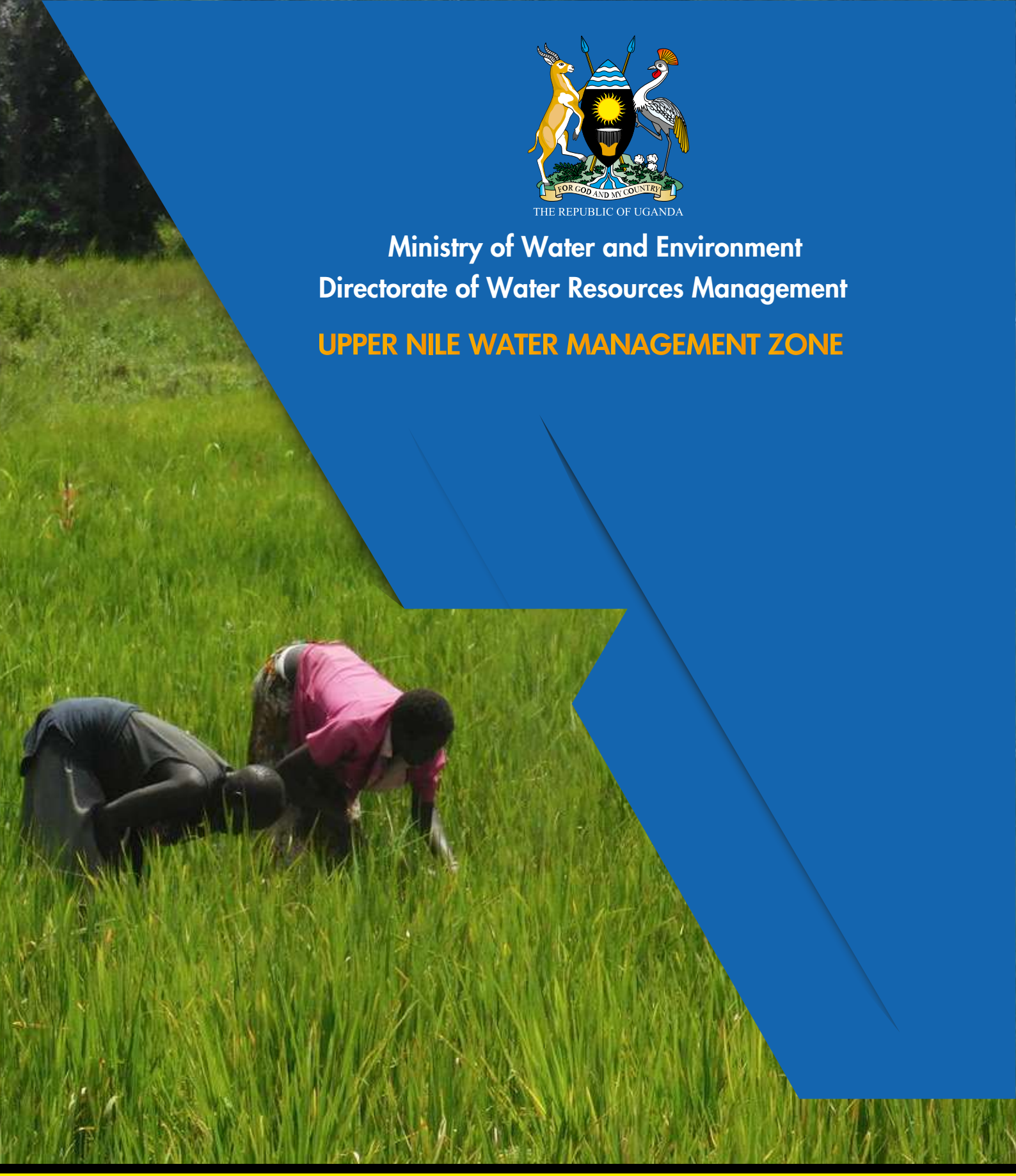
THE REPUBLIC OF UGANDA

Ministry of Water and Environment

Directorate of Water Resources Management

UPPER NILE WATER MANAGEMENT ZONE



Water Resources Development and Management Strategy and Action Plan

FOREWORD

Hon. Sam Cheptoris
Minister of Water and Environment
The Republic of Uganda

Water resources support key sectors of the economy namely hydropower generation, agriculture, fisheries, domestic water supply, industry, navigation etc. However, efficiency and sustainability of intervention under these sectors has recently been a concern in Uganda mainly due to inadequate sectoral collaboration in planning and implementation, increasing frequency of floods and droughts, environmental degradation and pollution of water resources. This situation therefore calls for development of mechanisms for promoting integrated planning, development and management of water resources so as to create synergy among various sectors, promote efficiency in utilization of available resources, reduce water and environmental degradation and ensure more efficient utilization of water resources to meet various social and economic demands.

In order to enact the Water Sector Reform that was started in 2006, the Ministry of Water and Environment established a new institutional setup to implement Integrated Water Resources Management (IWRM) that is aimed at the de-concentration of water resources management to the Water Management Zone (WMZ) and catchment levels. The Upper Nile Water Management Zone is the platform for the de-concentration of IWRM and catchment based water resources development and management planning in northern Uganda, within the policy and planning framework provided by the National Water Resources Strategy and relevant Water and Environment sub-sector strategies.

The formulation of the Water Resources Development and Management Strategy and Action Plan for the Upper Nile WMZ is based on the results of the diagnostic and situational analysis of the WMZ and on the outcomes of extensive stakeholder consultations carried out at all appropriate levels throughout the development of the planning process. The strategy provides a long-term direction for the management of all water resources within the WMZ, taking into consideration also the current and planned projects and activities, and is in line with the government's new approach to managing water resources at the zonal level. It aims at implementing a framework of objectives and strategic actions at the zonal level that are fully aligned with the National Water Resources Strategy and with other water and environment sector sub-strategies.

The WRDM Strategy for the Upper Nile WMZ provides a long-term direction for the management of all water resources taking into consideration the current and planned projects and activities. Its development is based on International and National goals, policies, and objectives that include the Sustainable Development Goals, Uganda Vision 2040, National Development Plan II, Water Sector Strategic Investment Plan (2010-2035), and National Water Resources Strategy, among others.

My Ministry is, therefore pleased to formally make this WRDM Strategy and Action Plan for the Upper Nile WMZ available for use by various stakeholders. It will enormously help and guide all developers and users of water and related resources at the national and local levels. I therefore wish to call upon all the relevant government ministries and agencies at both national and local levels, the civil society, the private sector, academia and research institutions, cultural institutions, religious institutions and the local communities to utilize this plan in order to optimally plan for the development and management of water and related resources for prosperity.

In line with the provisions of Section 5 of the Water Act, Cap 152 I, therefore, formally approve this WRDM Strategy and Action Plan for the Upper Nile WMZ for use by various stakeholders.

For God and My Country

ACKNOWLEDGEMENT

I would like to thank the Directorate of Water Resources Management for spearheading the preparing of Water Resources Development and Management Strategy and Action Plan for the Upper Nile WMZ. This is a stakeholder driven process that is key in ensuring that water resources are effectively planned for and sustainably developed and managed so as to support the achievement of the country's Vision 2040.

Special thanks go to all the stakeholders at the national, regional and local levels for their active participation and involvement in preparation of this plan. Special appreciation goes to the Upper Nile Water Management Zone for coordinating the strategy preparation process and for ensuring that the strategy is stakeholders' driven and addresses the needs of the people in the zone.

Finally, I wish to thank the World Bank through the Water Management and Development Project for providing the funding that enabled preparation and printing of this Strategy.

Alfred Okot Okidi

Permanent Secretary,
Ministry of Water and Environment

EXECUTIVE SUMMARY

Introduction

In order to enact the Water Sector Reform that was started in 2006, the Ministry of Water and Environment established a new institutional setup to implement Integrated Water Resources Management (IWRM) that is aimed at de-concentration of water resources management at the Water Management Zone and catchment levels. The Upper Nile Water Management Zone is the platform for de-concentration of IWRM and catchment based water resources development and management planning in northern Uganda, within the policy and planning framework provided by the National Water Resources Strategy[1] and relevant Water and Environment sub-sector strategies. The Upper Nile Water Management Zone is about 50,000 square kilometres (km^2) and includes the Ugandan part of three river catchments namely: Albert Nile, Aswa, and Kidepo. The Albert Nile River starts from Lake Albert and flows to the north through northern Uganda into South Sudan. The Aswa River is a major river in northeastern Uganda, which flows northwest into South Sudan and joins the White Nile near Nimule. The river originates from the hills in the Upper Nile region, flows through Lira District, and marks the border between the Districts of Pader and Gulu. The main tributaries of Aswa are Agago river and Pager river. The Kidepo River is a tributary of the Pibor River that runs in eastern South Sudan along the border between South Sudan and Ethiopia. Pibor River flows north for about 320 kilometres and joins the Akabo and Baro rivers to form the Sobat River, which is a southern tributary of the White Nile. Only the upper portion of the Kidepo Catchment is included in the study area.

Integrated Water Resources Management is vital for the development of the Upper Nile WMZ as it is a fundamental enabler of social and economic development. The implementation of IWRM is a key element of the Uganda Vision 2040 as it is included among the strategic opportunities to be addressed for strengthening the fundamentals of the economy of Uganda. The strategic planning of water resources development and management in the Upper Nile WMZ has been framed on three guiding principles: (i) Equity, (ii) Sustainability, and (iii) Efficiency. The national institutional framework for integrated and de-concentrated management of water resources entails management at four levels, namely: (i) national level (centre), (ii) Water Management Zone level, (iii) catchment level, and (iv) community level. The formulation of the Water Resources Development and Management Strategy for the Upper Nile WMZ is based on the results of the diagnostic and situational analysis of the WMZ and on the outcomes of extensive stakeholder consultations carried out at all appropriate levels.

The strategy development process

The WRDM Strategy for the Upper Nile WMZ provides a long-term direction for the management of all water resources taking into consideration the current and planned projects and activities. Its development is based on international and national goals, policies, and objectives that include the Sustainable Development Goals, Uganda Vision 2040, National Development Plan II, Water Sector Strategic Investment Plan (2010-2035), and National Water Resources Strategy among others.

The strategic planning process was comprised of four main phases:

i) The initial diagnostic and situational analysis where the comprehensive assessment of water resources was carried out;
ii) The identification of issues and opportunities for water resources development and management at the zonal level;
iii) Formulation of the objectives and strategic actions that informed the WRDM Strategy, with related activities, outputs and indicators;
iv) Preparation of the Strategic Action Plan for implementation of the WRDM Strategy over the timeframe up to 2040.

Vision and strategies

The vision set for the Upper Nile WMZ to guide water resources development and management strategy is:

"A sustainable, equitable and effective water resources management and development for socio-economic transformation of Upper Nile Water Management Zone by 2040."

The Strategy is structured in a suite of five sub-strategies that provide the framework for setting specific objectives and related strategic actions at the WMZ, catchment and primary sub-catchment levels. These are:

Water Governance is the sub-strategy that addresses the development of inte-grated water resources management capacity and decision making at the WMZ level including allocation, planning, regulation, monitoring, and control of water resources in a participatory and inclusive management framework

[1] *MWE-DWRM, National Water Resources Strategy, 2014*

Water for People is the sub-strategy that aims at ensuring the provision of ade-quate water supply and sanitation and hygiene services to all the urban and rural population of the Upper Nile WMZ

Water for Production is the sub-strategy that aims at allocating water resources to productive uses for the economic development of the Upper Nile WMZ within the national framework of sectoral development goals and objectives

Water for Energy is the sub-strategy that focuses on the increase of renewable energy production through development of hydropower capacity and manage-ment of water demand for energy production

Water for Environment is the sub-strategy that aims at ensuring conservation of water related ecosystems and sustainable use natural resources within the Upper Nile WMZ

The five sub-strategies are coupled with nine strategic objectives, as outlined below.

Water Governance	1. Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development
Water for People	2. Universal and sustainable access to safe water supply 3. Universal and sustainable access to improved sanitation and hygiene
Water for Production	4. Sustainable use, development and management of water resources in agriculture, livestock, aquaculture and forestry 5. Sustainable use, development and management of waterresources for agro-industry, industrial production, Oil and Gas 6. Sustainable use, development and management of water resources for other sectors (tourism, transportation, security)
Water for Energy	7. Sustainable use, development and management of water resources for renewable energy production
Water for Environment	8. Conservation of ecosystem services and functions 9. Mitigation of effects of extreme climatic events

For each of the above-mentioned sub-strategies and strategic objectives, strategic issues were evaluated in order to identify where they are located, how critical they were, which sectors were involved. Strategic opportunities were also identified. The identification of potential issues and opportunities was based on:

- Analysis of framework given by the National Strategy
- Results obtained from Diagnostic / Situational Analysis
- Information and suggestion gathered from stakeholders through specific consultations.

The issues were divided in three main categories: (i) ater availability for use, (ii) Environment and climate vulnerability and (iii) Water governance.

The analysis of critical issues was based on the assignment of specific values to each issue and each sub-catchment based on the elaboration of available data and information that was well organised in the catchment's knowledge base and on expert judgment.

Table 1: Summary of critical issues for UN WMZ catchments

SUMMARY OF CRITICAL ISSUES			
Sub - strategy	**Albert Nile**	**Aswa**	**Kidepo**
Water for People	Very high for most of issues in Ora, Enyau, Kochi, Laropi and AN between Ora and Kochi	Very high or high for most of issues for all sub-catchment, except Pager Aringa and Nyimur	Very high or high for most of issues

SUMMARY OF CRITICAL ISSUES			
Sub - strategy	**Albert Nile**	**Aswa**	**Kidepo**
Water for Production	High or very high for mainly availability and irrigation infrastructures in Ora, Enyau, Kochi, Laropi and AN between Ora and Kochi	Very high or high for most of issues for all sub-catchment, except Pager Aringa, Aswa III and Nyimur	Very high for many issues
Water for Energy	None	None	None
Water for Environment	Very high for ecosystems and high for many of the other issues for all sub-catchments	Very high or high for all issues in Aswa I, Agago, Aswa II, Pager Matidi; high in the other sub-catchments	Very high or high for all issues

Generic strategic actions were prioritised into strategic actions based on the identified strategic issues and their spatial extend. The resulted into prioritised specific strategic actions for the entire Upper Nile WMZ as well as for the Albert Nile, Aswa, and Kidepo catchments as presented in the tables below.

Table 2: Prioritisation of generic strategic actions for Albert Nile sub-catchments

GENERIC STRATEGIC ACTIONS	**ALBERT NILE CATCHMENT**										
	Pakwach	**Panyango**	**Ome**	**Ora**	**AN_up_Enyau**	**Enyau**	**AN_up_Kochi**	**Kochi**	**Laropi**	**Ayugi**	**Unyama**
	AN1	**AN2**	**AN 3**	**AN 4**	**AN5**	**AN6**	**AN7**	**AN8**	**AN9**	**AN 10**	**AN11**
Water infrastructure development.											
Water supply systems development needs.	-	-	-	X	X	XX	X	XX	-	-	X
Water sanitation systems development needs.	X	-	-	XX	XX	XX	-	XX	X	XX	X
Water irrigation demand and storage needs.	X	-	-	XX	XX	XX	X	XX	X	-	-
Water storage and transfer/allocation options that cross catchment boundaries.	X	-	-	-	XX	XX	X	XX	-	-	X
Efficiency actions for water use.	-	-	-	-	X	X	-	X	X	-	-
Improve water quality and sanitation monitoring systems.	X	-	-	X	X	XX	X	XX	X	X	-
Water resource and environmental protection											
Monitoring "at risk" catchments and sub-catchments determination in relation to environmental limits and cumulative effects.	X	X				X					X
Ensure protection of biodiversity values, natural features and areas of conservation value.	X	X	X	X	X		X			X	X
Ensure environmental protection and restoration of wetlands.	X		X		X		X	X			

Table 3: Prioritisation of generic strategic actions for Aswa and Kidepo sub-catchments

GENERIC STRATEGIC ACTIONS	**ASWA CATCHMENT**								**KIDEPO**
	Aswa I	**Agago**	**Aswa II**	**Pager Matidi**	**Pager Aringa**	**Pager Kitgum**	**Aswa III**	**Nyimur**	**Kidepo**
	AS1	**AS2**	**AS3**	**AS4**	**AS5**	**AS6**	**AS7**	**AS8**	**KI1**

Water infrastructure development.									
Water supply systems development needs.	X	X	X	X	-	XX	-	-	X
Water sanitation systems development needs.	XX	XX	XX	-	-	XX	-	-	-
Water irrigation demand and storage needs.	XX	XX	XX	X	X	XX	X	-	X
Water storage and transfer/allocation options that cross catchment boundaries.	XX	XX	XX	XX	XX	XX	XX	-	XX
Efficiency actions for water use.	X	XX	-	XX	XX	X	X	-	XX
Improve water quality and sanitation monitoring systems.	X	X	X	XX	-	-	-	-	XX
Water resource and environmental protection									
Monitoring "at risk" catchments and sub-catchments determination in relation to environmental limits and cumulative effects.	X	X	X				X		
Ensure protection of biodiversity values, natural features and areas of conservation value.	X			X	X				X
Ensure environmental protection and restoration of wetlands.	X			X					

Financial analysis

The financial analyses provide information for the water and environment sector finance and sector budget but also for identification of financial resources. Key sources of financing for the UNWMZ were identified as the Government of Uganda through general taxation supported by International Financial Institutions (IFIs). Some investments can be sourced from the private sector.

In case of water for production, a considerable proportion of the investments is assumed, by the Strategy and Investment Plan (DWMR, 2009), to be provided by private sector. Hydropower projects RoR (Run of River) would be generally financed by the private sector, while hydropower projects including large dams and multipurpose reservoirs have to be developed under the traditional model of a governmental agency or a public utility.

Multipurpose reservoirs and other storages facilities can have significant and multiple benefits, therefore, they need to be funded by public resources, drawing on IFIs aid when needed. There could be room for private involvement in partnership with the public sector where an acceptable balance between risks and rewards can be achieved. The tables below summarise the financial requirements for the strategy.

Table 4: Financial needs for water infrastructure development in 2040 for UN WMZ.

INFRASTRUCTURE	USER TYPE	Cost (Million USD)	Cost (Billion UGX)
Storage	Domestic urban	33	107
	Domestic rural	201	657
	Livestock	24	77
	Aquaculture	6	21
Water Supply	Domestic urban	161	526
	Domestic rural	569	1,864
Sanitation	Domestic urban	317	1,039
	Domestic rural	468	1,532
Off – farm Irrigation	Irrigation (all type)	1,501	4,913
Water Supply	Industry	158	519
TOTAL		3,437	11,255

Table 5: Financial needs for strategic objectives for UN WMZ.

Structural Component		**Cost (Thousand USD)**	**Cost (Million UGX)**
1.1	Monitoring systems and information management	21,200	69,400
1.2	Water allocation and water demand management	4,300	14,050
1.3	Water and environmental infrastructure	4,072,800	13,335,750
1.4	Water resource management and environmental protection	46,550	152,450
1.5	Public engagement and capacity development	5,350	17,600
TOTAL		4,150,200	13,589,200

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ABBREVIATIONS AND ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AQUASTAT	FAO global information system on water
ASR	Alkali Silica Reaction
ATM	African Textile Mill
BEL	Bujagali Energy Limited
BMU	Beach Management Unit
BOD	Biological Oxygen Demand
CAO	Chief Administrative Officer
CAS	Country Assistance Strategy
CBD	Convention on Biological Diversity
CBO	Community-based organization
CbWAP	Community-based Wetland Action Plan
CbWMP	Community-based Water Management Plan
CEO	Chief Executive Officer
CFR	Central Forest Reserve
CIAT	International Centre for Tropical Agriculture
CMO	Catchment Management Organization
CMP	Catchment Management Plan
CRU	Climate Research Unit
DAP	Di-ammonium Phosphate
DCDO	District Community Development Officer
DDP	District Development Plan
DEA	Directorate of Environmental Affairs
DEAP	District Environment Action Plan
DEC	District Environment Committees
DFO	District Fisheries Officer
DFR	Department of Fisheries Resources
DLG	District Local Government
DNRO	District Natural Resources Officer
DPO	District Production Officer
DRC	Democratic Republic of Congo
DSIP	Agriculture Sector Development Strategy and Investment Plan
DWAP	District Wetland Action Plan
DWD	Directorate of Water Development
DWD	Directorate of Water Development
DWO	District Water Officer
DWRM	Directorate of Water Resources Management
EAPP	Eastern Africa Power Pool
ECF	East Cost Fever
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EM-DAT	International Disaster Database
EMP	Environmental Management Plan
ERA	Electricity Regulatory Authority
ESIA	Environmental and Social Impact Assessment
FAO	United Nations Food and Agriculture Organization
FIE & FOC	Farm Income Enhancement and Forestry Conservation Project
FMD	Foot and mouth disease
FS	Faecal Sludge

FSM	Faecal Sludge Management
GDP	Gross Domestic Product
GETFIT	Global Energy Transfer Feeding Tariffs
GFS	Gravity Flow Scheme
GIS	Geographical Information System
GIZ	German International Cooperation
GoU	Government of Uganda
GPCC	Global Precipitation Climatology Centre
Ha	Hectare
HPP	Hydro-Power Plant
IBA	Important Bird Area
ICCM	International Conference on Chemicals Management
IDA	International Development Association
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producers
ISFG	Integrated Support to Farmers' Groups
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
Km	Kilometre
LFPR	Labour Force Participation Rate
LFR	Local Forest Reserve
LTU	Livestock Tropical Unit
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MEMD	Ministry of Energy and Mineral Development
MERECP	Mount Elgon Regional Ecosystem Conservation Programme
MES	Ministry of Education and Sports
MGLSD	Ministry of Gender, Labour and Social Development
MLG	Ministry of Local Government
MLHUD	Ministry of Lands, Housing and Urban Development
MOH	Ministry of Health
MSIOA	Multi-Sectoral Investment Opportunity Assessment
MTI	Ministry of Tourism and Industry
MWE	Ministry of Water and Environment
NAADS	National Agricultural Advisory Services
NAPA	National Adaptation Programme of Action
NARO	National Agricultural Research Organization
NBI	Nile Basin Initiative
NDP	National Development Plan
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
NEMA	National Environment Management Authority
NEPAD	New Partnership for Africa's Development
NERICA	New Rice for Africa (rice variety)
NFA	National Forestry Authority
NGO	Non-Government Organization
NGWDB	National Groundwater Data Base
NPV	Net Present Value
NTU	Nephelometric Turbidity Units
NWP	National Water Policy
NWRA	National Water Resources Assessment
NWSC	National Water and Sewerage Corporation

O&M	Operation and Maintenance
OP	Operational Procedure
OWC	Operation Wealth Creation
PMA	Plan for Modernization of Agriculture
POP	Persistent Organic Pollutants
PPA	Power Purchase Agreement
RAMSAR	Convention on Wetlands of International Importance
RGC	Rural Growth Centre
RWH	Rainwater Harvesting
SAICM	Strategic Approach to International Chemicals Management
SAIL	Sugar and Allied Industries, Limited
SAPP	Southern Africa Power Pool
SCMP	Sub-catchment Management Plan
SEAP	Sub-county Environmental Action Plans
SMM	Sio-Malaba-Malakasi
SSEA	Strategic Social and Environmental Assessment
SWAP	Sub-county Wetland Action Plan
SWC	Soil and Water Conservation
SWL	Static Water Levels
SWOT	Strength, Weakness, Opportunity, Threat
TC	Town Council
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
TSU	Technical Support Unit
UBOS	Uganda Bureau of Statistics
UEGCL	Uganda Electricity Generation Company Limited
UNRA	Uganda National Road Authority
UNRDS	Uganda National Rice Development Strategy
UO	Umbrella Organization
UPE	Universal Primary Education
USAID	United States Development Agency
USD	United States Dollar
UWA	Uganda Wildlife Authority
UWASNET	Uganda Water and Sanitation Network
WAFICOS	Walimi Fish Farmers' Cooperative Society
WATSAN	Water and Sanitation
WMD	Water Management and Development
WMDP	Water Management and Development Project
WMZ	Water Management Zone
WRU	Wetland Resources Users
WSDF	Water, Sanitation and Development Facility
WSDF-E	Water, Sanitation and Development Facility East
WSP	Waste Stabilization Ponds
WSSB	Water Supply and Sanitation Board
WSSP	Wetland Sector Strategic Plans
WUA	Water Users Association
WWF	World Wildlife Fund
WWTP	Wastewater Treatment Plant

1. INTRODUCTION

In order to enact the Water Sector Reform that was started in 2006, the Ministry of Water and Environment established a new institutional setup to implement Integrated Water Resources Management (IWRM) that is aimed at de-concentration of water resources management at the Water Management Zone and catchment levels. The Upper Nile Water Management Zone is the platform for de-concentration of IWRM and catchment based water resources development and management planning in northern Ugandawithin the policy and planning framework provided by the National Water Resources Strategy[2] and relevant water and environment sub-sector strategies. The Upper Nile Water Management Zone is about 50,000km^2 and includes the Ugandan part of three river catchments namely: Albert Nile, Aswa, and Kidepo. The Albert Nile River starts from Lake Albert and flows to the north through northern Uganda into South Sudan. The Aswa River is a major river in north-eastern Uganda which flows northwest into South Sudan and joins the White Nile near Nimule. The river originates from the hills in the Upper Nile region, flows through Lira District, and marks the border between the Districts of Pader and Gulu. The main tributaries of Aswa are Agago River and Pager River. The Kidepo River is a tributary of the Pibor River that runs in eastern South Sudan along the border between South Sudan and Ethiopia. Pibor River flows north for about 320 kilometres and joins the Akabo and Baro rivers to form the Sobat River, which is a southern tributary of the White Nile. Only the upper portion of Kidepo Catchment is included in the study area.

1.1 Objectives and Purpose of Water Resources and Management Strategy for the Upper Nile WMZ

The Water Resources and Management Strategy for the Upper Nile WMZ builds on the results of the diagnostic and situational analysis and is aimed at:

- Formulating a shared Upper Nile WMZ vision in 2040
- Identifying the strategic objectives of water resources management and development in the Upper Nile WMZ up to year 2040
- Identifying coherent sets of strategic actions as associated activities, their outputs and the output indicators
- Defining a framework of prioritized and sequenced strategic actions and activities for water resources management and development in the Upper Nile WMZ, including evaluation of financing and institutional options for implementation.

1.2 Report Structure

This report mainly has seven chapters prepared to ensure logical and consistent flow of information throughout the document as highlighted below:

Chapter 1: Introduction. This chapter presents the background, objectives of the strategy, and general layout of the report.

Chapter 2: Approach to Strategy Development. This chapter describes the general approach to development of the strategy document.

Chapter 3: Legislative and Institutional Framework. The existing policy, legal, and institutional arrangements, their linkages with the strategy, as well as the existing gaps are presented in this chapter.

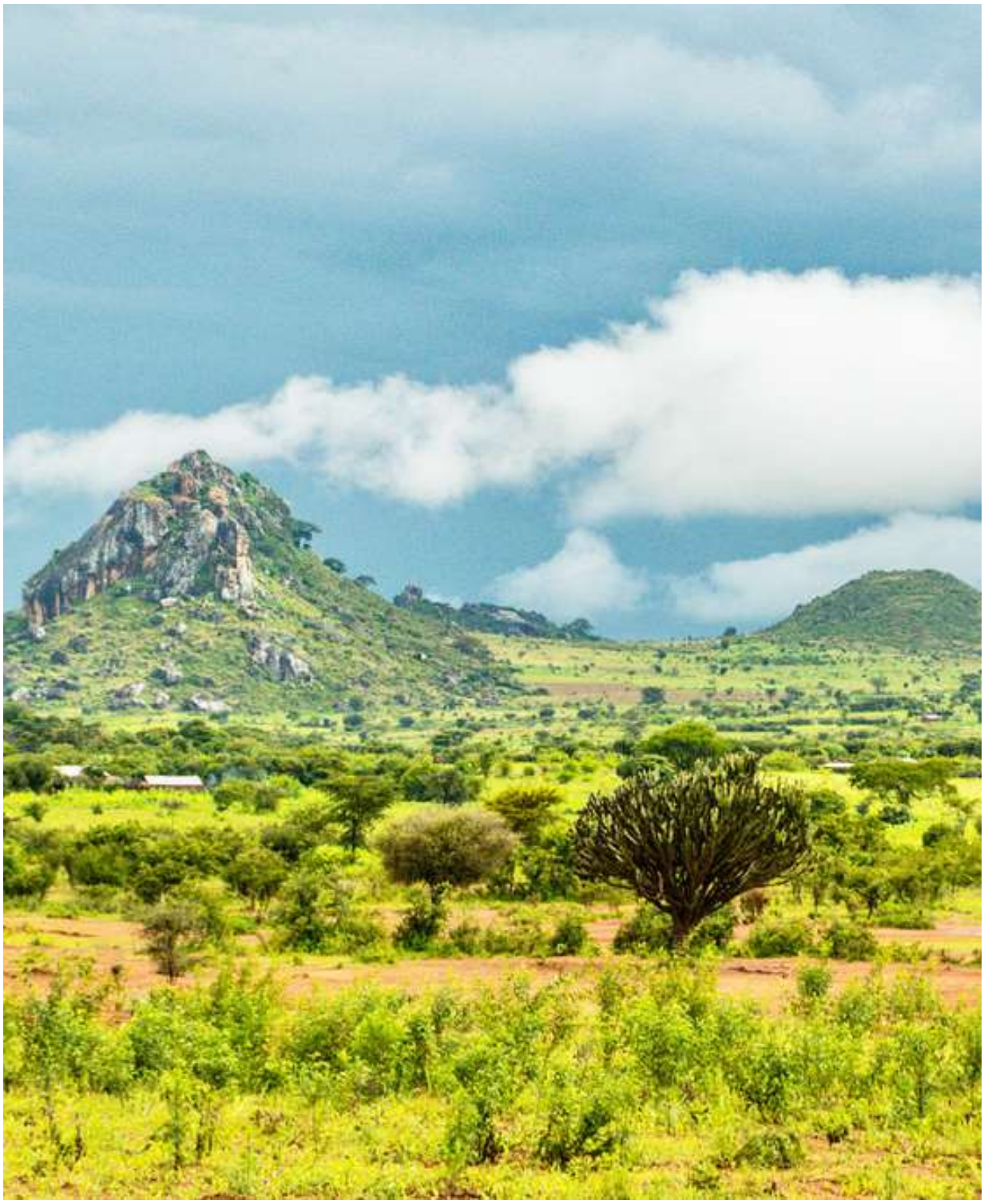
Chapter 4: Status of the Upper Nile Water Management Zone. This chapter discusses the main characteristics and features of the Water management Zone, which ultimately leads to identification of the major social, environmental, and water resources assessment issues together with the stakeholder engagement and issues' mapping.

[2] *MWE-DWRM, National Water Resources Strategy, 2014*

Chapter 5: Strategic Issues and Opportunities. This chapter discusses the strategic issues at the zone, catchment and sub-catchment levels.

Chapter 6: Vision, Objectives, and Analysis of Options. Catchment Water Management Zone visioning and strategic analysis is presented and discussed in this chapter. The prioritisation of issues identified with the generic strategies is completed under this chapter.

Chapter 7: Framework of the upper Nile WMZ Strategic Action Plan. This chapter presents the interventions in a logical framework with indicators. It then presents the associated investment costs. It also briefly discusses the possible sources of financing.



2. APPROACH TO THE DEVELOPMENT OF THE WATER MANAGEMENT ZONE STRATEGY DEVELOPMENT

The strategic planning of water resources development and management in the Upper Nile WMZ has been framed on three guiding principles: (i) Equity, (ii) Sustainability, and (iii) Efficiency. Integrated Water Resources Management is vital for the development of the Upper Nile WMZ as it is a fundamental enabler of social and economic development. The implementation of IWRM is a key element of the Uganda Vision 2040 as it is included among the strategic opportunities to be addressed for strengthening the fundamentals of the economy of Uganda.

A number of overarching goals and national objectives are related to water resources management. These goals derive from both international and national policy frameworks that are often cross-linked and interrelated:

- International Overarching Goals and Objectives: the Sustainable Development Goals and Goals and Objectives set within International Conventions and Regional Agreements
- National Strategic Goals and Objectives for IWRM: Uganda Vision 2040, National Development Plans I and II, Water Sector Strategic Investment Plan (2010-2035), National Water Resources Strategy, National Policies and Sector Plans and Strategies relevant to IWRM implementation.

The national institutional framework for integrated and de-concentrated management of water resources entails management at four levels, namely: (i) national level (centre), (ii) Water Management Zone level, (iii) catchment level, and (iv) community level.

Water Resources Development and Management Strategy for the Upper Nile WMZ up to 2040

The formulation of the Water Resources Development and Management Strategy for the Upper Nile WMZ is based on the results of the diagnostic and situational analysis of the WMZ and on the outcomes of extensive stakeholder consultations carried out at all appropriate levels throughout the development of the planning process. The strategy provides a long-term direction for the management of all water resources within the WMZ, taking into consideration also the current and planned projects and activities, and is in line with the government's new approach to managing water resources at the zonal level. It aims at implementing a framework of objectives and strategic actions at the zonal level that are fully aligned with the National Water Resources Strategy and with other water and environment sector sub-strategies.

The strategy is structured in a suite of five sub-strategies that provide the framework for setting specific objectives and related strategic actions at the WMZ, catchment and primary sub-catchment levels. Strategic Action Plan and the implementation framework are based on these sub-strategies.

These are:

Water Governance is the sub-strategy that addresses the development of integrated water resources management capacity and decision making at the WMZ level, including allocation, planning, regulation, monitoring and control of water resources in a participatory and inclusive management framework

Water for People is the sub-strategy that aims at ensuring the provision of adequate water supply and sanitation and hygiene services to all the urban and rural population of the Upper Nile WMZ

Water for Production is the sub-strategy that aims at ensuring availability of water resources for productive uses to support economic development of the Upper Nile WMZ within the national framework and sector development goals and objectives

Water for Energy is the sub-strategy that focuses on the increase of renewable energy production through development of hydropower capacity and management of water demand for energy production

Water for Environment is the sub-strategy that aims at ensuring conservation of water related ecosystems and sustainable use of natural resources within the Upper Nile WMZ.

Within each sub-strategy, long term comprehensive measures to be undertaken to achieve the desired water balance and water resources protection objectives within the Upper Nile WMZ are outlined. They

take into account the water situation assessment, the current and future water requirements and the strategic objectives. The strategic planning process comprises four main phases:

- The initial diagnostic and situational analysis where the comprehensive assessment of water resources is carried out
- The identification of issues and opportunities for water resources development and management at the zonal level
- The formulation of the objectives and strategic actions that inform the WRDM Strategy, with related activities, outputs and indicators
- Preparation of the Strategic Action Plan for implementation of the WRDM Strategy over the timeframe up to 2040.

A schematic outline of this strategic planning process is presented in the figure below:

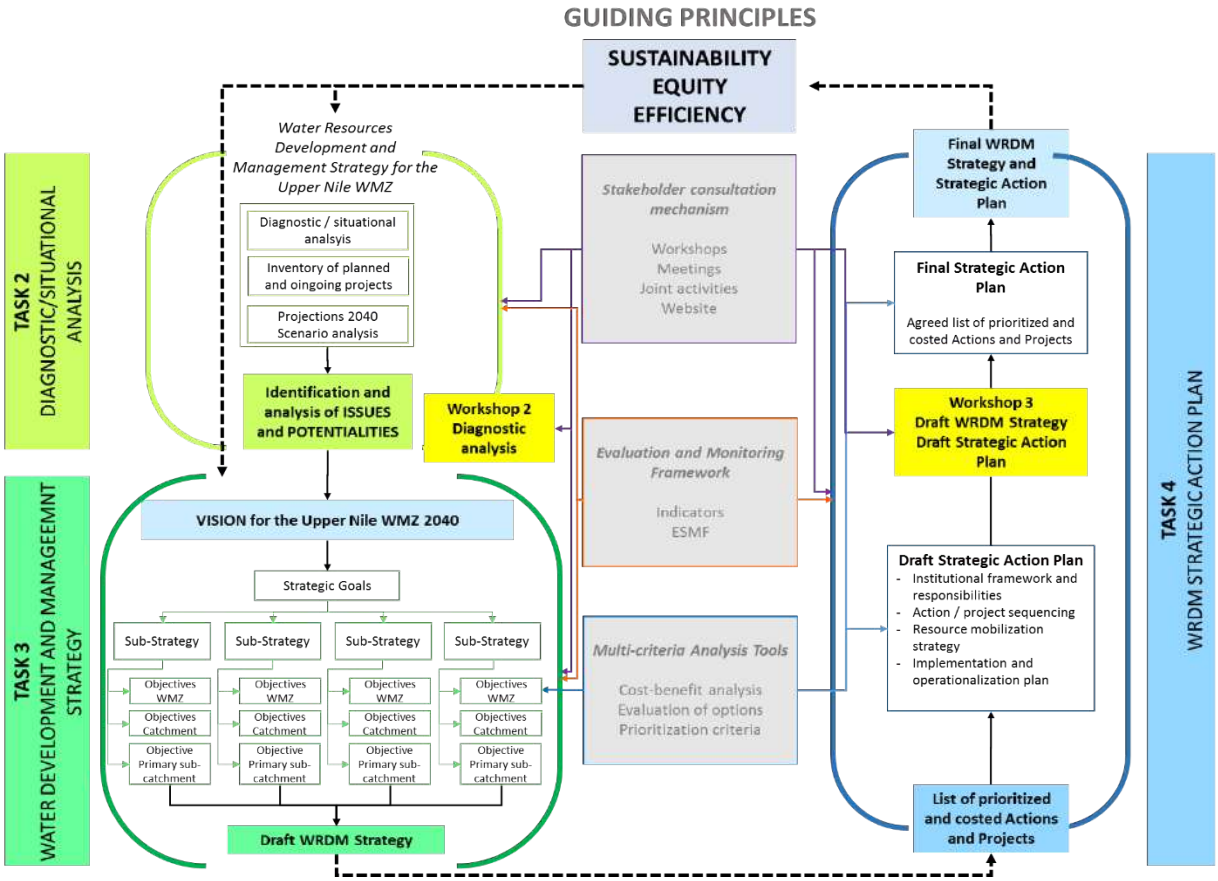


Figure 2.1: Schematic outline of the strategic planning process for the Upper Nile WMZ

Each sub-strategy is built on the following five structural components:

- Monitoring systems and information management
- Water allocation and water demand management
- Water infrastructure development
- Water resource management and environmental protection
- Public engagement and capacity development.

Table 2.1 below presents the function and purpose of each structural component. For each sub-strategy, the structural components have proper functions and their relative importance might be substantially different across the sub-strategies: for example, the infrastructural component is a major element of the water for people and water for production sub-strategies, while it is of less importance in the water governance sub-strategy.

Table 2.1: Functions and purpose of structural component of WRDM sub-Strategies

Structural component of WRDM sub-strategies	Functions and purpose
Monitoring systems and information management	This component guides collecting, accessing, analysing and sharing a wide range of information for the purposes of monitoring and evaluating water resources and operational management. It aims at providing institutions and stakeholders the water resources information required to enable them to meet their responsibilities towards effective water resources management as well as their reporting requirements regarding water resources and environment.
Water resources allocation and water demand management	This component aims at defining the criteria, limits and constraints, incentives and disincentives that shall be imposed on the uses of water resources in order to achieve the desired vision and achieve water resources management goals and objectives for the Upper Nile WMZ
Water infrastructure development	This component sets out a comprehensive needs evaluation and financial arrangements for infrastructure development for the WMZ. Reference shall be made to the responsibilities and costs associated with planning, design, implementation, operation and maintenance of the infrastructure
Water resource management and environmental protection	This component addresses water resource sustainability for the WMZ through incremental protection (including rehabilitation) of water resources and water related ecosystems.
Public engagement and capacity development	This component provides the basis for public engagement in the various aspects of the WRMD Strategy (through co-operation, collaboration and agreement). It shall address appropriate capacity building, the provision of opportunities for collaborative action, and communication and access to information, so that all role-players in the WMZ are adequately represented and that they participate in the formulation, implementation and review of the actions on a sustained basis

3. INSTITUTIONAL, LEGAL AND POLICY CONTEXT

Many of the processes required to bring about change in the management of water resources are long term and complex. This requires a strategic approach beyond the capacity of a single project, programme or development agency. It, therefore, necessitates the formation of a broader coalition for action and long term commitment to change by the leading agencies involved. A policy can be defined as statement of intent to achieve certain goal(s) by a local, regional or national governments of a country. A review of the institutional and policy context is aimed at identifying effective institutions and key linkages which can assist management to meet its aims. It is used to identify key partners, networks and information flows, and to decide on the appropriate institutional setting for the proposed activities. A synopsis of the legal and institutional context under which catchment management will occur is provided below.

3.1 Constitution of the Republic of Uganda (1995)[3]

The Constitution of the Republic of Uganda sets a number of national objectives and directive principles as it relates to and supports the principles of sustainable development. These include balanced and equitable development that requires that the State adopt an integrated and coordinated planning approach. It further stipulates that the State ensures balanced development between different areas of Uganda and between the rural and urban areas, with special measures employed to favour the development of the least developed areas.

The State is entrusted to protect important natural resources, including land, water, wetlands, minerals, oil, and fauna and flora on behalf of the people of Uganda. It must further endeavour to fulfil the fundamental rights of all Ugandans to social justice and economic development, with all developmental efforts directed at ensuring the maximum social and cultural well-being of the people. In terms of the Constitution, all Ugandans have a right to education, health services, clean and safe water, work, decent shelter, adequate clothing, food security, and pension and retirement benefits.

