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Directorate of Water Resources Management
Kyoga Water Management Zone

Lokere Catchment Management Plan

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Valuable contributions were made by the stakeholders of Lokere Catchment during fieldwork campaigns and workshops.

EXECUTIVE SUMMARY

This document presents the Catchment Management Plan (CMP) for Lokere Catchment, which is located in Karamoja and Teso regions in north-eastern Uganda. With an area of 8.156 km² Lokere Catchment covers the districts of Kaabong, Moroto, Kotido, Napak, Nakapiripirit, Amuria, Katakwi and Soroti wholly or partly. It has an approximate population of 420,000 (2016 approximation based on Population Census 2002 and 2014).

As part of its water resources management reform the Ministry of Water and Environment (MWE), through its Directorate of Water Resources Management (DWRM), is implementing Catchment Based Water Resources Management (CBWRM) based on the Integrated Water Resources Management (IWRM) approach which emphasizes the interrelationship of different sectors in the protection and conservation of the use and management of the water resources. This process deconcentrates water resources management (WRM) along catchment boundaries. Catchments are hydrological units independent of administrative boundaries where surface water converges to a single exit point at a lower elevation level. CBWRM links WRM to the management of land, ecosystems, and socio-economic systems, and allows to plan towards using water resources effectively and efficiently to achieve long-term sustainable development by balancing growing water demands with limited water resources. Thus, Uganda has been divided into four Water Management Zones (WMZs): Upper Nile, Albert, Victoria and Kyoga. Lokere Catchment is located in Kyoga Water Management Zone (KWMZ).

The catchment management planning process is based on the Catchment Management Planning Guidelines (MWE 2014). Therefore, the development of this plan followed these guidelines consisting of the following steps which build on each other:

- Stakeholder identification, engagement and analysis,
- Water Resources Assessment (WRA),
- Strategic Social and Environmental Assessment (SSEA),
- Options and scenarios analysis,
- Catchment Management Plan (CMP) and Implementation Plan (IP).

The catchment's stakeholders were highly involved in the development of the plan through workshops, interviews, focus group discussions, questionnaires and field surveys to raise awareness on the state of their catchment, engage and buy them in for the protection of the water resources and catchment. During the process a Catchment Management Organisation (CMO) structure was set up. It comprises of the Catchment Stakeholder Forum (CSF) bringing together the different stakeholders in the catchment annually, the Catchment Management Committee (CMC) which is the institution coordinating, managing and supervising catchment management activities in the catchment, the Catchment Technical Committee (CTC) which has not yet been constituted and the Catchment Management Secretariat (CMS). The secretarial services are presently performed by Kyoga WMZ.

As part of the planning process, a number of no-regret IWRM interventions were implemented in Kaabong, Kotido, Amuria and Katakwi Districts to pilot measures which can be upscaled after the completion of the CMP.

Land in Lokere Catchment is currently covered approximately by equal shares of forest and woodlands, grasslands, shrublands and croplands. Extensive wetland systems are present in Lower Lokere. Most lands are communally owned, except in the town centres of Moroto and Katakwi, and in Lower Lokere where individuals possess title deeds. Approximately 1/3 of Lokere Catchment has a protected status and is either under the auspices of the National Forest Authority (NFA) or the Uganda Wildlife Authority (UWA).

Settlements in Lokere Catchment are scattered with concentrations around productive agricultural areas, trading centres and water sources. The catchment is mainly inhabited by pastoralists and agro-pastoralists. Livestock rearing occurs throughout the catchment with cattle, goats and sheep being grazed in open grassland, shrubland, thicket and forest margins and on agricultural lands after crops have been harvested. Rain-fed crop production of mainly sorghum, millet and maize, and paddy rice (flood irrigation) complement livestock rearing. Mining (mainly marble around Moroto) is

another important economic activity, but permits are held by companies outside the catchment. There is no large-scale industry.

Lokere Catchment has gone through a long period of conflict, but since the start of the Karamoja Integrated Disarmament and Development Programme (KIDDP) in 2001 security has improved greatly.

The catchment receives a total average annual rainfall between 550 mm/year in Upper Lokere and 1,300 mm/year in Lower Lokere. The precipitation pattern is classified as bimodal, but is highly variable in space and time, with high peak events and long dry periods. Climate change projections indicate that temperatures, rainfall intensity and frequency of extreme events will increase.

Lokere Catchment is well drained with a dense network of meandering seasonal rivers and streams, the main one being River Lokere (Okere in Teso) and the wetlands downstream located in Amuria district. The river system is set on a large inland plateau, 400 m ASL, underlain by Precambrian crystalline basement rocks. The soils are in general fertile, but sensitive to soil erosion. In the downstream areas, the occurrence of soils with a very low infiltration capacity causes waterlogging.

In Upper Lokere rivers are characterized by large variations in low and peak flow, by a large sediment load and by a quick response to rainfall events. Flows cease within one to two days after a rainfall event. The rivers are deeply incised and filled with sand and silt. In Middle and Lower Lokere river discharge is more dominated by a base flow component. The extended wetlands and the thick pack of sedimentary material absorb part of the peak flows in the rainy season and release water slowly in the months that follow. Groundwater is concentrated in fractured rock and in a top-layer of loose material covering solid rock (regolith) and in the alluvium of river beds and flood plains. Chemical groundwater quality is in general good while microbiological contamination is a major concern, also in deep groundwater wells due to poor design, construction, operation and maintenance.

Safe water coverage in Lokere Catchment is low, and varies between 29% in Kaabong and 72% in Soroti. To cover current domestic water demand an absolute minimum of 3,493 m^3/d of extra potable water needs to be supplied. Water demand for livestock is high throughout the catchment. Incoming livestock from Turkana and South Sudan aggravates the shortages. Indicative calculations for Lokere and Lokere catchments[1] indicate that currently there is a combined shortage of 4 Mm^3 of water for livestock in normal years (3-month dry season) and of 28 Mm^3 in extremely dry years (9-month dry season). Currently -2016- water volumes required for irrigation are negligible, but the National Irrigation Master Plan for Uganda 2010 – 2035 found approximately 14,700 ha suitable for irrigated crop production. Making full use of that potential would require 87 Mm^3 of water for irrigation. Apart from productive uses, estimates indicate that 238 Mm^3/year have to be ensured as an environmental flow, a volume of water that has to remain untouched to safeguard the adequate functioning of ecosystems in the catchment e.g. for the aquatic life and wetland vegetation.

A SWAT hydrological model was run for 30 years (1984-2013), and the results indicate that on average 1,190 Mm^3 of water leaves the catchment as surface outflow, but that it varies between 500 Mm^3 and 2,600 Mm^3 (these numbers include the water coming from Lokok Catchment as it is a tributary to River Lokere). Almost 14% of the average annual precipitation is (temporarily) stored in shallow (13%) and deep (0.7%) groundwater aquifers. With 1,299 Mm^3 of recharge shallow aquifers are at least as important in terms of storage as wetlands. Less than 12 Mm^3 is currently abstracted from the catchment for domestic, livestock and agricultural use. The model also shows that runoff-rainfall ratios are high, particularly in the agricultural lands.

During the planning process three categories of issues were identified: institutional, water resources related, and socio-environmental.

The district structures have well laid out development plans, but have capacity gaps at different levels. Funding is limited, staffing inadequate and there is a lack of harmony of structures and sector coordination. Policies are poorly popularized among stakeholders and law enforcement is difficult and conflicts with livelihood activities of communities.

[1] Herders use Lokok and Lokere catchments as a combined resource when watering livestock. Hence the water demand for livestock calculations was combined.

Regarding water resources, environmental degradation is leading to high surface runoff rates, and consequently to a low water retention capacity and siltation of dams and valley tanks. The storage capacity is being undermined by agricultural encroachment. Monitoring of weather, surface flows, groundwater levels, groundwater abstractions, water quality and climate is insufficent. Access to data is difficult. Safe water coverage is low. Boreholes are the predominant source of safe water supply, but many are non-functional because of poor site selection, design, operation and maintenance challenges. There is insufficient water to meet livestock demands, particularly in the dry season, as a consequence of which livestock migrates downstream at times destroying farmlands. Flooding seems to be linked, at least in part, to the antecedent conditions of wetlands and the fact that communities are increasingly moving into flood plain areas. Locally in Lower Lokere, water logging occurs due to a high intensity rainfall on soils with a low infiltration capacity. Flooding of dams and valley tanks is related to flash floods in ephemeral streams which is, at least in part, caused by poor source protection, design, construction, operation and maintenance.

Therefore, the vulnerability to natural disasters is high and land degradation and soil erosion are severe, particularly in the agricultural lands of Moroto, Lopei Lokopo and in Lower Lokere. Bush burning is not controlled, deforestation due to charcoal production is problematic, conflicts over natural resources occur, and artisanal mining resulting in the clearance of vegetation and degradation of river banks.

Overarching challenges to the catchment are population growth, high poverty[2] and low literacy levels, land ownership which is not backed by formal documentation, poor access to basic services, weak enforcement of the protection of nature conservation areas, and major disruption of the norms and values due to the implementation of affirmative action, the disarmament and the encouragement of crop farming to the detriment of livestock rearing.

Based on the key issues identified, their causes and impacts, and in line with the Uganda Vision 2040, the stakeholders developed a vision for their catchment:

"A sustainably managed Lokere Catchment that supports livelihoods and development by 2040"

To achieve this common vision, the CMP addresses four strategic objectives:

- Strengthen natural resources management systems and structures,
- Restore degraded natural resources,
- Ensure sustainable access to water of adequate quality and quantity for domestic use and production, and
- Ensure that farming and animal husbandry systems are productive, drought and climate change proof, and improve household income.

To achieve the vision and strategic objectives, there is need to undertake measures which address the main issues and reverse those trends that undermine sustainable development in the catchment. These measures are called options. A set of options combined with external factors, government policy, ongoing trends and projections for the future then forms a scenario. Thus, three scenarios were developed along the main lines of interventions:

1) Ecosystem protection and restoration: focuses on improving the sustainability of cattle herding, protection of woodlands and wetlands and application of soil and water conservation measures in agricultural zones. The options under this scenario are oriented towards the revival of ecosystem functions, collaborative management of ecosystems and restrictions on natural resources exploitation.

2) Improved water and sanitation services for people: is purely oriented on increasing safe water coverage. This scenario is projected to impact local groundwater sources, but to have little influence on runoff-rainfall rates and thereby on the water balance.

3) Productive water infrastructure and farming productivity: that focuses on economic development, whereby the area of agricultural lands is increased with mono-cropping and mechanized agriculture. The scenario provides support for peoples' livelihoods. However, from a catchment perspective, this scenario will, in the end, result in a lowering of the agricultural productivity, high soil erosion rates and an aggravation of droughts and floods.

[2] Recent studies suggest that nearly 74% of the total population live below the poverty line (UNDP 2014). This poverty translates into high levels of food and nutrition insecurity. Root causes of poverty are reported to be adverse weather conditions, illiteracy, marginalisation, corruption, high prevalence of livestock and human diseases, crop pests and prolonged years of conflict.

Options and scenarios were evaluated based upon socio-economic, environmental, hydrological and financial criteria and discussed with the stakeholders. The analysis of the benefits and costs of the three scenarios shows that a single set of options cannot meet the strategic objectives. Interventions of the scenarios of "ecosystem restoration and protection", "improved water and sanitation services for people" and "productive water infrastructure and farming productivity" must be combined. Only by integrating the different scenarios can water resources' use and management benefit the people in the short term and be sustainable in the long run. Based on the outcomes a maximum-benefit scenario was formulated.

The maximum benefit scenario enhances the productivity of rain-fed agriculture, provides the opportunity to expand irrigated agriculture and increases safe water coverage, while it at the same time ensures the availability of water resources in the long term.

Following the maximum benefit scenario interventions were formulated along four thematic areas:

- **Institutional strengthening,**
- **Ecosystem protection and restoration,**
- **Water and sanitation and**
- **Agriculture and economic development**.

The first thematic area "institutional strengthening" cuts across the other three thematic areas. It concerns all levels (national, regional, local and community) and involves capacity building, policy enforcement, regulatory measures, streamlining of procedures, systems and structures, stakeholder involvement in decision making processes, access to information and data, coordination and dialogue within and between sectors, and integration of traditional management practices into governmental guidelines.

An overview of the options and interventions within the four thematic areas is given in Table 1. Some interventions exceed the borders of Lokere Catchment and are more applicable to water resources management in Uganda in general or deal with issues that are not entirely the responsibility of the Catchment Management Organization, but rather of a higher-level institution within the Ministry of Water and Environment and other line ministries and agencies.

TABLE 1: OVERVIEW OF INTERVENTIONS LOKERE CATCHMENT

A. Institutional strengthening	B. Ecosystem protection and restoration	C. Water and sanitation	D. Agriculture ans economic development
Strengthening the CMO ■ Implementation of CMO governance system ■ Support and strengthen the CMC ■ Establish the CMS ■ Support and strengthen the CSF ■ Establish and support the CTC **District level coordination** ■ Prepare districts for CMP implementation ■ Cross-sectoral district operations ■ Guide lower level CMP implementation ■ Guide development partners **Learning and knowledge management** ■ Awareness raising on CBWRM and CMP ■ Capacity building ■ General stakeholder learning ■ Knowledge management **Monitoring and evaluation of CMP implementation** ■ CMP review ■ Policy development **Sub- and micro-catchment management** ■ Sub-catchment management ■ Micro-catchment management **Funding of the CMP** ■ Proposal and partnership development ■ Innovation fund (basket fund)	**Productive and protected forests and woodlands** ■ Improve management of Central Forest Reserves ■ Improve tree cover in degraded areas ■ Regulate charcoal production and firewood use ■ Promote use of alternative sources of energy **Productive and sustainable rangelands** ■ Promote collaborative rangeland management with traditional rangeland management institutions and other stakeholders ■ Protect and rehabilitate rangelands **Protect wetlands and flood plains** ■ Sensitize and create awareness on the value of wetlands ■ Develop and implement community based wetland management plans ■ Restore degraded wetlands **Protect rivers and river banks** ■ Promote river bank management **Flood management systems and infrastructure** ■ Construct flood and waterlogging management infrastructure **Regulation and enforcement** ■ Support enforcement of regulations ■ Regulate gold and sand mining ■ Regulate marble mining	**Access to knowledge** ■ Promote capacity building ■ Support extension services ■ Improve knowledge management **Monitoring and planning** ■ Reinstate climate monitoring ■ Establish groundwater monitoring ■ Strengthen surface water monitoring ■ Establish water quality monitoring ■ Establish sediment monitoring ■ Establish flood monitoring ■ Enforce the water abstraction permit system **Management of piped water systems** ■ Extend and rehabilitate water supply systems ■ Construct new water supply systems **Management of rural water systems** ■ Rehabilitate and close non-functional water points ■ Improve operation and maintenance ■ Promote water harvesting for domestic use ■ Improve deep borehole drilling ■ Promote shallow groundwater development **Sanitation and waste management** ■ Upscale sanitation programmes ■ Promote waste management	**Improve livestock farming** ■ Research into livestock value chains ■ Develop and implement a plan to improve access to water for livestock ■ Improve access to pasture and work on rangeland management **Improve rain-fed farming** ■ Promote sustainable and productive rain-fed farming **Promote micro- and small-scale irrigation** ■ Promote micro and small-scale irrigation **Promote medium-scale irrigation** ■ Feasibility study ■ Demos for medium-scale irrigation **Promote road water harvesting** ■ Implement road water management and harvesting **Promote alternative economic activities** ■ Promote alternative economic activities

Part of the CMP is an Implementation Plan (IP) which is presented as a separate document together with the CMP. The IP is organised as a practical tool indicating interventions per thematic area, options, activities and sub-activities, locations (where applicable), project lead, possible partners for implementation, priority and budget for implementation as well as for structural operation and maintenance.

In the IP interventions are prioritised according to the urgency of implementation. The priority does not indicate the relevance, but rather an order of implementation in time. The priority is indicated as “critical”, “high”, “medium” and “low”. Critical are activities for which implementation should start immediately, which are conditional to any further implementation and key for sustainable catchment management. Highly prioritised are those activities of high relevance to key issues and with expected high impact on improving water resources management and stopping harmful practices. The activities should be implemented at short term, meaning within 3 years from CMP approval. Medium priority is set

for activities that are planned to be implemented at intermediate term, within 3-5 years from CMP approval. Activities with priority set at “low”, can be implemented in the longer term, meaning within 5 to 10 years[3] from CMP approval.

The CMP is a living document and part of a continuous management process. The CMP should be reviewed and updated periodically as described under the monitoring and evaluation activities and at least every 5 years in line with national and district planning cycles.

[3] The CMP objectives are aligned to the Uganda vision 2040.

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ACRONYMS AND ABBREVIATIONS

ACF	Action Contre le Faim (Action Against Hunger)
ARC2	African Rainfall Climatology model version 2
ASL	Above Sea Level
ASM	Artisanal and small-scale mining
BOD	Biochemical oxygen demand
CAO	Chief Administrative Officer
CBWRM	Catchment Based Water Resources Management
CCU	Climate Change Unit
CFM	Collaborative Forest Management
cm	Centimetre
CMC	Catchment Management Committee
CMO	Catchment Management Organisation
CMP	Catchment Management Plan
CMS	Catchment Management Secretariat
CSF	Catchment Stakeholder Forum
CTC	Catchment Technical Committee
DDP	District Development Plan
DEA	Directorate of Environmental Affairs
DHD	District Health Department
DIO	District Information Officer
DPO	District Production Officer
DWD	Directorate of Water Development
DWO	District Water Officer
DWRM	Directorate of Water Resources Management
DWSSC	District Water and Sanitation Coordination Committee
ENRM	Environmental Natural Resources Management
FAO	Food and Agriculture Organization of the United Nations
FDGs	Focus Group Discussion
FEWS	Flood Early Warning System
FIETS	Financial, Institutional, Environmental Technical and Social
GIS	Geo-Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ha	Hectare
IWRM	Integrated Water Resources Management
KIDDP	Karamoja Integrated Disarmament and Development Programme
KWMZ	Kyoga Water Management Zone
KUWS	Karamoja Umbrella of Water and Sanitation
l	Liter
LC	Local Council
LCB	Local Capacity Builders
LED	Local Economic Development
LLG	Lower Local Government
LSM	Large-scale mining
M&E	Monitoring and evaluation
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MEMD	Ministry of Energy and Mineral Development
MLG	Ministry of Local Government
mm	Millimetre
Mm^3	Million cubic meters
MOFED	Ministry of Finance, Planning and Economic Development
MoU	Memorandum of Understanding

Mt	Metric ton
MTTI	Ministry of Tourism, Trade and Industry
MWE	Ministry of Water and Environment
MWT	Ministry of Works and Transport
n.a.	not applicable
NAADS	National Agricultural Advisory Services
NaFORRI	National Forestry Resources Research Institute
NEMA	National Environmental Management Authority
NFA	National Forest Authority
NGO	Non-Governmental Organization
NRDs	Natural Resources Departments
NRM	Natural Resources Management
NWRA	National Water Resources Assessment
NWSC	National Water and Sewerage Corporation
O&M	Operation & Maintenance
OPM	Office of the Prime Minister
PME	Planning, Monitoring and Evaluation
RWTSUs	Regional Wetlands Technical Support Units
SME	Small and Medium Enterprises
SSEA	Strategic Social and Environmental Assessment
SWAT	Soil and Water Assessment Tool
TSU	Technical Support Unit
UBOS	Uganda Bureau of Statistics
UGX	Ugandan Shilling
UNMA	Uganda National Meteorological Authority
UNRA	Uganda National Roads Authority
UOs	Umbrella Organisation
UWA	Ugandan Wildlife Authority
UWASNET	Uganda Water and Sanitation NGO Network
UWS-E	Umbrella of Water and Sanitation East
VSLA	Village Saving and Loan Association
WASH	Water, Sanitation and Hygiene
WfP	Water for Production
WMZ	Water Management Zone
WSDF-E	Water Sector Development Facility East
WSS	Water Supply Scheme
WUC	Water Users Committee

GLOSSARY

3R-interventions	3R stands for Recharge, Retention and Reuse interventions. 3R presents interventions for storing and buffering water using small systems. Examples are sand and sub-surface dams.
Agricultural drought	Below average crop production as a consequence of water shortages during a certain period of time.
Agroforestry	A land use management system in which trees or shrubs are grown around or among crops or pastureland. It combines shrubs and trees in agricultural and forestry technologies to create more diverse, productive, profitable, healthy, ecologically sound, and sustainable land-use systems.
Antecedent condition	Antecedent conditions represent a temporary state within dynamic natural and social systems that precedes and influences the onset and magnitude of a hazard and its consequences.
Biodiversity	A measure of the variety of organisms present in different ecosystem.
Benchmark model	A base model in order to assess the relative change of a scenario or parameter change. Benchmarking is normally done by running a number of different parameters and trials against it.
By-laws	A rule or law established by an organization or community to regulate itself, as allowed or provided for by some higher authority.
Catchment	A drainage basin or catchment basin is an extent or an area of land where all surface water from precipitation converges to a single point at a lower elevation, where the stream joins another body of water, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.
Catchment management	Environmental planning concept that approaches sustainable resource management from a catchment perspective and integrates land and water management.
Catchment Management Committee	A committee composed of representatives of all relevant stakeholder groups, which collaborates with the water management zone during the formulation of a catchment management plan and plays a steering role during its implementation.
Catchment Management Secretariat	A secretariat providing support to the Catchment Management Committee, Catchment Stakeholder Forum and Catchment Technical Committee in coordination, planning, implementation and monitoring of activities in the catchment.
Catchment Stakeholder Forum	A forum bringing together all actors on catchment management to define key issues related to water resources, to provide input to and to review the Catchment Management Plan and to monitor the levels of commitment.
Catchment Technical Committee	A committee composed of technical staff from key stakeholders in the catchment and technical staff of other government ministries and agencies,

	providing technical expertise in planning, implementation and monitoring of activities in the catchment.
Collaborative forest management	A dynamic approach to promote sustainable and equitable forest resource management.
Community Based Organisation	A group of individuals organised by and for a particular community of people based on shared interests and/or attributes. The community could be defined geographically (e.g. a neighbourhood), could contain members from diverse backgrounds, and/or could be defined based on something like religious beliefs or a shared condition. Members may include various stakeholders, such as the public, elected officials, advocacy groups, and business leaders.
Community led total sanitation	An innovative methodology for mobilizing communities to completely eliminate open defecation. Communities are facilitated to conduct their own appraisal and analysis of open defecation and take their own action to become open defecation free.
Contour trenching	An agricultural technique where trenches are artificially dug along contour lines. A technique that can be easily applied in arid areas to allow for water, and soil conservation, and to increase agricultural production.
Curve number (SWAT)	Empirical parameter for predicting surface runoff based on slope, soil, vegetation cover and land use management practices.
Dam (or Valley Dam)	Embankment build in a concave location, perpendicular on the stream in a valley, where with one (earth or concrete) wall a big reservoir is made to store water. In the context of catchment management planning in northern Uganda dams are considered small if volume < 50000 m^3. All dams between 50000 m^3 and 5 Mm^3 are (in this plan) classified as medium-sized dams.
Deconcentration	The responsibilities and authorities of the central government is transferred to lower level government.
Dendritic pattern	A dendritic pattern is a pattern of growth that resembles a tree.
Drip-irrigation	A form of irrigation that saves water and fertilizer by allowing water to drip slowly to the roots of many different plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters.
Drainage	Downward flow of surface and sub-surface water from an area.
Ecosystem	A community of living organisms in conjunction with the non-living components of their environment (air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flow.
Environmental quality objectives	Documented limits and tolerances on measured ratios and levels of pollutants allowed in water.
Exclosure	Degraded area in (semi-) arid environment from where livestock is excluded to allow native vegetation to regenerate as a way to control soil erosion, increase rain water infiltration and increase the availability of fodder and biomass. Typical examples of exclosures feature fences that prevent animals

	from entering the area. Sometimes only targeted species are excluded while allowing other animals to move freely.
Extension services	The application of scientific research and new knowledge to certain practices through education.
Fanya juu	A terracing technique where the stones from rocky slopes are used to build bunds or terrace walls, often on very steep slopes. The terraces are constructed by throwing soil up slope from a ditch to form a bund along a contour.
Farmer Managed Natural Regeneration	Low-cost, sustainable land-restoration technique used to combat poverty and hunger amongst poor subsistence farmers in developing countries by increasing food and timber production, and resilience to climate extremes. It involves the systematic regeneration and management of trees and shrubs from tree stumps, roots and seeds.
Fault (geology)	A fault is a planar fracture or discontinuity in a volume of rock, across which there has been significant displacement as a result of rock-mass movement.
Focus Group Discussion	A focus group is a small, but demographically diverse group of people whose open discussions are analysed to determine the opinion that can be expected from a larger population.
Geo-Information System	A system designed to capture, store, manipulate, analyse, manage, and present spatial or geographic data.
Grass strip	An area of land maintained in permanent grass vegetation.
Groundwater	The water present beneath Earth's surface in soil pore spaces and in the fractures of rock formations.
Gully	A landform created by running water, eroding sharply into soil. Typically triggered off by surface runoff from compacted soil surfaces that limit infiltration of rain water and hence often starting from roads, cattle tracks and other denuded soils.
Habitat	An ecological or environmental area that is inhabited by a particular species of animal, plant, or other type of organisms. The term typically refers to the zone in which the organism lives and where it can find food, shelter, protection and mates for reproduction.
Heavy metals	Metals with relatively high densities, atomic weights, or atomic numbers. Examples are iron, copper, cadmium, mercury, lead, and gold.
Hydrological drought	Below average water availability from rivers, lakes and groundwater during a certain period of time.
Hydrological modelling	Hydrologic models are simplified, conceptual representations of a part of the hydrologic cycle which are primarily used for hydrologic prediction and for understanding hydrologic processes.
Infiltration capacity	The maximum rate at which water can enter a soil in a given condition depending on soil structure and texture, organic matter content, actual soil moisture, and vegetation cover.

Literacy	The ability to read, write and use arithmetic to understand, communicate and gain useful knowledge.
Metamorphism	The change of minerals or geologic texture in pre-existing rocks, without melting into liquid magma. The change occurs primarily due to heat and pressure.
Meteorological drought	Below average amount of rainfall during a certain period of time. In this study, a timespan of one month was used.
Micro-catchment	A small sub division of a sub-catchment area.
Mulching	A mulch is a layer of (often organic) material applied to the surface of an area of soil. Its purpose is any or all of the following: to conserve moisture, to improve the fertility and health of the soil, to reduce weed growth, to enhance the visual appeal of the area.
No-regret measure	Activities that always yield certain benefits.
Orographic influences	The effect of topographic elevation, mainly used in relation to precipitation inducing processes.
Regolith	A layer of loose, heterogeneous superficial material covering solid rock. It includes dust, soil, broken rock, and other related material.
Resilience	Resilience is the ability of a system, society, community, or individual exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2007).
Road water harvesting	Water can be harvested directly from road surfaces; the runoff can be diverted to recharge areas or storage ponds.
Safe water coverage	Percentage of the population that has access to a source of safe water supply (borehole, piped water supply or protected spring) within walking distance (1500 m).
Sand dam	A reinforced wall that reaches above the sand bed. The river is cascaded, hence reducing river speed and increasing infiltration. When it rains, the dam captures soil laden water behind it filling the reservoir over time and a sandy aquifer is created.
Scenario	Combination of options, external factors that influence their performance (climate, economic conditions, etc.), projections or forecasts of the future (population growth rate, urbanization rate, agricultural productivity, water use or demand rates, economic parameters, etc.), and government policy affecting either their performance (priority, funding, regulations, institutional arrangements, etc.).
Shallow groundwater	Relatively young water stored in local overburden (regolith) aquifers.
Sheet erosion	The uniform removal of soil in thin layers by the forces of raindrops and overland flow.

SME	SME stands for small and medium-sized enterprise. SMEs are businesses whose personnel numbers fall below certain limits.
Soil and water conservation	The practice of sustainable use of soil and water resources.
Stakeholder	Any individual, group of people, institution (government or non-government) or company that may have a relationship with management of the catchment.
Sub-catchment	A hydrologically defined first-level sub division of a catchment area.
Sub-surface dam	A dam constructed within the existing river bed sediment, anchored on an impermeable layer.
Valley dam	(see Dam).
Valley tank	(Synonyms: water pan, hafir, water harvesting tank) large excavation in a depression or low-lying area, where surface runoff is stored in an open reservoir, usually off-stream (away from the main stream), the reservoir bottom can be sealed with compacted clay or plastic lining material. NB: Although the term is very common in Uganda the term may be misleading since there is no dam or tank constructed (like, for example, the berkads in Somalia).
Village savings and loan association	A group of people who save together and take small loans from those savings. The purpose of a VSLA is to provide simple savings and loan facilities in a community that does not have easy access to formal financial services.
Water balance	The comparison of the quantities of water supplied, drained and removed that affect the change in storage over a certain period of time and within a given area.
Water demand	Amount of water required to cover the needs of specific users or uses, including the environment.
Waterlogging	Store of water above the surface as due to the existence of an (almost) impermeable layer. Soil may be regarded as waterlogged when the water table is too high to conveniently permit an anticipated activity, such as for example agriculture.
Water user committee	A committee set up by the community that is responsible for maintenance and operation of water access points.

