uses)
Purpose:to increase the contribution of the country's water resources to national development.

Action Details:

- Meet water demand for the oil sector in the Albertine Graben fully from surface water sources (Lake Albert or Albert Nile);
- Develop fully the hydropower potential (HPP) along the Nile, with the possible exception of Kalagala and Murchison Falls for environmental and tourism reasons; develop long-term planning tools and short-term optimization tools to guide release policies of Lake Victoria in order to optimize hydropower production (see 6.1.5);
- Meet short and mid-term industrial water demand fully; review this policy in 5-years time or when the pace and nature of Uganda's industrial development becomes clearer; at the same time, introduce pricing policies – or advance warning of future pricing policies – that encourage efficient water use and water allocation to high value uses (see 6.1.4);
- Develop bulk-water supply projects for high value uses.

Water quality concerns are addressed in 6.1.2.

Action: Develop irrigation potential in phases subject to better information on affected wetlands and in accordance with IWRM principles.
Purpose: to promote irrigation development, while taking into account the ecological value and other important functions of the affected wetlands.

Action Details:

- Cooperate with partners to prepare a comprehensive inventory of the ecological value and all functions of wetlands that may be affected by irrigation development;
- Cooperate with partners to prepare a comprehensive environmental, hydrological, and socio-economic impact assessment for the potential irrigation areas;
- Support the decision process on irrigation development as needed.

Additional Background Information

Development of the wetland and upland irrigation potential does not significantly conflict with hydropower production along the Nile or transboundary flows, but may have major adverse impacts on local wetlands, local ecosystem functions, the hydrologic regime of nearby rivers, and associated fisheries and tourism. Wetlands cover some 11% of Uganda's land area and represent important ecological values. They use large volumes of water to maintain their ecosystem functions and have a marked impact on the hydrology of the country's river systems. However, no comprehensive inventory exists of the ecological value and functions of the individual wetland areas. Hence information on one of Uganda's larges water users – wetlands – is currently inadequate, and no informed analysis can be made of the trade-offs between irrigation development and wetland and environmental protection, or other beneficial wetland uses such as fisheries and fish breeding, tourism, groundwater recharge, water purification, or flood protection. This situation will delay irrigation development.

Wetland protection is further discussed in 6.1.3.

Action: Continue engagement with Nile partners on equitable use of the Nile waters and their benefits.
Purpose: to determine the agreed-upon consumptive use of the Nile waters in Uganda, set the boundary conditions for the operation of water control infrastructure on the Nile system in the country, and ensure that water abstractions in upstream riparian countries are reasonable and take into account Uganda's interest.

Action Details:

- Prepare a position regarding Uganda's reasonable share of the Nile waters; note that this could exceed the consumptive water use associated with implementing Vision 2040;
- Continue the cooperation with Nile Basin Initiative, Lake Victoria Basin Commission and other international bodies.

Additional Background Information

Virtually all of Uganda lies within the Nile Basin, emphasizing the transboundary context of water resources management in the country. Uganda is both an upstream and downstream riparian. The majority (69%) of Uganda's renewable water resources originates outside the countryand the interests of the downstream riparians (South Sudan, The Sudan, and Egypt) have to be taken into consideration.

Nevertheless, among the key findings of the MIKE BASIN modeling exercise is the observation that wetland irrigation and hydropower development in Uganda by 2040 does not significantly affect Bahr el Jebel flows, due to the non-consumptive nature of hydro-electricity generation and already high evaporation losses from the wetlands prior to conversion to irrigation.

6.1.2 Management of Water Quality

Water resources management includes the management of both the quantity and quality of the water. Thus, if the quality of a certain water body is not sufficient for a specific purpose that quantity is in effect not available for that purpose. The quality of a given water resource is determined by natural factors and impacts from human activities which can be regulated to some degree. The latest Ugandan National Water Resources Assessment from 2012 summarized the critical priority issues regarding water quality management as follows:

- The most important water quality issue is bacterial contamination of both groundwater and surface water resulting from inadequate sanitation facilities, highlighting the importance of improving sanitation.
- Issues associated with groundwater, usually localized, include corrosiveness, turbidity, and high concentrations of iron, chloride and fluoride.
- Because of poor sanitation surface water, anywhere in the country, is unlikely to be of drinking water quality.
- Eutrophication resulting from excessive quantities of nutrients reaching water bodies can cause algal blooms that may lead to oxygen deficits and fish kills, or promote the excessive growth of weeds such as water hyacinth.
- Contamination by hazardous chemicals from industries and agriculture is still at low levels in Uganda, but they could be an issue and damage health locally.
- Soil erosion is mostly a localized issue in Uganda being concentrated in the Mt Elgon, Rwenzori, and south-western regions. The application of soil and water conservation measures is very limited.
- Wetlands play a crucial role throughout the country in capturing sediments and maintaining water quality. Their degradation or conversion into agricultural lands can therefore lead to issues related to significantly higher sediment yields in various river systems of Uganda.
- Inadequate water quality management is an issue requiring development of water quality objectives and emission standards as well as intensified water quality monitoring.
- Difficulty in maintaining the minimum requirements of ecosystems to water flows and water quality (environmental flows) is an issue

- Potential water quality impacts of the upcoming oil exploitation in Western Uganda can become a significant issue
- Rapid and inadequately regulated development of aquaculture

Key strategic outputs and actions

Output:
Wholesome drinking water sources safeguarded and the quality of surface and groundwater bodies kept within limits defined by water quality objectives

Actions:
- Establish proper sanitation facilities and protected drinking water sources for rural and urban populations;
- Reduce the amounts of point and non-point pollutants reaching the surface and groundwater bodies;
- Reduce the risk of environmental damage and water quality deterioration from oil exploitation;
- Promote conservation and wise use of wetlands;
- Protect environmental flows in rivers;
- Develop water quality objectives;
- Further develop water quality monitoring and assessment capacity;
- Enforce and monitor compliance with water quality standards and source protection guidelines.

Action: Establish proper sanitation facilities and protected drinking water sources for rural and urban populations;
Purpose: To reducethe bacterial contamination of groundwater sources and surface water resulting from inadequate sanitation facilities and unprotected drinking water sources.

Action Details:
- Ensure proper construction and maintenance of drinking water facilities to avoid contamination of the water sources;
- Ensure proper management of the catchments in which water sources are located (avoid interference with wastewater)in line with water source protection guidelines;
- Expand sanitation coverage;
- Enforce by-laws requiring all homesteads to have improved sanitation facilities;
- Reduce the proliferation of low-standard on-site sanitation, in particular those which can interfere with water sources.

Additional Background Information
The proportion of the population with access to urban sewerage and rural sanitation (7% and 49% respectively) in Uganda is one of the lowest in the world. Poor sanitary facilities in all urban centres increase the risk of contamination by pathogens and leads to an increase in the incidence of water-borne diseases such as cholera, dysentery and typhoid,which continue to be reported in several districts and are almost endemic in some of them.

Action: Reduce the amounts of point and non-point pollutants reaching the surface and groundwater bodies.

This action comprises the following components:

- Reduce the amounts of nutrients reaching the surface water bodies;
- Reduce the amounts of polluting effluents reaching the surface water bodies from industries;
- Reduce the amounts of hazardous chemicals (pesticides) reaching the surface water bodies from agriculture;
- Minimize sediment transports in rivers;
- Reduce the environmental impact from aquaculture.

Component 1:Reduce the amounts of nutrients reaching the surface water bodies.
Purpose: To avoid excessive growth of algae and macrophytes - e.g. water hyacinths, water ferns etc. (eutrophication).

Action Details:

- Mitigate and prevent environmental degradation;
- Encourage or implement soil and water conservation measures in areas with high erosion risk;
- Protect critical wetlands;
- Manage and protect forests; arrest or reverse deforestation;
- Improve treatment of urban wastewater; ensure no untreated wastewater reaches the water bodies;
- Address eutrophication due to pollution from upstream countries.

Additional Background Information
Most of the urban centres in Uganda drain their wastewater into swamps and open waters in the vicinity. This wastewater is rich in nutrients such as phosphate and nitrate. In some areas agricultural fertilizers also contributetothe loads of nutrients on the water bodies. Eutrophication has been occurringalong the shores of Lake Victoria around Entebbe, Jinja and especially in the Murchison Bay area (near Kampala) where large algal blooms regularly cause oxygen deficits and fish kills.

Component 2:Reduce the amounts of polluting effluents reaching the surface water bodies from industries.
Purpose: To avoid human and environmental damage due to effluents with organic matter and hazardous chemicals from industries.

Action Details:

- Ensure that industrial wastewaterdischarges comply with discharge regulations and permits before entering water bodies or the general sewage system;

- Ensure proper monitoring of wastewater;
- Monitor industrial production and new industrial developments;
- Promote use of clean production practices and support research in environmental friendly technologies.

Additional Background Information

The main industrial towns of Uganda are Kampala, Jinja, Mbale, Masaka, Kasese and Kilembe, Mbarara, Soroti and Tororo. The main industries are food processing, breweries, soap and detergent manufacture, cooking oil and leather and tanning industries. However, the actual production level of Ugandan industries is relatively low and thus, the industrial pollution is still being considered low although localized dangerous hot spots exist. However, with economic development, industrial activities are expected to increase and a number of measures to regulate industrial pollution are under implementation.

Component 3:Reduce the amounts of hazardous chemicals (pesticides) reaching the surface water bodies from agriculture.
Purpose: To avoid environmental damage due to effluents of hazardous chemicals (e.g. pesticides) from agriculture.

Action Details:

- Monitor the development of large-scale farming and the application of various products.

Additional Background Information

Currently, only few pesticides are being used in Uganda and it is mostly the large sugar and tea estates along the Lake Victoria coast line (between Kampala and Jinja) that use them. However, as mentioned for industries, increased industrial agricultural practice can be expected along with the economic development and a more rigid regulation of the area may be foreseen in the future.

Component 4:Minimize sediment transports in rivers.
Purpose:To mitigate erosion and effects of river bank sand mining.

Action Details:

- Establish mapping of critical areas;
- Identify vulnerable zones for full protection or regulation;
- Establish regulations for sand miners operating in vulnerable zones (e.g. permit system).

Additional Background Information

Soil erosion is a localized problem in the hilly areas of Uganda, especially those that are densely inhabited and those where the natural forests and grasslands have been denuded. In south-western Uganda and the Ruwenzori area; Elgon area and the western part of Karamoja, soil erosion has led to

the loss of large amounts of top soil. In these areas erosion is causing deposition of silt in the rivers and floodplains. Another source of increased sediments in the water courses is sand mining that takes place for construction purposes in many river banks and wetlands.

Mitigating measures with respect to erosion includes: Improving agricultural practices in the hilly and mountainous areas; re-establishing of terraces in areas that have been eroded; replanting grass, trees and shrubs, or allowing the land to fallow, for areas that has been denuded of vegetation. Such activities should be seen in the context of Integrated Land and Water Management (see also Section 6.1.3).

Component 5:Reduce environmental effects of aquaculture.
Purpose:To conserve the quality of the environment.

Action Details:

- Establish permit system for bigger fish farming plants including regulations for operations;
- Monitor the development of fish farming including production figures;
- Establish assessment tools for impact of fish farming on rivers and lakes.

Additional Background Information
Fish farming using the freshwater courses as water source is rapidly increasing in Uganda. The establishment of ponds diverts water from the rivers and streams, and creates excess organic matter including nutrients, which is either continuously discharged to the feeding watercourse or "washed out" occasionally creating a "cloud" of oxygen demanding water flowing downstream, impacting natural life in the river.

Action: Reduce the risk of environmental damage and water quality deterioration from oil exploitation.
Purpose: To establish means to mitigate environmental damage from oil spills.

Action Details:

- Develop environmental protection standards to be kept by the concessionaires;
- Establish monitoring and control system;
- Develop environmental oil spill sensitivity maps;
- Develop an oil spill contingency plan;
- Establish an oil spill mitigation unit with trained staff and necessary oil spill recovery equipment.

Additional Background Information
The oil exploration in Uganda has shown promising results and oil exploitation can be expected to commence in the Albertine Graben area shortly. With oil exploitation follows the risk of environmentally damaging oil spills along the chain from exploitation sites over transport and to the storage/refinery facilities. In order to cope rapidly and efficiently with accidental oil spills, an emergency organization needs to be set up. Moreover, monitoring and control of possible leakages at the production sites as well as at storage facilities will be required.

Action: Promoteconservation and wise use of wetlands.
Purpose: To maintain the ecosystem services provision capacity in wetlands, including natural purification.

Action Details:

- Establish mapping of wetlands critical to ecosystem services provision incl. natural purification;
- Establish collaboration with the National Wetlands Conservation and Management Programme on specific protection of wetland zones critical to water purification.

Additional Background Information
Wetlands in Uganda cover almost 30,000 square kilometers, or about 11% of the land area of the country. They include areas of seasonally flooded grassland, swamp forest, permanently flooded papyrus and grass swamp, and upland bog. The wetlands play an important role in the provision of various ecosystem services, including purification of surface waters. Organic matter settles and decays in the swamp sediments and nutrients are stripped from the water by various chemical and biological processes. The protection of wetlands serves several other purposes including conservation of wildlife and biodiversity as well as livelihood for rural communities living from the ecological production of the wetlands. Uganda has a National Wetlands Conservation and Management Program under implementation.

Action: Protect environmental flows in rivers.
Purpose: To protect vital ecosystems from damage due to low flow regimes or harmful water quality.

Action Details:

- Determine environmental flow requirements of rivers and streams;
- Identify critical rivers and streams;
- Include environmental flow requirements in catchment planning;
- Protect upstream forest areas and wetlands that provide dry season flows;
- Seek measures to reduce overland runoff and increase infiltration;
- Develop and put in place drought mitigation plans and ensure proper compliance.

The term Environmental Flows describes the minimum requirements to water quantity and quality that an ecosystem has in order to maintain a certain, pre-described condition. These requirements need to be considered in water management when allocating water and/or setting water quality objectives.

Action: Develop water quality objectives.
Purpose: To define suitable attainable water quality of different water bodies in relation to various desirable uses.

Action Details:

- Establish baseline conditions;
- Establish standard criteria for water quality requirements of different uses;
- Establish criteria for zoning classification;
- Establish a zoning of water courses according to classification.

Additional Background Information

The water quality objectives are functional descriptions of the desired water quality of a given water body considering on the one hand the natural conditions and the requirements of the ecosystems, and on the other hand the requirements of the human activities such as fishing, irrigation and livestock watering, drinking and domestic uses, mining and industry etc.Consideration should also be given to the quality of water leaving the country. In Uganda, the process of establishing water quality objectives is underway and requires a careful assessment of the needs of the different users along with national and international priorities.

Action: *Further develop water quality monitoring and assessment capacity.*

Purpose: To implement the DWRM Water Quality Monitoring Strategy.

Action Details:

- Ambient monitoring: trend detection, testing standards (e.g. human uses and ecological functioning), calculation of loads/transports;
- Effluent monitoring;
- control of spill-loads/discharges;
- Early warning: accurate warning (alarm, database, communicative systems), protection of functions;
- Operational monitoring: operational use, domestic water supply, irrigation, industrial use, livestock, fisheries.

Additional Background Information

A high standard water quality laboratory and a national water quality monitoring network were established under the Water Resources Assessment Project (WRAP) between 1996 and 2000. These water quality monitoring facilities have been operated since then to provide (1) a network for monitoring point and non-point pollution on selected water bodies, (2) an operational facility to provide technical back-up for water supply and water treatment facilities, and (3) a monitoring system to assess water quality trends in surface waters and groundwater. A total of 119 monitoring stations were established but, because of budgetary and logistic constraints, sampling has not been done at the same times, similar data have not been collected, and not all the envisaged stations have been sampled.

The Uganda Water Action Plan (1994), the National Water Policy (1999), and the 2004 Joint Water and Sanitation Sector Review, were used as the basis for a Water Quality Management Strategy, developed in 2006. It outlines how to control water quality in Uganda and sets out the legal, institutional and operational requirements for a comprehensive framework of water quality management. A key pillar in the strategy is the "Integrated Monitoring and Assessment" building on two basic principles: (1) "source-directed" management that sets standards for the discharge of pollutants, and (2) "resources-directed" management that sets water quality objectives for various uses including environmental requirements. The strategy defines a future water quality monitoring framework.

Action: Enforce and monitor compliance with water quality standards and source protection guidelines.
Purpose: to achieve better performance in relation to the water use and wastewater discharge mandate of DWRM and other agencies. This subject is addressed in paragraph 6.3.3.

6.1.3 Integrated Land and Water Management

Land management is a key determinant of the quality and flow of water resources, and many of the problems affecting land and water resources are interrelated. In Uganda, poor land management practices have led to widespread soil and land degradation, which causes depletion of water resources and lower capacity for agricultural production. Domestic water supply, for instance, is put at risk when the quality and flow from protected springs and boreholes is affected. Land degradation is also a primary cause of non-point pollution of the aquatic environment by organic matter and nutrients. Land-use changes have produced accelerated soil erosion on Mt Elgon and surrounding foothills, the Rwenzori's, and the south-western hilly region (Kabale and Kisoro districts). It leads to problems of suspended sediment, colour, and turbidity in the headwater-rivers and eutrophication of the water bodies in the country. This situation is exacerbated by mismanagement of buffers to open waters (riverbanks and lakeshores). Further, deforestation and degradation of forests and wetlands result in lower level of ecosystem services as well as shifts in the hydrologic regime because of lower water retention in the catchment, and subsequent higher floods and drought risks. Mandated institutions have not effectively enforced compliance with water legislation and regulations due to capacity constraints.

With pressure on land resources increasing because of demographic trends and higher demand for food, there is a growing reliance on marginal agricultural lands, continuing deforestation and wetland encroachment, degradation of river banks and lakeshores, and intensification of agricultural practices that are unsuitable for local soil and water conditions. The associated land and water degradation risks are accelerating.

Land and water management issues cannot be effectively addressed independently but require a coordinated and collaborative approach involving all sectors concerned and broad stakeholder participation. In particular the agriculture and water sectors share a common interest in arresting and reversing land degradation.

Agricultural practices have a major impact on the state of the water resources. However, land management decisions often take place at plot level, and farmers are reluctant to adopt improved

practices unless they see direct evidence of higher yields and associated higher household income. It points to a major complicating factor. The agricultural production system is subject to multiple constraining factors. Some are related to the bio-physical environment (water, nutrients, etc.) while others concern non-biophysical factors such as market access or low farm-gate prices. Only when all critical constraints in the production system are addressed simultaneously will higher yields and income be achieved, and incentives created for widespread adoption of improved land management practices in the agricultural sector. Measures implemented in isolation typically fail to produce direct benefits, and will most probably not provide sufficient incentives for improved practices.

On the other hand, the behavior at individual farmer or household level often undermines collective effort required to sustain ecosystem services.

Sustainable Land Management (SLM) strategies, therefore, need to be embedded in comprehensive agricultural modernization programs (that ultimately lead to higher household income) to be effective, sustainable, and ensure wider adoption.

Key strategic output and actions

Output: Catchments effectively managed.
Actions:

- Integrate land management into catchment management plans;
- Promote appropriate agricultural practices;
- Develop and apply incentives to improve adoption of sustainable land management practices;
- Promote better understanding of the intrinsic relationship between water and land management, and the inter-linkages of the agriculture and water sectors;
- Prepare land degradation and vulnerability maps, starting with selected hotspots;
- Implement targeted interventions in priority areas (hotspots).

Action: Integrate land management into catchment management plans.
Purpose: To plan the use and protection of land resources in a collaborative effort with all stakeholders' involved, and taking into account water resources challenges.

Action Details:

- Assess the state, resilience, and functions of the land resources, prepare land-use plans, prioritize conservation and restoration efforts, and assess the need for (large scale) public investments in a participatory manner involving communities and other stakeholders.
- Protect vulnerable areas (such as marginal agricultural lands, head water areas and steep-sloping lands, areas with poor and shallow soils).
- Establish a legal and institutional framework that effectively determines responsibilities for land management in the catchment, and ensures compliance to the catchment management plan.

The catchment management plans (see 6.1.1) will provide a broad framework at basin and sub basin level for use, conservation and protection of water resources, enforcement and compliance with policy and legal frameworks, improved land-use practices, and coordinated management of degraded landscapes.

Action: Promote appropriate agricultural practices.
Purpose: To arrest or reverse land degradation in the extensive rainfed farmlands and rangelands that negatively impact on the state of the water resources.

Action Details:

- Coordinate with partners to zone vulnerable lands for protection (such as steep slopes) against cultivation and collaborate with mandated institutions and partners to prevent encroachment or degradation of forests, wetlands, riverbanks and lakeshores within the over-all framework of the catchment management plans.
- Promote sustainable land management and agricultural practices such as conservation farming, tree-based farming on hill sides, and soil erosion control practices such as contour ploughing.
- Prepare bye-laws on soil management, soil erosion control, establishment of terraces or contour bunds, control of bush fires in collaboration with farmers, communities and local governments.
- Develop and implement community based rangeland and wetland management strategies such as determining livestock carrying capacity of particular rangelands and seasonal wetlands that are frequented by the itinerant herders, access and control of rangeland and wetland resources, stakeholder participation in regulating and monitoring resource use, among others.

Additional Background Information:
Poor farming practices are a principal cause for land degradation in Uganda. Soil erosion has reduced soil depth and organic content, decreasing moisture retention capacity and thus increasing vulnerability to drought. Intensive use of farmland without nutrient replenishment, and shortening or absence of fallow periods has led to widespread soil exhaustion and low soil fertility, and subsequent low yields.

The first comprehensive land-cover map for Uganda (1964) observed 3% farmed area (of the land area). AFRICOVER in 2002 identified farmed ecosystems on 34% of the land area, a 10-fold increase. This excludes the extensive rangelands in the country. Rapid population growth combined with food security concerns point to further expansion of agricultural activities, which will increase pressure on marginal agricultural lands that are highly vulnerable to land degradation. Rainfed agriculture (including rainfed rangelands) will remain dominant in Uganda in the foreseeable future, in spite of development of a large irrigation potential. It accentuates the importance of sustainable land-use practices in rainfed areas.

While technical solutions for improved agricultural practices (such as soil conservation measures, water harvesting techniques, use of fertilizer, contour ploughing, conservation farming, rangeland management, etc.) are well documented and clear-cut, their up-take requires behavioral change by individual actors in order to achieve widespread adoption. Experience shows that farmers are unwilling to implement better practices unless they see direct benefits, such as higher yields and more critically, higher income. Hence, only when all critical constraints in the agricultural production system (both biophysical and non-biophysical) are addressed simultaneously, is higher income possible, as a long-

term (self-sustained) incentive structure for improved land management (by individual actors). Agricultural modernization critically depends on interventions at national (policy) level with regard to land tenure (for communal areas), systems to ensure stable and profitable farm-gate prices, agricultural trade regulations, rural infrastructure programs, etc.

Action: Develop and apply incentives for improving adoption of sustainable land management practices.
Purpose: To address barriers to up-take of sustainable land management practices by farmers.