The State must promote sustainable development and public awareness of the need to manage land, air, water resources, as well as use of natural resources, in a balanced and sustainable manner for the present and future generations. All possible measures must be taken to prevent or minimise damage to land, air, and water resources resulting from pollution or other causes. The Constitution entrusts the State to ensure the conservation of natural resources and promote the rational use of natural resources to safeguard and protect the biodiversity of Uganda.

3.2 National Policies

3.2.1 National Water Policy (1999)

The 1999 National Water Policy, provides an overall policy framework that defines the government's policy objective as managing and developing water resources of Uganda in an integrated and sustainable manner, to secure and provide water of adequate quantity and quality for all social and economic needs sustainably, with the full participation of all stakeholders," (Directorate of Water Resources Management, MWE, 2012).

3.2.2 National Policy for the Conservation and Management of Wetland Resources (1995)

The National Policy for the Conservation and Management of Wetland Resources (1995) is aimed at restricting the continued loss of wetlands and their associated resources and to ensure that benefits derived from wetlands are sustainably and equitably distributed to all people of Uganda. The wetlands policy calls for:

- No drainage of wetlands unless more important environmental management requirements supersede
- Sustainable use to ensure that benefits of wetlands are maintained for the foreseeable future
- Environmentally sound management of wetlands to ensure that other aspects of the environment are not adversely affected
- Equitable distribution of wetland benefits
- The application of environmental impact assessment procedures on all activities to be carried out in a wetland to ensure that wetland development is well planned and managed.

Wetland related issues have been incorporated into the National Environmental Statute 1995. The Wetlands Policy is strengthened by a supplementary law specifically addressing wetland concerns. Wetland resources are regarded as forming an integral part of the environment and it is recognised that present attitudes and perceptions of Ugandans regarding wetlands need to be changed. Wetland conservation requires a coordinated and cooperative approach involving all the concerned people and organisations in the country, including the local communities.

Within the context of the guiding principles, the National Wetlands Policy set five goals:

[3]Source: This section is based on (Constitution of the Republic of Uganda, 1995)

- To establish the principles by which wetland resources can be optimally used over time
- To end practices which reduce wetland productivity
- To maintain the biological diversity of natural or semi-natural wetlands
- To maintain wetland functions and values
- To integrate wetland concerns into the planning and decision making of other sectors.

3.2.3 Uganda National Land Policy

The policy provides a framework for articulating the role of land in national development, land ownership, distribution, utilisation, alienability, management and control. The Land Policy has a specific objective that seeks to ensure sustainable utilisation, protection and management of environmental, and natural and cultural resources on land for national socio-economic development. It seeks to ensure that all land use practices and plans conform to principles of sound environmental management, including biodiversity, preservation, soil and water conservation and sustainable land management. Section 6.7, item 140 promotes optimal and sustainable use and management of environment and natural resources for the present and future generations.

3.2.4 National Forestry Policy

It provides for the establishment, rehabilitation and conservation of watershed protection forests. It aims at promoting the rehabilitation and conservation of forests that protect the soil and water in Uganda's key watersheds and river systems.

3.2.5 The Renewable Energy Policy for Uganda

The overall goal of the Renewable Energy policy is to increase the use of modern renewable energy, from the current 4% to 61% of the total energy consumption by the year 2017. Renewable sources of energy include solar energy, hydropower, biomass, wind and geothermal as well as peat and wastes. For hydropower, the Policy targets 1200MW of installed capacity by 2017 for large hydropower plants and 85MW of installed capacity by 2017 for small and micro hydropower plants.

3.2.6 Decentralisation Policy Strategic Framework (DPSF) 2013-2023

The Decentralisation Policy Strategic Framework (DPSF) 2013-2023 replaces the earlier one that was formulated in 2006. While re-affirming democratic decentralisation as Uganda's decentralisation policy, the DPSF (2013-2023) takes account of several important developments that have taken place since 2006, including changes in Uganda's national development planning framework and the emergence of Local Governments as agents of local development.

3.2.7 National Environmental Management Policy (1994)

This Policy has provisions to control land degradation in the country, and has specific objectives to integrate environmental concerns in all development policies, planning and activities at national, district and local levels, with full participation of the people.

3.2.8 The Uganda Wildlife Policy (2014)

Features of this policy that are relevant to IWRM include the following:

- Manage wildlife in a sustainable way to grant benefits for the present and future generations
- Promote the public/private partnership in wildlife management
- Promote the interests of communities around conservation areas
- Wildlife trade and off-take shall be based on sound scientific knowledge
- Youth and gender consideration shall be taken into account in sustainable management of wildlife.

3.2.9 Energy Policy for Uganda (2002)

The policy aims at the following issues that are relevant to integrated water resources management among others:

- Meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner
- Establish the availability, potential and demand of the various energy resources in the country.

3.2.10 Mining Policy of Uganda (2000)

The policy is aimed at developing 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.

3.2.11 National Climate Change Policy (2012)

The policy is to provide guidance and directions in addressing the problem of climate change while enabling the country to adapt and mitigate the effects of climate change. The draft Implementation Strategy, with costs, complements the National Climate Change Policy and offers a way towards putting it into operation.

3.2.12 Other relevant policies

Other relevant policies include the following:

- The National Fisheries Policy (2004) that ensures increased and sustainable fish production and utilisation by properly managing capture fisheries, promoting aquaculture and reducing post-harvest losses
- The Uganda Gender Policy that establishes a clear framework for identification, implementation and coordination of interventions designed to achieve gender equality and women's empowerment
- The National Health Policy that aims at reducing mortality, morbidity and fertility, and the disparities therein.

3.3 National legislation

3.3.1 Water Act Cap 152 (1997)

Uganda's Water Act Cap 152 provides for the use, protection and management of water resources and supply; and facilitates the devolution of water supply and sewerage undertakings. Its objectives are:

i) To promote the rational management and use of the water resources of Uganda by:
   - Use of appropriate standards and techniques for the investigation, use, control, protection, management and administration of water resources
   - Coordinating all public and private activities which may influence the quality, quantity, distribution, use or management of water resources
   - Coordinating, allocating and delegating responsibilities for the investigation, use, control, protection, management or administration of water resources

ii) To promote the provision of a clean, safe and sufficient supply of water for domestic purposes

iii) To ensure appropriate development and use of water resources other than for domestic use, e.g. watering of stock, irrigation and agriculture, industrial, commercial and mining uses, generation of energy, navigation, fishing, preservation of flora, fauna and recreation in ways which minimise damage to the environment

iv) To control pollution and promote the safe storage, treatment, discharge and disposal of waste, which may pollute water or otherwise harm the environment and human health.

According to the National Water Policy (1999) and the Water Act Cap 152, the responsibilities to provide water services and to maintain facilities are devolved to local councils in districts and urban centres, with full mandates to construct, acquire or alter any water supply work. The role of the Central Government's Agencies is that of guiding and supporting as required. The Act thus emphasises the shared responsibilities in development and management of water resources among stakeholders (including the Private Sector and NGOs), and to regulate human activities that can pose risks to water resources. It also provides for pollution control measures with associated penalties and fines.

Other water sector related policies that form synergies with the Water Policy include:

- The National Gender Policy of 1999, which recognises women and children as key stakeholders of water
- The Local Government Act of 1997, which underscores the role of Local Government in provision and management of water and sanitation, empowering the local authorities to plan and to implement development interventions according to local needs;
- The 1998 Land Act, which stipulates the responsibility of the Central and Local Government in protecting environmentally sensitive areas such as natural lakes, rivers, groundwater, natural ponds, natural streams, wetlands, forest reserves, national parks and any other land reserved for ecological and tourist purposes
- The 1998 Water Abstraction and Wastewater Discharge Regulations for controlling water abstraction and wastewater discharge, to promote sustainable and environmentally friendly development and use of water resources. Some issues feature at the level of policy and regulatory framework while others are crucial at catchment level. For instance, plans to develop irrigation schemes necessitate the development of a proper mechanism to protect water use rights and to settle disputes, especially between upstream and downstream water users. Issues

of equity exist, whereby some users, often-powerful up-stream users, put their interests first. In establishing the mechanism to handle user rights and conflict resolution, issues of active participation of all concerned stakeholders, including women, livestock keepers, and youths, should be taken into consideration.

The existing policy and legal framework promotes wise use of water resources from the lowest possible level, while considering roles to be played by different stakeholders at different levels. This offers an opportunity to ensure communities actively participate in development and maintenance of water sources.

3.3.2 National Environment Act (1995)

The National Environmental Act provides for *"sustainable management of the environment; to establish an authority as a coordinating, monitoring and supervisory body for that purpose; and for other matters incidental to or connected with the foregoing."*

The Act makes provision for a tiered approach to environmental planning, commencing with a National Environmental Management Plan to be prepared and reviewed every five years. Each district is required to prepare a District Environmental Action Plan every three years that compliments the National Environmental Management Plan. Both of these plans are made available to the public. At a project scale, the Act stipulates that developments of a certain nature (as determined under Section 19(7) of the Act) are required to undertake detailed Environmental Impact Assessment processes in a prescribed manner.

The Act also makes provision for the monitoring of air and water quality and makes provision for the establishment and implementation of minimum standards pertaining to emissions and effluent. Section 34 of the Act deals specifically with limitations in the use of rivers and lake systems and to minimise the negative impacts and control activities that have the potential to be detrimental to these systems. The Act goes on to make specific provisions for the protection of river banks and lake shores in Section 35 and protection and management of wetland systems in Section 36 and 37 respectively.

Hilly and mountainous areas have also been identified as areas requiring special attention and protection by the Act. The Act makes provision for the restoration of vegetative cover in these areas. This Act coupled with the provisions made in the Prohibition of the Burning of Grass Act (1974) and the Forest Act (1947) and the Cattle Grazing Act (1945) provide a good basis for restoration, protection and management of vegetative cover in hilly and mountainous areas.

3.4 Transboundary Issues[4]

The transboundary nature of Uganda's water resources are such that there are a number of international conventions relating to management of water resources with which Uganda must comply. Currently the key conventions/organisations to which Uganda is party are the Lake Victoria Protocol and Nile Basin Initiative.

3.4.1 Legal Framework for the Sustainable Management of the Nile Waters

Treaties regarding the management of the waters of the Nile basin date back to 1929 when Great Britain and Egypt signed an agreement under which no irrigation, power works or other measures were to be constructed or undertaken on the Nile, and its branches, or on lakes from which it flows in the Sudan, or in countries under British administration without priorconsent from the Egyptian government. The Agreement was followed by the 1959 Agreement on the Full Utilisation of the Nile Waters, which was signed between Egypt and Sudan. The 1959 Agreement allocates the waters of the Nile between the two signatory states.

3.4.2 Agreed Curve for the Lake Victoria Release

Before the construction of the Nalubale (Owen Falls) Dam, which began in 1951, the outflows from Lake Victoria were controlled naturally by the Ripon Falls some 3km upstream of the dam site. After the study of the discharge measurements, which had been made since 1923 at Namasagali, about 80km downstream of the lake outfall, an Agreed Curve was established, which described the natural relation between lake levels measured at the Jinja gauge and simultaneous measured outflows from the lake. Since 1954 (when the Nalubale Dam was completed), water flow from the Lake has been constrained to mimic the natural outflows from the lake using a rating "Agreed Curve" that correlates the flow of the Nile at the source with Lake Victoria water level.

3.4.3 Nile Basin Cooperative Framework Agreement

The Treaty was signed by Uganda in 2010 and has not been ratified yet. The Treaty is to establish a framework to "*promote integrated management, sustainable development, and harmonious utilisation of the water resources of the basin, as well as their conservation and protection for the benefit of present and future generations.*" For this purpose, the

[4]Source: (NELSAP, 2012)

Treaty envisages the establishment of a permanent institutional mechanism, the Nile River Basin Commission (NRBC). The Cooperative Framework Agreement (CFA) outlines principles, rights and obligations for cooperative management and development of the Nile Basin water resources. The Nile Basin Initiative (NBI) is a regional intergovernmental partnership launched in 1999 that seeks to develop the River Nile in a cooperative manner, share substantial socio-economic benefits and promote regional peace and security. It includes ministers in charge of water affairs in the riparian countries (Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, and Uganda). Eritrea participates as an observer. The NBI was conceived as a transitional institution until the Cooperative Framework Agreement (CFA) negotiations were finalised and a permanent institution created. The highest decision and policy-making body of NBI is the Nile Council of Ministers (Nile-COM), comprised of ministers in charge of water affairs in each NBI member state. The Nile-COM is supported by the Nile Technical Advisory Committee (Nile-TAC), comprised of 20 senior government officials, two from each of the member states. Two main investment programmes are developed within the NBI:

- The Eastern Nile Subsidiary Action Programme (ENSAP)
- The Nile Equatorial Lakes Subsidiary Action Programme (NELSAP).

3.5 International Conventions and Obligations

3.5.1 Sustainable Development Goals (SDGs)

The 2030 Agenda for Sustainable Development is a plan of action for people, planet and prosperity, that shall be implemented by all countries and all stakeholders, acting in collaborative partnership. The 2030 Agenda includes a dedicated goal on water and sanitation: the SDG 6 is to "ensure availability and sustainable management of water and sanitation for all." The SDG 6 covers the entire water cycle, including the management of water, wastewater, and ecosystem resources. The SDG 6 contains eight targets: six targets on outcomes across the entire water cycle, and two targets on the means of implementing the outcome targets.

Table 3.1: Targets of Sustainable Development Goal 6 and related indicators

SDG 6 "ensure availability and sustainable management of water and sanitation for all"		
Target		**proposed indicators for SDG 6 ***
Target 6.1	**"By 2030, achieve universal and equitable access to safe and affordable drinking water for all"**	**6.1.1 Percentage of population using safely managed drinking water services**
Target 6.2	"By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations"	6.2.1 Percentage of population using safely managed sanitation services, including a hand- washing facility with soap and water
Target 6.3	"By 2030, improve water quality by reducing pollution, eliminating dumping and minimising release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse globally"	6.3.1 Percentage of wastewater safely treated 6.3.2 Percentage of bodies of water with good ambient water quality
Target 6.4	"By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suff-ering from water scarcity"	6.4.1 Percentage change in water use efficiency over time 6.4.2 Percentage of total available water resources used, taking environmental water requirements into account (level of water stress)
Target 6.5	"By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate"	6.5.1* Degree of integrated water resources management implementation (0-100)
Target 6.6	"By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes"	6.6.1 Percentage of change in the extent of water-related ecosystems over time
Target 6.a	"By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies"	6.a.1 Amount of water- and sanitation-related official development assistance that is part of a government coordinated spending plan

SDG 6 "ensure availability and sustainable management of water and sanitation for all"		
Target		**proposed indicators for SDG 6 ***
Target 6.b	"Support and strengthen the participation of local communities in improving water and sanitation management"	6.b.1 Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

(*) UN Economic and Social Council, *Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators*, December 2015 - Source: http://www.unwater.org/sdgs/indicators-and-monitoring/en/

3.5.2 Ramsar Convention (1971)

The Convention on Wetlands (Ramsar, Iran, 1971) is an intergovernmental treaty that commits member countries to maintain the ecological character of *Wetlands of International Importance* and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. The Convention's mission is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world." The wise use of wetlands is defined as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". Uganda signed the Convention on the 4thJuly 1988. It currently has 12 Ramsar registered wetland systems, representing a combined area of 454,303ha.

3.5.3 UN Framework Convention on Climate Change (UNFCCC) and related Kyoto Protocol

Uganda ratified the UNFCCC in 1993. The First National Communication was developed in 2002. A Climate Change Policy was launched in 2012, with a related prioritisation of outputs under a short (1-5 years), medium (6-10 years) and long-term (10-15 years) time frames. The priorities in the National Climate Change Policy have been integrated in the Second National Development Plan (NDP II) 2015/16 – 2019/2020.

3.5.4 UN Convention on Biological Diversity (CBD)

The Convention's main objective is to ensure the conservation of biological diversity and sustainable use of its components. The NEMA is the National Focal Point for CBD and related protocols. A revised NBSAP 2015-2025 (NBSAP2) was issued in 2015 and addresses both the decade's Strategic Plan for Biodiversity and the Strategic Plan for the Cartagena Protocol on Bio-safety. The new document is linked to Vision 2040, the National Development Plan and the Sustainable Development Goals.

The maintenance of ecosystems' diversity and variety depends partially on a WRM approach that takes into account the environmental flows and the water balance that needs to be allocated for ecosystems' needs. The strategic objectives of the NBSAP are:

- To develop and strengthen co-ordination, measures and frameworks for biodiversity management
- To facilitate research, information management, and information exchange on biodiversity
- To reduce and manage negative impacts on biodiversity
- To promote the sustainable use and equitable sharing of costs and benefits of biodiversity
- To enhance awareness on biodiversity issues among the various stakeholders.

The Programme of Work on Protected Areas of the Convention on Biological Diversity (PoWPA) was issued in 2012. The main purpose of this programme under the CBD is to increase the coverage and representation of protected areas on the national territory. At present not all the ecosystems of Uganda are properly represented in the Protected Areas network. The programme therefore has set three main objectives:

- Assessment of ecological gaps in the protected area network
- Assessment of management effectiveness
- Assessing protected area capacity needs and the appropriate technology needs.

3.5.5 UN Convention for Combating Desertification

Uganda ratified the UNFCCC in 1997. A National Plan of Action on Drought and Desertification was developed in 1995 and a Status Report on National Action Programme (NAP) was prepared in 1998. A National Report to the UNCCD in Uganda was developed in 1999 in preparation of the National Action Programme (NAP) to combat drought and desertification that was launched in 2000. The Climate Change Department (CCD) of MWE is the national focal point for UNCCD.

3.6 Regional Treaties

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

The East African Community (EAC) is a regional intergovernmental organisation of fivepartner states: the Republics of Burundi, Kenya, Rwanda, the United Republic of Tanzania, and the Republic of Uganda, with its headquarters in Arusha, Tanzania. The mission of the community is to widen and deepen economic, political, social, and cultural integration in order to improve the quality of life of the people of East Africa through increased competitiveness, value added production, trade and investments. The EAC Vision 2050 is aimed at achieving shared development goals for the benefit of the region. The EAC promotes the development of regional priority projects for efficient infrastructure systems to support trade and industrialisation (energy power plants, power transmission lines, oil pipelines, road transport and port infrastructure, meteorological networks among others).

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

The East African Community has designated Lake Victoria and its basin as an "area of common economic interest" and a "regional economic growth zone" to be developed jointly by the partner states and established the Lake Victoria Basin Commission (LVBC) in 2001. The LVBC envisages a broad partnership of the local communities around the lake, the East African Community and its partner states as well as the development partners. A LVBC Operational Strategy (2007-2010) was launched in 2006 and is based on the five thematic areas of the EAC shared vision.

3.7 Plans and Strategies relevant to IWRM Implementation

3.7.1 Uganda Vision 2040

The Uganda Vision 2040 'A *transformed society from a peasant to a modern and prosperous country within 30 years*' represents the country's long-term perspective development plan and is based on the government of Uganda adoption of the Comprehensive National Development Planning Framework. The Vision 2040 provides for the development of a 30 year plan implemented through: (i) three 10-year plans, (ii) six 5-year National Development Plans (NDP), (iii) sector specific master and investment plans (SIPs), (iv) local government development plans, and (v) annual plans and budgets. The Vision 2040 provides a general framework for the strategic goals that will be formulated in the Upper Nile Water Management Zone Strategy. A set of selected Vision 2040 targets related to the Water and Environment Sector are presented in the table below.

Table 3.2: Selected Vision 2040 targets related to the Water and Environment Sector

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	Labour 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	% urbanisation		13	60
31	Forest cover (% land area)		15	24
32	Wetland cover (% of total area)		8	13

The Water Resources Development and Management Strategy for the Upper Nile WMZ is based on the target indicator values for 2040 related to water and environment.

3.7.2 National Water Resources Strategy

The National Water Resources Strategy, approved in 2015, aims at maximising the beneficial use of water resources and supporting the productive sectors to achieve their respective objectives, while ensuring environmental integrity and taking into account the transboundary context. The strategic goals of the WRDM Strategy for the Upper Nile WMZ are driven by three principal objectives set in the draft National Water Resources Strategy of Uganda according to the National Vision 2040 "*Water resources management in Uganda is effective in contributing to economic and social development and maintaining environmental services*". These are:

A. Sustainable and equitable allocation and provision of water of appropriate quantity and quality:
   a. Water resources availability for use
   b. Protection of water resources
   c. Integrated land and water management
   d. Demand management
   e. Water resources information, planning, and capacity
B. Adapting to the effects of extreme climate events:
   a. Prepare for increased hydrologic variability
   b. Prepare for a warmer climate
   c. Prepare for more severe rainstorms
   d. Effective flood management of the floodplain
C. Strengthening the water governance framework:
   a. Policy and legal framework
   b. Institutions
   c. Coordination Mechanisms
   d. Financing of water resources management.

This National Water Resources Strategy provides the main framework for developing the WRDM Strategy of Upper Nile WMZ.

3.7.3 National Development Plan II (NDP-II)

The Second National Development Plan (2015/16 - 2019/20) was launched in June 2015 with a theme: "*Strengthening Uganda's competitiveness for sustainable wealth creation, employment and inclusive growth*". The commitments of the NDP-II are in line with the Uganda Vision 2040 and its Spatial Framework, the East African Regional Integration Protocols, the Africa Agenda 2063, and the Post 2015 Sustainable Development Goals. The four Development Objectives of the NDP-II are:

i) Increasing sustainable production, productivity and value addition in key growth opportunity areas
ii) Increasing the stock and quality of strategic infrastructure to accelerate the country's competitiveness
iii) Enhancing human capital development
iv) Strengthening mechanisms for quality, effective and efficient service delivery.

The NDP-II prioritises interventions in five key growth opportunity areas that are: (i) Agriculture; (ii) Tourism; (iii) Minerals, Oil and Gas; (iv) Infrastructure, and (v) Human Capital Development.
Expected results of the plan include the following result: *"(vi) increasing access to safe water from 65% to 79% in rural areas and from 77% to 100% in urban areas."* The plan focuses on water for production infrastructure and facilities, targeting construction of large and small scale water schemes for irrigation, livestock (in the cattle corridor and also in non-cattle corridor areas), aquaculture and rural industries, and increase in water storage from 27.8 to 55 million cubic meters in 2019/20.

3.7.4 Joint Water and Environment Sector Support Programme (2013 - 2018)

The Joint Water and Environment Sector Support Programme (JWESSP) incorporates support to the environment and natural resources (ENR) sub-sector. 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. The JWESSP support is fully in line with the goals and targets of the NDP-II. The main instrument of the JWESSP is to manage the linkages between water, food security (water for production), health (sanitation) and in particular water resources, environment management, ecosystem services and climate change through catchment-based integrated water resources management in the Water Management Zones.

3.7.5 Climate Change Adaptation Strategy for the Water Sector (2011)

The overall objective of the strategy is to reduce vulnerability to climate change, build adaptive capacity and resilience to climate hazards, and use a policy-based approach to implement development programmes that are climate proofed. A

vulnerability assessment was developed to identify key water related and cross-sectoral climate change vulnerabilities in Uganda. The main areas of vulnerability identified are:

- Institutional (inadequate and weak institutional arrangements and capacity)
- Fluctuations of Lake Victoria's water levels
- Water quality and human health, particular on lake shorelines near urban areas or river mouths
- Generation of hydropower
- Potential over-exploitation of groundwater by agriculture
- Limited data, information and technology to provide critical information for optimal decision making
- Trans-boundary issues (potential conflict over water resources management in the Nile Basin).

Four broad objectives were the basis in designing a climate change strategy for Uganda's water sector, namely:

- Reduce vulnerability to climate change — (by assessing the likelihood that a climate event will occur and designing an appropriate response that will lessen the impact)
- Build adaptive capacity — (by overcoming barriers that prevent it. This includes strengthening communities and sectors by supporting activities that lessen vulnerability)
- Build resilience to climate hazards — (by analysing outcomes from various hazards and providing suitable responses to them)
- Use a policy-based approach — (implementing climate-related and development-related policy).

3.7.6 Water for Production Strategy and Investment Plan (2009)

This strategy and investment plan is aimed at promoting development of cost-effective and sustainable water for production supply and management for increased production and contribution to the modernisation of the agricultural sector in Uganda with a focus on poverty reduction and minimal environmental impacts. The water for production sub-sector strategy and SIP define specific coverage targets for four main strategic areas (livestock, crops, fishery and agro-industry) to 80% by 2035. In order to take drought and flood into consideration, a 50% additional storage capacity is added to the capacities required based on the rainfall and evaporation data, to cater for the annual variations in rainfall. The strategy includes planning of multi-purpose bulk water supply infrastructure projects.

3.7.7 National Irrigation Master Plan for Uganda (2010 – 2035)

The main objectives of the master plan are to achieve economic growth and poverty alleviation through improving the country's irrigation potential in a sustainable way thereby mitigating the potential impacts of climate change. The Irrigation Master Plan also promotes improvement of existing schemes and of crop yields and through livelihood differentiation.

3.7.8 National Water Quality Management Strategy (2006)

Water quality management plays a key role in WRM and it is one of the pillars and main objectives of any global WRM strategy. The main objectives of the NWQMS are the reduction of poverty through effective water quality management and the improvement of water quality standards to meet socio-economic and environmental needs. Ten strategic targets are identified both for the aquatic environment and monitoring of water quality at consumer level.

3.7.9 Rural Electrification Strategy and Plan (2013-2022)

The overall objective of the RESP 2013-2022 is: "*To position the electrification development programme on a path that will progressively advance towards achievement of universal electrification by the year 2040, consistent with the existing policy of the government, while ensuring the displacement of kerosene lighting in all rural Ugandan homes by 2030.*" During this 10-year planning period, the government's strategy is to achieve a rural electrification access of 22% by 2022 from the current level of about 5%. The RESP includes giving increased priority and enhanced support to investment in small distributed power generation facilities.

3.7.10 The National Forest Plan (2011/12-2021/22)

Deforestation and encroachment for cultivation is one of the major threats recognised in Uganda. The existence and conservation of wet forest and riverine forest ecosystem depends on sound WRM and on the adoption of strategies that would alleviate the existing pressures on forest resources. The main objectives of the NFP are set in the framework of the NEAP (now incorporated into the NDP). The strategic objectives of the NFP are:

i) To raise incomes for households through forest-based initiatives, targeting improvement of the well-being of small-scale, largely rural stakeholders
ii) To increase economic productivity and employment in forest industries, targeting large scale, commercial investors
iii) To restore and improve ecosystem services derived from sustainably managed forest resources

3.7.11 UWA Strategic Plan (2013-2018)

The conservation and sustainable management of wildlife integrates with WRM issues by enabling wildlife access water and mitigating the conflicts between wildlife and domestic animals related to water access. The mission and strategic

objective of the UWA strategic plan are: "To conserve, economically develop and sustainably manage the wildlife and protected areas of Uganda in partnership with the neighbouring communities and other stakeholders for the benefit of the people of Uganda and the global community" and "to have sustainably managed wildlife areas that are providing enjoyment, supporting community livelihoods and contributing to national development" respectively.

3.7.12 National Transport Master Plan (2008–2023)

The Transport Master Plan sets out a framework for the development of the sector over a15-year timeframe (2008–2023). The plan reflects the key role that transport plays in the development of agriculture, commerce and trade, the movement of people, and the delivery of health, education and extension services. Specific objectives of waterways sector policy and strategy include:

- Ensure provision of essential low-cost access to islands in Lake Victoria, to remote shorelines on Lake Victoria and other lakes (Albert, Kyoga and others), and along navigable rivers, especially the Victoria and Albert Niles
- Revive water transport services where there are good economic, social or strategic reasons for doing so
- Privatise existing public sector services (include ferries acting as 'road bridges'), while Government retains responsibility for provision and maintenance of infrastructure
- Allow market forces to determine fares and tariffs in the long run (as long as social obligations and the need to alleviate poverty are also met)
- Assign responsibility for rehabilitation and maintenance of infrastructure, and funding of these functions, to the road authorities responsible for maintenance of the adjoining roads;
- **Establish an effective regulatory regime which will ensure safety and appropriate standards of service**
- Eradicate or control the problem of water hyacinth on the lakes and rivers.

3.8 Institutional Setup

3.8.1 National Setup

The Ministry of Water and Environment is mandated to plan, manage, maintain, develop and coordinates all water and environmental sector activities in Uganda. The ministry is the ultimate authority responsible for water resources and environmental management in Uganda. It is mandated to manage and regulate all water resources, determine priorities for water development and management, and to set national policies and standards. The ministry is comprised of three directorates: Directorate of Water Development (DWD), Directorate of Environmental Affairs (DEA), and Directorate of Water Resources Management (DWRD). The Directorate of Water Resources Management is responsible for: (i) provision of water resources related advisory services to the Government of Uganda, private sector and NGOs at national and local levels; (ii) regulation of water use; (iii) water resources monitoring and assessment; and (iv) coordination of transboundary water resources initiatives. Figure 3.1 provides the overview of the water sector setup.

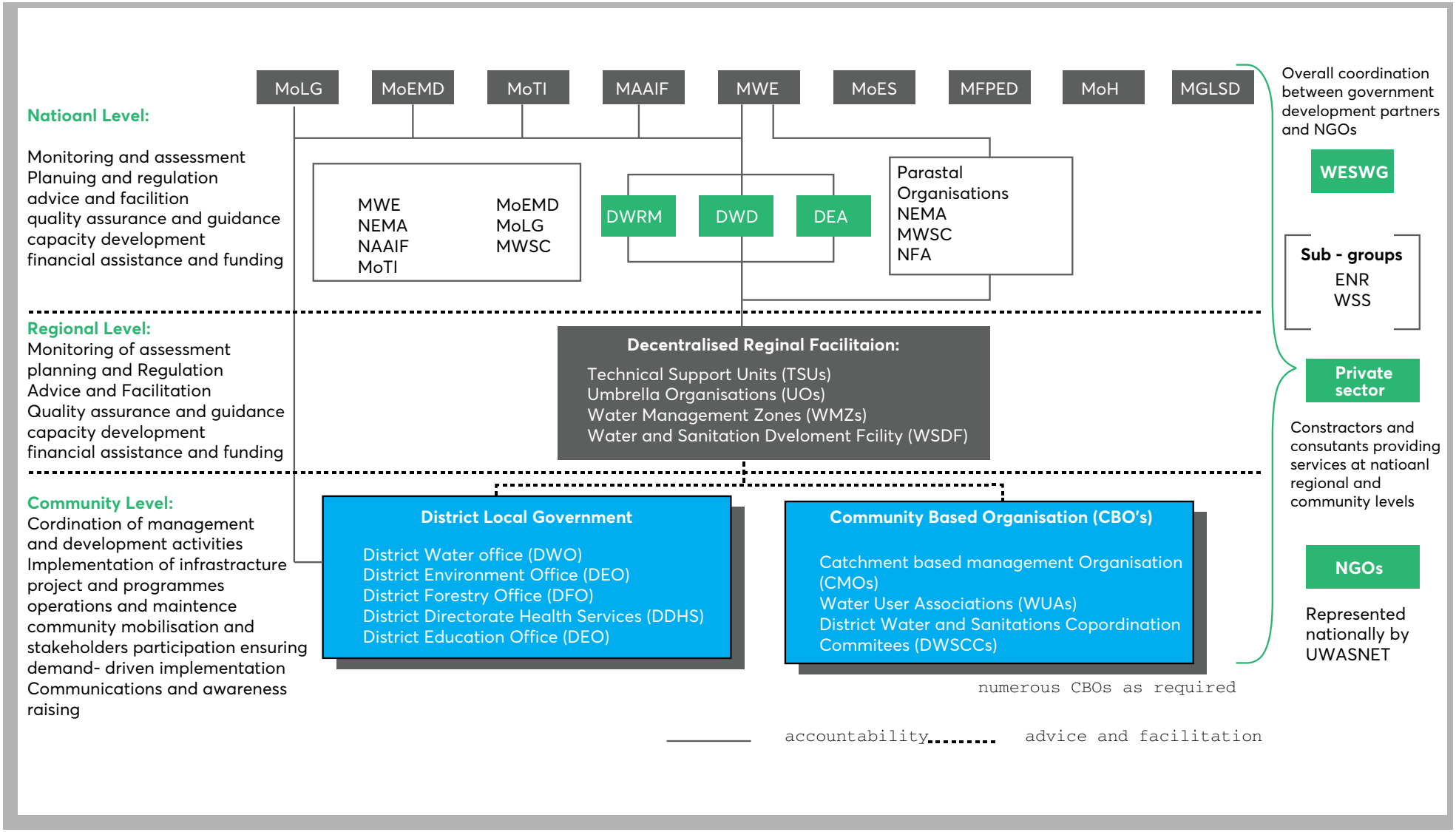


Figure 3.1: Overview of the water sector setup

Coordination is a key process for Integrated Water Resources Management (IWRM), which involves multiple stakeholders from different sectors, on different scales, and with different structures and interests. At the national level the following committees are relevant to integrated water resources management:

- The Policy Committee on Environment, which is chaired by the Prime Minister, at the highest level of political decision-making
- The Water Policy Committee, which is composed of directors, and enables high-level and strategic dialogue specifically in the water sector
- The IWRM Working group, which is an informal working group enabling technicians to coordinate
- The Water and Environment Sector Working Group (WESWG)
- The InterMinisterial Technical Committee regarding Water for Production, comprising of members from the MWE, Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF), Office of the Prime Minister, National Planning Authority and Ministry of Finance. It meets on a quarterly basis to coordinate investments and works regarding water for production.
- The Wetlands Advisory Group (WAG), which is a technical group dedicated to wetlands. The WAG improves coordination on wetlands issues, particularly on the issue of dry-land rice
- The MWE-DWRM has created Water Net, a network for building capacities of stakeholders connected to the water sector.

The NEMA is the apex body for environmental law enforcement in Uganda. However, several functions have been delegated to other institutions as lead agencies in their respective fields. NEMA is in charge of:

- Review and administrative clearance of environmental evaluations, in conjunction with other lead agencies
- Delivery of permits (for instance, permits for activities within the legal buffer zones of waterbodies). The responsibility of delivering permits is vested into the different lead institutions
- Monitoring compliance. The responsibility of control is distributed over 375 gazetted inspectors (2014) distributed in many Ugandan institutions (including the MWE). Only 30 of them belong to NEMA.

An Environmental Police has been formed at NEMA, comprising 25 officers. Only five regional Environmental Police officers (liaison officers) have been designated, among which one is based in Mbale (for the eastern region: his area covers 52 districts corresponding to ¼ of the country) and one in Jinja (for the South-eastern region). The liaison officers belong to the regular police but are specifically trained in environmental issues. They are under the command of the territorial police (Regional Police Commander/District Police Commander). Their functions include sensitisation, demarcation, control, issuing warnings, following up of cases, eviction, and prosecution.

Within each district, there are offices that are in charge of the environment, forestry, wetlands, agriculture, fisheries, and planning among others. However, the structure varies from district to district.

3.8.2 Regional Setup

As a result of the de-concentration of the management of water resources, DWRM created four Water Management Zones (WMZ) following hydrological boundaries. They operate on regional level with the objective of bringing the central services closer to the stakeholders. Their primary role is to facilitate sustainable development of the water resources for the economic and social benefit of the people in the catchment and to implement the water management measures needed to protect and conserve the catchment and its water resources, ensure sustainability and reduce or resolve conflicts over resource use. The WMZs provide for an interactive interface between the central and the local government level sector actors. They coordinate the activities of partners, and monitor and evaluate performance. They facilitate establishment of CMOs, and support them and Local Governments to implement relevant aspects of the de-concentrated functions and services of the DWRM. The WMZ offices are staffed by officials appointed by the Ministry of Water and Environment, to whom responsibility has been transferred to implement defined functions of DWRM. This is meant to strengthen linkages between the central DWRM and the local governments and enhance establishment of stakeholder participation.

The Directorate of Water Development (DWD) established the Water and Sanitation Development Facility (WSDF) as a mechanism for supporting water supply and sanitation facilities for rural growth centres and small towns, intended to promote a demand-responsive approach where Water Authorities/Town Councils or Town Boards apply for funding. The successful applicant is assisted by the WSDF to develop piped water supply systems.

Technical Support Units (TSU) established by DWD at the regional level have the mandate to support capacity building of district-based structures. This involves training, technical advice and support supervision of districts to enable them to effectively implement their roles in the rural sub-sector. The mandate also covers water for production.

Umbrella Organisations (UO) are also regional organisations constituted as associations of the local water supply and Sanitation Boards (WSSB) with the principal objective of providing operation and maintenance (O&M) back-up support (training, technical, legal and organisational support, supervision of rehabilitation and extension works as well as water quality monitoring).

The Directorate of Environmental Affairs has established offices for the wetland department on the regional level.

3.8.3 Catchment Level

At the local level, the Ministry of Water and Environment is represented by the Water Management Zone with the aim of bring services closer to the people. During the catchment management planning process, an institutional setup has to be created which brings stakeholders together to present and exchange their views and thus give the process legitimacy. The Water Management Zone establishes Catchment Management Organisations (CMO) comprising several bodies.

The **Catchment Stakeholder Forum (CSF)** brings together all actors on catchment management. The CSF defines key issues related to water resources in the catchment that require consideration in order to effectively protect, manage and develop water resources. It provides input to the CMP for coordinated, integrated and sustainable development and management of water and related resources in the catchment, including their implementation status.

The **Catchment Management Committee (CMC)** is composed of representatives of all relevant stakeholder groups (government, politicians, and community based organisations, NGOs, water users, media, academic institutions, and private sector) and collaborates with the WMZ during the formulation of a Catchment Management Plan and plays a steering role during its implementation. The CMC responsibilities include:coordination of stakeholder-driven definition of key issues related to water resources, promotion of coordinated planning and implementation as well as stakeholder-driven decision making related to integrated and sustainable development and management of water and related resources, development of plans for coordinated, integrated and sustainable development and management of water and related resources. It endorses the CMP and presents it to the Catchment Stakeholder Forum for information purposes. The CMC acts as an executive board for the Catchment Management Organisation.

The Catchment Management Secretariat (CMS) provides support to the Catchment Management Committee in coordinating the planning and implementation of activities in the catchment as well as following up of recommended actions by the stakeholders. The CMS acts as an administrative secretariat for the Catchment Management Committee as well as the Catchment Technical Committee.

The **Catchment Technical Committee (CTC)** forms the technical arm of the CMO and supports the CMC in their tasks. The CTC brings technical expertise and knowledge during the formulation of the Catchment Management Plan, puts into operation and sometimes implements programmes and projects from the plan, and generally ensures that the different districts collaborate to implement the plan. It comprises technical people from government, NGOs, private sector, development agencies and other relevant organisations in the catchment.

3.8.4 Community Level

The NGOs involved in water sector activities have formed a very important network with over 170 members that is called Uganda Water and Sanitation Network (UWASNET) for improved coordination of their activities in the water sector. The USWANET 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. The Water Act provides for the formation of Water and Sanitation Committees, Water User Groups, and Water User Associations, as local community level organisations, to ensure the sustainability of the water supply and sanitation facilities through proper management, operation and maintenance by the user communities.

Upon construction of a water source, a Water Users Committee (WUC) is usually established to take responsibility for its operation and maintenance. The NGOs and CBOs have important functions in the implementation of IWRM such as activities related to protection of water sources and supply facilities, 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 mobilisation and citizen participation.

The private sector plays a very important role in the water and environment sector by providing the following contributions: private sector contractors and consultants undertaking design and construction works in water supply and sanitation;

private hand pump mechanics and scheme attendants providing maintenance services; about 20 Private Operators managing piped water services in small towns and rural growth centres; as well as private forest owners with registered forests and processing of forest products in the forestry sub-sector. Private Operators are organised in the Association of Private Water Operators (APWO), which aims to professionalise its members, represent their interests at the sector level, provide support services (e.g. procurement of billing systems) and ensure knowledge exchange.

4. STATUS OF THE UPPER NILE WATER MANAGEMENT ZONE

4.1 Overview of the Upper Nile Water Management Zone

The Upper Nile Water Management Zone encompasses almost entirely the northern region of Uganda. It has an extension of about 50,000km^2 and includes the Ugandan part of three river catchments that form the Upper Nile Water Management Zone: Albert Nile, Aswa, and Kidepo.The Albert Nile River stems from Lake Albert and flows to the north through northern Uganda, then at the South Sudanese border it becomes the Bahr al Abyad, or the White Nile. The Aswa River is a major river in north-eastern Uganda which flows northwest into South Sudan where it joins the White Nile. The river originates from the hills in the Upper Nile region and flows through Lira District and marks the border between the Districts of Pader and Gulu. The main tributaries of Aswa are the Agago and Pager rivers. The course of the Aswa River delineates most of the border between the District of Atiak and Kitgum before crossing into South Sudan, east of the border town of Nimule, and joining the White Nile about 10 miles northwest of Nimule.The Kidepo River is a tributary of the Pibor River that runs in eastern South Sudan along the border between South Sudan and Ethiopia. Pibor River flows north for about 320 kilometres and joins the Akabo and Baro rivers to form the Sobat River which is a southern tributary of the White Nile. Only the upper portion of the Kidepo Catchment is included in the study area.