1. INTRODUCTION

The Ministry of Water and Environment (MWE) through its Directorate of Water Resources Management (DWRM), is implementing Catchment Based Water Resources Management (CBWRM) as part of its water resources management reform process initiated upon the Water Sector Reform Study of 2005 (MWE 2005). The reform involves the deconcentration of water resources management along catchment boundaries to ensure government functions and services are more responsive to local issues. In this regard, the country has been divided into four Water Management Zones (WMZs): Upper Nile, Albert, Victoria and Kyoga (Figure 1). Within each WMZ, there are smaller hydrological units called catchments. Lokere Catchment is one of the 11 catchments in Kyoga Water Management Zone (KWMZ). Lokere Catchment borders with Lokok Catchment to the west and with Awoja Catchment to the south-east (see Annex E for a map with all catchments in KWMZ). Lokere Catchment covers an area of 8,156 km² and has an approximate population of 420,000 (2016).

The present document provides the Catchment Management Plan (CMP) for Lokere Catchment, in Karamoja and Teso regions, in north-eastern Uganda. It provides a consensus strategy and common framework to support stakeholders of Lokere Catchment in their planning towards using water resources effectively and efficiently and achieving long-term sustainable development by introducing a concept for balancing growing demands with limited resources. This CMP was developed based on an Integrated Water Resources Management (IWRM) approach, following the Uganda Catchment Based Water Resources Planning Guidelines developed by MWE (2014). The CMP has been developed in close collaboration with the stakeholders of Lokere Catchment.

The catchment management plans for Lokere was developed in parallel to that for Lokok, under the project titled "Support to Integrated Water Resources Management in Karamoja for Increased Community Resilience" co-funded by German Development Cooperation and DFID (under its "Enhancing Resilience in Karamoja Project"), implemented by Deutsche Gesellschaft für International Zusammenarbeit (GIZ) GmbH.

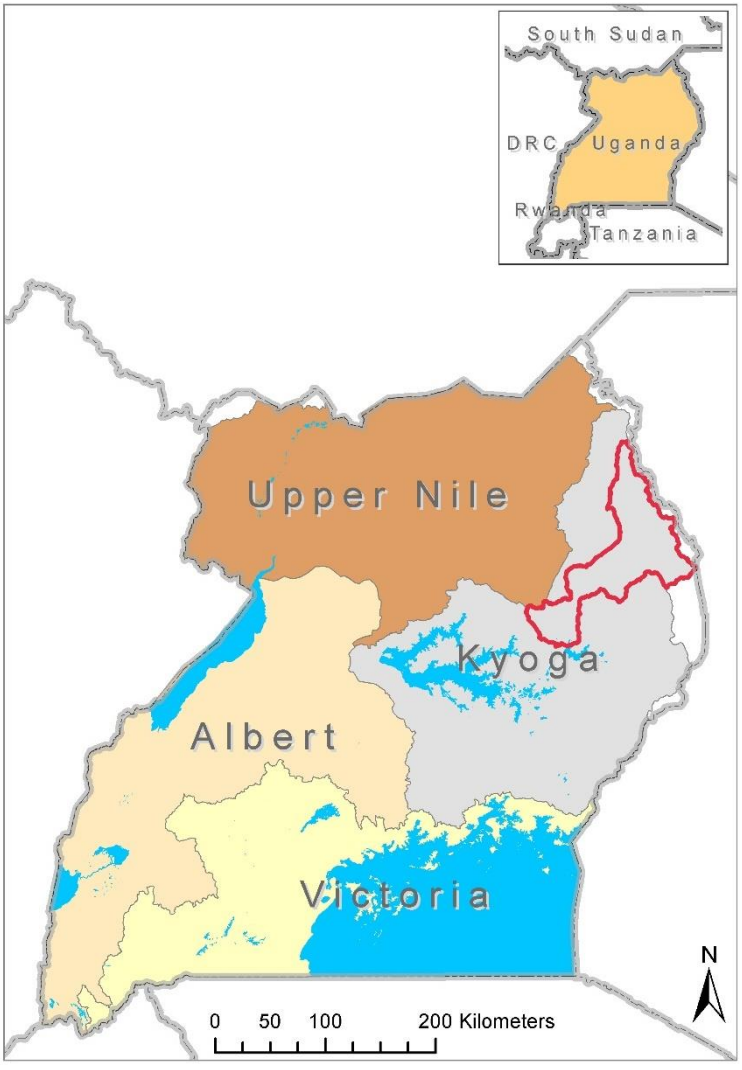


Figure 1: Lokere Catchment in Kyoga Water Management Zone in north-eastern Uganda

1.1 Catchment management

A catchment is a hydrological area where all surface water converges to a single exit point at a lower elevation, which in the case of Lokere Catchment is the convergence between the rivers Lokere and Awoja. Only within catchment boundaries it is possible to determine how much surface and groundwater is available for the environment and human usages. Catchments are independent of existing administrative boundaries, such as districts, sub-counties and parishes and consist of natural and human-modified ecosystems with a characteristic configuration of topography, geology, soils, land use and vegetation. This mix, its interaction, its spatial arrangement, and the norms and modalities of its governance contribute to its functionality, challenges and opportunities. Analysis and

intervention at catchment level can support the development of synergistic outside-the-box solutions to complex challenges (Landscapes for people, food and nature 2015).

This CMP deals with issues of the natural system of land, water and ecosystems as well as the social and economic systems that depend on natural resources. It addresses the problems of protecting, conserving and managing water and other related resources in a sustainable manner considering the social and economic system by a) using water for economic and social development; b) protecting the resource base that supports these economic and social benefits; and c) conserving the catchment's resources.

1.2 Integrated water resources management (IWRM)

Uganda Catchment Based Water Resources Management is based on Integrated Water Resources Management (IWRM). IWRM is a problem-focused and needs-driven holistic approach that recognises that many water use and management issues are interrelated and thus cannot be solved in isolation. The approach recognises spatial dependencies, the need to think across temporal scales, the existence of knowledge gaps and uncertainties, and the need to link research and policy (Jakeman and Letcher 2003). IWRM considers, recognizes and synergizes interests and activities related to water resources use and management. *Integrated* in IWRM refers to the integration of (Vos and Gerbrandy 2006):

- Uses (e.g. drinking water, industry, agriculture, livestock and environment)
- Analytical perspectives (e.g. technical, socio-economic, institutional and planning)
- Organizations and users (e.g. governments, users, managers and community based organizations)
- Geographic areas (e.g. upstream-downstream)
- Development (e.g. IWRM as part of wider rural transformation).

IWRM is founded on early, open and inclusive stakeholder engagement, and enables all those with an interest in water resources to communicate, liaise and work more effectively together (Tweed Forum 2010). The aim is to achieve resource sustainability, to deliver cross cutting improvements to water environments and secure future access to water to all users and simultaneously promote development. In this sense, IWRM is based on partnerships, facilitates change rather than dictating it, promotes visioning and planning, recognizes the importance of local knowledge, fosters learning and adaptive management and concentrates both on people and their natural resources base (Frost et al. 2006).

A Catchment Management Plan founded on IWRM principles includes interventions in terms of (based on Vos and Gerbrandy 2006) administrative changes and regulatory frameworks, research, technology and infrastructure, ecosystem protection and restoration, economic investment and financial instruments, social change, investment and financial propositions, and capacity building. But foremost a catchment management plan is iterative and adaptive, and hence should be updated regularly following the developments of the complexities between the natural and human environments.

1.3 The catchment management planning process

The catchment planning process in Uganda is presented in the Uganda Catchment Management Planning Guidelines (MWE 2014). The schematic diagram outlines the planning process in a series of steps, which each contain a varying number of tasks (Figure 2). According to the guidelines the process begins with delineating the catchment and the sub-catchment boundaries, development of a catchment information system and building the basis of the catchment knowledge base. Subsequently, different parallel assessments are undertaken:

- The Water Resources Assessment analyses the water balance based on mapping and assessing the water resources availability and projecting future water use.
- The Stakeholder Assessment is undertaken to develop the framework for stakeholder participation. This includes the engagement strategy for various stakeholders' groups in the different steps of the catchment management planning process. Furthermore, stakeholders will be mobilised to participate in the Catchment Management Organisation (CMO).
- The Strategic Social and Environmental Assessment (SSEA) identifies potential adverse consequences of development and the fragility of many economically and socially important natural assets. At a strategic level the major social and environmental issues are assessed for the catchment today and the potential issues in the future

that the plan should foresee and attempt to mitigate, considering the resource base, development opportunities, and the goals and direction that stakeholders desire.

Based on the information from the Water Resources Assessment and the SSEA and with the CMO in place, a framework for further planning is developed. This includes the catchment's natural resources, their status, the water balance, the opportunities for development, and the potential constraints and limitations as they have emerged from the study and analysis carried out. Subsequently the stakeholders develop their vision and objectives for the catchment to guide further development of options and scenarios of what the catchment could be like in the future.

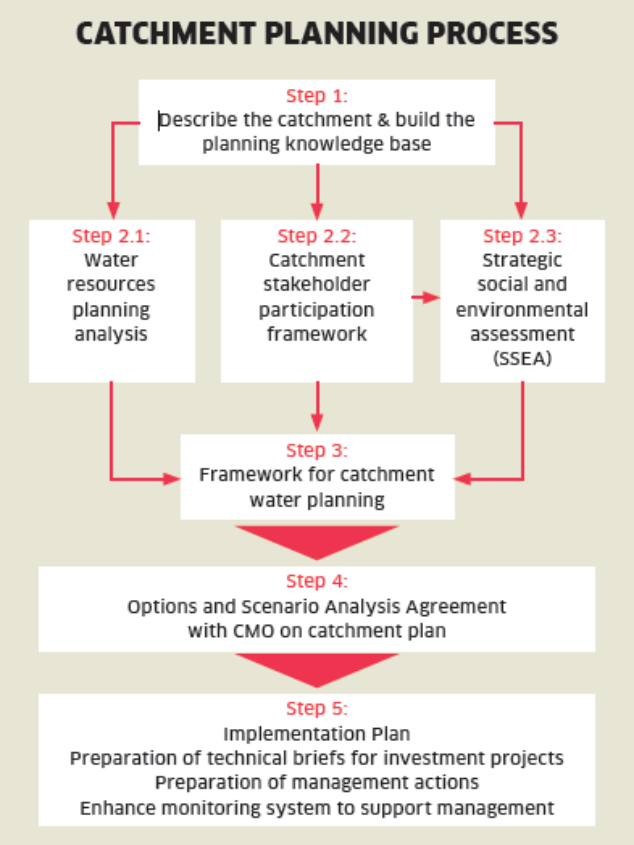


Figure 2: Catchment management planning process (MWE)

With the vision and objectives for the catchment in place and with a set of options and interventions further analysis is undertaken including the design of the options, assessment of the sustainability and compatibility of a larger number of different types of development options and management actions simultaneously and a so-called scenario analysis. The scenario includes a set of assumptions about the options and how they perform influenced by external factors and under projection of future trends. The results of this process of assessment and analysis lead to a Catchment Management Plan. Additionally, the Implementation Plan guides the actors involved to get into action and includes priorities, phasing and contributing partners.

1.4 Outline of the CMP

Chapter 2 explains the manner in which the project team operationalized the Uganda Catchment-based Water Resources Management Planning Guidelines. It specifies the different steps in the catchment planning process, and the methods and tools used in each of the steps.

Chapter 3 provides an overview of the policy, legal and institutional context in Uganda regarding water resources management. It specifies the relevant policies, laws and strategies, the way different actors are involved in water resources management, and the composition of the Catchment Management Organization, the entity in charge of decision making on water resources at catchment level.

Chapter 4 describes the main characteristics of the catchment, including the location, its main features, climate conditions and socio-economic aspects. The chapter also gives the details and main issues resulting from the stakeholder assessment, the water resources assessment and the strategic social and environmental assessment. The results of this chapter provide the information needed to understand the functioning of the catchment.

Chapter 5 links the main trends and issues in water resources management to options. Options are then combined into scenarios to assess their impact on the environment, livelihoods and water balance of the catchment. The chapter concludes with the maximum benefit scenario in which options from the different scenarios are combined and balanced to address all main current and projected water resources management issues, while minimizing negative side-effects.

Chapter 6 draws the intervention plan. The maximum benefit scenario is developed into a plan agreed on by all the stakeholders, which specifies all interventions, including the reasoning behind them, projected effects, and important considerations during implementation. Interventions are organized along four thematic areas: 1) institutional

strengthening, 2) ecosystem protection and restoration, 3) water and sanitation and 4) agriculture and economic development. Furthermore, the catchment's transcending interventions are described.

Chapter 7 describes sources of funding that could be tapped into to finance implementation.

Chapter 8 gives guidance on the implementation of the Catchment Management Plan. It specifies the set-up of the implementation plan, prioritization of interventions, roles and responsibilities, and the total budget needed for implementation, and for operation and maintenance.

2. METHODOLOGY

The methodology used in the development of the Lokere CMP is derived from the Uganda Catchment Management Planning Guidelines (MWE 2014) and followed the steps as shown in Figure 2. The planning process started with an inception phase which laid the basis for the subsequent assessments on water resources, stakeholders and socio-economic and environmental context. The assessment phase was followed by an analysis and design phase in which the different interventions were identified and designed. The final step included the development of the Catchment Management Plan and the Implementation Plan. The Catchment Planning process was further enriched by the implementation of several so-called no-regret IWRM measures in 3 districts of the Catchment. The methodology of each step of the process is described in detail in the respective reports and summarized here.

At some places the Catchment Planning Team slightly deviated from the guidelines. For example, the inception and assessment phases together also captured Step 1 of the guidelines "Describe the catchment & build the planning knowledge base". During the assessment phase, also the vision and objectives were developed by the stakeholders. Furthermore, step 3 "Framework for catchment water planning", which includes several interactions with the Catchment Management Organisation, was combined with the other steps. Development of technical briefs for investment projects, preparation of management actions and the development of a monitoring system are part of the implementation plan.

Several stakeholder workshops were held and aimed at:

- Presenting an overview of the catchment: the major issues, problems, trends and the opportunities and options identified by the planning team in the inception and assessment phases.
- Reviewing and agreeing on the major issues, problems and trends in the catchment which need to be addressed by the catchment plan. This includes the aspirations and needs for water expressed by the stakeholders.
- Developing a catchment vision, planning objectives and indicators, which further guided the formulation and evaluation of options and scenarios.
- Reviewing and agreeing on the range and scope of options to be considered.

2.1 Inception phase

To obtain a good understanding of the initial situation and to plan activities and resources effectively, an inception phase was undertaken. Available data was reviewed to identify gaps in the data. The Planning Team familiarized itself with relevant legislations including the framework for CBWRM.

As the Catchment Management Organisation (CMO) was envisioned from the start to play an important role and was planned to be set up during the CMP planning process, the inception phase was used to undertake an initial identification and to refine the stakeholder participation strategy.

2.2 Stakeholder analysis and engagement (Step 2.2)

Catchment Management Planning is a multi-stakeholder process in which government agencies together with local stakeholders, including community based organisations and private sector parties form a "platform" and work together in a complex and intense process that takes time, but is key for sustainability. During the preparation of the catchment management plan, stakeholder participation first aims at understanding the different interests (including the environment) of all stakeholders and finding common solutions for often competitive uses of resources. By discussing different perspectives, causes of problems and ambitions may become clear and thus add to solutions (or change). At the same time, stakeholders develop a greater understanding for CBWRM, facilitate the buy-in and create mechanisms that are institutionalised for conflict resolution, water regulation and enforcement and other water management measures. In the CMP development process stakeholders were engaged by being provided with information about the process through leaflets, presentations and field visits, consultation in data collection and by obtaining feedback on analysis. The stakeholders gave their input, advice, suggestions and recommendations in the identification of preferred options and in decision making.

Stakeholders meet on catchment management in the Catchment Management Organisation (CMO). The CMO compromises of the Catchment Stakeholder Forum (CSF), Catchment Management Committee (CMC), Catchment Technical Committee (CTC) and the Catchment Management Secretariat (CMS). A first step in mobilising the CMO is to understand who should be part of the CMO by analysing a) the relevant government policies, programmes and processes; b) which stakeholders are involved in natural resources management; and c) the key issues for these stakeholders regarding catchment management. Therefore, a stakeholder mapping and analysis was undertaken to identify all relevant actors and potential members of the different CMO bodies. At the time of the development of Lokere Catchment Management Plan the project team was involved in a similar trajectory regarding Lokok Catchment. To make efficient use of resources and as the districts and stakeholders largely overlap, a joint stakeholder analysis was undertaken for Lokok and Lokere Catchments. Data collection methods for the stakeholder analysis included workshops, in-depth interviews, Focus Group Discussions (FGDs), self-administered questionnaires and desk research of relevant documents to support the triangulation with the primary information collected from the respondents. All the districts within the Lokok and Lokere Catchments were sampled for the stakeholder assessment. An attempt was made to interview most of the district technical staff in all districts. The stakeholder assessment resulted in a stakeholder assessment and engagement report including:

- Stakeholder description: details the stakeholder characteristics based on their interventions, geographical scope, mission, partnerships and networks, resources and expertise.
- Stakeholder characterisation matrix (refer to the Stakeholder Assessment and Engagement report): stakeholders per category, sectors of intervention, interests, capacities, network and potential role in Catchment Management.
- Power dynamics matrix: depicts the influencing power and interest dynamics between stakeholders.
- Operational stakeholder engagement plan (Annex B): recommended engagement strategy per stakeholder group and per phase of the catchment management planning process.

The establishment of the CMO in Lokere Catchment was facilitated during the catchment planning process. In September 2016, the Lokere CSF was formally established. In November 2016, the Lokere CMC was formed (see Annex C for the elected CMC members). Participation of stakeholders throughout the project was achieved through:

- A five-day inception field visit to Moroto and Nakapiripirit districts in June 2016.
- A three-week field visit to all eight districts in July-August 2016, in which interviews, focus group discussions and field visits with stakeholders were organized.
- A three-week biophysical data collection campaign held in August 2016 in which local stakeholders were involved.
- Four Catchment Stakeholder Forums (May 2016, September 2016, November 2016 and March 2017).
- Two Catchment Management Committee meetings (November 2016 and February 2017).

2.3 Water resources assessment (Step 2.1)

The water resources assessment started with a review of existing reports and maps on the basic catchment characteristics and the water resources of the catchment which resulted in an (internal) desk study report, the preparation of thematic maps and the printing of basic remote sensing imagery. These first products provided a basic understanding of the context. This preliminary database was complemented with data gathered during field surveys on the catchment's geology, soil, water resources, land use and land cover, biodiversity, and its main challenges. The main tools employed for this assessment were screening formats for water resources and soil erosion, formats for secondary data retrieval, and field observation reporting formats. Finally, geo-information systems (GIS) analysis, hydrological modelling and statistical analysis were performed to assess soil erosion processes, make an inventory of the water infrastructure, map the water resource base, determine water demand and estimate the water balance. Feedback loops and iterations were built into these analyses to ensure that the required level of detail was achieved and that no elements were over-looked.

2.4 Strategic social and environmental assessment (Step 2.3)

The SSEA has been a participatory process that sought to strengthen the integration of socio-economic and ecological aspects of water resource management by:

- Describing the relevant external and in-situ factors influencing water resource use within the Lokere Catchment.
- Ensuring integration of stakeholders' and wider public socio-economic and environmental perspectives including measures to address issues and their causes into the Catchment Management Plan (CMP).

- Identifying and mapping out specific habitats, natural resources and land use zones that should be conserved to ensure survival of the fragile ecosystem.

The assessment involved desk studies, field data collection (focus group discussions and key informant interviews) and surveys. It aimed at analysing all social and environmental issues associated with catchment hazards in Lokere to inform the selection of environmental and social priorities and to assist in developing options and scenarios for the future in order to protect and conserve the water resources.

2.5 Options and scenarios (Step 4)

The options and scenarios phase elaborated on interventions (i.e. the options) that respond to the issues (i.e. the challenges) happening or projected to happen in the catchment, considering the capacities and interests of the stakeholders. A long list of options was developed using input from:

- A literature review.
- The Water Resources Assessment, Stakeholder Assessment and Strategic Social and Environmental Assessment.
- Field visits to identified hotspot sites and district offices, which included a landscape assessment, focus group discussions and a capacity assessment.
- CSFs which provided a platform to discuss issues, develop a vision and objectives for the catchment, and propose options for an enhanced management of water and related resources.

The project team verified the issues and options with stakeholders during a three-week field visit and the September and November CSFs. Stakeholders appraised and prioritized the options using an assessment framework. Scenarios were developed. The analysis integrated the options appraisal by stakeholders, expert judgement, and the impact on the water balance using hydrological modelling tools.

2.6 Catchment Management Plan and Implementation Plan (Step 5)

This final step focused on the integration of the results of previous steps in the underlying policy document, and consisted of two major stages:

- Summary, visualization, pooling and integration of key data, findings and recommendations from policy review (inception phase), stakeholder analysis, water resources analysis, strategic social and environmental assessment and option and scenario analysis as well as the results of the different stakeholder workshops.
- Elaboration of the catchment management and implementation plan.

2.7 Piloting IWRM measures

Three local NGOs experienced in the implementation of climate resilient livelihoods and IWRM measures were part of the Catchment Management Planning Team for Lokere Catchment. As part of the planning process a number of no-regret IWRM-interventions was implemented in Kaabong, Kotido, Amuria and Katakwi Districts by these local partners (Caritas Kotido for Kotido and Kaabong, Socadido for Amuria and TPO Uganda for Katakwi) in order to pilot measures for further uptake in the CMP. Ideally the Catchment Management Plan guides the selection and location of measures. With the CMP still under development, these pilot projects were selected, designed and built on existing local knowledge and quick scans by the technical partners.

The following interventions were piloted as no-regret measures:

1. On restoration and management of vulnerable ecosystems:
   - Support the participatory development of wetland management plans and ensure the restoration and demarcation of depleted wetlands.
   - Facilitate the adoption and enforcement of controlled grazing in riverine areas.
2. On agroforestry systems:
   - Establish community managed tree nurseries, creation of wood lots, live fencing and promote planting.

- Promote, provide training and enable access to information on alternative sources of energy and promote the adoption of energy saving practices/tools (in combination with sensitisation on the negative effects of uncontrolled bush burning and charcoal production).
- Introduce / promote practices that allow regeneration of natural vegetation.

3. On increased resilience to climate change impacts such as drought and floods:
   - Alternative livelihood activities for vulnerable communities or communities living in hot spot areas such as wetlands.
   - Promote 3R interventions (Recharge, Retention and Reuse) in flood prone areas of selected sites.

With the implementation of these no-regret measures the project reached out to a total of 20.455 direct beneficiaries as specified in Table 2. The experiences from the no-regret IWRM measures have been used in the selection and design of the interventions included in the CMP. A full overview of the success rate of the measures is included in Annex A.

TABLE 2: BENEFICIARIES OF THE NO-REGRET IWRM MEASURES

District	Partner	Direct beneficiaries	Indirect beneficiaries
Kotido / Kaabong	Caritas Kotido	14.441	24.120
Katakwi	TPO Uganda	2.500	15.000
Amuria	Socadido	3.514	5.500
Total		**20.455**	**44.620**

3. POLICY, LEGAL AND INSTITUTIONAL CONTEXT

The sustainable management of the water resources is not limited to the physical management, but also incorporates the institutional framework of legislation, policies, economic tools and the institutions and stakeholders involved in the management, regulation and utilisation of water resources.

Water is only one ingredient in the development equation. Many other factors also have to be in place if the provision of water is to have its full beneficial impact on society. Whilst water is essential to livelihoods, and always provides for subsistence and survival, it will not direct or drive economic development on its own. Even in the case of irrigated agriculture, water must be seen as providing for one of the needs in agricultural production; it will not on its own drive that agricultural development. Roads, access, power, markets, and institutional support are all part of an economic climate that needs to be supported by the provision of appropriate water supply.

A strong cooperative approach between role-players and especially governmental institutions is, therefore, essential to work together within their respective legislative and policy mandates to promote the approach to IWRM and to ensure the best economic, social and environmental development.

3.1 Legislative and policy framework

A synopsis of the legal context under which IWRM is implemented and managed is provided by:

- ***Constitution of the Republic of Uganda (1995):*** The State is required to adopt an integrated and coordinated planning approach, to ensure balanced development between different areas of Uganda and between the rural and urban areas, to protect important natural resources including land, water, wetlands, minerals, oil, fauna and flora, and endeavour to fulfil the fundamental rights of all Ugandans of social justice and economic development.

  The State is further required to promote sustainable development and public awareness of the need to manage land, air, water resources as well as the use of natural resources, in a balanced and sustainable manner for the present and future generations. Through the above the Constitution sets the scene for Integrated Water Resource Management.

- ***The Water Action Plan (1995):*** The IWRM approach has influenced the water policy in Uganda, and the Water Action Plan was based on this. It has furthermore informed the Water Act Cap 152 (1997) and the Water Policy (1999). Implementation of IWRM at the catchment level was also recommended in the Water Sector Reform Study (2005) and the Joint Sector Review (2006).

- ***The 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:
  - To promote the rational management and use of the water resources of Uganda;
  - To promote the provision of a clean, safe and sufficient supply of water for domestic purposes;
  - 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 and fauna and recreation in ways which minimise damage to the environment; and
  - 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.

  The Act is based on the principles of IWRM and advocates the involvement of all stakeholders in planning for the utilisation, development and management of water resources. It addresses cross-sectoral interests in water resources and roles to be shared among stakeholders (financial and technical), including the essential role of women in the provision, management and safeguarding of water.

- ***The 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. (DWRM, MWE, 2012).

  According to the National Water Policy and the Water Act Cap 152, the responsibilities to provide water services and to maintain facilities were devolved to local councils in districts and urban centres. 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 non-Government organisations (NGOs) 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 form synergies with the Water Policy in the way they reiterate the principles of IWRM. Policies include:

  - **The National Gender Policy of 1999**, which recognises women and children as the 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; and
  - **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.

  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 that communities can actively participate in the development and maintenance of water sources within the Awoja Catchment.

- ***National Policy for the Conservation and Management of Wetland Resources (1995):*** This policy is aimed at restricting the continued loss of wetlands and their associated resources, calling 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; and
  - 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.

- ***The 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."
  Section 34 of the Act deals specifically with limitations in the use of rivers and lake systems and aims 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, which 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)*, the *Forest Act (1947)* and the *Cattle Grazing Act (1945)* provides a good basis for restoration, protection and management of vegetative cover in hilly and mountainous areas.

3.2 Institutional framework for WRM

3.2.1 National level

The Ministry of Water and Environment (MWE) is the lead agency for formulating national water and sanitation policies, coordinating and regulating the sector. It is nationally mandated to formulate policies for all aspects of water resources management and development. It is responsible for setting the standards to manage and regulate all water resource developments, to determine priorities for water development and management as well as for monitoring and evaluation of all the sector development programmes. The Ministry of Water and Environment is divided into three directorates as shown in Figure 3.