Action Details:

- Assess policy barriers and facilitate policy reforms for enabling up-take of sustainable land management practices. The assessment may include, among others; institutional structures, mandate, roles and responsibilities at catchment and community level, partnerships and collaboration among mandated institutions, indigenous/ traditional systems of knowledge and practices, trans-boundary ecosystems, upstream/ downstream relationships, implications and requirements in response to policy changes at national level and linkages with local level actors and implications on the ground, incentives for collective action, sharing and learning from experiences and practices and changes in policies.
- Assess strategies for institutionalizing SLM technologies and linkages between agricultural development and other rural development programs and facilitate appropriate reforms; this may include payment for ecosystem functions.
- Promote incentives for improved soil management and water conservation such as increasing access to information on applicable soil and water conservation policies and laws.

Action: Promote better understanding of the intrinsic relationship between water and land management, and the inter-linkages of the agriculture and water sectors.
Purpose: to raise awareness among agriculture sector policy makers about the importance of increasing the profitability of small-holder farming to create the incentive structure for widespread, self-sustained, and long-term up-take of improved land management practices of agricultural land (that conserve land and water resources).

Action Details:

- Establish collaborative arrangements with MAAIF in promoting better understanding of the intrinsic relationship between water and land management, and the inter-linkages of the agriculture and water sectors.
- Jointly prepare policy briefs for high-level policy and decision makers on the holistic nature of the agricultural production system, the close inter-linkages between land and water management, and the need to establish a self-sustained incentive structure for protection of land and water resources in Uganda.

Additional Background Information:
Policy makers need to appreciate that without a proper incentive structure, it is doubtful that wider adoption of sustainable land management practices can be achieved. Such outcome would adversely impact on the state of the water resources in Uganda, climate proofing of the agricultural sector, food security, and on rural development. A holistic understanding of the nature of the agricultural production system is needed, and of the role of policies at national level (regarding stable and profitable farm gate

prices, reducing transportation costs, security of land tenure, agricultural trade regime, among others) in agricultural modernization, in raising the profitability of farming, and ultimately in creating incentives for soil and water conservation.

Action: Prepare land degradation and vulnerability maps, starting with selected hotspots.
Purpose: to map severely degraded catchments (hotspots) and other areas vulnerable to degradation, and determine appropriate land use practices.

Action Details:

- Establish collaborative arrangements with relevant partners and stakeholders on land degradation and vulnerability mapping;
- Map intensity of, and vulnerability to land degradation in specific locations by combining satellite images and geo-referenced databases on climate, soil, terrain, and land use/cover with soil and vegetation sampling and onsite knowledge from the local population;
- Evaluate the (hydrological) functions of the land units/resources at the appropriate spatial scale;
- Identify critical areas and watersheds;
- Assess and define levels of land management required and suitable land use activities.

Action: Implement targeted interventions in priority areas (hotspots).
Purpose: To reverse land degradation in areas of high value with regard to environment, impact on the hydrological processes, etc.

Action Details:

- Establish collaborative arrangements with partners in order to implement diverse engineering measures such as terraces, land leveling, and check dams;
- Re-establish the eroded terraces in the hilly and mountainous areas;
- Reforestation and/or restore important wetlands;
- Introduce incentives for improved land and soil conservation in hotspot areas;
- Strengthen enforcement of regulations for selected hotspot areas.

In the current socio-economic climate, funds can only be mobilized for relatively small-scale interventions in areas of high value. Appropriate interventions need to be carefully chosen in close collaboration with stakeholders and partners.

Key strategic output and actions

Output: Ecosystem delivery of goods and services that protect water resources sustained or enhanced.
Actions:

- Promote sustainable forest management;
- Promote conservation and wise use of wetland resources (see 6.1.2);
- Protect riverbanks and lakeshores;
- Promote incentives for sustaining ecosystem goods and services;
- Strengthen enforcement and compliance function in relation to water resources

protection.

Action: Promote sustainable forest management.
Purpose: Tosustain the role of forests in the watersheds and enhance their role in performing vital ecosystem and hydrological functions.

Action Details:

- Foster collaboration with institutions mandated to manage forestry resources and other relevant partners including private forest owners to: i) ensure total protection and/or restoration of forests on steep mountainous slopes and in other critical areas, including local or Central Forest Reserves, ii) enhance controlled and sustainable exploitation of forests and forestry resources, and iii) arrest deforestation and forest degradation through reforestation programs, tree planting and agro-forestry practices.
- Raise awareness of communities about the linkages between forest conservation and water resources management.
- Prepare bye-laws on protection and development of forestry resources in areas such as hilly areas and densely populated areas in collaboration with farmers, communities and local governments.
- Work with partners to encourage all measures such as efficient wood-fuel use, alternative sources of energy, efficient forest resources harvesting and utilization that address drivers of deforestation and forest degradation (fuel wood, charcoal production, timber harvesting, overgrazing, etc.).

Additional Background Information:
Forests moderate runoff patterns by increasing infiltration and reducing overland runoff, while sustaining base-flow and thus increasing dependable water supply. Forested areas also play a critical role in preventing soil erosion and enhancing water quality.

Uganda has witnessed a high rate of deforestation and forest degradation. Forest cover has declined from 10,800,000ha in late 1890 to 4,900,000ha in 1990 and 3,570,643 in 2005 (NFA, 2009). This presents a decline in forest cover from 35% to less than 15% of Uganda land surface. Loss of forest cover is due to logging, harvesting of wood-fuel, and conversion of natural forest to agricultural land. Because of the very low electrification rate (6% in rural areas and 40% in urban areas in 2010) a large segment of the population remains dependent on biomass energy sources, which include wood and charcoal, thus increasing pressure on forests and shrub lands.

Action: Protect and promote conservation and wise use of wetland resources.
Purpose: To preserve the essential hydrologic and water quality purification functions performed by wetlands. This subject has been discussed in paragraph 6.1.2.

Action: Protect riverbanks and lakeshores.
Purpose: Toensure that protected zones of riverbanks and lakeshores are maintained and their role in water resources protection is enhanced.

Action Details:

- Foster collaboration with the environmental management agencies (Districts, Wetland Management Department, NEMA) and other relevant partners to ensure protection of riverbank and lake shores.
- Promote wise use of riverbank and lake shore resources.

Additional Background Information:

According to The National Environment Regulations (1998), rivers banks and lakeshores are protected zones. These protected zones are intended to stabilise the river banks and lakeshores whilst serving as buffers to prevent soil deposition into the open water. Riverbanks and lakeshores have not been spared of degradation mainly due to agricultural encroachment and other forms of resource extraction such as sand mining.

Action: Promote incentives for sustaining ecosystem goods and services.
Purpose: To enhance community appreciation of the contribution of ecosystem goods and services to their livelihoods and wellbeing.

Action Details:

- Assess level of understanding of the relationship between ecosystem goods and services in relation to livelihoods and wellbeing and develop awareness messages about these relationships and incentives for protecting ecosystem goods and services.
- Promote incentives for protecting ecosystem goods and services such as Payments for Ecosystem services as avenues for mobilizing participation in ecosystem protection.

Broadly, ecosystem goods such as water and services such as climate modulation are poorly understood or appreciated, nationwide. It is this poor relationship that undermines sustenance of these values.

Action: Strengthen enforcement and compliance function in relation to water protection.
Purpose: To achieve better performance in relation to water resources and environmental protection by the relevant agencies. This subject is addressed in paragraph 6.3.3.

6.1.4 Water Demand Management

The current water resources situation in Uganda is characterized by overall water supply exceeding demand. Nevertheless, a significant part of the country – in particular in the cattle corridor – experiences occasional water shortages. Further, localized water deficits occur in a number of places (hotspots), but no large scale conflicts between water using sectors have been reported.

Consumptive water use is currently low with only around 70,000 ha of irrigated land (formal and informal), a low level of industrialization, and low per capita water use. Large volumes of water, though,

are needed to sustain the extensive wetland areas and other aquatic ecosystems, while Nile flows need to be maintained in order to operate the hydropower facilities on the Nile.

Water demand is set to increase significantly as a result of ongoing population growth, socio-economic development including industrialization, irrigation development, and oil production. Water demand in the upstream Nile countries is also expected to rise. A combination of higher water demand and the effects of climate change could lead to large scale competition for raw water.

It indicates that Uganda needs to encourage more efficient use of its water resources (both ground and surface water) and justifies the development of a water demand management strategy. Currently, interventions to influence water demand are limited. Domestic and industrial water use is charged according to consumption, but prices are kept at low levels and do not provide real incentives for individuals and larger users to save water or use it more efficiently. Low prices are sustained through transfers from the national budget to the utilities. A permit system with fees and charges exists for bulk water abstraction but water consumption is only occasionally monitored, or not at all.

Apart from increasing end-use efficiencies, demand management should also encourage using water for higher-value activities in terms of economic output. This is referred to as 'allocation efficiency', and applies in particular when users are competing for scarce water resources. Provision of safe water for domestic purposes is guaranteed by the Constitution. Demand management requires a balanced approach that combines: 1) resource planning and water allocation that takes into account economic considerations, 2) an incentive (or disincentive) structure, 3) regulation, 4) technical support and introduction of new technologies, and 5) education and awareness building. Measures can be mostly preventive, such as monitoring the compliance with water permits or introducing higher water prices, or aimed at managing a fully emerged water conflict. In the latter case, water managers typically need to set quotas based on a combination of allocation efficiency and historic rights.

Experience in other countries has shown that establishing a water conservation culture and allocating (scarce) water resources to activities with 'higher return to water" is a lengthy process, which can be fraught with political difficulties when established rights are challenged, and historic and socio-cultural use patterns are subjected to change. Therefore, demand management in Uganda should be introduced immediately to prevent wasteful usage and low-value use habits from being established.

In water deficit areas (hotspots), a strategic choice is between demand management and increasing water supply through bulk water transport (including possible inter-basin transfer), if technically and economically feasible. This is a political decision that depends on many parameters, many of which are not related to the water sector.

Key strategic output and actions

Output: End-use efficiencies increased
Actions:

- Raise awareness about the importance of water conservation;
- Ensure compliance to abstraction permits through monitoring;
- Develop water pricing policies that encourage efficient water use;
- Set water use efficiency standards;
- Encourage adoption of water efficient technologies.

Action details:

- Raise awareness about the importance of water conservation;
- Ensure that water abstraction permits for all large water users in the catchment are effectively complied with through regular monitoring; without proper monitoring there is always a risk of violation of water permits, which could lead to wasteful usage and possible water conflicts;
- Establish collaborative arrangements with relevant partners to develop (or review) water pricing policies and mechanisms that recognize water as an economic good and encourage efficient use; develop separate pricing policies for each sector (domestic, industrial, agriculture, livestock, mining); charging for water use is an effective tool for changing behavior in terms of water consumption; tariffs need to be set on a basis that is understandable and transparent, and that stimulates accountability in order to be acceptable; flat or fixed rates should be avoided as it does not encourage efficient use; instead, charges should be based on actual volume of water used; progressive pricing policies can be considered to protect vulnerable people in society; develop the legal and institutional mandate and subsequent enforcement capacity for effective implementation;
- Set efficiency standards and benchmarks for delivery systems for municipal water supply and irrigation; provide technical support as needed; ensure compliance;
- Establish collaborative arrangements with relevant partners to set water efficiency standards for the industrial and oil development sectors; prepare regulations and ensure compliance;
- Encourage the introduction of water efficient technologies (e.g. drip irrigation systems in the irrigation sector); provide technical support

Additional Background Information:

Measures to increase water end-use efficiency also serve to reduce capital investments in delivery systems and water production infrastructure (such as pumping stations or water treatment plants). Their implementation, therefore, could start immediately and should not be postponed until water shortages or even conflicts emerge. Furthermore, establishing a conservation ethic requires a behavior change that typically takes time. A phased approach may be considered for existing users. New users, however, should be subjected to the new regime (standards and pricing mechanisms). It is important to reiterate that achieving more efficient water use will probably not be successful without incentives (or disincentives in case of non-compliance) combined with monitoring.

Key strategic output and actions

Output: Water resources allocated to higher value economic activities.

Actions:

- Develop a set of standard tools for estimating the economic value of water for various

development options for use at catchment or local level;
- Develop a general equilibrium model to estimate overall economic changes associated with changes in water allocation for use at national level.

Action details:

- For use at catchment and local (hotspot) level, develop a set of standard and practical modeling tools for assessing the economic value of water for various development options and management policies; existing methodologies for estimating the economic value of water for hydropower and irrigation should be consolidated, whereas the economic value of other water using sectors should be developed jointly with national universities; build capacity at DWRM for using these tools;
- For more complex water allocation question follow the further development and use of general equilibrium models such as BEAM[1]through the World Bank.

Additional Background Information:

The objective of increasing allocation efficiency is to get most 'economic value per drop' when several sectors are competing for scarce water resources (see annex 4). However, the task of allocating water away from low-value uses to activities of high monetary or economic value is not a straightforward process. Policy makers also need to consider non-economic factors such as equitable access to water, social policies that include protecting vulnerable people, food security and rural development, and the value of the environment. Users should perceive the water distribution process as equitable and fair. The allocation mechanism should be sufficiently flexible to accommodate changing economic conditions (e.g. long-term changes in oil and food prices). Nevertheless, a certain level of security of tenure for water users is required to encourage long-term investments, for instance in efficient irrigation equipment. Additional factors that need to be considered are the distribution of costs and benefits across society (and even across generations). As a result, allocation of water only based on economics is rarely attained (nor desirable) in practice.

Inter-sectoral allocation of water resources in Uganda, therefore, should remain the task of the government – through granting permits - with little or no role for market-based allocation.

Nevertheless, the analysis of economic efficiencies provides a useful point of reference for water allocation decisions, also because it helps to understand the causes of inefficient water use.

It is important to note that the economic value of water is time and catchment specific. Development options and thus opportunity costs differ per basin, and so will local and catchment allocation priorities.

At national level, hydro-electricity generation on the Victoria and Kyoga Nile will compete with growing domestic and industrial water demand that is supplied by Lake Victoria, irrigation development - in particular in the Lake Kyoga basin, and water allocated to sustain the aquatic environment (see paragraph 6.1.1). Increasing water-use efficiencies for all uses is a no-regret measure (see above).

If just two sectors compete for scarce water resources, the economic value of water can be calculated using elements of cost benefit analysis (see Annex 3, presenting a sample calculation of the economic value of hydropower and irrigation in Uganda).

For more complex situations involving wider water allocation questions that involve several sectors and use multiple water sources, a general equilibrium model should be developed with the objective to assess the impact of changes to water allocation and investments in water management infrastructure on the overall economic welfare of the country.

Basin Economic Allocation Model (BEAM) has been developed as a decision support system to facilitate putting an economic value on water. The model estimates welfare changes associated with changes in water allocation between Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. The model addresses the Aral Sea basin as a whole covering five sectors: agriculture, hydropower, nature, households and industry.

6.1.5 Water Resources Information, Planning and Capacity

Effective water resources management needs to be based on a good understanding of the hydrological processes, the socio-economic development potential and objectives, and the implications and trade-offs of possible water resources management and development scenarios. It requires a broad range of information, a set of integrative analytical tools at catchment and higher level, and the human and institutional capacity to operate the tools, evaluate the information, and execute a systematic decision making process.

Data gaps are numerous and data – if available – are typically scattered across various database systems in different software formats, and maintained by different agencies. Reliability and validity of data series is varying.

A number of analysis tools exist, but not at lower level and not integrated. The Nile DSS established by the Nile Basin Initiative (NBI) is operational and well-supported, and evaluates the basin-wide response to alternative (higher level) water allocation and management policies. At national level, a complete MIKEBASIN setup was developed for the NWRA. This model covers the entire country, although coverage for the north and north-eastern parts of the country is limited as a result of scarce data coverage. The MIKEBASIN setup includes the main development options, but has to be supplemented by for instance a multi-criteria analysis module. Models at catchment level are mostly absent, apart from Ruiizi River. Coordinated operation of the cascade of (future) hydropower facilities along the Nile in Uganda to optimize electricity production and meet other system objectives will require a dedicated decision support system. Particular attention must be placed on ensuring consistency across the modeling layers. This concerns the physical model representation (i.e. water volumes or lake levels) but also with regard to management decisions.

The directorate has only few trained staff that can maintain the databases and models, and can perform model runs and water resources analyses.

Data acquisition has declined since its peak in the 1970s. Budgetary constraints combined with high incidences of vandalism have conspired to reduce the network coverage. Field visits to check station performance and conduct stream gauging and assess rating curve validity are expensive activities, while difficulties have been encountered in processing field measurements and updating central databases.

Given the anticipated increased role of groundwater for productive purposes, the current groundwater monitoring network is grossly inadequate. Water quality monitoring has been discussed in 6.1.2.

Modern electronic monitoring technology offers the possibility to substantially reduce the costs of hydro-metrological data acquisition (including discharge measurement). In addition, geostationary satellites – such as Meteosat Second Generation – cover the entire country and provide accurate weather monitoring data with a spatial resolution of 3 km every 30 minutes or less. When combined with ground-data, satellite imageries could be useful for rainfall estimation, evaporation assessment, drought monitoring, etc. It is a promising and potentially cost-effective avenue to pursue.
Within the above context, key strategic outputs and actions within water resources information, planning and capacity building are described below.

Key strategic output and actions

Output: Water Information System (WIS) established and operational at WMZ and national level.
Actions:

- Rationalize and modernize the hydrometric monitoring network for surface and groundwater, and water quality;
- Prepare a harmonized and integrated water resources data management system;
- Develop modeling and analysis tools, integrated into the WIS;
- Prepare information dissemination mechanisms.

Action details:

- Prepare a comprehensive analysis of the hydro-meteorological monitoring objectives;
- Reduce operating expenses of hydro-meteorological monitoring;
- Explore the use satellite imageries for rainfall and evaporation estimation, and drought monitoring;
- Develop a data management system that integrates data at various spatial and temporal scales from diverse sources and establishes automated links to the modernized monitoring network and the set of analytical tools and information dissemination mechanisms;
- Employ and further develop the Nile DSS;
- Consolidate the MIKEBASIN setup for Uganda;
- Prepare higher resolution water accounting models for the main catchments; consider using open-source software in order to reduce costs; prioritize hotspot catchments;

- Prepare a Lake Victoria release and hydropower optimization model for the Nile system in Uganda;
- Provide information dissemination mechanisms that include periodic reports and visualization and web-publishing tools.

Additional Background Information:

A comprehensive Water Information System (WIS) comprises a number of sub-systems that include: 1) hydrologic information system, 2) spatial data system, 3) information management system (basic data processing tools), 4) knowledge management system, and 5) data dissemination system.WIS will integrate various databases that are maintained at different physical locations and may use diverse data formats. It is important that mechanisms are prepared to include information and data from outside sources such as NGOs. A set of integrative models at various spatial and temporal scales is needed to quantify the response of the water resources system to alternative scenarios of basin development, hydrologic conditions, and management policies. Models are needed at Nile basin and national scale, as well as for the main catchments and for specific purposes (such as flood management or operation of the chain of hydropower facilities along the Nile).

The Nile DSS is the de-facto standard in the Nile Basin and is well supported by the NBI. It is important to ensure consistency of the Nile DSS with models at national scale, such as the MIKE BASIN setup that covers the entire country. Higher-resolution water accounting models are needed for the main catchments. At this point in time, use of physically-based models is discouraged except for specific smaller catchments where the implications of large-scale land cover changes need to be investigated.

For the Nile system in Uganda, a dedicated decision support system is needed for the series of hydropower facilities in order to optimize electricity generation and meet other system objectives. This DSS would include: 1) long-term planning tool with a horizon of two years or more to determine mid- and long-term Lake Victoria release policies, 2) short term release model to forecast the implications of the proposed lake release volumes for the coming 12-month period, which will support DWRM in negotiations with national stakeholders and international partners, 3) general hydraulic modeling tool for the Nile for analyzing routing times and possible impacts from hydropower development on daily flows and water levels, which will support DWRM in short-term operational decisions and impact assessment, and 4) short-term power generation optimization tool, which plans hourly dam releases and power production (the latter tool will be used by the Dispatch Unit of the Uganda Power Transmission Company, rather than DWRM);

Flood early warning tools are discussed in 6.2.3 while climate change assessment and seasonal forecasting models are discussed in 6.2.1.

Identifying the hydrometric monitoring objectives is a starting point in rationalizing the monitoring network for surface and groundwater resources, and water quality. Monitoring objectives in Uganda are multifold, concerns both water quantity and quality, and include: 1) Nile water accounting, 2) coordinated dam operation to optimize hydropower production, 3) water resources assessment at

catchment level, 4) flood management, 5) sustainable groundwater use, etc. A sustainable and cost-effective hydro-meteorological monitoring network should meet the following requirements: 1) low maintenance, 2) low risk of vandalism, 3) low frequency of field visits, and 4) stable control section (for hydrometric stations). In this regard, it is important to consider alternative monitoring technologies (such as satellite imagery which could include Meteosat Second Generation). Direct communication between key stations (groundwater, climate, surface water) and central computer – for instance through the cellular network - will reduce the need for expensive field visits and further decrease operating expenses.

Output: General water resources knowledge base expanded and integrated into a Water Information System

Actions:

- Establish cooperation with partners for the acquisition and/or development of various spatial and non-spatial data sets;
- Initiate development of information sets that are currently absent.

Additional Background Information:

Integrated water resources management (IWRM) affects and is affected by many socio-economic sectors, and requires a broad and diverse range of information. In many cases, the acquisition of this information is outside the mandate and/or technical capacity of the water resources agencies and cooperation with various partners is needed. Hence DWRM needs to establish collaborative arrangements with various partners including NGOs to develop spatial and non-spatial data sets on for instance: 1) land cover / land use, 2) erosion risk, 3) land degradation and vulnerability, 4) flood risk, 5) soils, 6) (reserve) arable land, 7) hydro-geology, 8) geology, 9) topography, 10) stream network, 11) carrying capacity of rangelands, 12) ecological value of wetlands, etc;

A number of critical information sets are currently absent that may delay development of Uganda's water resources. These include: 1) detailed assessment of groundwater potential for productive purposes, 2) environmental objectives for all water bodies in Uganda including in-stream flow requirements and hydrologic regime required to maintain current ecosystem functions (see 6.1.1 and 6.1.2), 3) inventory of the various functions and classification of the environmental value of all wetlands in Uganda (see 6.1.1), 4) up-to-date geo-referenced inventory of present-day water use combining information from various sources (NWSC, permit database, UBOS, MAAIF, etc.), 5) updated inventory of water resources development options at national and (sub) catchment level, and 6) water use projections disaggregated to (sub) catchment level.

Institutional and human capacity aspects are discussed in 6.3.3.

6.2 Adapting to the effects of extreme climate events

6.2.1 Reduce Vulnerability to Warmer Climate Conditions

There is overwhelming scientific evidence of a warming trend of the Earth's atmosphere and a gradual increase of temperature in Uganda is anticipated in the coming decades. Uncertainties remain over the magnitude and speed of future temperature increase. Uganda is highly vulnerable to the impacts of a warming climate owing to a multiplicity of factors, such as the generally high potential evaporation rates that accentuate the impacts of (periodic) moisture shortages to crop production, combined with the large rural population that depend for its livelihood on rainfed agriculture or (semi) pastoralism. The rural poor have generally limited possibilities to diversify into less-climate sensitive livelihoods, and therefore have low resilience to climate shocks.