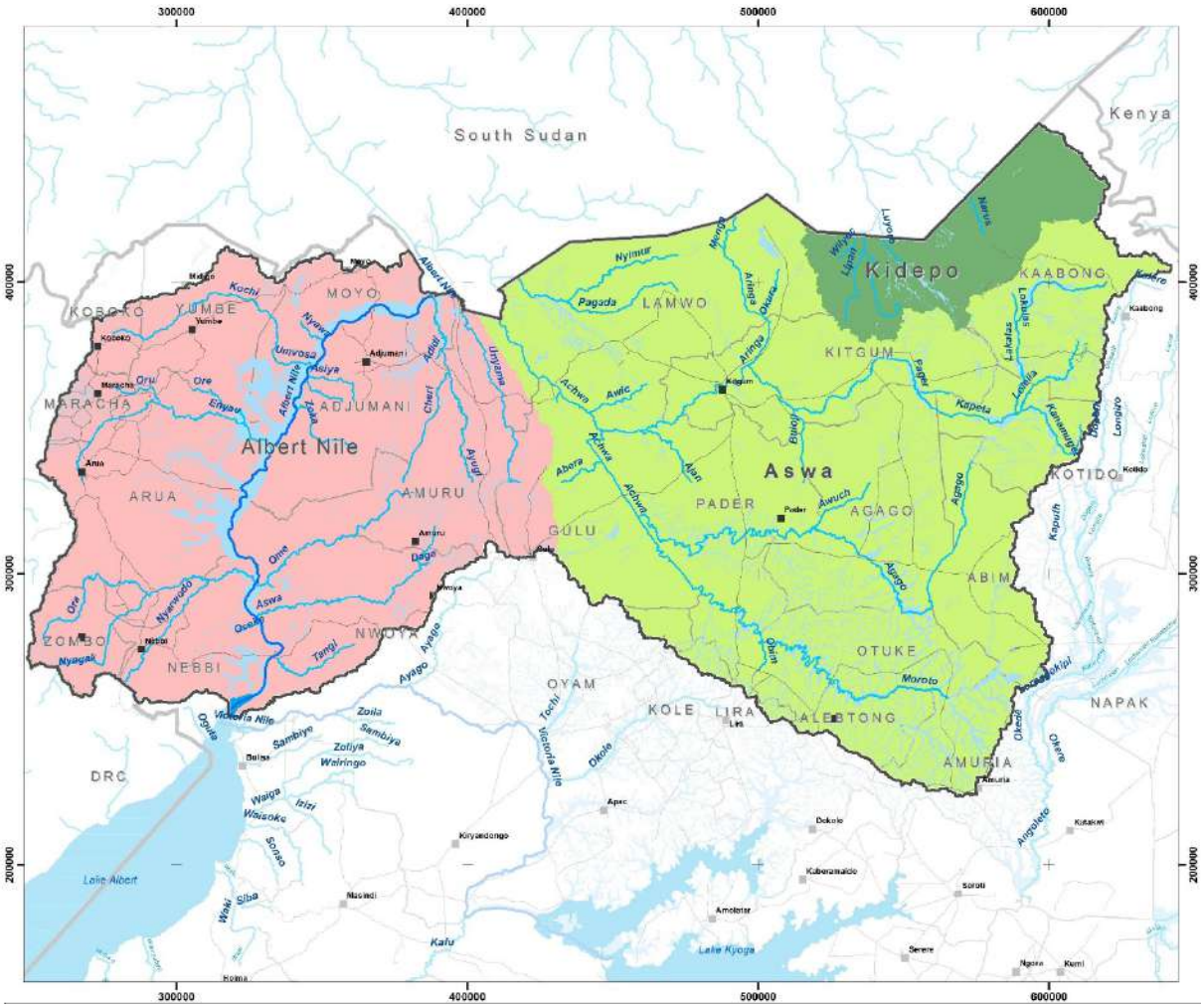


Figure 4.1: Upper Nile WMZ and three catchments of Albert Nile, Aswa, and Kidepo

The eastern part of the Upper Nile WMZ is a plateau with an average altitude of 1300m above sea level (masl) and is characterised by flat-topped hills with gently sloping sides and broad swamp-filled valleys. This northern area of the country has a number of mountains that are of volcanic origin. The western Rift Valley extends along the western border of Upper Nile WMZ and drops to an altitude of about 630m where the Nile leaves the country downstream of Laropi. From Lake Albert, the Albert Nile, follows the western arm of the East African Rift Valley into South Sudan, while the mentioned plateau drains directly into the Bahr el Jebel via the Aswa River, which follows the Aswa shear zone along a 300km north-westerly direction in northern Uganda. The Upper Nile WMZ encompasses 24 districts of the northern region of Uganda

and includes a population of 4,811,000 people. The Table 4.1 below presents the district areas under the Upper Nile MWZ in kilometres and by percentage of total district area.

Table 4-1 Districts included in the study area and percentage of involved area.

District name	Surface [km^2]	Surface inside the study area [%]	District name	Surface [km^2]	Surface inside the study area [%]
Abim	2,352	78%	Lamwo	5,592	92%
Adjumani	3,086	99%	Lira	1,328	39%
Agago	3,494	100%	Maracha	444	98%
Alebtong	1,526	80%	Moyo	1,856	83%
Amuria	2,587	42%	Napak	4,977	6%
Amuru	3,624	98%	Nebbi	2,000	85%
Arua	4,366	100%	Nwoya	4,772	53%
Gulu	3,450	76%	Otuke	1,549	100%
Kaabong	7,220	53%	Oyam	2,189	10%
Kitgum	3,957	99%	Pader	3,360	100%
Koboko	760	46%	Yumbe	2,322	75%
Kole	1,073	14%	Zombo	898	93%
Kotido	3,701	39%			

The river network of Uganda is organised according to a hierarchical hydrological structure that is formed by Water Management Zones, catchments, sub-catchments, and micro-catchments. For the development of the diagnostic and situational analysis, the three main catchments were divided into sub-catchments. Sub-catchments were delineated and used as water balance units for modelling purposes in the Upper Nile WMZ. The sub-catchments delineation was made using Digital Elevation Model data, hydrography and guidance, methodology and elaboration provided in following documents: (i)*Uganda Catchment Management Planning Guidelines* (DWRM, 2014), (ii)*Consultancy Services for the Identification of a Multipurpose Water Resources Management and Development Project in Aswa Basin* (NBI-NEL, 2012) – Aswa MWRMD Project;and (iii) C*onsultancy Services for the Identification of a Multipurpose Water Resources Management and Development Project in Lake Kyoga Basin*(NBI-NEL, 2012).

For the Aswa Catchment, the sub-catchments structure adopted in the Aswa MWRMD project was considered. For the Albert Nile and Kidepo catchments, a specific sub-catchment delineation was not available, therefore the sub-catchment were delineated from the DEM.There are 20 sub-catchments that were delineated in the Upper Nile WMZ: 11 in the Albert Nile Catchment, eight in the Aswa Catchment, and one in the Kidepo Catchment, as shown in the Figure 4.2 and Table 4.2 below.

Table 4.2: List of delimited sub-catchment for Albert Nile, Aswa, and Kidepo rivers.

River basin	Sub-catchment	Area (Km^2)	River basin	Sub-catchment	Area (Km^2)
Albert Nile	Ora	2,319	Aswa	Aswa III	2,666
	Pakwach	1,306		Pager Kitgum	3,416
	Panyango	2,024		Nyimur	2,084
	Ome	1,518		Pager Aringa	1,493
	AN_up_Enyau	2,982		Pager Matidi	6,255
	Enyau	2,183		Agago	5,109
	AN_up_Kochi	1,730		Aswa II	1,588
	Kochi	1,633		Aswa I	5,063
	Laropi	953	Kidepo	Kidepo	3,259
	Ayugi	2,526			
	Unyama	1,574			

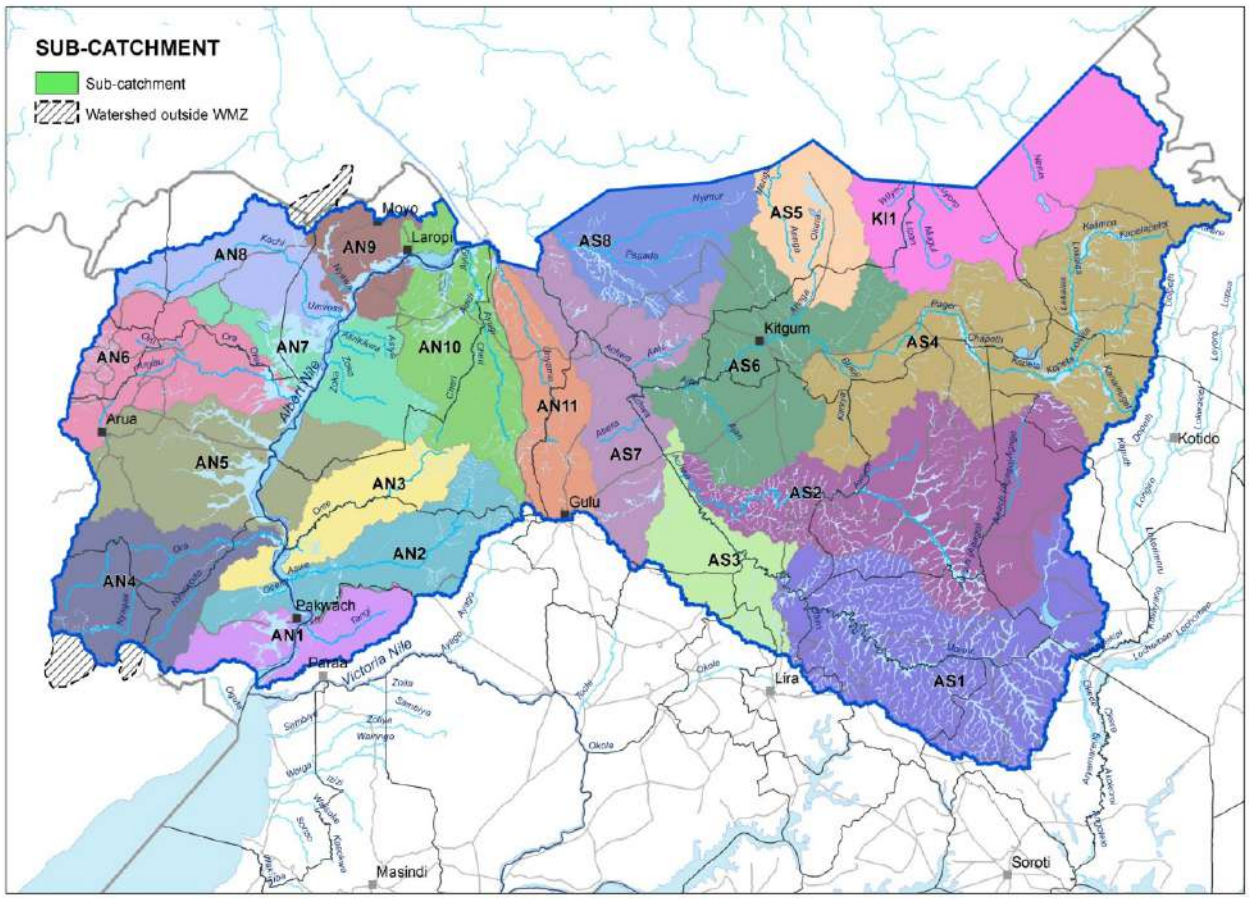


Figure 4.2: Map of delineated sub-catchments for Albert Nile, Aswa, and Kidepo catchments

4.2 Socio-economic Context

4.2.1 Population

According to the results of the 2014 National Population and Housing Census (NPHC), Uganda's population was estimated at about 34 million. The total population of the districts that are entirely or partially encompassed in the Upper Nile WMZ is approximately 6.3 million. Of the 24 districts encompassed in the Upper Nile WMZ, 10 are entirely included and the remaining 14 are only partially included in the WMZ. The area of the Upper Nile WMZ is 76% of the total area of the districts encompassed in the WMZ, and the population within the Upper Nile WMZ is 4.83 million (77 % of total population of the districts encompassed in the WMZ).

Table 4.3: Census 2014 Final Results - Total population in Northern Districts

District	Male	Female	Urban	Rural	Total	District	Male	Female	Urban	Rural	Total
Abim	52,963	56,076	17,400	91,639	109,039	Kotido	85,291	93,618	13,990	164,919	178,909
Adjumani	111,503	121,310	43,022	189,791	232,813	Lamwo	64,577	69,473	17,481	116,569	134,050
Agago	110,095	117,391	29,167	198,319	227,486	Lira	196,891	213,625	99,059	311,457	410,516
Alebtong	109,276	116,051	6,628	218,699	225,327	Maracha	87,278	98,898	8,901	177,275	186,176
Amuria	131,533	139,068	7,066	263,535	270,601	Moyo	67,937	69,552	10,507	126,982	137,489
Amuru	92,502	98,014	9,846	180,670	190,516	Nebbi	184,507	200,713	57,335	327,885	385,220
Arua	373,762	411,427	62,657	722,532	785,189	Nwoya	62,899	65,195	13,489	114,605	128,094
Gulu	215,610	228,123	152,276	291,457	443,733	Otuke	51,444	54,173	6,217	99,400	105,617
Kaabong	79,932	89,342	11,543	157,731	169,274	Oyam	188,704	199,307	11,857	376,154	388,011
Kitgum	98,438	105,574	44,604	159,408	204,012	Pader	88,148	95,575	14,080	169,643	183,723
Koboko	102,091	106,072	37,825	170,338	208,163	Wakiso	952,781	1,054,919	638,487	1,369,213	2,007,700
Kole	117,439	124,439	8,833	233,045	241,878	Yumbe	229,811	255,771	35,606	449,976	485,582
						Zombo	115,411	124,957	45,847	194521	240,368

Source: UBOS, 2015

Table 4.4: District area and population within the Upper Nile WMZ

District name	Total Area (km²)	Total Population (2014)	Area within UN-WMZ (%)	Population within UN-WMZ (%)	Population within UN-WMZ (2014)	Population within UN-WMZ (2030)	Population within UN-WMZ (2040)
Abim	2,749	109,039	74%	100%	109,039	174,895	221,706
Adjumani	2,955	232,813	100%	100%	232,813	373,424	473,372
Agago	3,524	227,486	100%	100%	227,486	364,880	462,540
Alebtong	1,551	225,327	80%	78%	175,755	282,124	357,635
Amuria	2,587	270,601	42%	50%	135,301	217,018	275,102
Amuru	3,671	190,516	99%	100%	190,516	305,581	387,370
Arua	4,339	785,189	100%	100%	785,189	1,259,417	1,596,501
Gulu	3,501	443,733	76%	80%	354,986	569,592	722,044
Kaabong	7,307	169,274	56%	94%	159,118	255,477	323,855
Kitgum	4,109	204,012	100%	100%	204,012	327,229	414,811
Koboko	759	208,163	47%	73%	151,959	242,895	307,906
Kole	1,061	241,878	13%	15%	36,282	59,190	75,033
Kotido	3,610	178,909	38%	26%	46,516	74,804	94,825
Lamwo	5,443	134,050	100%	100%	134,050	215,012	272,560
Lira	1,342	410,516	39%	28%	114,944	181,417	229,973
Maracha	441	186,176	100%	100%	186,176	298,620	378,546
Moyo	1,890	137,489	83%	100%	137,489	220,528	279,552
Nebbi	2,024	385,220	85%	88%	338,994	545,679	691,731
Nwoya	4,732	128,094	54%	55%	70,452	113,956	144,456
Otuke	1,650	105,617	100%	100%	105,617	169,406	214,748
Oyam	2,248	388,011	10%	15%	58,202	90,812	115,118
Pader	3,331	183,723	100%	100%	183,723	294,686	373,558
Yumbe	2,330	485,582	75%	89%	432,168	694,333	880,171
Zombo	898	240,368	100%	100%	240,368	385,542	488,733
TOTAL	68,052	6,271,786	76%	77%	4,829,275	7,716,517	9,781,847

4.2.2 Water Sector Contribution to Economic Development

From 2005/6 to 2012/13, the Ugandan economy grew, on average, by 7% per annum. In fiscal years 2013/14 and 2014/15, the national economy grew by 4.5% and 5.9% respectively. In Financial Year 2014/2015, the National GDP was Shs74,565 billion and GDP/capita was Shs2,085[5]. The contribution of main sectors to the national economy is presented in the table below. Agriculture is the largest water-related contributor to the economy measured in GDP contribution, employment and export value, followed by tourism. According to the National Water Resources Strategy, the economic sectors directly dependent on 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 US$1,965million (corresponding to around two thirds of all export from Uganda).

Table 4.5: 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[6]	1.2	11	
Tourism	4.0[7]	225[8]	773[9]
Mining & quarrying	0.4	48	100.3

[5] Source: UBOS, 2016 http://www.ubos.org/statistics/macro-economic/national-accounts/

[6] Electricity supply by national utility including hydropower and thermal power

[7] 2011 estimate by World Travel &Tourism Council (WTTC). This is the direct estimate and does not include indirect and induced impacts.

[8] 2011 estimate by WTTC

[9] 2010 estimate by WB: Uganda, Migration and Remittances Fact Book 2011

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

4.3 Water Resources Assessment

The main purposes of the Water Resources Assessment of the Upper Nile WMZ are to:

i) Describe the state of the physical resource base in the basin including demand and availability of surface and ground water, and water quality
ii) Identify sensitive ecosystems and critical portions of the natural environment within a watershed context and assess the effects of water quality on the ecosystems
iii) Assess social issues, vulnerabilities, challenges (including gender issues, vulnerable groups, etc.) related to water resources development and management
iv) Delineate the watersheds within the Upper Nile WMZ
v) Prepare an inventory of matters related to the physical resource base including the effects of water development on the environment.

This assessment of consistence, availability and quality of water resources within the WMZ is a key element of the water balance analysis and provides the ground for the formulation of a consistent and sustainable Water Development and Management Strategy and Action Plan. In the Water Resources Assessment, an inventory of matters and problems related to the physical water resource base is developed in terms of:

- Water Resources Availability for Use: Surface and Groundwater, Water Quality, Flooding, Drought
- Effects of climate change on water resources: Effects of Water Development on the Environment, Sources and causes of degradation of land and water, Riparian ecosystems, Wetland ecosystems, Other ecosystems and Natural Resources, Environmental issues
- Assessment of future watershed conditions, their use and associated values: Future use and values of water resources, Future use and values of environmental resources (ecosystems and natural resources).

The assessment of water resources is based on the analysis of hydrometeorology, surface and groundwater hydrology, hydrogeological conditions, water quality, integration of climate change scenarios, and the delineation of watersheds.

4.3.1 Surface Water Assessment

The water resources availability is estimated for the three catchments in the Upper Nile WMZ.A monthly water-balance model has been used to examine the various components of the hydrologic cycle (for example, precipitation, evapotranspiration, and runoff). Surface flows have been estimated using a conceptual rainfall-runoff model linking climate to runoff and, in catchments, the runoff estimates for individual sub-catchments have been accumulated to give estimates for the total flows at the downstream points. Based on available time series of rainfall, the following monthly flows are calculated at selected gauging stations along the Albert Nile River and its tributaries.

Table 4-6: Mean monthly flow at selected gauging stations along Albert Nile and its tributaries

GAUGING STATIONS ALONG ALBERT NILE'S TRIBUTARIES - FLOW (m^3/s)					
MONTH	R. Achwa at Kilak County	R. Ora at Inde - Pakwach Road	R. Enyau at Arua - Moyo Road	R. Kochi at Yumbe - Moyo Road	R. Ayugi at Atiak - Laropi Road
1	1.0	9.3	1.6	1.4	1.3
2	0.7	7.6	1.3	0.7	1.0
3	0.8	9.5	1.8	1.1	2.0
4	2.9	12.5	2.7	2.0	4.9
5	6.3	13.5	3.1	1.9	18.6
6	8.0	11.0	3.9	2.2	9.0
7	9.9	16.8	6.0	7.2	14.2
8	17.2	25.6	10.8	14.1	24.3
9	23.6	31.8	10.7	14.1	22.0
10	22.0	31.9	10.8	14.3	23.2
11	13.3	31.8	8.5	5.1	14.1
12	3.5	15.5	3.9	1.5	3.4
AVG	8.7	18.1	5.4	5.7	11.6
Period	1969 - 1982	1956 - 1978	1955 - 2015	1955 - 1978	1955 - 2000
Area (km^2)	536	2,775	749	838	1,066
Rainfall/wetness ($l/s/km^2$)	16.1	6.5	7.1	6.8	10.9

Table 4.7: Mean monthly flow at selected gauging stations along the Aswa and its tributaries

ASWA GAUGING STATIONS - FLOW (m^3/s)						
MONTH	R. Aswa I at Puranga	R. Agago at Lira - Kitgum Road	R. Aswa II at Gulu - Kitgum Road	R. Aringa at Kitgum - Mucwini Road	R. Pader at Kitgum – Matidi Road	Aswa III + Nyimur*
1	1.7	0.3	3.6	0.3	0.5	11.0
2	0.6	0.2	1.5	0.2	0.4	2.3
3	1.4	1.9	3.7	0.3	0.4	4.5
4	3.4	2.2	9.5	0.3	1.9	12.1
5	15.7	3.8	41.8	1.0	4.7	52.3
6	14.6	4.2	35.4	1.5	4.3	50.8
7	20.0	7.5	50.8	1.8	9.7	82.0
8	40.9	13.7	131.0	3.8	15.2	240.8
9	44.4	14.0	142.6	3.2	10.4	252.1
10	27.3	8.3	86.0	1.7	4.6	143.8
11	16.3	4.8	41.7	1.5	3.0	71.5
12	8.1	2.4	20.6	1.1	1.9	46.7
AVG	16.6	5.3	48.4	1.4	4.9	82.6
Period	1953 - 1978	1963 - 1981	1953 - 1978	1967 - 1978	1959 - 1978	1967-1978
Area (km^2)	5,063	4,395	12,222	1,493	6,255	27,674
Udom. ($l/s/km^2$)	3.3	1.2	4.0	0.9	0.8	3.0

4.3.2 Ground Water Assessment

Estimates of potential groundwater recharge have been derived from water balance model. Groundwater resources were evaluated, in order to characterise the groundwater availability and exploitation potential within the Upper Nile WMZ. Positive and negative aspects related to this matter are summarised in Table 4.8 in order to identify sub-catchments with high potential and those under critical conditions for ground water exploitation. Values from zero (worst) to four (best) have been assigned for each Upper Nile WMZ sub-catchment according to static water levels, drilling success, ground water recharge and water quality. In the column "overall" the average value of hydrological parameters has been calculated to provide the final classification.

Table 4.8: Potential for groundwater exploitation for Upper Nile WMZ sub-catchments.

River basin	Sub-catchment name	Inferred static water level	Drilling success rate	Groundwater recharge	Water quality	Overall
Albert Nile	Ora	3	3	4	2	3.0
	Pakwach	0	3	2	3	2.0
	Panyango	1	4	4	3	3.0
	Ome	1	4	4	3	3.0
	AN_up_Enyau	2	2	3	3	2.5
	Enyau	4	4	3	4	3.8
	AN_up_Kochi	3	1	3	3	2.5
	Kochi	4	4	2	4	3.5
	Laropi	2	2	2	4	2.5
	Ayugi	3	1	2	3	2.3
	Unyama	3	3	3	4	3.3
	Aswa III	3	3	3	3	3.0
	Pager Kitgum	1	4	1	3	2.3
	Nyimur	1	4	3	4	3.0
Aswa	Pager Aringa	0	3	0	3	1.5
	Pager Matidi	0	2	0	2	1.0
	Agago	3	4	1	3	2.8
	Aswa II	4	4	4	3	3.8
	Aswa I	4	4	3	2	3.3
Kidepo	Kidepo	2	3	0	2	1.8

Within the Upper Nile WMZ, the Enyau, Kochi, and Unyama sub-catchments are the most favourable areas for groundwater exploitation; groundwater potentiality is good also for Ora, Panyango, and Ome sub-catchments. In the remaining part of the Albert Nile Catchment, the potential is low. In the upper portion of Aswa River (Aswa I and Aswa

II), overall groundwater exploitation potential is very high and good results have been obtained in Aswa II, Nyimur, and Agago. Low potential areas include Pager Aringa, Kidepo, and Pager Matidi sub-catchments. Additional investigations are needed to verify local hydrological conditions, but these results appear to be in line with current spatial distribution of borehole and wells belonging to the water supply system.

4.3.3 Water Quality

The existing national water quality monitoring network of DWRM includes only one station for monitoring of surface water resources inside the Upper Nile WMZ, coded SWR017 (Upper Aswa). Most of the monitoring network covers the central-southern part of the country. The available data does not have sufficient spatial and temporal coverage to assess the state of water bodies in the Upper Nile WMZ, due to discontinuity both in time and spatial distribution. Based on available water quality measures, an indirect assessment of organic and nutrients pollution loads from various sources was developed.

The National Water Resources Assessment (NWRA, 2013) contains general information regarding water quality and pollution sources. An estimation of pollutants' loads is done for various sources, namely for people (sanitation), industry, aquaculture, livestock and land runoff. Since the economy of Uganda is still predominantly agricultural, organic matter and nutrients are the major pollutants of the aquatic environment, thus considered pollutant is organic matter, measured through the Biological Oxygen Demand (BOD), total nitrogen (TN) and total phosphorous (TP).

The quality of a given water resource is determined by natural factors and impacts from human activities which can be regulated to some degree. In the following analysis, anthropogenic pollution is considered to identify how human activities can be regulated in order to manage water quality issues.
The parameters used for estimation of N&P loads contained in the NWRA were the basis for the analysis. Population census of 2014 was used to update loads estimations and future scenarios were created based on future population estimations and future water demand. The main organic and nutrient pollution sources from human activities considered were: (i) human settlements, (ii) agriculture and livestock breeding areas, (iii) aquaculture, and (iv) industrial areas.

Pollution related to sanitation systems was considered to be one of the most important factors affecting water quality. The total amount of pollutants depends on the total population number and on the per capita pollutants production.The NWRA (2013) proposed the following values for populations in developing countries with a relatively low protein intake:

- BOD: 40 g/PE/d
- TN: 5 g/PE/d
- TP: 2 g/PE/d.

Pollution from livestock depends on the total number of livestock and on the per capita pollutants production. The total number of livestock is obtained by multiplying the total number of each different type of animal by a conversion factor, in order to have the total number in livestock tropical units (LTU). Pollution contributions were estimated on the basis of values suggested in the NWRA and on bibliographic typical values as follows:

- BOD: 300 kg/LTU/year
- TN: 50 kg/LTU/year
- TP: 10 kg/LTU/year.

In northern Uganda, agriculture is mostly subsistence farming. Based on values obtained from Malawi and the similarity with the Uganda situation, the NWRA (2013), proposes values for the quantity of nutrients in runoff from the land. The more likely export coefficients (nutrients lost per unit area of land per year in kg/ha/year) both for cultivated and uncultivated land are:

- TN: 1.4 kg/ha/year
- TP: 0.3 kg/ha/year.

A document produced by the International Food Policy Research Institute on the use of fertilizers in Uganda in 2008 gives an idea of the amount of fertilizers used. In the northern part of Uganda, there are only around 40 fertilizer dealers, each one selling on average 10t of fertilizers per year, meaning about 0.08kg/ha/year in the Upper Nile WMZ. This amount is much lower than the natural nutrients runoff from uncultivated land and thus it can be neglected for current scenario.

In future scenarios, fertilizer use is likely to increase, thus greater leaching of nutrients from soils can be expected. In the NWRA, values for Malawi were adjusted to take into account a more intensive land use in Uganda in the next years, namely values for cultivated land are supposed to be:

- TN: 2.8kg/ha/year
- TP: 0.6kg/ha/year.

Pollution from aquaculture is calculated accordingly to the amount of fish produced. As suggested from the NWRA, the following values have been considered for each ton of fish produced with cage system, which is considered to be the most polluting system:

- TN: 64kg/t;
- TP: 10kg/t.

Industrial pollution is still quite limited in northern Uganda, as the economy of Uganda is still predominantly based on agriculture. From the NWRA, no contribution to pollution loads from the industrial sector is present in the Upper Nile WMZ. The contribution of the industrial sector to pollution can be estimated based on the number of employees. Only employees from the food processing sector have been considered, since wastewater from this sector is expected to have a high organic load, while wastewater from other sectors are characterised by other types of pollutants that have been neglected. From bibliographic review, following values have been considered:

- BOD: 2,500kg/employee/year
- TN: 10kg/employee/year
- TP: 0.0 kg/employee/year.

From assumptions explained above, it is possible to calculate the total load of organic pollutants and nutrients (BOD, TN, and TP) for each sub-catchment. This load represents the amount of pollutant produced at the pollution source, without taking into account any degradation, decay or retention process.

The results for the three scenarios - current 2015, 2030, and 2040 - are presented *Figure 4.3* **BOD loads at source in t/year for each sub-catchment in 2015, 2030 and 2040.**

and *Figure 4.4* **Total nitrogen loads at source in t/year for each sub-catchment in 2015, 2030 and 2040.** below.

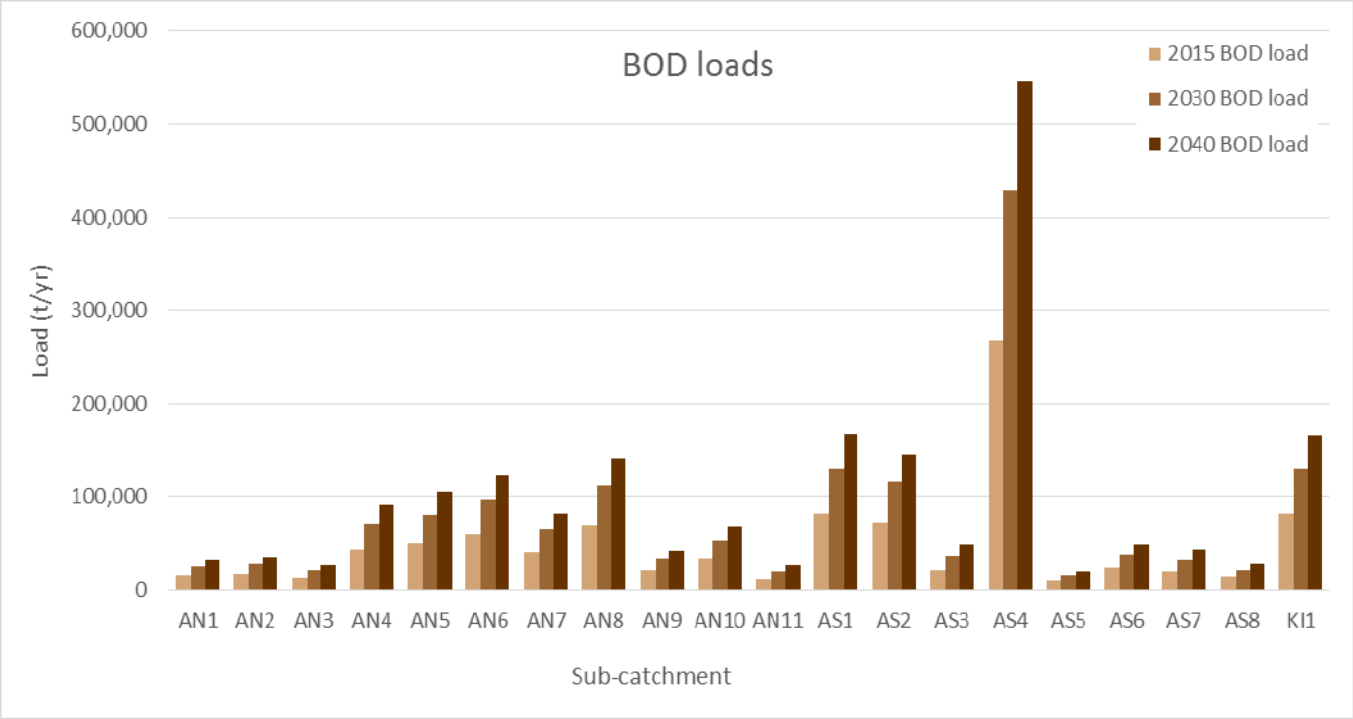


Figure 4.3: BOD loads at source in t/year for each sub-catchment in 2015, 2030 and 2040.

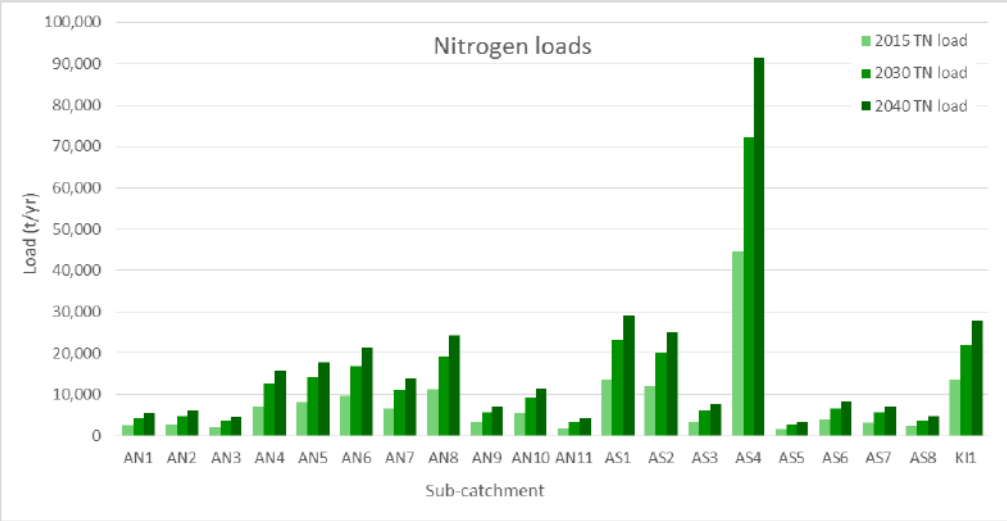


Figure 4.4: Total nitrogen loads at source in t/year for each sub-catchment in 2015, 2030 and 2040.

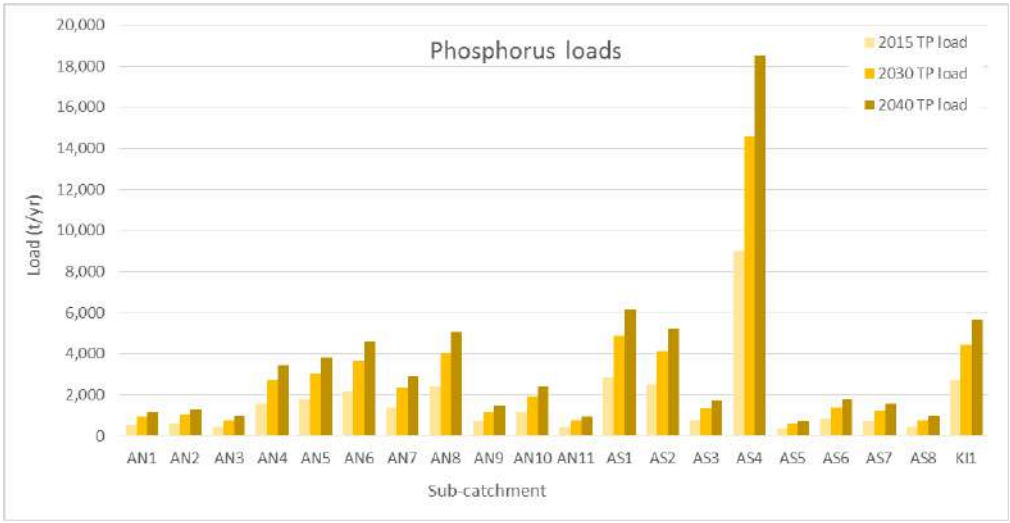


Figure 4.5: Total phosphorus loads at source in t/year for each sub-catchment in 2015, 2030 and 2040.

4.4 Climate variability and extreme climate events

The climate variability and change was assessed in order to evaluate the effects of climate change within the timeframe of the Strategy. It aimed at evaluating the water availability and performing water balance for future scenarios. The main activities can be summarised in the following steps:

- Investigate the physical basis of climate change
- Assign values to specific parameters in the water resource assessment for future scenarios
- Integrate these parameters in the water resource assessment for future simulations.

In particular, data regarding future projections for 2010-2040 of main climatic variables (temperatures and rainfall) has to be considered for the analysis. As a conclusion, it is found that within the spectrum on temperatures in Uganda, and in particular for the mean annual value (about 24°C), potential evapotranspiration shall increase of about 7% in 2030 and 10% in 2040. These results have been included in the water resources assessment and water balance scenarios.

4.4.1 Water Balance

The water resources assessment initially considered the mean hydrological year, associated with the current condition on surface network and groundwater system in a pristine scenario. In addition, the drought year and the impact of climate change in 2030 and 2040 have been evaluated. The analysis of water uses estimated the current water demand from different economic sectors and the projected demands to year 2030 and 2040. Combining the above mentioned evaluation of water resources and water uses, four scenarios for water balance were elaborated:

- Scenario 1: mean hydrological year and water use 2015
- Scenario 2: drought hydrological year and water use 2015
- Scenario 3: mean hydrological year with climate change at 2030 and water use 2030
- Scenario 4: mean hydrological year with climate change at 2040 and water use 2040.

The results of water balance analysis for the above mentioned scenarios included the mean and drought hydrological year and climate change affecting mean hydrological year in 2030 and 2040.

The key of codes listed in the following tables are:

WDg or WDgross	Gross Water Demand
WDn or WDnet	Net Water Demand (return flow is considered thus, for instance, hydropower plants has null water requirements)
Qsb	Overall resource in a sub-catchment
Qtot	Overall resource in a sub-catchment and in its upstream sub-catchments (Qtot = Qsb if there are no upstream sub-catchments)
dry period	from November to April
wet period	from May to October.

The objective of reconciliation analysis is to provide a comprehensive balance of beneficial, effective and efficient water requirements, and assessed water availability (quality and quantity) for the current situation and for potential future scenarios within a WMZ. The analysis takes into account the water situation assessment, the vision and the water required to meet the reconciliation. The intended outcome is a catchment-based reconciliation of water resources availability versus demand requirements for the current state and for the projected situation articulated in the vision and subsectors areas up to 2040.The ultimate scope of reconciliation is the gap filling of water demand in 2040 for the highest number of users.

In the analysis, different water demands are considered separately by distinguishing between consumptive uses (domestic, crops, livestock, fishery and industry) and non-consumptive uses (hydropower plants), as reported in the Table 4-9. It is noteworthy that the gross water demand is higher in dry period mainly due to higher water requirements for agriculture (rainfed in wet season).
From water balance (Table 4.10) it can be noted that overall water demand for people and production in 2040 cannot be supplied during the dry semester for Kidepo River and for the Aswa sub-catchments, except Nyimur. Within the Albert Nile River basin, water deficits have been found in Pakwach, Enyau, Kochi and along the main course of Albert Nile upstream the confluence with Enyau.
For all the Albert Nile sub-catchments the water surplus during the wet semester would generally allow to compensate the deficits during the dry period: in fact, in the wet semester gross demand for people and production is lower than 20% of water resources. This is generally valid also for Aswa River catchment, except for the eastern part of the basin (for Agago is 40%, Aringa 50%) and Kidepo River (70%). For Pager Matidi the water deficit in the dry period cannot be compensated with water storage during the wet semester.

Another crucial component for water reconciliation is the environment. The water dependent ecosystems are taken into consideration for water resource allocation through both water for the wetlands and Environmental Flows (EF). The former aims at maintaining the ecosystem services and livelihoods. This evaluation includes future needs due to climate change scenarios and it has been entirely included in the water resource assessment. The latter aims at establishing minimum flow levels needed to sustain healthy rivers and riparian ecosystems. This is estimated on the basis of river monthly discharges and is expressed as a percentage of mean flow during the dry and wet period.
As shown in Table 4-11, for the Aswa River sub-catchments the environmental flows are generally very low: all of them have Environmental Flows less than 3% of water resources during the wet semester, while Environmental Flows range between 3% and 5% for half of the sub-catchments during the dry period. This does not appear to be an adequate threshold for ecosystem protection especially for the large seasonal and perennial wetlands in the upper part of Aswa and Agago rivers. Because of this, the minimum EF percentage for Aswa and Kidepo Rivers is fixed at 10%.

In the Albert Nile Catchment, most of sub-catchments have a ratio between environmental flow and river discharge around 3-4% in the wet semester and 10-15% during the dry period. Even in this case, further investigation should identify an

additional water reserve. On the contrary, the Ora, Enyau, and Kochi sub-catchments have high values of Environmental Flow because the hydrological river regime does not have relevant variation during the year, thus Environmental Flow is around 15-30% in wet period and 45-55% during dry seasonal. This latter limitation might be too restrictive for these basins thus the maximum Environmental Flow percentage is fixed at 30%.Besides, the complementary percentage to the values included in Table 4.11 leads to the identification of the amount for "sustainable water use" or rather the portion of water resources that might be withdrawn preserving environmental flow.

Table 4.9: Water demand in 2040 for UN WMZ sub-catchments.