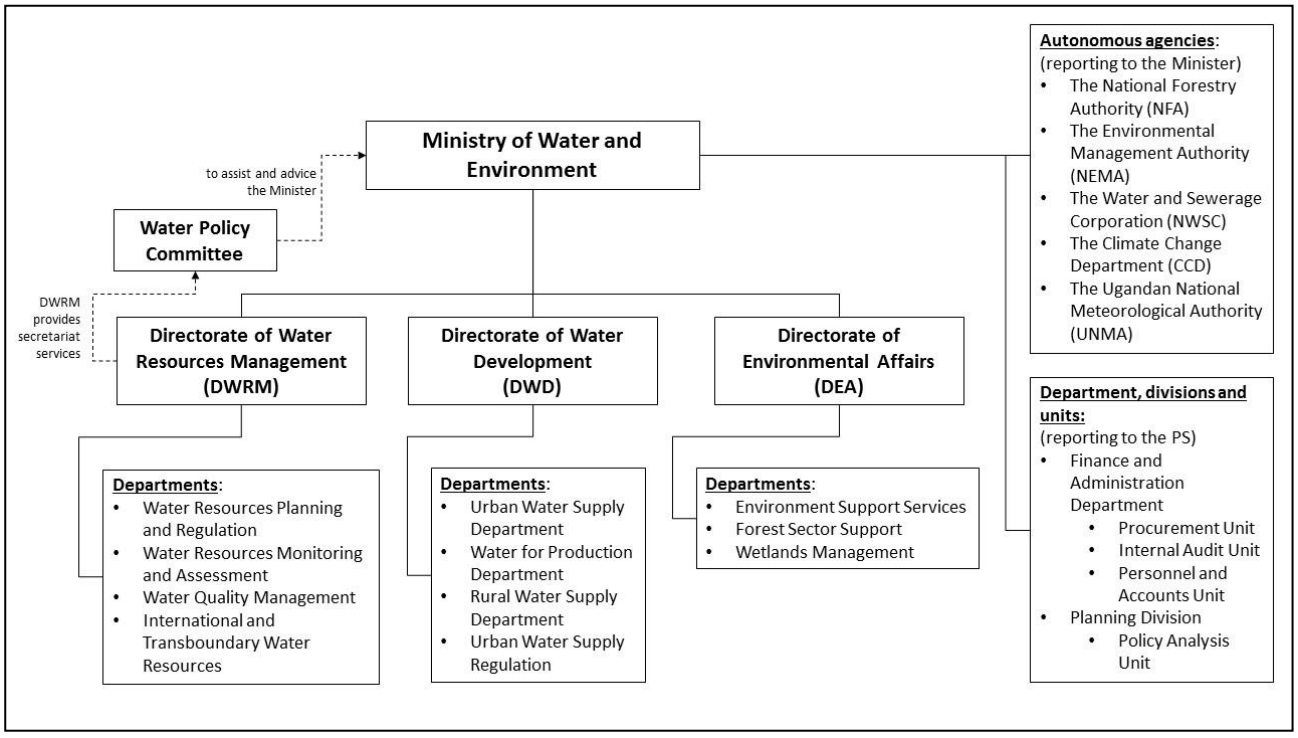


Figure 3: Structure of the Ministry of Water and Environment (adopted from www.mwe.go.ug)

The Directorate of Water Resource Management (DWRM) has responsibility for the development, maintenance and support of enforcement of national water laws, policies and regulations. In addition, it manages, regulates and monitors national water resources through issuance of water use permits, abstraction and wastewater discharge permits. DWRM is the lead in developing the agenda for CBWRM and coordinates the deconcentrated units (water management zones). It consists of four departments namely Monitoring and Assessment, Planning and Regulation, Water Quality as well as Transboundary and International Water Resources Management.

The Directorate of Water Development (DWD) has the responsibility for providing overall technical oversight for the planning, implementation and supervision of the delivery of urban and rural water and sanitation services across the country, including water for production. It is responsible for the regulation of the provision of water supply and sanitation and the provision of capacity development and other support services to local governments, private operators and other service providers. The Directorate comprises of three Departments: Rural Water Supply and Sanitation, Urban Water Supply and Sanitation and Water for Production.

DEA is responsible for environmental policy, regulation, coordination, inspection, supervision and monitoring of the environment and natural resources as well as the restoration of degraded ecosystems and mitigating and adapting to climate change. DEA comprises of three departments: Environmental Support Services (DESS), Forestry Sector Support

Department (FSSD) and Wetlands Management (WMD). The fourth department, the Department of Meteorology (DOM) has recently been turned into an autonomous authority, the Ugandan National Meteorological Authority (UNMA).

The MWE further works closely with the National Environment Management Authority (NEMA) mandated with the coordination, monitoring, regulation and supervision of environmental management, the National Water and Sewerage Corporation (NWSC), with the mandate to operate and provide water and sewerage services in the larger urban centres, and the National Forest Authority (NFA), whose mandate is to manage Central Forest Reserves and to supply high quality forestry-related products and services.

Other national entities significantly impacted by technical water management issues are the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), the Ministry of Tourism and Industry (MTI) and the Ministry of Energy and Mineral Development (MEMD). The Ministry of Education and Sports (MES) is responsible for the implementation of Water and Sanitation in Schools, and the Ministry of Health (MOH) is responsible for sanitation via the environmental health department. The Ministry of Local Government (MLG) oversees the implementation of Local Government Development Plans, which include water supply and programmes for the improvement of hygiene and sanitation in institutions and public places.

The Water Policy Committee, which is composed of directors of some of the above mentioned key institutions (MWE, NEMA, MAAIF, MTI, MEMD, MLG and NWSC), enables high-level and strategic dialogue specifically in the water sector.

3.2.2 Regional level

As a result of the deconcentration of the management of water resources, DWRM created four Water Management Zones (WMZ) following hydrological boundaries. They operate on regional level with the objective to bring 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.

On regional level 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.

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

Umbrella Organizations (UO) are also regional organisations constituted as associations of the local Water Supply and Sanitation Boards (WSSBs) 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).

DWD has further deployed staff from its Department of Water for Production to the regions while DEA has also established offices for its Wetlands Department on regional level.

These deconcentrated units in the regions are based together for improved cooperation and integration and represent the MWE on regional level.

3.2.3 Catchment level

During the catchment management planning process an institutional framework has to be created which brings the stakeholders together to present and exchange their views and thus gives the process legitimacy. Hence, the WMZ

establishes Catchment Management Organisations (CMOs) which builds on and utilizes to the maximum practicable extent existing structures and relationships. The CMOs consists of several bodies (Figure 4):

- 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 organizations, 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.

There is fourth body, not included in the figure, but described in Uganda Catchment Planning Guidelines 2014, which is the **Catchment Technical Committee (CTC).** It 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, operationalizes and sometimes implements programmes and projects from the plan, and generally ensures that the different districts collaborate to implement the plan. It comprises of technical people from government, NGOs, private sector, development agencies and other relevant organizations in the catchment.

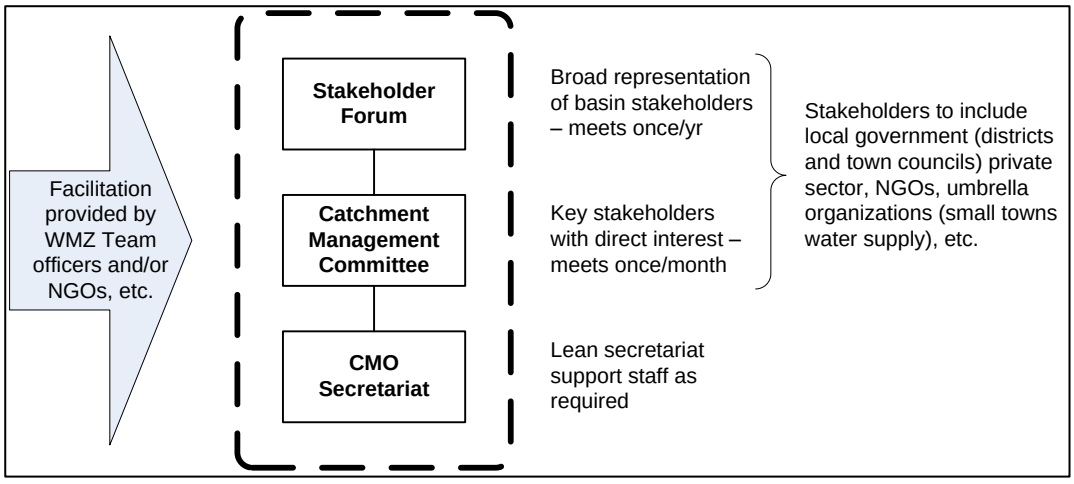


Figure 4: Catchment Management Organisation structure (DWRM 2016)

Other relevant institutions on the catchment level are (for details also see the Stakeholder Characterisation Matrix in the Stakeholder Assessment and Engagement report):

- District Natural Resources Department (sometimes including District Environment Office, District Forestry Office and District Wetlands Office), District Works or Engineering Department under which the District Water Office falls, District Production Department with the District Agricultural Office, District Veterinary Office and District Fisheries Office, District Planning Department, Department of Community Based Services, District Information

Department and District Health Department. However, the structure varies from district to district according to the natural conditions in the district,

- Policies at national level are translated into Sector Development Plans which are implemented at district level under the Decentralization Policy. All districts in Lokere Catchment have 5-year district development plans in which all sector plans are integrated. Natural Resources Management activities are mandated to be implemented by every district government.
- Sub-counties,
- CBOs and CSOs,
- Water User Associations etc.

Additionally, there are a number of private sector and NGOs which also act in the water sector, providing services, advice and facilitation. They work on catchment and regional level or sometimes combine the two.

Many of these NGOs are coordinated at the national level through the Uganda Water and Sanitation NGO Network (UWASNET), an umbrella organisation largely funded by development partners including MWE.

4. STATUS OF THE CATCHMENT

4.1 Location and biophysical context

Lokere Catchment is located in the districts of Kaabong (5.4%), Moroto (32.0%), Kotido (3.8%), Napak (32.9%) and Nakapiripirit (2.2%) in Karamoja Region and Amuria (11.0%), Katakwi (9.5%) and Soroti (3.3%) in Teso Region (Figure 5). Lokere Catchment covers a total area of 8,156 km².

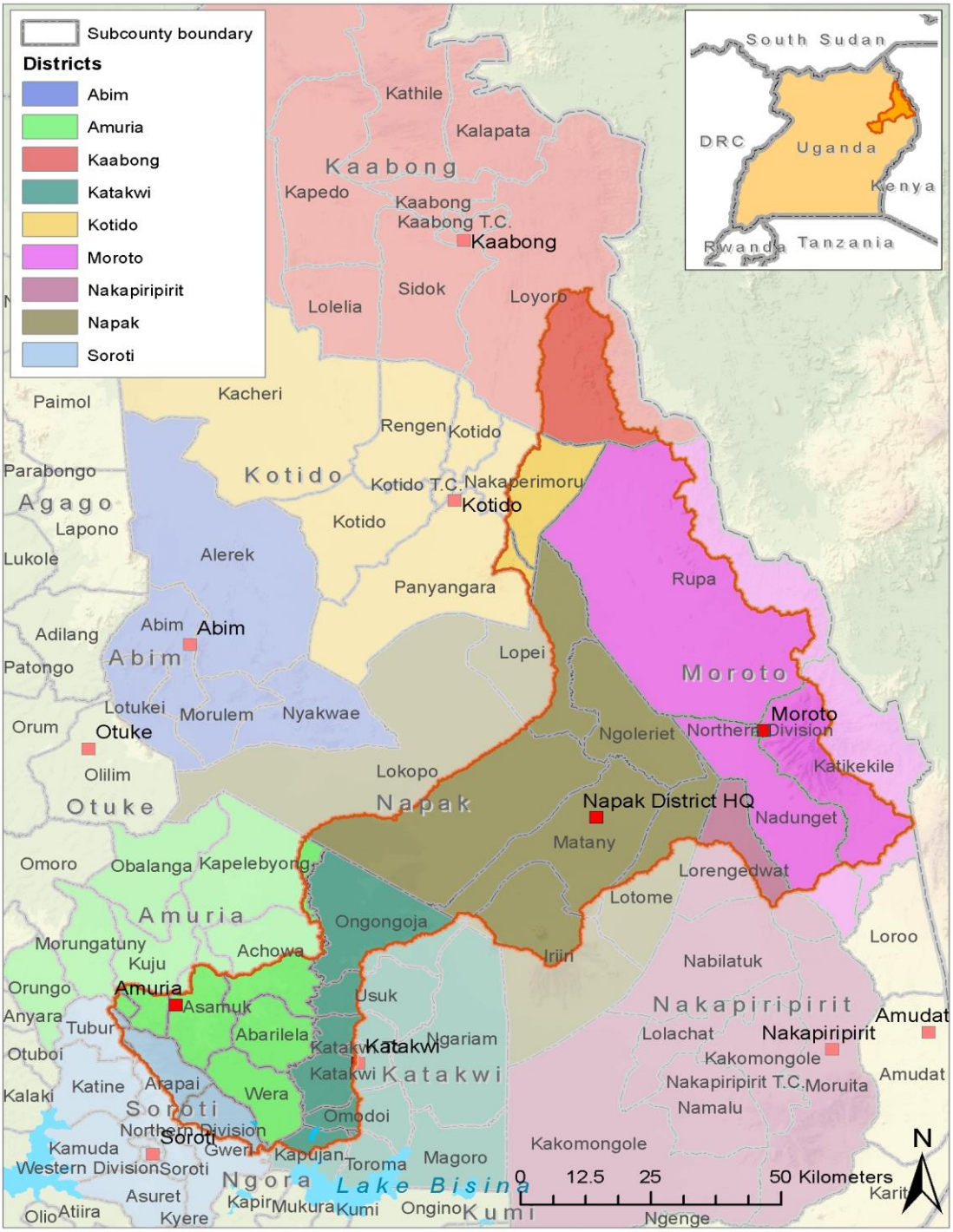


Figure 5: Districts and Sub-Counties in Lokere Catchment

Lokere Catchment is strongly defined by Lokere River (*Okere* in Teso), its tributaries and the downstream wetland complex of Lower Lokere. The catchment is set on a large inland plateau, 400 m ASL (Figure 7). With a height of 3,083 m ASL Mount Moroto is the most noticeable landmark in the catchment. East of Mount Moroto the Rift Valley Escarpment towers over the plains. Also relevant to Lokere Catchment is Mount Napak, which is just over 3,000 m ASL and is located along the southern border of the catchment. Lokere River originates from Mount Moroto, Mount Napak and the rugged peaks at the Kenyan border (Figure 7). Via a dendritic drainage system of seasonal rivers and extensive wetlands, the river flows to the southwest, merging with the waters coming from the Awoja Catchment just east of Lake Bisina. From there, the water flows jointly towards Lake Kyoga in the west.

Upper, Middle and Lower Lokere

In order to address issues related to their location the catchment was mapped into an upper, middle and lower part (Figure 6). The Upper, Middle and Lower parts of the catchment have specific environmental and hydrological characteristics. Upper Lokere is characterized by the highlands of Mount Moroto and the escarpment along the Ugandan-Kenyan border. Middle Lokere extends from Lopei-Lokopo-Matany to the agricultural lands in Katakwi District. Lower Lokere is characterized by the agricultural lands in the districts of Katakwi, Amuria and Soroti.

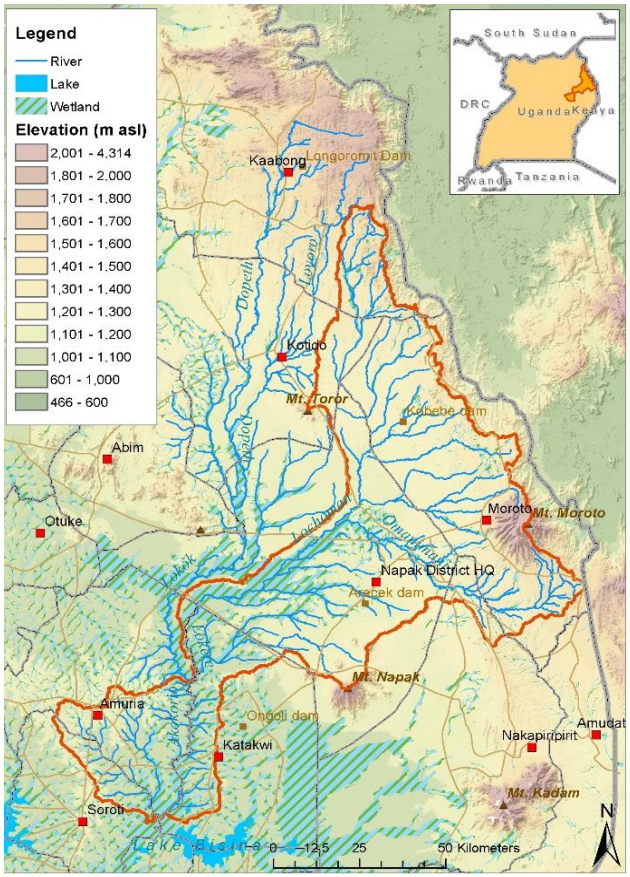


Figure 7: Topographic map of Lokere Catchment

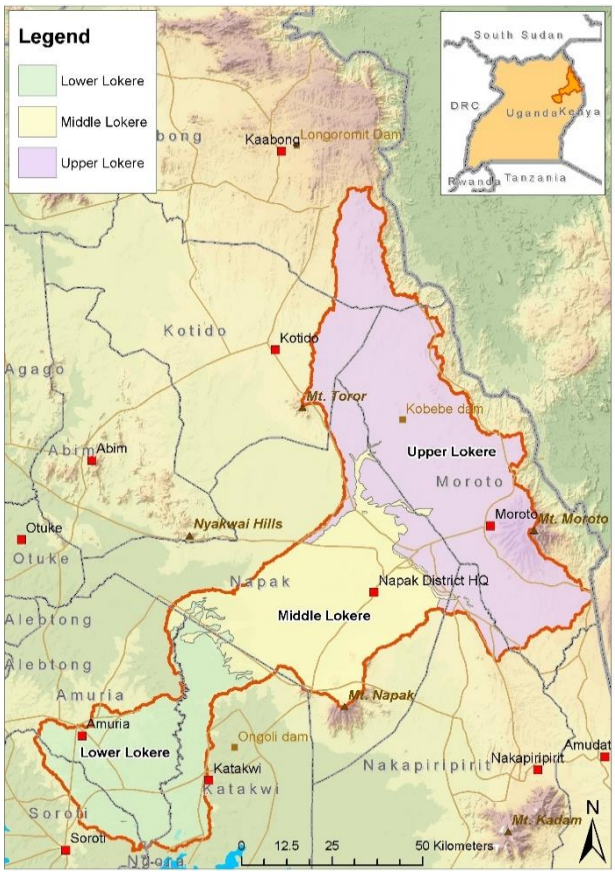


Figure 6: Upper, middle and lower Lokere Catchment

4.1.1 Schematization

To have a good initial understanding of the in- and outflows and the main features of the catchment a simple schematization (Figure 8) was made. The main streams originate in the east and flow south-westwards, along which several tributaries join these rivers. The Lochoman Wetlands dominate the system halfway. After the confluence of Lokok and Lokere the waters flow into an extensive wetland system that joins with the waters coming from the Awoja Catchment. Water for production facilities, such as valley tanks and dams, large piped water supply systems and concentrations of boreholes can be found around Moroto, Katakwi, Amuria and Soroti towns. There are several springs in

the catchment close to Mount Moroto and Mount Napak. Two medium sized dams exist in Lokere Catchment: Kobebe and Arecek. There is one flow gauge in the catchment at Akokorio (Soroti-Katakwi Road)[4].

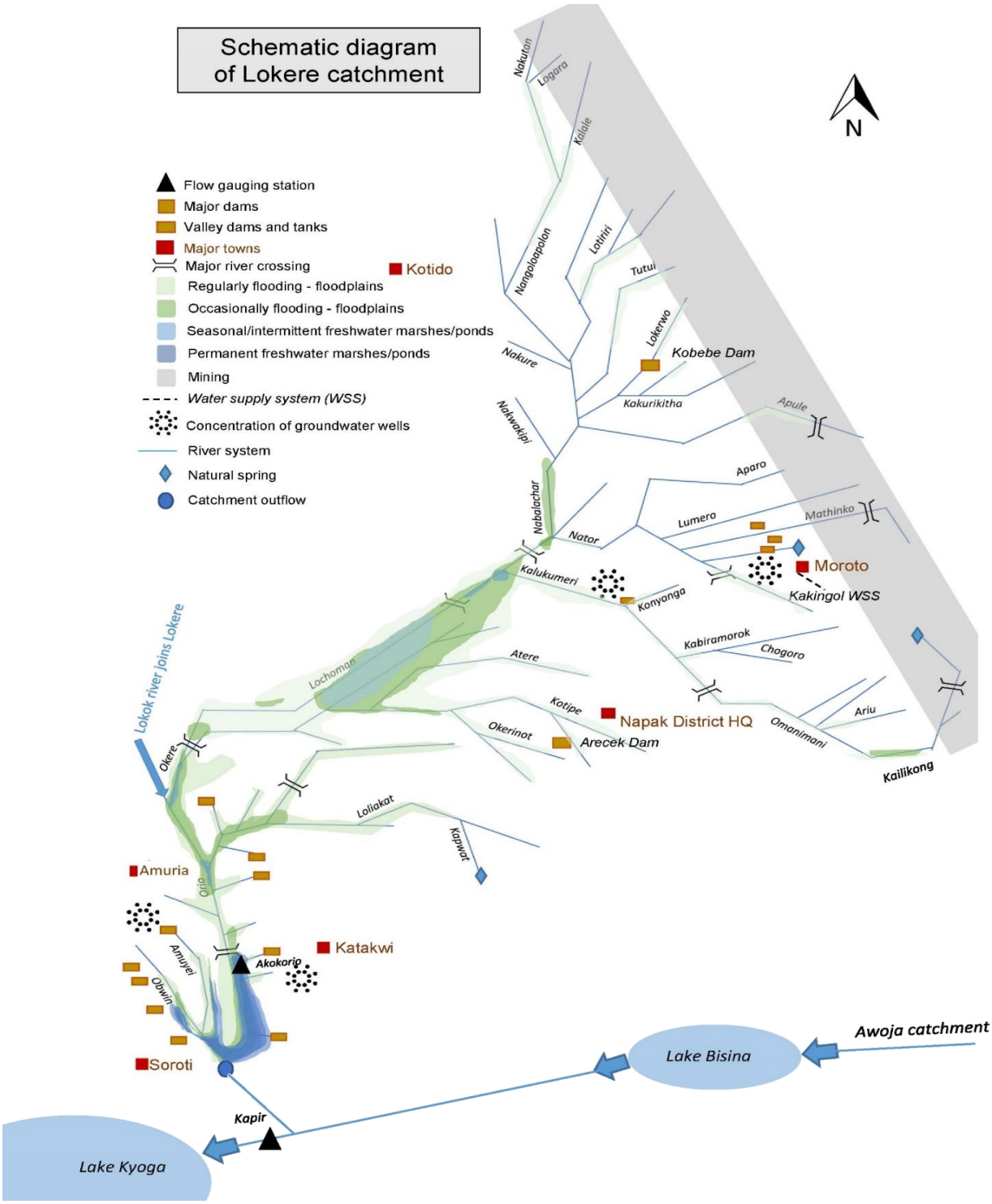


Figure 8: Schematization of Lokere Catchment indicating its main features

[4] There is also a surface water monitoring station after the confluence of Lokere and Awoja Rivers. If more data or a hydrological model is available for Awoja Catchment, this station can be used to support the understanding of the Lokere hydrological system.

4.1.2 Geology and soils

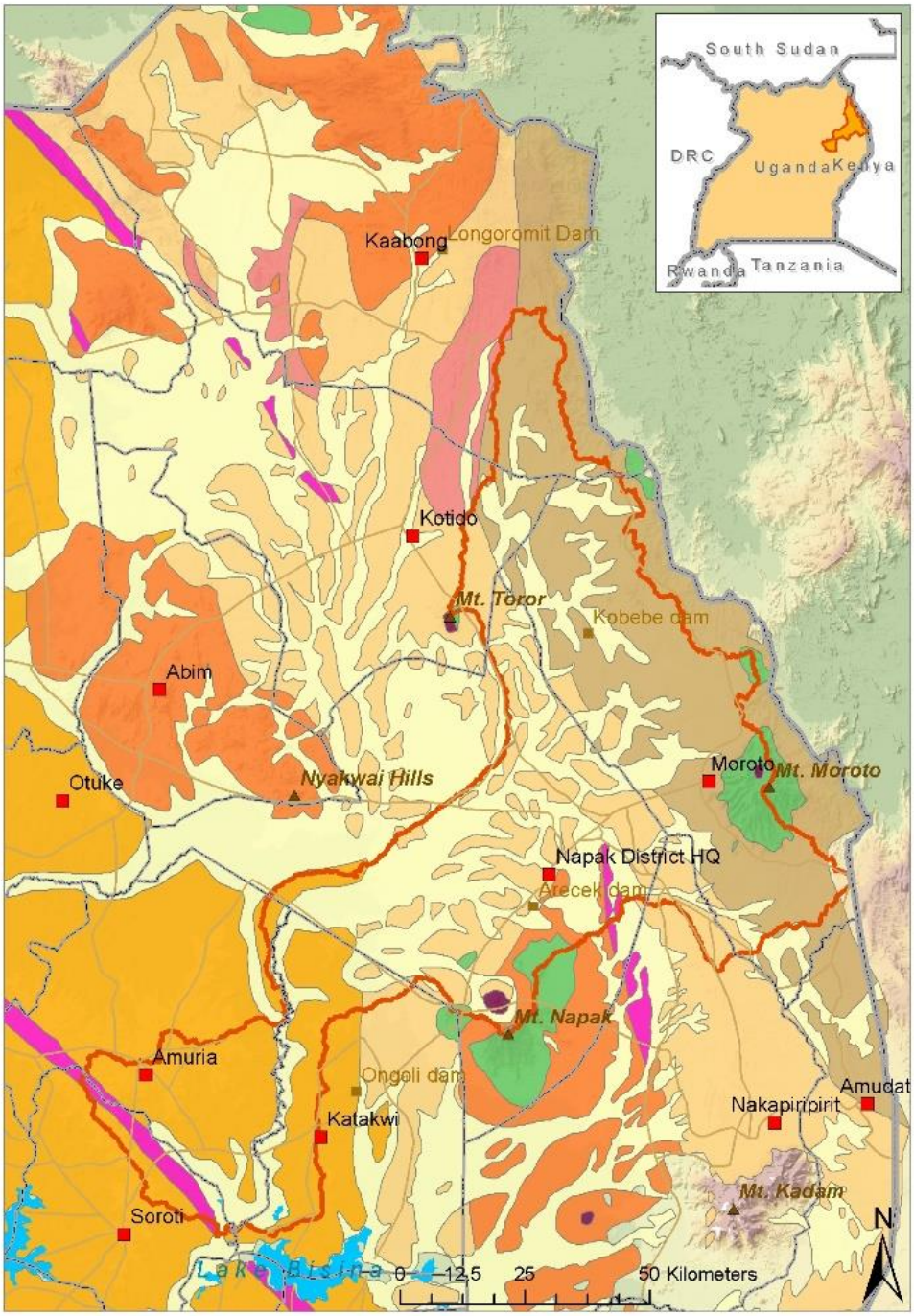
Geologically Lokere Catchment is underlain by Precambrian crystalline basement rocks of the Gneissic Granulitic Complex, which have been modified by high-grade metamorphism, deposition of sediments, volcanic activity and rift faulting (MWE 2013a) (Figure 9). Gneissic Granulitic Complex rocks include granitoids, highly granitized rocks and gneissic formation, which are metamorphic rocks, and facies rocks of acid gneisses, amphibolites, quartzites and marbles. The basement formations are predominantly consolidated with dispersed localized fracturing, which contain little to no water. Groundwater is concentrated in fractured rock and in the topping regolith – a layer of loose material covering solid rock originating from weathering and plant growth in situ.

Mount Moroto, Mount Napak and the smaller mountains along the Ugandan-Kenyan border are tertiary inactive and dormant volcanoes. These outcrops are chiefly characterized by soda-rich agglomerates, lavas and tuffs, while locally eroded remnants of former volcanoes, such as carbonatite rings and syenite complexes, are present. Some of these sediments are of volcanic origin, while others are associated with earlier depositional episodes (MWE 2013a). Groundwater close to these volcanic rocks is known to be high in fluoride.

The river beds and flood plains form a fingered pattern which mainly consists of alluvium, black soils and moraines with inselbergs scattered throughout. Throughout geological time, cycles of erosion have acted upon the land surface. The more resistant lithologies, such as granites and quartzites, are less sensitive to weathering and thus form the outcrops, while the less consolidated materials, including shales and phyllites, around them have been eroded. After uplifting of the Ugandan Plateau in between the eastern and western arms of the East African Rift Valley (Katumwehe et al. 2015), sediments aggraded in the wide drainage channels of the valleys. The lower reaches of Lokere River feature extensive swamps. The dendritic pattern of the tributary drainage is filled with lacustrine deposits and covered with a dense papyrus vegetation (MWE 2013a). These alluvial sediments and flood plains are locally rich in shallow groundwater and provide fertile grounds for crop production.

Cataclistic rocks are metamorphic rocks that have been (partly) deformed by the progressive fracturing associated with fault zones. The long North-West South-East strip is associated with the Amuria Fault Zone (Saalmann et al. 2016). The more local cataclistic features between Napak and Moroto are linked to thrust faults along the granulite facies rocks of the Karasuk Supergroup (Katumwehe et al. 2015). Across Soroti Town, hence just south of Lokere Catchment, runs the steeply dipping 11 km-wide Aswa Shear Zone (Saalman et al. 2016). The drainage system seems to be deviated by the Amuria Fault, which means that possibly groundwater accumulates immediately north of the system.

The soils (Figure 10 and Table 3) in the far eastern highlands, at the border with Kenya, are mostly sandy gravels and red sandy loams (leptosols), all with a notable very low fertility. These soils support little vegetation and are most suitable for extensive (migrant) pastoral activities. At the foothills, on the contrary, highly fertile luvisols can be found. In the large open plains in the upper and middle catchment cambisols – further away from the streams - and vertisols – closer to the streams – alternate. Cambisols are typically well-drained sandy loams, loams and sandy soils, which are among the better soils for crop production (UN FAO, 2009). Vertisols, also known as black cotton soils, are black and grey strongly swelling and shrinking clay soils with wide and deep cracks when dry. Vertisols are very prone to soil erosion (Jones et al. 2013). Young soils formed on volcanic ashes, such as alisols and nitisols, occur in pockets around the extinct volcanoes of Mount Moroto and Mount Napak. Alisols are highly acid, which makes them unsuitable for many types of crop production. Nitisols are to a lesser extent characterized by this acidity, and in combination with their high fertility, better apt for crop production. The lower parts of Lokere Catchment are characterized by fluvial depositions and soils, such as arenosols and plinthosols, which developed in areas of seasonal and permanent waterlogging and are used by the local population, the Teso, for paddy rice cultivation.