Higher temperatures will increase evaporation and lake water losses, and will raise evapotranspiration and thus lead to higher agricultural water demand and drought risks. For the semi-arid zone that covers some 20% of Uganda's land area, higher temperatures lead to intensified drying, and higher risks of wind erosion and land degradation. This could threaten the semi-pastoralist farming systems prevalent in this area.

Higher water temperatures in the various lakes could strengthen thermal stratification, increase algal productivity, accelerate microbial mineralization, and reduce oxygen dissolution, among other effects. Mitigation measures to address the above issues are discussed in 6.1.2.

There is consensus among climate scientists that the general warming trend will be accompanied by a movement towards more extreme events such as floods and droughts. Floods are discussed in paragraphs 6.2.3 and 6.2.4. Since there are still large uncertainties associated with the changing weather patterns, a sensible approach for now would be to prepare for warmer but more variable conditions than previously recorded, and implement no- and low-regret adaptation measures.

Many effective adaptation actions – such as water harvesting and increasing the moisture retention capacity of the soil – are concerned with capturing and conserving rainfall but their implementation is outside the domain of DWRM. It accentuates the importance of interdisciplinary coordination and collaboration.

It is against this background that the following key strategic outputs and actions have been prepared.

Key strategic output and actions

Output: Reduced vulnerability to warmer climate conditions

Actions:

- Prepare climate change vulnerability and risk maps at national and catchment level;
- Develop effective drought preparedness plansat national and catchment level;
- Strengthen cooperation mechanisms with MAAIF and other partners on integrated land and water management;
- Expand water storage capacity
- Improve seasonal climate outlook

Action: Prepare climate change vulnerability and risk maps at national and catchment level.
Purpose: To identify and rank the potential harmful impacts associated with climate change on the water and related sectors at national and catchment level, as a function of multiple parameters including climatic, agro-ecological, and socio-economic factors.

Action Details:

- Establish cooperative arrangements with relevant partners and stakeholders on climate change vulnerability and risk mapping;
- Actively participate in preparing climate change vulnerability and risk maps at national level – which is spearheaded by the Climate Change Unit at MWE; take the lead in preparing climate change vulnerability maps at catchment level;
- Identify hotspot areas that are particularly vulnerable to the impact of a changing climate, and where human security may be at risk;

Action: Develop effective drought preparedness plans at national and catchment level.
Purpose: To plan the use of water resources during an extended period of below average rainfall or streamflow (as a result of a drought) in a joint process with stakeholders.

Action Details:

- Assess the impacts of periodic drought events at national and catchment level;
- Establish cooperative arrangements with relevant partners and stakeholders and jointly prepare a plan how to use the water resources in times of drought, at national and catchment level; differentiate between shallow, medium-level, and extreme droughts;
- Raise awareness with stakeholders (at the appropriate level) about the potential impacts of periodic droughts, and jointly assess policy options to reduce vulnerability to drought events and increase preparedness; at catchment level, these adaptation plans should be integrated into the catchment management plan.
- For hotspot areas and priority catchments, prioritize the development of more detailed climate change vulnerability and risk maps, and identify potential adaptation measures jointly with stakeholders and partners; this activity should be integrated in developing catchment management plans (see 6.1.1);

Action: Strengthen cooperation mechanisms with MAAIF and other partners on integrated land and water management.
Purpose: To increase the resilience to climate change of the dominant rainfed sector through long-term and structural actions that include soil conservation measures and water harvesting techniques.

Action Details:

- Raise awareness and promote greater understanding of integrated land and water management, and the importance of improved farming practices and agricultural modernization to sustainable water resources management and climate proofing of the rainfed sector;
- Strengthen cooperation mechanisms with MAAIF, NAADS and other partners in order to promote wide-spread adoption of soil conservation and water harvesting techniques;

- As in paragraph 6.1.3 “Integrated land and water management”.

Additional Background Information:
With rainfed acreage estimated at 4,943,000 ha in 2003 (AFRICOVER), agriculture in Uganda will remain predominantly rainfed in the coming 40 years, evenwhen the large irrigation potential is developed. Improved agricultural practices will therefore be part of any solution to strengthen resilience to climate variability and adapt to higher temperatures.

Rapid population growth coupled with inappropriate agricultural practices has led to widespread soil and land degradation. It is manifested by a reduction of the moisture retention capacity of soils. Rainfall, therefore, runs off or evaporates, rather than being stored in the soil. With less water being available for crops, the probability of a moisture deficit at critical stages of plant growth goes up. Measures that restore and conserve soils (see paragraph 6.1.3), and increase soil moisture retention will strengthen the resilience of the agricultural sector to a warmer and more variable climate.

The aim is to capture and store rainwater before it runs off to rivers or evaporates in order to 1) increase water availability during the dry season and periodic droughts, 2) control soil erosion and siltation 3) reduce peak flows in rivers, and 4) reduce pollution because of high runoff.

Households or farmers will not invest in small water harvesting infrastructure or soil management unless they see direct evidence of real benefits (i.e. higher household income). This complicating factor has been discussed in paragraph 6.1.3. Widespread up-take of water harvesting techniques and soil management by the local population is the only way that significant areas of land can be treated at a reasonable cost on a sustainable basis. Hence implementing these measures need to be embedded in comprehensive rural development and agricultural modernization programs, that clearly aim to increase the profitability of (small holder) farming. If this cannot be achieved, it is doubtful if wider adoption of sustainable land management practices will be achieved, with serious adverse impacts to climate proofing of the rainfed sector and the state of the water resources in general.

Action: Expand water storage capacity.
Purpose: To capture and store runoff in reservoirs ranging from small to large and make the water available for productive use as no or low-regret measures.

Action Details:
- Coordinate and implement stakeholder driven catchment planning (see 6.1.1) that identifies opportunities for water retention structures and associated water use (such as supplementary irrigation or livestock watering), and ensure that options are prioritized with high local water demand; establish cooperation mechanisms with MAAIF and MWE/WfP in order to prioritize and support construction of water retention structures;
- Prioritize catchment protection activities upstream of the water retention structures to ensure their sustainability;
- Sensitize decision makers and development partners about the importance of increasing water storage capacity to increase resilience to climate change, and support all initiatives to address the current funding constraints;

Action: Improve seasonal climate outlook.
Purpose: To provide seasonal rainfall predictions in order to obtain timely warnings for a possible drought event, with the aim to increase preparedness and reduce its impact.

Action Details: (see 6.2.3)

Additional Background Information
A critical component of planning for drought is the provision of timely and reliable climate information, including seasonal forecasts. However, the vulnerability to drought in Uganda is different from that of many other countries in the world. Potential evaporation rates are high because of its location on the equator, while widespread soil degradation because of poor agricultural practices has led to low soil moisture storage capacity. Under these conditions, absence of rain for a short period (2-3 weeks) can lead to a moisture deficit at a critical stage of plant growth, and thus negatively affect agricultural production. This situation does not necessarily represent a drought – i.e. a prolonged period of rainfall shortage. In fact, it can quite well occur in a 'normal' or even 'wet' year.

Nevertheless, better seasonal climate forecasts are valuable, in particular if they can indicate the timing of the onset of the seasonal rains (for the agricultural sector) and for planning of the use of water resources and establishing release policies based on the climate outlook.

6.2.2 Reduce Vulnerability to More Severe Rainstorms

Rising global temperatures are predicted to increase the intensity of extreme weather events. A higher frequency of more severe rainstorms will result in more flash floods and larger flooding events, more soil and stream-bank erosion and the consequent siltation of rivers and lakes, damage to hydraulic structures and occasional overtopping of road embankments, and increased risk of contamination of storm and flood-waters with human waste that would lead to an increase of water-borne diseases. Storm damage to agriculture is also expected to rise.

Flood risks and flood damage will likely increase significantly because of the rising turbulence of the climate, owing to the fact that global warming coincides with accelerated land degradation in the upland catchments while use of low-lying areas for agricultural, residential, and industrial purposes is intensifying.

In particular the wide floodplains in the Kyoga basin are attractive areas for agricultural activities and various types of development, and include growing human settlements. How to ensure effective flood protection of the floodplain while maximizing its productive use is discussed in paragraph 6.2.4.

It is against this background that the following key strategic outputs and actions have been prepared.

Key strategic output and actions:

Output: Reduced vulnerability to more severe rainstorms.
Actions:

- Improve catchment management practices;
- Strengthen urban planning and management of storm-water runoff;
- Promote measures to improve dam safety, taking into consideration more intense rainstorms;
- Improve and elevate sanitation facilities in the floodplain and flood prone areas;
- Review flood frequency curves and adjustthese to more intense rainstorms and flood events;

Action: Improve catchment management practices.
Purpose: to arrest and reverse land degradation in order to attenuate the hydrological processes.

Action Details: this subject is discussed in detail in paragraphs 6.1.1 and 6.1.3.

Action: Strengthen urban planning and management of storm-water runoff.
Purpose: to reduce the risk and damage of floods in urban areas from intensive rainstorms.

Action Details:

- Improve storm-water management by redesigning drainage systems e.g. by using gabions to capture and temporarily store rainfall in the contributing area, and draining it slowly to reduce the peak of the flood; expand parks and other green spaces to absorb flood waters, and create or expand natural buffers such as ponds, small lakes, and marshlands;
- Improve physical planning laws and regulations to prohibit development along river banks, low lying areas, and (seasonal) wetlands;
- Improve sanitation in order to prevent contamination of floodwaters;

Additional Background Information:
Uganda is subject to rapid urbanization and city managers are challenged to expand key water supply, sanitation, and urban drainage infrastructure. Urban flooding risks are mounting because of 1) the rapidly expanding build-up areas with large impervious surfaces that cause increase in run-off, 2) development in low-lying areas and drained marshlands because of land scarcity in urban areas, and 3) rudimentary urban drainage systems that are designed to evacuate water quickly rather than temporarily storing it. Urban flood waters are often contaminated with fecal and other hazardous materials, thereby elevating the risks of water-borne disease.

Action: Promote measures to improve dam safety, taking into consideration more intense rainstorms.
Purpose: To ensure the safety of new and existing dams, and prevent dam failure that can compromise public safety.

Action Details:

- Review the threshold above which dams are subject to regulation to take into account the increased risk of failure due to extreme weather events; failure of retention structures below the threshold do not risk human life and have low economic and/or environmental losses that

are principally limited to the owner's property; these structures can be constructed without formal oversight, although the owner remains subject to common law responsibility;
- Review the dam categorization system, which classifies dams (subject to regulation) as a function of height, storage volume, consequences of failure (low, significant, and high hazard potential), seismic activity in the dam area, and other relevant parameters; adjust the system in accordance to the increased risk of failure because of the expected more intense rainstorms;
- Adjust the comprehensive directives and regulations to ensure dam safety, taking into account more turbulent weather conditions than previously recorded;

Additional Background Information:
Dam safety is an important public safety concern. Dam failure can cause harm to the public, damage property, and negatively impact water quality. The risks of failure increase with more intense rainstorms and consequent higher runoff volumes and (flash) floods. This strategy advocates establishing many small water retention structures – including small earth-fill dams, the overall majority of which do not exceed a height of a few meters – across Uganda in order to capture rainfall before it runs off to rivers. Design of many of these small dams in Uganda will take place without access to adequate hydro-meteorological data. In those cases, it may be more cost-effective and practical to opt for a conservative design rather than engage in expensive (and possibly inconclusive) data acquisition, in particular for smaller structures.

Action: Improve and elevate sanitation facilities in the floodplain and flood prone areas.
Purpose: To reduce the risk of groundwater contamination and prevent the outbreak of water-borne diseases after a flood event. This subject is covered in paragraph 6.1.2 (Management of Water Quality).

Action Details:

- Prioritize improvement of sanitation facilities in the floodplain and flood prone areas;
- Work together with relevant partners (such as Ministry of Health and Local Government) to create awareness about the importance of preventing water-borne diseases in the aftermath of a flood event;
- Accelerate and promote the development of affordable sanitation technology in flood prone areas;
- Encourage putting in place an enabling framework to support and facilitate an accelerated implementation of flood-prone sanitation through regulation, technical and capacity building support to local government and communities, and appropriate incentives (financial);
- Enforce compliance to the improved sanitation regulation; prohibit – in time – the use of traditional pit latrines and non-improved systems in the floodplain and flood prone areas;

Additional Background Information:
The indirect damage from flood events can be significant and include the outbreak of water-borne diseases such as cholera, which can occur when human waste is dispersed from latrines by the floodwaters. Hence sanitation facilities in the floodplain need be constructed above the maximum flood limit, and be entirely isolated from the surrounding environment during a flood event. An additional benefit of such systems is that it cannot contaminate groundwater resources, which is a real risk in the floodplain normally characterized by a high water table.

Action: Review flood frequency-curves and adjust these to more intense rainstorms and flood events.
Purpose: To provide accurate information for hydraulic design and flood mitigation planning.

Action Details:

- Expand the hydrologic monitoring network and modernize existing stations; ensure regular discharge measurements during the flood period at all stations; establish reliable stage-discharge relations that also include high-flow events (these topics are discussed in detail in paragraph 6.1.5);
- For all larger catchments, use distributed rainfall-runoff modeling to estimate floods of a given return period based on storm magnitude, area coverage, and return period;
- Data acquisition to provide input for the above distributed models;
- For uniform hydrological regions, prepare regional flood frequency curves that can be used for design flood estimation for small catchments where data are scarce or absent;
- Stakeholders (such as Ministry of Works) timely informed about probable higher flood events; they should be kept abreast on progress on updating the flood frequency curves for larger and smaller catchments, and be encouraged to address the likely impacts of higher discharge such as increased scour at bridge abutments and hydraulic structures, (more) overtopping of road embankments, and higher required waterway areas for bridges and culverts, etc.

Additional Background Information:
Estimates of flood discharge with various risks of exceedence are needed for a wide range of engineering problems. Industries and residential areas need to be located above maximum expected flood levels, while maximum discharge estimates are needed for hydraulic design of bridges and culverts. Design floods are typically derived through statistical analysis of historic flood records. An important feature of flood hydrology is the very high variability of annual floods, which makes it very difficult to make reliable estimates of high return period floods even with quite long period of records. In practice, the hydrological records available in Uganda (between 10 and 50 years) are often not long enough to give reliable flood estimates. This is compounded by the uncertainties in the rating curve for high-flow events experienced at most hydrologic stations. Furthermore, the simultaneous changes of the climate and land-use patterns in the catchment will alter the hydrologic response to a rain event, and thus reduce the validity of the historic flood frequency curves. Flood estimation methods, therefore, should preferably be based on rainfall frequencies and rainfall-runoff relations.

6.2.3 Reduce Vulnerability to Increased Hydrologic Variability

As discussed in 6.2.1, rising global temperatures are predicted to increase the intensity of extreme weather events, which is expected to amplify the variability of the hydrologic regime of the rivers, streams, and lakes in Uganda. Flood events have been discussed in paragraphs 6.2.2 and 6.2.4.

Of particular interest to Uganda is the increased hydrologic variability of Lake Victoria, whichcould have a large impact on Uganda's economy because of the direct correlation with Nile flows and associated

hydropower production. Because Nile flows constitute the dominant components of the water balance of Lake Kyoga, the hydrologic variability of Lake Victoria is also directly linked to that of Lake Kyoga and its surrounding wetlands.

Preparing for increased hydrologic variability of Lake Victoria, therefore, is an important strategic issue that warrants a comprehensive discussion.

The principal components of the Lake Victoria water balance are over-lake rainfall (82 – 85% of total inflow) and lake evaporation (75 – 78% of total outflow), making the lake highly sensitive to climate change. Relatively small changes in either component because of climate change could dramatically alter the water level of the lake, the outflow from the lake and the conditions for the downstream riparians.

While the general warming trend of the global climate leads to a steadily increasing lake evaporation rate, its possible impact on the rainfall regime on the equatorial plateau is uncertain. A scenario with drier hydrologic conditions - where higher evaporation is not compensated by higher rainfall, and which thus leads to lower net-basin supply to Lake Victoria – implies lower lake levels, lower downstream river flow, less hydro-energy generation, and would impact Lake Kyoga and the surrounding wetlands as well as the Sudd in South Sudan. Climate change could also increase the frequency of extreme hydrologic floods and droughts for Lake Victoria (i.e. prolonged periods with consistent higher or lower than average net-basin supply). The former would increase flood risks in the Lake Kyoga basin, while the latter would raise serious concerns regarding hydropower production in the downstream river system and influence the environmental and ecological integrity of Lake Victoria and Lake Kyoga.

It is evident that climate change may equally increase the hydrologic variability of the other (smaller) river and lake systems in Uganda. Their vulnerability and possible adaptation and mitigation measures need to be considered on a case-by-case basis and will be included in the catchment management plans (see 6.1.1).

It is against this background that the below key strategic outputs and actions have been prepared.

Key strategic output and actions

Output: Preparedness for higher variability of lake levels achieved.
Actions:

- Establish capacity to monitor long-term climate trends;
- Establish capacity for climate change impact assessment, with special attention to Lake Victoria;
- Inform and support policy dialogue on the implications of climatic change, with special attention to Lake Victoria;

Action: Establish capacity to monitor long-term climate trends.

Purpose: To establish the direction and magnitude of change of the climatic parameters in Uganda, and in particular in the Lake Victoria basin, as early as possible.

Action Details:

- Establish cooperative arrangements with the co-basin states through the Nile Basin Initiative (NBI) and Lake Victoria Basin Commission (LVBC) on long-term climate trend analysis;
- Select climatic stations with long records (preferably 60 years or more of good quality data) in distinct climatic zones in the Lake Victoria region;
- Ensure maintenance and high quality data acquisition at these stations, with the purpose to provide better estimates of the rainfall and evaporation for Lake Victoria and the equatorial lakes, and to facilitate long-term climatic trend analysis;
- Establish new strategic key climatic stations, if needed;
- Increase capacity for data and trend analysis.

Action: Establish capacity for climate change impact assessment, with special attention to Lake Victoria.
Purpose: To determine the impact of potential climate change on surface and groundwater bodies, in particularly on Lake Victoria with the aim to support long-term water resources and energy planning.

Action Details:

- Review existing climate change studies in the region and the Nile Basin;
- Develop and test hydrologic models for the Lake Victoria watersheds – including those outside Uganda;
- Establish capacity to use global climate models (GCM), and build the database needed for bias correction and downscaling GCM runs;
- Assess likely future hydrologic regime of Lake Victoria, using the rainfall and temperature sequences generated by global climate models and the above hydrologic models;
- Assess future water resources and energy response using the long-term water resources planning tools that includes the downstream river system.

Additional Background Information:
To coordinate mid-term energy planning and lake release policies, a long-lead seasonal climate outlook for Lake Victoria will reduce the vulnerability to higher variability of mean annual rainfall. It requires a better understanding of the main factors that influence the seasonal climate outlook of the Lake Victoria region (such as ENSO, multi-year trends, variations of the Indian Ocean Dipole, etc), and will comprise developing dynamic forecasting models that can produce seasonal forecasts that serve as input into the hydrologic watershed models that calculate the net-basin supply of Lake Victoria.

Action: Inform and support policy dialogue on the implications of climatic change, with special attention to Lake Victoria.
Purpose: To timely inform high-level decision makers at national and regional level about climatic trends and their implications; of particular concern are possible drier hydrologic condition onthe lake and the associated lower hydro-electricity production.

Action Details:

- Prepare (and regularly update) a series of targeted policy briefs for high-level policy and decision makers that outline the Lake Victoria context, describe the observed climate trends and possible

climate change implications, and discuss vulnerabilities and policy options (such as diversifying energy sources, inter-connecting power grids, etc);

- Institutionalize periodic reviews to update policy briefs with the latest scientific information and insights in climatic trends;
- Ensure dissemination of the policy briefs to relevant policy forums and decision making bodies; facilitate strategic discourse on climatic change implications on Lake Victoria as needed.

Additional Background Information:
By strengthening cooperation mechanism with the Nile Basin states through NBI and LVBC, it is possible to make better use of existing capacity and information, and coordinate development and management of the Nile Basin and Lake Victoria water resources to prepare for possible climate change. Collaboration looks particularly promising on developing long-lead seasonal forecasting tools, climate trend analysis, and developing and using hydrologic tools for shared watersheds such as Lake Victoria.

6.2.4 Effective Flood Management of the Floodplain

The areas in Uganda most affected by floods are the low-lying areas at the foothills of Mount Elgon and the Rwenzori's that are part of the original floodplain. Floodplains in Uganda are generally attractive sites for agricultural activities and various types of development, and include significant and growing human settlements. Extreme rainfall on the steep upland watersheds results in rapid runoff that collects in the downstream low-lying areas. Inundation of the floodplain is a natural event that occurs periodically and cannot and should not be prevented.Flooding typically does not extend far beyond the original floodplain. Due to the existence of large wetland areas in the river system that absorb flood waters, water levels in the floodplains tend to rise slowly, allowing people and livestock to evacuate safely to higher dry grounds. Nonetheless, while the risk to people and livestock is currently small, it is noted that loss of life does occur but is accidental. Furthermore, floodwaters damage infrastructure and crops, and cause the spread of water-borne diseases.

As discussed in 6.2.3, climate change combined with accelerating watershed degradation and encroachment of the floodplain is anticipated to increase flood risks and associated damage of the floodplain.

In the Ugandan socio-economic and climatic context, it is not realistic to protect the large floodplains against the maximum possible flood that will occur. Hence the aim should not be to prevent flooding from an extreme event, but to mitigate its consequences and ensure that human life is not brought in jeopardy.

Flood management, furthermore, should be considered in the context of the entire river basin rather than implementing local protection measures in the vicinity of a previous flood event. Land management is a key element of any flood management strategy in Uganda. This incorporates land use planning in the floodplain, but also protection of critical wetlands that absorb the flood wave, as well as watershed restoration activities in the uphill areas such as reforestation, water and soil conservation, and improved agricultural practices.

It is against this background that the following key strategic outputs and actions have been prepared.

Key strategic output and actions:

Output: Effective flood management achieved.
Actions:

- Prepare flood mitigation and prevention plansin the context of the entire river basin;
- Develop floodplain zoning and reach community buy-in;
- Protect the upland catchments (see 6.1.3);
- Protect and manage wetlands (see 6.1.2 and 6.1.3);
- Review and strengthen hydro-meteorological monitoring capacity;
- Flood forecasting and early-warning systems established;
- Water-related disaster management plans developed.

Action: Prepare flood mitigation and prevention plansin the context of the entire river basin.
Purpose: To plan and prioritize in outline the flood mitigation and prevention measures in an integrated manner also involving key stakeholders and partners (Wetlands, Forestry, Local Government, etc) early in the flood management effort.

Action Details:

- Prepare a broad analysis of the dynamics of flood events in the river basin; identify the major runoff contributing areas, as well as the key wetlands that attenuate the flood wave;
- Identify the areas at risk and make an initial assessment of the flood hazards and number of people put in danger by the period flood events;
- Identify possible intervention measures;
- Plan and prioritize intervention measures in close coordination with all stakeholders, and integrate the flood management plan into the catchment management plan.