WATER DEMAND 2040 (m³/d)										
Catchment	**Sub-Catchment Name**	**SubC. ID**	**People**	**Crop (dry period)**	**Crop (wet period)**	**Livestock**	**Aquaculture**	**Industry**	**Total Consumptive (dry period)**	**Total Consumptive (wet period)**
Albert Nile	Pakwach	AN1	12,558	170,871	0	358	12,300	1,377	197,464	26,593
	Panyango	AN2	10,868	128,237	0	1,485	10,854	1,076	152,520	24,283
	Ome	AN3	8,842	102,867	0	1,451	8,976	940	123,076	20,209
	Ora	AN4	47,343	644,314	0	534	46,142	4,787	743,120	98,806
	AN_up_Enyau	AN5	40,016	635,266	0	788	41,135	6,083	723,288	88,022
	Enyau	AN6	49,524	627,351	0	440	51,222	5,343	733,880	106,529
	AN_up_Kochi	AN7	17,986	200,827	0	203	17,979	829	237,823	36,996
	Kochi	AN8	34,227	371,944	0	372	34,977	2,347	443,866	71,922
	Laropi	AN9	7,459	113,918	0	300	7,580	720	129,977	16,059
	Ayugi	AN10	15,896	173,003	0	1,128	15,783	1,123	206,933	33,930
	Unyama	AN11	14,263	164,252	0	1,068	12,761	2,555	194,899	30,647
Aswa	Aswa I	AS1	44,916	967,321	42,436	1,226	46,990	5,486	1,065,939	141,053
	Agago	AS2	27,289	408,925	123,234	2,390	27,249	812	466,666	180,975
	Aswa II	AS3	24,407	414,880	0	488	23,003	6,935	469,714	54,834
	Pager Matidi	AS4	26,051	457,808	228,891	4,524	25,891	2,003	516,277	287,360
	Pager Aringa	AS5	4,013	57,179	22,408	1,361	3,888	281	66,722	31,952
	Pager Kitgum	AS6	14,987	187,753	15,200	2,559	14,728	1,295	221,322	48,769
	Aswa III	AS7	22,863	229,980	0	2,507	19,718	4,083	279,151	49,171
	Nyimur	AS8	4,718	72,833	0	1,905	4,670	186	84,312	11,479
Kidepo	Kidepo	KI1	12,022	162,121	79,170	1,712	11,912	980	188,747	105,796
UN WMZ			440,248	6,291,651	511,339	26,799	437,757	49,242	7,245,697	1,465,385

Table 4.10: Water resources and deficits in 2040 for UN WMZ sub-catchments.

WATER RESOURCES AND DEFICIT 2040										
Catchment	Sub-Catchment Name	SubC. ID	WR - Dry period (MCM)	WR - Wet period (MCM)	WR - Year (MCM)	Deficit - Dry period (%)	Deficit - Wet period (%)	Deficit - Dry period (MCM)	Deficit - Wet period (MCM)	Deficit - Year (MCM)
Albert Nile	Pakwach	AN1	35	119	154	106%	6%	-1	113	112
	Panyango	AN2	90	341	431	32%	2%	62	336	398
	Ome	AN3	58	225	282	41%	2%	35	221	256
	Ora	AN4	205	353	558	67%	6%	69	333	402
	AN_up_Enyau	AN5	127	331	458	106%	6%	-6	313	307
	Enyau	AN6	122	279	401	111%	8%	-13	257	244
	AN_up_Kochi	AN7	54	206	260	86%	5%	9	197	206
	Kochi	AN8	64	205	269	133%	9%	-20	188	168
	Laropi	AN9	39	125	164	65%	4%	15	121	136
	Ayugi	AN10	112	501	613	36%	2%	73	493	566
	Unyama	AN11	91	394	484	40%	2%	55	388	443
Aswa	Aswa I	AS1	40	338	378	497%	9%	-156	309	152
	Agago	AS2	18	117	135	489%	32%	-70	80	11
	Aswa II	AS3	36	241	277	239%	5%	-49	230	181
	Pager Matidi	AS4	13	80	93	832%	86%	-95	12	-83
	Pager Aringa	AS5	4	22	25	375%	32%	-9	16	7
	Pager Kitgum	AS6	23	120	144	181%	9%	-18	111	93
	Aswa III	AS7	43	314	357	120%	3%	-8	304	297
	Nyimur	AS8	28	133	161	59%	3%	12	131	143
Kidepo	Kidepo	KI1	8	46	54	486%	54%	-30	22	-8

Table 4.11: River flow regime within UN WMZ sub-catchments.

RIVER FLOW REGIME								
Catchment	**Sub-Catchment Name**	**SubC. ID**	**River discharge (m^3/s)**				**Environmental flow (%)**	
			Mean in Dry semester	**Mean in Wet semester**	**Yearly Mean**	**Monthly Minimum**	**Dry semester**	**Wet semester**
Albert Nile	Pakwach	AN1	2.7	9.3	6.0	0.41	15%	4%
	Panyango	AN2	6.9	25.7	16.3	0.90	13%	4%
	Ome	AN3	4.4	17.1	10.7	0.49	11%	3%
	Ora	AN4	14.7	26.4	20.6	7.77	53%	29%
	AN_up_Enyau	AN5	9.5	25.5	17.5	2.36	25%	9%
	Enyau	AN6	8.9	21.1	15.0	4.73	53%	22%
	AN_up_Kochi	AN7	4.2	15.9	10.1	0.44	10%	3%
	Kochi	AN8	4.8	15.6	10.2	2.14	45%	14%
	Laropi	AN9	3.0	9.6	6.3	0.90	30%	9%
	Ayugi	AN10	8.5	36.9	22.7	1.03	12%	3%
	Unyama	AN11	6.7	28.7	17.7	0.81	12%	3%
Aswa	Aswa I	AS1	3.6	28.8	16.2	0.11	3%	0.4%
	Agago	AS2	1.6	10.6	6.1	0.05	3%	0.5%
	Aswa II	AS3	2.9	18.5	10.7	0.16	5%	0.9%
	Pager Matidi	AS4	1.1	8.4	4.8	0.11	10%	1.3%
	Pager Aringa	AS5	0.4	2.4	1.4	0.06	15%	2.4%
	Pager Kitgum	AS6	2.1	10.9	6.5	0.33	16%	3.1%
	Aswa III	AS7	3.5	24.5	14.0	0.13	4%	0.5%
	Nyimur	AS8	2.3	11.0	6.6	0.34	15%	3.1%
Kidepo	Kidepo	KI1	0.8	4.7	2.8	0.11	14%	2.4%

After setting the above mentioned parameters, the water reconciliation for 2040 was made. In particular, three alternative reconciliations were proposed:

- "**Natural Reconciliation**" if volume for sustainable use during the dry period (hydrological scenario with climate change) is higher than the sum of water requirements for all different consumptive users
- "**Reconciliation with storage**" if the sustainability is reached conserving the water resources in dry period and water surplus during wet semester; in this case the volume to be stored is calculated
- "**Partial Reconciliation**" when the previous case does not allow to entirely satisfy water demand for 2040 (dry period).

An explanation on water reconciliation is provided with example of calculation done for Pager Aringa sub-catchment.

Table 4-12: Parameters for water reconciliation in 2040 (Pager Aringa).

PARAMETERS FOR RECONCILIATION – Pager Aringa	
Resources dry period (MCM) =	3.5
Environmental Flow in dry period (%) =	15.2%
Environmental flow dry period (MCM) =	0.54
Demand dry period (MCM) =	12.0
Demand wet period (MCM) =	5.8
Balance dry period (MCM) =	-8.8
Balance wet period (MCM) =	15.8
Sustainability dry period (MCM) =	3.0
Reconciliation in dry period =	WITH STORAGE
Storage for Reconciliation (MCM) =	9.0

When the storage for water reconciliation ("Storage for Reconciliation") is identified, then each single water user is considered in order to associate a certain portion of this volume. In particular, the storage during the dry semester is calculated as the volume to supply 90 days of consumption for domestic use and 180 days of consumption for any other users (for irrigation with storage, managed wetland, livestock, and aquaculture).According to the above mentioned criteria,the percentage of water reconciliation for each type of users for 2040 is finally assessed (Table 4.13). Values lower than 100% indicate the development of a specific economic activity is necessarily limited in comparison with projection for 2040: this is to exploit the available resources in a sustainable manner. Values of reconciliation higher than 100% point out opportunities to further developments.

Table 4.13: Water reconciliation for 2040 (Pager Aringa).

WATER RECONCILATION FOR 2040 – Pager Aringa sub-catchment					
Type of users	**Unit reference for users**	**Reconcilable (%)**	**Storage dry semester (MCM)**	**Reconcilable Users**	**Reconcilable (m^3/d)**
Domestic urban supply	People	100%	0.10	13,452	1,027
Domestic rural supply	People	100%	0.26	73,426	2,608
Irrigation (all types)	Irrigated area (ha)	100%	7.7	1,905	79,587
Livestock	LTU	100%	0.25	26,847	1,361
Aquaculture	Pond area (ha)	100%	0.7	161	3,888
Industry	Employees	100%	-	480	281
Total in dry period (m^3/d)		-	25,083	-	66,722
Total in dry period (MCM)		-	9.0	-	12.0

At catchment scale the results of water reconciliation for the three river basins of Upper Nile WMZ, in terms of volume (MCM), are included in the following table. For Albert Nile River basin the water reconciliation is "natural" for four sub-catchments (Panyango, Ome, Ayugi and Unyama), while storage is required for others. For Aswa River basin only Nyimur can reach natural water reconciliation, six sub-catchments must implement storage (all three along Aswa main course, Pager Aringa and Pager), while one sub-catchment cannot reach the complete water reconciliation (Pager Matidi). In the Kidepo River catchment, one sub-catchment cannot reach the complete water reconciliation.

Table 4.14: Parameters for water reconciliation in 2040 for Upper Nile WMZ catchments.

PARAMETERS FOR WATER RECONCILIATION			
Parameters	**Albert Nile**	**Aswa**	**Kidepo**
Resources dry period (MCM)	997	205	8.1
Demand dry period (MCM)	700	571	34
Demand wet period (MCM)	100	145	19
Balance dry period (MCM)	278	-392	-30
Balance wet period (MCM)	2,959	1,193	22
Environmental Flow in dry period (%)	23%	11%	14%
Reserve Flow dry period (MCM)	227	23	1.1
Sustainability dry period (MCM)	770	181	7.0
Reconciliation in dry period	7 Naturally, 4 with Storage	1 Naturally, 6 with Storage, 1 Partially	Partially
Storage for Reconciliation(MCM)	123	329	22

Water reconciliation is complete for all the water sectors in all the sub-catchments of Albert Nile River.In two sub-catchments, Ora and AN-up-Kochi, aquaculture needs to be done intensively compared to what has been generally considered in the present study. For Aswa River basin the water reconciliation is complete for domestic, industrial water supply, and livestock in all the sub-catchments. While in Pager Matidi there is no development for aquaculture and development for irrigation is also very limited.Kidepo has full development of domestic and industrial water supply, and livestock. Irrigation and aquaculture might be only partially developed according to projection on 2040.

Table 4.15: Water reconciliation in 2040 for UN WMZ catchments.

WATER RECONCILIATION (%)			
Type of users	**Albert Nile**	**Aswa**	**Kidepo**
Domestic urban supply	100% for all sub-catchments	100% for all sub-catchments	100%
Domestic rural supply	100% for all sub-catchments	100% for all sub-catchments	100%
Irrigation (all types)	100% for all sub-catchments	very limited for two sub-catchments	53%
Livestock	100% for all sub-catchments	100% for all sub-catchments	100%
Aquaculture	Two sub-catchments intensive aquaculture	null for 1 sub-catchments	40%

WATER RECONCILIATION (%)			
Type of users	**Albert Nile**	**Aswa**	**Kidepo**
Industry	100% for all sub-catchments	100% for all sub-catchments	100%

At catchment scale, water reconciliation for the three river basins of Upper Nile WMZ, in terms of numbers of users, is presented in the following table.

Table 4.16: Users reconciliation in 2040 for Upper Nile WMZ catchments.

USERS RECONCILIATION (people, irrigated hectares, LTU, pond hectares, employees)			
Type of users	Albert Nile	Aswa	Kidepo
Domestic urban supply	671,396	518,838	34,367
Domestic rural supply	5,131,740	3,193,450	231,816
Irrigation (all types)	129,735	80,497	3,186
Livestock	160,306	334,517	33,763
Aquaculture	10,746	5,803	197
Industry	41,832	35,933	1,674

Table 4.17 and Table 4.18 present water reconciliation for each sub-catchment. They, in addition, show sub-catchments with partial or complete reconciliation in the dry periods and storage requirements. Reconciliation is "natural" when storage is not necessary or when it does not exploit the entire surplus in wet period so that opportunities for further development can be identified. This is the case for seven sub-catchments in the Albert Nile and only for Nyimur in Aswa River basin.In Pager Matidi and Kidepo sub-catchments development in 2040 can be partially achieved, therefore, strategies in these sub-catchments should concentrate on actions for ecosystem conservation, most efficient water use (in order to reduce water demand), and improvement of water allocation through management, among others.

Table 4.17: Water reconciliation in 2040 for Albert Nile sub-catchments.

Parameters	Albert Nile										
	Pakwach	Panyango	Ome	Ora	AN_up_ Enyau	Enyau	AN_up_ Kochi	Kochi	Laropi	Ayugi	Unyama
	AN1	AN2	AN3	AN4	AN5	AN6	AN7	AN8	AN9	AN10	AN11
Resources dry period (MCM)	35	90	58	205	127	122	54	64	39	112	91
Demand dry period (MCM)	36	27	22	134	130	132	43	80	23	37	35
Demand wet period (MCM)	5	4	4	18	16	19	7	13	3	6	6
Balance dry period (MCM)	-1	62	35	69	-6	-13	9	-20	15	73	55
Balance wet period (MCM)	113	336	221	333	313	257	197	188	121	493	388
EF in dry period (%)	15%	13%	11%	53%	25%	53%	10%	45%	30%	12%	12%
Reserve Flow dry period (MCM)	5	14	9	62	31	37	8	19	12	17	14
Sustainability dry period (MCM)	30	77	49	144	95	86	46	45	27	95	77
Reconciliation in dry period	With storage	Natural	Natural	Natural	With storage	With storage	Natural	With storage	Natural	Natural	Natural
Storage 4 Reconciliation (MCM)	6	Not Necessary	Not Necessary	Not Necessary	35	47	Not Necessary	35	Not Necessary	Not Necessary	Not Necessary

Table 4.18: Water reconciliation in 2040 for Aswa and Kidepo sub-catchments.

Parameters	Aswa								Kidepo
	Aswa I	Agago	Aswa II	Pager Matidi	Pager Aringa	Pager Kitgum	Aswa III	Nyimur	Kidepo
	AS1	AS2	AS3	AS4	AS5	AS6	AS7	AS8	KI1
Resources dry period (MCM)	40	18	36	13	4	23	43	28	8
Demand dry period (MCM)	192	84	85	93	12	40	50	15	34
Demand wet period (MCM)	25	33	10	52	6	9	9	2	19
Balance dry period (MCM)	-156	-70	-49	-95	-9	-18	-8	12	-30
Balance wet period (MCM)	309	80	230	12	16	111	304	131	22
EF in dry period (%)	3%	3%	5%	10%	15%	16%	4%	15%	14%
Reserve Flow dry period (MCM)	4.0	1.8	3.6	1.3	0.5	3.7	4.3	4.2	1.1
Sustainability dry period (MCM)	36	16	33	12	3	19	39	24	7
Reconciliation in dry period	WITH STORAGE	WITH STORAGE	WITH STORAGE	PARTIAL	WITH STORAGE	WITH STORAGE	WITH STORAGE	NATURAL	PARTIAL
Storage 4 Reconciliation (MCM)	156	68	52	12	9	21	11	NOT NECESSARY	22

4.4.2 Scenario 1: Mean hydrological year and water use 2015

Currently, in the mean hydrological year, the overall water resource for Upper Nile WMZ is about 6.9 BMC/year, while groundwater recharge is about 3.66 BMC/year. In 2015 the gross demand from SW and GW is about 240 MCM/year, while the net demand is about 88MCM/year.

Table 4.19: Scenario 1: Mean hydrological year and water demand 2015

MEAN HYDROLOGICAL YEAR									
Catchment	Area (Km²)	Resource (MCM/y)		Gross demand (MCM/y)			Net demand (MCM/y)		
		Overall	GW recharge	from SW	from GW	Total	from SW	from GW	Total
Albert Nile	21,235	4,761	2,256	175	6.3	182	31	4.7	36
Aswa	27,674	2,060	1,351	47	5.5	53	44	4.0	48
Kidepo	3,259	86	51	5.2	0.4	5.7	4.9	0.3	5.2
UN WMZ	52,168	6,906	3,659	228	12	240	80	9.0	89

In the water balance scenario that combines the mean hydrological year and water use for 2015 the ratio between water demand and water availability is generally very low (less than 4%). For Ora (AN4), Pager Matidi (AS4), and Pager Aringa (AS5) sub-catchments this ratio is about 23%, 13% and11% respectively when gross water demand is considered. In terms of net water demand, only AS4 and AS5 are considered because a large part of the water requirements of AN4 are related to hydropower. The groundwater exploitation varies from 0.1% to 1.2%. At catchment scale the gross water demand ranges between 8% and 24% of water resources in the dry period, while it is around 1% to 4% in wet period. This applies to the AswaCatchment in the dry period alsowhen considering net water demand. In the Kidepo River catchment the water demand, both gross and net, are about 20% of water resources in the dry period.

Table 4.20: Water Balance for the mean hydrological year 2015

MEAN HYDROLOGICAL YEAR				
Catchment	Area (Km²)	Water Balance		
		WDgross/Q	WDnet/Q	GW exploitation
Albert Nile	21,235	3.8%	0.8%	0.3%
Aswa	27,674	2.6%	2.3%	0.4%
Kidepo	3,259	6.6%	6.1%	0.9%
UN WMZ	52,168	3.5%	1.3%	0.3%

MEAN HYDROLOGICAL YEAR					
Catchment	Area (Km²)	WDgross/Q		WDnet/Q	
		Dry period	Wet period	Dry period	Wet period
Albert Nile	21,235	8.3%	2.4%	2.0%	0.4%
Aswa	27,674	12.3%	1.1%	11.3%	1.0%
Kidepo	3,259	23.9%	3.7%	22.2%	3.4%
UN WMZ	52,168	9.2%	2.0%	3.9%	0.6%

4.4.3 Scenario 2: Drought hydrological year and water use 2015

In the drought hydrological year the overall water resources for Upper Nile WMZ is about 4.05BMC/year, while groundwater recharge is about 2.18BMC/year. In 2015 the gross demand from surface water and ground water is about 244MCM/year, while the net demand is about 92MCM/year. It has to be noted that during a drought year water demand is slightly higher than the mean year (even if they are both referred to 2015): this is because crop requirements are higher due to lower precipitation Number

Table 4.21: Scenario 2: Drought hydrological year and water demand 2015

DROUGHT HYDROLOGICAL YEAR				
Catchment		Resource (MCM/y)	Gross demand (MCM/y)	Net demand (MCM/y)

		Overall	GW recharge	from SW	from GW	Total	from SW	from GW	Total
Albert Nile	21,235	3,012	1,486	175	6.3	182	31	4.7	36
Aswa	27,674	1,012	678	51	5.5	56	47	4.0	51
Kidepo	3,259	23	15	5.4	0.4	5.8	5.1	0.3	5.4
UN WMZ	52,168	4,047	2,179	231	12	244	83	9.0	92

In the water balance scenario that combines the dry hydrological year and water use for 2015, the ratio between water demand and water availability is generally very low for most of the sub-catchments (less than 8%, it was 4% in the mean hydrological year). For sub-catchments Ora (AN4), Pager Matidi (AS4), and Pager Aringa (AS5), ratios increase to about 31%, 45% and 47%respectively when gross water demand is considered. Again this issue is relevant in terms of net water demand only for AS4 and AS5, because a large part of the water requirements of AN4 is related to hydropower.

The groundwater exploitation varies from 0.2% to 3.6%. At catchment scale in the dry period, the gross water demand is about 12% of water resources for Albert Nile, 29% for Aswa River basins and 79% for Kidepo River catchment. During the mean hydrological year, ground water exploitation was around 8% to 24% for the three basins. The ratio between gross water demand and water resources is low in wet periods varying from 2.5% for Aswa River to 15% for Kidepo River.These ratios still hold when net water demand is considered. There are very limited net water requirements in the Albert Nile River basin.

Table 4.22: Water balance for the drought hydrological year 2015

DROUGHT HYDROLOGICAL YEAR				
Catchment	Area (Km²)	Water Balance		
		WDgross/Q	WDnet/Q	GW exploitation
Albert Nile	21,235	6.0%	1.2%	0.4%
Aswa	27,674	5.6%	5.0%	0.8%
Kidepo	3,259	25.1%	23.3%	3.1%
UN WMZ	52,168	6.0%	2.3%	0.6%

DROUGHT HYDROLOGICAL YEAR					
Catchment	Area (Km²)	WDgross/Q		WDnet/Q	
		Dry period	Wet period	Dry period	Wet period
Albert Nile	21,235	12.5%	3.8%	2.9%	0.6%
Aswa	27,674	28.6%	2.5%	26.2%	2.2%
Kidepo	3,259	79.3%	14.6%	73.6%	13.6%
UN WMZ	52,168	14.9%	3.5%	6.4%	1.1%

4.4.4 Scenario 3: Mean Hydrological Year with Climate Change at 2030 and Water Use 2030

In the mean hydrological year, considering the climate change in 2030, the overall water resources for Upper Nile WMZ is about 6BCM/year, while groundwater recharge is about 3.2BCM/year. In 2030, the gross demand from surface water and ground water is about 2.4BCM/year, while the net demand is about 1.20BCM/year.

Table 4.23: Scenario 3: Mean hydrological year and water demand 2030

MEAN HYDROLOGICAL YEAR - CLIMATE CHANGE 2030									
Catchment	Area (Km²)	Resource (MCM/y)		Gross demand (MCM/y)			Net demand (MCM/y)		
		Overall	GW recharge	from SW	from GW	Total	from SW	from GW	Total
Albert Nile	21,235	4,268	2,036	1,027	24.1	1,051	638	18.1	656
Aswa	27,674	1,704	1,124	1,299	21.0	1,320	503	15.2	518
Kidepo	3,259	62	38	34.5	1.7	36.2	32.6	1.3	33.9
UN WMZ	52,168	6,034	3,197	2,360	47	2,407	1,173	34.6	1,208

In the water balance scenario that combines the mean hydrological year with climate change and water use for 2030, the ratio between water demand and water availability is generally high for most of sub-catchments when considering gross water requirements.

At the annual scale,six sub-catchments have values lower than 20%, while for Agago and Pager Matidi gross demand equalizes water resources. When net water demand is considered, only the eastern sub-catchment of Aswa River (Pager Matidi) shows a high value of92%. The groundwater exploitation varies from 0.5% to 6%.

At the catchment scale, when considering gross water demand, the dry period is critical for Aswa and Kidepo Rivers because gross water requirements are twice as much as the water available in the dry period. In the Albert Nile, demand is around 60% of water resources. In wet periods these gross water demands are about 13% of water resources for Albert Nile River, 27% for Kidepo River and 56% for Aswa River basin. Critical situations in Aswa and Kidepo River catchment can be found also with the net water demand but exclusively in dry periods.

Table 4.24: Water Balance for the mean hydrological year 2030

MEAN HYDROLOGICAL YEAR - CLIMATE CHANGE 2030				
Catchment	Area (Km²)	Water Balance		
		WDgross/Q	WDnet/Q	GW exploitation
Albert Nile	21,235	25%	15%	1.2%
Aswa	27,674	77%	30%	1.9%
Kidepo	3,259	58%	54%	4.6%
UN WMZ	52,168	40%	20%	1.5%

MEAN HYDROLOGICAL YEAR - CLIMATE CHANGE 2030					
Catchment	Area (Km²)	WDgross/Q		WDnet/Q	
		Dry period	Wet period	Dry period	Wet period
Albert Nile	21,235	59%	13%	43%	6%
Aswa	27,674	218%	56%	164%	10%
Kidepo	3,259	234%	27%	220%	25%
UN WMZ	52,168	88%	27%	66%	8%

4.4.5 Scenario 4: Mean Hydrological Year with Climate Change at 2040 and Water Use 2040

In the mean hydrological year, considering climate change in 2040, the overall water resources for the Upper Nile WMZ is about 5.7BMC/year, while groundwater recharge is about 3BMC/year. In 2040, the gross demand from surface water and ground water is about 3.9BCM/year, while the net demand is about 2.1BCM/year.

Table 4.25: Scenario 1: Mean hydrological year with climate change and water demand for 2040

MEAN HYDROLOGICAL YEAR - CLIMATE CHANGE 2040									
Catchment	Area (Km²)	Resource (MCM/y)		Gross demand (MCM/y)			Net demand (MCM/y)		
		Overall	GW recharge	from SW	from GW	Total	from SW	from GW	Total
Albert Nile	21,235	4,074	1,949	1,757	51.2	1,808	1,078	38.4	1,117
Aswa	27,674	1,570	1,037	1,958	44.7	2,002	903	32.6	935
Kidepo	3,259	54	33	75.3	3.7	79.0	71.1	2.8	73.9
UN WMZ	52,168	5,697	3,019	3,790	100	3,889	2,052	73.7	2,126

In the water balance scenario that combines the mean hydrological year with climate change and water use for 2040, the ratio between water demand and water availability is generally high for most of sub-catchments when considering the gross water requirement. At the annual scale,six sub-catchments have values lower than 30% (it was 20% in 2030), while for five sub-catchments gross demand cannot be satisfied. In 2040, net water demand is a critical issue. Two sub-catchments of Aswa River cannot be

satisfied and half of the sub-catchments in the Upper Nile WMZ have a net water demand that ranges between 40% and 80% of water availability. The groundwater exploitation varies from 1% to 15%.

At the catchment scale, the Aswa River Catchment has gross water requirements that are four times the water availability in dry periods. The Albert Nile and Kidepo River basins show similar issues in terms of gross water demand. They don't have enough water resources in the dry periods and unsustainable demands during wet periods. Critical situations in the dry periods are present when net water requirements are considered for Aswa and Kidepo River basins. Albert Nile River is exploited for about the 85%. There are no critical issues in the wet period when net water demand is taken into account for the three catchments.

Table 4.26: Water balance for the mean hydrological year with climate change 2040

MEAN HYDROLOGICAL YEAR - CLIMATE CHANGE 2040				
Catchment	Area (Km²)	Water Balance		
		WDgross/Q	WDnet/Q	GW exploitation
Albert Nile	21,235	44%	27%	2.6%
Aswa	27,674	128%	60%	4.3%
Kidepo	3,259	147%	138%	11.3%
UN WMZ	52,168	68%	37%	3.3%

MEAN HYDROLOGICAL YEAR - CLIMATE CHANGE 2040					
Catchment	Area (Km²)	WDgross/Q		WDnet/Q	
		Dry period	Wet period	Dry period	Wet period
Albert Nile	21,235	109%	23%	85%	9%
Aswa	27,674	381%	89%	327%	19%
Kidepo	3,259	578%	70%	542%	66%
UN WMZ	52,168	159%	44%	129%	13%

4.5 Upper Nile WMZ Profile

This section presents the outcomes from the analysis of investment projects and evaluation of their relationship with issues and opportunities in water and environmental resources management identified during the resource assessment.The main issues related to water availability in the three river catchments in the UN WMZ are identified. For each issue, a degree of significance is given ranging from one (very low criticality) to four (very high criticality). These results are specific to the Upper Nile WMZ, as they are based on the diagnostic and situational analysis of this area. These considerations are related to each sub-catchment without considering water resources from upstream watersheds in order to analyse the "internal" water resources of the Upper Nile WMZ. In particular,for sub-catchments along the Albert Nile, water outflowing from Albert Lake is not included. The water balance calculations have been performed for different catchment conditions combining various hydrological years and water demand conditions resulting into different scenarios. Each scenario results from a specific hydrological situation and a specific water demand. Hydrological situations include the current situation and the future hydrological conditions influenced by climate change effects, while water demands change according to the degree of population increase and economic growth.

Table 4.27: Issues on water availability in primary sub-catchments of UN WMZ

ISSUES ON WATER AVAILABILITY				
Catchment	Sub-catchment	Drought	Climate change 2030	Climate change 2040
Albert Nile	Ora	2	2	2
	Pakwach	3	2	3
	Panyango	3	2	2
	Ome	3	2	3
	AN_up_Enyau	3	2	3
	Enyau	3	2	2
	AN_up_Kochi	3	2	3

ISSUES ON WATER AVAILABILITY				
Catchment	Sub-catchment	Drought	Climate change 2030	Climate change 2040
	Kochi	3	2	3
	Laropi	3	2	3
	Ayugi	3	2	2
	Unyama	3	2	2
Aswa	Aswa III	3	2	3
	Pager Kitgum	4	3	4
	Nyimur	4	3	3
	Pager Aringa	4	4	4
	Pager Matidi	4	4	4
	Agago	4	3	4
	Aswa II	3	2	3
	Aswa I	4	3	3
Kidepo	Kidepo	4	4	4

4.5.1 Scenario 1: Mean hydrological year and water use for 2015

Based on the above mentioned indicators and procedure, almost all sub-catchment of the Upper Nile WMZ have the following few issues:

- Supplying water to all the users using exclusively the resources within the single sub-catchment
- Supplying water in dry periods for Kidepo River (low) and Pager Aringa and Matidi (high).

Table 4.28: Issues on water balance in the mean year in primary sub-catchments of UN WMZ

ISSUES ON WATER BALANCE - CURRENT SCENARIO							
Catchment	Sub-catchment	Supply level (sub catchment)	Supply level (upstream)	Dry period	Wet period	GW exploitation	Environment
Albert Nile	Ora	1	-	1	1	1	1
	Pakwach	1	-	1	1	1	1
	Panyango	1	1	1	1	1	1
	Ome	1	1	1	1	1	1
	AN_up_Enyau	1	1	1	1	1	1
	Enyau	1	-	1	1	1	1
	AN_up_Kochi	1	1	1	1	1	1
	Kochi	1	-	1	1	1	1
	Laropi	1	1	1	1	1	1
	Ayugi	1	1	1	1	1	1
	Unyama	1	-	1	1	1	1
Aswa	Aswa III	1	1	1	1	1	1
	Pager Kitgum	1	1	1	1	1	1
	Nyimur	1	-	1	1	1	1
	Pager Aringa	1	-	3	1	1	1
	Pager Matidi	1	-	3	1	1	1
	Agago	1	-	1	1	1	1
	Aswa II	1	1	1	1	1	1
	Aswa I	1	-	1	1	1	1
Kidepo	Kidepo	1	-	2	1	1	1

4.5.2 Scenario 2: Drought Hydrological Year and Water Use for 2015

Reduced water availability during the drought year causes some issues in sub-catchments of Aswa River, especially in dry period, as follows:

- Significant water supply issues for the following sub-catchments as follows: in Ora and Kidepo (low) and Pager Aringa and Matidi (high) gross demands become high in proportion to the water resources
- In the dry period, issues of water supply are significantin Pager Matidi, Aringa, and Kidepo in the Aswa River basin
- There is sufficient water for water supply during wet semester, except for Pager Matidi and Aringa where some concern may be raised
- There are no problems identified from withdrawing water from wells
- There is sufficient water for minimum flow along the river network, except for Pager Matidi and Aringa, and Kidepo sub-catchments.

Table 4-29: Issues on water balance in the drought year in primary sub-catchments of UN WMZ.

ISSUES ON WATER BALANCE - DROUGHT SCENARIO							
Catchment	Sub-catchment	Supply level (sub catchment)	Supply level (upstream)	Dry period	Wet period	GW exploitation	Environment
Albert Nile	Ora	2	-	1	1	1	1
	Pakwach	1	-	1	1	1	1
	Panyango	1	1	1	1	1	1
	Ome	1	1	1	1	1	1
	AN_up_Enyau	1	1	1	1	1	1
	Enyau	1	-	1	1	1	1
	AN_up_Kochi	1	1	1	1	1	1
	Kochi	1	-	1	1	1	1
	Laropi	1	1	1	1	1	1
	Ayugi	1	1	1	1	1	1
	Unyama	1	-	1	1	1	1
Aswa	Aswa III	1	1	1	1	1	1
	Pager Kitgum	1	1	1	1	1	1
	Nyimur	1	-	1	1	1	1
	Pager Aringa	3	-	4	2	1	3
	Pager Matidi	3	-	4	2	1	3
	Agago	1	-	2	1	1	1
	Aswa II	1	1	1	1	1	1
	Aswa I	1	-	3	1	1	1
Kidepo	Kidepo	2	-	4	1	1	2

4.5.3 Scenario 3: Mean Hydrological Year with Climate Change at 2030 and Water Use for 2030

Projections on water uses for 2030 identify issues on water supply for the Albert Nile River and Kidepo classified as lowbut very high for Aswa River. Issues concerning water balance areof concern all over the Upper Nile WMZ for the dry period and conservation of minimum flow is at risk in some situations. These issues can be elaborated as follows:

- There are sufficient water resources to satisfy the gross water demand for half of the Albert Nile Catchment. In Enyau and Laropi sub-catchments, concerns of insufficient water resources to cover the gross water demand are high. In the Aswa River basin the situation varies from Nyimur where gross demand can be met to Agago, Pager Matidi and Aswa III where satisfaction of the gross demand is of high concern

- During the dry period the sub-catchments in Albert Nile River basin behave differently: generally high and low gross demand satisfaction are found
- Most of the sub-catchments in the Aswa basin, except Nyimur, and the Kidepo Catchment have significant problems during the semester from November to April
- There are no water supply issues during the wet semester for Pager Aringa and Kitgum
- There are no issues for withdrawing water from wells
- There are concerns of meeting minimum flow requirements for some tributaries of Albert Nile (Ora, Pakwach, Albert Nile upstream Enyau, Enyau, and Kochi), Kidepo River and the Aswa River basin except the lower portion.

Table 4.30: Issues on water balance in 2030 in primary sub-catchments of UN WMZ.

ISSUES ON WATER BALANCE - SCENARIO CLIMATE CHANGE 2030							
Catchment	Sub-catchment	Supply level (sub catchment)	Supply level (upstream)	Dry period	Wet period	GW exploitation	Supply level (sub catchment)
Albert Nile	Ora	2	-	2	1	1	2
	Pakwach	2	-	3	1	1	2
	Panyango	1	1	1	1	1	1
	Ome	1	1	2	1	1	1
	AN_up_Enyau	2	1	3	1	1	2
	Enyau	3	-	3	1	1	2
	AN_up_Kochi	1	1	3	1	1	1
	Kochi	2	-	4	1	1	2
	Laropi	3	1	2	1	1	1
	Ayugi	1	1	1	1	1	1
	Unyama	1	-	2	1	1	1
Aswa	Aswa III	1	1	4	1	1	1
	Pager Kitgum	2	1	4	1	1	2
	Nyimur	1	-	2	1	1	1
	Pager Aringa	3	-	4	1	1	2
	Pager Matidi	4	-	4	2	1	4
	Agago	4	-	4	2	1	3
	Aswa II	2	1	4	1	1	2
	Aswa I	3	-	4	1	1	2
Kidepo	Kidepo	3	-	4	2	1	3

4.5.4 Scenario 4: Mean Hydrological Year with Climate Change at 2040 and Water Use for 2040

According to the water balance for 2040, issues slightly increase in comparison with 2030 for supply level, significantly during dry periods and conservation of environmental flow. From Table 4-31, it can be noted that:

- Issues of supplying gross water demand are high for most of Albert Nile catchments and very high for the Aswa and Kidepo River basins
- In most cases, the mentioned issues are solved considering the residual resource of upstream sub-catchments (not totally for Page Kitgum and Aswa II)
- During dry periods most of the sub-catchments in UN WMZ critical water deficiency problems
- Water deficiency for water supply remains during the wet semester for Kidepo (low), Pager Kitgum (high) and Aringa (very high)
- There are no issues for withdrawing water from wells

- Issues concerning the conservation of environmental flow are significant for several reaches of Albert Nile and high or very high for half of Aswa River and Kidepo River sub-catchments.

Table 4.31: Issues on water balance at 2040 in primary sub-catchments of UN WMZ.

ISSUES ON WATER BALANCE - SCENARIO CLIMATE CHANGE 2040							
Catchment	Sub-catchment	Supply level (sub catchment)	Supply level (upstream)	Dry period	Wet period	GW exploitation	Supply level (sub catchment)
Albert Nile	Ora	3	-	4	1	1	2
	Pakwach	3	-	4	1	1	2
	Panyango	2	1	2	1	1	1
	Ome	1	1	3	1	1	1
	AN_up_Enyau	3	1	4	1	1	3
	Enyau	4	-	4	1	1	3
	AN_up_Kochi	2	1	4	1	1	2
	Kochi	3	-	4	1	1	3
	Laropi	4	1	4	1	1	2
	Ayugi	1	1	3	1	1	1
	Unyama	1	-	3	1	1	1
Aswa	Aswa III	1	1	4	1	1	2
	Pager Kitgum	3	2	4	1	1	3
	Nyimur	1	-	3	1	1	1
	Pager Aringa	4	-	4	2	1	4
	Pager Matidi	4	-	4	4	1	4
	Agago	4	-	4	3	1	4
	Aswa II	3	2	4	1	1	3
	Aswa I	4	-	4	1	1	4
Kidepo	Kidepo	4	-	4	3	1	4

The following table presents issues at a scale of catchment and Water Management Zone. Issues are evaluated with a qualitative scale as follows: very good (VH), good (H), low (L), and very low (VL).Where all the sub-catchmentsbehave differently, the situations is indicated as "all type", while two values are given when half of the sub-catchments can be classified in one group and the other half in another group.

Table 4.32: Summary of issues on water balance in the three catchments of Upper Nile WMZ.

ISSUES	Albert Nile	Aswa	Kidepo	UN WMZ
Impact of Drought	H	H / VH	VH	H / VH
Impact of CC 2030	L	L / VH	VH	L / H
Impact of CC 2040	L / H	H /VH	VH	L / VH
Potential deficit in dry period	all type	H /VH	VH	H
Supply level 2030	H /VH	VL / VH	L	all type
Supply level 2040	L / VH	VL / H	VL	all type

Opportunities for WRDM have been analysed by assigning to them values varying from one (very good opportunity) to four (very low opportunity).

Table 4-33: Summary of opportunities on water availability in the three catchments and related sub-catchments of Upper Nile WMZ

Table 4.33: Summary of opportunities on water availability in the three catchments and related sub-catchments of Upper Nile WMZ

OPPORTUNITIES ON WATER AVAILABILITY				
Catchment	Sub-catchment	Potential resources	Available resources	Groundwater potential
Albert Nile	Ora	1	2	2
	Pakwach	2	2	2
	Panyango	2	2	2
	AN_up_Enyau	2	2	2
	Enyau	2	2	2
	AN_up_Kochi	2	2	2
	Kochi	2	2	3
	Laropi	2	2	2
	Ayugi	2	2	2
	Unyama	1	1	2
Aswa	Aswa III	2	2	2
	Pager Kitgum	2	4	3
	Nyimur	2	3	3
	Pager Aringa	2	4	4
	Pager Matidi	4	4	4
	Agago	2	4	4
	Aswa II	1	2	2
	Aswa I	2	3	2
Kidepo	Kidepo	4	4	4

The following table presents a summary of potential opportunities for the Upper Nile WMZ and catchments evaluated using a qualitative scale: very good (VH), good (H), low (L) and very low (VL). Where all the sub-catchments behave differently, the situations is indicated as "all type", while two values are given when half of the sub-catchments can be classified in one group and the other half in another group.

Table 4.34: Summary of Opportunities on water availability in the three catchments of UN WMZ

OPPORTUNITIES	Albert Nile	Aswa	Kidepo	UN WMZ
Potential resources	H	H	VL	H
Available resources	H	L / VL	VL	all type
Groundwater system	H	VL / H	VL	all type
Current SW exploitation	VL	VL	VL	VL
Current GW exploitation	VL	VL	VL	VL
Potential storage in wet period	VH	H	L	H / VH

4.6 Stakeholder Consultations

During the diagnostic phase, extensive consultationswith stakeholders at the national, regional, and local levels was carried out in two rounds (November-December 2015 and April 2016), in order to collect views and opinions about the issues and opportunities related to water resources development and management in the Upper Nile WMZ.The main issues highlighted by key stakeholders are summarised in the following table.

Table 4.35: Main issues highlighted in the stakeholder consultations

Sub-Strategy	Main Issues highlighted in the stakeholder consultations
Water for people	- Livelihoods and food security of the vulnerable largely depend on access to water - Constraints of access to water for vulnerable groups - Long distances for water collection

Sub-Strategy	Main Issues highlighted in the stakeholder consultations
	- Poor coverage and use of sanitation facilities leading to the spreading of diseases and to open defecation - Payment for accessing water points and sanitation facilities affects, to a major extent, the vulnerable groups - Special funding is needed to focus on sanitation and hygiene in schools, in order to reduce transmission of water-related diseases and implement hygiene and health education - Burden of water collection affects school attendance and opportunity to be educated - Negative attitude towards use of latrines, poverty and illiteracy are major social factors which undermine improved sanitation - Insufficient water supply especially in rural areas - Many boreholes do not provide water that meets Water Quality standards - River Enyau supply system is not enough to provide water for people and irrigation during the dry season - Many big towns and cities are missing sewage systems - Water supply and sanitation planning for refugee and IDPs settlements is required - Districts with very low water supply in the Acholi region were identified as the following: Kitgum, Gulu, Amuria, and Pader - Some health centres in rural areas do not have access to water and basic sanitation services – undermining the quality of health services - Water theft and failure to pay for water used.
Water for production	- Limited development of irrigation infrastructure - Limited livestock watering facilities. Existing facilities have all silted up due to poor operation and maintenance - Limited access to land, clean water and irrigation technologies - Limited access to irrigation technologies by women and vulnerable groups - Food security is often dependent on women's subsistence production to feed the population. Female farmers, however, have very little or no access to irrigation water for agricultural purposes and are entirely dependent on rainfall - Lack of implementation of customary and statutory laws granting to women rights over land - Sharing of water for production facilities by humans with animals - Conflicts over water use for cattle are common especially in Kaabong.
Water for energy	- Need to increase energy supply to meet the needs of industries,growing urban areas and other productive activities.
Water for environment	- Climate change impacts and pressures on pastoralist communities - Water scarcity in Karamoja (Kaabong, Katakwi, Napak, Adjumani districts) - Land and rangelands degradation - Water resources in the cattle corridor overexploited: Kaabong, Katakwi, Napak, Adjumani - Low community awareness on effects of environmental degradation - Need of updating the district wetland inventories; the beginning of these activities was scheduled starting from 2016 - Encroachment of human activities on wetlands, forests and forest reserves - Overexploitation of forests and deforestation - Deforestation associated with refugee camps and IDPs to provide charcoal (to sell) and fuel wood - Need for involving the communities and establishing many Collaborative Forestry schemes with local communities. Conflicts for land ownership and use of resources between Protected Areas and local communities - Impacts of extractive and productive activities (such as oil exploration) that are authorised inside Protected Areas (Murchison Falls National Park).