Precambrian (Gneissic Granulitic Complex)	Undifferentiated gneisses	Most common metamorphic rock in north-eastern Uganda
	Acid gneisses	Metamorphic rock with a higher proportion of quartz minerals
	Banded gneisses	Metamorphic rock with crystalline laminar inclusions
	Granitoids	Crystalline rock with granite appearance
	Granulite facies	Crystalline rock with large grain inclusions
Tertiary	Volcanic rocks and sediments	Fine grained crystalline rocks and eroded sediments
	Carbonatite and Syenite	Marble-like limestone and crystalline rocks associated with volcanism
Pleistocene - recent	Alluvium, black soils and moraines	Unconsolidated sediments and soils
Other	Cataclasites	Crystalline rock present in large-scale ancient faults

Figure 9: Geological map of Lokere Catchment with a brief description of the different formations (Source: Uganda National Geological Map, ND)

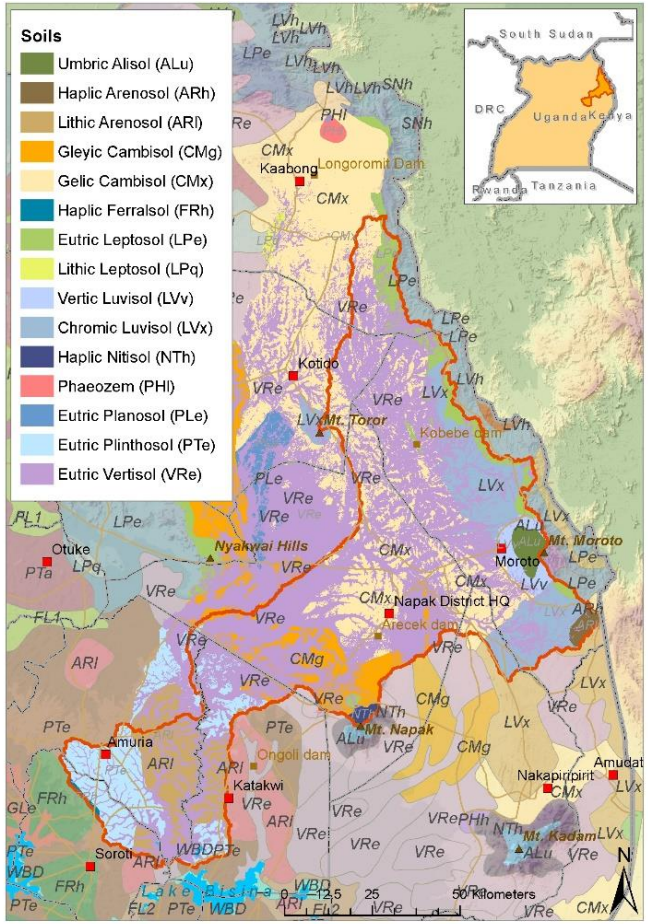
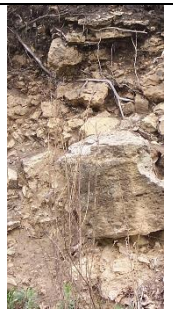


Figure 10: Soil map of Lokere Catchment. Based on the original FAO Soil Classification for Uganda, refined using Landsat Imagery 8 - 2015

Table 3: Characteristics of the main soil types in Lokere Catchment. Description based on the FAO Soil Atlas of Africa (Jones et al. 2013), photographs from ISRIC (2016).

 **Alisols (AL)** have a clay-rich horizon in the subsoil, acid soils, rich in aluminium oxides (often at levels toxic to crops). Suitable for tea production	 **Fluvisols (FL)** are fertile soils, highly suitable for wetland rice production because of the proximity to fresh water	 **Nitisols (NT)** have a well-developed structure with shiny surfaces of clay and iron coatings. Widely used for cropping, but fertilizer application is necessary to make these soils productive
 **Arenosols (AR)** are a result of the in-situ weathering of quartz-rich material. When bare prone to wind erosion. Suitable for crop production, but often irrigation and fertilizer application are recommended	 **Leptosols (LP)** are shallow soils over hard rock or very gravelly material, which have a weak soil structure. Not suitable for crop production.	 **Plinthosols (PT)** accumulate iron and manganese oxides under the influence of fluctuating groundwater. Limited opportunities for agriculture. When still soft plinthite can be cut and used as a building stone
 **Cambisols (CM)** are among the better agricultural soils in Africa, have a nutrient-holding capacity to retain fertilizers	 **Luvisols (LV)** have a well-developed soil structure which contributes to a good water-holding capacity. Highly suitable for crop production.	 **Vertisols (VR)** are clayey soils that exhibit wide cracks which open upon drying and close when wetting. Suitable for cropping but only if the right measures are taken. Very susceptible to erosion and droughts.

4.1.3 Climate

The total average annual rainfall in the Lokere Catchment varies between 550 mm/year in the Upper Lokere and 1,300 mm/year in the Lower Lokere (Figure 11, ARC2 FEWS dataset). The precipitation pattern is classified as bimodal, but is highly variable in space and time, with high peak events and long dry periods. Variance in annual rainfall is highest in the middle parts of the catchment (Figure 11). Lower Lokere is relatively wet, while the Upper Lokere is relatively dry. On average, the short, but intense rainy season runs from April to July, with typically a dry spell at the beginning of June which lasts approximately for two weeks. The long rainy season runs from September till December/January, but is less intense than the short rainy season. In general, precipitation is concentrated in a few rainy days during the rainy season. Stormy events of over 35 mm in a few hours in Upper Lokere and over 50 mm in a few hours in Lower Lokere are common. Annual rainfall on Mount Moroto and Mount Napak is 50 to 150 mm higher than in their immediate surroundings due to rain shadows and orographic influences.

In Upper Lokere the short rainy season (thus after the long dry season) starts on average on the 3rd of April with a standard variation of 23 days. In Lower Lokere it starts almost three weeks earlier, on the 11th of March with a standard variation of 11 days. The uncertainty of these starts, and the difficulty to determine them on that very moment, forms a major constraint to rain-fed crop production, particularly in Upper Lokere.

In Upper Lokere rainfall is so erratic that the long rainy season between September and January is often inexistent (in fact one should then speak about a unimodal rainfall pattern) (Figure 12). Stakeholders indicate that communities in these arid lands do not count on these second rains. If rains come, they are considered as an extra. After the rainy seasons, the hot dry season with strong desert winds takes over. The dry season lasts between 2 to 9 months, depending on the year and the location in the catchment (Figure 13). The long dry season lasts longer the further one moves north in the catchment. As a result of the high rainfall variability Lokere Catchment suffers from acute water shortages during the dry season in the Middle and Upper Catchment and heavy flash floods during the rainy season in Middle and Lower Lokere. During the dry season the Karamojong migrate many kilometres in search of water and pasture for their animals. The uncertainty of rainfall and the difficulty to determine the start of the rainy season at that very moment (is it an incidental shower or the real start) in combination with the inexistence of (supplementary) irrigation schemes limits the possibilities for growing crops that are not tolerant to water stress.

Actual evapotranspiration in Lokere Catchment varies between 300 mm/year in the Central plains around Napak to about 1,400 mm/year on Mount Moroto and is strongly related to land cover, presence of open water, rainfall, temperature and wind (based on MODIS database, refer to the Water Resources Assessment). Stagnant water, for example, results in high evapotranspiration rates above large wetland areas, such as Lower Lokere.

Most climate change models indicate that temperatures, rainfall intensity and frequency of extreme events will increase in Lokere Catchment as a consequence of climate change.

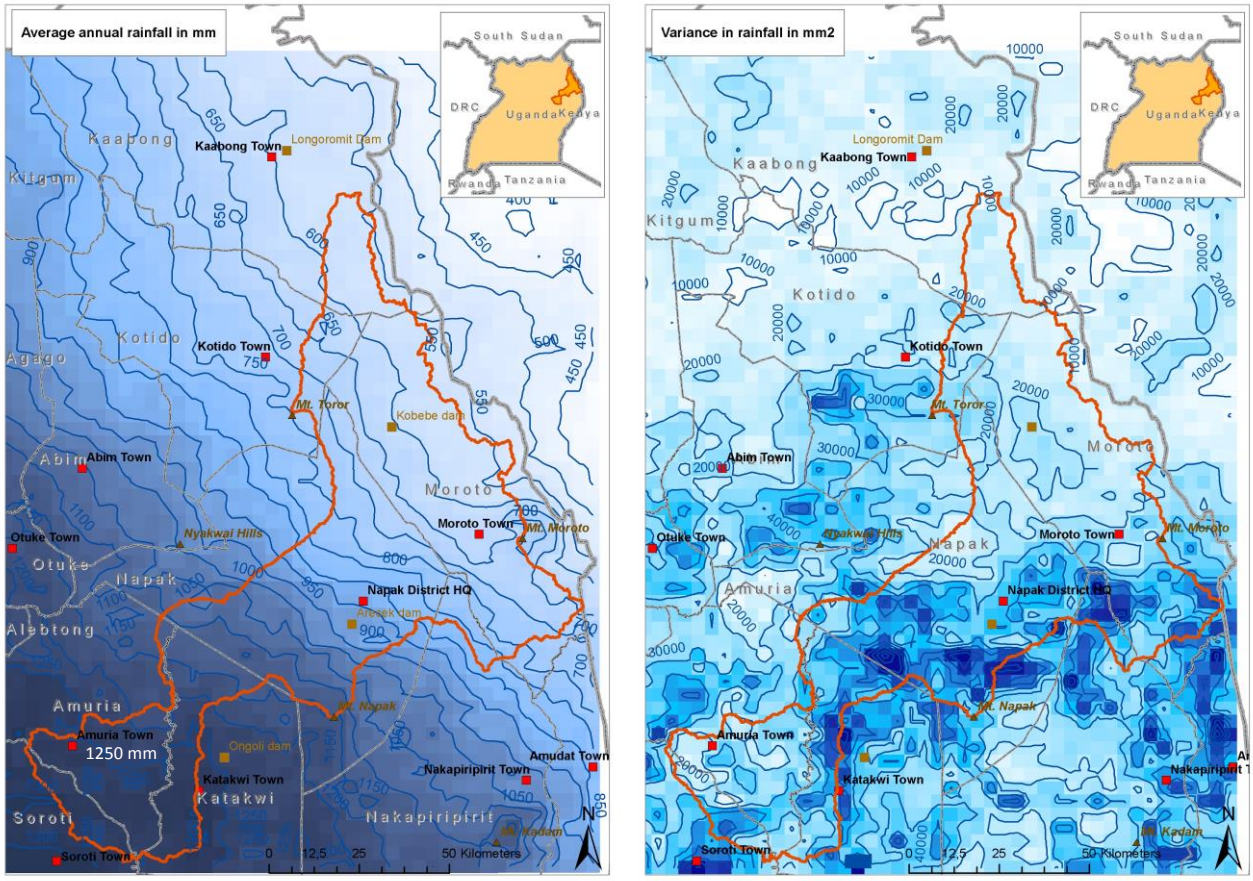


Figure 11: Average annual rainfall in mm (left) and and indication of the annual variability (statistical variance in mm^2) (right). (Data source: EARS Environmental Monitoring 2016).

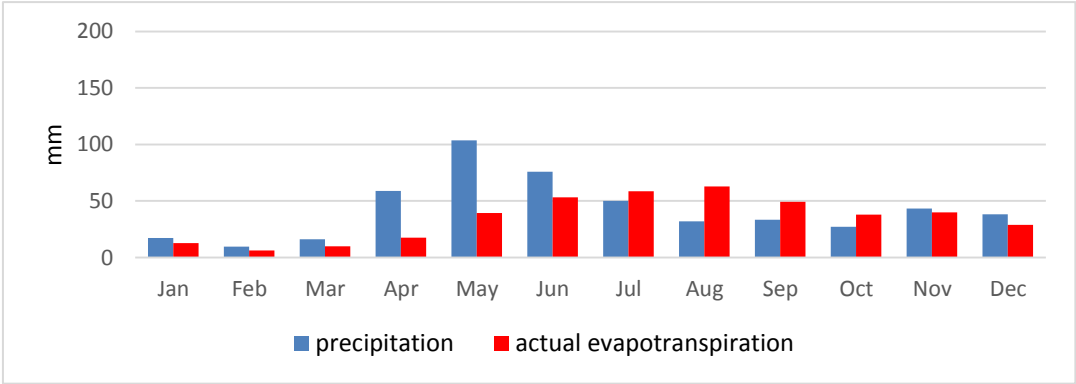


Figure 12: Average rainfall (ARC 2, 1983-2015) and actual evapotranspiration (MODIS, 2000-2014) in Upper Lokere (Matheniko Game Reserve).

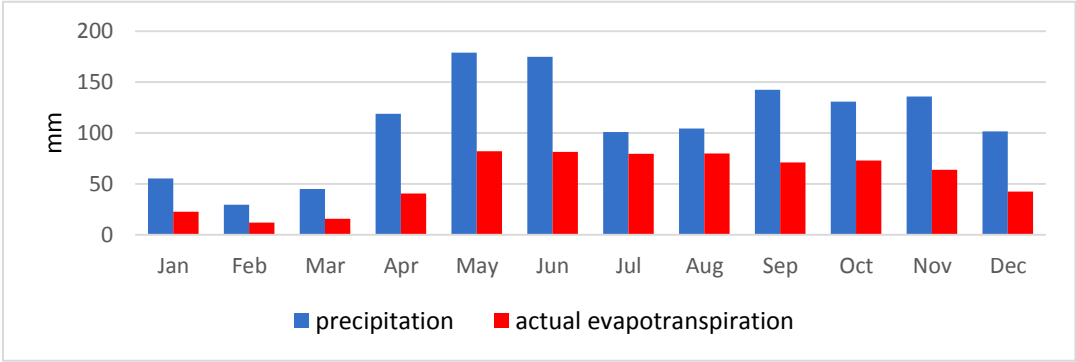


Figure 13: Average rainfall (ARC 2, 1983-2015) and actual evapotranspiration (MODIS, 2000-2014) in Lower Lokere (Arabaka Village).

4.2 Stakeholders

Stakeholder participation is an essential part of Catchment Based Water Resources Management as mentioned above, In this regard an inventory of stakeholders and the power dynamics were developed and the key issues identified. First steps in mobilising the CMO are to understand who should be part of the CMO by analysing a) the relevant government policies, programmes and processes; b) which stakeholders are involved in natural resources management; and c) the key issues for these stakeholders regarding catchment management.

4.2.1 Inventory of stakeholders

For the stakeholder assessment, stakeholders were grouped according to their organisational types. All have a different interest in Catchment Management, different influencing power, different capacities and different challenges to cope with. The full mapping of stakeholders with all these different characteristics is included in the Stakeholder Assessment and Engagement report and provides a snap shot of the current stakeholder spectrum.

- Water users (primary stakeholders): farmers, miners, fishing folk, firewood collectors / charcoal burners, bee keepers, livestock herders, households
- National level government departments
- Government directorates
- Statutory organs
- Zonal institutions
- Local government departments (district offices)
- Political leaders
- Community Based Organisations
- National NGOs
- International NGOs
- International development (funding) partners
- Cultural leaders
- Religious leaders
- Private sector
- Media
- Academia
- Research institutions and learning centres

Chapter 3 already described the direct and indirect involved stakeholders of water resources management at government level including the ministries, directorates, departments, autonomous agencies, statutory bodies and zonal institutions. The Ministry of Water and Environment with its Directorate of Water Resources Management is the owner of the CBWRM process in general and the Kyoga Water Management Zone is the delegated owner of the process for Lokere Catchment. This section focuses on the stakeholders within Lokere Catchment.

The water users are the households, farmers, miners, fishing folk, firewood collectors, livestock herders, bee keepers, etc. As those are ultimately directly or indirectly affected by any actions, the water users are the primary stakeholders for CBWRM. As such they have the highest interest in water resources management, but their influence in catchment management is rather low. Their focus will be rather local. They have a good knowledge of the area. Involving the water users in the catchment management planning process will promote the uptake of their prioritised issues and options and contributes to acceptance of the CMP in the community. When their voices are not heard or they do not have the chance to participate in the planning process, the sustainability of the project outcomes are at risk as changes will not easily be adopted. At the same time, the water users appear to have little technical knowledge of CBWRM and are unaware or ignorant about the environmental laws and policies and their contribution to environmental and water conservation. Livelihood-insecure communities usually fear that any activity relating to environmental conservation leads to their eviction.

The district technical offices as mandated by-law to implement government plans and policies and as representatives of the primary stakeholders have high interest in and high influence on the Catchment Management Planning process. Their priorities are set in District Development Plans. They work along elaborate structures and have sustained financial support. The district technical offices have the knowledge and skills as well as the information base. They are decision makers within their operational area. It is within their task to build capacity of others and to undertake monitoring and evaluation activities. They operate with the political support of the District Councils. Nevertheless, the district technical offices also experience challenges by limited funding and inadequate staffing in the environment and natural resources management departments, which restricts the capacity of the districts to promote sustainable land management and bio-diversity conservation initiatives. Limited resources, inadequate staff and political interference in policy implementation and law enforcement result in poor policy and law enforcement by the districts. There is limited coordination and synergy building between the different government departments. Environment committees at sub-county and parish level are weak. More redundancy is noticed at parish level while these are nearer to communities. Also due to limited funding and inadequate staff, the environment policies lack popularisation at community level.

The political leaders include the LC5s, LC3s, LC1s and the RDCs. As political leaders their influence is high, though their interest in CBWRM appears to be limited. They have the mandate to approve (or disapprove) the implementation of projects by (i)NGOs in the district as well as to direct all projects and organizations to comply with District Development Plans through signing of MOUs. They approve development plans and budgets. The LC5s monitor service delivery by the district technical staff. They can mobilize the primary stakeholders and they can influence the success or failure of a project in the district. At the same time, they have limited technical capacity in most of the development themes. Political leaders usually participate in any project and expect benefits or financial returns, which are usually high. When their expectations are not met, they have the tendency to turn against the project.

Several Community Based Organisations (CBOs) are active in Lokere Catchment, collaborating on and representing shared interests in water infrastructure, environmental conservation, agriculture, livestock, fishery, mining, financial services, or livelihoods in general. Lokere also hosts several NGOs working on livelihoods, WASH, energy, disaster risk reduction, climate change adaptation, environmental conservation, rangeland management and peace building. As representatives of water users their interest in catchment management should be high, nevertheless their understanding of IWRM, including catchment based planning and implementation, national environmental policies and laws, is rather low. Also their influencing power is low compared to the decision makers. The local organisations have good knowledge of the context and have a wide coverage. The organisations focus on community development and have a lot of respect in the communities. The organisations have a wide social network. In their set-up, they have low operational costs. Since they have a long-term or permanent existence, they can play a big role in the sustainability of a project. On the other hand, integration of natural resources management / environment into their activities is not their priority. Most CBOs and NGOs have short funding periods not capable of yielding impact to communities coupled with limited resource mobilization skills. Their accountability of resources used, is poor. Their geographical scope in implementation of projects is limited to their direct surroundings. They may suffer from the so-called founder syndrome.

Another group which is close to the water users are the cultural leaders (community elders). The elders are highly respected and regarded credible. As promotors of culture, they can support or lead cultural and attitudinal change. Cultural institutions play an active role in conflict resolution on land and border conflicts. They have wide structures for information dissemination and mobilization. Their success in work is based on strong community cultural beliefs and values. They can determine the success or failure of a project especially in Karamoja. On the other hand, the cultural institutions are not supported by policies and legal frameworks and their roles are not consistent with formal laws and policies. Some of their activities conflict with policies and government development frameworks. For example, in Karamoja the traditional leaders believe that drought and destruction of the ecosystem is caused by the disappearance of God during violent conflict times and that to restore the environment they should make sacrifices in the shrines for God to come back. Furthermore, they have limited knowledge on CBWRM and they have limited skills in project planning and management. Traditional practices are poorly documented. Their activities are limited in scope and limited to building cultural unity, conflict resolution and protection of cultural beliefs and values. They do not contribute to a wider scope of community development.

Religious institutions can be found in Lokere from Catholic, Protestant and Islamic background. They reach out to a large number of people, as they have many followers. The different churches have wide and organized structures, which can be used for sensitization and information dissemination. They are trusted, forge unity and can be used for attitudinal change. They have community focused programmes. However, their programmes are rather exclusive and they do not involve other stakeholders in their programming. They have limited programmatic and community development skills. Additionally, they have restricted knowledge of the national environmental laws and policies, as well as CBWRM. They work in isolation from the government structures. Internal conflicts exist within their religious denominations.

A few research institutions are present in Lokere Catchment, including NARO Nabuin-Zardi and NASSARI. Both provide agricultural advisory services to farmers, NGOs, CBOs and district production departments, they provide farmers with new technologies and information (facts and case studies) from research and they provide farmers with drought resistant seeds for drought mitigation. The research institutions also play an important role in the access to information and technologies regarding climate change adaptation. Furthermore, Makerere University has several relevant departments to support knowledge management and innovation on CBWRM. In general, the influence of these research institutions on CBWRM in the catchment is low and their interest is mainly driven from research perspective. Academics are less involved in practical community development programmes and have a limited presence in the catchment.

Several media companies are active in the catchment. However, they do not have a high interest in CBWRM and natural resources management and they are driven by profit maximisation. On the other hand, their influence is big and they can play a big role in reaching out to communities and information dissemination through news programmes, publications and radio.

Besides the CBOs which have already been described as civil society partners above, the private sector mainly consists of companies active in mining. Their influence in decision making is high because of the economic benefits they bring and because of their high-level connections. Their interest in CBWRM is limited for the same reason of profit making. They have a limited focus on community development work, or even exploit activities against the interest of the communities. They also show little interest in environmental conservation.

Under the development partners one can find the multilateral agencies, institutional donors and international NGOs. Their interest in CBWRM depends on their strategic programmatic objectives and their influence depends on their relationship with district offices or higher government. In general, the development partners provide funding for development and implementation of plans. Quite some development partners work on WASH, IWRM and livelihood programmes. Some provide access to water sources and public works investments like the water and community roads infrastructure. Capacity building is part of their programmes. They have the capacity to carry out vulnerability, capacity and needs analysis as a basis for project development. They have extensive local and international networks, promote research and data collection, documentation and knowledge sharing. Furthermore, a watch dog from civil society they promote transparency and support civil society to fight corruption. Challenges within this stakeholder group include the concentration on specific sectors and geographical areas, duplication of activities, overlap of implementation areas and even competition relating to programme and project impact and visibility in communities. Most of them want to protect their interests in line with the donor regulations. There is more emphasis on social needs at the expense of natural resources management, dictated by the funding priorities of the donors. Additionally, sector coordination is limited and independent planning is not in line with District Plans. These approaches may be conflicting to development (emergency approach versus service delivery, cash for work and participatory development approaches), which confuses communities. The working relationship with the local government departments is not always good, arising from failure to share plans and declare budgets with the DLGs. At last, project periods of international organisations are often short, project indirect costs are high because of international organisational structures.

4.2.2 Power dynamics

An analysis of the interests and influencing power of the different stakeholder groups is visualised in Figure 14. The position in the chart and the extent of the circle (of influence) show their position regarding CBWRM, and thus whether they form strong allies or potential blockers.

The stakeholders positioned in the top right corner with high influence and high interest could be strong allies for CBWRM in Lokere Catchment. The stakeholders with a larger circle would potentially form stronger partners than the others, because of their roles and responsibilities within the catchment and in Uganda.

The stakeholders with high influence and little interest have the potential to be blockers of the catchment management process and it is therefore important to keep them well-informed and lobby towards their support for improved water resources management in collaboration with other stakeholders. The map shows that these stakeholders are all very influential and a strategy for their engagement carefully needs to be rolled out.

The stakeholders with high interest but little influence could become stronger participants in CBWRM through the CMP. However, their capacity in this (e.g. negotiation skills) should be strengthened to become strong discussion partners and collaborators. It is mostly this group of stakeholders (water users) that is highly affected by a lack of proper CBWRM and should develop some strategies to overcome issues they are faced with.

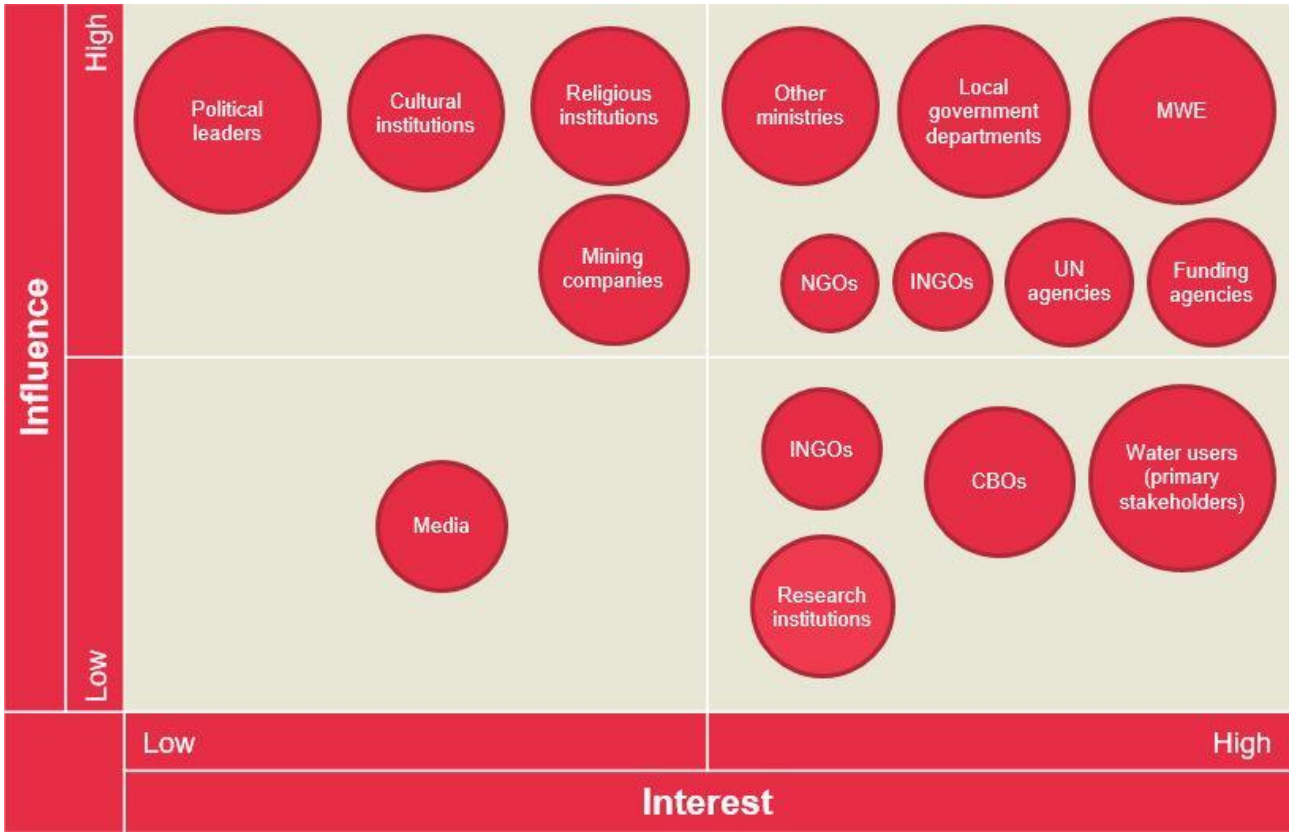


Figure 14: Stakeholder influence / interest map

4.2.3 Issues on stakeholders

The development and implementation of interventions in terms of water for domestic use, sanitation, water for production and natural resources management, for example, are handled by different government institutions.

The district structures have well laid out development plans including natural resources management, but they have capacity gaps in different sectors, as the stakeholder assessment points out. These include, but are not limited to:

- Limited funding to implement sector plans.
- Inadequate staffing in the environment and natural resources management departments, and lack of skilled staff.
- Weak implementation of by-laws, coupled with poor policy and law enforcement by the districts. This is exacerbated by political interference in policy implementation and law enforcement.
- Lack of harmony of structures in all districts e.g. environment committees that are important in implementation and management of interventions are in place in most of the districts in Lokere, but not functional. The district environment planning structures are weak especially at parish level. The parish environmental committees are supposed to sensitize and monitor activities related to environmental protection and conservation, but demand for allowances for their work.
- Inadequate sector coordination to enhance proper participatory and inclusive planning, implementation, monitoring and supervision by partners and government agencies.
- Policies have not been popularized among the different local users and stakeholders in Lokere Catchment. Most of the community members in Lokere confessed ignorance of any policies or laws guiding the use of natural resources in wetlands and on environmental conservation.
- The enforcement of laws especially against wetland encroachment and deforestation has conflicted with the livelihood activities of most of the communities. For example, during most of the FGDs with the communities in the Karamoja Region, they reported that they cut trees for charcoal burning and selling as fuel wood, because of the limited sources of livelihoods. In Karamoja, most of the crop production activities especially in the pastoral zones take place along the river.
- Responsibility (and accountability) for operating and maintaining facilities are not clear. Typical established institutions like a Water User Committee for a reservoir or dam are not functional. The structures are complex, they lack capacity, a sense of ownership, funding and personnel.