Additional Background Information:
The initial flood management plans will probably be quite conceptual and lacking details, which is because the existing information does not allow for preparing a comprehensive analysis of the flood dynamics and its impact. This is inevitablebut not critical. Most structural components of the flood management plan concern long term undertakings. The non-structural elements - such as zoning of the floodplain – can be spearheaded. Naturally the plans will progressively become more factual and detailed, when the understanding of the flood dynamics increases, and more detailed information becomes available.

Action: Develop floodplain zoning and reach community buy-in.
Purpose: To maximize the economic use of the floodplain while allowing periodic inundation.

Action Details:

- Prepare (flood) risk maps of the floodplain and adjacent areas, specifying the probability of inundation and flood depth in planning floods; LIDAR imagery can provide topographic maps with contour elevations of about 0.20 – 0.25 m; initially restrict mapping activities to selected priority areas, but over time expand the mapping extent to all floodplains;

- In close collaboration with the local population, develop zoning rules that stipulate the economic activities allowed in specific parts of the floodplain;
- Implement education programs that sensitize local residents of the risks of ignoring land-use and flood-proofing regulations and guidelines;
- Administer floodplain rules and ensure compliance;
- Coordinate with partners to ensure that 1) key access roads are raised above the design flood level and capable of withstanding prolonged submersion 2) adequate bridge and culvert waterway areas are provided, and 3) proper protection against erosion and scour is provided;
- Coordinate with partners to flood-proof (elevate) drinking water facilities like boreholes; ensure that these will not be submerged;
- Coordinate with partners to flood-proof villages and health facilities; this can be with embankments, or by raising the homesteads, grain stores, tube wells, and latrines above flood level.

Additional Background Information:
It is important to develop a system that allows for periodic inundation of the floodplain while maximizing its productive use and minimizing the risks to the people living there. Indeed, agricultural land benefits from silt deposited during an inundation. Floodplain management plans need to be developed with full participation of stakeholders in order to improve decision making and minimize conflicts, and increase the acceptance by the local communities.

Advance planning and proper regulation and zoning, based on the anticipated extent and depth of flooding, can substantially reduce the damage caused by a periodic flood event for a relatively modest investment. Most floodplain management measures can also be implemented in a relatively short time scale, in stark contrast to catchment protection measures that have a long implementation horizon.

Action: Protect the upland catchments.
Purpose: To maintain and increase the capacity to store rainwater in upland forest areas and agricultural lands, reduce soil erosion risks, and release runoff slowly in order to attenuate the flood peaks. This subject is covered in 6.1.3.

Additional Background Information:
Deforestation and poor agricultural practices in the upland catchment areas have reduced the (rain) water storage capacity in the vegetation and soil, causing rapid and higher runoff that exacerbates downstream flooding. The unprotected soil is subject to erosion, and the sediments carried downstream are deposited in wetlands, reducing the capacity of the swamps to absorb the flood wave. Many water and soil conservation measures are long-term undertakings that need to be implemented by individual land owners and farmers.

Action: Protect and manage wetlands.
Purpose: To ensure that storage capacity is safeguarded to absorb the flood volume and hereby lower and delay the flood wave. This subject has been covered in 6.1.2 and 6.1.3.

Action: Review and strengthen hydro-meteorological monitoring capacity.

Purpose: To provide reliable data that serve to better understand the hydrologic processes in the river basins, and to provide input into flood forecasting and warning systems.This subject is covered in detail in paragraph 6.1.5.

Action: Establish flood forecasting and early-warning systems.
Purpose: To mitigate the potential damage from a flood event by providing sufficient advance notice to the affected population and relevant authorities.

Action Details:

- Prioritize floodplains as a function of flood risks;
- For high priority basins, collect basic information, including hydro-meteorological data, needed to develop flood forecasting systems;
- Postpone development of flood forecasting and warning systems until their need becomes obvious, in particular when flood events could threaten human life.

Additional Background Information:
Flood warnings are based on short-term weather forecasting that provide quantitative forecasts of rainfall combined with the antecedent moisture conditions in the catchments. Weather forecasting in Uganda is carried out by the Meteorological Office at Entebbe International Airport. A weather radar – covers the entire country, and offers the most accurate method to forecast spatial and temporal rainfall, with a lead time of a few hours.

The response of the watershed to a rain event is determined through distributed rainfall-runoff models or conceptual catchment models. A hydro-dynamic model will simulate the propagation of the flood wave along the river channel and in the wetlands, and predict discharge, inundation levels, and associated flood risks at various locations in the floodplain.

Flood warnings are based on algorithms that combine rainfall and flood forecasting, data from real-time river monitoring stations, and real-time rainfall. Given the size of the river basins in Eastern Uganda and the large wetland areas that absorb the flood wave, a maximum warning time of more than one day can be expected. The format of the flood warning needs to be carefully designed. Text messaging has proved effective to disseminate the flood warning to the community at risk and the relevant authorities.

The implementation of the above described flood forecasting and warning system is quite feasible in Uganda. Nevertheless, it has low priority at present. Given the generally slow onset of flood events of the floodplain, loss of life is rare and accidental, and proper zoning can mitigate the impacts of a flood event.

Action: Develop flood-related disaster management plans.
Purpose: Develop a coordinated and pre-planned response to a possible flood disaster.

Action Details:

- Coordinate with partners in the preparation of the flood-related disaster management plans.

6.3 Strengthening the Water Governance Framework

As indicated in sections 4.3.1, 4.3.2, 4.3.3 and 4.3.4 there is a comprehensive policy, legal, and institutional framework for management of water resources in Uganda. However, there are a number of weaknesses and challenges which should be addressed in order to create an enabling policy, legal, and institutional environment for effective water resources management.

6.3.1 Strengthen the Policy and Legal Framework for Water Resources Management

Effective water resources management requires an enabling policy and legal framework that regulates water use/abstraction, waste water and effluent discharge, guides planning for water resource use and management, ensures harmonized institutional mandates and better performance among the lead agencies and achieves strong co-ordination mechanisms among lead agencies and with NGOs, civil society, umbrella organisations, and private sector.

Key Strategic Outputs and Actions

Output: Effective legal & policy measures for water resources management

Actions:

- Strengthen measures for regulating water use allocations to all sectors (including priority high value projects);
- Strengthen measures for improving water use efficiency (such as water harvesting and storage and utilization technologies).

Action details:

- Harmonize the Water Act with the Wildlife Act to ensure effective regulation of water resources in national parks and game reserves;
- Harmonize the National Forestry and Tree Planting Act to ensure effective regulation of water resources in forests;
- Develop Regulations that ensure regulation of the use of groundwater;
- Develop regulations for water harvesting and storage and water recycling;
- 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;
- Incorporate relevant customary laws and practices in the Water Act, regulations, ordinances and by laws;
- Develop Water legislation that provide for compensation and restoration rather than for penal sanction only;

- Domesticate all the principles in the signed and ratified international agreements;
- Ratify the UN Convention on Non Navigational Use of Water Courses, 1997, the Nile Cooperative Framework Agreement, 2010 and the Protocol on Environment and Natural Resources, 2006;
- Publicize the Water policy and Water related legislation and translate in local languages for wider dissemination;
- Develop incentives for compliance such as providing compliance assistance tools, providing self regulation tools, developing rules for implementing amnesty and grace periods of enforcement of laws;
- Ensure training in water law and policy for all stakeholders;
- Develop mechanisms that encourage private institutions to complement public institutions in the development and implementation of PES schemes;
- Update every year fees and tariffs to reflect realities and management process;
- Develop rules to institute measures to prevent environment degradation around water points;
- Develop rules that subject major water conservation and management projects to the environmental Impact Assessment (EIA) process and include the costs and benefits of protecting watershed forests, wetlands and other key ecosystems in the economic analysis of such water projects;
- Develop rules to issue an on-the-spot fine called a Penalty Infringement Notice (PIN) for pollution offenders of water resources;
- Ensure the implementation of water sources protection guidelines.

6.3.2 Strengthen Institutional Capacities for Water Resources Management

The institutional reforms have been made to shift the responsibility of water resources management from the DWD to DWRM thus separating water regulatory functions from water development functions. However, there is no autonomous body to regulate the use and development of water resources.

The WMZ & sub-catchment structures have been established to promote water management at the lowest applicable level. However, the legitimization of the institutional framework for WMZ is still ongoing. There are other weaknesses which include legal and institutional framework attainment of economic benefits from the water resource management.

Key Strategic Outputs and Actions

Output: Effective institutional framework for water resources management.

Actions:

- Strengthen the capacity of WPC;
- Strengthen the institutional framework for WMZ to ensure their requisite capacity to fulfil their responsibilities at zone levels;
- Strengthen water resources management by establishing an autonomous authority that separates the water resource management functions from the service delivery function;

- Strengthen the institutional mandates and clarify operational arrangements between the DWRM, DWD, NEMA & DEA, NWSC and MAAIF;
- Strengthen the institutional and legal framework for environmentally sound construction of dams and reservoirs;
- Strengthen the capacity for training in water law and policy.

Output: Improved institutional performance.

Actions:

- Strengthen capacities for enforcing compliance with Water Act and Regulations and for monitoring compliance by water users, waste water and effluent discharge, mining activities, oil and gas activities, tourism, agriculture, and water transport,
- Strengthen capacities for planning for water resources use and management at local, catchment and national levels;
- Strengthen capacities for participating and benefitting from regional/international policy, planning and management of trans-boundary water resources under auspices of with EAC, AU, NBI, among others;
- Strengthen capacities for mobilizing resources for water resources management.

Output: Effective water resources planning, monitoring and communication for water sub-sector.

Action:

- Strengthen tools and capacities for and planning and budgeting for water subsector
- Strengthen Monitoring, Evaluation and reporting system and capacities for water subsector
- Strengthen communication and outreach on water resources and subsector performance

Action details:

- Expand the membership of WPC to include all other relevant sectors such as wildlife, forests, land, wetlands & tourism;
- Mainstream the institutional framework for water quality and quantity management;

- Strengthen the capacity of districts to mainstream IWRM into district and town development plans, district environmental action plans, poverty eradication action plans, district water development plans and other relevant plans;
- Strengthen the capacity of WMZ to collect data at watershed level and generate valuable information at WMZ and catchment levels and monitor enforcement of water permits;
- Strengthen the institutional framework for collection of appropriate water data and information system;
- Train personnel & build institutional capacities for training in water law & policy;
- Strengthen the capacity of Umbrella organizations to exercise responsibilities for integrated water resources management at the national or basin level.

6.3.3 Strengthen Coordination Mechanisms for Water Resources Management

Effective coordination of activities in the water sector is important given thebroad range of actors in the sector, their area of intervention, and their varyingoperational policies and procedures.A fragmented approach to planning and management of water resources oftenleads to a sub-optimal situation involving additional costs in terms of lost opportunities,externalities, and unused capacity.

Integrated water resources management requires proper coordination ofactivities in the water subsectors to effectively address multi-sector, inter-related issuessuch as water-related health and environmental problems and multi-purposehydropower dam projects.

Section 4.3.4 provided institutions that are involved in water resources management. To ensure implementation of strategies provided in sections 6.1 and 6.2, the institutions have to coordinate and collaborate effectively. However, there are still challenges and weaknesses regarding coordination and collaboration of institutions involved in water resources management. These include:

- Limited exchange information/data on water availability;
- Limited outreach programme for water resources management;
- Limited coordination and linkage between institutional planning and program implementation;
- Lack of a champion for water resources management.

Key Strategic Outputs and Actions

Output: Effective coordination and collaboration mechanisms for water resources management at all levels.

Actions:

- Establish a functioning of the National Coordination Mechanisms based on the National Steering Committees, with coordination and linkage role at regional national and local levels;
- Establish an effective monitoring and evaluation mechanism that involve all the key stakeholders;
- Establish one centre for coordinating all water resources management plans and programs;
- Develop outreach programmes for water resources management;
- Develop an effective information sharing systems;
- Develop inter institutional linkages of projects, plans and programmes;

Output : Effective institutional collaboration and participation.

Actions:

- Strengthen mechanisms for strengthening institutional collaboration and participation in water resources management by mandated institutions and stakeholders;
- Strengthen capacity for effective participation in trans-boundary water resources management processes, specifically, the EAC and NBI processes;
- Harmonize institutional mandates of lead institutions (MoWE, WPC, DWRM, DWD NWSC, NEMA, Districts);
- Strengthen functioning of WPC.

Action details:

- Strengthen coordination with and cooperation with key regional organisation such as LVBC, LVFO, EAC, NBI, IGAD, AU, AfDB, UN, FAO and the World Bank;
- Develop outreach water programmes;
- Establish a mechanism for participatory monitoring and evaluation at different levels. The following will be undertaken: communities monitoring capacity will be developed, a computerized data base will be developed at districts and national level and a comprehensive reporting and feedback mechanism from each level will be established.
- Provide support to general water education focusing on youth and women as important advocates for information dissemination and attitude changes, and exchange of information, using as much as possible local media and mobile phones;
- Strengthen research and technological development capacity. The following will be undertaken: promotion of the applied research and technological development, strengthening the collaboration with sector stakeholders, local and international research institutions, institutionalizing the mechanisms for coordinating and dissemination of sector research and encouraging local researchers.
- Establish one stop centre to ensure effective institutionalized linkages between key sector actors including Central Government, Local Government, Development Partners, Private Sector, NGOs, CBOs and the Communities;
- Establish a data base with relevant information on water resources at national and water management levels.

6.3.4 Financing of Water Resources Management

The water resources management structure (DWRM, Catchment Management Organizations and Sub-Catchment Organizations) has generally inadequate financial resources to plan, develop, regulate, and manage Uganda's water resources, and cannot meet the investment needs in water resources management and service delivery improvement. The result is, among others, that there is a very

significant gap between available finance and investment opportunities and operational funds are generally inadequate.

Among the reasons for these issues are insufficient and sometimes unpredictable central fund allocations/budget cuts and poor financial management. Revenue collection from permits is going to the treasury and cannot supplement the meager allocations. The staffing level at DWRM is below 50% of the stipulated necessary staff which leads to decreased functionality. Catchment Management Organizations (CMO) and Sub-Catchment Management Organizations (SCMO) are poorly supported financially and are non-operational or highly ineffective.

Financing issues are present at:

- DWRM at central and WMZ level, and
- CMO/SCMO level

The current responsibilities of DWRM at central and WMZ level include policy formulation, planning, regulation and monitoring and assessment and water quality. Sustainable funding of operational and capital costs upto the year 2040 is a challenge because of the continually decrease of the percentage of GoU budget allocated to the water sector (from 4.9% in fiscal year 2004/5 to 2.2% in fiscal year 2009/10 [Uganda Water Assistance Strategy, p. 28]), and probable reduction of future donor sources. Oil revenues may be coming as an additional GoU source, but this is not expected to provide a short and mid-term financial solution for DWRM. Within the current institutional set-up DWRM is unable by itself to generate additional funding for operational and capital expenditures.

CMOs and SCMOs are being established to manage and implement the preparation and implementation of catchment management plans. There is an emerging need to fund: 1) management expenditures which initially include operational expenditures for a small office, and 2) development expenditures for the implementation of the catchment management plan (tree planting, river bank protection, small dams etc.).

***Key strategic outputs and actions*:**

Output: Improved levels and sustainability of funding for water resources management;DWRM and WMZ gradually able to cover a significant part of their operationaland development funds.

Actions:

- Strengthen capacity for attracting funding to the water sector from non-traditional sources (e.g., PES, Polluter Pays Principle);
- Measures for water revenue retention and use at source;
- Increase fees and charges for raw water abstractions and wastewater discharge;

- Explore public-private partnership opportunities;
- Explore possibilities for transforming DWRM into an autonomous body.

Action details:

- Assess and subsequently improve DWRM service delivery efficiency in all required services and in particular in regulation and monitoring. This could be achieved through outsourcing of services provided cost efficiency and quality can be assured. An example is facilitation which over time could be outsourced from WMZs to NGOs thus reducing overall DWRM funding requirements.
- Gradually increase the fees and charges for raw water abstraction and wastewater discharges for bulk water for utilities and for individual and municipal wastewater dischargers thus reducing the overall financial requirement to the sector budget. A first phase target is to have users and consumers financial contributions to cover all operational expenditures.
- Improve capacity at MWE and DWRM to assess, test and develop new funding mechanisms for PPP and other funding modalities for private sector participation in irrigation development thus reducing GoU budget requirement. This action should be undertaken jointly with donors, development banks and other international and local funding institutions.
- Investigate institutional options under which DWRM could be operated as an autonomous body providing its own funds for operation and development through for example collection of fees for raw water use and wastewater discharge.
- Develop legal instruments to ensure that all water uses, especially water use for economic purposes are charged for and the charges can be reviewed from time to time.
- Develop legal instruments to ensure incorporation of environmental costs in water fees.

***Key strategic outputs and actions*:**

Output: CMOs and SCMOs able to cover preparation of catchment management plans and in the longer term also a significant part of their operationaland development funds

Actions:

- Raise funds through stakeholder contributions;
- Raise funds through external aid funding.

Action details:

- Operational and management expenditures could be voluntary contributions or subscription of membership fees. CMO collection of water fees would require a statutory instrument.
- Development expenditures for CMO implementation of catchment management plans would require the use of grant funding options such as Joint Partnership Fund, WSDF and possible MAAIF financial support for establishment of dams. Lessons learnt on funding through JWESSP (2013-18) and WMDP (WB 2012-18) would be important in developing a financing strategy. All potential external sources should be screened including climate change funds, EU water facility funds, environmental funds and others. Funding modalities which would require the participation of a development or commercial bank to undertake financial management and disbursement should also be considered.

The financing arrangements for the water sector should aim at having a sustainable source of financial resources to meet the costs for water resources development and management.

Water resources management entails a variety of technical, administrative and legal activities that cost money to implement and that must be funded. These activities include water resources exploration, assessment, water allocation, pollution control, monitoring and evaluation, regulation and enforcement, environmental protection, basin planning and research and development, and other cross-sector activities such as catchments management, basin planning and development.

6.4 Schematic Overview of Vision, Objectives, and Outputs

This paragraph summarized in a schematic the vision, objectives, and outputs presented in the above text.

Table 6.1: Schematic overview of Vision, Objectives, and Outputs

VISION FOR WATER RESOURCES MANAGEMENT IN UGANDA FOR 2040: "Water resources management in Uganda is effective in contributing to economic and social development and maintaining environmental services"

PRINCIPLE OBJECTIVE 1: Ensure sustainable and equitable allocation and provision of water of appropriate quantity and quality

Water Resources Availability for Use
- Output 1: Beneficial use of the available water resources enhanced

Management of Water Quality
- Output 2: Wholesome drinking water sources safeguarded and the quality of surface and groundwater bodies kept within the limits defined by water quality objectives

Integrated Land and Water Management
- Output 3: Catchments effectively managed
- Output 4: Ecosystem delivery of goods and services that protect water resources sustained or enhanced

Water Demand Management
- Output 5: End-use efficiencies increased
- Output 6: Water resources allocated to higher value economic activities

Water Resources Information, Planning, and Capacity
- Output 7: Water Information System (WIS) established and operational at WMZ and national level
- Output 8: General water resources knowledge base expanded and integrated into a Water Information System

PRINCIPLE OBJECTIVE 2: Adapting to the effects of extreme climate events

Reduce Vulnerability to Warmer Climate Conditions
- Output 9: Reduced vulnerability to warmer climate conditions

Reduce Vulnerability to More Severe Rainstorms
- Output 10: Reduced vulnerability to more severe rainstorms

Reduce Vulnerability to Increased Hydrologic Variability
- Output 11: Preparedness for higher variability of lake levels achieved

Effective Flood Management of the Floodplain
- Output 12: Effective flood management achieved

PRINCIPLE OBJECTIVE 3: Strengthening the Water Governance Framework

Strengthen Policy and Legal Framework for Water Resources Management
- Output 13: Effective legal & policy measures for water resources management

Strengthen Institutional Capacities for Water Resources Management
- Output 14: Effective institutional framework for water resources management
- Output 15: Improved institutional performance
- Output 16: Effective water resources planning, monitoring, and communication for the water sub sector

Strengthen Coordination Mechanisms for Water Resources Management
- Output 17: Effective coordination and collaboration mechanisms for water resources management at all levels
- Output 18: Effective institutional collaboration and participation

Financing of Water Resources Management
- Output 19: Improved levels and sustainability of funding for water resources management
- Output 20: CMOs and SCMOs able to cover preparation of catchment management plans and in the longer term also a significant part of their operationaland development funds

6.5 Priority Setting

The Water Strategy provides a large number of investment projects/programmes that cannot be undertaken immediately or simultaneously, although they all may seem rational and viable in the context. There will be resource constraints in terms of staff, facilities, equipment and financing, that will set limits to the number of investment programmes that can be undertaken at any given time. In other instances, there is need for logical flow of interventions so that synergies and complementarities are utilized. This requires that priorities are set by the appropriate decision levels in consultation with stakeholders.

Priorities are often influenced by a large number of criteria. Among these are for instance paired criteria such as:

a. Benefit / cost *(where are benefits highest and the costs lowest?)*
b. Impact /effort *(where are impacts highest and the level of efforts / resource input lowest)*
c. Urgency / importance *(where are the most important and urgent projects /programs)*

The following criteria for prioritizing interventions will be applied:

a. Linking and dependencies*, where different investments are dependent on each other. In some cases investments have to be implemented sequentially, in other situations they can be implemented in parallel. Investments will be placed into groups where all members of the group are implemented together.*
b. Timing, *where investments may achieve their benefits early and costs late or vice versa as compared to a situation, where there is a concurrent flow of benefits and costs.*
c. Phasing and opportunity costs*, where the use of a disproportionate amount of resources for a certain investment will obstruct the implementation of other investments and give an unbalanced development.*
d. Risks, *where there is a real possibility that the investment will not achieve its goals and where resources can be wasted.*

Based on 5 sets of criteria, 14 projects /programmes investments have been prioritized (Table 6.2).The policy, legal, institutional, and coordination outputs have not been included in this exercise. During prioritization, investments were ranked high (3), medium (2) or low (1) for the criteria; important, urgent and impact. For effort required and risk level they are rated low (3), medium (2) or high (1). The last column summarizes the main dependencies. Details about the project/programs are presented in Annex 5, while Table 6.3summarizes the project/program scores.