Sub-Strategy	Main Issues highlighted in the stakeholder consultations
Water governance	- Capacity building needs for water management issues in the WMZ - Need of involving local administration level in the consultations about WRM - Difficult organisation and logistics for O&M issues and for awareness raising - Communities feel that the government should support operation and maintenance - Some water user committees have overstayed and others are inactive - Poor transparency and accountability of the O&M funds collected - Difficulties in reaching and serving adequately some remote districts and counties - Need of training for use and maintenance of water pumping points - Need of protecting water collection points from vandalism - Need of institutional coordination between various WRM projects - Understaffing of many bodies and institutions concerned with WRM (i.e. WMZs) - Financial constraints: funds are still insufficient to support expected level of service delivery in WRM - Sectoral and cross-sectoral opportunities exist both at national and regional level, alongside potential conflicts, particularly owing to overlapping roles and responsibilities

5. STRATEGIC ISSUES AND OPPORTUNITIES

5.1 Governance and Institutional Issues

An institutional diagnostic assessment provides a complete profile of the key institutional characteristics of the UNWMZ in relation to its water resources management functions. Accordingly, key parameters that affect the degree to which an institution will deliver on its mandates were assessed. These include institutional set-up and coordination, networks and collaboration, existing human resources, planning and decision-making, operations and logistics, financial resources, existing monitoring and evaluation systems, and the existing policy environment.

Owing to the multiplicity of these parameters, a combination of methods was used; including the Policy Environment Mapping technique, Sectoral Institutional Assessment (SIA), the Participatory Institutional Assessment (PIA) approach and the Gendered Analysis of Institutions. The assessment sought to analyse the current institutional situation in order to provide a sound basis for development of appropriate and effective strategic direction for institutional capacity strengthening to enhance effective management and development of water resources in the Upper Nile WMZ.

5.1.1 Institutional set-up

Usually, structural set-up determines how well established and ready an institution is to deliver on its mandates. This institutional diagnostic assessment established that, particularly at regional level, not all the required institutional arrangements are yet in place to effectively develop and manage water resources at WMZ level. It is true that the UNWMZ offices and sister institutions (WSDF, TSU, Umbrella organisation, etc.) have been established, among other functions, to take on roles of the CMO secretariat. However, the stakeholder forums and the Catchment Management Committees (CMCs) do not yet exist for a number of catchments and sub-catchments, except for the Upper Aswa and the Lower Aswa sub-catchments. Even those that are in place are not yet fully functional. The Regional Wetlands TSUs are somehow missing in physical presence and functionality, yet they are vital in providing technical assistance and facilitation to stakeholders as part of the Catchment Technical Committee.

In the current institutional set-up, certain roles and responsibilities tend to be carried out across a number of agencies, e.g. water quality assessments, which are conducted by TSUs, umbrella organisations and the UNWMZ, all under the same roof highlighting issues concerning efficiency.

The two charts below demonstrate the gap between the recommended structure and the existing one. The recommended department of information services and liaison is, for example, not yet in place. The Local Governments do not yet also have focal offices officially designated to handle catchment management functions. The reason is that the initial institutional set-ups for such stakeholder institutions were not specifically arranged to provide for catchment management functions.

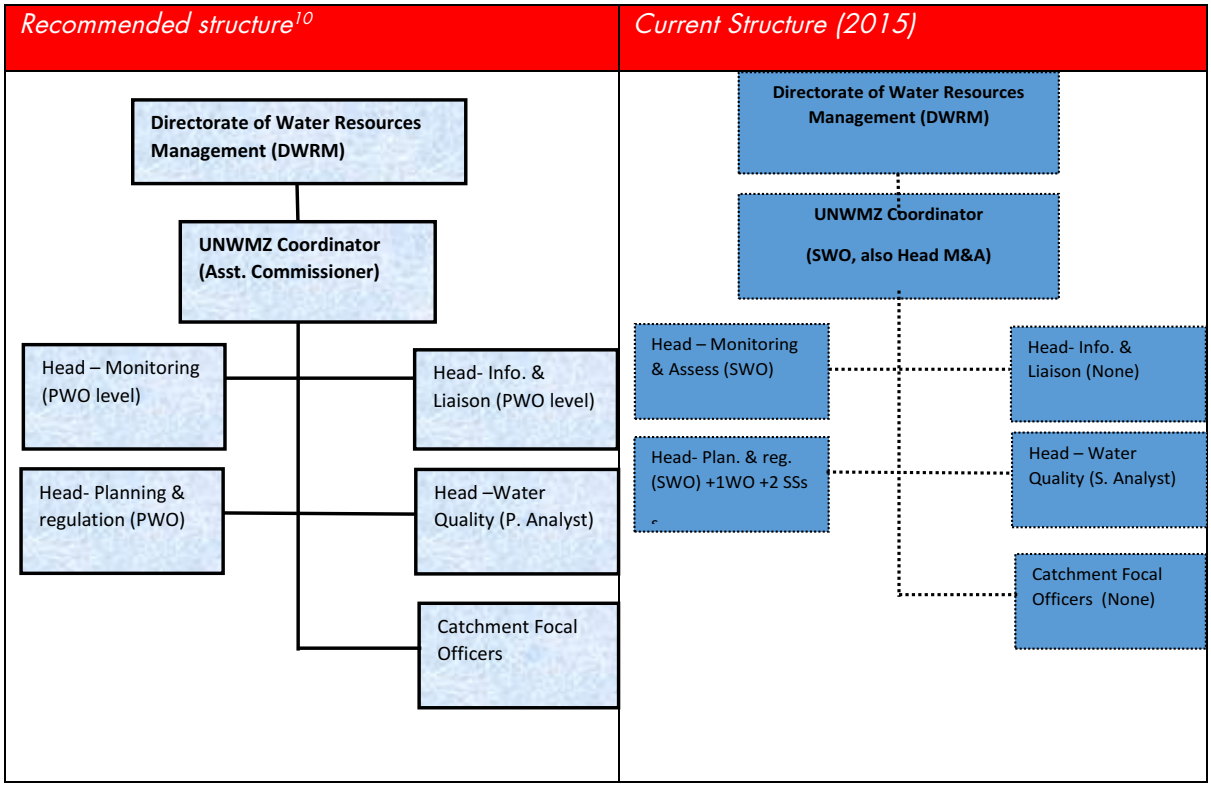


Figure 5.1: Organisational structure for catchment-based WRM in UNWMZ

An incomplete institutional set-up at zone level will likely affect the level of expected service delivery at zone scale, and the few duplicated roles will reduce efficiency. However, this initial establishment and implementation of the UNWMZ and the few existing CMOs is a demonstration of commitment on the side of government and partners to set up and implement the necessary institutional frameworks in the Upper Nile WMZ. Discussions are also on-going to have WRM focal points designated at DLG level. For example, Agago District officially designated the DWO as the focal point for preparation of Catchment Management Plans and strategy under this project.

5.1.2 Human Resources

Human resourcesare fundamental to the achievement of any set organisational targets. Unfortunately, UNWMZ is still profoundly understaffed (see figure 5.1 above). The team is composed of only six technical staff to cover all the three traditional departments. They include one Senior Hydro-Geologist under the Monitoring and Assessment Department; two Social Scientists, one Water Officer and one Senior Water Officer under the Regulation Department, and one Senior Water Analyst under the Water Quality Department. Of these, only the two social scientists are female; and 50% of the staff are hired on contract basis. The Monitoring and Assessment and Water Quality Departments are least staffed. The new proposed department of Information Services and Liaison also has no staff yet. The Senior Hydro-geologist also doubles as the Team Leader, yet he is the only staff under the Monitoring and Assessment Department.

The concern is that staff are too over-loaded to effectively deliver on their mandates. Promotions take long to come their way, affecting staff motivation levels. The Figure above shows that none of the existing staff, for example, is yet at principle level in order to qualify to head the departments under which they fall. Some officers have insufficient specialised knowledge and skills to deliver on their mandates. For example, staff initially trained in engineering, chemistry, etc. still have limited stakeholder analysis and engagement skills; or insufficient skills to apply GIS tools in their

[10] DWRM (2010). Operationalisation of catchment-based Water Resources Management. A Report prepared by COWI Uganda for the DWRM, MWE.

hydrologic analyses. This will likely affect impactful service delivery. A temporary opportunity is that the team often relies on staffing support from the centre for certain tasks. There are also government promises to recruit more staff with time.

5.1.3 Networks, Collaboration and Coordination

Institutions are part of a whole system of complementary and networked agencies. Therefore, how an institution effectively networks and collaborates with others greatly bears on how it will deliver on its own mandate. Particularly, owing to the cross-sectoral nature of catchment-based WRM, there are a number of institutions that the UNWMZ could network and collaborate with in order to efficiently and effectively deliver on its mandate. These include central government agencies like UWA, NEMA, NPA, etc. and Ministries like Energy, Water and Environment, Agriculture, Tourism and Wildlife, Local Government, Finance, etc. At regional level, there are local and International Organizations like IUCN and CARE International; regional programmes implemented by NUSAF, NBI, etc.; and the private sector. Even internally under the same roof, there are institutions like WSDF, NFA, TSUs and the umbrella organisation that provide great opportunities for networking, collaboration and leveraging of resources. However, the UNWMZ has not yet fully developed clear mechanisms for institutional networking and collaboration. Arrangements for a coordinated approach are still weak, even with agencies that fall under the same roof. Except for a few isolated cases, each institution still plans and implements their work independently. The few existing collaboration mechanisms are informal and haphazard, and do not present a systematic and complete opportunity for leveraging of resources.

For example, there is a missed opportunity of not closely networking and collaborating with Guru Nanak Oil Mills. They provide effective economic options to promote conservation of the shea butter trees by providing export market for shea butter to the US, Europe, Asia, and other parts of the world. The market is steadily growing and, in 2015 alone, the oil mills purchased from farmers shea nuts worth US$113,636, which is about 50% of the donors' Joint Partnership Funding support to the UNWMZ for FY 2014/2015.

Table 5.1: Value of shea nuts purchased by Guru Nanak Oil Mills, 2013-2015

Year	Shea purchased (Tons)	Value (UGX)	Value (US$)
2013	90	135,000,000	40,909
2014	120	180,000,000	54,545
2015	250	375,000,000	113,636
Total	460	690,000,000	209,091

Source: Interview with the MD and Accountant, Guru Nanak Oil Mills, Lira, December 2015

Weak/lack of networking and collaboration mechanisms may result into duplication of roles in some cases with adverse impacts on efficiency and reduced levels of delivery. Opportunities for synergies are missed as demonstrated with the private sector. The chance is that currently, there is a high level of willingness to collaborate among the various institutions. They appreciate their complementary roles, and the positive step that has so far been taken to devolve WRM functions.

From national-level consultations, the key challenge that emerged is that the bottleneck for effective WRM is coordination and collaboration. Many of the agencies argue that water resources management and development was not their mandate though they recognise that they benefit from the results. Therefore, they think they had a role to play. Others argue that there were too much duplication and parallel initiatives that if coordinated well would have more impact.

The biggest challenge raised was the weak capacity of DWRM to coordinate all partners. For example, one agency indicated that in one particular river, three different agencies got permits to use the water without knowledge of the others. This resulted into conflicts and a process to resolve and agree came much later. Coordination efforts reported are random and driven by individuals/projects, and are not institutionalised. The guidelines developed by DWRM were acknowledged but some agencies felt that WRM was transferring its role to them. Some agencies like WMDF/UWA felt that whereas they have all capacity and skills for WRM, they are not utilised. With better coordination, they would be used more effectively. On the other hand, some two agencies felt they had no role in WRM. In fact one of them refused the interview. Hence, awareness may need to be stepped up. The key solution echoed by most respondents was the need to better coordinate among various agencies and stakeholders.

5.1.4 Planning and Decision-making

Considering the cross-sectoral nature of catchment-based WRM, it is imperative that all planning processes are consultative to involve all stakeholders. This ensures stakeholder ownership of the plans and ultimately catalyses their engagement during plan implementation. In the UNWMZ, work plans are prepared at regional level, and submitted to the centre for review and approval. However, there is no evidence that consultations are held with stakeholder institutions like WSDF, TSUs, the umbrella organisations, and NFA during preparation of these work plans. Local Government and CMO engagement in planning and decision-making is also still quite low. Decision-making over other aspects of water use and management also still remain centralised. For example, the zone still only serves as a conduit for receipt and transmission of permit applications to DWRM in Entebbe. Once not involved in the initial planning and decision making, stakeholder institutions will hardly integrate catchment management interventions into their own work plans and development plans. Opportunities for collaboration and leverage of human, financial and other resources will likely be missed out. Reviews, decision-making and approval processes that still heavily rely on the DWRM Centre are also sometimes characterised by delays in service delivery. The opportunity is that the on-going catchment management planning process is improving stakeholder engagement in planning and decision-making; and that full stakeholder engagement strategies are being emphasised. The devolution process is still in its infancy stages, and once capacity has been built at the zones, opportunities exist for complete devolution of WRM functions.

At national level, all stakeholder institutions value the role of WRM. They indicate that it sustains the quality and quantity of water. There was a general awareness about the role of WRM among the majority of the respondents. The consultations show that agencies especially DWD take the role of catchment management seriously, through still random or included as a condition by donors. Many are integrating a number of WRM in their plans and budgets albeit small. The NPA noted that access to water is a key priority and that WRM is an important basis to achieve key development goals of NDP II.

5.1.5 Operations and Logistics

Availability of logistics and operational requirements also affects service delivery in any institution. In the UNWMZ, operations and logistics are arranged at zone level. For example, all logistics for fieldwork are organised at the zone. This supports delivery of services in a timely fashion. However, some key logistics are insufficient. For example, for all the six field staff, the zone has only two field vehicles, which have to serve both fieldwork within the zone and coordination trips to and from DWRM or ministry offices in Kampala and Entebbe. Different officers sometimes wish to travel to different parts of the zone concurrently but are forced to re-schedule their trips pending availability of vehicles. According to UNWMZ staff, a minimum of four field vehicles would suffice to support smooth field-based operations.

The UNWMZ also relies on services of WSDF procurement and finance staff for procurement of key inputs and processing of funds. These officers are sometimes not readily available. In some instances, the processing of operational and logistical requirements takes longer than anticipated. The impact is that service delivery is delayed, and expected results are ultimately adversely impacted. The opportunity is that, for the start, WSDF is willing to provide this kind of staffing support.

5.1.6 Financial Resources

Availability of timely and sufficient financing also heavily determines how an institution will deliver on its mandates. For the UNWMZ, key sources of financing currently include Government of Uganda, the World Bank, and the Joint Partnership Fund (Austrian Development Cooperation, DANIDA, and others). Some donors also finance catchment-based WRM interventions through NGOs e.g. Austria Development Cooperation funding to IUCN for interventions in the Upper Aswa sub-catchment. The key concern is that existing financial resources are insufficient, sometimes characterised by budget cuts. For example, the Joint Partnership Fund for the UNWMZ reduced by 25% from about Shs1 billion in FY 2013/14 to about Shs0.75 billion in FY 2014/15.

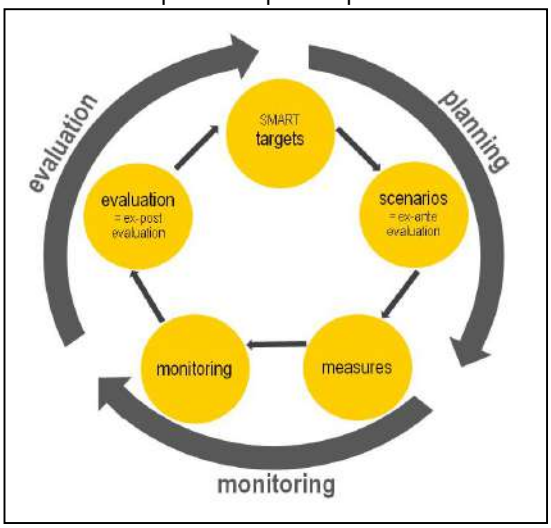
Oftenwhat is budgeted is not realised, demonstrating inconsistency and unreliability in flow of funds. Fund releases usually delayand once received, processing of funds often takes longer than anticipated owing to internal bureaucracies. Government of Uganda funding contribution is yet to be realised at zone level because of lack of a dedicated bank account. The phasing out of donor-funded projects (e.g. Phase 1 of

IUCN's project in 2014) also often adversely affects the momentum already built in catchment-based WRM at the zone.

The impact is that service delivery cannot be achieved at targeted scale and in a timely fashion.The opportunity is that government and development partners seem to be commitment to funding catchment-based WRM, and that this is only the beginning. Many other partners' interventions (e.g. NFA, WSDF, TSUs, umbrella organisation, NUSAF, etc.) could also leverage resources if good collaboration and networking arrangements are put in place. Fund processing time also seems to have improved with the opening of the zone's bank account in Lira.

5.1.7 Monitoring and Evaluation Systems

Good performance monitoring mechanisms help institutions to measure their progress towards achievement of set results. Evaluation allows a reflection on whether the set development outcomes were actually achieved or not, and the underlying reasons for the level of achievement. Based on this, lessons are learnt to inform necessary adjustments to implementation strategies (adaptive management). Monitoring and Evaluation (M&E) is, therefore, a process that helps to improve performance and achieving results.



However, in the UNWMZ, there are currently no formal M&E mechanisms in place. This means that progress towards set targets and outcomes of interventions are neither formally and effectively measured nor evaluated as part of an institutional mechanism. M&E is not institutionalised, and is only done at individual project level, e.g. IUCN's BDR Project, and the World Bank-supported Water Management and Development Project. This means the institution faces a risk of being unable to detect any deviations from progress, and misses out on the opportunity to implement corrective measures in a timely fashion.

Ultimately, the institution may likely not achieve its set targets and results. The opportunity is that the WSDF is an example to learn from, with an M&E staff in place, and clear M&E indicators, roles and responsibilities at zone level. In addition, the UNWMZ also has mandate to contribute towards agreed targets at national level. Therefore, indicators against which their performance should be measured already exist. The gap is, therefore, lack of mechanisms to strictly implement an M&E system at zone level.

5.1.8 Enabling Policy Environment

The Policy Environment Mapping that was conducted indicates that there exists an enabling policy and legal environment for sustainable development and management of water resources in the UNWMZ and Uganda in general.

For example, the Constitution of Republic of Uganda (1995) strongly provides for the highest level policy and legal requirement for IWRM in the country. The Water (amendment) Act (2013) provides for establishment of the Water Management Zones and Catchment Management Organisations (CMOs); and clearly stipulates the functions of these institutional frameworks. The Local Government Act (1997) also devolves management of water and other natural resources. The National Water Policy (1999) promotes management and development of the water resources in an integrated and sustainable manner. The National Policy for the Conservation and Management of Wetlands (1995) establishes the principles by which wetland resources can be optimally used now and in the future. The National Environment Management Policy (1994) promotes integration of environmental concerns in all development policies, plans and activities. The Uganda National Land Policy (2013) ensures that all land use practices and plans conform to principles of sound environmental management.

The only challenge seems to be at operational level – enforcement of these policies and laws, e.g. enforcing the permit system; or how to harmonise enforcement of environmental laws, considering the

cross-sectoral nature of catchment management issues. Otherwise, the existing policies, laws and guidelines support effective delivery on the zone's roles and responsibilities.

5.2 Water for People

5.2.1 Water Insecurity

When water demand is much higher than available resources, conflicts among different users are expected, causing a severe water insecurity condition. This situation could be even more severe due to the expected increase of extreme climatic events and particularly during droughts, as it has been evaluated with specific analysis.

According to the projections redacted within the sectoral national plans, industry will have a negligible impact on overall water demand (1-2%), followed by livestock (generally lower than 10%), and portable use. In the Aswa and Albert Nile River catchments, demand from fishery will be relatively high (20-40% in 2040)and crops have the highest demand (45-60% in 2040). Specifically, water insecurity due to domestic water demand will be high in Laropi sub-catchment, along most parts of Pager (Matidi and Kitgum sub-catchments) and in the lower part of Aswa River (Aswa III). This will also be true for the latter sub-catchments for agriculture water demand.

Besides potential user conflicts, further water insecurity might come from water sharing in transboundary context. Both Albert Nile and Aswa Rivers drain northwest into South Sudan. Discharges along the Albert Nile River are dominated by the outflow from Lake Albert that drains a vast upstream watershed (more than 400,000km²). In addition, small upstream portions of the Albert Nile River basin (about 500km²) belong to DRCongo and South Sudan.

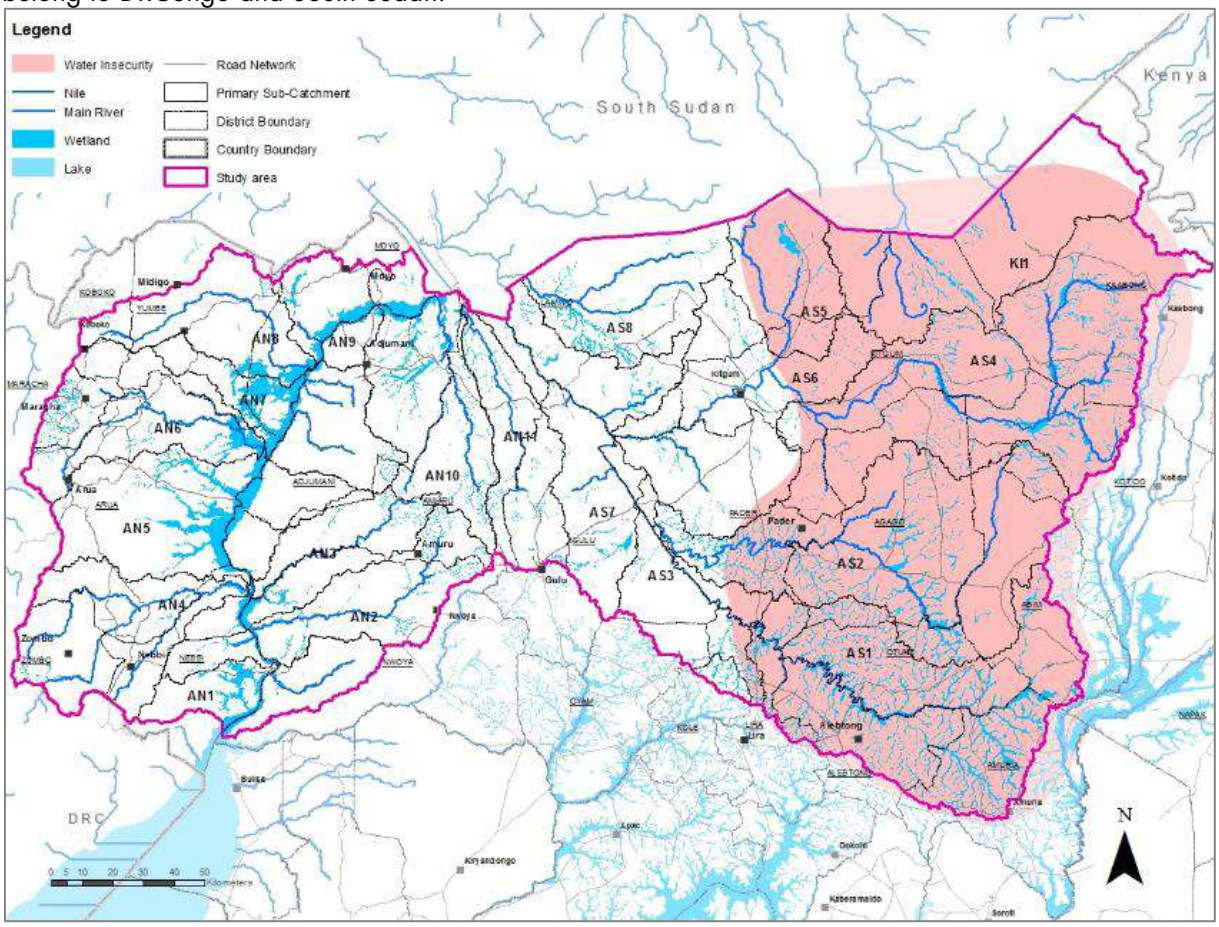


Figure 5.2: Critical issue: Water insecurity

5.2.2 Insufficient Water Resources Availability

Insufficient water availability has been considered a very critical issue in sub-catchments where in the future water demand is expected to be greater than available water resources on an annual basis. This evaluation has been conducted considering the projected water requirements for economic and social development, environment conservation and impact of climate changes (water balances for each sub-catchment).
In 2040, the yearly gross water demand within Albert Nile River catchment will be around half of overall water resources, while in the Aswa River basin water requirements will exceed water availability by approximately 30%. There are no relevant issues in the two river catchments concerning water for domestic and industrial uses and hydropower development on the annual scale. In terms of water requirements for irrigation, issues are found in the eastern part of Aswa River basin (Agago, Matidi, and Aringa) especially during the dry semester. In fact, during this period, generally from November to April, available water resources are between 10% and 20% of water resources of wet period within the Aswa River catchments. This ratio ranges from 20% to 30% for the Albert Nile Catchment, except for Enyau and Ora tributaries that show high values.

The overall water demand for people and production in 2040 cannot be supplied during the dry semester for all Aswa sub-catchments, except Nyimur. Within the Albert Nile River basin, water deficits will be in Pakwach, Enyau, and Kochi and along the main course of Albert Nile upstream of the confluence with Enyau.

5.2.3 Insufficient Water Storage

Storagewill be very important in sub-catchments where in 2040 the dry season projections of water demand are higher than available water resources. This means that, even if there is no deficit on an annual basis, water shortages can occur during the dry season due to the different monthly hydrological conditions. Storage is important to keep water during the wet season when it is more abundant for use in the dry season. Lack of water storage is highly critical in the western part of the Albert Nile Catchment (Pakwach, Albert Nile between Ora and Enyau confluence, Enyau, and Kochi) and almost the entire Aswa Catchment.

Lack of storages for domestic use has been considered to be very critical in cases where large townsare located in the upper part of the sub-catchment. In such cases, the main river has a very small draining micro-catchment, and without storage, water supply is subject to seasonal variations with water shortage risks. The situation is expected to worsen with increase in population, and for such cases a more reliable water supply system is necessary. This situation is found in Arua Municipal Council, Koboko Town Council, Gulu Municipal Council, and Kitgum Town Council.

5.2.4 Inadequate Water Supply and Irrigation Infrastructure

The lack of adequate infrastructure has been assessed both for water supply and irrigation infrastructure.

The lack of water supply infrastructure has been considered to be critical in sub-catchments where water supply access is low. Information regarding both rural and urban water supply access has been used. Areas that have the lowest rural water supply access include Yumbe, Moyo, Adjumani, Kaabong, and Kotido districts. Also Koboko, Arua, Nebbi, Pader, Agago, Amuria, Kole, and Oyam have a low access, with values lower than 75%. Districts with low urban water supply access are Koboko, Yumbe, Nebbi, Kaabong, Agago, Kotido, Kole, and Alebtong.

In the entire UN-WMZ only one large irrigation scheme is being implemented in Lamwo District (rehabilitation of the Agoro irrigation scheme). Even though the entire study area is affected by lack of irrigation infrastructure, this issue has been considered critical in areas that are more indicative of agricultural development. That is, areas where subsistence farmland is already present and where the necessity for irrigation schemes is stronger. Most critical areas include Ora and Enyau sub-catchments that are almost entirely occupied by subsistence farmland. Also Albert Nile between Ora and Enyau confluence, Kochi, Aswa I and Aswa II sub-catchments have a wide area used for agriculture and lack irrigation infrastructure.

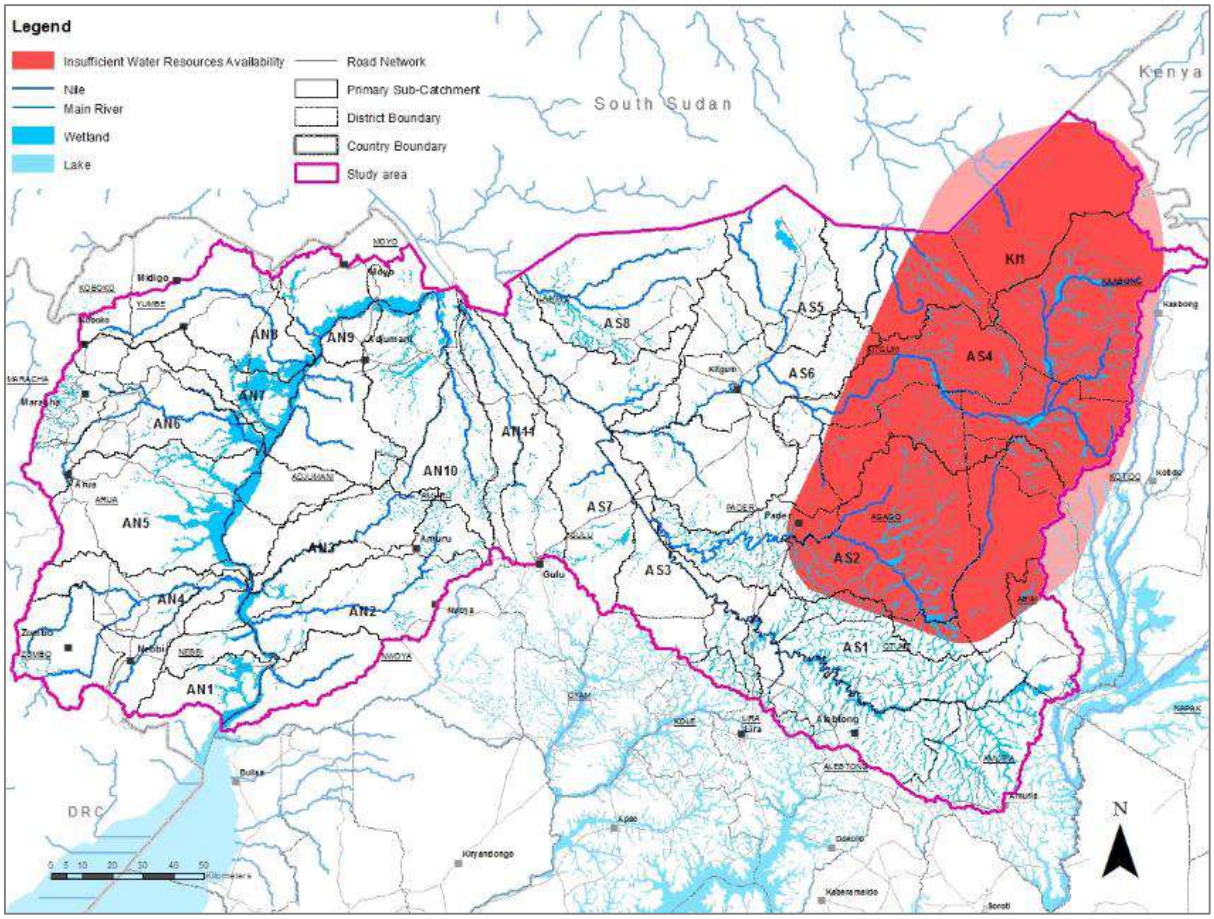


Figure 5.3: Critical issue: Insufficient water resources availability

5.2.5 Inadequate Water Supply Infrastructure and Services

The lack of adequate water supply infrastructure has been evaluated based on the access to water supply (both rural and urban). The most critical areas are the sub-catchments of the West Nile, where the population density is high (Aswa I, Agago, Pager Matidi, Pager Kitgum and Kidepo) and existing large urban centres (Arua, Koboko, Nebbi) do not have sufficient water supply facilities to cater for their population.

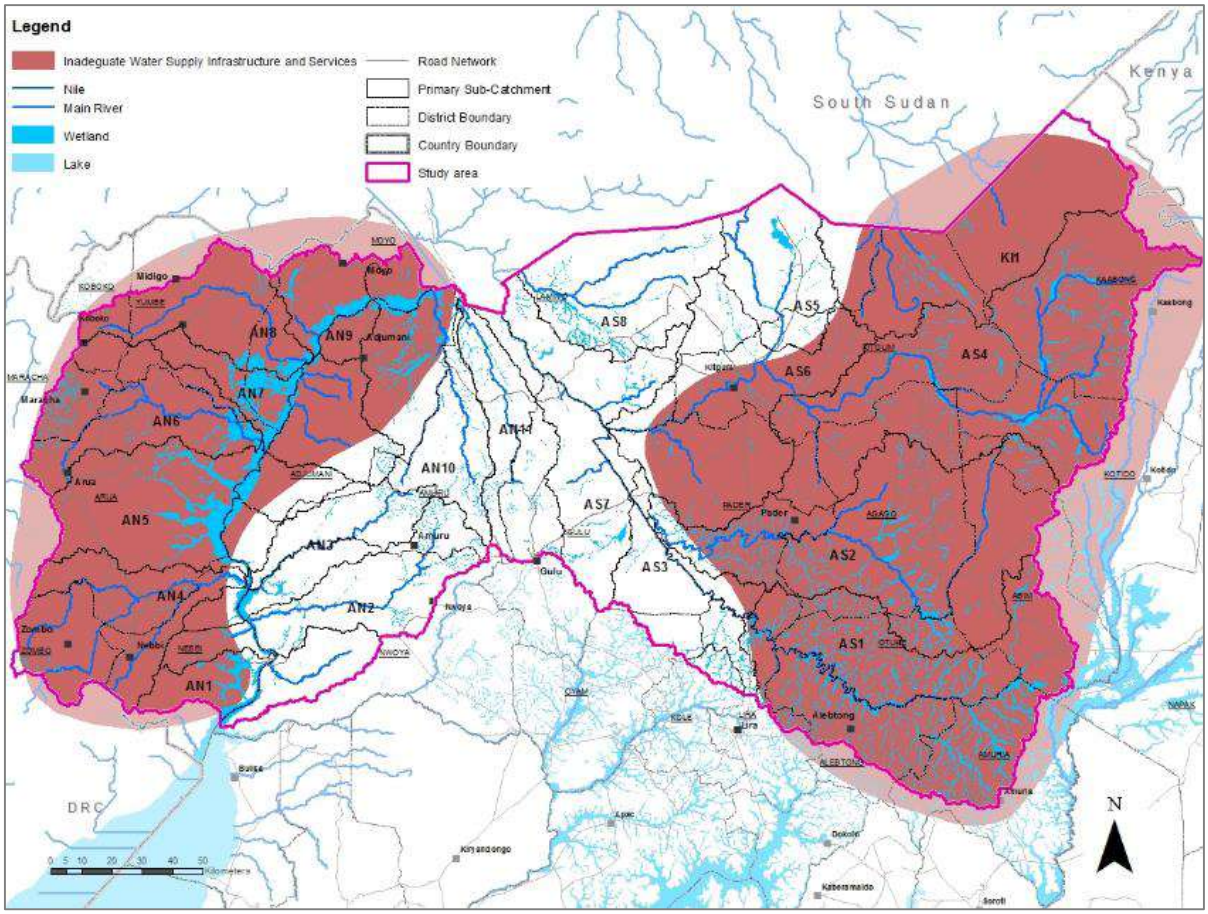


Figure 5.4: Critical issue: Insufficient water resources availability

5.2.6 Inadequate Wastewater and Sludge Management

This concerns areas where sanitation facilities are inadequate and areas with inadequate sludge management systems, including collection, storage, transportation, treatment and final disposal. Information regarding the coverage of sanitation facilities and population density was combined to define these areas. The most critical sub-catchments are those that are highly populated including Ora, Enyau, Kochi, and Aswa II sub-catchments.

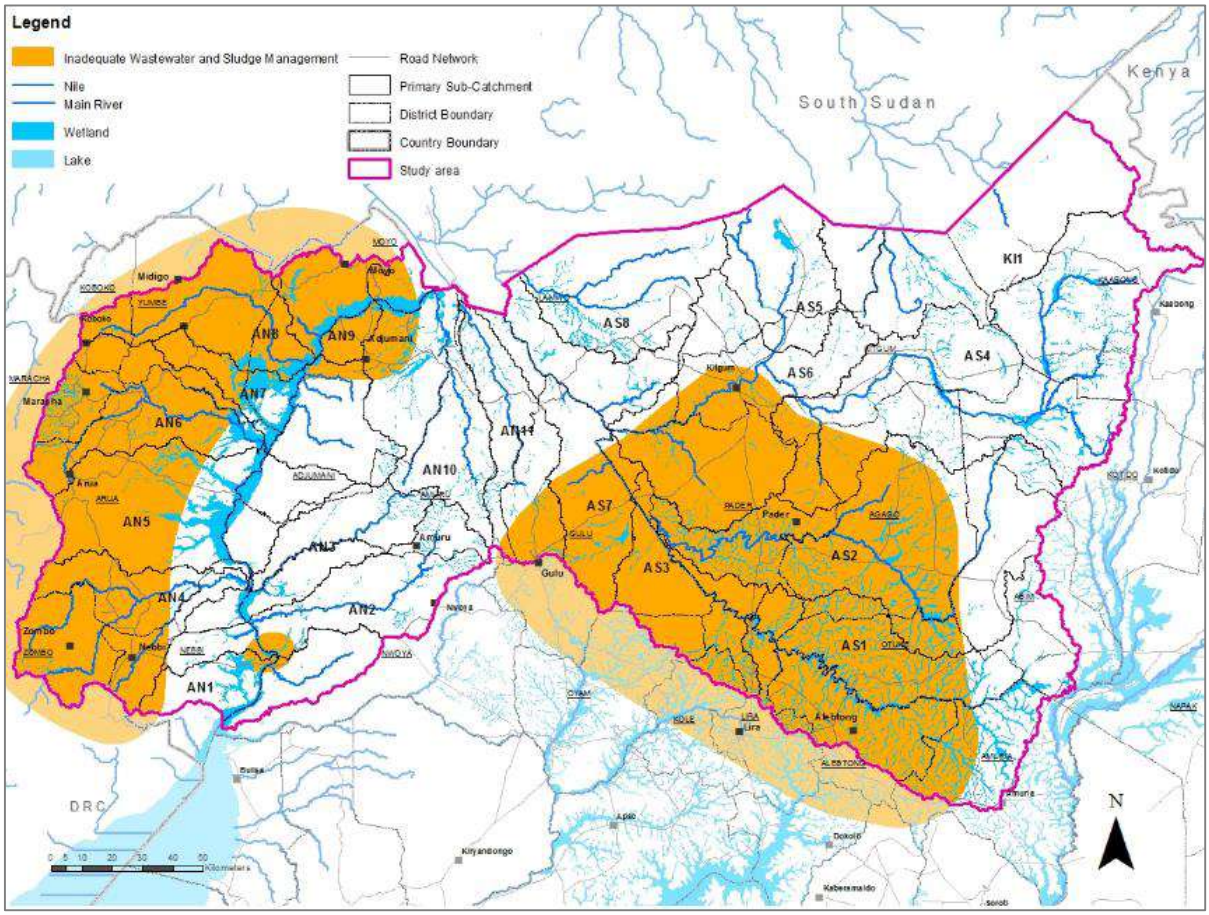


Figure 5.5: Critical issue: Inadequate wastewater and sludge management

5.2.7 Lack of Sewerage and WWTP (urban areas)

The lack of sewerage systems and wastewater treatment capacity has been considered very critical in large cities (more than 20,000 inhabitants). It is fundamental to have adequate systems to collect and treat all wastewater from the cities in order to avoid hygienic and environmental problems related to inappropriate management of sewage. Lack of sewerage systems and wastewater treatment facilities is critical for Pakwach (around 22,000 inhabitants), Nebbi TC and Paidha TC (around 35,000 and 33,000 inhabitants respectively), Arua (around 60,000 inhabitants), Koboko TC, and Yumbe TC (around 38,000 and 35,000 inhabitants respectively), Adjumani (around 43,000 inhabitants), Gulu (around 150,000 inhabitants) and Kitgum (around 44,000 inhabitants).