- Water users have limited influence on decision making in water resources management and the development of water infrastructure.
- Gender remains a contentious issue. Representation in line with use is not always in place.

The coordination of plans and activities of governmental, non-governmental and knowledge organizations, such as Nabuin ZARDI and the University of Busitema, is poor. The interlinkages between stakeholder engagement, knowledge development, implementation, monitoring and evaluation are not sufficiently integrated in water management. Institutionalization of these concepts and frameworks at all levels is needed to make it effective. Curricula at different levels and of different faculties or courses, from secondary education up to university, currently lack the required attention for the problem-focused and needs-driven holistic approach integrating different water uses (drinking, industry, agriculture, livestock, environment), analytical perspectives (technical, socio-economic, institutional, planning), actors (government, managers, CBOs, users) and geographical areas (up-stream, downstream). Building the recognition and in-depth understating that many water use and management issues are interrelated and thus cannot be solved in isolation, is not sufficiently addressed.

4.3 Water resources

4.3.1 Streams, rivers and wetlands

Lokere Catchment is well drained with a dense network of meandering seasonal rivers and streams (Figure 17). The only permanent streams run in the Mount Moroto Ranges (IIRR 2015), all other rivers and streams are seasonal. They originate in the mountainous areas along the border with Kenya, of which the rivers Nangoloapolon, Apule, Matheniko and Omanimani are the most noticeable. These streams merge into Lockoman River, a major river flowing through seasonal wetlands, which continues as Lokere River until it congregates with Lokok River coming from the north. Downstream of the confluence the river is known as Akokorio and later on as Kapir. The outlet of Lokere Catchment is approximately 5 km upstream of Kapir Bridge (Soroti-Mbale road). The catchment has been sub-divided by MWE into five sub-catchments: Nangoloapolon, Omanimani, Lockoman, Akokorio and Kapir (Figure 18). Sub-catchments allow for the further deconcentration of tasks and responsibilities related to water resources management in the future.

In Upper and Middle Lokere rivers are deeply incised and filled with sand and silt, and the river power index (SPI) is high (Pers. Comm. Dr. Barassa, Makerere University, August 2016). A high SPI reflects steep slopes and large areas draining into the same point in a river. Such characterization often results in a relatively high erosion risk. In Upper Lokere flows cease one to two days after a rainfall event. These low residence times are indicative of the low base flow component in the system. Groundwater inflow to the rivers is minimal. This is consistent with the measured deep groundwater table. Heavy rainfall causes high surface runoff (Gavigan 2013 based on UNDP 1968). According to Gavigan (2008), flow in the Omanimani is exemplary for the “flashy” surface runoff in Upper Lokere. It is very peaky and strongly correlated with the occurrence of rainfall events.

In Lower Lokere flow is strongly dominated by a base flow component. During and after the rainy season, shallow groundwater originating from the wetlands and flood plains (which cover 10.5% of the catchment) feeds the rivers. This flow is sustained for approximately one month after the river flow ceased in the Middle and Upper Lokere. The base flow is topped by local rainfall peaks. In the permanent wetlands water is retained by the underlying low permeability of the clay rich soils (Gavigan 2008).

The annual maximum flow rate varies strongly over the years and is highly location specific. The maximum flow rate of 130 m^3/s at Akokorio Station was measured on 23-08-1975 (Figure 15). Normal yearly peak flow rates during the rainy season remain below 20 to 25 m^3/s (Figure 16). The current monitoring system does not measure the low flow during the dry season.

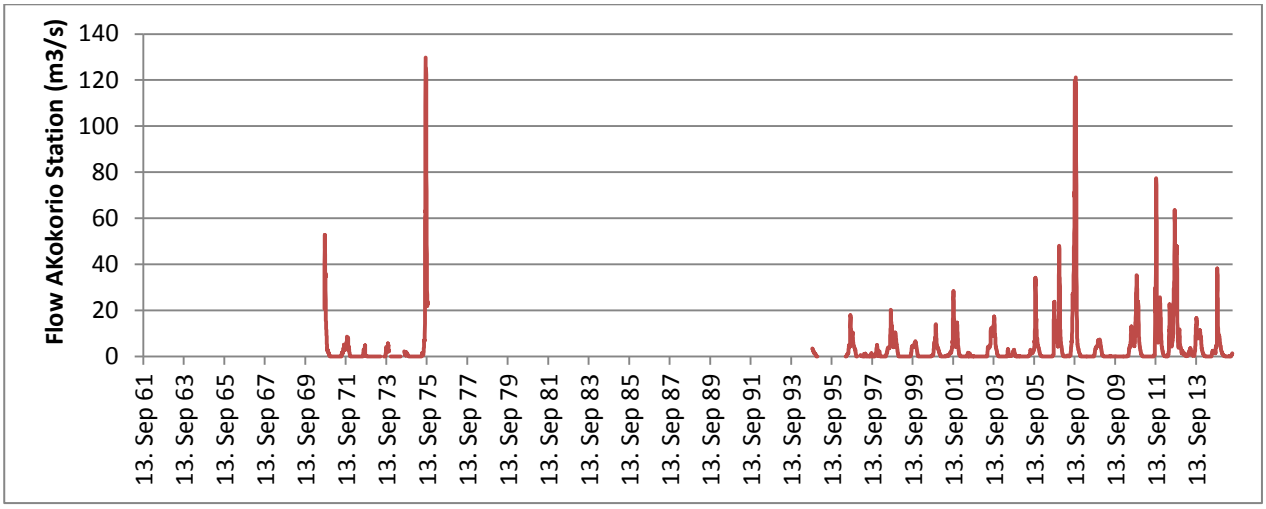


Figure 15: Flow in Lower Lokere at Akokorio Station (Database MWE 2016)

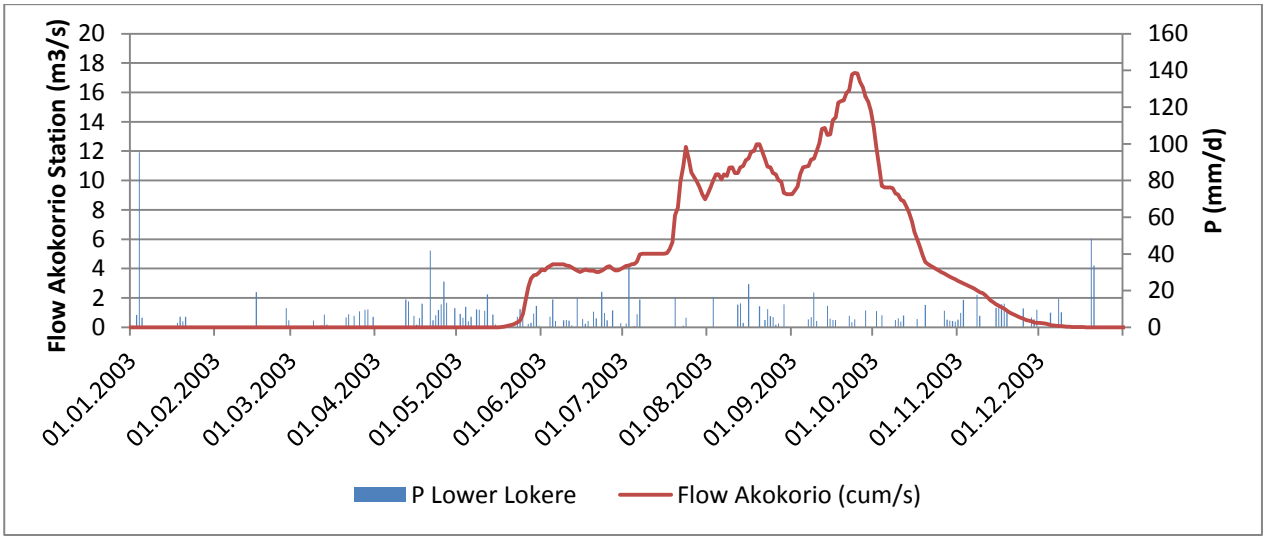


Figure 16: Normal flow conditions in 2002-2003 in Lower Lokere measured at Akokorio Station (Database MWE 2016)

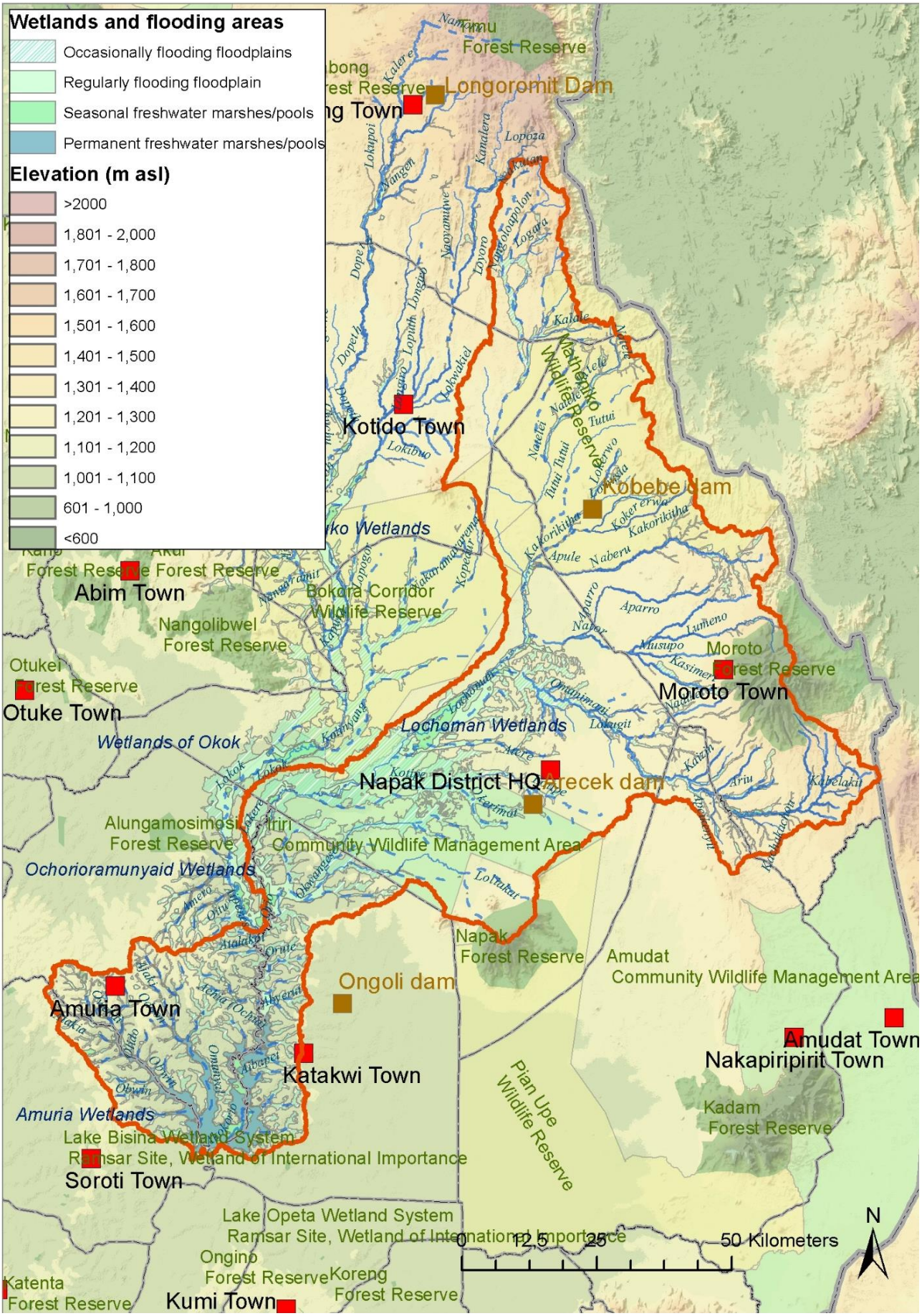


Figure 17: Streams and rivers in Lokere Catchment

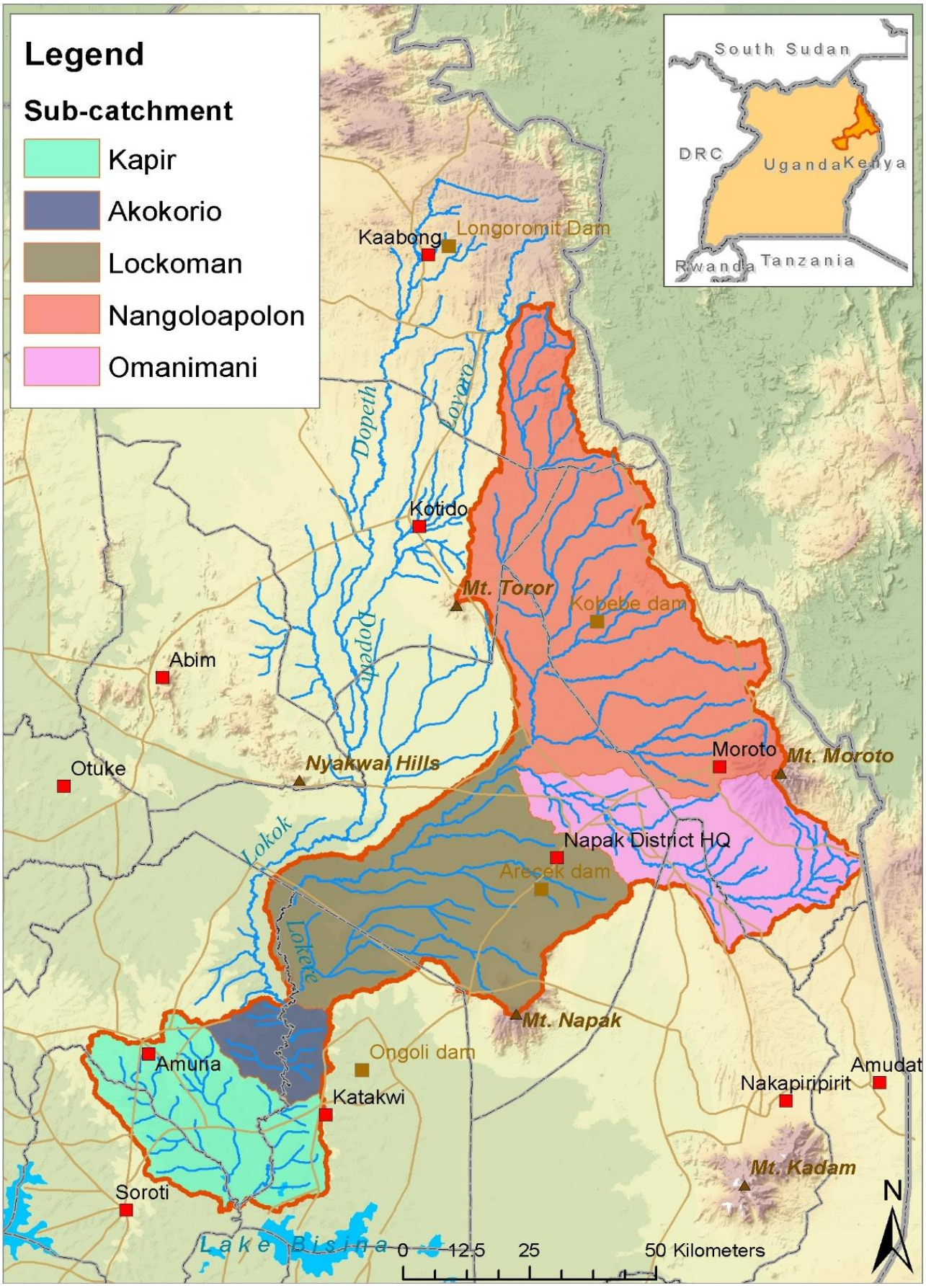


Figure 18: Sub-catchments in Lokere Catchment

4.3.2 Groundwater

Three major geologic environments are relevant to understand the occurrence of groundwater in Lokere Catchment:

- Precambrian basement, including banded and acid gneisses, cataclasites along faults, and highly granitized rocks, which have been modified by high-grade metamorphism and are heavily compacted.
- Rocks and outcrops of volcanic origin, including Toror Hills.
- Sandy river beds, wetlands and flood plains.

Unweathered basement rocks do not hold groundwater. Only the weathered overburden, faults and fractures contain water. Groundwater pockets in basement rocks are highly compartmentalized. The presence and thickness of weathered material, the occurrence of preferential paths for groundwater flow and its specific hydrogeologic characterization are highly variable over short distances, making the potential to host groundwater highly localized. Drilling depths vary between 40 and 120 m and most boreholes yield between 1.0 and 1.5 m^3/h. The transmissivity (T) of the weathered aquifer has been reported to be 2 to 58 m^2/d, but mostly in the lower end of the range (Gavigan, et al. 2009).

Shallow groundwater is present in local overburden aquifers, such as river beds, wetlands and flood plains. Water is abstracted through scoop holes, dug wells and drilled (sometimes manual) wells depending on the depth of the water table. The quality and productivity of shallow groundwater sources is highly dependent on the hydrogeological characteristics of the aquifer. When an impermeable, or less permeable layer is present (thick layer of clay or loam, for example), shallow groundwater wells can be developed as a safe source of water supply. If such protecting layer is not present it is crucial to implement and enforce due measures to protect water quality (source, well and tap protection) and study the groundwater fluctuation characteristics prior to investments.

4.3.3 Water demand

Based on the district development plans safe water coverage in Lokere Catchment varies between 29% in Kaabong and 72% in Soroti, averaging 54%. Water demand is highest around regional growth centres (Moroto, Iriri, Lokopo-Lopei-Matany) and Lower Lokere (Soroti, Amuria and Katakwi districts) and will continue to grow in these areas. To cover current demand an absolute minimum of in total 1.3 Mm^3/year of extra potable water needs to be supplied (Figure 19).

Water demand for livestock is high throughout the catchment, but currently the pressure concentrates in areas with valley tanks and dams, for example around Kobebe and Arecek. Incoming livestock from Turkana and South Sudan aggravates the shortages. Indicative calculations for Lokok and Lokere Catchments[5] indicate that currently there is a combined shortage of 4 Mm^3 of water for livestock in the two catchments in normal years (3-month dry season) and of 28 Mm^3 in extremely dry years (9-month dry season) (Figure 19). Projections indicate that livestock water demand will triplicate by 2040.

Currently -2016- water volumes required for irrigation are negligible. Previous assessments found approximately 14,700 ha suitable for irrigated crop production in Lokere Catchment (based on Volume 1 of the National Irrigation Master Plan for Uganda 2010 – 2035, PEM Consult 2011, see also the Water Resources Assessment). Irrigated citrus, mangos and vegetables with the soils and climate of Lokere Catchment on average need 6,000m^3/ha/year of irrigation water. Making full use of that potential would require 87 Mm^3 of water for irrigation.

Apart from the productive uses it is important to guarantee an environmental flow. To safeguard the functioning of ecosystems in the catchment (e.g. support fish life and wetland vegetation, avoid stagnant waters that may increase the incidence of water related diseases), a minimum amount of water has to be kept flowing through the system. It is estimated that this flow should equal 238 Mm^3/year for Lokere Catchment.

[5] Herders use Lokok and Lokere Catchments as a combined resource when watering livestock. Hence the water demand for livestock calculations were combined.

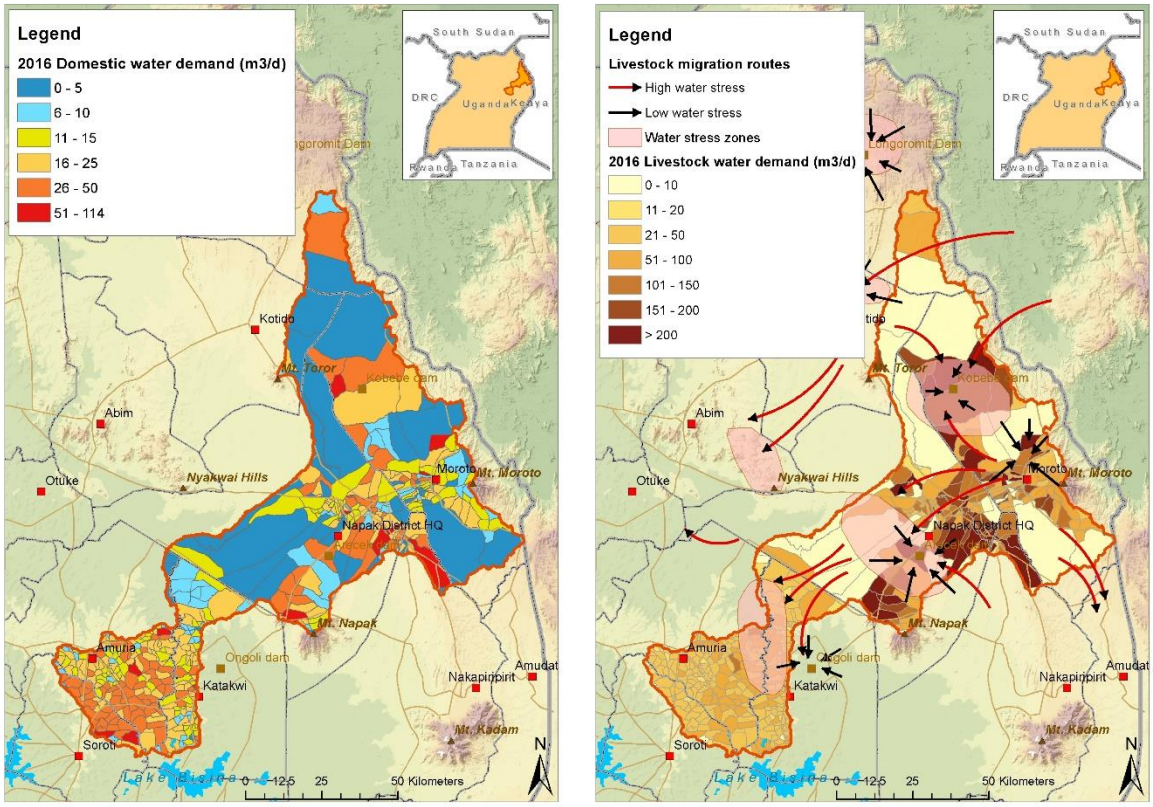


Figure 19: Current - 2016 - domestic (left) and livestock (right) water demand per parish in Lokere Catchment

4.3.4 Water balance

A SWAT hydrological model was run for 30 years (1984-2013), simulating daily time steps, while writing monthly output data for Lokere (and Lokok) Catchment(s). The model output was calibrated with the flow gauge series for Akokorio flow gauging station. SWAT simulations capture the trends and overall hydrological processes, but the model overestimates "normal" flow and underestimates peak flows at Akokorio flow gauging station. Calibration proved challenging, also because it is unclear how reliable the available flow time series is. The results were also compared with the findings by WE Consult (2014) (Karamoja runoff 0-250mm/year), Taylor and Howard (1996) (40% runoff in similar catchments) and Gavigan et al. (2009) (5% total outflow). The modelling experts estimate that average annual rainfall could deviate as much as +/-20% from reality, peak river outflow up to +/-50, and the average annual river outflow +/-30%. Note that all model outputs are combined numbers for Lokok and Lokere since Lokok is a tributary to Lokere at Kapelebyong.

Table 4 provides the average annual water balance for Lokere Catchment. The water balance of Lokok Catchment has an important impact on the water balance of Lower Lokere. On average, 80% of the incoming precipitation leaves the catchment in the form of evapotranspiration. Slightly more than 11% (1190 Mm^3) leaves the catchment in the form of surface outflow. Almost 13.7% of the average annual precipitation is (temporarily) stored in shallow (13%) and deep (0.7%) groundwater aquifers. With 1368 Mm^3 of recharge shallow aquifers are at least as important in terms of storage as wetlands (Table 5). An average of 11.9 Mm^3 per year (9.5+2.4Mm^3) is currently abstracted from the catchment for domestic, livestock and agricultural use, which is only 0.1 % of the incoming precipitation.

TABLE 4: AVERAGE ANNUAL WATER BALANCE IN LOKERE CATCHMENT

	Precipitation	Evapo. and Transpiration	Surface runoff	Shallow aquifer recharge	Deep aquifer recharge	Groundwater abstraction	Surface water abstraction	Surface outflow
mm	766	613	69	100	5.3	0.7	0.2	87
Mm^3	10488	8393	941	1369	73	9.5	2.4	1190
% of P	100	80	9.0	13.0	0.7	0.1	0.0	11.3

TABLE 5: STORAGE CAPACITY OF THE WETLANDS IN LOKERE CATCHMENT

Wetland type	Area (km^2)	Normal flooding storage (Mm^3)	Maximal flooding storage (Mm^3)
Regularly flooding flood plain	482	96	362
Seasonal/intermittent freshwater marshes/pools	160	119	238
Permanent freshwater marshes/pools	182	182	727
Total	823 (6% of the catchment area)	397	1327 (=100 mm rainfall)

The average annual outflow of the catchment equals 1,190 Mm^3, but it varies between 500 Mm^3 and 2,600 Mm^3 (Figure 20 and Figure 21). In general, in Lokere Catchment a higher annual rainfall results in a higher annual discharge and a lower annual rainfall results in a lower discharge, but the relationship is non-linear. Below average rainfall often leads to very low outflows, while above average rainfall results in very high outflows. This effect seems to be strongly linked to the status and the antecedent conditions of the storage systems (i.e. shallow groundwater systems, wetlands, valley tanks and dams) in the catchment. A comparison of the annual outflow (500 Mm^3) in the dry years with the current abstraction rates (11.9 Mm^3) for domestic, livestock and agricultural use shows that in terms of water resources there are ample opportunities to improve water supply. To do so, water needs to be stored in the catchment during the wet season to be used during the dry season.

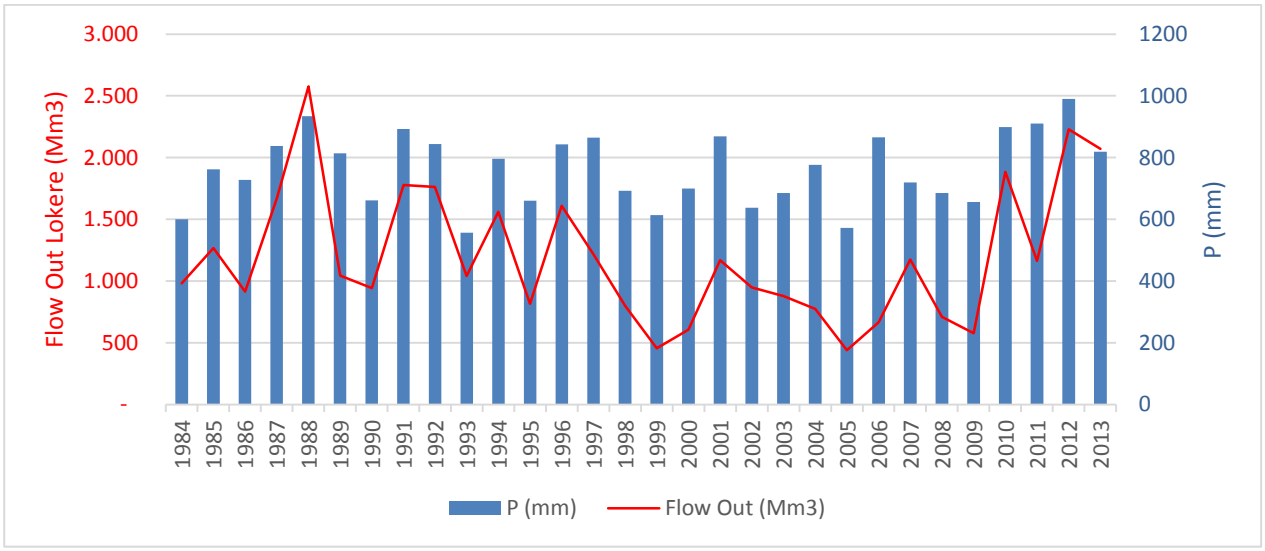
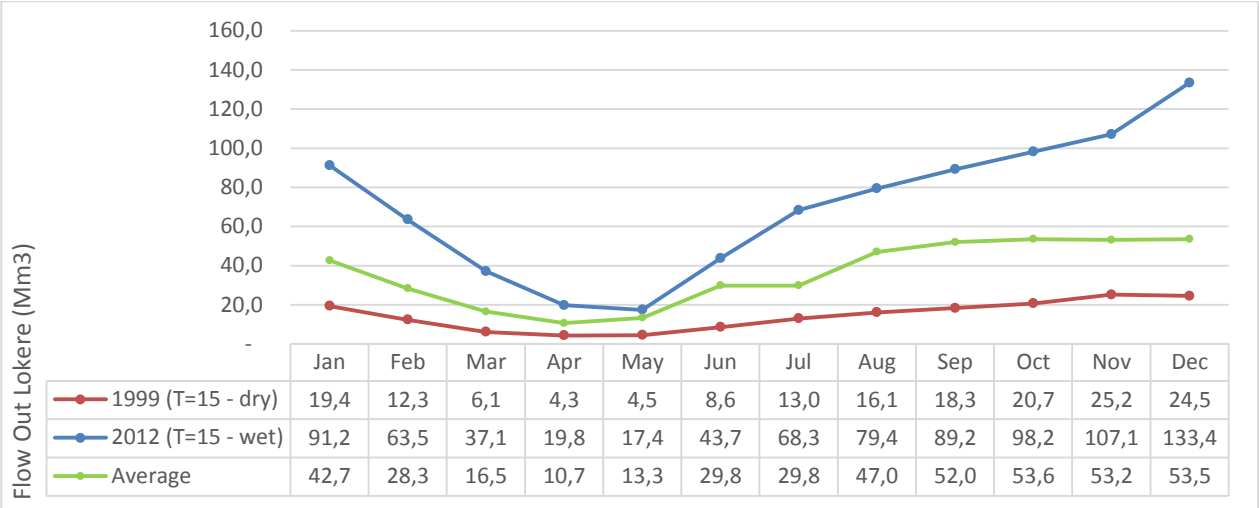


Figure 20: Total annual surface outflow (in million m3) and precipitation (mm) in Lokere Catchment



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999 (T=15 - dry)	19,4	12,3	6,1	4,3	4,5	8,6	13,0	16,1	18,3	20,7	25,2	24,5
2012 (T=15 - wet)	91,2	63,5	37,1	19,8	17,4	43,7	68,3	79,4	89,2	98,2	107,1	133,4
Average	42,7	28,3	16,5	10,7	13,3	29,8	29,8	47,0	52,0	53,6	53,2	53,5

Figure 21: Monthly surface outflow from Lokere Catchment in average, dry and wet years. T=15-dry: A dry year (low rainfall) that has a statistical return period of 15 years. T=15-wet: A wet year (high rainfall) that has a statistical return period of 15 years.