Table 6.2: Criteria, ratings, and dependencies

Project /program	***Total priority score***	***Important***	***Urgent***	***Impact***	***Effort***	***Risk***	***Dependent on implementation of***
1: Available water resources used in line with Uganda's Water Policy	11	High (3)	Medium (2)	High (3)	High (1)	Medium (2)	3, 7, 19, 20

2: Drinking water sources safeguarded and the quality of water bodies kept within limits defined by water quality objectives	11	High (3)	High (3)	High (3)	High (1)	High (1)	3, 7
3: Catchments effectively managed	12	High (3)	High (3)	High (3)	High (1)	Medium (2)	1, 7, 19, 20
4: Ecosystem delivery of goods and services in targeted catchments and watersheds sustained or enhanced	11	High (3)	Medium (3)	medium (3)	High (1)	High (1)	1, 3, 19, 20
5: End-use efficiencies increased	6	Low (1)	Low (1)	Medium (2)	High (1)	High (1)	19, 20
6: Water resources allocated to higher value economic activities	12	Medium (2)	Medium (2)	Medium (2)	Low (3)	Low (3)	19, 20
7: Water information system (WIS) established and operational at WMZ and national level	12	high (3)	High (3)	medium (2)	Medium (2)	medium (2)	3, 19, 20
8: General water resources knowledge base expanded and integrated into a water information system	12	High (3)	Medium (2)	Medium (2)	Medium (2)	Low (3)	3, 7, 19
9: Reduced vulnerability to a warmer climate achieved	9	High (3)	Low (1)	Medium (2)	Medium (2)	High (1)	8, 7
10: Reduced vulnerability to more severe rainstorms achieved	9	High (3)	Low (1)	Medium (2)	Medium (2)	High (1)	3, 7
11: Preparedness for higher variability of lake levels achieved	9	High (3)	Low (1)	Medium (2)	Medium (2)	High (1)	9
12: Effective flood management achieved	9	High (3)	High (3)	Medium (2)	High (1)	High (1)	3, 7
19: Improved levels and sustainability of funding for water resources management	11	High (3)	High (3)	High (3)	High (1)	High (1)	1, 3,
20: CMOs and SCMOs able to cover preparation of catchment management plans and in the longer term also a significant part of their operational and development funds	11	High (3)	High (3)	High (3)	High (1)	High (1)	1, 3, 19

Table 6.3: Project / Program scores

Score	Projects / programs
12	*3: Catchments effectively managed* *6: Water resources allocated to higher value economic activities* *7: Water information system (WIS) established and operational at WMZ and national level* *8: General water resources knowledge base expanded and integrated into a water information system*
11	*1: Available water resources used in line with Uganda's Water Policy* *2: Drinking water sources safeguarded and the quality of water bodies kept within limits defined by water quality* *4: Ecosystem delivery of goods and services that protect water resources sustained or enhanced* *19: Improved levels and sustainability of funding for water resources management* *20: CMOs and SCMOs able to cover preparation of catchment management plans and in the longer term also a significant part of their operational and development funds*
9	*11: Preparedness for higher variability of lake levels achieved* *9: Reduced vulnerability to warmer climate conditions achieved* *10: Reduced vulnerability to more severe rainstorms achieved* *12: Effective flood management achieved*
6	*5: End-use efficiencies increased*

When looking at the dependencies in the sense that some projects /programs should be implemented or be under implementation before others can be initiated, the following picture appears (see Table 6.4).

Table 6.4: Dependencies

Project /program	Number of projects /programs that are dependent on the project /program in first column
1: Available water resources used in line with Uganda's Water Policy	3
3: Catchments effectively managed	13

9: Water information system (WIS) established and operational at WMZ and national level	10
19: Improved levels and sustainability of funding for water resources management	12
20: CMOs and SCMOs able to cover preparation of catchment management plans and in the longer term also a significant part of their operational and development funds	10

Although there is a certain degree of subjectivity represented in the above three tables, they still show some significant tendencies. The highest priorities are appearing in a group of projects /programs which deals with effective management in catchments and provision of an adequate information base. An almost equally high priority is attached to finding ways to increase revenues from water resources allocations in order to finance the improvements in water resources management. Projects / programs dealing with climate change adaptation come out at the lower end of the priorities. In other words, one would recommend DWRM to increase revenue, establish the system upon which rational decisions can be made also for the water sector as well as for water-dependent sectors, emphasize de-concentration of management to catchment levels and then embark on important but less urgent projects /programs.

7 Implementing the Strategy

7.1 Duration

The Water Strategy provides goal, objectives and outputs for water resources management for 26 years effective 2014/15 FY until 2040. This is intended to provide long term planning perspective aligned to the Vision 2040. Strategy objectives and outputs are described in section 6.1 to 6.3, while priority investment areas are described in section 6.5. Activity Schedule for first 5 years is presented in Annex 6 while activity schedules for subsequent years will be derived in subsequent planning period after 2018/19 FY. This planning will be preceded by a comprehensive review of performance of the first 5 years. Planning for the subsequent periods will follow same arrangement.

7.2 Implementation Arrangements

7.2.1 Implementation

The National Water Strategy will be implemented as an integral part of the Water and Environment Sector through the established planning, budgeting, implementation and reporting mechanisms. This arrangement will be adjusted from time to time to reflect modifications in the sector.

The Water resources management component budget will support implementation of the described Strategies and actions including field investments, coordination activities, training and capacity building, communications/awareness and stakeholder outreach and engagement activities, as well as procuring the recommended equipments, facilities and human resources.

The coordination and implementation arrangements fall within the over-all mandate of MWE. Within the MWE, the day-to-day implementation responsibility is delegated to the Directors of DWRM, DWD and DEA. The Directors will delegate tasks and responsibility to Departments and Units according to their mandates and or areas of specialization. The Directors will be responsible for monitoring implementation progress and for reporting on performance of their delegated components.

The MWE will engage other organizations such as NEMA, NFA, UWA, NWSC and Districts that have complimentary mandates as well as academic and research institutions (NARO, Universities), NGOs, private sector, communities, where appropriate. The MWE Top Management will provide policy level management and coordination guidance.

7.2.2 Reporting

Reporting on the implementation progress will follow Government procedures and formats. The following categories of reports are envisaged:

a) Management and technical reports comprising of formal quarterly, semi-annual and annual reports.
b) Component reports on water resources planning, regulation, assessment and quality.
c) Task reports which would be required only when a specific task has been delegated/assigned.

Quarterly reports shall include:

a) Narrative progress towards achievement of quarterly and annual targets and outputs.
b) Financial performance and status.
c) Assessment of success and limiting factors and remedial actions taken to address failures or shortcomings.
d) Emerging issues encountered and recommended action to be taken.
e) Procurement and contract management plan for next quarter.

Semi – annual and annual reports shall be a consolidation of quarterly and semi-annual reports respectively. Semi-annual reports shall include an over-all assessment of implementation and budget performance for the reporting period and projections for the activities for the next reporting period.

In addition to these reports, the assigned Directors may provide other reports as shall be required by the Permanent Secretary from time to time.

7.2.3 Institutional Arrangements and Mandates

The institutional arrangements for implementing the Strategy are derived from the institutional mandates described in section 4.3 and 6.3.

The **Ministry of Water and Environment**has the overall responsibility for mobilizing and managing the human and financial resources required to implement Strategy. Further, the ministry will ensure that the Water Strategy fits within the ministry mandate and institutional arrangements for service delivery.

The **Directorate of Water Resources Management (DWRM)**is responsible for the over-all management, technical and coordination functions within and outside the MWE. On the day to day, these functions are delegated to the respective departments for Water Resources Assessment and Monitoring, Quality Assurance, Water Resources Planning and Regulation. Specifically, the DWRM mandate encompasses:

a. Guiding strategic direction for Strategy implementation.
b. Undertaking overall planning and mobilization of support, resources and investments in water resources management.
c. Monitoring implementation performance and outcomes of the Strategy.
d. Developing guidelines, procedures and instruments for implementation and service delivery at all levels.

e. Developing and guiding implementation of knowledge management and dissemination mechanisms.
f. Fostering collaboration, communication, co-learning and capacity building between and across government agencies, private sector, non-government organizations and the general public.
g. Providing technical assistance to relevant stakeholders.

Heads of Departments within DWRM, DWD and DEA have over-all responsibility for supervising all technical aspects of the delegated or assigned task as well as guiding the decentralized water resources management Units of MWE, namely, Technical Support Units (TSU), Umbrella Organizations (UO) and Water and Sanitation Development Facility (WSDF).

7.3 Implementation Requirements and Budget

Success full implementation of this Strategy will requires significant investments in the following areas:

a) Human resources in terms of skills commensurate with the scope of the Strategies and intervention activities and, adequate deployment to implement and monitor implementation progress.
b) Institutional capacities and facilities.
c) Institutional collaboration and stakeholder participation in implementation and monitoring.
d) Legal and policy environment for implementation.
e) Budget

Table 7.1 presents a framework for the priority capacity requirements, which will be filled out by DWRM.

Table 7.1: Framework for priority capacity requirements

Implementation requirements		
Category	Specification/Fields	Number
Human Resources		
Equipments		
Facilities		
Partnerships, Collaboration and Stakeholders Participation		
Policy environment		

7.4 Monitoring and Evaluation Implementation Progress and Outcomes

7.4.1 The M & E Mechanism

The mechanism for monitoring and evaluation implementation progress and outcomes is proposed in this section. Monitoring and evaluation will be an on-going activity to track Strategy implementation progress against inputs, outputs, results or outcomes.

Monitoring implementation aims at providing regular overview of the implementation of activities in terms of in-put delivery, work schedules and planned outputs/targets, etc. It will involve routine information gathering, analysis and reporting to MWE/Government, partners and stakeholders.

Evaluation shall be conducted in form of a systematic and objective assessment of on-going or completed activities in terms of their design, implementation and results. In addition, evaluation will deal with strategic issues such as relevance, effectiveness and efficiency of the strategies and inputs.

Over-all, the monitoring and evaluation mechanism will focus on:

a) Promoting accountability for the achievement of Strategy objectives through the assessment of actions, outputs, results, effectiveness and performance of lead institutions and stakeholders involved in Strategy implementation.

b) Promoting learning, feedback, and information sharing on results and lessons learned, as a basis for policy levels decision-making on matters of water resources availability, utilization and water quality.

7.4.2 Implementation Modalities

a) Responsibility for the monitoring function

DWRM is responsible for ensuring that the Monitoring and Evaluation mechanism has been applied. However, the day-to-day responsibility for implementing the M&E mechanisms shall be undertaken by the designated officer(s) within in the lead implementing institutions.

b) Reporting on monitoring and evaluation results

Lead institutions shall prepare reports on their respective components in accordance with the reporting formats.

c) Information dissemination

Quarterly progress reports and Annual reports will be shared among the Lead institutions. DWRM will consolidate reports from Lead institutions and submit monitoring report to MWE and partners as appropriate.

d) Data collection

Data will be collected by lead institutions on agreed indicators (Annex 7). In addition, data collected by NGOs/CSOs, Private sector institutions and other participating institutions shall be incorporated in the database.

e) Data analysis

Data will be analyzed by Lead agencies e.g., water samples will be analyzed by DWRM using standard methods provided in the Water Quality Monitoring Strategy. Samples shall be analyzed at accredited laboratories within and outside Uganda as appropriate.

Annex 7 provides the assessment tool for monitoring and evaluating the strategy at output level only. It is expected that implementing institutions will develop and apply annual assessment at activity level for purposes of measuring and tracking institutional performance and accountability.

7.5 Risk Management

Successful implementation of the Strategy requires planning for and dealing with uncertainties, complexity and ambiguitythat the MWE must understand and effectively manage as it strives to achieve Strategy objectives. Risk management and issue resolution are the tools for achieving this. A risk is an uncertain event or set of events which, should they occur, will have an effect on the achievement of goals and objectives. Issues are events that have happened, were not planned, are currently affecting the water resources management and need to be actively dealt with and resolved. Risks, should they occur, become issues. Risks are either strategic risks from factors outside the water sector or operational risks related to resistance to change or friction.

The risk management is an important part of the implementation activities and understanding these risks can reduce the likelihood of negative consequences for the Strategy.Risk management is a process involving identifying and sourcing risk, evaluating and prioritizing risk and, managing and mitigating risk.

The following risks have been identified:

a) Maintaining the balance between water use and water availability and water quality.
b) Achieving effective institutional collaboration and participation.
c) Meeting water demand

The MWE will apply the following strategies to mitigate/manage these risks.

a) Focusing on its mandate and sticking to the Strategy priorities.
b) Identifying and engaging strategic partnerships.

c) Developing and applying Monitoring and Evaluation mechanism as a management tool
d) Applying a Cost-benefit analysis tool when determine activities and approaches to use in their implementation.
e) Ensuring effective governance in reference decision making on strategy implementation and financial management.
f) Strengthening institutional capacity.

8 References and further Reading

Acres International. 2003. East African power master plan study, Phase I. Draft Report.

Allen, R.G., Pereira, L.S., Raes, D.,Smith, M. (1998) Crop evapotranspiration: Guidelines for computing crop water requirements. FAO Irrigation and Drainage Paper No. 56. Food and Agriculture Organization of the United Nations, Rome.

Balk, D. et all; Mapping the Risks of Climate Change in Developing Countries

Bovee, K. D. (1986): "Development and evaluation of Habitat Suitability Criteria for use in Instream Flow Incremental Methodology.". U.S. Fish and Wildlife Service Biological Report, 86 (7), U.S. Fish and Wildlife Service.

Buontempo C., J. K. Lørup, M. Sanderson, M. Butts, E. Palin, R. McCarthy, R. Jones, R. Betts, M. Antar (2011) The impact of uncertainties in climate impacts assessments: the case of the Nile basin, In : Coping with Global Environmental Change: Climate Change, Soil and Desertification, Water Management, Food and Health, Hexagon Se-ries on Human, Environmental Security and Peace (HESP) (Eds. H-G Brauch, Ú. O. Spring, C. Mesjasz, J. Grin, P. Kameri-M bote, B. Chourou, P. Dunay, J. Birkmann) vol. 5 (Berlin – Heidelberg – New York: Springer-Verlag) 2011. Pages 765-772 ISBN: 978-3-642-17775-0 (Print) ISBN: 978-3-642-17776-7 (Online) DOI 10.1007/978-3-642-17776-7 (http://www.afes-press-books.de/html/hexagon_05.htm).

Collins, M. and Knight, S.K. (Eds) (2007): Ensembles and probabilities: A new era in the prediction of climate change. Philosophical Transactions of the Royal Society A 365, Number 1857 / August 15, 2007.

Coen, V.W. (1998). Report on opportunities in agriculture, trade and investment in Uganda. Directorate of Marketing National Department of Agriculture, Pretoria, South Africa.

Dagg, M., Woodhead, T & Rijks, D.A. 1970. Evaporation in East Africa. Bulletin of the International Association of Scientific Hydrology 15: 61-67.

Dyson, M., Bergkamp, G., and Scanlon, J. (2003): "Flow: The Essentials of Environmental Flows". IUCN, Gland, Switzerland and Cambridge, UK.

DWAF (1997), White Paper on a National Water Policy for South Africa. Department of Water Affairs and Forestry, Pretoria

DWRM (2011b). The declining trends of water resources in Uganda: A Case study of River Rwizi, Lake Wamala, Lake Victoria Catchments and representative Groundwater Monitoring stations. Water Resources Monitoring & Assessment Division, Department of Monitoring and Assessment, Directorate of Water Resources Management (DWRM), Entebbe.

DWRM (2012),National Water Resources Assessment, Entebbe, UGANDA

DWRM (2012), Framework and guidelines for water source protection, Volume 1: Framework for Water Source Protection, DWRM, June 2012 (Draft 2)

DWRM (2008); Alasdair Macdonald; Integrated Flood Management Strategy; Uganda 2008

Emerton, L. and Bos, E. (2005): "Value. Counting Ecosystems as an Economic Part of Water Infrastructure". IUCN, Gland, Switzerland & Cambridge, UK.

Euroconsult. 1989. Agricultural Compendium for Rural Development in the Tropics and Subtropics. Elsevier, Amsterdam.

EVD International. 2007. Feasibility Study for Ferry Services on Lake Albert and Lake Kyoga. Inland Water Transport Development Uganda. Final Report.

FAO. 1987. Irrigation and water resources potential for Africa. AGL/Misc/11/87. FAO, Rome.

Fichtner Water & Transportation. 2008. Kampala sanitation program. Feasibility study. Ministry of Water and Environment, Kampala, Uganda.

Fowler, H.J., Ekström, M., Kilsby, C.G., Jones, P.D. (2005): New estimates of future changes in extreme rainfall across the UK using regional climate model integrations. 1. Assessment of control climate. Journal of Hydrology 300, 212–233.

Fowler, H. J., Blenkinsop, S., Tebaldi, C. (2007): Review: Linking climate change modelling to impact studies: recent advances in downscaling techniques for hydrological modelling, International Journal of Climatology 27, 1547-1578.

Frei, C., Christensen, J.H., D´equ´e, M., Jacob, D., Jones, R.G., Vidale, P.L. (2003): Daily precipitation statistics in regional climate models: evaluation and intercomparison for the European Alps. Journal of Geophysical Research 108(D3): 4124, DOI: 10.1029/2002JD002287.

Frei, C., Schöll, R., Fukutome, S., Schmidli, J., Vidale, P.L. (2006): Future change of precipitation extremes in Europe: an intercomparison of scenarios from regional climate models. Journal of Geophysical Research-Atmospheres 111: D06105, DOI: 10.1029/2005JD005965.

Gavigan, J., Mackay, R. & Cuthbert, M.O. 2008. Climate change impacts on groundwater recharge in NE Uganda and the potential role of groundwater development in livelihood adaptation and peace building; Presented at Groundwater and Climate Change in Africa conference, Kampala 24-28 June 2008. http://www.chipspeace.org/files/GWCLIM_NEUganda.pdf

Georgakakos, A. P, Decisions Support Systems for Integrated Water Resources Management with an Application to the Nile Basin, Atlanta, 2004

Giorgi, F., Jones, C., and Asrar, G. R. (2009). Addressing climate change needs at the regional level: the CORDEX framework, WMO Bulletin, 58 (3).

GoU (2010): National Development Plan (2010/11 – 2014/15). Government of Uganda, Kampala.

GoU (2012): Uganda Vision 2040. Government of Uganda, Kampala.

Howell, P. & Allan, J. (eds). 1994. The Nile: Sharing a Scarce Resource. Cambridge University Press.

International Finance Corporation (2207), The Value of Water for Irrigated Paddy and Hydropower Generation in the Great Ruaha Tanzania 2002-04" as part of "Raising irrigation productivity and releasing water for inter-sector needs" project research implemented by Overseas Development Group, University of East Anglia, Sokoine University of Agriculture in Tanzania and The International water Management Institute in South Africa

Jensen, R.A. 2009. Scoping study for hydropower regulation tool for Uganda. Unpublished mission report no.7. DWRM, Entebbe, Uganda.

Jones, R. G., Noguer, M., Hassell, D. C., Hudson, D., Wilson, S. S., Jenkins, G. J., and Mitchell, J. F. B. (2004): Generating high resolution climate change scenarios using PRECIS, Met Office Hadley Centre, Exeter, UK.

Kansiime, F. & Nalubega, M. (1999). Wastewater treatment by a natural wetland: the Nakivubo Swamp, Uganda. Processes and Implications. PhD thesis, University of Wageningen, Netherlands. A.A. Balkema Publishers, Rotterdam, The Netherlands.

King, J., Tharme, R. E., and Watkins, D. (2000): "Environmental Flow Assessments for Rivers: Manual for the Building Block Methodology". Water Research Commossion Report No TT 131/00.

King, J., Brown, C. A. & Sabet, H. (2003): "A Scenario-based Holistic Approach to Environmental Flow Assessments for Rivers". River Research and Applications 19, 619-639. King et al., 2000

Korsgaard, L. & Schou, J.S. (2010): Economic valuation of ecosystem services in developing countries. Water Policy.Vol. 12 Issue 1, pp. 20-31.

Korsgaard, L., Jønch-Clausen, T., Rosbjerg, D. & Schou, J.S. (2008): A service and value based approach to estimating Environmental Flows in IWRM. International Journal of River Basin Management. Vol. 6, Issue 3, pp. 257–266.

Langdale-Brown, I., Osmaston, H.A. & Wilson, J.G. 1964. The vegetation of Uganda and its bearing on landuse. Government of Uganda, Entebbe, Uganda.

Lejju, J.B. 2009. Vegetation dynamics in western Uganda during the last 1000 years: climate change or human induced environmental degradation? African Journal of Ecology 47: 21 – 29.

Leung, R.L., Mearns, L.O., Giorgi, F., Wilby, R.L. (2003): Regional climate research: Needs and opportunities. Bulletin of the American Meteorological Society 84, 89–95.

LVBC & WWF-ESARPO, 2010. Assessing Reserve Flows for the Mara River. Nairobi and Kisumu, Kenya.
MFPED 2010

NBI, State of the River Nile Basin 2012, Uganda, October 2012

McAllister A. 2008 Agricultural water use in the Nile Basin – an overview. Nile Basin Initiative Efficient Water Use in Agricultural Production project, Nairobi, Kenya.

McSweeney, C. F., Jones, R. G., and Booth, B. B. B. (2012): Selecting ensemble members to provide regional climate change information, J. Climate, doi:10.1175/JCLI-D-11-00526.1, http://405 dx.doi.org/10.1175/JCLI-D-11-00526.1, 2012.

MEMD (2011): Project for Master Plan Study on Hydropower Development in the Republic of Uganda – Final Report. March 2011. JICA / Electric Power Development Co.

MEMD, Bujagali II, Economic and Financial Evaluation Study, Final Report February 2007, Kampala

Millenium Ecosystem Assessment (2005): "Ecosystems and Human Wellbeing". Island Press, Washington DC.

MFPED (2012), Central Government Public Expenditure and financial Accountability Assessment Report, Kampala, Uganda

MWE (2009), Uganda Water Sector Investment Plan (2009 – 2035), Ministry of Water and Environment, Kampala, Uganda.

MWE (2011): A National Irrigation Master Plan for Uganda (2010-2035). November 2011. Ministry of Water and Environment/Pem Consult, Kampala, Uganda.

MWE (2012), Uganda Water and Environment Sector Performance Report 2012. Ministry of Water and Environment, Kampala, Uganda.

MWE (2013): Uganda National Water Resources Assessment. Ministry of Water and Environment, Kampala, Uganda.

MWE, JWESSP 2013-18, Preparation of the Final Programme Document Dec 2012, Ministry of Water and Environment, Kampala, Uganda

MWE, Water and Environment Sector, Third and Fourth Joint Government of Uganda-DP Sector Review, Oct 2011 and Oct. 2012

MWE, National Water Policy, Uganda

MWE, Capacity Development Strategy 2012-17, MWE August 2012

MWE, Resources Mobilization Strategy-Concept for CbIWRM in Uganda. Patrick Kahangire July 2012

Nakileza, B. and Nsubuga, E.N.B. (eds). 1999. Rethinking natural resource degradation in semi-arid sub-Saharan Africa: a review of soil and water conservation research and practice in Uganda, with particular emphasis on the semi-arid areas. Soil and Water Conservation Society of Uganda (SWCSU), Makerere University, Uganda.

National Environment Management Authority (NEMA) Uganda (2010): State of the Environment Report.

New, M., Lister, D., Hulme,M. & Markin, I. 2002. A high-resolution data set of surface climate over global land areas, Climate Research 21:1-25.

Nippon Koei Co. Ltd & TAIYO Consultants Co. Ltd. 2006. The study on poverty eradication through sustainable irrigation projects in eastern Uganda. Ministry of Agriculture, Animal Industries and Fisheries, Kampala, Uganda.

Nkonya, E. 2002. Soil conservation practices and non-agricultural land use in south western hills of Uganda. IPRI. Washington DC.