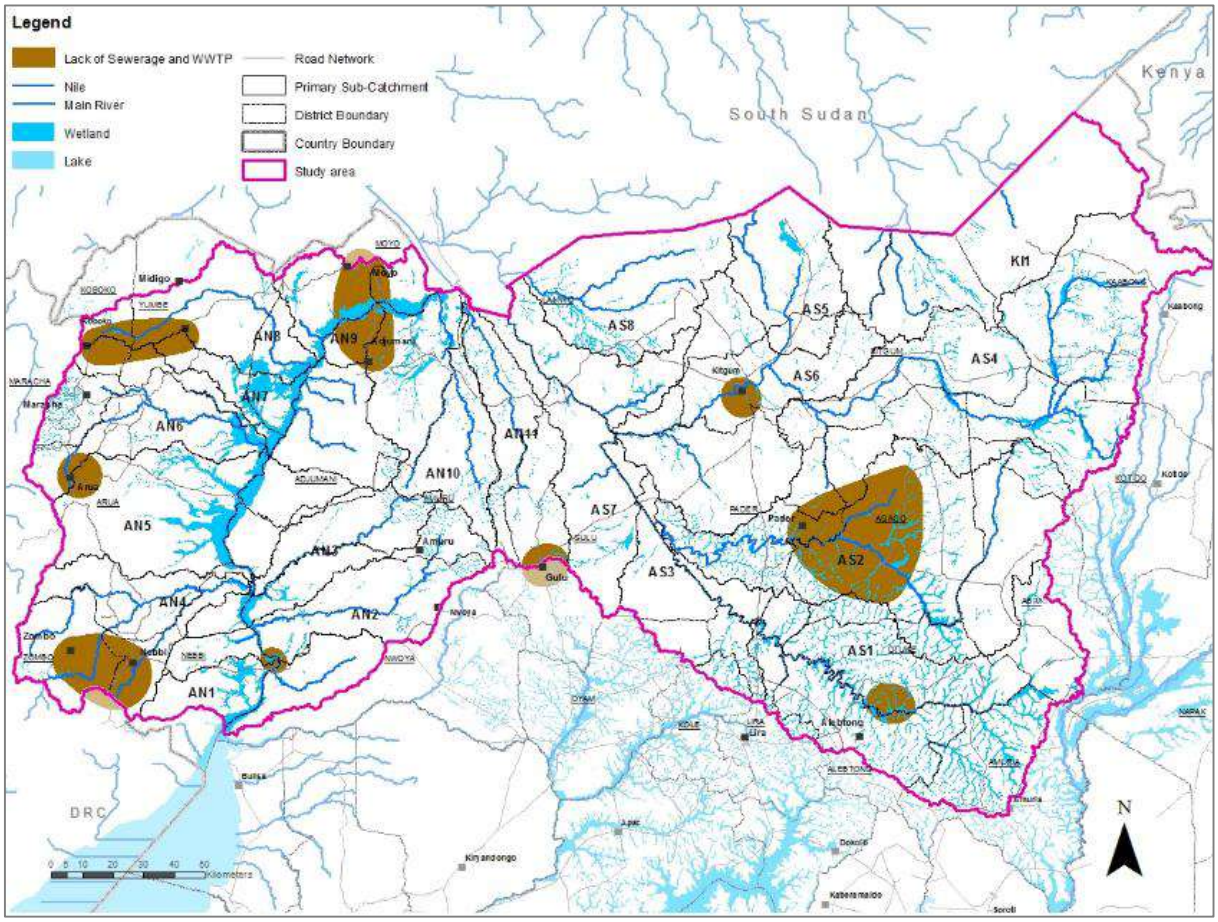


Figure 5.6: Critical ilssue: Lack of sewerage and wastewater treatment capacity

Improved sanitation facilities are required in sub-catchments with high household densities (more than 20 households without improved sanitation facilities per square kilometre). Most critical areas are urban areas with a high population density, in particular Arua MC and its surroundings, Maracha District, Koboko TC, and Yumbe TC and their surroundings, Paidha TC, Nebbi TC, Kitgum TC, Pader TC, most populated areas of Agago District (including Patongo TC, Kalongo TC and Agago TC), Kole and Lira districts and most populated areas of Alebtong and Amuria districts.

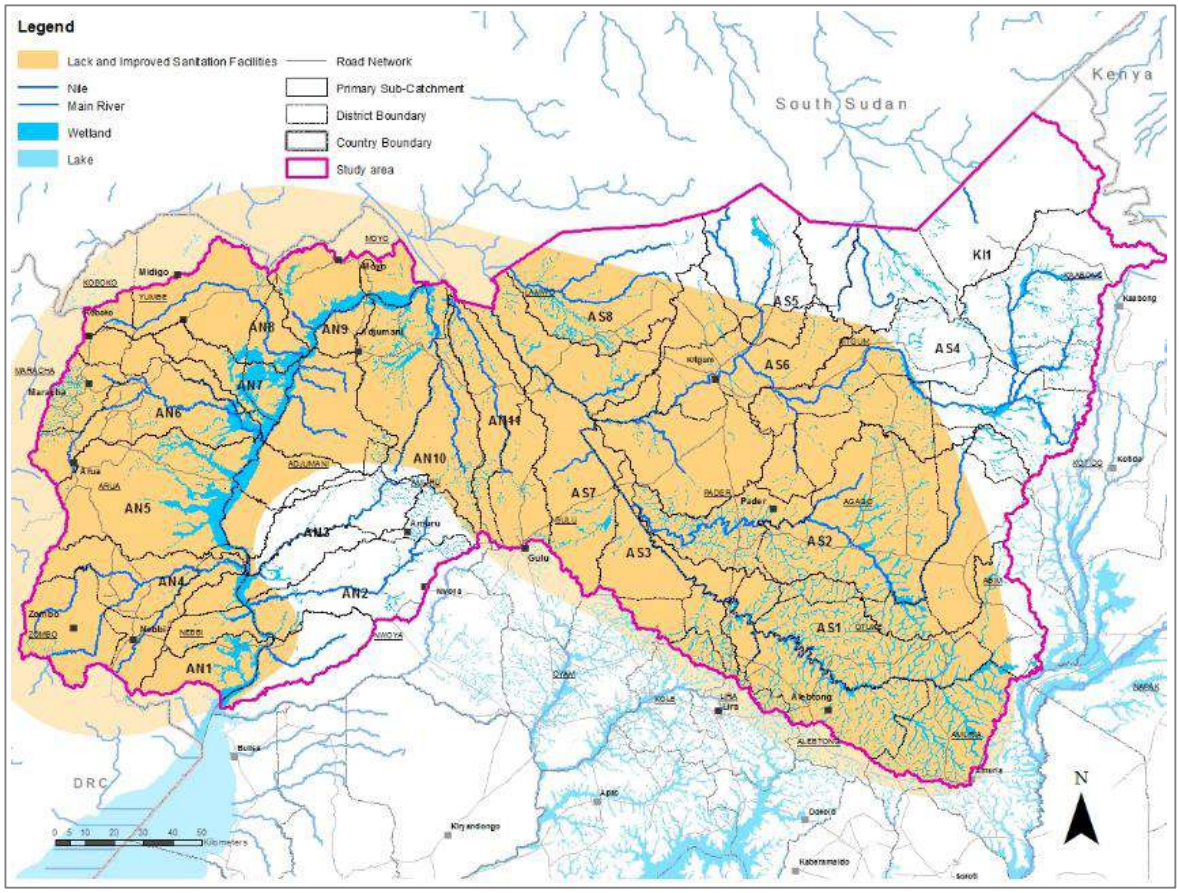


Figure 5.7: Critical issue: Lack of improved sanitation facilities

5.3 Water for Production

5.3.1 Pollution loads

Anthropogenic pollution loads have been considered critical depending on the estimated potential pollution loads based of the presence of human activities. In particular, pollution load (in tons of BOD per square kilometre per year) has been estimated based on the expected number of people, livestock, agricultural land, aquaculture surface and industrial activities. Most critical areas are Enyau and Kochi sub-catchments in Albert Nile due to high population densities and Pager Matidi and Kidepo sub-catchments inthe Aswa Catchment due to high livestock densities.

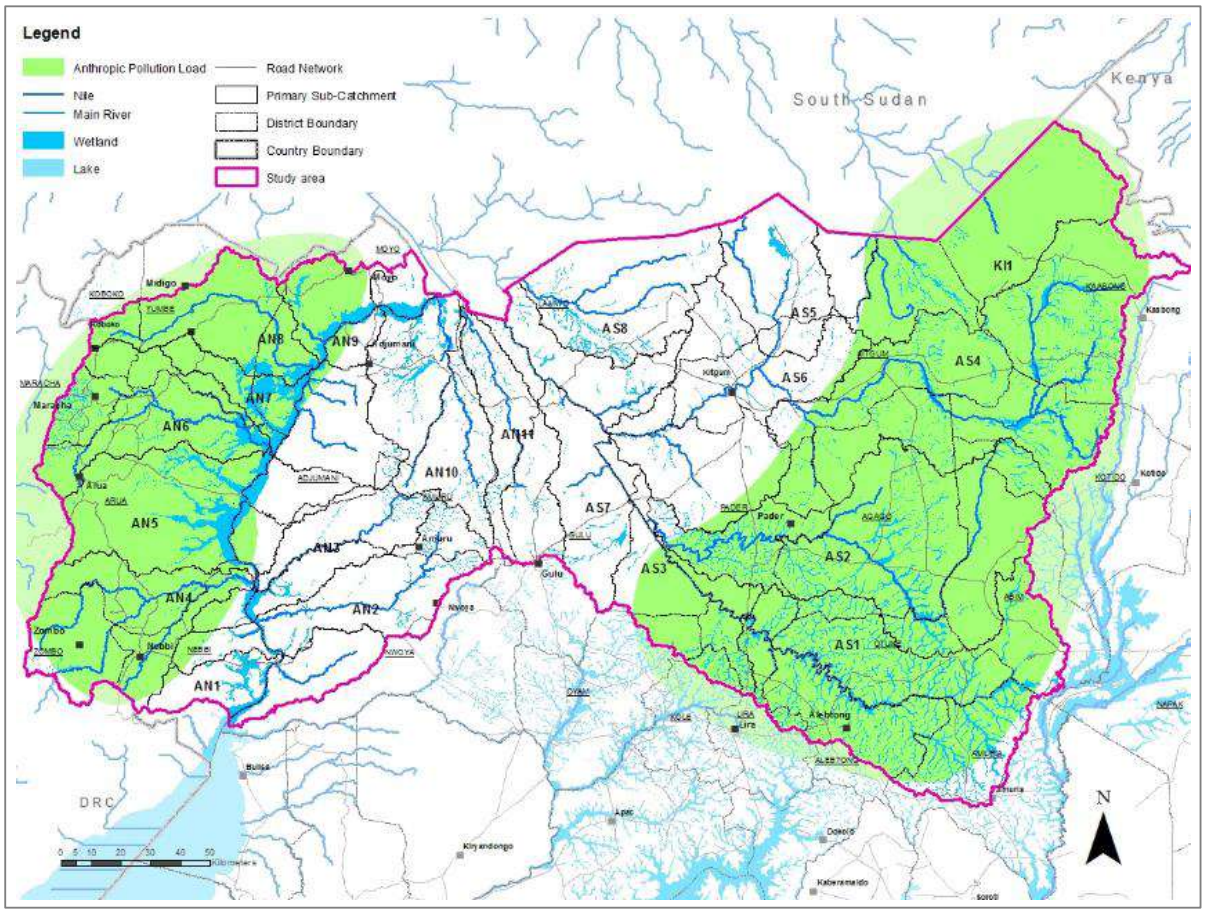


Figure 5.8: Critical issue: Anthropogenic pollution loads

5.3.2 Risk of Contamination of Water Sources

The risk of contamination of water sources has been considered critical depending on the estimated potential pollution loads. The pollution load (in tons of BOD per square kilometre per year) has been estimated based on the expected number of people, livestock, agricultural land, aquaculture surface and industrial activities. The coexistence of high population density and several human activities is generally associated with high water contamination risk. Where sanitation is inadequate, the risk of actual contamination of water resources is higher. Most critical areas are Enyau and Kochi sub-catchments for Albert Nile (high population density) and Pager Matidi sub-catchment for Aswa and Kidepo (high livestock density).

5.4 Water for Environment

5.4.1 Land Degradation and Erosion

Land degradation has been evaluated taking into account four indicators: cultivated area, rainfall/wetness coefficient, river slope, and river banks degradation in the catchment. Considerable farmland area is associated with high values due to the potential soil erosion through poor agricultural practices. High rainfall/wetness coefficient and river slopes give rise to high erosion potential since increased water velocity permits a greater degree of scouring (carrying capacity for sediment).

High erosion potential is associated with river banks degradation. River bank degradation can be estimated using the potential for uncontrolled livestock access and cropping too close to the river banks. This exacerbates erosion problems and siltation of stream and rivers.

In the Albert Nile Catchment, land erosion risk is wide spread mainly due to the presence of wide areas of farmlands coupled with poor agricultural and land management practices (bush burning, cultivation along hill slopes, deforestation, overgrazing, etc.). Uncontrolled livestock access and cropping too close to the river banks lead to bank erosion problems, especially in low land areas of Albert Nile.

In the Aswa Catchment land erosion risk is very high in the southern area (mostly in Otuke, Alebtong, and Amuria districts) due to considerable areas of subsistence farmland and relatedanthropogenic activities. In Otuke District, degraded land and poor fertility in upland areas result in cultivation close to the swamp where soil is fertile and productive. Massive deforestation and silting of rivers and valley dams have been reported in Pader District.

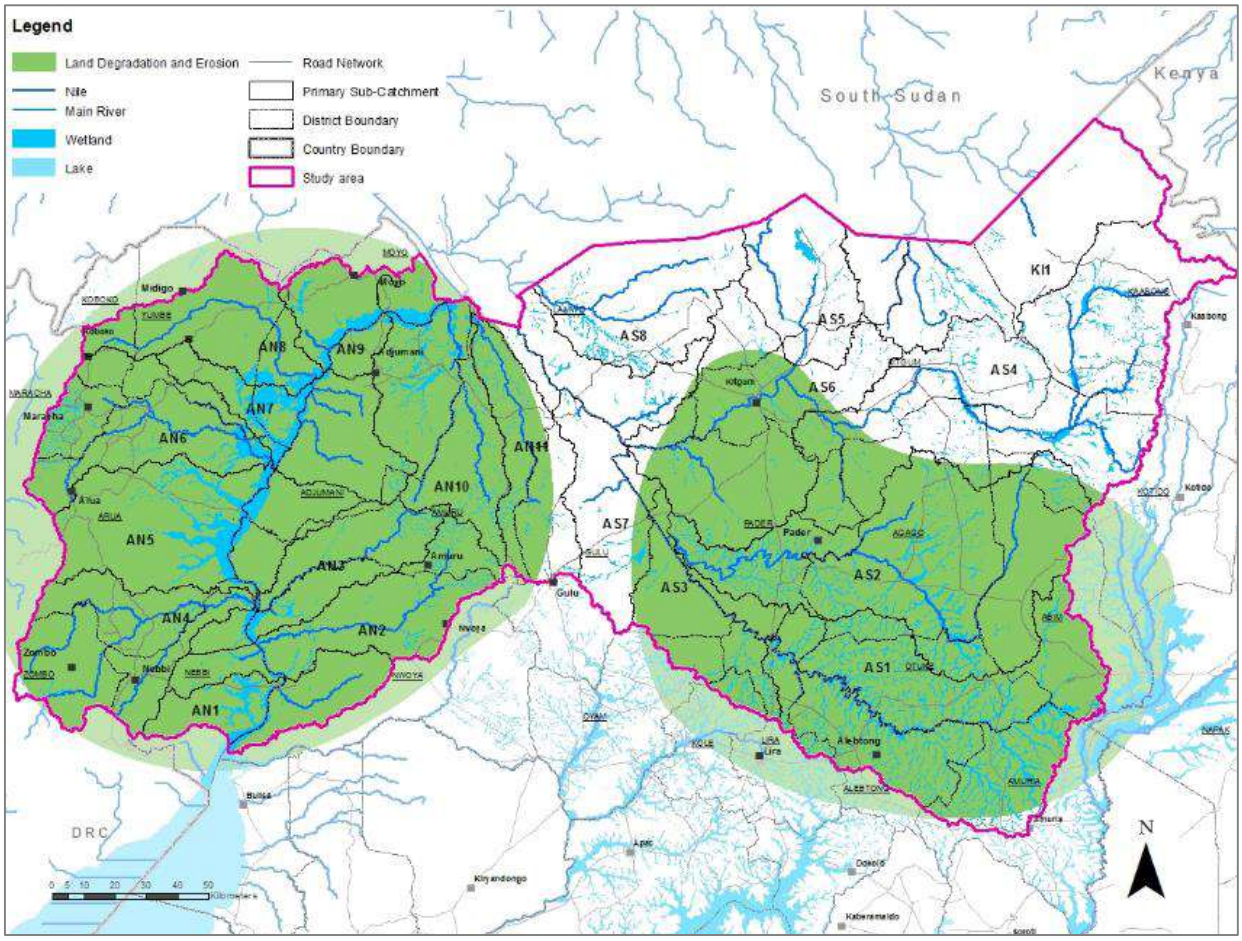


Figure 5.9: Critical issue: Land degradation and erosion

5.4.2 Climate Change and Extreme Climate Events

Climate change and extreme climate events have been investigated through the projections redacted by the Intergovernmental Panel on Climate Change (IPCC). The results show a decrease in water resources by about 15% in 2040 for the Albert Nile River Catchment and 30% within the Aswa River basin.

More emphasis should be put on sub-catchments withlimited water resources but experiencing flooding during wet periods and droughts during low rainfall periods. These sub-catchments include Ora, Enyau,

Ayugi, and Unyama Rivers in the Albert Nile River basin and the whole Aswa Catchment except the lower part of Pager and Aswa, and Nyimur.

5.4.3 Vulnerability to Drought Risk

During drought years the overall water resources decrease by about 40% for the Albert Nile River Catchment and by 55% within the Aswa River basin. Generally this reduction is higher in the sub-catchment where resource availability is lower in the mean year. This includes all the Sub-catchments in the Aswa basin and increases towards the upper part of Aswa, Agago, and Pager sub-catchments.

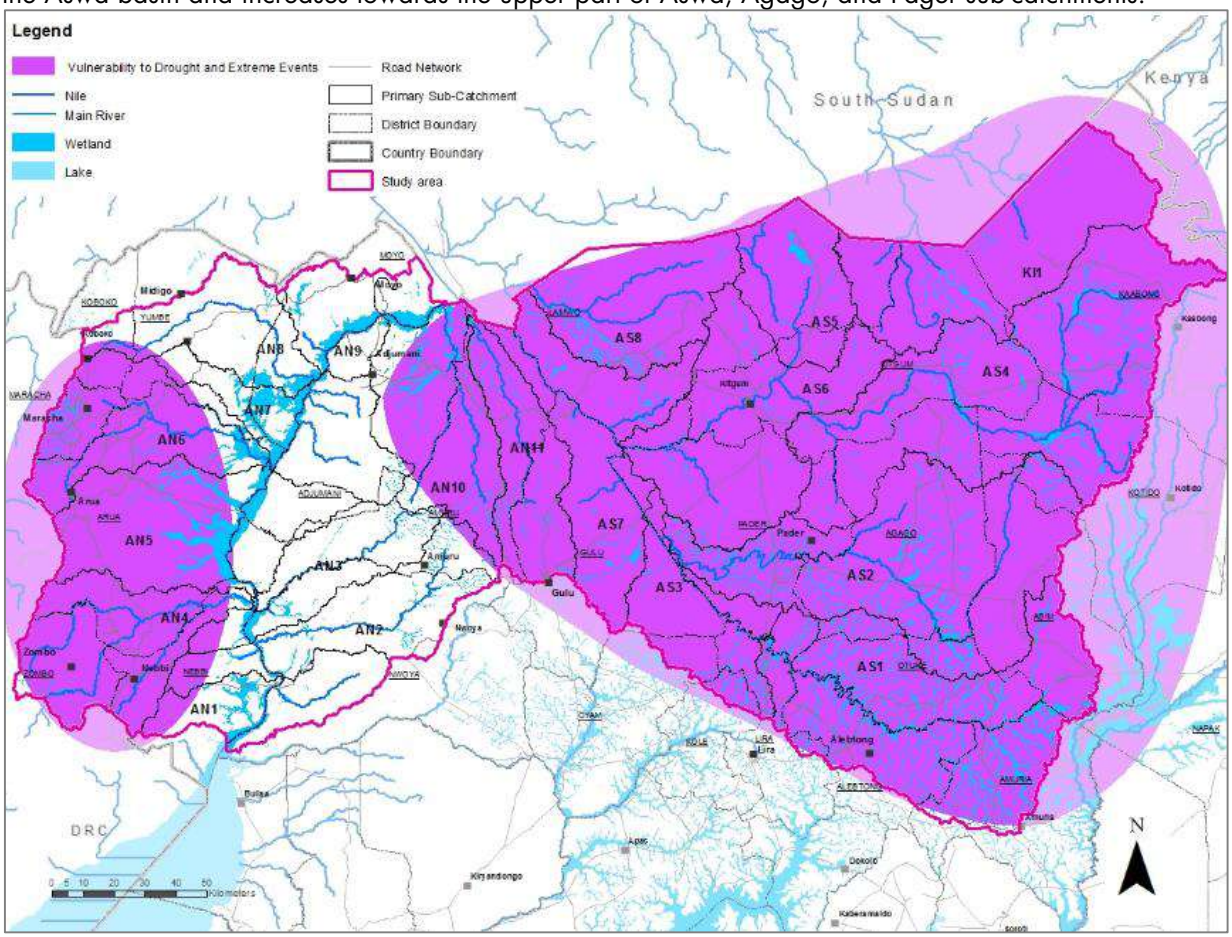


Figure 5.10: Critical issue: Vulnerability to drought and extreme events

5.4.4 Vulnerability to Flood Risk

Risk of flood events has been evaluated taking into account seven indicators: presence of towns and infrastructure vulnerable to flooding; the rainfall/wetness coefficient and river slope which can cause water bodies over flooding their banks; the extension of wetland, flood prone areas, and farmland area and exposure of assets that can be damaged. Static water level indicates the probability of groundwater flooding to occur when water levels in the ground rise above the surface level. River banks degradation indicatesa higher probability that a river flood may occur during heavy rains.

In the Albert Nile Catchment, vulnerability to flood events is very high in the areas of Maracha, Arua, and Zombo districts where there are several towns and villages with high population density and existing infrastructure. High risk to flooding can be associated with considerable river slopes and high surface runoff.In the Aswa Catchment, vulnerability to flood events is very high in some areas of Alebtong, Amuria, and Otuke districts. Flood risk is mainly due to river bank overflow in the Aswa-Moroto river and the existence of main roads in low land areas in Alebtong District.

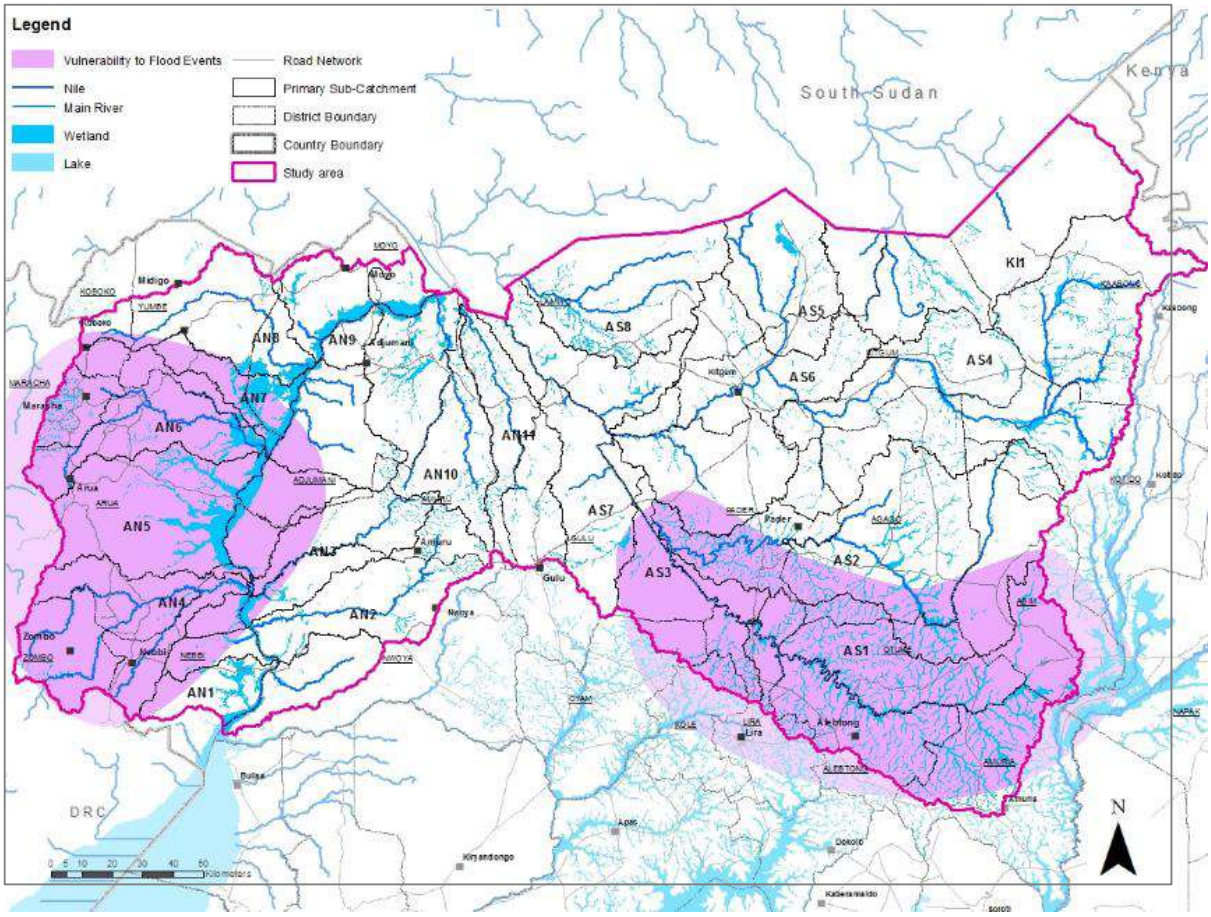


Figure 5.11: Critical issue: Vulnerability to flood events

5.4.5 Pressure on Water Dependent Ecosystems

The pressure on water dependent ecosystems has been considered critical based on the presence of potentially sensitive ecosystems. Various factors have been considered, namely the extension of wetlands, forest and rangelands areas; existence of protected areas, wetland and forest management plans; and the population density. High population density and developed anthropogenic activities increase pressure on ecosystems. This issue is important for the entire WMZ and more evident in Enyau and Aswa II sub-catchments.

5.5 Overall mapping of criticalities for UN WMZ

Taking into account all the above mentioned issues, assigned values and spatial extend the following maps present areas with critical issues ranked asvery high, high and low in UN WMZ.

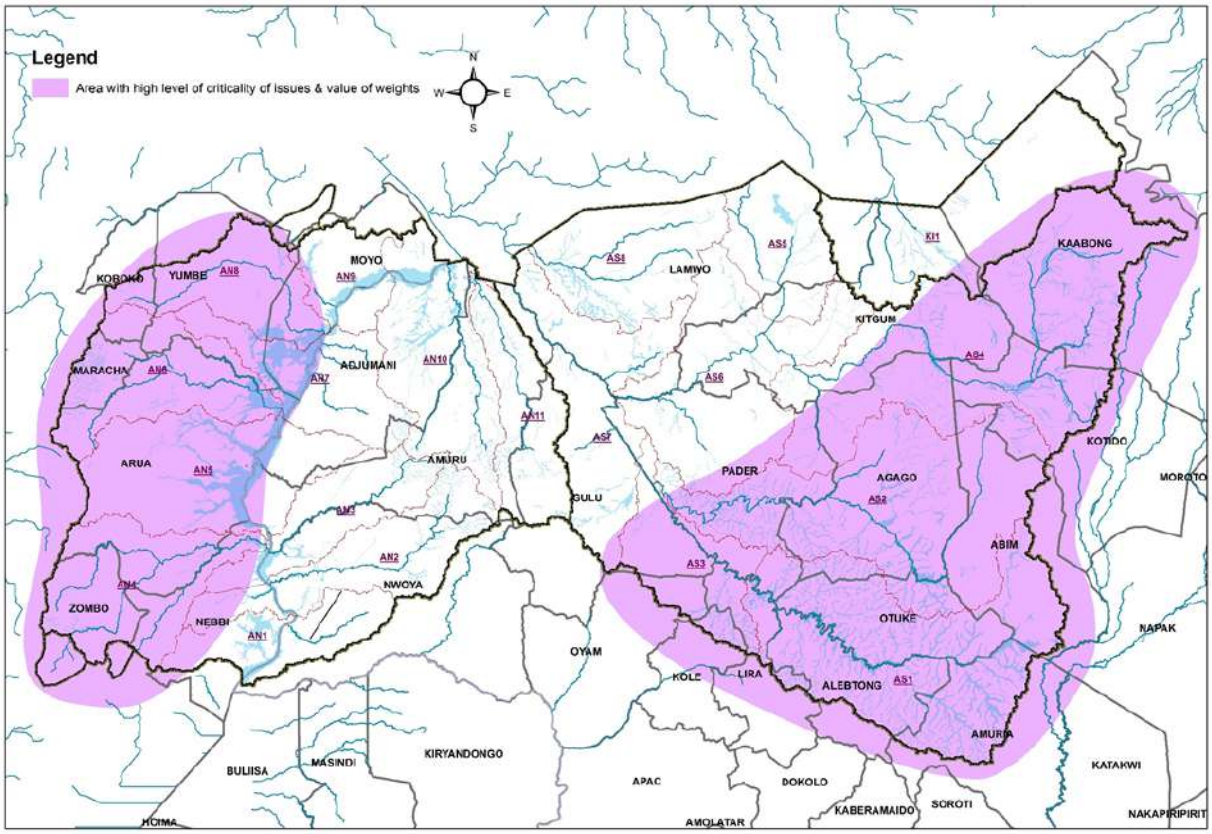


Figure 5.12: Map showingcritical issues rated Very High in the Upper Nile WMZ

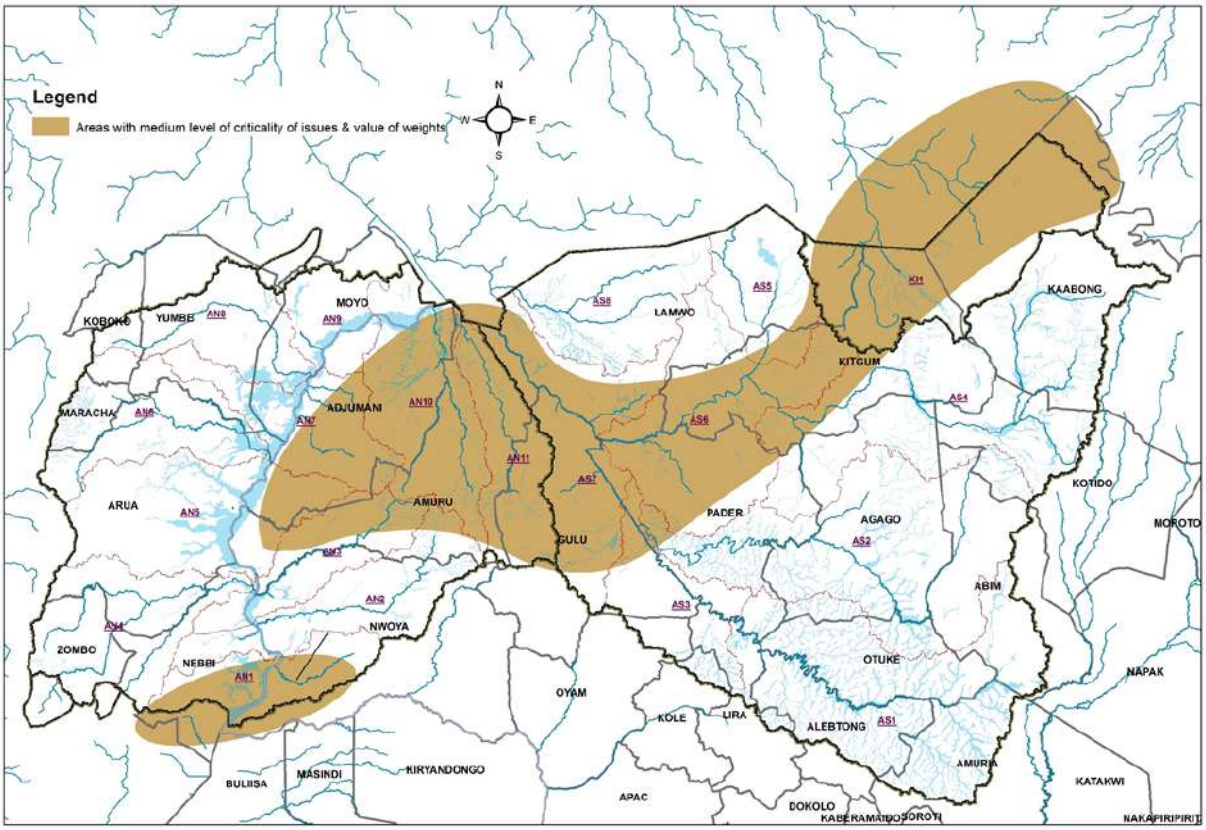


Figure 5.13: Map showing critical issues rated High in the Upper Nile WMZ

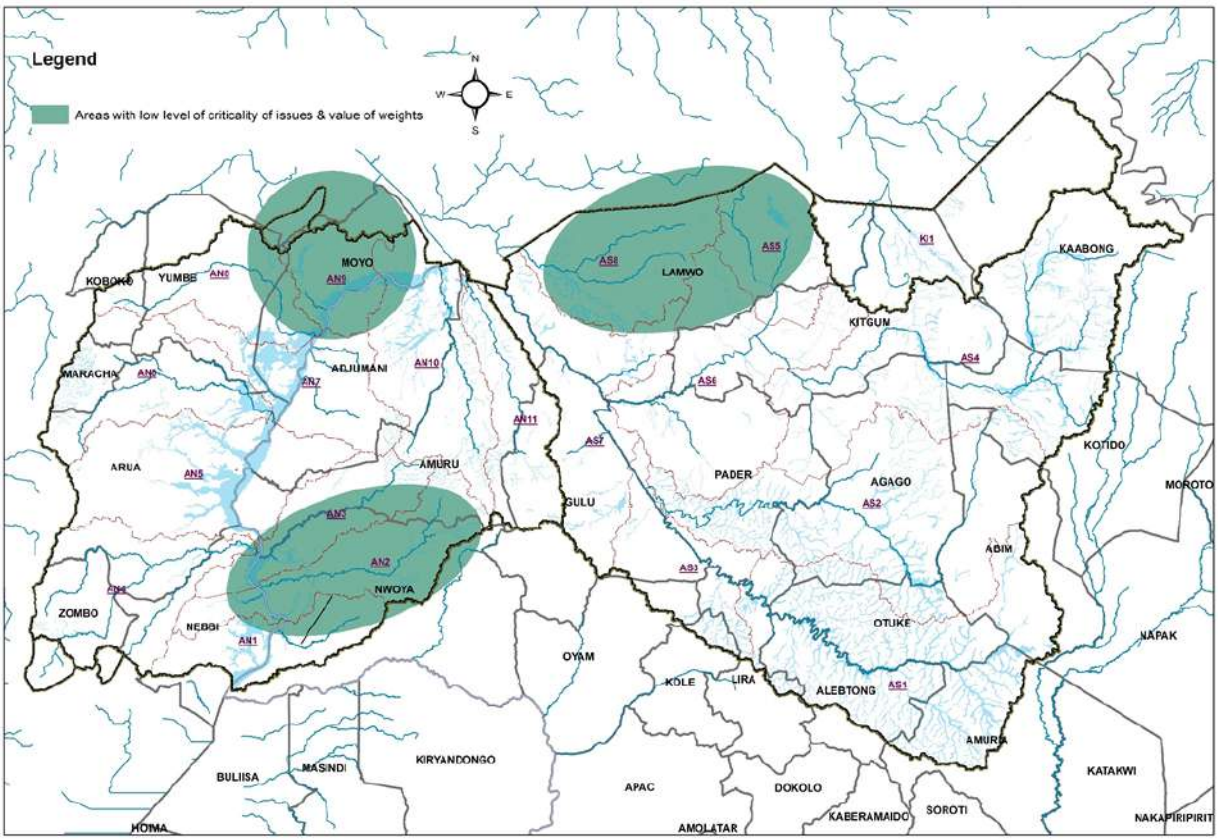


Figure 5.14: Map showing critical issues rated Low in the Upper Nile WMZ

6. VISION, OBJECTIVES, AND ANALYSIS OF OPTIONS

6.1 Vision and Objectives

The objective of the vision is to present a collective, medium-to-long term vision for the desired future state of the WMZ and its sub-catchments that can be used to derive strategies that are realistic and locally attainable. The intended outcome is a statement of the desired state for the Upper Nile WMZ, achieved through stakeholder consultation, which provides a medium-to-long-term direction that can be used as a basis for deriving sub-strategies. The setup of the vision for Upper Nile WMZ considered the following:

- Guiding principles ofIntegrated Water Resources Management (IWRM)
- Existing enabling environment and institutional setup
- Current Water and Environment Sector and sectoral key national documents
- Evaluation of the financing needs of the Water and Environment Sector Strategic Investment Plan.

The National Water Resources Strategy includes a vision for managing and developing the nation's water resources up to 2040 and defines the associated set of concrete 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 into the following three principal objectives:

1. Ensure sustainable and equitable allocation and provision of water of appropriate quantity and quality.
2. Mitigate the effects of extreme climatic events
3. Strengthening the water governance framework.

The Upper Nile WMZ vision is aimed at providing the overarching strategic intent of the Water Resources Development and Management Strategy for the zone. It guides the water resources development and management strategy, identified sub-strategies with their objectives, and strategic actions to be developed over the defined timeframe up to 2040.

The agreed vision for water resources development and management in the Upper Nile WMZ is:

"A sustainable, equitable and effective water resources management and development for socio-economic transformation of Upper Nile Water Management Zone by 2040."

6.2 Generic Strategic Actions for IWRM in the Upper Nile WMZ

The strategic planning process identifies policy implementation options in the form of management strategies and tools that support on-the-ground decision-making and actions that realise the objectives of policy recommendations over time.

In general, institutional, economic and finance instruments for WRMD become more and more important for making better decisions that improve water management as well as social goals for current and also future generations.

For each objective area, a list of generic strategic actions includes covering data gaps fillings, capacity building, data and analysis tools, further investigations, monitoring, infrastructure development, and industry/education/community initiatives.

The identified generic strategic actions to be implemented in the UN WMZ strategic action plan and implementation programme are listed below:

- Information Management and Monitoring Systems
  - Capturing information into the Water Information System
  - Ensure that information database is available and in formats compatible with national standards
  - Ensure that water management information is available to institutions, committees and other stakeholders on time, in the right format and with the desired information
  - Ensure that groundwater and surface water quantity and quality monitoring network will produce reliable and usable data
  - Update and maintain a hydrometric database required for controlling compliance of water use allocation.

- Carry out hydrological, hydrogeological, water quality and socio-economic surveys for the purposes of planning and development of water resources.

- Water Allocation and Water Use Management
  - Water allocation:
    - Ensure that major water users are known and are managed through a licensing or permit system
    - Implement rules to ensure that water allocation is managed in public interest
    - Implement water allocation in accordance with sustainable use, economic efficiency, and social equity principles
    - Implement monitoring compliance system for water allocation
    - Implement monitoring compliance system for pollution permits/ licenses.
  - Pollution control:
    - Ensure that major water polluters and the extent and seriousness of surface and ground water pollution are known
    - Implement polluters' licensing according to the regulations.
- Water infrastructure development:
  - Water supply systems development needs
  - Water sanitation systems development needs
  - Water irrigation demand and storage needs
  - Water storage and transfer/allocation options that cross catchment boundaries
  - Efficiency actions for water use
  - Improve water quality and sanitation monitoring systems.
- Water resource and environmental protection:
  - Implement environmental standards for surface and groundwater quality and quantity
  - Monitoring "at risk" catchments and sub-catchments in relation to environmental limits and cumulative effects
  - Ensure protection of natural character, natural features and areas of conservation value
  - Ensure biodiversity issues
  - Ensure environmental protection and restoration of wetlands, forests and other ecosystems, river banks, hilly areas, e.t.c.
- Public engagement and capacity development:
  - Ensure continuous support and capacity building of WMZ team, coordination structures at the catchment, local government and community level
  - Develop and maintain a formal stakeholder database, established with clear roles and responsibilities in water resources management
  - Develop and maintain an active stakeholder participation process through regular consultation activities
  - Develop and maintain databases of projects and action implementation in formats compatible with other national institutions and catchment organisations
  - Regularly update the WRMD Strategy and actions plan, incorporating stakeholder views.

6.3 Identification of Issues and Opportunities

The identification of potential issues and opportunities is based upon: (i) analysis of framework given by the National Strategy; (ii)results obtained from Diagnostic/Situational Analysis; (iii) information and suggestion gathered from stakeholders through specific consultations. The issues are divided in three main categories: (i) water availability for use; (ii) environment and climate vulnerability; and (iii) water governance. In general, on the basis of all gathered information, the identification of strategic issues has been conducted to get a comprehensive view of current and future catchment conditions. At the same time this work should allow an optimal set up of subsequent analyses of actions to solve these issues. Strategic issues must be effectively identified, therefore, some issues have been aggregated and the results are presented in **Table 6.1** to **Table 6.3** below.

Table 6.1: Strategic issues related to water availability for use

WATER DEMAND AND USE		
Sub-Strategy	**Strategic Objectives**	**Strategic Issues**
Water for people	Universal and sustainable access to safe water	Insufficient water resources availability
		Insufficient water storage
		Inadequate water supply infrastructure and services
		Risk of contamination of water sources

WATER DEMAND AND USE		
Sub-Strategy	**Strategic Objectives**	**Strategic Issues**
		Water insecurity (Climate Change, seasonal variability, transboundary, conflict for use)
	Universal and sustainable access to improved sanitation and hygiene	Lack of improved sanitation facilities and need for hygiene improvement
		Inadequate wastewater and sludge management
		Lack of sewerage systems and treatment capacity
Water for production	Sustainable use, development and management of water resources in agriculture, aquaculture, livestock and forestry	Insufficient water resources availability
		Insufficient water storage
		Lack of irrigation, livestock and aquaculture infrastructure
		Risk of contamination of water sources
		Water insecurity (Climate Change, seasonal variability, transboundary, conflict for use)
	Sustainable use, development and management of water resources for agro-industry, industrial production, Oil and Gas	Insufficient water resources availability
		Water insecurity (Climate Change, seasonal variability, transboundary, conflict for use)
Water for Energy	Sustainable use, development and management of water resources for energy production	Insufficient water resources availability
		Lack of water storage for HP
		Lack of effective criteria for water resources allocation (high value water use).