Surface runoff

The average surface runoff of the catchment is 50 mm, which corresponds to a runoff-rainfall ratio of 7%. Runoff-rainfall ratios are, however, highly dependent on the location in the catchment (Figure 22). The highest runoff-rainfall ratios (up to 25%) occur around Lokopo-Lopei-Matany, Iriri and in Lower Lokere. Generally, areas with a higher precipitation and characterized by soils with a limited infiltration capacity have the highest runoff-rainfall ratio. The modelling results, however, show that the impact of land use and land cover is significant. Runoff-rainfall ratios in agricultural areas, e.g. Lokopo-Lopei-Matany, are high compared to the surrounding rangelands.

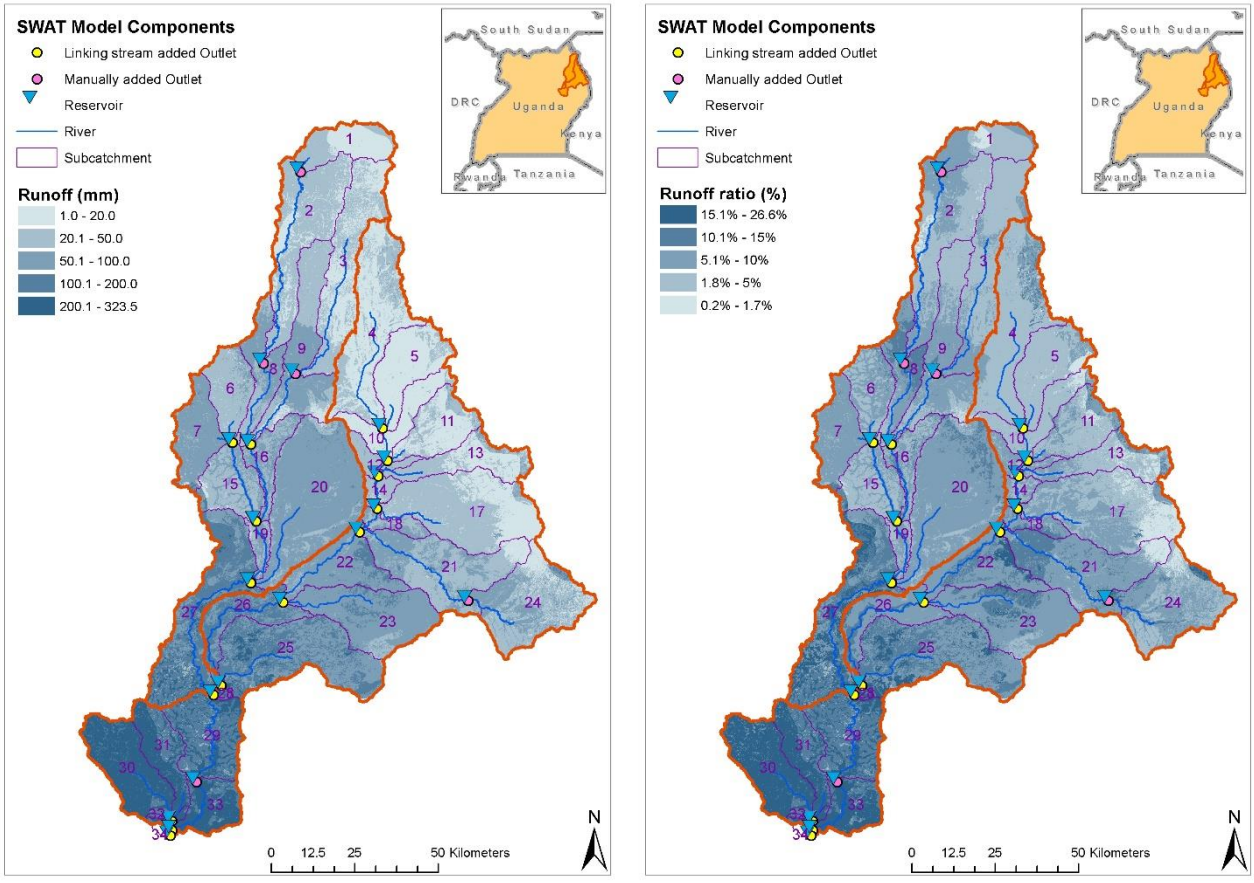


Figure 22: Average absolute annual surface runoff (left) in mm and surface runoff-rainfall ratio (right) in percentage.

4.3.5 Issues on water resources

Lokere Catchment is characterized by reasonable but highly uncertain rainfall, with long dry spells and intense rainfall events. Environmental degradation is evident on agricultural lands (Moroto, Matany, Iriri and Lower Lokere), around medium-sized valley dams (Kobebe and Arecek), on steep slopes (Mount Moroto and Mount Napak), in wetlands (Lochoman, Kapelebyong and Lower Lokere) and on river banks, which results in high runoff-rainfall ratios (i.e. of up to 25%). Sedimentation of reservoirs such as behind valley tanks and dams is strongly linked to erosion upstream. Climate change, population growth and economic development are expected to worsen environmental degradation, thereby further increasing runoff-rainfall ratios.

The streams and rivers in Upper and Middle Lokere are characterized by a flashy runoff. Wetlands play a vital role in water regulation. Indicative calculations show that peak flows could become at least 10 times as high if the buffering function of wetlands would disappear from the catchment. Monitoring of flows, groundwater levels, groundwater abstractions, water quality and climate is poor. Access to existing data is difficult.

Safe water coverage varies between 29% in Kaabong and 72% in Soroti (source: District Development Plans). Boreholes are the predominant source of safe water supply, but many are non-functional due to poor site selection, design, operation and maintenance. The Uganda Water Supply Atlas by MWE-DWD (www.wateruganda.com) is a great step forward (although keeping it updated turns out to be challenging), but the databases with the technical specifications on water abstraction points are incomplete and outdated and data is not accessible for stakeholders.

Weather and water resources monitoring and evaluation is not institutionalized. There is just a limited number of monitoring stations and many are non-functional. To some extend these challenges can be traced back to the insecurity context in the 1990s and 2000s. There is, however, more to it.

- Access to existing data is difficult for stakeholders.
- There is no to limited feedback to those collecting the data on the ground.
- Operation and maintenance of monitoring stations is poor.
- Data storage, processing and analysis is not transparent to the involved stakeholders.

The absence of this knowledge base undermines many development initiatives. Issues are more easily brought into the regional, national and international agendas when data is available to support their claims. Also, the development of purposeful and effective interventions is much easier when sufficient information is available to properly understand the problem. However, MWE is developing a plan to establish a Water Institute at the Entebbe premises for study, research and training purposes, incorporate the existing data bases, as well as harmonising the currently scattered training activities.

There is insufficient water to cover the water demand of livestock, particularly in the dry season, as a consequence of which livestock migrates downstream. The pressure on natural resources is further increased by livestock migrating from Turkana and South Sudanese herders into Lokere Catchment during period of drought (www.wateruganda.com).

The National Irrigation Master Plan (PEM 2011) found almost 14,700 ha suitable for irrigation in Lokere Catchment. Large-scale agricultural developments, however, do not match local livelihoods, may locally undermine the resilience of the system and require huge investments infrastructure. Also most irrigable lands are located in the downstream parts of the catchments, while the suitability for dams is highest in the upstream parts of the catchment. Currently another problem is that many reservoirs are built without being based on sound hydrological assessments.

On average, almost 11% (1,000 Mm^3) of the incoming precipitation leaves the catchment in the form of surface outflow. Shallow groundwater potential is high in Lower Lokere, in wetland and flood plain areas, and there are multiple opportunities to further develop the resources by means of sand dams and sub-surface dams, but this resource remains underutilized.

Chemical water quality is good, except for the fluoride content at the foot of Mount Moroto and Mount Napak. Microbiologic contamination is a major concern. Due to poor sanitation and sharing of water points with livestock, contamination with e-coli is common.

Hydrological and agricultural droughts are recurrent and intense in Lokere Catchment, mainly due to a combination of dry spells, environmental degradation and an increased demand for natural resources. Flooding seems to be linked, at least in part, to the antecedent conditions of wetlands. The absence of adequate monitoring and early warning systems may be concomitant to the disastrous impact of floods in Lower and Middle Lokere. Locally in Lower Lokere, waterlogging occurs due to high intensity rainfall on soils with a low infiltration capacity. Flooding of dams and tanks is related to flash floods in ephemeral streams, which are the result of high runoff-rainfall ratios which are mainly related to environmental degradation. Poor design, construction, operation and maintenance of water for production infrastructure also play an important role.

4.4 Social and environmental context

4.4.1 Socio-economy

The total population of Lokere Catchment in 2016 is estimated at 420,000 people[6]. The majority of the population is rural. Population density is highest in and around regional growth centres and in Lower Lokere, hence water demand is highest in these areas. Table 6 provides a summary of the total population of the Lokere Catchment per district as described in the DDPs. As the catchment only partially overlaps with the districts, the total population in the districts as described in the table is much higher than the total population estimated to live in the catchment.

TABLE 6: POPULATION GROWTH RATES FOR THE DISTRICTS IN LOKERE CATCHMENT (UBOS, 2014)

District	Population 2014	% growth rates
Amuria	270,928	3.4
Kaabong	167,879	-1.5
Katakwi	166,231	2.76
Kotido	94,881	3.15
Moroto	104,539	2.52
Nakapriripirit	156,690	5.2
Napak	45,219	2.11
Soroti	296,833	3.58
Average		**2.65**

The region is among the poorest in Uganda. Recent studies suggest that 74% of the total population live below the poverty line (UNDP, 2014). This poverty translates into high levels of food and nutrition insecurity and underdevelopment. Root causes of poverty are reported to be adverse weather conditions, illiteracy, marginalisation, corruption, high prevalence of livestock and human diseases (Akliku 2016), crop pests and prolonged years of conflict. The livelihood and income stress is leading to environment stressing activities like charcoal burning.

Livelihoods

The main livelihood of the Karamojong and Iteso in Lokere Catchment revolves around a mixed agro-pastoral economy. An increasing number of people rely on agro-pastoral livelihoods, which combine livestock rearing with crop production. The pastoral livelihood zone runs along the extreme eastern border with Turkana-Kenya, which comprises mostly of eastern Kaabong and Nakapiripirit, a huge proportion of Kotido, and Moroto as well as parts of Napak. It is characterised by prolonged dry spells and erratic rainfall. Approximately 51,299 households depend on this livelihood zone. Pastoral communities in the region practice a unique dual settlement system that has been developed over time by the agro-pastoralists as a means for overcoming vulnerability to adverse weather conditions and aftershocks.

Livestock rearing and management occurs throughout the catchment with cattle, goats and sheep being grazed in open grassland, scrubs, thickets and forest margins and on agricultural lands after crops have been harvested. According to the 2008 Livestock Census by UBOS, household livestock numbers are high in Kotido District, while Soroti District has the lowest numbers (Table 7).

Livestock grazes all accessible areas of the catchment. The only areas that receive little grazing include dense forest, permanently flooded swamps and other impenetrable habitat. Thickets and scrubs are invariably heavily grazed especially in the dry season. In Nakapiripirit district, grazing land is concentrated around Lorengedwat. In dry seasons, pastoralists move to Lotome sub-county in Napak district.

[6] Catchments are independent of existing administrative boundaries such as districts. In order to obtain a close to accurate estimation of the catchment population, parish population figures from the 2002 Census were combined with the numbers from the 2014 Census (only district level)

The principal grazing areas are found on the wet grasslands. In the dry season the level of cattle grazing exceeds the carrying capacity of the environment leading to both environmental damage and conflicts. Some of the most affected areas are found within the northern parts of the catchment at the Kenyan border, around Kobebe dam and in Lotome.

TABLE 7: MEAN NUMBER OF NON-MIGRATORY LIVESTOCK PER HOUSEHOLD. SOURCE: LIVESTOCK CENSUS (UBOS, 2008)

District	Mean number of cattle per household	Mean number of goats per household	Mean number of sheep per household	Mean l/day per household for cattle, goats and sheep
Katakwi	8.2	3.8	1.0	324
Soroti	3.3	3.0	0.7	145
Amuria	6.0	2.1	0.7	230
Kotido	25.2	19.3	20.1	1177
Moroto/Napak	19.1	7.6	6.1	772
Nakapiripirit	19.1	15.5	11.1	868
Kaabong	10.9	11.0	8.8	529

In addition, other activities take place on a smaller scale, such as gathering of wild fruits, wood and food and harvesting honey. These activities are carried out throughout the year alongside pastoral activities. There is no large-scale industry. Some households produce soap, dairy products, dry meat, process hides and skins, mill of maize, sorghum and rice, produce of crafts and artisan gold products.

The livelihood options are all directly dependent on the environment and for the last few years cyclical droughts (every two to four years) and erratic rainfall have drastically affected crop production and pasture for livestock, thereby causing a direct negative impact on the livelihood of the population within the catchment. In Upper Lokere, there is a gradual shift from cattle rearing to crop production. In water stressed areas, crop production takes place around rivers in search for fertile and moist land. This has resulted in massive tree cutting to pave way for agricultural land and charcoal burning as an alternative option. Other communities in turn, have resorted to the selling of firewood and brick laying. In Moroto and Kaabong, communities have resorted to artisanal and small-scale alluvial mining. Artisanal mining of gold, silver, copper, iron, gemstones, limestone and marble is increasingly becoming an important source of income. In one way or another, all these activities lead to cutting down of trees and vegetation cover, thus compounding the environmental challenges in the region.

Mining

Over 50 different minerals are known to occur within the catchment area, including gold, silver, copper, iron, gemstones, limestone and marble (Hinton et al., 2011). Some of the minerals such as marble and limestone have a history of prospection and mining. Others are unexplored, but indicated. According to Houdet et al., 2014, twenty foreign and domestic companies have exploratory and/or mining rights in the region. These numbers are expected to rise with the growing demand for metals and minerals, favourable long-term trends in global commodity prices and increased exploration. In spite of its rich mineral potential, the commercial viability of large-scale mining (LSM) and artisanal and small-scale mining (ASM) and the full range of economic, social and environmental costs and benefits of mining in Karamoja remain unclear (IUCN, 2014).

Limestone is mined at large-scale in Upper Lokere, mainly around Mount Moroto by companies from outside the catchment, mainly to produce cement. Few revenues from these activities feed into the catchment. Furthermore, stakeholders complain about the large trucks that destroy the roads and the borrow pits that are left open after closure of the mining sites.

Artisanal mining is practiced in Upper Lokere, mainly in Kaabong District. The most commonly reported ASM activities with negative environmental impacts involve the clearance of vegetation for mining activities. This, in turn, results in degraded and fragmented habitats for wildlife (Muwanga, 2012). Other frequently cited environmental impacts of gold and diamond ASM are:

- Locally increased silt during the washing and panning process.
- The diversion of waterways to access mineralized deposits on the river bed or to obtain water needed for washing.
- Use of pumps to remove water when digging below the water table.
- The direct dumping of waste, tailings and effluents in waterways and removal/disruption of river beds and river banks because of intensive scooping, dredging or vacuuming.

The use of toxic materials such as mercury and cyanide is a major issue in ASM as it mostly leads to pollution of drinking water for humans and animal species. Artisanal miners indicate that they are not using mercury and cyanide in the process.

Land tenure

Land tenure systems within the catchment area is multiple. In both the Karamoja and Teso sub-regions, land is under common, state and private property regimes. Most land is communally owned except in the town centres of Soroti, Moroto, Kaabong and Kotido, where individuals possess title deeds. Where the land is owned by the community, its use is traditionally controlled by a hierarchy of clan elders. The communal land is collectively managed by the clan and is characterized by a common pool of resources such as grazing fields and water sources. Land use is practiced under a dual system of both customary law and statutory legal systems. The communal land tenure system is, however, susceptible to the "tragedy of the commons". Increased human pressure on the landscape level (partially resulting from population growth), high poverty levels, lack of environmental law enforcement, low level of awareness on environmental degradation and shortage of capacities and resources for monitoring and community-based natural resources management (e.g. for water and rangeland) have resulted in the overexploitation of natural resources at various locations.

Security

Security has long been an issue in large areas of Lokere Catchment. Between the 1990s and early 2000s Karamoja Sub-region was a no-go area. "Gun ownership is pervasive, and armed criminality and cattle raiding by civilians in Karamoja exposes the population there, as well as those in neighbouring districts, to high levels of violence, and restricts even the movement of humanitarian workers. It poses significant challenges to the government's responsibility to provide for its citizens' security and human rights" (Emerson 2007). In 2001-2002, 2007-2008 and 2009-2010 the Office of the Prime Minister of the Ugandan government implemented the Karamoja Integrated Disarmament and Development Programme (KIDDP) towards creating conditions for promoting human security and recovery in Karamoja (Office of the Prime Minister 2007). KIDDP was oriented towards improving safety conditions, but as the pace of thoroughness of disarmament was not equal throughout the area many *Karamojong* groups who handed in their weapons were left to misery and violence. As conditions deteriorated, between 2006 and 2010 thousands of *Karamojong* women and children moved to Kampala (Sundal 2010). In 2007, the Ugandan government began to resettle these people to Karamoja. Regardless of the initial intent to remove weapons from communities in Karamoja, the forceful means involved had unintended negative consequences for communities as well as for civil-military relations, including increased insecurity for communities due to attacks from Kenyan neighbours; stripping of essential and productive assets; the erosion of traditional mechanisms to cope with vulnerability and food insecurity; shifts in gender-based labour roles, responsibilities and identities; transfer of animal management responsibilities; and the collapse of the dual settlement and migratory systems central to the success of pastoral and agro-pastoral livelihoods. In the last few years the security situation in Lokere Catchment and Karamoja as a whole has stabilised and peace returned.

Conflicts over water resources are another issue in Lokere Catchment. In a survey carried out under the Reform of the Urban Water and Sanitation Sector Programme (Dektar et al, 2017), it was established that 88.7% of water users in the catchment indicated that there were water related conflicts. Accordingly, these conflicts manifest in forms of verbal abuses, quarrels, physical confrontations/fights and disagreements between ethnic groups. The causes of these conflicts include animals trampling over gardens, attempts to restrain Turkana pastoralists who are crossing borders to access water and pasture for livestock, over grazing and drinking by large numbers of animals which threatens water security. Other causes include, priority being given to livestock over people in terms of water access especially at boreholes, ethnic differences and intrusion by strangers/pastoralists, ownership and monopoly of water resources by certain groups/people. However, there are structures and fora in place for reporting, mediation and settlement of conflicts. These structures include Local Council I (where most conflicts are reported, upto 63.9%), elders, youths and cultural leaders (Dektar et al, 2017).

4.4.2 Land cover and land use

Land in Lokere Catchment is currently covered approximately by equal shares of forest and woodlands, grasslands and shrublands, and croplands (Figure 23, map developed based on Landsat Imagery 2015 and calibrated with data from field surveys, refer also to the Water Resources Assessment). In addition, extensive wetland systems are present in Middle and Lower Lokere.

Land use forms a major divide in Lokere Catchment. The upper and middle parts of the catchment are part of the agro-pastoral zone. The grass- and bushland consisting of acacia shrubs and thickets in open grassland is used for grazing. The Karamojong traditionally make a living from pastoralism, hunting and gathering fruits. Patches of small-scale rain-fed agriculture (sorghum, finger millet, maize, groundnuts, simsim, sunflower, cowpeas, green grams, beans, soya beans, cassava and sweet potatoes) are concentrated around the somewhat larger towns and settlements. The areas covered by wood- and bushlands are known for wood logging and charcoal production. At the far eastern rim, at the border with Kenya, artisanal mining (e.g. gold, marble) is common as mentioned above. In Lower Lokere, the Teso population is primarily engaged in crop production. In and around the wetlands paddy rice is cultivated. Further away from the streams, lands are used to grow rain-fed crops. Locally there are some small-scale irrigated fruit orchards (citrus, mango, papaya, pawpaw, guava, passion fruit, avocado, jack fruit and mulberry), vegetable gardens (tomato and onions), and tree plantations (moringa[7], neem and calliandra).

Approximately 1/3 of Lokere Catchment has a protected status and is under the auspices of the Uganda Wildlife Authority (UWA) or National Forest Authority (NFA). The wildlife reserves of Iriri, Bokora Corridor and Matheniko (Figure 23) are managed by UWA. Moroto Forest Reserve in the far east and Napak Forest Reserve at Mount Napak are managed by NFA. Conservation sometimes translates into problems, such as loss of access to resources, crop damage caused by wildlife and conflicts over natural resources (Visser et al. 2015). The reserves are very important for the biodiversity and conservation of ecosystems. In general, the reserves managed by UWA are in better condition that those under the management of NFA. In Moroto Forest Reserve deforestation and encroachment of agriculture are heavy and have led to serious degradation of the ecosystem.

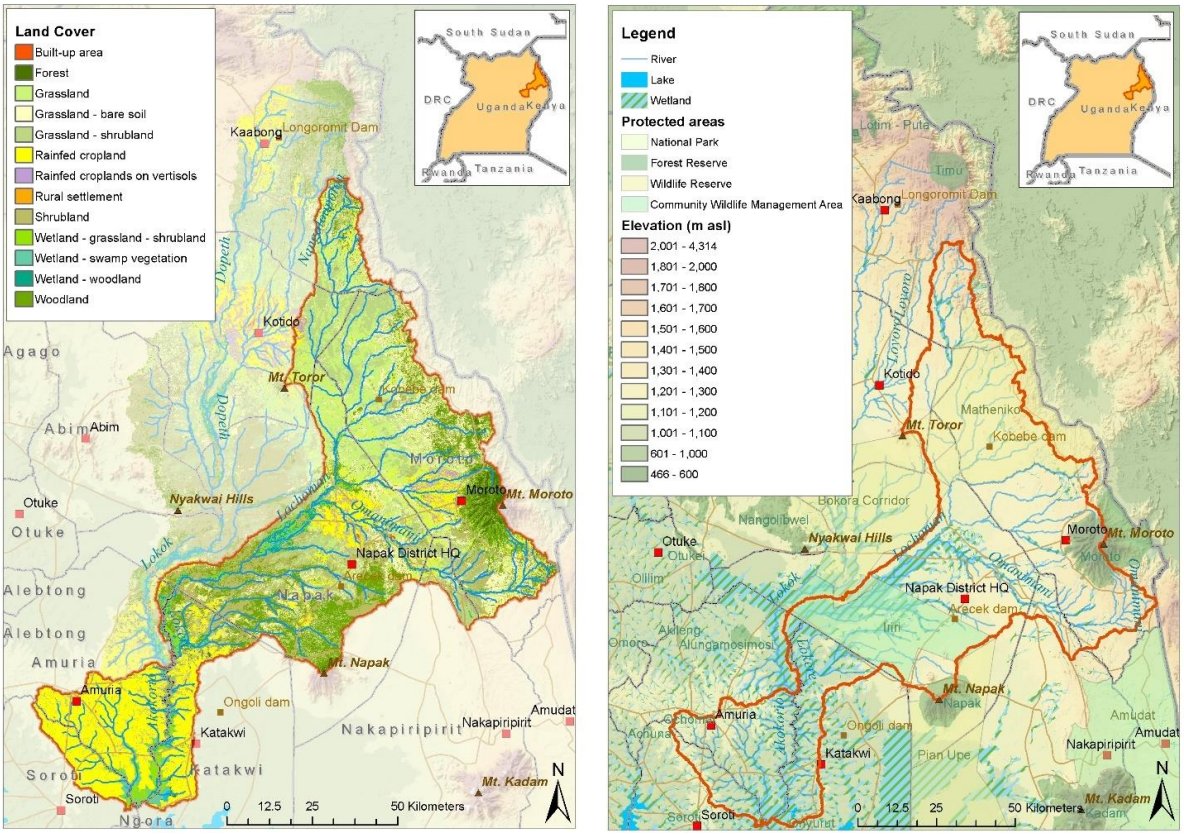


Figure 23: Land cover[8] (left) and protected areas (right) in Lokere Catchment, Source: NFA 2016.

[7] See for the value chain development of Moringa: http://fairventures.org/en/portfolio/moringa-value-chain-development-in-karamoja-teso/
[8] Developed during this project using Landsat Imagery 2015, calibrated with data from field surveys. See also the Water Resources Assessment

4.4.3 Zoning

Lokere Catchment presents a diversity of conditions in terms of climate, soil types, culture and beliefs, population, opportunities and economic status. The upstream part of the catchment is different from the downstream one and even within the upstream areas considerable differences exist among districts, Napak, for example, is much wetter and more fertile (and greener) than the more northern districts of Kaabong. And again within one district, such as Moroto District, for instance, there is a greener belt around Mount Moroto and a drier belt on the plains.