NOAA – National Weather Service - Climate Prediction Centre, http://www.cpc.ncep.noaa.gov (visited 18 February 2013)

Ohlsson, L., Turton, A., the Turning of a Screw; Social Resource Scarcity as a Bottle-neck in Adaptaion to Water Scarcity, Gotenborg, 2004

Operationalizing Catchment-based Water Resources Management: Briefing Note, DWRM, February 2012

Pearce D., Atkinson, G., and Mourato, S. (2006): "Cost-Benefit Analysis and the Environment. Recent Developments". OECD Publishing,

Penning de Vries, F. and Molden D., Implications of Land and Water Degradation for Food Security, with Particular Reference to Asia and Africa; International Symposium Sustaining Food Security and Managing Natural Resources in Southeast Asia - Challenges for the 21st Century; Thailand 2002.

Penning de Vries, F. et all, Integrated Land and Water Management for Food and Environmental Security; IWMI, GEF 2003

Poff, N. R., Allan, J. D., Bain, M. B., Karr, J. R., Prestegaard, K. L., Richter, B. D, Sparks, R. E. & Stromberg, J. C. (1997): "The natural flow regime. A paradigm for river conservation and restoration.". BioScience 47, 769-784.

Postel, S. and Richter, B. (2003): "Rivers for Life. Managing water for people and nature". Island Press, Washington D.C

PPA (2007): Bujagali II, Economic and Financial Evaluation Study, International Finance Corporation, Final Report. February 2007.

Reiser, D. W., Wesche, T. A. & Estes, C. (1989): "Status of Instream Flow Legislation and Practices in North Amerika". Fisheries 14, 22-29.

Rijks, D.A., Dagg, M. & Woodhead T. 1970. Evaporation in East Africa. Bulletin of the International Association of Scientific Hydrology, 15: 61-67.

Smakhtin, V.; Revenga, C.; and Döll, P.(2004). Taking into account environmental water requirements in global-scale water resources assessments. Comprehensive Assessment Research Report 2. Colombo, Sri Lanka: Comprehensive Assessment Secretariat.

Smakhtin, V.; Anputhas, M. 2006. An assessment of environmental flow requirements of Indian river basins. Colombo, Sri Lanka: International Water Management Institute. 42p. (IWMI Research Report 107)

Smakhtin, V.; Arunachalam, M.; Behera, S.; Chatterjee, A.; Das, S.; Gautam, P.; Joshi, G. D.; Sivaramakrishnan, K. G.; Unni, K. S. 2007. Developing procedures for assessment of ecological status of Indian river basins in the context of environmental water requirements. Colombo, Sri Lanka: International Water Management Institute. 40p. (IWMI Research Report 114).

Suttcliffe, J.V., Parks; The Hydrology of the Nile Basin; Monographiae Biologicae Volume 89, 2009, Springer Verlag

Tharme, R. E. and King, J. (1998): "Development of the Building Block Methodology for Instream Flow Assessments and Supporting Research on the Effects of Different Magnitude Flows on Riverine Ecosystems". Water Research Commission Report No 576/1/98.

Tharme, R. E. (2003): "A Global Perspective on Environmental Flow Assessment: Emerging Trends in the Development and Application of Environmental Flow Methodologies for Rivers". River Research and Applications 19, 397-441.

UBOS (2010), Uganda National Household Survey 2009/10. Uganda Bureau of Statistics (UBOS), Kampala

UBOS (2010), Statistical Abstract 2010. Uganda Bureau of Statistics (UBOS), Kampala

UBOS (2012), Statistical Abstract 2012. Uganda Bureau of Statistics (UBOS), Kampala

Uganda. 1995. Uganda water action plan: Annex 12. Assessment of soil erosion impact on water resources. Directorate of Water Development, Entebbe, Uganda.

Uganda. 2000. Wetlands and the law: legislation governing ownership, use and access to wetlands and their resources. Ministry of Water and Environment, Kampala.

Uganda. 2005. Guidelines for smallholder paddy rice cultivation in seasonal wetlands. Ministry of Water and Environment, Kampala.

Uganda. 2007. Climate change: Uganda national adaptation programmes of action. Ministry of Environment, GEF and UNEP, Kampala: 94 pp.

Uganda. 2009. Guidelines for wetlands edge gardening. Ministry of Water and Environment, Kampala.

Uganda. 2009. The national livestock census report 2008. Ministry of Agriculture, Animal Industries and Fisheries, Kampala.

Uganda. 2009. Developments and investment opportunities in renewable energy resources in Uganda. Energy Regulatory Authority, Kampala.

UNESCO. 2005. National Water Development Report Uganda. Prepared for the second UN World Water Report. Entebbe, Uganda.

UNEP (2013) ”Adaptation to Climate-change Induced Water Stress in the Nile Basin: Comprehensive Assessment of Flood & Drought Prone Areas” United Nations Environment Programme (UNEP), Nairobi, Kenya.

Water Governance in Context; Working Paper #2: Catchment Management Frameworks and Issues of Scale; Mekong Research Group, The University of Sydney,

WMO. 1982. Hydrometeorological Survey of the Catchments of Lake Victoria, Kyoga and Mobutu Sese Seko. World Meteorological Organisation Report, Geneva, Switzerland.

World Bank (2011), Uganda Water Assistance Strategy, June 2011

World Bank (2012), Uganda Tourism Sector Situational Assessment: Tourism Reawakening

World Bank (2013), Uganda Economic Update, February 2013

World Bank, Project Appraisal Report, Water Management and Development Project, WB 2012

WREM International. 2005. Study on Water Management of Lake Victoria. Main Report. Ministry of Energy and Mineral Development, Kampala, Uganda.

WREM International. 2005. Study on Water Management of Lake Victoria; Technical Report 10: Climate Change Assessment, Ministry of Energy and Mineral Development, Kampala, Uganda.

ANNEXES

Annex 1:NDP 2010-2014, Selected sector objectives, strategies, and interventions directly related to the water sector
Annex 2: Estimated water use in the petroleum industry
Annex 3: Water allocation modelling and scenario analysis of water development options using MIKE BASIN and MIKE CUSTOMISED (separate report)
Annex 4: The economic value of water used for rice irrigation, hydropower production, and oil production
Annex 5: Key implementation projects and programs
Annex 6: Activity Schedule for 2014-2019
Annex 7: Monitoring and Evaluation Framework

Annex 1: NDP 2010-2014, Selected sector objectives, strategies, and interventions directly related to the water sector

Primary Growth Sector: Agriculture
Objective 1- Enhance agricultural production and productivity
Strategy 4: Enhance productivity of land through sustainable land use andmanagement of soil and water resources
Strategy 5: Increase supply for water for agricultural production (irrigation, water for livestock,aquaculture)
Water for Crops: i) Rehabilitate five government irrigation schemes (Mobuku, Kibimba, Kiige, Olweny and Agoro); ii) Reorganize management of irrigation schemes and transfer management to the lowest appropriate level and systems to ensure their sustainability; iii) Establish new irrigation schemes (informal, small scale, commercial). iv)…. v) Establish demonstrations on small-scale irrigation technologies, and rain water harvesting and management to ensure transfer of irrigation knowledge vi) Establish a monitoring framework for supply, utilization and management of water for crops.
Water for Livestock: i) Increase water storage through surface water reservoirs, gravity flow or pumped schemes, and ground water exploitation
Water for Aquaculture: i) Support the increase in acreage of small-scale aquaculture from 5,000 ha to 20,000 ha and large-scale aquaculture to 25,000 ha by 2015
Strategy 8: Improve agricultural livelihoods in Northern Uganda
Objective 3 – Create an enabling environment for competitive investment inagriculture
Strategy 2: Enhance sector policy formulation, planning, and coordination
Strategy 3: Enhance Intra and Inter-Sectoral Coordination
Strategy 4: Build capacity to respond to Climate Change
i) identify climate effects, vulnerabilities and coping mechanisms as they relate to the various agricultural production strategies pertaining across Uganda
ii) improve climate forecasts along with procedures for use in agricultural management
iii) integrate climate risk management in agricultural business strategies
iv) strengthen central and local government capacity to integrate climate change into planning

Annex 1 (continuation – Primary Growth Sector)
Primary Growth Sector: Forestry
Objective 1 - Restore Forest Cover from 3,604,176 hectares37 to 4,933,746 hectares (1900 levels) by 2015
Strategy 1: Re-forestation and afforestation of 1,266,000 hectares in 698 forest reserves and 730,000 ha in national parks and game reserves
Strategy 3: promote commercial tree-planting on private lands
Strategy 4: increase involvement of the population in tree planting
Strategy 6: Strengthen the capacity of relevant sector institutions to effectively enforce forest and environmental laws and regulations
Objective 2 - Restore degraded natural forests in forest reserves and private Forests
Strategy 1: improve low stocked natural forests using the landscape approach
i) Prepare and implement a Landscape Restoration Action Plan; the area of well-stocked natural forests will be increased ii) prepare and implement a phased approach to sustainable forest management; the coverage of natural forests under sustainable forest management regime will increase
Strategy 2: Protect the Government permanent forest estate
Objective 3: Reduce pressure on forest cover as a source of wood fuel and construction material
Strategy 6: regulate forest activity on private land in line with land use policy
i) regulate forest harvesting activities in fragile eco-systems; legal guidelines and standards will be developed ii) …. iii) support the development of a land use plan
Primary Growth Sector: Tourism
Objective 2 – Increase the contribution of tourism to GDP and employment
Primary Growth Sector: Mining
Objective 1 - Promote and empower artisanal and small scale miners
Strategy 6: Develop infrastructure for mining activities
i) extend and improve physical infrastructure into potential and existing mining areas through construction of roads, power grid lines and substations, and piped water systems
Objective 4 - Promote environmental and social responsibility in mining
Primary Growth Sector: Oil and Gas Sector
Objective 2- carry out commercial production of oil and gas and build subsequent infrastructure for distribution, operations, and management
Strategy 3: refinery development
Primary Growth Sector: Manufacturing
Objective 1 – Promote development of value added industries especially the agro-industries

Annex 1 (continuation – Complementary Sector)
Complementary Sector: Transport
Objective 5 - Increase the volume of passenger traffic and cargo freight by marine transport
Strategy 1: Increase navigable routes and improve marine transport infrastructure
i) Conduct hydrographic surveys to map navigable routes on Lake Victoria and other lakes. ii) Rehabilitate the two Ugandan wagon ferries and replace the MV Kabalega. iii) Rehabilitate port infrastructure at Port Bell, Jinja and Butiaba.
Complementary Sector: Energy
Objective 1 - Increase power generation capacity
Strategy 1: Construct large hydropower plants and thermal power plants through public and private investments
Strategy 2: Develop mini hydro power plants to generate 150MW
Complementary Sector: Water for Production
Objective 1 - Increase acreage under irrigation from the current level of 14,418 hectares to 22,000 hectares
Strategy 1: Develop public irrigation schemes
Strategy 2: Promote micro-level irrigation
Strategy 5: Rehabilitate existing irrigation schemes
Objective 2 - Increase supply of water in the cattle corridor from the current 36 per cent to 50 per cent and those outside the cattle corridor from 21 per cent to 30 per cent
Strategy 1: Construct valley dams and valley tanks and set up reliable O&M structures and systems
Objective 3 - Strengthen management of water catchment areas around Water for production facilities
Strategy 1: Manage water resources at catchment areas
Strategy 2: Build capacity for water resource management
Objective 4 - Increase water supply systems for rural industries to facilitate agro-processing and other industrial activities
Strategy 1: Provide water for production supply systems to key industrial areas
Objective 5 - Increase water supply for multi-purpose use in water stressed areas of the country
Strategy 1: Construct bulk water supply schemes
Complementary Sector: Land Management and Administration
Objective 1: create an inclusive and pro-poor policy and legal framework for the land sector
Strategy 4: Formulate and implement the Government Land Management Policy

Annex 1 (continuation – Social Sector)
Social Sector: Water and Sanitation
Objective 1 – Increase access to safe water supply in rural areas from 63% to 77% by 2015
Strategy 1: construct, maintain, and operate the water supply systems in rural areas
Strategy 2: improve functionality of water supply systems
Objective 2 – Increase access to safe water supply in urban areas from 60% in 2008 to 100% by 2015
Strategy 1: construct, maintain, and operate piped water supply systems in urban areas
Objective 3 – 3 increase access to improved sanitation from 69% to 80% in rural areas and 77% to 100% for urban areas
Strategy 1: promote good sanitation and hygiene practices in households, communities, and rural growth centers
Strategy 2: promote good sanitation and increase sewerage systems to cover urban areas
i) intensify sewerage connections in towns with existing systems, and put sewerage systems in towns with piped water supply systems; ii) implement Kampala Sanitation Master Plan; iii) modernize solid waste management and treatment in the city and major towns
Objective 4 – improve efficiency and effectiveness in water and sanitation delivery
Strategy 1: improve the policy, legal, and regulatory framework
Strategy 2: strengthen the institutional structures and systems and coordination of water and sanitation activities
Strategy 4: enhance sector coordination and management

Annex 1 (continuation - Enabling Sectors)
Enabling Sector: Environment
Objective 1 - Restore degraded ecosystems (wetlands, forests, range lands and catchments) to appropriate levels
Strategy 1: Restore the forest cover to 1990 levels
Strategy 2: Restore the wetlands, rangelands and monitor restoration of all ecosystems
i) gazette wetlands to increase acreage ii) implement catchment-based management systems to restore the rangelands and catchments iii) monitor and inspect restoration of ecosystems (forests, wetlands, catchments)
Strategy 3: support environmental improvement initiatives
i) support sustainable provision of ecosystem services through restoration of fragile ecosystems (river banks, lakeshores, hilly and mountainous areas, and wetlands) ii) ..
Objective 2 – ensure sustainable management of environmental resources and minimize degradation
Strategy 2: strengthen the policy, legal, and institutional framework to support environmental management
Strategy 3: develop national, regional, and international partnerships and networks to enhance trans-boundary environmental management
Strategy 6: promote compliance with environmental laws and regulations
Objective 3 – identify and address emerging environmental issues and opportunities
Strategy 1: improve electronic and other hazardous waste management
Strategy 2: sustainable management of oil and gas resources
Strategy 3: improve the management of chemicals
Enabling Sector: Climate Change
Objective 1 – develop national capacity for coordination and implementation of climate change adaptation and mitigation activities in the country in support of social welfare and national development
Strategy 1: address legal and institutional frameworks necessary for the implementation of the UNFCCC
… iii) undertake sectoral studies and identify their role in climate change action ….
Objective 2 – ensure climate proof development planning
Strategy 1: re-define climate change as a development issue
… iv) strengthen weather and climate monitoring for improved data generation v) conduct climate change research and technology development …

Annex 1 (continuation - Enabling Sectors)
Enabling Sector: Meteorology
Objective 1 – provide modern meteorological services to effectively and efficiently support the various sectors of the economy
Strategy 1: overhaul, automate and inter-link the meteorological system
.. i) increase the type and number of automated weather and climate observation stations to meet national and international requirements; the whole system will be automated and inter-linked ii) provide accurate real time, short and long term forecasts to facilitate the effective performance of the different socio-economic sectors including air transport, defense, agriculture, health, industry, water resources management…
Enabling Sector: Wetlands
Objective 1 - Enhance the sustainable use of wetlands in order to achieve the optimum, ecological value and socio-economic benefits for development
Strategy 1: Conserve the biodiversity value of wetlands
i) Strengthen national data and information for wetland management and regularly update district wetland inventories. ii) Establish a monitoring system to assess and enhance value of wetlands. iii) Carry out mapping of current bio-diversity of wetland and assess the values. …
Strategy 2: enhance the ecological value of wetlands
i) assess, document, and disseminate the ecological and socio-economic values of wetlands ii) promote wise-use of wetlands for socio-economic development iii) Gazette wetlands in collaboration with Survey and Mapping and the Land Registry
Strategy 3: ensure sustainable use of wetlands for economic purposes
…. ii) undertake socio-economic and wetland valuation studies in critical and vital wetlands … v) strengthen collaboration with key sectors….through harmonization of relevant sectoral policies
Strategy 4: institute and operationalize appropriate policy, legal, and institutional frameworks
Strategy 5: restore degraded wetlands and ensure sustainable management
Strategy 6: promote transboundary cooperation for sustainable management of wetlands

Annex 2: Estimated water use in the petroleum industry

Introduction

Fresh water plays an integral part in many operating processes in the petroleum industry. For example, water is widely used in cooling systems, for heating and crude washing, and to maintain pressure in oil reservoirs. While water is typically recycled and used multiple times (for instance in closed-loop processing systems), most water eventually returns to the environment and needs to be treated and cleaned before discharge so as not to pollute the environment. Consumptive water use in a traditional petroleum refinery is chiefly concerned with cooling: large amounts of water evaporate in cooling towers.

Water Use in the Petroleum Industry

Water is used in the oil industry: 1) for well development, 2) at the Central Production Facility, and 3) for petroleum refining.

1) Well development

To increase reservoir pressure and provide a 'sweep' effect to push oil towards the production well, water is injected into the oil-containing layers. The reservoir's geo-mechanics determine the water consumption for each field. At present, information on water consumption is only available for the King Fisher field, which is expected to produce between 30,000 and 40,000 barrels per day at peak production. This would require a volume of water of maximum 7,500 m3/day, equaling 2.74 mcm/year.

No geo-physical information is available for the other well fields, but the geological structures in the Albertine Graben are quite similar, and water use for the other fields can be extrapolated. Thus at peak production (i.e. 180,000 barrels per day), maximum consumptive water use for well development is estimated at 16.43 mcm/year. Possible return flows are captured at the Central Production Facility.

Fields are estimated to run for at least 25 years, and most water will be abstracted from Lake Albert or the Albert Nile.

2) Central Production Facility (CPF)

Three CPFs are proposed in Uganda: a) King Fisher – at the south-eastern tip of Lake Albert, b) Kayso-Tonya – on the eastern shore of Lake Albert, and c) Buliisa – at the northern tip of Lake Albert and servicing the production wells in Murchison Falls National Park. All proposed oil production is on-shore.

The consumptive water use at the CFP is minimal. However, when arriving at the processing facility, oil typically contains large quantities of water, up to 80%, and water and oil need to be separated. Treatment facilities ensure that water is brought back to original standards before being returned to the environment.

3) Petroleum refining

A refinery with a maximum capacity of 180,000 barrels per day is planned in Hoima and will be constructed in a 10-year period in 4 phases:

Phase 1: 20,000 barrels per day
Phase 2: 60,000 barrels per day
Phase 3: 120,000 barrels per day
Phase 4: 180,000 barrels per day

Since the refinery is still in the design phase, no definite figure is available of consumptive water use. However, the tentative water footprint can be estimated from similar installations elsewhere. For instance, the consumptive water use of a typical refinery of 160,000 barrels per day is approximately 18 mcm/yr, of which 10 mcm/yr is lost to evaporation and the rest is discharged (CGLI Water Foot-printing Workshop July 16, 2010). Water loss can be reduced if closed-loop cooling systems are installed.

This would translate into in a maximum consumptive water use of some 20 mcm/yr for the Hoima facility, of which 7.5 mcm/yr would be discharged to the environment.

Conclusion

Maximum consumptive water use during peak production (i.e. 180,000 barrels per day) is estimated at some 36.5 mcm/year. This figure will be less if closed-loop cooling facilities are installed at the Hoima refinery. Almost all water will be abstracted from Lake Albert or the Albert Nile.

Given the abundance of water resources in the Lake Albert region, access to water for oil production should not be a major concern, and no conflicting local demands are expected. However, the potential pollution risks are real and the impact of the oil industry on the environment and possible river, lacustrine, and groundwater pollution should be minimized. To this effect, the government has prepared a sensitivity atlas, and is taking very serious actions to prevent pollution, and to mitigate the consequences of potential pollution.

While future oil discoveries are quite possible in the Albertine Graben, there are no plans as yet to increase the capacity of the Hoima refinery. Therefore, absent the construction of a pipeline for transport of crude oil to the Indian Ocean for export, the expected maximum oil production is 180,000 barrels per day.

References

Notes made during discussions with Dr. Joseph Kobusheshe, Environmental Engineer, PEPD, 28 March 2013

http://www.ipieca.org/publication/water-resource-management-oil-and-gas-industry (visited 10 April 2013)

http://sustainabilityreport.shell.com/2012 (visited 10 April 2013)

www.cgli.org/waterfootprint (visited 10 April 2013)

Annex 3: Water allocation modelling and scenario analysis of water development options using MIKE BASIN and MIKE CUSTOMISED

(separate report)

Annex 4: The economic value of water used for rice irrigation, hydropower production, and oil production

1.0 THE CONTEXT

There is increasing awareness about the importance of water as a strategic resource in national development. Understanding its value is one way of appreciating its importance, and it is for this reason that water resources valuation should take prominence in the process of developing the strategy for its management. The economic value of water varies in time, space and use, while competition among water uses has tended to increase its value. As a result of concerns about issues such as water scarcity and economic efficiency, economics will play an increasingly important role in decisions concerned with water resources investment and management.

It is important to keep in mind that the economic value of water is site and time specific, and can in fact only be accurately defined when there is large-scale competition for scarce water resources between two or more water users (sectors). It reflects the fact that production economics depends on choice of technology, land, labour, and capital costs, which all vary as a function of specific location and point in time. Therefore, calculatingthe economic value of water to society in case of large scale competing uses serves as critical input into the water allocation process.Competition for scarce water resources may be the result of many reasons such as violation of water rights or inefficient water resources planning, or may arise as a result of increasing demand for water or from climate change which could reduce catchment specific water resources availability.

In Uganda no current or recent large-scale cases of water competition have, according to the consultant, been reported. This may be because Uganda is endowed with relatively abundant water resources and current demand levels pose no serious threat on the resource base, as a result of which resource planning and management has been able to cope with existing challenges. With no current large scale competition the economic value of water in Uganda is not defined. However, as indicated earlier, increasing water demandcombined with climate change will increase competition for water. It would make the economic value of water highly relevant as an element in water allocation.In Uganda, little has been done in valuing natural resources (including water) and this may partly explain why some of the natural resources such as wetlands and forests have been rather poorly managed in spite of the abundant scientific knowledge available in the country about those resources. One reason why economic valuation may have been neglected in decision-making for the management of natural resources is the fact that it is not always a direct undertaking. In Uganda, it is among the missing links between scientific knowledge and efficient management of the resources. It is now evident that any strategy aimed at sustainable and efficient management of the natural resources must integrate economic valuation as part and parcel of the planning process. It is for this reason that this strategy considers the establishment of economic values of water resources an important element of the exercise.

Thus, the attempts in the following to estimate the economic value of water in its use for hydropower generation, for irrigation,and for oil production serve primarily to illustrate existing and already used methodologies. Further, it must be emphasized that these estimated economic values for the above uses

should not be compared. First of all, these values are not by definition based at the same catchment.Furthermore, all values are based on secondary data sources and their meaning is therefore mainly indicative. Finally, the economic value of water for hydropower is based on non-consumptive use (based on the amount of water discharged through the turbines), whereas the economic value of water for irrigation and for oil production is based on consumptive use of the water resources.