In the following table issues of flood and drought are related to the lack or limited infrastructure development for adaptation to climatic variability.

Table 6.2: Strategic issues related to environment and climate vulnerability

ENVIRONMENT AND CLIMATE VULNERABILITY	
Strategic Objectives	Strategic Issues
Conservation of ecosystem services and functions	Pressure on water dependent ecosystems
	Anthropogenic pollution load
	Land degradation and erosion
Mitigation of effects of extreme climatic events (flood, drought)	Vulnerability to flood events
	Vulnerability to drought events
	Increasing of extreme climate events

As already underlined, aiming at a comprehensive but effective identification of issues, the strategic issues for water governance are grouped. These five groups are relevant for the development of theaction plan.

Table 6.3: Strategic issues related to water governance

WATER GOVERNANCE	
Strategic Objectives	**Strategic Issues (5 groups)**
Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development	Strengthening of policy, legal and institutional framework for IWRM at WMZ and catchment level
	Limited enforcement of WRM regulation and lack of compliance with existing standards
	Weak implementation of IWRM at WMZ and catchment levels
	Limited integration of IWRM into sectoral and local planning frameworks
	Expand and improve the water resources knowledge base and information management system
	Inadequate hydro-meteorological monitoring network
	Inadequate water quality monitoring network and laboratory facilities

WATER GOVERNANCE	
Strategic Objectives	**Strategic Issues (5 groups)**
	Inadequate groundwater monitoring network
	Inefficient WR/WQ information management system
	Coordination and cooperation
	Limited harmonization of institutional mandates between national and local government bodies and agencies
	Limited inter-agency cooperation and collaboration
	Weak stakeholder engagement
	Strengthening of institutional capacity for IWRM implementation at WMZ and catchment level
	Inadequate institutional capacity
	Inadequate technical capacity and lack of tools for water resources allocation
	Low level of awareness
	Strengthening of financing mechanism for IWRM implementation at WMZ and catchment level
	Insufficient funding for Catchment based WRM
	Limited effective criteria for water resources allocation (high value water use)

WATER GOVERNANCE	
Strategic Objectives	**Strategic Issues (five groups)**
Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development	Strengthening of policy, legal and institutional framework for IWRM at WMZ and catchment level
	Limited enforcement of WRM regulation and lack of compliance with existing standards
	Weak implementation of IWRM at WMZ and catchment levels
	Limited integration of IWRM into sectoral and local planning frameworks
	Expand and improve the water resources knowledge base and information management system
	Inadequate hydro-meteorological monitoring network
	Inadequate water quality monitoring network and laboratory facilities
	Inadequate groundwater monitoring network
	Inefficient Water Resources/Water Quality information management system
	Coordination and cooperation
	Limited harmonisation of institutional mandates between national and local government bodies and agencies
	Limited inter-agency cooperation and collaboration
	Weak stakeholder engagement
	Strengthening of institutional capacity for IWRM implementation at WMZ and catchment level
	Inadequate institutional capacity
	Inadequate technical capacity and lack of tools for water resources allocation
	Low level of awareness
	Strengthening of financing mechanism for IWRM implementation at WMZ and catchment level
	Insufficient funding for catchment based WRM
	Limited effective criteria for water resources allocation (high value water use)

6.4 Prioritisation and Sequencing of Generic Strategic Actions

In order to prioritise the strategic actions, as a result of the reconciliation analysis the strategic issues are evaluated according to the following criteria:

- Population growth
- Economic development in the basin
- Water availability and resource development
- Environmental conservation
- Social concerns
- Institutional issues.

The list of generic strategic actions is prioritised based on the critical level, spatial extend of issues identified in the previous chapter and population levels. The resulting prioritized specific strategic actions are presented in Table 6.4 and Table 6.5 below.
For the Albert Nile River basin:

- In Albert Nile between Ora and Enyau, Enyau and Kochi sub-catchments water infrastructure development is needed and should be prioritized for all sectors;
- For Pakwach, Ora, Albert Nile between Enyau and Kochi, Enyau, Laropi all strategic issues are very important except water supply
- Ayugi and Unyama require some actions in a few sectors
- Panyango and Ome do not require any priority interventions.

For the Aswa River basin:

- Aswa I, Agago, Aswa II, Pager Matidi and Pager Kitgum sub-catchments need water infrastructure development for all sectors and more so for water supply
- Pager Aringa and Aswa III require some actions in a few sectors
- Nyimur does not require any priority intervention.

Kidepo River Catchment requires water infrastructure development as a priority for all sectors, except sanitation.

In the Upper Nile WMZ strategy, it is very important to take advantage of existing opportunities. In situations when water resources are enough to satisfy all foreseen demands (according to above mentioned projections)with limited infrastructure in existence, there is an opportunity to increase water exploitation to get further economic development. This is the case for Panyango and Ome sub-catchments in Albert Nile River basin and Nyimur in Aswa River basin.Therefore, investment interventions are expected in these areas to exploit these opportunities. Specific strategic actions are included in the framework of the Upper Nile WMZ Strategic Action Plan with related activities, outputs and indicators. More details are provided in the action plan.

Table 6.4: Prioritisation of strategic actions for Albert Nile sub-catchments

GENERIC STRATEGIC ACTIONS	ALBERT NILE CATCHMENT										
	Pakwach	Panyango	Ome	Ora	AN_up_Enyau	Enyau	AN_up_Kochi	Kochi	Laropi	Ayugi	Unyama
	AN1	AN2	AN3	AN4	AN5	AN6	AN7	AN8	AN9	AN10	AN11
Water infrastructure development											
Water supply systems development needs.	-	-	-	X	X	XX	X	XX	-	-	X
Water sanitation systems development needs.	X	-	-	XX	XX	XX	-	XX	X	XX	X
Water irrigation demand and storage needs.	X	-	-	XX	XX	XX	X	XX	X	-	-
Water storage and transfer/allocation options that cross catchment boundaries.	X	-	-	-	XX	XX	X	XX	-	-	X
Efficiency actions for water use.	-	-	-	-	X	X	-	X	X	-	-
Improve water quality and sanitation monitoring systems.	X	-	-	X	X	XX	X	XX	X	X	-
Water resource and environmental protection											
Monitoring "at risk" catchments and sub-catchments determination in relation to environmental limits and cumulative effects.	X	X				X					X
Ensure protection of biodiversity values, natural features and areas of conservation value.	X	X	X	X	X		X			X	X
Ensure environmental protection and restoration of wetlands.	X		X		X		X	X			

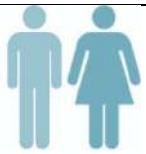
Table 6-5: Prioritization of Generic Strategic Actions for Aswa and Kidepo sub-catchments

GENERIC STRATEGIC ACTIONS	ASWA CATCHMENT								KIDEPO
	Aswa I	Agago	Aswa II	Pager Matidi	Pager Aringa	Pager Kitgum	Aswa III	Nyimur	Kidepo
	AS1	AS2	AS3	AS4	AS5	AS6	AS7	AS8	KI1
Water Infrastructure Development									
Water supply systems development needs.	X	X	X	X	-	XX	-	-	X
Water sanitation systems development needs.	XX	XX	XX	-	-	XX	-	-	-
Water irrigation demand and storage needs.	XX	XX	XX	X	X	XX	X	-	X
Water storage and transfer/allocation options that cross catchment boundaries.	XX	XX	XX	XX	XX	XX	XX	-	XX
Efficiency actions for water use.	X	XX	-	XX	XX	X	X	-	XX
Improve water quality and sanitation monitoring systems.	X	X	X	XX	-	-	-	-	XX
Water resource and environmental protection									
Monitoring "at risk" catchments and sub-catchments determination in relation to environmental limits and cumulative effects.	X	X	X				X		
Ensure protection of biodiversity values, natural features and areas of conservation value.	X			X	X				X
Ensure environmental protection and restoration of wetlands.	X			X					

7. FRAMEWORK OF THE UPPER NILE WMZ STRATEGIC ACTION PLAN

7.1 Water Resources Development and Management Strategic Framework of Actions

The Water Resources Development and Management Strategy for the Upper Nile WMZ is structured on five sub-strategies and nine strategic objectives, as listed in the table below.

Water Governance		1. Equitable, participatory and accountable water governance for sustainable and inclusive growth and development
Water for People		2. Universal and sustainable access to safe water supply 3. Universal and sustainable access to improved sanitation and hygiene
Water for Production		4. Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry 5. Sustainable use, development and management of water resources for Agro-industry, Industrial production, Oil and Gas 6. Sustainable use, development and management of water resources for Other Sectors (tourism, transportation, security)
Water for Energy		7. Sustainable use, development and management of water resources for renewable energy production
Water for Environment		8. Conservation of ecosystem services and functions 9. Mitigation of effects of extreme climatic events

In the following WRDM Strategic Framework of Actions, each of the nine strategic objectives has been structured in five structural components as described in previous paragraph and for each component a set of Strategic Actions has been defined with related activities, outputs and indicators. The objectives, components and strategic actions have been numbered in order to outline the hierarchical framework of action in a consistent and logical way.

7.1.1 Water Governance

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
1.1 Monitoring Systems and Information Management	1.1.1	Collection, storage, elaboration and management of integrated data on water resources	Develop technical guidelines, protocols and specifications for planning of field survey and sampling activities, data collection, integrated data storage and elaboration, WR database population and information management	Data collection and management toolkit of the WMZ	Number of documents issued, by type
	1.1.2	Establish and maintain a GIS based knowledge and information management system for the Upper Nile WMZ	Create a GIS infrastructure to support data storage, elaboration, exchange and information management	GIS database of water resources Upper Nile WMZ	Number of GIS layers implemented % coverage % integration achieved Number of users Number of documents issued, by type
			Develop technical guidelines, protocols and specifications for GIS-database population and management of spatial information, including management of metadata		
			Implement specific agreements to harmonize the WMZ GIS database with the existing national platforms for data loading, sharing, exchange and integration with other GIS databases maintained by other institutions		
	1.1.3	Establish and maintain a Web-GIS database of water resources	Create and implement a web-GIS database for publication of relevant information on water resources of the Upper Nile WMZ	Web-GIS database of water resources Upper Nile WMZ	Number of GIS layers implemented % coverage
	1.1.4	Expand and upgrade the hydro-meteorological monitoring network in the UN-WMZ	Rehabilitation and upgrading of existing hydro-meteorological monitoring stations in the Upper Nile WMZ	Fully operational Hydro-meteorological network	Number of hydro-meteorological stations operational % coverage
			Installation and implementation of new hydro-meteorological monitoring stations		
	1.1.5	Expand and upgrade the GW and hydrogeological	Rehabilitation of existing GW monitoring stations in the UN-WMZ		Number of GW stations operational

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
		monitoring system in the UN WMZ	Installation of new GW monitoring stations in the UN-WMZ, , in line with the national WQ Strategy	Fully operational groundwater monitoring network	% coverage
	1.1.6	Expand and upgrade the knowledge base on groundwater resources and aquifers in the UN WMZ	Develop detailed hydrogeological studies on shallow aquifers and subsurface groundwater potential resources Studies on deep aquifers and related groundwater potential resources Evaluation of potential for groundwater recharge (Managed Water Recharge MAR) GIS database and water balance	Web-GIS database of groundwater resources of Upper Nile WMZ	*Number ofGIS layers implemented* % coverage Number of aquifers mapped
	1.1.7	Expand and upgrade the WQ monitoring network and laboratory facilities for surface and groundwater bodies in the UN WMZ	Rehabilitation of existing WQ monitoring stations in the UN-WMZ Installation of new WQ monitoring stations in the UN-WMZ, in line with the national WQ Strategy Creation and implementation of a Regional WQ laboratory of Upper Nile, in line with the national WQ Strategy	Fully operational WQ monitoring network and laboratory	Number WQ stations operational % coverage Number of WQ samples tested
	1.1.8	Establish and maintain a Upper Nile WMZ Modelling Unit	Set up a modelling unit coordinated with the central DWRM Hydrologic Department Develop technical guidelines and specifications for WR modelling and scenario development and analysis at the WMZ and catchment levels	WMZ Modelling Unit and tools	Number of staff assigned Number of documents issued, by type
	1.1.9	Disseminate knowledge on water resources of the Upper Nile WMZ	Publication of a comprehensive GIS Atlas of Water Resources in the UN-WMZ (web-GIS) including: - Surface water bodies - Groundwater bodies	Public outreach information materials	*Number of publications produced, by type* % of Upper Nile WMZ covered

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
			- Water Quality and Health of water bodies - Water related ecosystems		
1.2	Water Allocation and Water Demand Management	1.2.1 Strengthen and enforce the IWRM regulatory framework at the WMZ level	Develop and implement WMZ specific operational procedures for implementation of legal framework for IWRM (wetland, riverbanks, pollution prevention, sediment control, control of priority pollutants, waste management, etc.) in line with the national catchment planning guidelines	IWRM Operational Procedures for Upper Nile WMZ	*Number of documents issued, by type*
			Establish and implement the Water Management Zone Steering Committee of Upper Nile WMZ to support planning, coordination and supervision of IWRM implementation in the WMZ	Upper Nile Steering Committee	*Number ofmembers* Number of meetings held/year
		1.2.2 Improve and expand the water permit management system in the WMZ	Develop and implement a multi-year Water Resources Inspection and Control Programme in the Upper Nile WMZ, harmonized and coordinated with the central DWRM operational programmes	Inspection and control programme	Number of inspections and controls planned % coverage
			Develop and implement a Programme for compliance audit of water permits within the WMZ, harmonized and coordinated with the central DWRM operational programmes	Compliance monitoring programme	Number of compliance audits planned % coverage % compliance
		1.2.3 Ensure appropriate environmental flows in water bodies in the WMZ	Define and implement a set of Technical Standards for determination, implementation and management of environmental flows in the Upper Nile WMZ	Technical Standards on environmental flows	*Number of documents issued, by type*
		1.2.4 Promote integrated land and water management in the Upper Nile WMZ	Define and implement a set of Technical Guidelines for improving agricultural and forestry practices in the Upper Nile WMZ,	Technical Standards on	Number of documents issued, by type

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
			including provisions for assessment and management of the land carrying capacity for livestock in the Upper Nile WMZ	irrigation water efficiency	
	1.2.5	Establish and implement the Catchment Management Organisations in the Upper Nile WMZ	Establish and mobilize the Catchment Management Organizations and focused and time-bounded Scope/Area Catchment Management Committees to address critical issues/areas within the Upper Nile WMZ, in line with the national catchment planning guidelines, including specific rules and procedures	Functional Catchment Management Organizations	Number of CMO established Number of focus CMC established *Number ofCMP issued*
	1.2.6	Develop Water Sector funding mechanisms for decentralized IWRM implementation at the WMZ and catchment levels	Development of targeted Water Sector funding mechanisms (proposed fee of 3% of investment projects) for supporting decentralized IWRM implementation at the WMZ and catchment levels	IWRM funding mechanism	% coverage Capital Investment per capita per year
			Promote Public-Private Partnerships for IWRM at the WMZ and catchment levels		
			Develop targeted Programs for IWRM – especially in water stressed areas		
1.3 Water Supply Infrastructure Development and Management	1.3.1	Improve the knowledge base on the water supply and sanitation service coverage in the Upper Nile WMZ	Create and maintain a GIS based Inventory of water supply and sanitation service coverage in the WMZ (population served, urban and rural areas covered)	GIS Atlas of Water Supply Service	Number of GIS layers implemented % coverage % population covered
	1.3.2	Improve the knowledge base on the state of water supply and sanitation infrastructure in the Upper Nile WMZ	Create and maintain a GIS based Inventory of water supply and sanitation facilities (sources of water, facilities by type, distribution systems, sewerage networks, WWTPs, efficiency levels, performance of operators, etc.)	GIS Atlas of Water Supply and Sanitation Facilities	Number of WSS facilities mapped, by type

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
	1.3.3	Improve the knowledge base of WS projects in the Upper Nile WMZ	Create and maintain a GIS based Inventory of water supply projects for water supply in the Upper Nile WMZ (planned, pipeline, under development and completed projects)	GIS Atlas of Water Supply and Sanitation Projects	Number of WSS projects, by type
	1.3.4	Improve the knowledge base on the water for production supply coverage in the Upper Nile WMZ	Create and maintain a GIS based Inventory of water for production supply coverage in the WMZ (population served, uses)	GIS Atlas of Water Supply Service	Number of GIS layers implemented % coverage % population % demand met Water uses, by type
	1.3.5	Improve the knowledge base on the state of water for production facilities in the Upper Nile WMZ	Create and maintain a GIS based Inventory of water for production facilities (sources of water, facilities by type, uses by type, WFP storage capacity, performance of operators, etc.) including: • Irrigation water supply • Livestock watering facilities • Aquaculture • Other productive uses	GIS Atlas of Water for Production Facilities	Number of WFP facilities mapped, by type
	1.3.6	Improve the knowledge base of WS projects in the Upper Nile WMZ	Create and maintain a GIS based Inventory of water supply projects for water supply in the Upper Nile WMZ (planned, pipeline, under development and completed projects)	GIS Atlas of WFP Projects	Number of WFP projects, by type
	1.3.7	Improve the knowledge base on the industrial water supply facilities in the Upper Nile WMZ	Create and maintain a GIS based Inventory of industrial water supply facilities (sources of water, facilities by type, uses by type, WWTP capacity, performance of operators, etc.)	GIS Atlas of Industrial Water Supply Facilities	Number of Industrial Water Supply facilities mapped, by type
	1.3.8	Improve the knowledge base on the state of industrial water supply	Create and maintain a GIS based Inventory of industrial water supply projects in the Upper Nile WMZ (planned, pipeline, under development and completed projects)	GIS Atlas of Industrial Water Supply Projects	Number of Industrial Water Supply Projects, by type

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
		projects in the Upper Nile WMZ			
	1.3.9	Improve the knowledge base on the Oil and Gas water facilities in the Upper Nile WMZ	Create and maintain a GIS based Inventory of Oil and Gas water facilities (sources of water - SW and GW, facilities by type, uses by type, WWTP capacity)	GIS Atlas of Oil and Gas Water Facilities	Number of Oil and Gas Water Facilities mapped, by type
	1.3.10	Improve the knowledge base on the state of industrial the Oil and Gas Water Facilities projects in the Upper Nile WMZ	Create and maintain a GIS based Inventory of Oil and Gas Water Facilities projects in the Upper Nile WMZ (planned, pipeline, under development and completed projects)	GIS Atlas of Oil and Gas Water Facilities Projects	Number of Oil and Gas Water Facilities Projects, by type
	1.3.11	Improve the knowledge base on hydropower facilities in the Upper Nile WMZ	Create and maintain a GIS based Inventory of hydropower facilities (sources of water, facilities by type, installed capacity)	GIS Atlas of hydropower facilities	Number of HP Facilities mapped, by type
	1.3.12	Improve the knowledge base on hydropower projects in the Upper Nile WMZ	Create and maintain a GIS based Inventory of Hydropower projects in the Upper Nile WMZ (planned, pipeline, under development and completed projects)	GIS Atlas of hydropower Projects	Number of Hydropower Projects, by type
	1.3.13	Improve the knowledge base on multipurpose facilities in the Upper Nile WMZ	Create and maintain a GIS based Inventory of multipurpose facilities (sources of water, facilities by type, uses by type, storage capacity)	GIS Atlas of multipurpose facilities	Number of Multipurpose Facilities mapped, by type
	1.3.14	Improve the knowledge base on multipurpose projects in the Upper Nile WMZ	Create and maintain a GIS based Inventory of multipurpose projects in the Upper Nile WMZ (planned, pipeline, under development and completed projects)	GIS Atlas of multipurpose facilities Projects	Number of Multipurpose Facilities Projects, by type
	1.3.15	Improve the knowledge base on the water works in the Upper Nile WMZ	Create and maintain a GIS based Inventory hydraulic works, sediment control interventions, drainage facilities in the WMZ	GIS Atlas of Water Works in the Upper Nile WMZ	Number of GIS layers implemented % coverage

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
					Number of water works mapped, by type
1.4 Water Resource Management and Environmental Protection	1.4.1	Establish and maintain a Web-GIS database of water permits of the Upper Nile WMZ	Develop and implement a comprehensive GIS database of water permits at the WMZ level	GIS database of water permits in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of permits registered, by type
	1.4.2	Establish and maintain a Web-GIS database of water source protection in the Upper Nile WMZ	Develop and implement a comprehensive GIS database of water for protection plans and related measures in the WMZ level	GIS database of water source protection in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of water sources with WSP measures
	1.4.3	Establish and maintain a Web-GIS database of areas with integrated land and water management measures	Develop and implement a comprehensive GIS database of areas with integrated land and water management measures in the WMZ level, including: - Reforestation / afforestation - River corridors and ecologic corridors - Wetland restoration and protection - Riverbanks and aquatic ecosystem restoration - Water scenic landscape protection - Protected areas - others	Web-GIS database of integrated land and water management areas in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of areas mapped, by type
	1.4.4	Improve knowledge base on flood risk in the Upper Nile WMZ	Develop a Flood Risk assessment in the Upper Nile WMZ considering flood events with different return periods (2, 10, 20, 100, 200 years) for the main rivers of Upper Nile WMZ, including GIS mapping of flood prone areas	Vulnerability Assessment Study and Atlas of Flood Risk in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of areas mapped, by type % population at risk

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
			and related vulnerability of population and assets		
	1.4.5	Improve knowledge base on drought risk in the Upper Nile WMZ	Develop a Drought Risk assessment in the Upper Nile WMZ considering drought events with different return periods in the Upper Nile WMZ, including GIS mapping of drought prone areas and related vulnerability of population and assets and ecosystems	Vulnerability Assessment Study and Atlas of Drought Risk in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of areas mapped, by type % population at risk
	1.4.6	Establish and maintain a water demand management system	Update and expand the knowledge base on water resources and maintain the water balance updated at the catchment level based on the evolution of water demand and licensed permits over time	Water Demand Management procedure	Number of documents published, by type % coverage
	1.4.7	Establish and maintain a environmental flows and reserve management system	Update and expand the knowledge base on water related ecosystems and maintain adequate environmental flows and water reserve for the river systems in the Upper Nile WMZ	Environmental Flows and Reserve Management procedure	Number of documents published, by type % coverage
	1.4.8	Improve the knowledge base on environmental flows and water reserve	Develop and implement a comprehensive GIS database of facilities with approved/regulated environmental flows and reserve in the WMZ level, including: - Dams - Water abstraction facilities on rivers - Hydraulic works - Regulated wetlands - Others	GIS Atlas of Environmental Flows and Reserve	Number of GIS layers implemented % coverage Number of facilities, by type
	1.4.9	Implement and maintain a comprehensive knowledge base of the Upper Nile WMZ	Create and maintain a comprehensive library and archive of reference documents (paper and digital documents) related to water		

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
			resources management in the Upper Nile WMZ, including: - Research and studies on water resources - Cartography - Database and GIS - Field research and monitoring data		
	1.4.10	Cross-sectoral and cross-level coordination platform for WRMD planning at the WMZ level established and functional	Establish a cross-sectoral coordination platform for IWRM implementation between WMZ and Regional Agencies, CMOs and Local Government at the catchment level, private sectors, including specific rules and procedures for cooperation	Cross sectoral coordination platform for IWRM implementation	*Number of documents issued, by type*
			Develop a register of institutional competences, references, procedures, agreements etc. in order to harmonize institutional mandates between the WMZ and the national, regional and local government bodies and agencies involved in IWRM implementation at the WMZ level		
1.5 Public engagement and capacity development	1.5.1	Stakeholder engagement mechanism developed and established at the WMZ level	Develop and implement a multi-year Stakeholder Engagement Programme, including specific procedures, means and tools for stakeholder consultation	Stakeholder Engagement Programme for the Upper Nile WMZ	Number of stakeholder engagement activities planned % of Upper Nile WMZ covered
			Establish a WMZ Stakeholder Forum for coordination of stakeholder engagement at the catchment, sub-catchment and local levels in the Upper Nile WMZ, including specific rules and procedures for participation	WMZ Stakeholder Forum	Number of Stakeholder involved

	Strategic Objective 1		Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
			Develop a WMZ communication and awareness programme with targeted outreach materials (multimedia) for knowledge dissemination and awareness raising in the Upper Nile WMZ	Targeted WMZ Communication Programme	Number of awareness raising activities planned Number of communication materials produced % of Upper Nile WMZ covered
	1.5.2	Institutional capacity building at the local Level	Develop a multi-year programme of capacity building of local governments and stakeholders, to create the Enabling Environment for decentralized IWRM implementation at the WMZ and catchment levels	Capacity Building Programme for IWRM implementation the local level	*Number of training activities planned* % of Upper Nile WMZ covered
	1.5.3	Build technical capacity for implementation increased through specific training programmes at the WMZ level	Provide technical training to GIS Unit staff Develop a technical training Programme on WR modelling for the WMZ Modelling Unit Promote scientific research and knowledge exchange with other WMZs and with trans boundary WRM institutions Plan and provide regular training and capacity building to technical staff for enforcement of regulations at the catchment level	Capacity Building Programme for Upper Nile WMZ technical staff	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered
	1.5.4	Promote trans-boundary cooperation on IWRM at the WMZ and catchment levels	Promote Trans-boundary WRM cooperation through exchange of information with neighbouring countries and organization of international workshops/seminars/public events on IWRM in the Upper Nile WMZ	Trans-boundary knowledge exchange programme	Number of events planned and organized Number of participants

7.1.2 Water for People

		Strategic Objective 2		Universal and sustainable access to safe water supply		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
2.1	Monitoring systems and information management	2.1.1	Improve information management on WQ for Water supply	Create a databank of WS and establish a mechanism for sharing information produced and elaborated by WS scheme operators (public and private) with other involved institutions in formats compatible with the national standards	GIS based WS Atlas and databank of Upper Nile WMZ	*Number ofGIS layers* % coverage *Number of WS facilities (by type, location, source of water, use)*
		2.1.2	Ensure adequate water quality control on water supplied for domestic/household use (SW and GW sources)	Develop and implement a multi-year Programme of WQ monitoring for SW and GW sources and WS schemes in the WMZ, in line with the National WQ strategy	Water Quality Monitoring multi-year Programme	% of UN WMZ covered Number of WQ controls (by type, location, source of water, use)
2.2	Water Allocation and Water Demand Management	2.2.1	Improve information management on Water Permits for Water Supply (SW and GW)	Establish and maintain a GIS based inventory of Water Permits for the WMZ on water bodies that are used for domestic/livelihood water supply	GIS based Inventory of Water Permits for Water Supply in the Upper Nile WMZ	Number of GIS layers implemented % coverage *Number of water permits (by type, location, water body, user)*
		2.2.2	Ensure appropriate environmental flows	Define and implement a set of Technical Standards for determination, implementation and management of environmental flows in the Upper Nile WMZ	Technical Standards on environmental flows	*Number of documents issued, by type*
2.3	Water supply infrastructure	2.3.1	Expand the water supply infrastructure for full coverage of urban and	Develop a Programme for design, construction and implementation of new	Programme for WSS in the Upper Nile WMZ	% population covered

		Strategic Objective 2		Universal and sustainable access to safe water supply		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
	development (urban and rural)		rural population in the Upper Nile WMZ	piped water supply schemes to cover 100% of urban population in the Upper Nile WMZ		Number WSS facilities planned (type, capacity)
		2.3.2	Increased water storage capacity for domestic water supply in areas with seasonal deficits in the upper Nile WMZ	Develop a Pre-Feasibility Study for design, construction and implementation of new water storage facilities for drinking water supply in sub-catchments with seasonal water deficit: - AN_up_Enyau and Enyau (main towns Arua), Kochi (main towns Koboko and Yumbe), Unyama (main town Gulu) in the Albert Nile catchment; - Pager Aringa sub-catchment (main town Kitgum) in Aswa catchment	Pre-Feasibility Study for water storage facilities in Albert Nile catchment	Number of water storage facilities planned (type, capacity, Number of people served)
		2.3.3	Develop bulk diversion schemes for water supply in areas with water deficit within the Upper Nile WMZ	Develop a Pre-Feasibility Study for design, construction and implementation of bulk transfer schemes for drinking water supply in deficit areas of the Upper Nile WMZ: - Pager Aringa sub-catchment (main town Kitgum) in Aswa catchment	Pre-Feasibility Study for bulk transfer schemes in Upper Nile WMZ	Number of water transfer schemes planned (type, capacity, Number of people served)
		2.3.4	Develop water supply facilities using groundwater sources in areas with water deficit within the Upper Nile WMZ	Develop a detailed hydrogeological study for assessment of potential capacity for water supply from groundwater	Hydrogeological study of Upper Nile WMZ	Number of aquifers bodies investigated % coverage of Upper Nile WMZ
				Based on the hydrogeological assessment, develop a GIS based knowledge base of groundwater bodies for developing sustainable groundwater exploitation in critical areas of Upper Nile WMZ	Groundwater supply potential study	Number of aquifers bodies investigated % coverage of Upper Nile WMZ

		Strategic Objective 2		Universal and sustainable access to safe water supply		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
		2.3.5	Expand rainwater harvesting facilities in areas with seasonal water deficit within the Upper Nile WMZ	Develop and implement a technical standard for installation and operation of rainwater harvesting installations at village and household level	Technical Standard for RH installations in the Upper Nile WMZ	Number of documents issued, by type
2.4	Water resource Management and environmental protection	2.4.1	Promote water efficiency practices (water conservation, reuse, recycling) in the Upper Nile WMZ	Develop and implement technical guidelines to promote implementation of technologies and best practices for efficient use of water (conservation, reuse, recycling) in urban and rural areas	Technical Guidelines for water efficiency in urban and rural areas of Upper Nile WMZ	*Number documents issued, by type*
				Develop and implement a technical standard for leakage detection in WS schemes and regular assessment of piped water distribution networks	Technical Standards for water efficiency in urban and rural areas of Upper Nile WMZ	Number of documents issued, by type
		2.4.2	Develop Water Source Protection Plans in the Upper Nile WMZ	Develop and implement water source protection plans according to the framework WSP guidelines (source-catchment level)	WSP Plans	Number of WSP Plans developed and implemented, by sub-catchment
				Promote community-based management of point water sources through establishment of WSP Committees at local level (village)	WSP Boards/ Committees established and operational	Number of water sources with WSP Boards/ Committees established
				Develop and implement a technical guideline for applying disinfection technologies and practices to small water supply schemes and point sources in rural areas in the WMZ in case of emergency	Technical Guidelines for water disinfection in rural areas of Upper Nile WMZ	Number of documents issued, by type
2.5	Public engagement and capacity development	2.5.1	Awareness raising on wise use of water resources	Develop a multi-year Awareness Raising Programme to promote protection, conservation and efficient use of water resources in the Upper Nile WMZ, including	Awareness Raising Programme on Wise use of water resources	Number of awareness raising activities planned

		Strategic Objective 2		Universal and sustainable access to safe water supply		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
				preparation of targeted communication materials		Number of communication materials produced % of Upper Nile WMZ covered
		2.5.2	Build technical capacity for improving water supply services in rural areas	Develop a multi-year Capacity Building Programme for applying disinfection technologies and practices to small water supply schemes and point sources in rural areas in the WMZ, including preparation of training manuals in local languages	Technical Capacity Building Programme	Number of training activities planned Number of training manuals produced % of Upper Nile WMZ covered

	Strategic Objective 3		*Universal and sustainable access to improved sanitation*		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
3.1 Monitoring systems and information management	3.1.1	Improve information management on wastewater discharge points in the Upper Nile WMZ	Establish and maintain a GIS based Inventory of Water Discharge Points (from public and private facilities or infrastructure) to the surface water bodies of Upper Nile WMZ	GIS Inventory of waste water discharge points	Number of GIS layers implemented % coverage Number of water discharge points (by type, location, facility, WQ, recipient water body)
	3.1.2	Improve information management on sanitation facilities in the Upper Nile WMZ	Develop a GIS based inventory of existing and planned sanitation facilities (sewerage and WWTPs) in urban areas of the Upper Nile WMZ	GIS Inventory of sanitation facilities	Number of GIS layers implemented % coverage *Number of sanitation facilities (by type, capacity, location)*
	3.1.3	Develop the knowledge base for an integrated pollution prevention and control programme in the Upper Nile WMZ	Develop a GIS inventory of pollution sources (point and non-point sources) aimed at developing an Integrated Pollution Prevention Programme to protect and conserve water resources in Upper Nile WMZ	Study on pollution sources in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of pollution sources (by type, location, WQ, priority pollutants, recipient water body)
3.2 Water Allocation and water demand management	3.2.1	Promote water efficiency practices (water conservation, reuse, recycling) in the Upper Nile WMZ	Develop and implement technical guidelines to promote implementation of technologies and best practice tools for reuse/recycling of treated water for other uses in urban and rural areas	Technical Guidelines for treated water reuse in urban and rural areas of Upper Nile WMZ	Number of documents issued, by type
	3.2.2	Promote integrated pollution prevention and	Develop and implement technical standards to implement an integrated pollution	Technical Standards for integrated pollution	Number of documents issued, by type

		Strategic Objective 3		*Universal and sustainable access to improved sanitation*		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
			control in the Upper Nile WMZ	prevention and control system to protect and conserve water resources in the Upper Nile WMZ	prevention and control in the Upper Nile WMZ	
3.3	Sanitation infrastructure development (urban and rural)	3.3.1	Develop the knowledge base for a water and sanitation programme of the WMZ	Develop a GIS based detailed land use mapping of urban areas and agglomerates aimed at developing a Master Plan for design, construction and implementation of sewerage systems and WWTPs in major towns, small towns and RDCs	Study on groundwater development potential in the Upper Nile WMZ	Number of aquifers Number of GIS layers implemented % coverage
		3.3.2	Improve management of sludge from sewage and sanitation facilities	Develop and implement a technical standard for collection, treatment and management of sludge from sewage and sanitation facilities in urban and rural areas of Upper Nile WMZ	Technical Standards for sludge management in urban and rural areas of Upper Nile WMZ	Number of documents issued, by type
		3.3.3	Improve sanitation and hygiene facilities in public buildings	Develop and implement Technical Standards for developing improved sanitation and hygiene facilities for public institutions and schools	Technical Standards for improved sanitation and hygiene	Number of documents issued, by type
3.4	Water resource management and environmental protection	3.4.1	Develop the knowledge base for a pollution prevention programme in the Upper Nile WMZ	Develop a GIS Inventory and Atlas of pollution (from point and non-point sources) aimed at developing an Integrated Pollution Prevention Programme in Upper Nile WMZ	GIS Atlas of pollution sources in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of pollution sources (by type, location, WQ, pollution load, recipient water body)
3.5	Public engagement and capacity development	3.5.1	Awareness raising on waste management	Develop a multi-year Awareness Raising Programme on importance of waste and sludge management in the Upper Nile WMZ, including preparation of targeted communication materials	Awareness Raising Programme on Sanitation and hygiene	Number of awareness raising activities planned

		**Strategic Objective 3**		***Universal and sustainable access to improved sanitation***		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
						Number of communication materials produced % of Upper Nile WMZ covered
		3.5.2	Build technical capacity for improving sanitation and hygiene services in minor urban areas and rural areas	Develop a multi-year Capacity Building Programme for applying improved sanitation and hygiene technologies in minor urban areas and rural areas of Upper Nile WMZ, including preparation of training manuals in local languages	Technical Capacity Building Programme on improved Sanitation and Hygiene	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered
		3.5.3	Build technical capacity for integrated pollution prevention and control	Develop a multi-year Capacity Building Programme for developing an Integrated Pollution Prevention and Control system in the Upper Nile WMZ, including preparation of training manuals in local languages	Technical Capacity Building Programme on Integrated Pollution Prevention and Control	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered

7.1.3 Water for Production

	Strategic Objective 4		Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
4.1	Monitoring Systems and Information Management	4.1.1 Improve information management on Water for production facilities for agricultural sectors	Create a GIS based inventory of water for production facilities of Agricultural Sectors in the Upper Nile WMZ	GIS Atlas and databank of Water for Production facilities (Agriculture)	Number of GIS layers implemented % coverage Number of WFP facilities (by type, location, capacity, use)
		4.1.2 Ensure adequate quality control on water supplied for production (SW and GW) for agricultural production	Develop and implement a multi-year Programme for WQ monitoring for SW and GW sources and WFP storage facilities of Agricultural Sectors in the WMZ, in line with the National WQ strategy	WFP Quality Monitoring multi-year Programme (Agriculture)	% of UN WMZ covered Number of WQ controls (by type, location, water source, use)
4.2	Water Allocation and Water Demand Management	4.2.1 Promote optimisation of water for production uses	Define and implement a set of Technical Standards for water efficiency (conservation, reuse, recycling) in Agricultural Sectors based on best practices and BATs for WFP in the Upper Nile WMZ	Technical Standard on efficient use of water for production (Agriculture)	*Number of documents issued, by type*
		4.2.2 Ensure appropriate environmental flows	Define and implement a set of Technical Standards for determination, implementation and management of environmental flows in the Upper Nile WMZ	Technical Standards on environmental flows	*Number of documents issued, by type*
4.3	Infrastructure Development for Agriculture	4.3.1 Improve water for production facilities	Define and implement a Technical Standard for water for production storage facilities and infrastructure design, construction and management in the Upper Nile WMZ, including multipurpose facilities	Technical Standard on water for production facilities	*Number of documents issued, by type*

	Strategic Objective 4		Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
	4.3.2	Rehabilitate and improve functionality of existing water for production storage facilities	Develop and implement a GIS based Programme for rehabilitation and management of existing water for production storage facilities and infrastructure in the Upper Nile WMZ	Multi-year Programme for rehabilitation of WFP facilities	% of UN WMZ covered Number of WFP storage facilities rehabilitated (by type, location, water source, use)
	4.3.3	Increase water for production storage capacity in the Upper Nile WMZ in areas with seasonal deficits of Upper Nile WMZ	Develop a Pre-Feasibility study for design, construction and implementation of new water for large production storage facilities (multipurpose) in sub-catchments with seasonal deficit: - Ora, AN_up_Enyau, Enyau, AN_up_Kochi, Kochi, Laropi in Albert Nile catchment; - Aswa I, Aswa II, Pager-Aringa and Nyimur in Aswa catchment.	Pre-Feasibility Study for new WFP storage facilities	% of UN WMZ covered Number of WFP storage facilities planned (by type, location, water source, use)
			Develop a Programme for design, construction and implementation of small water storage facilities in the Upper Nile WMZ	Multi-year Programme for small WFP facilities	% of UN WMZ covered *Number of WFP storage facilities planned (by type)*
	4.3.4	Develop bulk diversion schemes for water for production in areas with water deficit of Upper Nile WMZ	Develop a Pre-Feasibility Study for design, construction and implementation of bulk transfer schemes for water for production supply in deficit areas of the Upper Nile WMZ.	Pre-Feasibility Study for bulk transfer schemes in Upper Nile WMZ	Number of water transfer schemes planned (by type, capacity, water source, use)
	4.3.5	Develop underground water storage for production in areas with	Based on the detailed hydrogeological assessment of the Upper Nile WMZ, develop a Programme for WFP underground water storage and groundwater recharge	Programme for WFP underground water storage and groundwater recharge	Number of aquifers bodies % coverage of Upper Nile WMZ

	Strategic Objective 4		Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
		water deficit within the Upper Nile WMZ			
	4.3.6	Expand irrigation schemes in the upper Nile WMZ	Develop a Pre-Feasibility study for design, construction and implementation of new irrigation schemes in suitable areas of the Upper Nile WMZ: - Ora, Enyau and Kochi sub-catchments in the eastern part of Albert Nile catchment; - Aswa I, Agago and Aswa II sub-catchments in Aswa catchment	Pre-Feasibility Study for new irrigation schemes in Upper Nile WMZ	Number of irrigation schemes planned (by type, area, water source, capacity, use)
	4.3.7	Promote irrigation water efficiency and water conservation agricultural practices	Define and implement a Technical Standard for design, implementation and management of irrigation schemes in the Upper Nile WMZ, including provisions for water efficiency, water quality and integrated land management	Technical Standard on irrigation water efficiency	*Number of documents issued, by type*
	4.3.8	Improve water for production facilities in aquaculture and fishery	Define and implement a set of Technical Standards for developing intensive and semi-intensive aquaculture facilities in the Upper Nile WMZ, including provisions for water efficiency, water quality and protection of biodiversity	Technical Standards on aquaculture and fishery	Number of documents issued, by type
4.4 Water Resource Management and Environmental Protection	4.4.1	Develop the knowledge base for a Pollution Prevention and Sediment Management Programme in the Upper Nile WMZ	Develop a GIS Inventory and Atlas of pollution and sediment loads (from point and non-point sources) aimed at developing an Integrated Pollution Prevention and Sediment Management Programme in Upper Nile WMZ	GIS Atlas of pollution and sediment loads in the Upper Nile WMZ	*Number of GIS layers implemented* % coverage