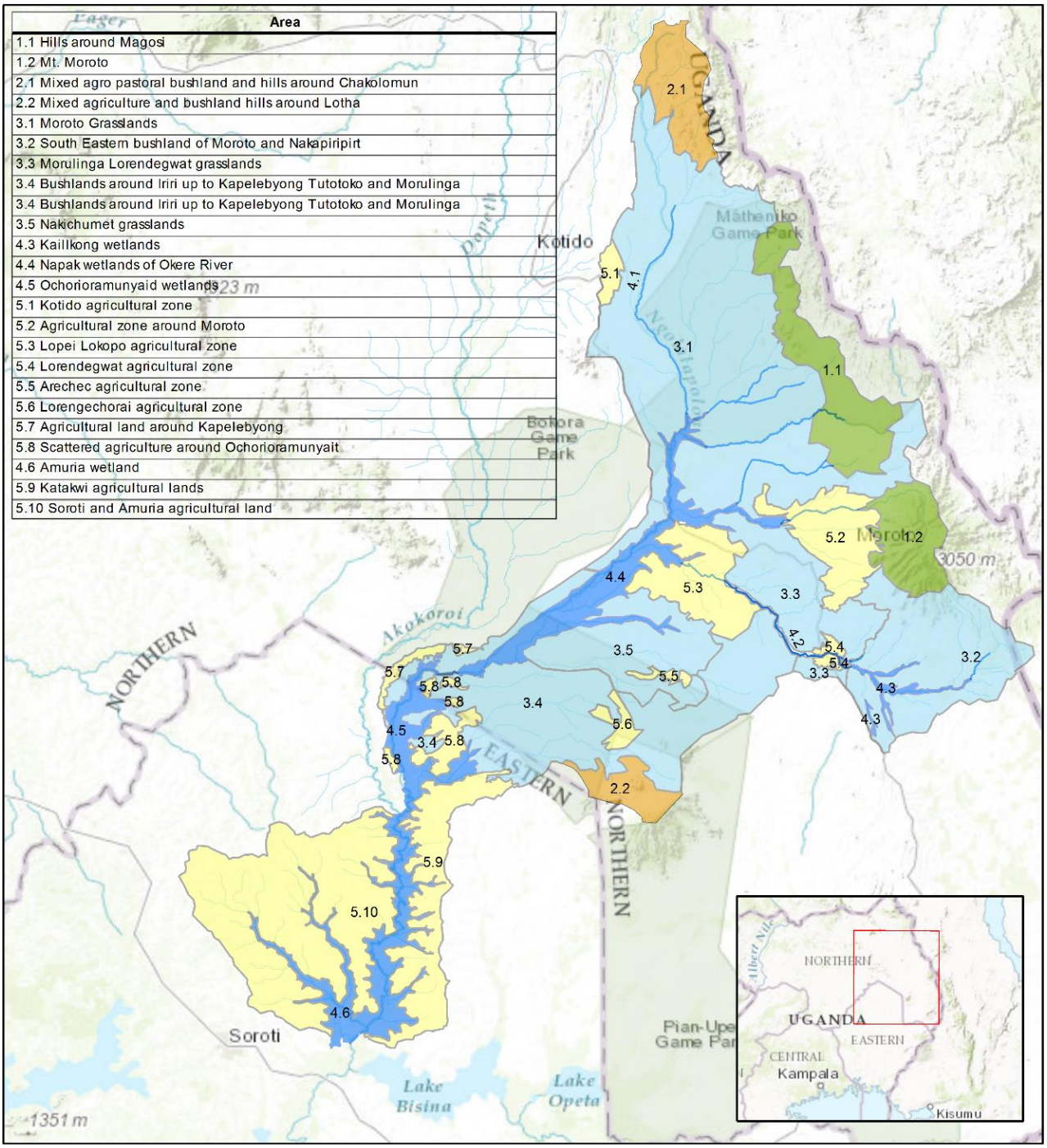
Figure 24: Waterlogging in the downstream areas (RAIN 2016)

Issues that occur in a catchment have different impacts depending on the location where they occur. Issues such as flooding, low economic development and resettlement impact different areas to a different extent. To enable a better understanding of which issues occur where and which impact they have the catchment was divided into zones using multi criteria zoning based on land use, population, slope, precipitation, soil and water availability (Figure 24).

In Lokere Catchment five landscape zones were differentiated: Agro-pastoralist bushland, forest, grassland, flood zone/wetlands, and agricultural lands. In total these zones amounted to have 27 different areas as shown in Table 8 and Figure 25.

TABLE 8: LANDSCAPES ZONES PER AREA IN LOKERE CATCHMENT

Catchment	Zone	Characteristic of zone in the section of the catchment
Upper	Forested hills around Magosi, Mount Moroto (1.1 and 1.2)	Hills that drain into the small rivers of upper Lokere Catchment. Reduction of forest can cause rapid surface runoff into these rivers.
	Agro-pastoralist zone of Chakolomun (2.1)	Similar as the hills around Magosi, also a hilly area.
	Grass and bush north of Moroto, Moroto and Nakapiripirit and Morulinga and Lorengedwat (3.1, 3.2 and 3.3)	Vast grasslands which accommodate big herds of cattle and a wildlife corridors. As long as the area is not burned or extremely overgrazed the middle wetlands will continue to function.
	Upper Lokere river (4.1), Kailikong and Omanimani (4.2 and 4.3)	Rivers that drain into the middle wetlands, too much surface runoff will cause siltation, too little surface runoff will cause a decrease in the size of the wetland.
Upper	Kotido and Moroto agricultural zone (5.1 and 5.2)	Erosion sensitive areas which potentially silt up the wetlands in the middle catchment.
Middle	Mixed agriculture and bushland of Lotha (2.2)	Hilly area feeding some of the smaller streams.
	Iriri up to Kapelebyong, Tutotoko and Morulinga, Nakichumet grass and bushland (3.4 and 3.5)	Areas which drain into the large Napak wetland. Overgrazing and over burning can cause flash flooding.
	Napak wetlands of Lokere river (4.4)	The wetland in the middle catchment protects the lower catchment from flooding. If it silts up flooding in the lower section can be expected to occur more regularly.
	Lopei, Lokope, Lorengedwat, Arechek, Lorengechorai and Kapelebyong agricultural areas (5.3, 5.4, 5.5, 5.6 and 5.7)	Some of these agricultural zones directly encroach on the wetlands.
Lower	Ochorioramunyait and Amuria wetlands (4.5 and 4.6)	Main areas of waterlogging and flooding if the upstream system deteriorates.
	Ochorioramunyait, Katakwi, Soroti and Amuria agricultural lands (5.8, 5.9 and 5.10)	Low productivity, waterlogging.



Lokere Catchment - Landscape Zoning

Support to Improved Integrated Catchment Management for Increased Community Resilience

Legend

Landscape Zones

- Grassland
- Wetlands
- Forest
- Pastoral bushland
- Agriculture
- 4.1 Upper Lokere rivers
- 4.2 Omanimani and upstream

N

Map Projection: Arc 1960 UTM Zone 35N
Grid, Map Coordinate:
Geodetic Datum: GCS_WGS_1984
Author: Arnoud Keizer
Date: 19-1-2017

Data Sources:
Google Earth satellite,
OpenStreetMap contributors,
Acacia Water

SCALE1:931.030

0 10 20 40 Kilometers

Figure 25: Landscape zones in Lokere Catchment

4.4.4 Issues on the social and environmental context

Lokere Catchment is faced with many social and environmental challenges. The SSEA identified the issues that need to be resolved and provided recommendations for comprehensive planning that will help to avoid problems and maximise opportunities for IWRM and sustainable development. Some of the key social and environmental issues identified are summarised in Table 9 and Figure 27. Some issues like population dynamics and low literacy levels are overarching and external and can only be addressed by the catchment management plan in an indirect way.

TABLE 9: SUMMARY OF KEY SOCIAL AND ENVIRONMENTAL ISSUES IN LOKERE CATCHMENT

Issue	Description
Population dynamics	The current population of the catchment is estimated at 418,717 people and is concentrated around productive agricultural areas, trading centres, and water sources. The population within the region is increasing. The UBOS (2014) estimates the ratio of males to females at 48.4% to 51.6% respectively. The regional average population growth rate is 2.65%, Population increase has been recorded around the Napak wetlands of Lokere river, new settlements in Moroto and Soroti towns. This increase in population has intensified unsustainable and destructive practices in livestock herding and agriculture, threatening the ecosystem functions of woodlands and wetlands.
High poverty levels	The upper parts of the catchment are known to be one of the poorest areas in Uganda, with poverty levels of nearly 74%. A large proportion of the population reside in the rural areas and depend on pastoralism and subsistence farming for survival, with barely any surplus produce for the market. This poverty translates into high levels of food and nutrition insecurity, underdevelopment, overexploitation of resources and encroachment into sensitive ecosystems such as wetlands and forests in search of alternative sources of livelihoods such as charcoal burning. Lower parts of the catchment experience less poverty issues due to a more stable climate and stronger connection to markets and government services even though people mainly depend on subsistence agriculture. Root causes of poverty are reported to be adverse weather conditions, illiteracy, marginalisation, high prevalence of livestock and human diseases, crop pests and prolonged years of conflict.
Low literacy levels	The Ugandan National Census (UBOS 2014) shows that the region has the lowest education rates in Uganda – only 6% of women and 12% of men are literate compared to a national average of 67%. These low literacy rates are a major barrier to successfully generating income and improving livelihoods – especially for women. Lack of an income means that communities remain trapped in a continuous cycle of poverty, leading to overexploitation of resources in search of sources of livelihoods.
Limited access to basic services	Access to adequate basic services such as education, health and sanitation, agriculture and veterinary extension is still a big challenge and is far below the national average. Access to energy is limited within the region. Over 90% of the population relies mostly on forest products such as wood and charcoal for cooking and lighting homes with far-reaching impacts on the environment. Lack of access to clean and safe water limits the available drinking water, and compromises basic hygiene practices within families, exposing them to water and sanitation-related diseases like diarrhoea and cholera which rank high as a cause of child mortality.
Land ownership system	Land is under common, state and private property regimes. Most land is communally owned except in town centres (Moroto) where individuals possess title deeds. Where the land is held in customary tenure, claims to right of access, use and ownership are not backed by formal documentation. Instead, its use is traditionally controlled by a hierarchy of clan elders and is characterised by a common pool of resources such as grazing fields and water points. However, the power of these traditional institutions has been eroded over time due to the power of the gun, the disarmament process and the set of protected kraals, leading to overexploitation of resources at various locations. Threats to tenure security, included but not limited to minerals and mining interests, often undertaken without community knowledge, involvement or consent have been reported within the catchment, with rates of land grabbing on the rise.
Vulnerability to natural disasters	The most common natural disasters experienced in the catchment are floods and droughts. Major flooding events occur in the lower catchment towards September, when rainfall in the upper catchment is far less compared to downstream. Napak and Amuria district are prone to flooding because of intense storms, poor draining soils and low slopes. This has resulted in loss of property, reduced soil productivity and erosion. The north-eastern part of the catchment experiences long dry spells every year. These prolonged dry spells result in: total crop failure with far-reaching impacts on food security, leaving communities vulnerable to starvation; reduced water and pasture for livestock; disease outbreaks; loss of biodiversity and increased resource use conflicts.

TABLE 9: SUMMARY OF KEY SOCIAL AND ENVIRONMENTAL ISSUES IN LOKERE CATCHMENT

Issue	Description
Land degradation and erosion	Increased human pressure on the land (partially resulting from population growth), weak environmental law enforcement, low level of awareness on environmental degradation and shortage of capacities and resources for monitoring and community-based natural resources management (e.g. for water and rangeland) have led to severe land degradation. Some of the activities include: land use changes, deforestation, uncontrolled bush burning, wetlands, river banks and forest encroachment for cultivation and grazing of livestock, and overgrazing exceeding carrying capacity of rangelands. All these activities lead to accelerated erosion within the catchment. Consequently, this degradation results in higher overland runoff rates, increased siltation in mid- and downstream rivers and wetlands and thereby more frequent and intense droughts and floods. Figure 27 gives an overview of the most degraded areas according to the stakeholders' perception.
Agricultural encroachment	In connection with the high population growth the demand for agricultural land is continuously increasing. However, coupled with the visible and progressing land degradation and overutilization the soil fertility reduces, especially in the drier parts of the catchment where rain-fed agriculture becomes unreliable. Thus, the population encroaches on protected woodlands and forests, as well as rivers and wetlands.
Artisanal mining	Artisanal mining is widely practiced within the catchment area, with sand and gold being the common minerals. This artisanal mining often has widespread negative socio-environmental impacts. These include the clearance of vegetation for mining activities, increase of silt deposits during the mineral washing and panning process, diversion of waterways to access mineralized deposits in the river bed or to obtain water needed for washing , removal of the top soil due to the use of semi-mechanical techniques such as dredges, water pumps, hoses and vacuums, and increased land and river bank degradation. Worldwide often toxic materials such as mercury and cyanide are used in gold mining, which are highly pollutive; miners in the catchment, however, indicate they do not use chemicals.
Low productivity	The variability of the precipitation, the pressure on the land and traditional agricultural methods contribute to a low productivity. The farmers lack improved agricultural techniques and inputs despite an effort by international and national organisations. The value chains for markets are hardly developed.
Tree cutting for charcoal production	After the termination of the conflicts in Lokere and Karamoja as a whole many people turned to charcoal production to earn some income for survival. In the last few years the number of charcoal producers has increased and charcoal burning has become a business with transporters taking trucks of charcoal to urban centres, especially Mbale and Kampala. This leads to accelerated deforestation.
Uncontrolled bush burning	When controlled, bush burning is a critical means for transforming nutrients in the soil, with benefits to the quantity and quality of grass cover, and an important means to control tse tse fly numbers. Within the catchment, however, bush burning is a rampant practice because uncontrolled. It often has disastrous consequences, such as loss of life and property, and damage to ecosystems, including forests and soil fertility. Areas around the open woodland of Bokora corridor are worst affected (Figure 26).
Reduced water levels	With development and the population increase the demand of water rises especially for domestic consumption. Many boreholes and wells are not functioning which increases the demand on the remaining unevenly distributed water sources within Lokere. Thus, in many groundwater sources the water level has reduced and the potentials are low. The low availability of water also affects the water quality and leads tp water-borne diseases.
Water shortage for animals	In the past the pastoralists used to migrate with their cattle in an annual rhythm. However, due to the changing environment and a rising sedentarisation process with agricultural activities being taken up these traditional migrations are getting lost. This puts pressure on the land and water resources for the animals coupled with an accelerated deforestation and a loss of the vegetation cover. Additionally, the number of cattle augments, worsened by an influx of cattle from the Turkana in search of water during the dry season. Valley tanks and dams are scarce and tend to dry out more and more quickly following the pressure of high demands.
Conflicts over natural resources	Resource use conflicts have intensified within the catchment because of increased pressure on natural resources and insecure land tenure, bringing about competition for scarce grazing land and water especially during the dry season. The pressure on natural resources persists and is affecting their productivity and sustainability. Conflicts over natural resources, mainly water, pasture and agricultural land are common particularly along the southern border of Lokere Catchment, in the hills around Chakolomun and in the cross-boundary zone of large herder groups from Kotido, Kaabong, Moroto and Turkana, Kenya during the dry season moving to Kobebe Dam.

TABLE 9: SUMMARY OF KEY SOCIAL AND ENVIRONMENTAL ISSUES IN LOKERE CATCHMENT

Issue	Description
Weak institutional coordination and enforcement	Protected areas in the catchment continue to be encroached for human activity, either due to poor enforcement of by-laws, or due to poor community attitudes towards conservation. Although there are various pieces of legislation spelling out the need for community involvement in management of Uganda's natural resources including wetlands, wildlife, and forests, there is limited progress in practice. This is largely constrained by a lack of capacity of the lead agencies (NFA, UWA and WMD) to implement collaborative management initiatives and in wetlands, The challenge is further compounded by understaffing in the local governments with recruitment priorities put on other sectors rather than on water resources management. There is also a decline in budgetary allocation for the ENRM sector, directly resulting in limited implementation of community initiatives.
Socio-cultural influences	Communities living in the upper part of the catchment have been affected by major disruption to the norms and values (including attitudes and aspirations) which have underpinned their existence. Implementation of affirmative action in the region and the disarmament exercise encouraged sedentary agriculture as an alternative to pastoralism. The influx of investment and the government ever-shifting approaches to development continue to affect the lifestyle of the region. Destruction of social values in this way has a high degree of association with increased alcohol dependency and misuse, violence, economic disempowerment, lack of self-esteem and cultural belief and increasing powerlessness. This further limits the role communities play in decision-making processes.

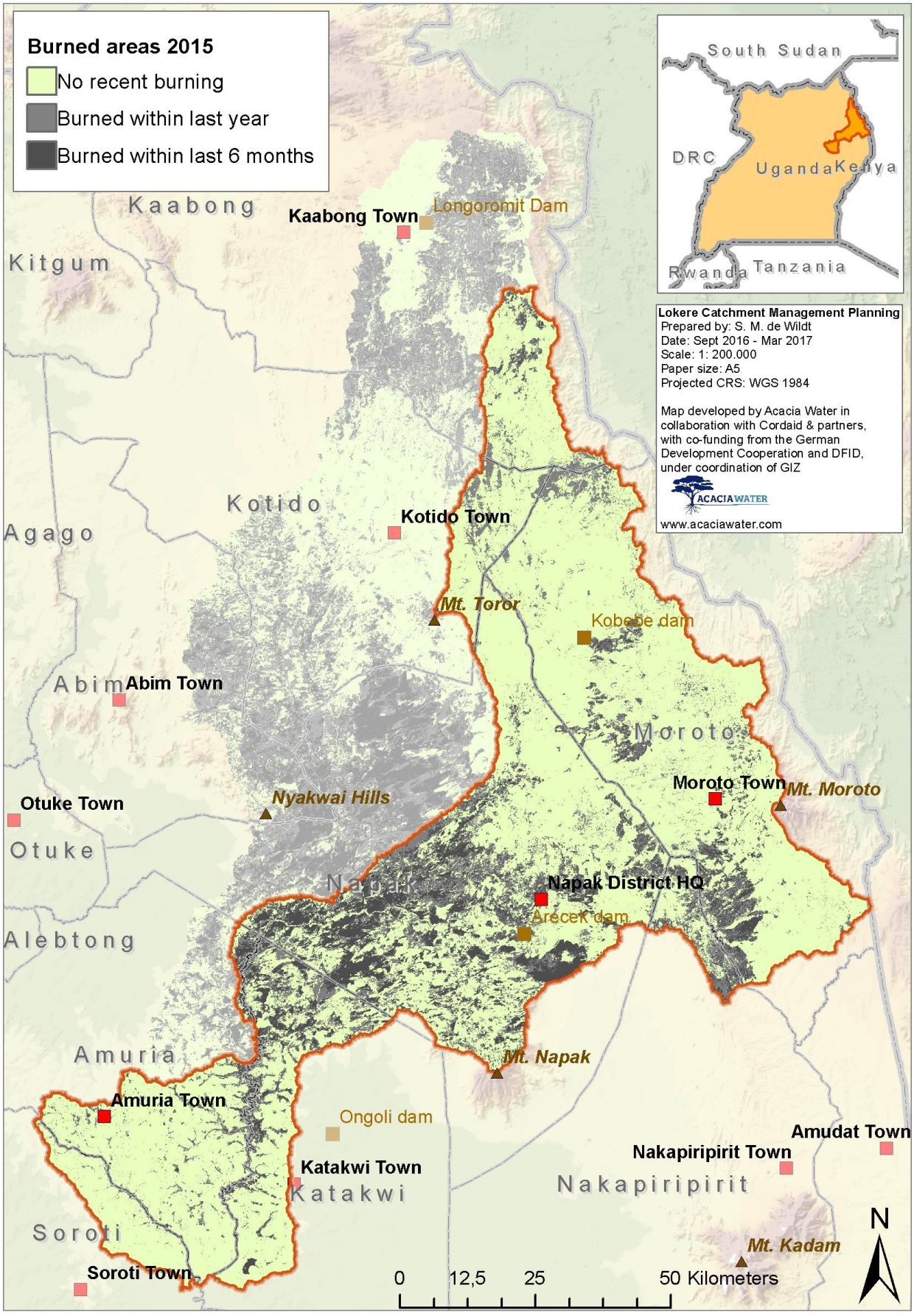


Figure 26: Burned areas in 2015. Map developed by Acacia Water based on Landsat 2015 Imagery

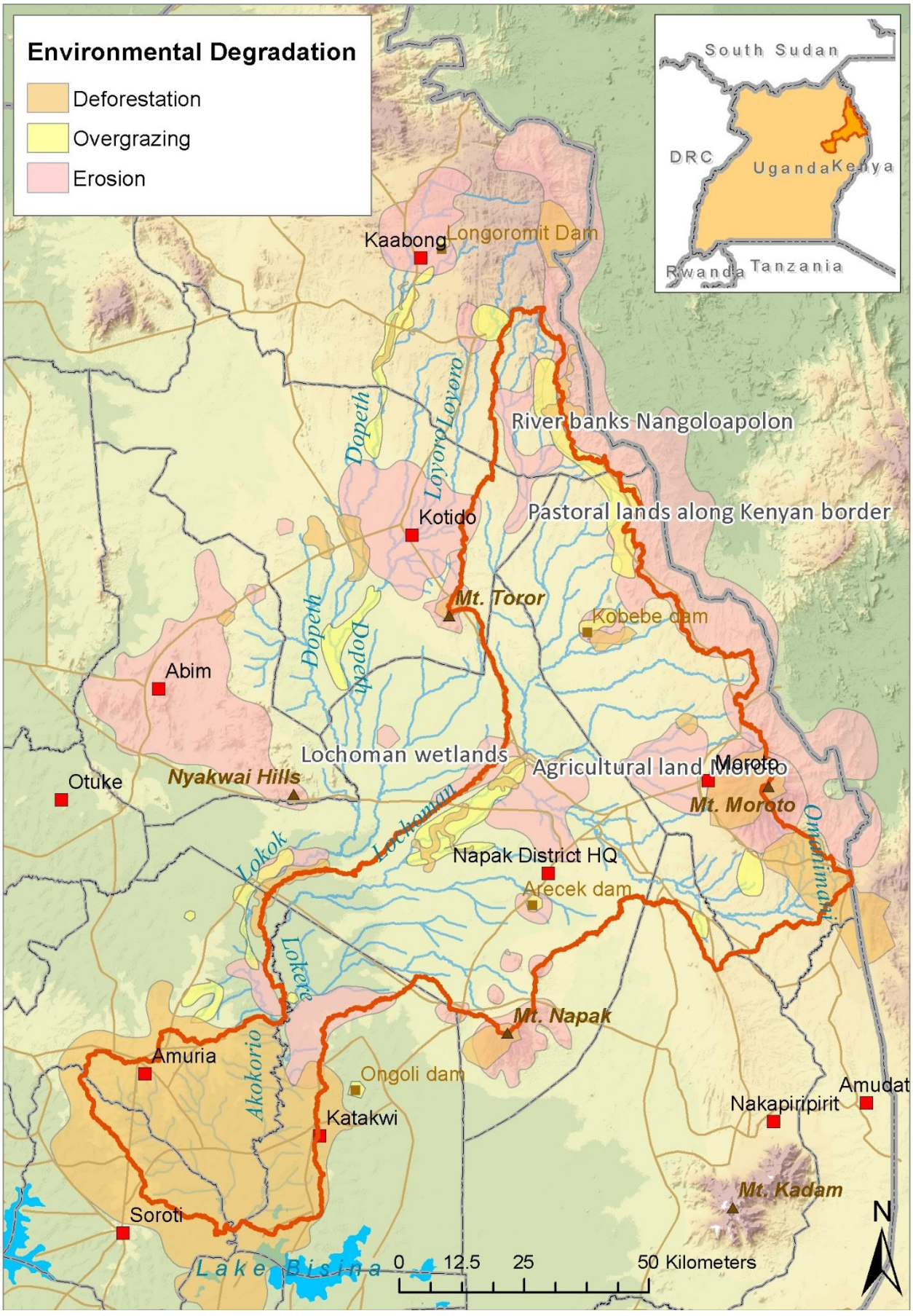


Figure 27: Overview of environmentally degraded areas in Lokere Catchment

4.5 Vision and objectives

After the issues regarding the stakeholders, the water resources as well as social, economic and environmental aspects have been elaborated and discussed, a common direction and understanding for a sustainable integrated future development of the catchment for the socio-economic benefit of its people and its environment considering the above mentioned situation and background was developed. Thus, the participants of the Catchment Stakeholder Forum held in Moroto in September 2016 developed a vision where they would like to see their catchment in 2040 (in line with the Uganda Vision). They agreed on:

A sustainably managed Lokere Catchment that supports livelihoods and development by 2040

The process took into account the issues, strategic implications and catchment driving factors.

In order to achieve the vision four strategic objectives were also formulated by the CSF participants. They read as follows:

1. ***To strengthen natural resources management systems and structures.***
2. ***To restore degraded natural resources.***
3. ***To ensure sustainable access to water of adequate quality and quantity for domestic use and production.***
4. ***To ensure that farming and animal husbandry systems are productive, drought and climate change proof, and improve household income.***

The conservation and restoration of the natural and water resources were very important aspects for the stakeholders. They must be benefitting the improvement of the socio-economic development of the catchment in a sustainable manner now and in the future through the enhancement of agricultural systems and thus the livelihoods. However, any development cannot progress without an adequate supply of water.

5. OPTIONS AND SCENARIOS

In the CSF held in Moroto in September 2016 the stakeholders were consulted several times to support the identification of intervention opportunities that contribute to the achievement of the vision and the strategic objectives (see also Annex B). In this chapter, the options for catchment management interventions that respond to the identified issues are elaborated. Through a scenario analysis the ideal combination of options is determined.

5.1 Options

To achieve the vision and strategic objectives, there is need to undertake measures which address the main issues and reverse those trends that undermine sustainable development in the catchment. These measures are called options. Based on the analysis of the catchment linked to the issues and particularly in regard to the different landscape zones options were developed classified under four thematic areas which are:

- Ecosystem protection and restoration,
- Water and sanitation,
- Agriculture and economic development and
- Institutional strengthening.

These thematic areas relate strongly to the aspects raised in the four strategic objectives and thus the vision. The last thematic area, the "institutional strengthening" is overarching and cross-cutting referring to all thematic areas and their options. Figure 28 outlines the different thematic areas (1, 2, 3, 4) linked to their respective options (1.1, 1.2 etc.). These options are specified in this section, after which they are analysed in the scenarios section and then lead to interventions.

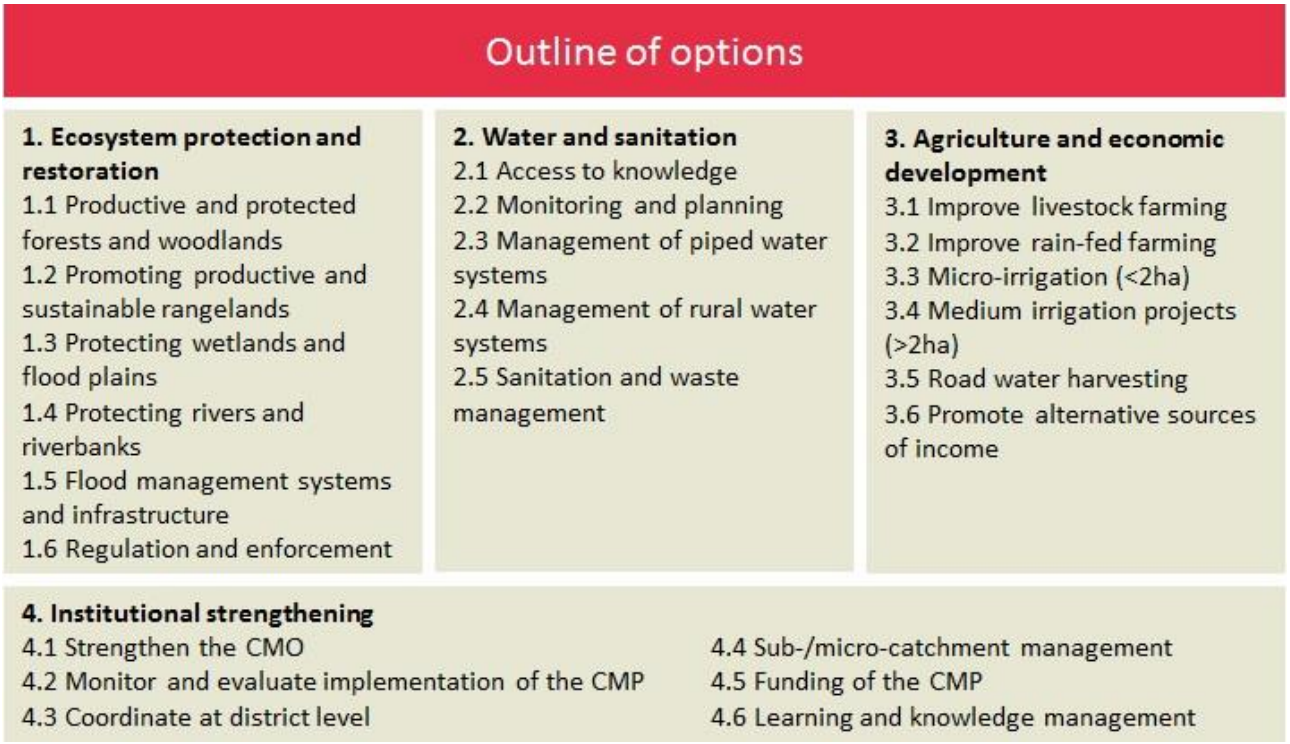


Figure 28: Outline of options

Table 10 gives a perspective on the kind of issues identified per zone and the options which relate to these issues.