In case of significant competition for water for example between irrigation and hydropower, these calculated economic values should be based on site and time specific primary data sources, should they serve as an element in water allocation between the two sectors. Decisions on water allocation should, however not only depend on the economic value of water but also consider other socio-economic issues such as the impact of allocating water to one sector on local employment and social development.

d) The approach

A review of studies on water value estimates in alternative uses shows wide variations in valuation approaches. Most studies have used productivity approaches (estimating net income per m3 of water used) but others have used market valuation.[1] Choice of the valuation method greatly depends on accessibility to data as well as the time available to do the analysis. When data are available, it is possible to use direct estimates of product values of water. There is little evidence to show that the choice of valuation methodology influences the estimates of the value of water in agricultural production.[2]
The approach to estimate the economic value of water for use in irrigation and for hydropower production in Uganda was to search for and use secondary data, since the limited resources did not allow for collection of primary data, in particular not in sectors such as hydropower, irrigation and oil development, all characterized by limited data access or availability. Thus all data used is from secondary sources.

3.0ESTIMATION OF THE ECONOMIC VALUE OF WATER FOR IRRIGATED RICE

The methodology already developed and tested[3] uses the change in net income between cultivating a rain-fed crop and an irrigated crop (rain-fed maize and irrigated sugarcane as an example). The methodology uses economic and not financial values in order to express the value to society and not to individuals. The economic value of water is expressed as the annual economic change in net income by shifting to irrigated crop production divided by the total volume of irrigated water used.
The potential for wetland development through irrigation in Uganda is well acknowledged[4] and since wetland irrigation is a key element in water resources development which potentially could create competition for water with hydropower development, this is a highly relevant case for estimating the economic value of water. Wetland irrigation is applied in wetlands with no former agricultural activity, therefore the net income from rain-fed crop production is assumed to be zero. Wetland irrigation is typically based on establishing dykes where water flows by gravity to the field through opening the dyke. Rice is

[1]Aylward, B., et al, 2010. *The Economic Value of Water for Agricultural, Domestic and Industrial Uses: A Global Compilation of Economic Studies and Market Prices.*

[2] Aylward, B. et al, 2010. Op cit.

[3]The Value of Water for Irrigated Paddy and Hydropower Generation in the Great Ruaha Tanzania 2002-04"is part of "Raising irrigation productivity and releasing water for inter-sectorneeds" project research implementedby Overseas Development Group, University of East Anglia, Sokoine University of Agriculture in Tanzania and The International water Management Institute in South Africa

[4]A national Irrigation Master Plan for Uganda 2010-2035

considered to be representative of a wetland crop because it is a major crop already grown under irrigation including wetland in Uganda.
Table 1 provides an estimated yield per ha of milled rice and an estimated 2013 price in US$/kg thus resulting in an estimated revenue in US$/Ha.

Table 1: Estimated 2013 revenue from irrigated rice

Item	*Amount*
Revenue:	
a) Yield – milled (kg/ha)	3,200
b) Price (US $/kg)	1.0
Revenue(yield* price)-US$/Ha	**3,200**

Source: Computed from rice production data projections - Mr John Ogwang (unpublished)

Table 2 provides a summary of variable rice production costs under wetland irrigation divided into input and labour cost.

Table2: Estimated 2013 Production Costs for Irrigated Rice (US $/Ha)[5]

Item	**Production cost of irrigated rice, milled (US $/Ha)**
1. Inputs	
a) Knapsack	200
b) Seed	25
c) Fertilizer:	
i) DAP	375
ii) UREA	300
d) Bagging materials	20
e) Pesticides	15
f) Fungicides	12
g) Tarpaulins	80
Sub-Total	**1,027**
2. Labour	
a) Land Clearance	240
b) Irrigation canal opening/clearing	24
c) Land Preparation	320
d) Nursery bed preparation & mgmt.	24
e) Fertilizer application	10
f) Transplanting	200
g) Irrigation water mgmt.	100
h) First weeding	120
i) Top dressing fertilizer application	10
j) Second weeding	96

[5] Exchange rate was estimated at 1 US $ = UGX 2,500

k) Pest & disease control	12
l) Bird scaring	150
m) Harvesting & threshing	120
n) Transportation	50
o) Milling	200
Sub Total	**1,676**
PRODUCTION COSTS	**2,703**

Source: Computed from rice production data projections - Mr John Ogwang (unpublished)

Capital costs for wetland irrigation includes land and establishment of dykes.

The following assumptions are made:

e) *Establishment of dykes. It is assumed that the investment expenditure related to the establishment of dykes per Ha is 3000 US$, that the physical lifetime of a dyke is 10 years, and that a loan can be amortized in 10 years at an annual interest rate of 8%.*
f) *The price of rice as well as all input and labour prices are assumed to be economic prices.*
g) *The cost of land has not been included in the calculations.*
h) *The amount of consumptive water use is calculated based on a growing season of 120 days, a net irrigation demand of 250 mm (which has taken into account the effective rainfall), and an irrigation efficiency of 50% (based on 60% field efficiency and 85% conveyance efficiency), resulting in 5000 m3 per hectare per harvest.*

The net income per Ha is calculated in Table 3 and with the estimated amount of irrigation water applied the economic value of water is calculated as an average value per m3 consumptive water. The estimated economic value of water for irrigation of 0.05 US$ is expressed as an average productivity figure in changing from a production system based on rain-fed cropping (here a zero base) to an irrigated cropping system.

Table 3: Estimated 2013 change in net income from irrigated rice and economic value of water - (US $/Ha)

Item	Irrigated rice production
1. Revenues(US$/Ha) – based on two harvests per year	6,400
2. Production cost (US $/Ha) – based on two harvests per year	5,403
3. Capital expenditure cost-annualised (US$/Ha)	447
4. Net income (US $/Ha): (1)-(2)-(3)	550
5. Amount of irrigated water used (m3/ Ha)	**10000**
Economic value of water -US$/m3: (4:5)	**0.05 US$**

Source: Computed from rice production data projections - Mr John Ogwang (unpublished)

4.0 ESTIMATION OF THE ECONOMIC VALUE OF WATER FOR HYDROPOWER GENERATION

According to Uganda's Hydropower Masterplan, the rate of increase for power demand in the country is estimated at 8-10% per year. This is against a background of chronic power supply deficits attributed mainly to low availability of power infrastructure. Even with the available infrastructure, production is still

below installed capacity. Actual power generation at the Kiira and Nalubale facilities was estimated at 140-200 MW compared to installed capacity of 409MW, while output at Bujagali is estimated at around 150 MW although the facility has installed capacity of 250 MW. This is mainly due to below average Victoria Nile flows because of low Lake Victoria levels in recent years.

The secondary data utilized to assess the economic value of water for hydropower generation is based on Bujagali II[6] which has been the only recent hydropower study available with relevant economic and financial data. The following assumptions have been utilized:

- The estimated 2007 investment cost of 534.6 million US$ has been inflated by an annual 6% growth rate to an amount of 758.3 milllion US$ in 2013.
- The hydropower plant has an installed capacity of 250 MW-the power generation is calculated at a basis of 5000 hours per year amounting to 1250 Gwh.
- The amount of water discharge through the turbines has been estimated at 865m3/second corresponding to an average discharge for the period 1896-2008 (according to the Hydropower Master Plan).
- The economic price of electricity is based on a willingness to pay for electricity by industrial and commercial customers which are considered to be the largest demand segment. A 2005 willingness to pay amount of 0.125 US$/kWh has been inflated by an annual growth rate of 6% to an amount of 0.199 US$/kwh in 2013.
- An annual amount estimated at 3% of the total investment cost is allocated for operation, maintenance cost, management and administration cost.
- The annualized investment cost has been calculated based on the total investment cost of 758.5 million US$, a physical life time of the hydropower plant of 25 years and an annual interest rate of 6%.
- The financing cost during construction has not been included.

Based on these assumptions Table 4 estimates the economic value of water for hydropower production.

Table 4 Estimated economic value of water used for hydropower production (2013 prices)

	Hydropower
Gross revenue from hydropower generation-million USD	**237.5**
Electricity generation, Gwh	1250
Economic price per kWh of electricity	0.19
Variable generation cost-million USD	
Operation, maintenance, management and administration cost	22.8
Capital cost-million USD	
Total investment cost	758.3
Annualised investment cost	59.3
Physical life time, years	25
Annual interest rate, percentage	6
Total annual variable and investment cost-million USD	**82.1**
Total net income-million USD	**155.4**
Economic value per m3 of water discharged through turbines-US$/m3	0.005

[6]International Finance Corporation: Bujagali II, Economic and Financial Evaluation Study, Final Report, February 2007.

Million m3 of water through turbines annually (1896-2008 average)	27,278

Source: International Finance Corporation: Bujagali II, Economic and Financial Evaluation Study, Final Report, February 2007.

The economic value of water for hydropower production estimated at 0.005 US$/m3 is a productivity measure based on average non-consumptive water use (water discharged through the turbines). In other similar studies (i.e. Tanzania and Zambia) the economic value of water for hydropower production has been estimated also on a consumptive basis where the evaporation from the hydropower dam has been calculated. In the case of Uganda the hydropower plants operate as run-of-the-river facilities using Lake Victoria as the primary "reservoir". Evaporation losses from the small reservoirs created by the respective dams are small but nevertheless occur. Thus an estimate of the consumptive economic value of water remains as an outstanding issue in comparing inter-sector economic values.

A concrete water conflict between hydropower and for example upstream irrigation will need to carefully take into account all local conditions in estimating the economic value of water as an input for allocating scarce water resources. For example, a hypothetical irrigation facility located between Bujugali and Kiira would potentially create a water conflict between irrigation and Bujugali only. In that case, the economic value of water for hydropower should be based on Bujugali hydropower production only.

5.0 ESTIMATION OF THE ECONOMIC VALUE OF WATER USED FOR OIL PRODUCTION

As a final illustrative example the economic value of water used in oil production has been estimated. The oil industry is using consumptive water for well development, for central processing facilities, and for oil refinery. Consumptive water use related to the central processing facility is minimal and has therefore been left out in the following estimation.

Again it should be noted that the economic value of water used for oil production is not based on any current water conflict with other sectors in a specific catchment. Nevertheless, the methodology used is similar to estimating the economic value of water for hydropower production, and would represent a step towards resolving a potential water conflict between competing sectors.

The main assumptions are:

- An estimated total investment cost of 10 billion US$ (including development, central processing and refinery cost).
- The average daily refinery production is assumed to be 90,000 barrels of oil based on four phases with daily production level of 60,000, 90,000, 120,000 and 180,000 barrels respectively.
- The amount of consumptive water use, almost all of which will be abstracted from Lake Albert or the Albert Nile, has been estimated at an annual level of 18 million m3 (8 million m3 for well development and 10 million for oil refinery).
- The economic price of oil has been estimated at the level of an international oil price of 100 US$ per barrel.
- An annual amount estimated at 10% of the total investment cost is allocated for operation, maintenance cost, management and administration cost.
- The annualized investment cost has been calculated based on the total investment cost of 10 billion US$, a physical life time of the facilities of 25 years and an annual interest rate of 6%.
- The financing cost during construction has not been included.

Based on these assumptions Table 4 estimates the economic value of water for oil production.

Table 4 Estimated economic value of water used for oil production (2013 prices)

	Hydropower
Gross revenue from oil development and refinery-million USD	**3,285**
Annual number of barrels produced (90,000 per day)	32,850,000
Economic price per barrel USD	100
Variable generation cost-million USD	
Operation, maintenance, management and administration cost	1000
Capital cost-million USD	
Total investment cost	10,000
Annualised investment cost	782.7
Physical life time, years	25
Annual interest rate, percentage	6
Total annual variable and investment cost-million USD	**1782.7**
Total net income-million USD	**1502.3**
Economic value per m3 of consumptive water	83.4
Million m3 of consumptive water	18

Source: Consultants' calculations based on data provided by Petroleum Exploration & Production Department (PEPD) under Ministry of Energy and Mineral Development

The economic value of consumptive water for oil production is a productivity measure based on estimated net income per average consumptive water use. With a relatively small consumptive water use the estimated economic value of water per m3 is bound to be high and in this case as high as 83 US$/m3.

6.0 TOURISM AND FISHERY

Tourism and fishery are sectors which often compete for non-consumptive water resources. Water allocation between the two sectors is difficult from a methodological point of view. It may be relatively easy to estimate the change in net income for tourism and fishery but the difficulty is that in order to harvest the full economic potential both sectors require access to the entire water environment for example a lake. The idea of allocating non-consumptive water between the two sectors is therefore often not attractive for any of the sectors and the question also would be how to divide the non-consumptive quantity of water. The economic value of water of water as a concept for water allocation becomes less useful in a situation where two sectors both require full access to the water environment and where sharing the environment would imply a reduced or even non-attractive economic benefit for both sectors.

The solution to such a problem is therefore an overall economic and environmental assessment taking all parameters into account prior to deciding the use of the lake or the water environment. In case of a large comnflict this can be achieved by a cost benefit analysis including an assessment of employment impact and environmental impact analysis. For smaller and less complicated conflicts local authorities should be active in finding solutions

7.0 CONCLUDING REMARKS

The change in net income method calculates only average values and not marginal values of water and therefore is not fully suitable for decision making on cross-sectoral water allocation. Ideally, estimating the marginal values of water requires the use of optimization models such as general equilibrium models, which assumes the availability of a large amount of data.

General equilibrium models are also suitable for complex situations involving cross-country water allocation questions with focus on several sectors and use of multiple water sources. The general equilibrium model is developed with the objective of assessing the impact of changes to water allocation and investments in water management infrastructure on the overall economic welfare of the country.

The World Bank has identified 16 river basins (including the Nile River Basin) where a general equilibrium model could be relevant to develop. Currently the Basin Economic Allocation Model (BEAM) is being developed as a decision support system to facilitate putting an economic value on water. The model estimates welfare changes associated with changes in water allocation between Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. The model addresses the Aral Sea basin as a whole covering five sectors: agriculture, hydropower, nature, households and industry.

The experience from the development of BEAM would be relevant for all Nile River Basin countries including Uganda. The current effort at the level of MFPED to develop the Uganda Integrated Macro-economic Model (Computable General Equilibrium Model) would, if successful,be important in relation to any development during the strategy period of an economic cum water allocation model such as BEAM.

Annex 5: Key implementation projects and programs

Water resources availability for use (see also section 6.1.1) Output 1: Beneficial use of the available water resources enhanced	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM in collaboration with key water-dependent sector representatives. DWRM is accountable to the Minister of Water & Environment and advised by the Water Policy Committee
Planning/designing the implementation	Water Policy and associated legislation/regulations are in place, but stricter enforcement and compliance need to be a priority, nationally. Implementation period will be long and perhaps several years depending on resource input. Efforts will continue with lower intensity and at operational levels.
Resource management	Enforcement requires many field checks both by water quality specialists and hydrologists putting strain on DWRM qualified staff resources and transport logistics. Legal assistance has to be contracted in case of sanctions, fines and penalties.
Risk management and assumptions	Major risks are lack of collaboration from water users and wastewater dischargers neglecting environmental values
Stakeholder engagement	Improved awareness raising on regulations among water users and wastewater dischargers
Review, monitoring and evaluation	Results monitoring can include “increase in numbers of permits and revenue”,

Management of water quality (see also section 6.1.2) Output 2: Wholesome drinking water sources safeguarded and the quality of water bodies kept within limits defined by water quality objectives	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM in collaboration with DWD and DEA. DWRM is accountable to the Minister of Water & Environment and advised by the Water Policy Committee
Planning/designing the implementation	Protection of groundwater sources, spring sources and surface water sources need to be improved to comply with design guidelines and sanitary waste and other pollutants need to be under control. Water quality objectives need to be defined for all surface water bodies and assessment skills improved. Implementation has national scope, but starts at hot-spots.
Resource management	Check of protection requires many field trips both by water quality specialists and hydrologists putting strain on DWRM qualified staff resources and transport logistics. Laboratory capacity has to be taken into account in the campaign designs. DWD staff resources must assist regarding water supply sources and DOE to assist on water quality objectives.
Risk management and assumptions	Lack of staff resources and poor logistics, lack of funds for improvements, costs of improvements not covered by communities in rural areas, changes in minimum flows due to climate change
Stakeholder engagement	Awareness raising on sources protection and wholesome water supply among broad stakeholder groups
Review, monitoring and evaluation	Results monitoring through “health statistics” and water quality sampling

Integrated land and water management (see also section 6.1.3) Output 3: Catchments managed effectively	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM in collaboration with WMZs and Catchment Management Authorities, (when operational) facilitates, while MAAIF is the lead Ministry in cooperation with forestry authorities
Governance and accountability	DWRM in collaboration with DEA and directed by MAAIF. Water Policy Committee to play an advisory role. MAAIF is accountable to the Minister of Agriculture
Planning/designing the implementation	Develop land use plans, promote sustainable agricultural practices and protect vulnerable lands according to the results of a scoping exercise (hot-spots). Develop incentives for the individual farmers to buy into sustainable land management practices.
Resource management	The key to implementation is mobilization of farmers and communities who will have to do the largest amount of work guided by MAAIF and MWE.
Risk management and assumptions	Inadequate buy-in from partners, farmers and communities for changing practices and implementing small scale infrastructure
Stakeholder engagement	Awareness raising on sustainable land management and associated agricultural practices
Review, monitoring and evaluation	Monitoring of arresting erosion and sedimentation

Integrated land and water management (see also section 6.1.3) Output 4: Ecosystem delivery of goods and services that protect water resources sustained or enhanced	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM in collaboration with WMZs and Catchment Management Authorities, (when operational) facilitates, while MAAIF is the lead Ministry in cooperation with forestry authorities
Governance and accountability	DWRM in collaboration with DEA and directed by MAAIF. Water Policy Committee to play an advisory role. MAAIF is accountable to the Minister of Agriculture
Planning/designing the implementation	Planning for sustainable forest management, conservation of wetland resources, protect riverbanks and lakeshores and develop incentives for sustaining ecosystem goods and services
Resource management	Requirements for staff and specialists are large as the scope is catchment-wide (selected priority catchments) and as field work and mobilization of farmers and communities is essential for success. Funds for implementation works, reforestation, vegetation at riverbanks etc. will be needed.
Risk management and assumptions	Inadequate buy-in from partners and communities for ecosystem protection
Stakeholder engagement	Awareness raising on ecosystem usefulness and mobilization of support from stakeholder groups
Review, monitoring and evaluation	Monitoring of implementation of collaborative interventions and works

Water demand management (see also section 6.1.4) Output 5: End-use efficiencies increased	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides project/program management in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM leads and facilitates the work of water supply authorities, Ministry of Trade, Industry and Cooperatives, Ministry of Agriculture, Animal Industry and Fisheries, Ministry of Energy and Mineral Development. DWRM is accountable to Ministry of Water and Environment. Water Policy Committee can play an advisory role.
Planning/designing the implementation	Planning will take place within three areas, 1) introduction of water efficient technologies, 2) behavioral changes, 3) pricing and rate structures encouraging water efficiency. Standards and benchmarks will be developed and applied during implementation.
Resource management	Major water users will be targeted first and will introduce water efficient technologies while ultimately all water users will be targeted by awareness campaigns and tariff structures. DWRM's needs resources to facilitate, raise awareness and develop tariffs, while water users are encouraged to change behavior and introduce water efficient technologies.
Risk management and assumptions	Institutional and individual water users do not gain sufficient understanding of the need for water use efficiency.
Stakeholder engagement	Institutional and individual stakeholders need to be mobilized through awareness campaigns and financial incentives.
Review, monitoring and evaluation	Monitoring of institutional and individual water use reductions

Water demand management (see also section 6.1.4) Output 6: Water resources allocated to higher value economic activities	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM is lead and Water Policy Committee advises. DWRM is accountable towards the Ministry of Water and Environment.
Planning/designing the implementation	Implementation includes modeling tools for assessing the economic value of water in all water-dependent sectors. Allocation according to high economic value is only one allocation criteria among many others, such as equity, food security, social policies, environment and rural and urban development.
Resource management	DWRM regulation staff and specialist advisers for allocation criteria
Risk management and assumptions	The risk of allocation being seen as unfair must be avoided
Stakeholder engagement	Key water dependent sector should be consulted and trials of model application should be made.
Review, monitoring and evaluation	Monitoring of number of permits issued with high economic value as a key criteria.