	Strategic Objective 4		Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
					Number pollution of and sediment load sources (by type, location, WQ, pollution load, recipient water body)
	4.4.2	Promote integrated land and water management in the Upper Nile WMZ	Define and implement a set of Technical Guidelines for improving agricultural and forestry practices in the Upper Nile WMZ, including provisions for assessment and management of the land carrying capacity for livestock in the Upper Nile WMZ	Technical Standards on irrigation water efficiency	*Number of documents issued, by type*
	4.4.3	Develop the knowledge base for an Integrated Land & Water Management Programme in the Upper Nile WMZ	Develop a GIS Inventory and Atlas of degraded areas and areas at risk of erosion (mountain slopes, riverbanks, linear infrastructure) aimed at developing an Integrated Land & Water Management Programme in Upper Nile WMZ	GIS Atlas of land degradation hotspots in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of land degradation hotspots (by type, location, WQ, pollution load, recipient water body)
4.5 Public engagement and capacity development	4.5.1	Awareness raising on water efficiency in Agriculture	Develop a multi-year Awareness Raising Programme on importance of water efficiency in Agriculture in the Upper Nile WMZ, including preparation of targeted communication materials	Awareness Raising Programme on water efficiency in Agriculture	Number of awareness raising activities planned *Number of communication materials produced* % of Upper Nile WMZ covered
	4.5.2	Build technical capacity for improving efficient use	Develop a multi-year Capacity Building Programme for applying water efficiency	Technical Capacity Building Programme	Number of training activities planned

	Strategic Objective 4	Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry		
Structural Component	**Strategic Action**	**Activities**	**Output**	**Indicator**
	of water resources for production in agricultural sectors	practices and technologies in agricultural sectors in the Upper Nile WMZ, including preparation of training manuals in local languages	on water efficiency in Agriculture	*Number of training manuals produced* % of Upper Nile WMZ covered

	Strategic Objective 5		Sustainable use, development and management of water resources for Agro-Industry, Industrial production, Oil and Gas		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
5.1 Monitoring Systems and Information Management	5.1.1	Improve information management on Water for Production facilities for Industrial Sectors	Create a GIS based inventory of water for production facilities of Industrial Sectors in the Upper Nile WMZ	GIS Atlas and databank of Water for Production facilities (Industry)	Number of GIS layers implemented % coverage Number of WFP facilities (by type, location, capacity, use)
	5.1.2	Ensure adequate quality control on water supplied for production (SW and GW)	Develop and implement a multi-year Programme for WQ monitoring for SW and GW sources and WFP storage facilities of Industrial Sectors in the WMZ, in line with the National WQ strategy	WFP Quality Monitoring multi-year Programme (Industry)	% of UN WMZ covered Number of WQ controls (by type, location, water source, use)
	5.1.3	Ensure adequate quality control of water for production in the Industrial Sectors	Develop and implement a set of Water Quality standards for industrial production	WQ Standards for Industry	*Number of documents issued, by type*
5.2 Water Allocation and Water Demand Management	5.2.1	Promote optimisation of water for production uses	Define and implement a set of Technical Standards for water efficiency (conservation, reuse, recycling) in Industrial Sectors based on best practices and BATs for WFP in the Upper Nile WMZ	Technical Standards on efficient use of water for production (Industry)	*Number of documents issued, by type*
	5.2.2	Ensure appropriate environmental flows	Define and implement a set of Technical Standards for determination, implementation and management of environmental flows in the Upper Nile WMZ	Technical Standards on environmental flows	*Number of documents issued, by type*
5.3 Water Infrastructure Development	5.3.1	Develop the knowledge base for an Industrial Water for Production Programme of the WMZ	Develop a GIS based detailed land use mapping of industrial areas and related WFP facilities aimed at developing a Master Plan for design, construction and	Study on industrial WFP in the Upper Nile WMZ	Number of GIS layers implemented % coverage

	Strategic Objective 5		Sustainable use, development and management of water resources for Agro-Industry, Industrial production, Oil and Gas		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
			implementation of Industrial Water for Production Facilities based on industrial water demand		Number of WFP facilities planned (by type, location, source water body, capacity, use)
	5.3.2 Develop adequate multipurpose water for production storage facilities		Define and implement a Technical Standard for design, implementation and management of multipurpose water for production storage facilities in the Upper Nile WMZ	Technical Standard on multipurpose water for production storage facilities	*Number of documents issued, by type*
	5.3.3 Promote integrated development of agro-tourism and agro-industrial processing facilities		Define and implement a set of Technical Standards for developing integrated tourism and fresh fish-processing and market facilities along the Nile river in the Upper Nile WMZ	Technical Guideline on water & integrated tourism and fish	*Number of documents issued, by type*
5.4 Water Resource Management and Environmental Protection	5.4.1 Develop the knowledge base for Industrial Pollution Prevention and Control in the Upper Nile WMZ		Develop a GIS Inventory and Atlas of industrial pollution sources aimed at developing an Industrial Pollution Prevention and Control Programme in Upper Nile WMZ	GIS Atlas of industrial pollution sources in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of industrial pollution sources (by type, location, WQ, pollution load, recipient water body)
5.5 Public engagement and capacity development	5.5.1 Awareness raising on water efficiency in Industry		Develop a multi-year Awareness Raising Programme on importance of water efficiency in Industrial processes in the Upper Nile WMZ, including preparation of targeted communication materials	Awareness Raising Programme on water efficiency in Industry	Number of awareness raising activities planned *Number of communication materials produced* % of Upper Nile WMZ covered

		Strategic Objective 5		Sustainable use, development and management of water resources for Agro-Industry, Industrial production, Oil and Gas		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
		5.5.2	Build technical capacity for improving efficient use of water resources for production in industrial sectors	Develop a multi-year Capacity Building Programme for applying water efficiency practices and technologies in industrial sectors in the Upper Nile WMZ, including preparation of training manuals	Technical Capacity Building Programme on water efficiency in Agriculture	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered

	Strategic Objective 6		Sustainable use, development and management of water resources for Other Sectors (Tourism, Transportation, Security)		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
6.1	Monitoring systems and information management	6.1.1 Improve information management on Water for Production facilities for Industrial Sectors	Create a GIS based inventory of water for production facilities of Industrial Sectors in the Upper Nile WMZ	GIS Atlas and databank of Water for Production facilities (Industry)	Number of GIS layers implemented % coverage Number of WFP facilities (by type, location, capacity, use)
		6.1.2 Ensure adequate quality control on water supplied for production (SW and GW)	Develop and implement a multi-year Programme for WQ monitoring for recreational and other uses in the WMZ, in line with the National WQ strategy	Water Quality Monitoring multi-year Programme (Recreational and other uses)	% of UN WMZ covered Number of WQ controls (by type, location, water source, use)
6.2	Water allocation and water demand management	6.2.1 Promote optimisation of water for recreation and other uses	Define and implement a set of Technical Standards for water efficiency (conservation, reuse, recycling) for recreation and other uses based on best practices and BATs in the Upper Nile WMZ	Technical Standards on water efficiency for recreation and other uses	*Number of documents issued, by type*
6.3	Water infrastructure development	6.3.1 Promote integrated development of eco-tourism facilities in the Upper Nile WMZ	Define and implement a set of Technical Standards for developing eco-tourism facilities in the Upper Nile WMZ	Technical Guideline on water & eco-tourism	*Number of documents issued, by type*
		6.3.2 Ensure appropriate environmental flows	Define and implement a set of Technical Standards for determination, implementation and management of environmental flows in the Upper Nile WMZ	Technical Standards on environmental flows	Number of documents issued, by type
		6.3.3 Develop adequate multipurpose water storage facilities,	Define and implement a Technical Standard for design, implementation and management of multipurpose water storage facilities	Technical Standard on multipurpose water storage facilities	Number of documents issued, by type

	Strategic Objective 6		Sustainable use, development and management of water resources for Other Sectors (Tourism, Transportation, Security)		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
	including recreational functions		including recreational functions in the Upper Nile WMZ	including recreational functions	
	6.3.4	Promote reuse of treated wastewater for landscaping, green areas and other uses in the Upper Nile WMZ	Define and implement a set of Technical Standards for reuse of treated wastewater for landscaping, green areas and other uses in the Upper Nile WMZ	Technical Guideline on treated water reuse	Number of documents issued, by type
6.4 Water resource management and environmental protection	6.4.1	Develop the knowledge base for a Road Infrastructure Drainage Programme in the Upper Nile WMZ	Develop a GIS based detailed land use mapping of road infrastructure aimed at developing a Programme for Road Infrastructure drainage and stormwater management in the Upper Nile WMZ	GIS Atlas of road infrastructure in the Upper Nile WMZ	Number of GIS layers implemented % coverage *Number roads mapped (by type)*
	6.4.2	Develop the knowledge base for a Water Landscapes enhancement Programme in the Upper Nile WMZ	Develop a GIS based detailed land use mapping of scenic water landscapes aimed at developing a Programme for tourismenhancement of water bodies in the Upper Nile WMZ	GIS Atlas of scenic water landscapes in the Upper Nile WMZ	*Number of water bodies mapped* Number of GIS layers implemented % coverage
6.5 Public engagement and capacity development	6.5.1	Awareness raising on water efficiency in Industry	Develop a multi-year Awareness Raising Programme on importance of treated water reuse, recycling, recovery for other uses	Awareness Raising Programme on treated water reuse, recycling, recovery	Number of awareness raising activities planned *Number of communication materials produced* % of Upper Nile WMZ covered

7.1.4 Water for Energy

		Strategic Objective 7		**Sustainable use, development and management of water resources for renewable energy production**		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
7.1	Monitoring systems and information management	7.1.1	Improve information management on hydropower plants	Create a GIS based inventory of hydropower plants (existing and planned) in the Upper Nile WMZ	GIS Atlas of hydropower	Number of GIS layers implemented % coverage Number of HP facilities (by type, location, capacity, status)
7.2	Water allocation and water demand management	7.2.1	Develop the knowledge base for establishing an Energy Peak Demand Management System in the Upper Nile WMZ	Define and implement a Technical Standard for management of hydropower plants associated with reservoirs to accommodate the peak energy demand (pumped hydroelectric storage)	Technical Standard on hydropower and pumped hydroelectric storage	*Number of documents issued, by type*
7.3	Water infrastructure development	7.3.1	Develop adequate multipurpose water storage facilities including hydropower	Develop a Pre-Feasibility study for design, construction, implementation and management of multipurpose water storage facilities including hydropower in the Upper Nile WMZ	Pre-Feasibility Study for new small HPP in Upper Nile WMZ	*Number of HPP planned (by type, water body, capacity, use)*
7.4	Water resource management and environmental protection	7.4.1	Ensure appropriate environmental flows	Define and implement a set of Technical Standards for determination, implementation and management of environmental flows in the Upper Nile WMZ	Technical Standards on environmental flows	*Number of documents issued, by type*
7.5	Public engagement and capacity development	7.5.1	Awareness raising on renewable energy potential and energy efficiency	Develop a multi-year Awareness Raising Programme on importance of development of renewable energy and energy efficiency, as well as integrated land and water management in the Upper Nile WMZ, including preparation of targeted communication materials	Awareness Raising Programme on energy	Number of awareness raising activities planned Number of communication materials produced % of Upper Nile WMZ covered

		**Strategic Objective 7**		**Sustainable use, development and management of water resources for renewable energy production**		
Structural Component		**Strategic Action**		**Activities**	**Output**	**Indicator**
		7.5.2	Build technical capacity for full development of the hydropower potential in the Upper Nile WMZ	Develop a multi-year Capacity Building Programme for technical evaluation of hydropower projects and for applying the best energy efficiency practices and technologies in the Upper Nile WMZ, including preparation of training manuals	Technical Capacity Building Programme on Energy	Number of training activities planned Number of training manuals produced % of Upper Nile WMZ covered

7.1.5 Water for Environment

	Strategic Objective 8		Conservation of ecosystem services and functions		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
8.1 Monitoring systems and information, management	8.1.1	Improve information management on functional and ecological state of water bodies in the Upper Nile WMZ	Create a GIS based inventory of water bodies in the Upper Nile WMZ, based on the assessment of their hydrological, geo-morphological and ecological state (SW and GW bodies)	GIS Atlas of Water Resources of Upper Nile WMZ	Number of GIS layers implemented % coverage *Number of water bodies mapped (by type, location, WQ, ecological state)*
			Create a GIS based inventory of degraded ecosystems in the Upper Nile WMZ (water bodies, wetlands and water dependent ecosystems)	GIS Atlas of Degraded Ecosystems in the Upper Nile WMZ	Number of GIS layers implemented % coverage *Number of water bodies mapped (by type, location, severity of degradation state)*
	8.1.2	Develop an Environmental Monitoring Programme on water bodies (SW and GW) to determine their ecological state	Develop and implement a multi-year Programme for Environmental Monitoring of water bodies (SW and GW) to determine the baseline ecological state and evolution trend over time, in line with the National WQ strategy	Environmental Quality Monitoring multi-year Programme (Environment)	% of UN WMZ covered *Number of water bodies mapped of (by type, location, WQ, ecological state and trend)*
8.2 Water allocation and water demand management	8.2.1	Adequate water quantity allocated for wetlands and aquatic ecosystems	Develop and implement a set of Technical Standards for determination, implementation and maintenance of environmental flows and environmental water reserve in the wetlands and aquatic ecosystems of the Upper Nile WMZ	Technical Standards of environmental flows and water reserve	*Number of documents issued, by type*

	Strategic Objective 8		Conservation of ecosystem services and functions		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
8.3	Water and environmental infrastructure	8.3.1 Create a green infrastructure system to establish and protect ecologic corridors along water bodies of the Upper Nile WMZ	Based on the updated Land Cover of NFA, develop and implement a Programme for creating a green infrastructure system to protect ecosystems, ecologic corridors and natural landscapes in the water bodies of Upper Nile WMZ	Programme on Ecologic Corridors and Green Infrastructure along water bodies	% of UN WMZ covered Area of green infrastructure created (by type, extension, water body, function)
		8.3.2 Create a green infrastructure system in the cattle corridor of the Upper Nile WMZ	Based on the updated Land Cover of NFA, develop and implement a Programme for creating a green infrastructure system to protect ecosystems, ecologic corridors and natural landscapes and support livelihoods in the cattle corridor of Upper Nile WMZ	Programme on Green Infrastructure in the cattle corridor	% of UN WMZ covered Area of green infrastructure created (by type, extension, cattle corridor area, use)
8.4	Water resource management and environmental protection	8.4.1 Expand the knowledge base on Wetlands in the Upper Nile WMZ for improving Wetland Management and Protection in the Upper Nile WMZ	Create and implement the GIS database of Wetlands of Upper Nile WMZ, updating the baseline on wetland status and values, in line with the National Wetland Strategy and proceeding from District Wetland Inventories	GIS Atlas of Wetlands	Number of GIS layers implemented % coverage Number of wetlands mapped (by type, location, area, ecological state, uses)
		8.4.2	Develop and implement a set of Technical Guidelines for Sustainable Management of Wetlands and their natural resources, in line with the National Wetland Strategy	Technical Guidelines on wetland management	*Number of documents issued, by type*
		8.4.3 Enforce riverbanks protection zones	Develop and implement a set of Technical Guidelines for delineating and enforcing riverbank protection zones along all the rivers of Albert Nile, Aswa and Kidepo catchments	Technical Standards on riverbank protection zones	Number of documents issued, by type
		8.4.4 Promote integrated land and water management in the Upper Nile WMZ	Define and implement a set of Technical Guidelines for improving agricultural and forestry practices in the Upper Nile WMZ,	Technical Standards on	*Number of documents issued, by type*

	Strategic Objective 8		Conservation of ecosystem services and functions		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
			including provisions for assessment and management of the land carrying capacity for livestock in the Upper Nile WMZ	irrigation water efficiency	
			Define and implement a set of Technical Guidelines for the creation of vegetation buffer strips along water bodies to prevent/reduce discharge of sediment and nutrient loads to rivers, lakes and wetlands and to groundwater	Technical guidelines on Vegetation buffer stripes along water bodies	*Number of documents issued, by type*
			Based on the updated Land Cover of NFA, develop and implement a Programme for integrated Forest & Water ecosystems management in the Upper Nile WMZ, including the creation of vegetated buffer strips (rings) around protected forests where harvesting activities are regulated and sustainable use is allowed	Programme on Forest and Water ecosystems Management	Number of documents issued, by type
8.5	Public engagement and capacity development	8.5.1	Awareness raising on water, environment and management of natural resources	Develop a multi-year Awareness Raising Programme on importance of sustainable development of water resources and management of natural resources in the Upper Nile WMZ, including preparation of targeted communication materials	Awareness Raising Programme on water, environment and management of natural resources	*Number of awareness raising activities planned* Numberof communication materials produced % of Upper Nile WMZ covered
		8.5.2	Build technical capacity for wetland management in the Upper Nile WMZ	Develop a multi-year Capacity Building Programme for sustainable development and management of wetlands and aquatic ecosystems in the Upper Nile WMZ, based on best practices and standards, including preparation of training manuals	Technical Capacity Building Programme on management of wetlands and aquatic ecosystems	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered

	Strategic Objective 8		Conservation of ecosystem services and functions		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
	8.5.3	Build technical capacity for ecosystem assessment in the Upper Nile WMZ	Develop a multi-year Capacity Building Programme for wetlands and aquatic ecosystems assessment in the Upper Nile WMZ, based on best practices and standards, including preparation of training manuals	Technical Capacity Building Programme on ecosystem assessment	Number of training activities planned Numberof training manuals produced % of Upper Nile WMZ covered
	8.5.4	Build technical capacity for determining and implementing environmental flows and water reserves in the Upper Nile WMZ	Develop a multi-year Capacity Building Programme for determination and implementation of environmental flows and water reserves in the Upper Nile WMZ, based on best practices, including preparation of training manuals	Technical Capacity Building Programme on environmental flows and water reserves	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered

	Strategic Objective 9		Mitigation of effects of extreme climatic events		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
9.1	Monitoring systems and information management	9.1.1 Create a knowledge base on vulnerability of water resources and land to climate variability and change for Upper Nile WMZ	Create a GIS based inventory of vulnerable water bodies in the Upper Nile WMZ, based on the assessment of the vulnerability assessment (SW and GW bodies)	GIS Atlas of Vulnerability to climate variability and change in the Upper Nile WMZ	Number of GIS layers implemented % coverage Number of water bodies mapped (by type, location)
			Create a real-time data sharing web-database of meteo-climatic and hydrological information to enable hydrologic drought/flood prediction and warning systems, including regular publication of bulletins and reports	Flood-drought real-time data sharing web-database	Web-database % coverage Number of user access
		9.1.2 Create and maintain an inventory of flood prone areas in the Upper Nile WMZ	Develop a GIS based inventory of areas prone to flood events with different return periods (2, 10, 20, 100, 200 years) for the main rivers of Upper Nile WMZ	GIS Atlas of Flood prone areas	Number ofGIS layers implemented % coverage Number of water bodies mapped (by type, location, extension, flood event severity, return period)
		9.1.3 Create and maintain an inventory of drought prone areas in the Upper Nile WMZ	Develop a GIS based inventory of areas prone to drought events with different return periods (2, 5, 10, 20, 50, 100, 200 years) in the Upper Nile WMZ	GIS Atlas of Drought prone areas	Number ofGIS layers implemented % coverage Number of areas mapped (by type, location, extension, drought event severity, return period)

	Strategic Objective 9		Mitigation of effects of extreme climatic events		
Structural Component		**Strategic Action**	**Activities**	**Output**	**Indicator**
9.2 Water Allocation and Water Demand Management	9.2.1	Increase preparedness to severe climate events (flood / drought)	Develop a GIS based Flood Response and Management Plan for the Upper Nile WMZ, including regulatory and management procedures for hydraulic structures	Flood Response and Management Plan	% of Upper Nile WMZ covered Number offlood area covered, by water body Number of population covered, by water body
			Develop a GIS based Drought Response and Management Plan for the Upper Nile WMZ	Drought Response and Management Plan	% of Upper Nile WMZ covered Number of drought area covered Number of population covered
9.3 Water Infrastructure Development	9.3.1	Develop the knowledge base to increase infrastructure resilience to climate variability and change in the Upper Nile WMZ	Develop a GIS based detailed mapping of road infrastructure aimed at preparing a Master Plan for design, construction and implementation of an adequate drainage systems along main roads, including culverts	Study on road infrastructure drainage in the Upper Nile WMZ	Number of GIS layers implemented % coverage Km roads mapped (by type)
9.4 Water Resource Management and Environmental Protection	9.4.1	Promote integrated land and water management in the Upper Nile WMZ	Develop and implement guidelines for land use planning and regulation of human activities in flood prone areas in the Upper Nile WMZ	Technical Standards on flood protection	*Number of documents issued, by type*
9.5 Public engagement and capacity development	9.5.1	Awareness raising on water, environment and management of natural resources	Develop a multi-year Awareness Raising Programme on flood protection and DRM in the Upper Nile WMZ, including preparation of targeted communication materials	*Raising awareness programme on water, environment and management of natural resources*	Number of awareness raising activities planned *Number of communication materials produced* % of Upper Nile WMZ covered

	Strategic Objective 9		Mitigation of effects of extreme climatic events		
Structural Component	**Strategic Action**		**Activities**	**Output**	**Indicator**
			Sensitisation campaign to increase communities awareness on severe climate risks and related preparedness and response measures, and means to increase community resilience	*Raising awareness programme on severe climate events*	Number of awareness raising activities planned *Number of communication materials produced* % of Upper Nile WMZ covered
	9.5.2	Build technical capacity for wetland management in the Upper Nile WMZ	Develop a multi-year capacity puilding Programme for sustainable development and management of wetlands and aquatic ecosystems in the Upper Nile WMZ, based on best practices and standards, including preparation of training manuals	*technical capacity Building programme on management of wetlands and aquatic ecosystems*	Number of training activities planned *Number of training manuals produced* % of Upper Nile WMZ covered

7.2 Financial needs analysis

7.2.1 Introduction

This financial analysis includes the evaluation of costs for the IWRM implementation in the Upper Nile WMZ related to both strategic actions and infrastructure foreseen for water reconciliation of all uses (domestic supply, irrigation, livestock, aquaculture and industry). This estimation provides information for the water and environment sector finance and sector budget that is required by the relevant overall government macro-economic planning and policy frameworks. It is useful in defining allocations for all sectors in the Medium Term Expenditure Framework by the Ministry of Finance Planning and Economic Development.

Currently, at national level, the "Water Sector Strategic Investment Plan 2010-2035" (MWE 2009) identifies financial resource requirements to reach the targets set for year 2015, 2020 and 2035 by the National Development Plans (NDP) and the Vision 2035. The present analysis reviews and integrates this national plan focusing on IWRM strategic actions in the UN WMZ for year 2040.

In line with already established financial mechanisms for Uganda, this analysis distinguishes explicitly costs for potable water supply, sanitation, environment, water for production, among others. Decentralisation is mainstreamed in all sectors, therefore, the Ministry of Water and Environment sets standards, procedures and allocation criteria for the District Water and Sanitation Conditional Grant (DWSCG). This financial tool enables investment decision at district level.

Because financial requirements are mostly for capital expenditure (more than 80% of overall need for Upper Nile WMZ, as reported in the following paragraphs), the key sources of financing for the UNWMZ are the Government of Uganda through general taxation, supported by International Financial Institutions (IFIs). There can be investments from private sector. A larger part of financial needs for water infrastructure for water supply and sanitation is expected to be provided by the government of Uganda with support from Development Partners such as IFIs, particularly the International Development Association (IDA) which is an agency of World Bank Group supporting developing countries. The development finance support given by IDA is in the form of very long-term loans (around 35–40 years), with long grace periods (up to 10 years) and with no interest payment, which is replaced by an annual servicing fee (0.75%).

For water for production, a considerable proportion of the investment is expected to come from the private sector. This option is already considered in the "Water for Production Strategy and Investment Plan" (DWMR, 2009):

- For livestock facilities, 30% of the investments are carried out by commercial ranches directly and/or as subsistence livestock owners' contributions
- For irrigation facilities, the off-farm investments in water supply infrastructure are carried out by the water sector, while all on-farm investments are done by the farmers or commercial enterprises
- For fisheries, only one percent of the total investment in fishery facilities is financed by the water sector.

For all types of infrastructure related to water for production it can be foreseen that costs for operations and maintenance (O&M) would be covered by the tariffs applied to water users.

Marked by the intrinsic attractiveness of hydropower, the government of Uganda's 2007 Renewable Energy Policy and the REFit and GEFit programmes (supported by the IFIs), there has been a large participation of the private sector in the development of the vast Ugandan hydropower potential. Hydropower projects usually are Run of River without large dams and reservoirs. Private sector involvement and funding for these hydropower projects can be retained as a financing model for the UN WMZ.

Hydropower projects including large dams and multipurpose reservoirs involve costs not recoverable under the REFit Tariff framework. These hydro schemes have to be developed under the traditional model of a governmental agency or a public utility managing the various phases of the project life cycle:

planning, design, construction, operation, as well as rehabilitation and upgrading when the time comes. Multipurpose reservoirs and other storages facilities can have significant benefits, including: water supply regulation; irrigation regulation; hydroelectric production; aquaculture; maintenance of water quality and environmental flows; flood mitigation; climate change mitigation; and tourism and leisure facilities. Therefore, multipurpose water projects need to be funded by public resources, drawing on IFIs aid when needed. The hydropower component could be an opportunity for private sector partnership with the public sector in multipurpose projects where an acceptable balance between risks and rewards can be achieved between the various stakeholders. Again, the IFIs can have a crucial role in filling this gap by providing technical and financial assistance to the Government of Uganda.

Taking into account the above mentioned criteria, financial needs for water infrastructure development and strategic actions are calculated in the following paragraphs.

7.2.2 Water Infrastructure Development

Among the surface water development options, it is proposed to implement large reservoirs, valley tanks, sand and sub-surface dams. As already described, the present work has identified sites for implementation of large reservoirs and related dimensioning of storage volumes has been conducted.
Valley tanks are small water storages used primarily for livestock, groundwater recharge, limited irrigation and aquaculture. Valley tanks are, by definition, off-channel storage dams. A typical excavated valley tank might be 50m long by 30m wide and between 1m and 2m deep, resulting in a total storage capacity of around 1,500 to 3,000m^3.

A sand dam is created by progressively building a low dam wall across a flat river valley with considerable sediment transport, thereby creating a sub-surface water reservoir in the sand trapped behind the dam. The cost for a sand dam is related to the construction of the dam wall and will vary depending on the topography of the river valley and the material used for construction of the wall.A sub-surface dam is constructed by building a dam wall of clay or masonry in a trench across a river valley to a depth reaching an impermeable layer and thereby creating a sub-surface reservoir in the area behind the dam. Sand dam and sub-surface dams are in particular appropriate in areas with long dry periods and high evaporation as the loss of water is less from the sub-surface reservoirs compared to normal valley tanks or dams.The proposed technology mix for livestock storage is a combination of valley dams and tanks, sand dams and sub-surface dams on the basis of mean values provided by SSIP for the northern districts: 70%, 25%, 3% and 2% respectively. In addition, fish ponds developed for aquaculture can act as water storage facilities.

For what concerns irrigation schemes, because the water withdrawal is either a run-of-the river or from a large storage, the considered infrastructure is similar in concept to small simple schemes situated close to the water sources, but requiring pumped withdrawal system. This is what is called "Type A Formal Irrigation Schemes" in the Irrigation Master Plan.

The options for domestic supply, as presented in the SSIP, are: protected springs, deep boreholes, shallow wells, gravity fed scheme, and piped scheme. In particular, the technology mix for future domestic water supply, again according to SSIP for the northern districts, is as follows: protected springs around 2%, deep boreholes 57%, shallow wells 6%, gravity fed scheme 2%, piped scheme 33% and rainwater tanks 0.11%.

Industrial development can be associated to domestic water supply infrastructure. Infrastructure for people includes sanitation systems that can be mainly related to large sanitation system. For sanitation service the assumption is that the collected and treated waste water from the urban population will be around 80% of the waste water, while 50% for rural people.

The financial analysis for the water infrastructural development is conducted using parametric capital costs of similar interventions. The assessment of these values is based on the Term of Reference of the present study and on the knowledge derived from the national reference documents, such as:

- Uganda Catchment Management and Planning Guidelines (DWRM, April 2014)
- Strategic Sector Investment Plan for the Water and Sanitation Sector in Uganda, Government of Uganda, Ministry of Water and Environment (July 2009)

- "Water for Production Strategy and Investment Plan" (DWMR, August 2009)
- "Uganda Water Supply and Sanitation - Country Status Overviews" (African Ministers' Council on Water (AMCOW, 2011)
- "National Irrigation Master Plan" (2011).

Data have been extracted also from some similar initiatives already conducted in Uganda as listed below:

- "Development of the Awoja Catchment Management Plan in the Kyoga Water Management Zone" (Awoja CMP, 2013)
- Investment Plan redacted within the "Consultancy Services for the Identification of a Multipurpose Water Resources Management and Development Project in Aswa Basin" (NBI-NEL, 2012)
- "Water Risk and Sustainability Assessment (WRSA) for the River Rwizi Catchment" (DWRM, May 2015)
- Indicative Investment Strategy and Action Plan included in the "Nile Equatorial Lakes Multi Sector Investment Opportunity Analysis (NEL MSIOA)" by NELSAP / NBI in December 2012.

The costs, presented in US$ and Uganda Shillings (UGX), are generally related to m^3 or ha andadjusted to equivalent 2016 prices. They include both design and implementation costs.

It has to be noted that in the present work, the implementation of various development options is related to typical capital costs. More reliable cost estimates would be obtained identifying specific locations and undertaking additional investigations. Below are the tables (**Table 7-1** and **Table 7-2**) where all unit costs are summarized.

Table 7.1: Typical unit costs for storage and excavation

STORAGE & EXCAVATION	
Option	Unit cost (US$/$m^3$)
Valley Tanks	11.5
Valley Dams	4.5
Sand Dams	17.2
Sub-surface Dams	4.5
Fish Pond for Aquaculture	11.5

Table 7.2: Typical unit costs for water supply and sanitation

WATER SUPPLY AND SANITATION	
Option	**Unit cost (USD/m^3/d)**
Protected Springs	248
Deep boreholes	1,335
Shallow wells	500
Gravity fed scheme	4,333
Piped scheme	3,744
Large sanitation system	6,659

For Type A irrigation infrastructure, the unit cost is 190 (US$/$m^3$/d).

Table 7.3: Water sector financial needs for water reconciliation in 2040 for UN WMZ (Million US$).

CAPEX (Million USD)					
INFRASTRUCTURE	**USER TYPE**	**Albert Nile**	**Aswa**	**Kidepo**	**UN WMZ**
Storage	Domestic urban	19	13	1	33
	Domestic rural	128	67	6	201
	Livestock	9	13	2	24
	Aquaculture	4	2	0.2	6
Water Supply	Domestic urban	88	68	4.6	161
	Domestic rural	343	210	15.8	569
Sanitation	Domestic urban	174	134	9	317
	Domestic rural	281	175	13	468
Off – farm Irrigation	Irrigation (all type)	382	1,054	65	1,501
Water Supply	Industry	87	68	3.2	158
TOTAL		1,514	1,804	119	3,437

Table 7.4: Water sector financial needs for water reconciliation in 2040 for UN WMZ (Billion UGX).

CAPEX (Billion UGX)					
INFRASTRUCTURE	**USER TYPE**	**Albert Nile**	**Aswa**	**Kidepo**	**UN WMZ**
Storage	Domestic urban	62	41	3.2	107
	Domestic rural	419	219	19	657
	Livestock	28	43	6	77
	Aquaculture	13	7	0.7	21
Water Supply	Domestic urban	288	223	15.0	526
	Domestic rural	1,124	689	51.8	1,864
Sanitation	Domestic urban	570	440	29	1,039
	Domestic rural	919	572	42	1,532
Off – farm Irrigation	Irrigation (all type)	1,249	3,450	214	4,913
Water Supply	Industry	286	222	10.3	519
TOTAL		4,957	5,908	390	11,255

At the Upper Nile WMZ scale, a reduction of 30% of investment in livestock by the water sector has a negligible impact on financial needs that is decreased by about US$11 million. Instead, on-farm financial needs are really significant: considering all type of irrigation infrastructure, financial needs are about US$980 million (30%). If the entire investment for fish ponds is related to the water sector, financial needs would increase by US$620 million (an increase of 20% for overall financial needs).

7.2.3 Strategic Actions for IWRM Implementation

The Upper Nile WMZ needs to face costs associated with all the strategic actions. Some of these costs are related to the design and construction for all the infrastructure prioritised but the bigger part of the implementation costs are for personnel, consultants, stakeholders meetings/conferences/ workshops and, in some cases, also equipment that are needed. Some assumptions are based upon information extracted from similar initiatives already conducted in Uganda, such as the "Development of the Awoja Catchment Management Plan in the Kyoga Water Management Zone" (Awoja CMP, 2013). Technical employees and consultants are estimated in terms of the person-months and the unit costs are US$2,500 and US$15,000 respectively. The number of meetings is proportional to the overall duration of actions and each meeting costs on average around US$7,500. The costs for equipment are estimated according to the use foreseen in specific actions.

Pre-feasibility costs are typically around 1.5% of capital costs and feasibility phase is about 3%. design and construction supervision costs can be at 10% therefore for the proposed infrastructure the overall costs for personnel, consultants and meetings are up to 14.5% of CAPEX (not to the above mentioned unit cost and person months). A specific duration will be assigned to each strategic actions: generally actions related to knowledge base and promotion are two years long, while actions such as raising awareness , building technical capacity or monitoring systems take about five years. Longer periods (10 or 25 years)

are considered when designing and constructing of infrastructure are involved depending on their size, type, extent, and complexity among others.

The strategic actions are prioritised as follows. Actions related to data information and water governance are given the highest priority because they are considered to be the most crucial and take the shortest time to develop. Actions that take long to implement are necessarily spread over several years with lower priority. Here below are the cost estimates in thousands of Euros. Further details are provided in the action plan.

Table 7-5: Cost estimation for each strategic objective within the UN WMZ catchments.

Strategic Objective		Structural Component		Cost (Thousand US)	Cost (Million UGX)
1	Equitable, participatory and accountable water governance for sustainable and Inclusive growth and development	1.1	Monitoring Systems and Information Management	14,200	46,450
		1.2	Water Allocation and Water Demand Management	1,050	3,500
		1.3	Water and Environmental Infrastructure	2,550	8,350
		1.4	Water Resource Management and Environmental Protection	1,700	5,550
		1.5	Public engagement and capacity development	1,050	3,500
2	Universal and sustainable access to safe water supply	2.1	Monitoring Systems and Information Management	4,350	14,250
		2.2	Water Allocation and Water Demand Management	250	750
		2.3	Water and Environmental Infrastructure	1,103,050	3,611,750
		2.4	Water Resource Management and Environmental Protection	1,000	3,350
		2.5	Public Engagement and Capacity Development	550	1,850
3	Universal and sustainable access to improved sanitation and hygiene	3.1	Monitoring Systems and Information Management	500	1,650
		3.2	Water Allocation and Water Demand Management	400	1,300
		3.3	Water and Environmental Infrastructure	900,050	2,947,050
		3.4	Water Resource Management and Environmental Protection	300	950
		3.5	Public engagement and capacity development	800	2,600

Strategic Objective		Structural Component		Cost (Thousand US)	Cost (Million UGX)
4	Sustainable use, development and management of water resources in Agriculture, Livestock production, Fishery and Aquaculture, Forestry	4.1	Monitoring Systems and Information Management	400	1,300
		4.2	Water Allocation and Water Demand Management	250	750
		4.3	Water and Environmental Infrastructure	1,752,650	5,738,700
		4.4	Water Resource Management and Environmental Protection	800	2,600
		4.5	Public engagement and capacity development	550	1,850
5	Sustainable use, development and management of water resources for Agro-industry, Industrial production, Oil and Gas	5.1	Monitoring Systems and Information Management	350	1,100
		5.2	Water Allocation and Water Demand Management	250	750
		5.3	Water and Environmental Infrastructure	163,800	536,300
		5.4	Water Resource Management and Environmental Protection	100	350
		5.5	Public engagement and capacity development	250	750
6	Sustainable use, development and management of water resources for Other Sectors (tourism, transportation, security)	6.1	Monitoring Systems and Information Management	100	350
		6.2	Water Allocation and Water Demand Management	50	200
		6.3	Water and Environmental Infrastructure	18,550	60,700
		6.4	Water Resource Management and Environmental Protection	550	1,850
		6.5	Public engagement and capacity development	100	350
7	Sustainable use, development and management of water resources for renewable energy production	7.1	Monitoring Systems and Information Management	100	350
		7.2	Water Allocation and Water Demand Management	300	950
		7.3	Water and Environmental Infrastructure	76,550	250,700
		7.4	Water Resource Management and Environmental Protection	100	350

Strategic Objective		Structural Component		Cost (Thousand US)	Cost (Million UGX)
		7.5	Public engagement and capacity development	400	1,300
8	Conservation of ecosystem services and functions	8.1	Monitoring Systems and Information Management	400	1,300
		8.2	Water Allocation and Water Demand Management	900	2,950
		8.3	Water and Environmental Infrastructure	54,750	179,250
		8.4	Water Resource Management and Environmental Protection	40,850	133,750
		8.5	Public engagement and capacity development	1,050	3,500
9	Mitigation of effects of extreme climatic events	9.1	Monitoring Systems and Information Management	800	2,600
		9.2	Water Allocation and Water Demand Management	900	2,950
		9.3	Water and Environmental Infrastructure	900	2,950
		9.4	Water Resource Management and Environmental Protection	1,150	3,700
		9.5	Public engagement and capacity development	550	1,850
TOTAL				4,150,250	13,589,200

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9. ANNEXES

ANNEX I: STATUS ON MAIN ON-GOING PROJECTS

Main Programme / Projects WATER SECTOR		Year	Resp.	Funding	Water Sector	Water for People	Water for Production	Water for Energy	Water for Environment	Relevance / Appropriate-ness UN-WMZ	Status
International Projects	Nyimur Multipurpose Project (Uganda-South Sudan)	2014 - 2017	MWE DWD	NBI – NELSAP		X	X	X	X	HIGH / HIGH	Under development
	Lakes Edward and Albert Fisheries and Water Resources Management Project (LEAF II) Project	2015 - 2019	MAAIF	NBI – NELSAP			X			MEDIUM / MEDIUM	Under development
	Identification of a Multipurpose Water Resources Management and Development Project in Aswa Basin (Uganda/South Sudan) - Multi-Purpose Water Resources Development and Management Strategy	2012	MWE DWRM	NBI - NEL Water Resources Development Project	X	X	X	X	X	HIGH / HIGH	Completed
National Projects	WMDP – Component 1.1 - Lot 3: Preparation of two (2) Catchment water resources Development and Management plans in Upper Nile Water Management Zone [Aswa and Albert Nile]	2013-2018	MWE DWRM	World Bank	X	X	X	X	X	HIGH / HIGH	Under development
	WMDP – Component 1.2 - Lot 4: Detailed Assessment of	2013-2018	MWE DWRM	World Bank	X	X	X	X	X	HIGH / HIGH	Under development

Main Programme / Projects WATER SECTOR		Year	Resp.	Funding	Water Sector	Water for People	Water for Production	Water for Energy	Water for Environment	Relevance / Appropriate-ness UN-WMZ	Status
	Requirements for Water Resources Information System										
	WMDP – Component 2.1 - Town Water Supply and Sanitation under NWSC	2013-2018	MWE DWRM	World Bank	X	X			X	HIGH / HIGH	Under development
	WMDP – Component 2.2 - Development of Catchment/Water Source Protection Plans for the water supply in the small towns of Lot2: Rukungiri, Katwe-Kabatoro and Koboko	2013-2018	MWE DWRM	World Bank	X	X			X	HIGH / HIGH	Under development
	Water Supply and Sanitation Programme (WSSP)	2012-2015	MWE DWD	African Development Bank	X	X	X			HIGH / HIGH	Under development
	European Union-Millennium Development Goals – Initiative Project (MDG 7.c)	2012-2017	MWE - WSDFs	EU – GoU - ADA	X					HIGH / HIGH	Under development
	Northern Uganda Peace, Recovery and Development Plan III (PDRP 3)	2015-2021	OPM	National Budget, DPs, EU	X		X	X		MEDIUM / MEDIUM	Proposed
	Third Northern Uganda Social Action Fund (NUSAF 3)	2015-2020	OPM	World Bank IDA					X	LOW / LOW	Under development
	Karamoja Livelihoods Programme (KALIP)	2009 - 2015	OPM	European Union	X	X	X		X	LOW / LOW	Completed

Main Programme / Projects WATER SECTOR		Year	Resp.	Funding	Water Sector	Water for People	Water for Production	Water for Energy	Water for Environment	Relevance / Appropriate-ness UN-WMZ	Status
	Agricultural Livelihoods Recovery programme (ALREP)	2009 - 2015	OPM	European Union	X	X	X		X	LOW / HIGH	Completed
	Karamoja Integrated Development Programme (KIDP II)	2015-2020	OPM	NA	X	X	X		X	HIGH / HIGH	Under development
	Conservation and Sustainable Use of the Threatened Savanna Woodland in the Kidepo Critical Landscape in North Eastern Uganda	(2013 – 2017)	UNDP	GEF					X	LOW / HIGH	Proposed
	Water Supply Atlas Update 2016	2015 -2016	MWE	National Budget	X	X				HIGH / HIGH	Under development
	National Wetland Inventory	2010-2015	MWE	National Budget					X	HIGH / HIGH	Under development
Projects developed by GOs and NGOs	Building Drought Resilience through Land and Water Management in Kenya (Lower Tana sub-catchment) and Uganda (the Upper Aswa-Agago sub-catchment)	2015-2020	IUCN ESARO	Austrian Development Cooperation	X	X	X		X	HIGH / HIGH	Under development
	Program for Recovery and Reconstruction of Northern Uganda (REAP)	2009	PMO	Japan International Cooperation Agency - JICA		X	X			MEDIUM / MEDIUM	Completed

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