Water resources information, planning and capacity (see also section 6.1.5) Output7: Water information system (WIS) established and operational at WMZ and national level	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM is lead and Water Policy Committee advises. DWRM is accountable towards the Ministry of Water and Environment.
Planning/designing the implementation	Implementation will include, hydrologic information system, spatial data system, information management system, knowledge management system and data dissemination system. These combines with analytic tools.
Resource management	Existing software systems have to be purchased and maintained.
Risk management and assumptions	Staff trained in use of the system are leaving DWRM/WMZ
Stakeholder engagement	Key users of information will have to be consulted on their needs and preferences
Review, monitoring and evaluation	Monitoring of the function and use of the water information system

Water resources information, planning and capacity (see also section 6.1.5) Output8: General water resources knowledge base expanded and integrated into a Water information system	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM is lead and Water Policy Committee advises. DWRM is accountable towards the Ministry of Water and Environment. Partners within land use, soils, geology, rangelands, ecology etc. cooperate in data provision and interpretation.
Planning/designing the implementation	Establish spatial data layers on factors influencing hydrology and water bodies. Prepare water quality and environmental objectives.
Resource management	Staff resources and data transfer capabilities required
Risk management and assumptions	Lack of provision of data from partners
Stakeholder engagement	Partners need to be convinced that the knowledge base is also useful for them
Review, monitoring and evaluation	Monitoring of population of knowledge base

Climate change adaptation (see also section 6.2.1) Output 9: Reduced vulnerability to warmer climate conditions	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control
Governance and accountability	DWRM leads and facilitates dialogues and the work of partners/key stakeholders. Water Policy Committee advises. DWRM is accountable towards Ministry of Water and Environment. Key partners are found mainly within hydropower, agriculture, fisheries, environment, lake transport, health etc.
Planning/designing the implementation	Implementation includes vulnerability and risk mapping, hot-spot interventions, drought preparedness plans, water storage and rainwater harvesting, land and water management, seasonality and adjustment of water demand assessments to higher anticipated temperatures
Resource management	Preparedness is a cross-sectoral issue that requires work by qualified staff from all key partners

Risk management and assumptions	Uncertainty in forecasts for a warmer climate
Stakeholder engagement	The sectors are interdependent and all key partners must be heavily involved
Review, monitoring and evaluation	Monitoring of temperature against expected temperature
Climate change adaptation (see also section 6.2.2) Output 10: Reduced vulnerability to severe rainstorms	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control
Governance and accountability	DWRM leads and cooperates with urban/municipal authorities on stormwater, Ministry of Works and Transport, Ministry of Agriculture, Animal Industry and Fisheries and others on effects of more severe rainstorms.
Planning/designing the implementation	Implementation includes review of flood frequency curves, revised guidelines for stormwater drainage, dam safety, soil conservation and sanitary facilities
Resource management	Qualified staff from all partners will assist DWRM and approve guidelines etc.
Risk management and assumptions	Rainstorm estimates uncertain
Stakeholder engagement	All key partners must be heavily involved
Review, monitoring and evaluation	Monitoring of rainfall frequencies

Climate change adaptation (see also section 6.2.3) Output 11: Preparedness for higher variability of lake levels achieved	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control
Governance and accountability	DWRM leads and facilitates dialogues and the work of partners/key stakeholders. Water Policy Committee advises. DWRM is accountable towards Ministry of Water and Environment. Key partners are found mainly within hydropower, agriculture, fisheries, environment, lake transport etc. Upstream riparian states are also key stakeholders.
Planning/designing the implementation	Implementation will include, climatic trends and seasonality, climate impact assessment, policy dialogue implications and reactions, efficient water use in upstream riparian states and cooperation with the Nile Basin Initiative
Resource management	Specialists on downscaling of climate trends required as well as IT staff to produce a Lake Vic water balance and lake level model. Staff resources from each Lake-dependent sector will have to assess the impacts and the need for preparedness.
Risk management and assumptions	Uncertainty in climate trends
Stakeholder engagement	Sectors which are dependent on lake levels and outflows are key stakeholders and need to be engaged
Review, monitoring and evaluation	Monitoring of lake levels against expected/calculated levels

Climate change adaptation (see also section 6.2.4) Output 12: Effective flood management achieved	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control
Governance and accountability	DWRM leads and cooperates with Ministry of Works and Transport, Ministry of Agriculture, Animal Industry and Fisheries, wetland authorities and others on mitigation of flood risks
Planning/designing the implementation	Implementation includes flood plain zoning, protection of upland catchments, afforestation, wetlands management, flood warnings and disaster risk management.
Resource management	Qualified staff from all partners will assist DWRM
Risk management and assumptions	Flood estimates uncertain

Stakeholder engagement	All key partners must be heavily involved
Review, monitoring and evaluation	Monitoring of reduction of flood fatalities and damages

Strengthening policy and legal framework for water resources management (see also section 6.3.1) Output 13: Effective legal and policy framework for water resources management	
Implementation concepts	Observations and actions
Management control and project/program management	To be completed by DWRM
Governance and accountability	Idem
Planning/designing the implementation	Idem
Resource management	Idem
Risk management and assumptions	Idem
Stakeholder engagement	Idem
Review, monitoring and evaluation	Idem

Strengthening institutional capacity for water resources management (see also section 6.3.2) Output 14: Effective institutional framework for water resources management	
Implementation concepts	Observations and actions
Management control and project/program management	To be completed by DWRM
Governance and accountability	Idem
Planning/designing the implementation	Idem
Resource management	Idem
Risk management and assumptions	Idem
Stakeholder engagement	Idem
Review, monitoring and evaluation	Idem

Strengthening institutional capacity for water resources management (see also section 6.3.2) Output 15: Improved institutional performance	
Implementation concepts	Observations and actions
Management control and project/program management	To be completed by DWRM
Governance and accountability	Idem
Planning/designing the implementation	Idem
Resource management	Idem
Risk management and assumptions	Idem
Stakeholder engagement	Idem
Review, monitoring and evaluation	Idem

Strengthening institutional capacity for water resources management (see also section 6.3.2) Output 16: Effective water resources planning, monitoring, and communication for the sub-sector	
Implementation concepts	Observations and actions
Management control and project/program management	To be completed by DWRM
Governance and accountability	Idem
Planning/designing the implementation	Idem
Resource management	Idem
Risk management and assumptions	Idem
Stakeholder engagement	Idem

Review, monitoring and evaluation	Idem

Strengthening coordination mechanisms for water resources management (see also section 6.3.3) Output 17: Effective coordination and collaboration mechanisms for water resources management at all levels	
Implementation concepts	Observations and actions
Management control and project/program management	To be completed by DWRM
Governance and accountability	Idem
Planning/designing the implementation	Idem
Resource management	Idem
Risk management and assumptions	Idem
Stakeholder engagement	Idem
Review, monitoring and evaluation	Idem

Strengthening coordination mechanisms for water resources management (see also section 6.3.2) Output 18: Effective institutional collaboration and participation	
Implementation concepts	Observations and actions
Management control and project/program management	To be completed by DWRM
Governance and accountability	Idem
Planning/designing the implementation	Idem
Resource management	Idem
Risk management and assumptions	Idem
Stakeholder engagement	Idem
Review, monitoring and evaluation	Idem

Financing of water resources management (see also section 6.3.4) Output 19: Improved levels and sustainability of funding for water resources management	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM is lead and accountable towards Ministry of Water and Environment
Planning/designing the implementation	Enforce water abstraction and wastewater discharge regulations and gradually increase revenue from present and additional license owners
Resource management	A national license campaign require considerable staff resources and logistic support
Risk management and assumptions	Water users are reluctant to accept higher charges and enforcing becomes difficult
Stakeholder engagement	Water user must be made aware of the usefulness of an efficient water resources management organization (DWRM, WMZs, Catchments)
Review, monitoring and evaluation	Monitoring of increase in revenue

Financing of water resources management (see also section 6.3.4) Output20: CMOs and SCMOs able to cover preparation of catchment management plans and in the longer term also a significant part of their operational and development funds	
Implementation concepts	Observations and actions
Management control and project/program management	DWRM provides management control in collaboration with WMZs and Catchment Management Authorities, (when operational)
Governance and accountability	DWRM is lead and accountable towards Ministry of Water and Environment
Planning/designing the implementation	Enforce water abstraction and wastewater discharge regulations and gradually increase revenue from present and additional license owners and use part of the revenue to finance the operations of Catchment Management Organisations and Sub-catchment Organisations.
Resource management	A national license campaign require considerable staff resources and logistic support
Risk management and assumptions	Water users are reluctant to accept higher charges and enforcing becomes difficult.
Stakeholder engagement	Water user must be made aware of the usefulness of an efficient water resources management organization (DWRM, WMZs, Catchments)
Review, monitoring and evaluation	Monitoring of increase in revenue

Annex 6: Activity Schedule for 2014-2019

The action schedule for first 5 years is presented under each objective and corresponding Output. The timing for each intervention takes into account priorities and chronological sequence of related activities. However, it is anticipated that funding will also influence the timing for implementing particular interventions.

For each intervention, implementation lead and collaborating or participating institution is proposed. The lead role is proposed based on mandate.

Note: DWD = Directorate of Water Development, DWM = Directorate of Water Resources Management; WDM = Wetlands Management Department; NEMA = National Environment Management Authority; MoFA = Ministry of Foreign Affairs; MAAIF = Ministry of Agriculture, Animal Industry and Fisheries; MEMD = Ministry of Minerals and Energy Development ; NGOs = Non-Government Organizations; CSO = Civil Society Organizations; NWSC = National Water and Sewerage Corporation; CMOs = Catchment Management Organizations; SCMO= Sub-Catchment Management Organizations; MoH= Ministry of Health; R&D = Research and Development Organizations; DOM= Department of Metrological; MoPS= Ministry of Public Service; MoFPED= Ministry of Finance, Planning and Economic Development; OPM = Office of the Prime Minister; MoWT = Ministry of Works and Transport; UCPC= Uganda Clean Production Centre; UNBS = Uganda National Bureau of Standards; MOJCA = Ministry of Justice and Constitutional Affairs

The tables below present the framework for the activity schedule for 2014-2019, which will be filled out by DWRM.

Objective/ Strategy	**Outputs**	**Intervention/activity**	**Lead Role**	**Participation role**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19**
Objective 1: Ensure sustainable and equitable allocation and provision of water of appropriate quantity and quality									
Water resources availability for use	Beneficial uses of the available water resources enhanced	Improve domestic water supply from a combination of surface and groundwater sources, and rainwater harvesting (also see Management of Water Quality)	DWD	DWRM, NGOS/CSOS					
		Develop high-value water projects in accordance with IWRM principles.	DWRM	DWD NWSC, NEMA, DEA,URBAN AUTHORITIES, MEMD, MAAIF					
		Develop irrigation potential in phases subject to better information on affected wetlands and in accordance with IWRM principles	MAAIF	DWRM, NEMA WMD					
		Prepare and implement catchment management plans, starting with priority catchments	DWRM	NGOS, DISTRICTS, DWD, CMOs, WMD					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
		Continue engagement with Nile partners on equitable use of the Nile waters and their benefits	MWE/DWRM	MoFA, MOJCA					
Management of Water Quality	Wholesome drinking water sources safeguarded and the quality of surface and underground water resources kept within limits defined by water quality objectives.	Establish proper sanitation facilities and protected drinking water sources for rural and urban populations	DWD, DISTRICTS, URBAN AUTHORITIES	NGOs, MoH, DWRM					
		Reduce the amounts of point and non-point pollutants reaching surface and underground water resources and bodies.	DWRM NEMA DISTRICTS,	NGOs/CSOs, CMOs, URBAN AUTHORITIES					
		Reduce risk of environmental damage and water quality deterioration from oil exploitation	NEMA, DWRM	MEMD, NGOS/CSOs, OIL companies					
		Protect environmental flows in rivers	DWRM NEMA WMD	DISTRICTS, NGOS/CSOs,					
		Promote conservation and wise use of wetlands	WMD, DISTRICTS, NEMA	NGOS/CSOs					
		Develop water quality objectives	DWRM	NEMA					
		Further develop water quality monitoring and assessment capacity	DWRM	NEMA					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
		Enforce and monitor compliance with water quality standards and source protection guidelines	DWRM	NEMA, DISTRICTS					
Integrated land and water management	Catchments effectively managed.	Integrate land management into catchment management plans	DWRM	NFA,UWA, DISTRICTS, MAAIF, MLHUD					
		Promote appropriate agricultural practices	MAAIF	NARO, NGOS/CSOs, R&D AGENCIES					
		Develop and apply incentives to improve adoption of sustainable land management practices	MAAIF NARO	DISTRICTS. MLHUD					
		Promote better understanding of the intrinsic relationship between water and land management, and the inter-linkages of the agriculture and water sectors	DWRM	NEMA, MAAIF					
		Prepare land degradation and vulnerability maps, starting with selected hotspots	DWRM	NEMA, DOM, DISTRICTS					
		Implement targeted interventions in priority (hotspots)	DWRM	DISTRICTS, NEMA					
	Ecosystem delivery of goods and services that protect water resources	Promote sustainable forest management and conservation and wise use of wetland resources (ref: management of water quality)	NFA, FSSD, WMD, DISTRICTS	UWA, NEMA, DEA, NGOs/CSOs					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
	sustained or enhanced.	Protect riverbanks and lakeshores	NEMA	DISTRICTS					
		Promote incentives for sustaining ecosystem goods and services	NEMA	NGOs/CSOs, NFA, UWA, WMD, DWRM					
		Strengthen enforcement and compliance function in relation to water resources protection	DWRM	NEMA, DISTRICTS					
Water demand management	End-use efficiencies increased	Raise awareness about the importance of water conservation	DWRM	NGOs/ CSOs, DISTRICTS, NEMA, DWD					
		Ensure compliance with water abstraction permits through monitoring.	DWRM	DWD, NWSC; WATER AUTHORITIES					
		Develop pricing policies that encourage efficient water use	DWRM	DWD, NEMA, NWSC					
		Set water use efficiency standards	DWRM	DWD, NWSC, UNBS					
		Encourage adoption of water use efficient technologies	DWRM	DWD, UCPC					
	Water resources allocated to high value economic activities.	Develop a set of standard tools for estimating the economic value of water for various development options at catchment or local level	DWRM	NEMA, MoFPED, NPA					
		Develop a general equilibrium model to estimate overall economic changes associated with changes in water allocation for use at national level.	DWRM	NEMA, MOFPED, NPA					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
Water resources information, planning, and capacity	Water Information System (WIS) established and operational at WMZ and national level.	Rationalize and modernize the hydrometric monitoring network for surface and groundwater, and water quality	DWRM	MAAIF					
		Prepare a harmonized and integrated water resources data management system	DWRM	DWD					
		Develop modeling and analysis tools, integrated into the WIS	DWRM	DWD, NEMA, NGOs/CSOs					
		Prepare information dissemination mechanisms including visualization and web-publishing tools	DWRM						
	General water resources knowledge base expanded and integrated into a Water Information System	Establish cooperation with partners for the acquisition and/or development of various spatial and non-spatial data sets	DWRM						
		Initiate development of important information sets that are currently absent	DWRM						

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
Objective 2: Mitigate the effects of extreme climatic events									
Reduce Vulnerability to Warmer Climate condition s	Reduced Vulnerability to Warmer Climate conditions	Prepare climate change vulnerability assessments and risk maps at national and catchment level	DOM	NEMA, DWRM					
		Develop effective drought preparedness plans at national and catchment level	DOM	NEMA, OPM, DWRM					
		Expand water storage capacity	DWD	DWRM, DISTRICTS, NGOs/CSOs					
		Strengthen cooperation with MAAIF and other partners in integrated land and water management	DWRM	MAAIF					
		Improve seasonal climate outlook	DOM	NEMA, DWRM, CSOs/NGOs, DISTRICTS, MAAIF					
Reduce Vulnerability to more severe rainstorms	Reduced Vulnerability to more severe rainstorms	Improve catchment land management practices	DWRM	NFA, UWA, DISTRICTS, NEMA					
		Strengthen urban planning and management of storm-water runoff	DWRM, URBAN AUTHO RITIES, KCCA						

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
		Promote measures to improve dam safety, taking into consideration more intense rainstorms	DWRM	MEMD					
		Improve and elevate sanitation facilities in the floodplain and flood prone areas	DWD	DWRM, DISTRICTS					
		Review flood frequency curves and adjust these to more intense rainstorms and flood events	DWRM						
Reduce Vulnerability to increased hydrologic variability	Preparedness for higher variability of Lake levels	Establish capacity for monitoring long-term climate trends	DOM	NEMA					
		Establish capacity for climate change impact assessment , with special attention to lake Victoria	DWRM	NEMA					
		Inform and support policy dialogue on the implications of climatic change with special attention to lake Victoria	NEMA	DWRM, DOM, DWD, NWSC					
Effective Flood Management of the Floodplains	Effective flood risk management	Prepare flood mitigation and prevention plans in the context of the entire river basin	DWRM	DWD, NEMA, DISTRICTS, WMD					
		Develop floodplain zoning and reach community buy-in	DWRM	DISTRICTS					
		Protect the upland catchments	DISTRICT, NFA, UWA	NEMA					
		Protect and manage wetlands	WMD, DISTRICTS	NEMA					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
		Review and strengthen hydro-meteorological monitoring capacity	WRM	DOM					
		Establish flood forecasting and early-warning systems	DWRM	DOM, OPM					
		Develop flood-related disaster management plans	OPM	DOM, DWRM					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
Objective 3: Strengthening the water governance framework									
Strengthen policy and legal framework for water resources management	Effective regulation of water resources	Harmonize legal mandates (Land Act, Wildlife Act, Forestry and Tree Planting Act, Public Health Act, etc)	WPC	NFA,UWA, URBAN AUTHORITIES, MLHUD					
		Strengthen measures for regulating water use at all levels	DWRM	DWD, DISTRICTS					
		Harmonize water legislation with international law principles	DWRM	NEMA					
		Strengthen Water Act	MWE	WPC					
	Effective policy measures for water resources management	Strengthen measures for regulating water use allocations to all sectors (including priority high value projects)	DWRM	WPC					
		Strengthen measures for improving water use efficiency (water harvesting and storage, utilization technologies.	DWRM	DWRM, DISTRICTS, NEMA					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
Strengthen institutional capacities for water resources management	Improved institutional performance	Strengthen capacities for enforcing compliance with Water Act and Regulations and for monitoring compliance by water users, waste water and effluent discharge, mining activities, oil and gas activities, tourism, agriculture, water transport	DWRM	NEMA, DEA					
		Strengthen capacities for planning for water resource use and management at local, catchment and national levels	DWRM	DISTRICTS, DWD					
		Strengthen capacities for participating and benefitting from regional/international policy, planning and management of trans-boundary water resources under auspices of with EAC, AU, NBI, among others	DWRM	NEMA					
		Strengthen capacities for mobilizing resources for water resources management.	DWRM	MoFPED. MPS					
	Effective institutional collaboration and participation	Strengthen mechanisms for strengthening institutional collaboration and participation in water resources management by mandated institutions and stakeholders.	MWE	WPC					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
		Strengthen capacity for effective participation in trans-boundary water resources management processes, specifically, the EAC and NBI processes.	DWRM	NEMA					
		Harmonize institutional mandates of lead institutions (MoWE, WPC, DWRM, DWD NWSC, NEMA, Districts).	MPS	WPC					
		Strengthen functioning of WPC	MWE	WPC					
	Effective water resources planning, monitoring and communication for water subsector	Strengthen tools and capacities for planning and budgeting for water subsector	MWE	MoFPED, WPC					
		Strengthen Monitoring, Evaluation and reporting system and capacities for water subsector	MWE	WPC					
		Strengthen communication and outreach on water resources and subsector performance	MWE	DWRM, DWD, NEMA, NWSC, DISTRICTS, NGOs					
Strengthen financing of water resources management	Improved levels and sustainability of funding for water resources management	Strengthen capacity for attracting funding to the water sector from non-traditional sources (e.g., PES, Polluter Pays Principle)	MWE	DWRM, NEMA, MoFPED					
		Measures for value-for water tariffs	DWRM	MoFPED,					

Objective/ Strategy	Outputs	Intervention/activity	Lead Role	Participation role	2014/15	2015/16	2016/17	2017/18	2018/19
			NWSC						
		Measures for strengthen financing arrangements for CbWRM	DWRM	MoFPED, DISTRICTS					
		Measures for water revenue retention and use at source.	MoFPED	MWE, WPC					

d)

Annex 7: Monitoring and Evaluation Framework

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
Objective 1: Ensure sustainable and equitable allocation and provision of water of appropriate quantity and quality					
Water resources availability for use	Beneficial uses of the available water resources enhanced	i. Proportion of domestic water supply from surface, ground and rain water harvesting. ii. Levels of water use related conflicts emanating from high-value water projects. iii. Information/knowledge of irrigation potential of targeted/critical wetlands. iv. No. of Catchment Management Plans developed and implemented. v. Effective engagement with Nile partners. vi. Scope of benefits accruing to Uganda from Nile Cooperation and participation. vii. No and Size of projects under Nile Cooperation implemented in Uganda	i. Baseline survey reports ii. Field Observation iii. Records of Water Abstraction permits iv. Nile Basin Cooperation records and reports	DWRM	The Nile CFA is signed and ratified by all Nile Partners

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
Management of Water Quality	Wholesome drinking water sources safeguarded and the quality of surface and underground water resources kept within limits defined by water quality objectives.	i. Trends in cost of treating water for human consumption ii. Trends waterborne diseases and epidemics iii. Quality of consumed water	i. Departmental reports & budgets ii. Baseline Reports iii. Health monitoring reports iv. Water quality monitoring data/reports	DWD, NWSC, DWRM	N/A
Integrated land and water management	Catchments effectively managed	i. Improvements in vegetation cover and land use in priority catchments arising out of integrated land and water use management ii. Level of understanding the relationship between water and land management	i. Catchment management reports ii. Departmental and Districts monitoring reports iii. Field observations	NEMA, DISTRICTS, WMD	N/A
	Ecosystem delivery of goods and services that protect water resources sustained or enhanced.	i. Trends in quantity and quality of water released	ii. Water Abstraction monitoring reports	DWRM	N/A

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
Water demand management	End-use efficiencies increased	i. Efficient utilization of water resources (less water for equal or more outputs) ii. Compliance levels to abstraction permit and permit conditions	Water abstraction monitoring reports	DWRM	N/A
	Water resources allocated to higher value economic activities.	i. Access/supply of water high value economic activities on sustainable basis ii. Knowledge of economic value of water for various development options at catchment and local levels	i. Water Abstraction Permits ii. Approved EIAs iii. Technical reports	DWRM, NEMA	N/A
Water resources information, planning, and capacity	Water Information System (WIS) established and operational at WMZ and national level.	i. Effective WIS being applied at WMZ and DWRM headquarters ii. National water resources database	i. Database system and information at WMZ and DWRM ii. WIS Database	DWRM	N/A

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
Objective 2: Mitigate the effects of extreme climatic events					
Reduce Vulnerability to Warmer Climate conditions	Reduced Vulnerability to Warmer Climate conditions	i. Information on Climate Change vulnerability and risk at national and catchment levels ii. Drought preparedness Plans iii. National water storage capacity Institutional collaboration between MAAIF and MWE/WMD iv. Up to-date seasonal climate outlook	i. Technical reports ii. Departmental report	DWRM MAAIF, WMD	N/A
Reduce Vulnerability to more severe rainstorms	Reduced Vulnerability to more severe rainstorms	i. Levels of vulnerability to more severe rainstorms ii. Capacities for management of storm run for urban areas iii. Up to date flood frequency curves	i. Technical reports ii. Departmental report	DWRM, DWD, URBAN AUTHORITIES	N/A
Reduce Vulnerability to increased hydrologic variability	Preparedness for higher variability of Lake Levels achieved	i. Knowledge of long term climate trends Knowledge of climate change impacts on Lakes ii. Policy level responses to implications of climate change on Lake levels	i. Technical reports ii. Departmental report	MWE, DWRM, NEMA	N/A

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
Effective Flood risk management achieved	Effective flood management achieved	i. Flood mitigation and prevention measures ii. Capacities for managing flood related disasters	i. Technical reports ii. Departmental report	DWRM, NEMA, WMD	N/A

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
Objective 3: Strengthening the water governance framework					
Strengthen policy and legal framework for water resources management	Effective regulation of water resources	i. Harmonized legal instruments ii. Measures for regulating water use iii. Effective Water legislation	Legal Documents/Acts Technical Reports	WPC, MWE, DWRM	N/A
	Effective policy measures for water resources management	i. Measures for water resources allocation to high-value projects ii. Measures for water efficiency	Technical documents/reports	DWRM	N/A
Strengthen institutional capacities for water resources management	Improved institutional performance	i. Acceptable levels of compliance with Water and Regulations ii. Water resources management strategies and plans at all levels iii. Acceptable level of international cooperation iv. Level of Public sector funding	Technical Reports	DWRM	N/A
	Effective institutional collaboration and participation	i. Harmonized institutional mandates ii. Effective inter-agency cooperation and stakeholder collaboration iii. Effective WPC iv. Trans boundary collaboration	Technical Report Meeting records Field observation	DWRM	N/A

Monitoring and Evaluating Strategy implementation at Strategy and Output levels					
Strategy/ Output	**Output**	**Indicator(s)**	**MoV**	**Responsibility**	**Assumption**
		initiatives			
	Effective water resources planning, monitoring and communication for water subsector	i. Integrated Water sector plans and budgets ii. Integrated data/information on sector performance and impacts iii. Level of awareness of water resource issues	Water sector plans and budgets and reports Water sector M&E frameworks documents KAP in relation to water use	DWRM	N/A
Strengthen financing of water resources management	Improved levels and sustainability of funding for water resources management	i. Innovative funding measures in place ii. Value for money water tariffs iii. Levels of funding for CbWRM	Technical Reports Budgets and financial reports Tarrifs	DWRM	N/A