TABLE 10: LINKS BETWEEN LOCATION, ISSUES AND OPTIONS

Landscape zones	No.	Location	Issues identified	Options
Woodland	1.1	Hills around Magosi	Area difficult to access, very poor infrastructure. Indications of seasonal artisanal gold mining, in some occasions with mercury. Groundwater probably (locally) high fluoride and salinity. Low to no water coverage causing resource struggles.	1.1 Productive and protected forests and woodlands 3.6 Promote alternative sources of income 2.4 Management of rural water systems
	1.2	Mount Moroto	Drying up of perennial springs and rivers, particularly due to deforestation/de-vegetation causing increased surface runoff and reduced water infiltration into the soil.	1.1 Productive and protected forests and woodlands
			Some boreholes/wells on the slopes and foot of the mountain have a relatively high fluoride and salinity content. Wells in and around Moroto Town are polluted with bacteria. Burning and soil erosion, natural resource conflicts.	2.4 Management of rural water systems 2.2 Monitoring and planning
				2.5 Sanitation and waste management
Agriculture	2.1	Mixed agro pastoral bushland and hills around Chakolomun	After disarmament, more people are settling here. Land clearing results in deforestation and erosion on slopes. Burning of areas to open up land for agriculture.	1.1 Productive and protected forests and woodlands 3.2 Rain-fed farming 3.6 Promote alternative sources of income
			Erosion and conflicts over water sources.	2.4 Management of rural water systems
			Artisanal gold mining reported.	3.6 Promote alternative sources of income
	2.2	Mixed agriculture and bushland hills around Lotha	Tree cutting, land clearing, charcoal production / result in deforestation and erosion. Burning at small-scale.	1.1 Productive and protected forests and woodlands 3.2 Rain-fed agriculture 3.6 Promote alternative sources of income
			Groundwater locally with high levels of fluoride and salinity contents.	2.4 Management of rural water systems 2.2 Monitoring and planning
			High livestock density.	1.2 Promoting productive and sustainable rangelands
Bushland/ grassland	3.1	Upstream thin bushland - Moroto	Valley tanks and dams for irrigated agricultural production underutilized. High livestock density, increases exponentially during periods of drought. Silted dams Conflict over water, encroaching farmers.	1.2 Promoting productive and sustainable rangelands 3.1 Livestock farming
				3.5 Road water harvesting
			Erosion, tree cutting for charcoal, overgrazing in the north of the zone.	1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
			Low productivity.	2.6 Promote alternative sources of income 1.2 Promoting productive and sustainable rangelands 3.2 Rain-fed agriculture 2.1 Access to knowledge

TABLE 10: LINKS BETWEEN LOCATION, ISSUES AND OPTIONS

Landscape zones	No.	Location	Issues identified	Options
	3.2	South eastern bushland of Moroto and Nakapiripirit	Tree cutting, bush burning, soils erosion.	1.2 Promoting productive and sustainable rangelands
				2.5 Water harvesting from roads 3.6 Promote alternative sources of income
			High livestock density during rainy season, but livestock moves out to the east during periods of drought when water is not enough for the animals. Pressure on land use and conflicts with farmers.	1.2 Promoting productive and sustainable rangelands 3.1 Improve livestock farming
			Salty boreholes.	2.4 Management of rural water systems 2.2 Monitoring and planning
	3.3	Morulinga Lorengedwat grasslands	Sheet and gully erosion taking place around the scattered villages where agriculture is set up (soils prone to erosion, particularly in flooding areas).	1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
			Issues related to burning and tree cutting.	1.1 Productive and protected forests and woodlands
	3.4	Bushlands around Iriri up to Kapelebyong, Tutotoko and Morulinga	Deforestation along south-eastern border of Lokere Catchment in Napak District. Bush burning takes place regularly. Charcoal production. Overall land use is extensive, especially around Bokora Wildlife Reserve.	1.2 Promoting productive and sustainable rangelands 1.1 Productive and protected forests and woodlands 3.5 Road water harvesting
			Overgrazing around water sources, causing gully erosion. During extended periods of drought livestock concentrates around water tanks and water dams - overgrazing and conflicts. High livestock density that further increases during periods of drought.	1.2 Promoting productive and sustainable rangelands 1.1 Productive and protected forests and woodlands 3.1 Improve livestock farming 3.6 Promote alternative sources of income
	3.5	Nakichumet grasslands	Concentration of livestock during dry season due to presence of nearby Arecek Dam, leading to overgrazing and land/gully erosion, especially on the vertisols.	1.2 Promoting productive and sustainable rangelands 3.1 Improve livestock farming
			Bush burning is a major issue, some areas overgrazed at the western side of this zone.	1.2 Promoting productive and sustainable rangelands 1.1 Productive and protected forests and woodlands 3.6 Promote alternative sources of income
Wetlands and Rivers	4.1	Upper Lokere rivers (northern Moroto)	Highly seasonal, carry only water for few days and useful groundwater in the river disappears quickly.	1.3 Protecting wetlands and flood plains 1. Flood management systems and infrastructure 2.2 Monitoring and planning
	4.2	Omanimani and upstream rivers	Highly sensitive to rain events and flash floods, river bank erosion taking place as well as encroachment of river banks.	1.3 Protecting wetlands and flood plains 1.4 Protecting rivers and river banks 3.2 Rain-fed farming 2.2 Monitoring and planning
			Low water buffering capacity.	1.5 Flood management systems and infrastructure 2.2 Monitoring and planning

TABLE 10: LINKS BETWEEN LOCATION, ISSUES AND OPTIONS

Landscape zones	No.	Location	Issues identified	Options
	4.3	Kailikong wetlands	Deforestation and overgrazing, burning for pasture sometimes entering into the wetland.	1.3 Protecting wetlands and flood plains 1.1 Productive and protected forests and woodlands 3.1 Improve livestock farming
			Peak flows last very short time.	1.5 Flood management systems and infrastructure
	4.4	Napak wetlands of Lokere river	This wetland is an important water buffer and ecosystem. Encroachment and deforestation by pastoralists and farmers is taking place. Potential risk of conflict between farmers and pastoralists.	1.3 Protecting wetlands and flood plains 1.1 Productive and protected forests and woodlands 1.2 Promoting productive and sustainable ragelands 3.6 Promote alternative sources of income
			Erosion of river banks, high surface runoff and loss of soil.	1.5 Flood management systems and infrastructure 1.4 Protecting rivers and river banks
			When the wetland is flooded, it cuts of accessibility to the north and west (i.e. West-Napak and Kotido).	1.5 Flood management systems and infrastructure 3.5 Road water harvesting 2.2 Monitoring and planning
			In the dry season, heavy burning in and outside the wetland. Wood logging also occurs for charcoal production.	1.1 Productive and protected forests and woodlands 1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
	4.5	Ochorioramunyai wetlands	Important water buffer and ecosystem, encroachment by agriculture. Loss of agricultural lands during periods of high water.	1.3 Protecting wetlands and flood plains 1.5 Flood management systems and infrastructure 1.6 Regulation and enforcement 3.6 Promote alternative sources of income
			Increasingly used by pastoralists from upstream during extended periods of drought. Large-scale burning taking place.	1.2 Promoting productive and sustainable rangelands 3.1 Improve livestock farming 3.6 Promote alternative sources of income
	4.6	Amuria wetlands	Wetland encroachment. Reduction of fish stock. Flooding.	1.3 Protecting wetlands and flood plains 1.5 Flood management systems and infrastructure 1.6 Regulation and enforcement 3.6 Promote alternative sources of income 2.2 Monitoring and planning
Small-scale farm land	5.1	Kotido agricultural lands	Low productivity and erosion.	3.2 Rain-fed farming 1.2 Promoting productive and sustainable rangelands
				2.4 Management of rural water systems 3.6 Promote alternative sources of income 2.1 Access to knowledge
	5.2	Around Moroto town	Low productivity and erosion.	3.2 Rain-fed farming 2.1 Access to knowledge

TABLE 10: LINKS BETWEEN LOCATION, ISSUES AND OPTIONS

Landscape zones	No.	Location	Issues identified	Options
				1.5 Flood management systems and infrastructure
				3.3 Micro-irrigation (<2ha) 1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
			River bank erosion.	1.5 Flood management systems and infrastructure 1.4 Protecting rivers and river banks
			Low groundwater potential.	1.5 Flood management systems and infrastructure 2.3 Management of piped water systems 2.4 Management of rural water systems 2.2 Monitoring and planning
	5.3	Lopei Lokopo agricultural zone	Land shortage.	3.2 Rain-fed farming (intensification) 3.6 Promote alternative sources of income
			Low productivity and erosion.	3.2 Rain-fed farming 1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income 2.1 Access to knowledge
				1.5 Flood management systems and infrastructure
				3.3 Micro-irrigation (<2ha)
			River bank erosion.	1.5 Flood management systems and infrastructure 1.4 Protecting rivers and river banks
	5.4	Lorengedwat agricultural zone	Small erosion issues related to land degradation, deforestation and wood logging.	3.2 Rain-fed farming
				1.1 Productive and protected forests and woodlands 1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
	5.5	Arecek agricultural zone (around Nakichumet)	Concentration of livestock during dry season due to presence of nearby Arecek Dam, leading to overgrazing and land/gully erosion, especially on the vertisols.	1.2 Promoting productive and sustainable rangelands 3.1 Improve livestock farming 3.6 Promote alternative sources of income
			Potential of Arecek Dam for irrigated agriculture is underutilized.	3.3 Micro-irrigation
	5.6	Lorengechora agricultural zone	Especially on north eastern side of the road there are issues with gully erosion due to inappropriate land use and poor application of soil and water conservation measures.	3.2 Rain-fed farming 1.1 Productive and protected forests and woodlands 1.2 Promoting productive and sustainable rangelands
	5.7	Agricultural land around	Land degradation and small erosion issues mainly related to deforestation	3.2 Rain-fed farming

TABLE 10: LINKS BETWEEN LOCATION, ISSUES AND OPTIONS

Landscape zones	No.	Location	Issues identified	Options
		Kapelebyong	and wood logging. Increased resettlement leading to transformation of bushland to agricultural land.	1.1 Productive and protected forests and woodlands 1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
			Low soil fertility outside the wetland causing people to get into wetland farming.	1.5 Flood management systems and infrastructure 1.3 Protect wetlands and flood plains
			Domestic water shortages.	2.4 Management of rural water systems
	5.8	Scattered agriculture around Ochorioramunyait	Land degradation and small erosion issues mainly related to deforestation and wood logging.	3.2 Rain-fed farming 1.1 Productive and protected forests and woodlands 1.2 Promoting productive and sustainable rangelands 3.6 Promote alternative sources of income
			Low productivity.	1.5 Flood management systems and infrastructure 2.1 Access to knowledge 3.2 Rain-fed farming
	5.9	Katakwi agricultural zone	Land degradation and erosion, waterlogging.	3.2 Rain-fed farming 1.5 Flood management systems and infrastructure 3.3 Micro-irrigation (<2ha) 1.1 Productive and protected forests and woodlands 3.6 Promote alternative sources of income
	5.10	Soroti and Amuria agricultural lands	Land degradation and erosion, waterlogging.	3.2 Rain-fed farming 1.5 Flood management systems and infrastructure 1.1 Productive and protected forests and woodlands 3.4 Medium-scale irrigation 3.6 Promote alternative sources of income

5.2 Scenarios

A set of options combined with external factors, government policies, ongoing trends and projections for the future then form a scenario. Thus, a scenario analysis was undertaken to assess the "behaviour" and impact of sets of options under certain expected circumstances or trends. Such analysis aims to select or prioritise those sets of options that counter certain negative trends or accelerate positive trends. This section introduces the scenarios, shows which trends take place when no interventions are carried out and then describes the impact of the options at catchment level when implemented. Thus, scenarios were developed along the three thematic areas of options leading to the achievement of the strategic objectives:

- Ecosystem protection and restoration.
- Improved water and sanitation services for people.
- Productive water infrastructure and farming productivity.

Since the thematic area of "Institutional strengthening" is cross-cutting over the other three thematic areas it is not taken into consideration separately for the scenario development.

5.2.1 Scenario 1: Ecosystem protection and restoration

There are several issues which affect the catchment that can be addressed by the options that fall under the scenario of ecosystem protection and restoration. If these issues are not addressed trends which have negative effects on the environment evolve. These issues include the increase in population that will cause an intensification of unsustainable and destructive practices in livestock herding and agriculture which will threaten the ecosystem functions of wood- and grasslands as well as wetlands. The consequence of these trends can be that the upper wetlands of Napak silt up due to soil erosion from the agricultural zones that is 5.2 Agricultural zone around Moroto and 5.3 Lopei Lopoko agricultural zone. This may substantially change the water balance and negatively impact the downstream part of the wetlands with increased flooding. Below the models for the different scenarios show to what extent the peak surface runoff (and thereby also the soil erosion) decreases under this scenario. In livestock herding the main area of concern is the further deterioration of the upper parts of zone that is 3.1 Moroto grassland and 3.2 South-eastern bushland of Moroto and Nakapiripirit. Scattered patches of agriculture further downstream will have an impact on the forest cover and resources availability for pastoralists. There is also a risk that arable land will deteriorate and more people fall into the poverty trap which makes them migrate to the towns or seek alternative livelihoods such as gold mining or charcoal burning. These scenarios can be foreseen in the upper and middle catchment zones. The lower catchment may also feel the impact because of changes in the water balance caused by a siltation of the wetlands and local flooding due to encroachment and waterlogging. There is a risk that these trends could be further exacerbated by the impacts of climate change, which will make agricultural lands more prone to erosion (Table 11).

TABLE 11: SCENARIO 1 - ECOSYSTEM PROTECTION AND RESTORATION

Trends without implementing the options	Option	Impact after implementing the options
Increased deforestation caused by burning likely to take place in zones 1.2. Mount Moroto, 2.1 Mixed agro pastoral bushland and hills around Chakolomun, 3.1 Upstream thin bushland - Moroto 3.2, South eastern bushland of Moroto and Nakapiripirit, 3.3, Morulinga Lorengedwat grasslands and particularly zones 3.4 Bushlands around Iriri up to Kapelebyong, Tutotoko and Morulinga and 3.5 Nakichumet grassland. Increased resources encroachment into bush and forest for firewood and charcoal by people from within the catchment, but also outside seeking to make business of charcoal. Will happen in zones 2.2 Mixed agriculture and bushland hills around Lotha, 3.1 Upstream thin bushland - Moroto, 3.4 Bushlands around Iriri up to Kapelebyong Tutotoko and Morulinga, Increasing loss of trees due to agricultural encroachment likely to take place from zones 5.3 Lopei Lokopo agricultural zone, 5.4 Lorengedwat agricultural zone, 5.6 Lorengechora agricultural zone, 5.7 Agricultural land around Kapelebyong and 5.8 Scattered agriculture around Ochorioramunyait.	1.1 Productive and protected forests and woodlands	The proposed collaborative forest management will lead to an increase in tree coverage and water infiltration. The regulation of charcoal should lead to a decrease in denudation in critical zones. Provision of alternative tree products will also reduce surface runoff if interventions are strategically planned. Thereby option 1.1 presents huge opportunities for improvement of the catchment's water balance.
Post conflict development is likely to increase the number of cattle in the catchment and the pressure on existing boreholes, dams and tanks in the grassland zones particularly around zones 1.1 Hills around Magosi, 1.2 Mount Moroto, 2.1 Bushland and hills around Chakolomun, 3.1 Upstream thin bushland - Moroto, 3.2 South eastern bushland of Moroto and Nakapiripirit. This may include international cattle migration from Kenya as well.	1.2 Promoting productive and sustainable rangelands	This option critically addresses both the profitability of livestock as well as its function in landscape management. Traditional management of pasture and burning and improved spread of water facilities will dramatically reduce the pressure on grasslands. Thereby siltation of wetlands and rapid surface runoff can be avoided, particularly at areas already suffering from erosion. The emphasis on reduced agriculture in areas of highly variable rainfall in favour of pastoralism will equally have a positive influence on the vegetation cover.
Increased pressure on agricultural land can lead to siltation of wetlands in areas such as zones 4.4 Napak wetlands of Lokere river and, 4.5 Ochorioramunyaid wetlands. Additionally,	1.3 Protecting wetlands and flood plains	Protecting the wetlands and river beds will be a prerequisite to maintain the buffering function and reduce the likelihood of downstream flooding. This option alone is not enough. Only in combination

TABLE 11: SCENARIO 1 - ECOSYSTEM PROTECTION AND RESTORATION

Trends without implementing the options	Option	Impact after implementing the options
increased pressure on the banks of the wetlands at 4.5 Ochorioramunyaid wetlands and 4.6 Amuria wetland will create more peak run off and flooding New settlements around zones 5.7 Agricultural land around Kapelebyong and 5.8 Scattered agriculture around Ochorioramunyait, is likely to increase the agricultural production causing encroachment of the wetlands through burning and the production of rice in the wetlands. Soil erosion would further destabilize the water balance.		with the improved agricultural practices in the agricultural zones upstream, can further siltation be prevented. Additionally, improved agriculture and reduced surface runoff from the agricultural lands in the lower catchment will be required to reduce the pressure on the wetlands.
Population increase and climate change are likely to reduce shallow groundwater sources in the zone 5.2 Around Moroto Town in the upper rivers of the catchment. Sand mining and increased agricultural production could take place along the river banks of Omanimani and Moroto rivers.	1.4 Protecting rivers and river banks	The protection of the rivers and river banks will reduce soil erosion and conserve agricultural lands.
Increased need for agricultural lands demands sustainable forms of flood water regulation around Lopei (5.3 Lopei Lokopo agricultural zone)	1.5 Flood management systems and infrastructure	These are typical catchment improvement mechanisms whereby retention and recharge infrastructure increase the water retaining capacity of the landscape and adds to the profitability. If done right the impact can be expected directly around the areas of intervention in terms of increased groundwater, increased agricultural opportunities. These interventions will also positively influence the water balance slightly, but not as much as for instance 1.1 or 1.2 may do.
Loss of sustainable productive agricultural options will increase the lure of petty gold mining as additional income. The impact of this small-scale mining at catchment level will be small and easy to overcome with better options of livelihood. Large-scale mining will be likely to impact water reserves more substantially	1.6 Regulation and enforcement	If investments in mining and industry also include people from the catchment and the impact on water resources regulated this option prevents negative impact on the water resources.

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- **Strengths.** The strength of this scenario is that the promotion or protection of vegetation (trees, grass and reeds) improves the water balance of the catchment. Soil which is left bare or is burned bare cakes or hardens (hard pans) and therefore causes direct surface runoff. Vegetation reduces the negative impact of rain on the ground and slows down surface runoff, thereby also causing water to infiltrate or delay its arrival in lower catchment (Box 1). The hydrological modelling shows that if wetlands such as the Lokichar wetland disappear, the impact on the lower catchment will be substantial. Caused by the lack of the vegetation of the wetlands the surface water flow from the upper agricultural areas will not be decelerated and the sediments deposited thus increasing the water table in the lower catchment. The protection of rangelands also provides a check on uncontrolled farmland expansion in areas where rain-fed agriculture could be riskier due to variability in rainfall. These areas include the Nakichumet grasslands in the middle catchment. In the lower catchment, the protection of wetlands will prevent further waterlogging and flooding downstream.

- **Weaknesses.** The weakness of the focus on the protection of natural vegetation is the constant attraction these areas have on the population of the catchment. Unless more profitable livelihood options are at hand or strong community based management arrangements are in place the temptation to chop trees, open up wetlands or burn grass unplanned will continue to cause the deterioration of the catchment leading to a so called 'tragedy of the commons' Certain areas such as the Moroto hills are already encroached by farmers. Similarly the downstream wetlands are encroached for paddy or super rice and maize production. Protection of ecosystems requires strong regulations and enforcement; it also requires communities around these areas to share the objectives with the protecting organisation.

- **Opportunities.** Opportunities include the development of management plans with communities. The wetlands in the lower catchment can be protected by community by-laws, alternative crops (upland rice instead of paddy) and the collaboration with district government. Rangeland management for improved pasture and reduced hard pans caused by burning can be arranged through collaboration with traditional pastoralist authorities.

- **Threats.** Population pressure and newly emerging settlements will continue to threaten the protection of critical areas. Drought and climate change also destabilizes pasture management.

Box 1: 3R – Water Recharge Retention and Reuse

Upper Lokere is known as one of the driest areas in Uganda. At the same time the annual precipitation equals the rainfall of many European countries. The main cause of drought therefore is not the absence of rainfall, but the unequal distribution over the year. A set of methods and technologies that aim at keeping the water in the system when it is available and create a buffer for the rest of the year is gathered under the principle of 3R: Retention, Recharge and Reuse of water. Some of the techniques that fall under this method have been used since time immemorial, others have been tried and tested in other areas and can be implemented in new area.

Water recharge technologies aim at redirecting surface water runoff from fields or rivers into the ground. Storing water in the ground prevents water from evaporating, contamination and also causing problems with flooding downstream. Technologies such as a sand and sub surface dams, terracing and infiltration pits fall under recharge measures.

Water retention technologies store water for future usage. Common forms of retention are dams and tanks. Large-scale surface water storage needs to be well understood from a catchment perspective: what is downstream from these dams and will this system benefit from reduced inflow.

Water reuse technologies focus on ways to keep water in the system, so to use or clean wastewater for productive use. Water from households can be used to work for small-scale irrigation and also water from roads can be redirected into dams or the ground rather than discarding it without reuse.

Reference guides on 3R, water harvesting and water buffering can be sourced at http://www.rain4food.net/sharing-documents/ or www.bebuffered.net

5.2.2 Scenario 2: Improved water and sanitation services for people

Newly emerging settlements and population increase in some areas will be the main scenario to deal with when strategizing water and sanitation in the catchment. The consequence of these trends can be reduced sustainability in terms of environmental sustainability (drying up of sources) and technical sustainability (reduced operation and maintenance). The presence of salinity and fluoride will favour the development of alternative technical solutions such as shallow groundwater development and water buffering (Table 12).

TABLE 12: SCENARIO 2 - IMPROVED WATER AND SANITATION SERVICES FOR PEOPLE

Trends without implementing the options	Option	Impact after implementing the options
Increase in population and use of infrastructure requires more operation and maintenance.	2.1 Access to knowledge	Boreholes need to be complemented by water for production facilities to ensure the availability of water.
Increase in population but reduction of groundwater reserves.	2.2 Monitoring and planning	Planning should include the combination of water for production and water for consumption. This could mean more surface water retention and thereby less surface runoff into the wetlands of the middle catchment.
Population increase will cause a dramatic increase in the need to manage water supplies in the towns of Moroto and other rural growth centres like Lopei and Lorengedwat. Poverty will have an effect on the demand for clean water and the willingness to pay for water. Climate change can reduce potential of surface water buffers or deep aquifers to sustainably provide the growing towns with water.	2.3 Management of piped water systems	The impact of managing piped water systems is very limited if the groundwater reserves of Moroto and Napak are sufficient. If not the impact on the well-being of the people will be large and these towns may see less urbanisation. If alternative (unprotected) sources of water remain available, poverty reduces market potential. Increased private sector development of markets

TABLE 12: SCENARIO 2 - IMPROVED WATER AND SANITATION SERVICES FOR PEOPLE		
Trends without implementing the options	**Option**	**Impact after implementing the options**
		will lead to better market supply of water services.
Security and new settlements will increase the demand for improved water sources and potentially also the willingness to pay for water and the motivation to partake in the operation and maintenance particularly in growing rural centres such as zones 2.1 Bushland and hills around Chakolomun, 2.2 Hills around Lotha, 5.3 Lopei Lokopo agricultural zone, 5.4 Lorengedwat agricultural zone, 5.5 Arecek Agricultural zone, 5.6 Lorengechora agricultural zone and 5.8 Scattered agriculture around Ochorioramunyait. Government laws to ban the use of shallow aquifers reduce the potential for clean water in rural growth centres and along river banks. The reduction of NGO activity and poorly equipped government extension services will reduce operation and maintenance.	2.4 Improve rural water systems	The impact is minimal since most of the rural water sources do not pump out water at such a quantity that it effects the catchment. Improvement of the rural water services will only very slightly reduce the groundwater availability. The extension services should be sure that boreholes do not pump out water 12 hours a day only to provide water for cattle. This will eventually negatively impact the catchment when the groundwater reserves deplete and cattle keepers have to migrate again to other areas for water. Part of O&M should be water source protection.
Increase of population around new settlements will cause major sanitation issues. Areas where unsanitary practices are common also see a further fragmentation of settlements as people move to new areas. Areas with an increase of population (lower catchments) have better hygiene practices.	2.5.Sanitation and waste management.	Sanitation has little effect on erosion and peak surface runoff, but large effect on water quality and prevention of diseases.

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- **Strengths.** The provision of water and sanitation for all will increase the well-being of the people in the catchment, reducing water-borne diseases and time wasted by women and children to collect water.

- **Weaknesses.** Currently the operation and maintenance aspect of WASH is poorly safeguarded in communities or local government. Implementation of boreholes has shown considerable problems with pollution reaching the water sources. The history of emergency relief in the upper catchment which brought free infrastructure led to many abandoned or poorly maintained boreholes. Boreholes are also overused to provide for cattle. The influence on the water balance is limited. The influence on groundwater may be negative should more boreholes be developed.

- **Opportunities.** Standards for the implementation of infrastructure and operation and maintenance need to be set up. Opportunities exist which can focus on rechargeable and renewable shallow water sources to reduce the over reliance on deep groundwater. Additionally, opportunities exist to combine surface water storage for cattle with shallow or deep groundwater provision: the so called Multiple Use Services. A business approach to WASH could be promoted.

- **Threats.** Poverty will threaten the water source sustainability when people decide not to invest in their own infrastructure. A business approach to WASH could be promoted, but could be threatened by the organisations which continue to provide free or almost free infrastructure.

5.2.3 Scenario 3: Productive water infrastructure and farming productivity

This scenario is that climate change and newly emerging settlements at marginal agricultural lands with variable rainfall threaten the productivity of agricultural land and rangelands. The runoff models in the next section show the dramatic increase of runoff should large tracks of grassland be turned into farmland. To counteract this trend soil and water management principles should be promoted with subsistence and small-scale farmers through incentives or conditional

loans or programmes. Population increase and market demands will increase the potential for more sustainable and diversified rain-fed agriculture, agroforestry or orchards. Potential for small-scale irrigation or medium-scale irrigation projects needs only to be attempted when farmers have the capital to invest in land and seeds, particularly in the lower parts of the catchment. At present there appears to be little potential besides programmes that require substantial governmental or non-governmental support in O&M. This scenario sees less opportunity for development of settled intensive commercial livestock keeping in the area because of the aridity, climate variability and potential land grabbing. However, against the trends of climate uncertainty and variable rainfall it highlights the need to restrict farmland development in areas with high variability of rainfall and favours pastoralist management of rangelands. The increased development of Uganda as a whole and the further urbanisation will increase the demand for meat and the trend is that the areas with variable rainfall can play a large role in accommodating this trend, particularly if more sustainable burning mechanisms are in place. In these areas livestock production hinges on the availability of water at locations where there is no conflict with agricultural development. There are large tracks of land that remain underutilized because of low water availability. Particularly in the lower catchment there is a huge opportunity for an intensification and marketing, particularly if the right crops are chosen, that is crops which do not lead to further encroachment of the wetlands. For micro-irrigation, this potential is already present in the lower agricultural zones. (Table 13).

TABLE 13: SCENARIO 3 - PRODUCTIVE WATER INFRASTRUCTURE AND FARMING PRODUCTIVITY

Trends without implementing the options	Option	Impact after implementing the options
Climate change is likely to reduce rangeland productivity, particularly in combination with unsustainable forms of rangeland management and uncontrolled burning. This trend will set in motion the increased mobility of herds of cattle, not only from within Uganda, but also from outside, reducing profitability of livestock. Longer dry spells will cause the depletion of smaller water sources in the rangelands of zones 3.1 Upstream thin bushland – Moroto, 3.2 South eastern bushland of Moroto and Nakapiripirit and 3.3 Morulinga Lorengedwat grasslands thereby increasing pressure on larger water resources in 3.1 Upstream thin bushland - Moroto and 5.5 Arecek Agricultural zone and towards the wetlands of 4.5 Ochorioramunyaid wetlands. Mobility will drive livestock to the more fertile and wet areas in the south and west if the above trend perseveres. It will also further increase soil erosion and siltation around the larger water sources in the north east. Increased market demand for beef likely to create more potential for value chain development in beef.	3.1 Improve livestock farming	The option indirectly affects the water balance in a positive way. If market outlets for livestock are improved this could mean more profitable forms of livestock management. In combination with the measures taken at option 1.1 the improvement of rangelands at the expense of agriculture in the areas with highly variable rainfall positively impacts the vegetation. Implementing water tanks and dams and particularly spreading of water sources affects the mobility of livestock and when done planned at landscape level form an excellent tool to manage large tracks of grass and bushland. Cattle follow water and spreading water points and making them limited in capacity but spread out over the landscape reduces pressure on pasture. Increased market demand for beef is likely to create more potential for value chain development in beef.
Further settlements in the zones 5.8 Scattered agriculture around Ochorioramunyait and 5.7 Agricultural land around Kapelebyong will decrease vegetation cover and increase waterlogging of agricultural land. Climate change will negatively impact the productivity in areas of increased settlement and unpredictable rainfall leading to soil depletion, erosion and poverty. This particularly refers to zones 3.3 Morulinga Lorengedwat grasslands and 3.4 Bushlands around Iriri up to Kapelebyong Tutotoko and Morulinga. Insecurity at the borders of agricultural areas around zones with little permanent agriculture in the middle catchment can be foreseen when climate change or water depletion causes increased migratory practices of pastoralism.	3.2 Improve rain-fed farming	This option has been singled out as having the highest possible impact on the water balance. In all the agricultural zones the increase of land under agriculture is directly affecting the water balance through increased erosion, increased direct surface runoff and decreased water buffering and infiltration. Improving the productivity of rain-fed farming through improved methods of soil and water management (in situ) or river related productivity (spate irrigation, recession agriculture) will reduce the direct siltation and peak discharges in the adjacent wetlands. Population increase will create potential markets due to the increased demands for diverse agricultural production in all the agricultural zones. It is expected that value chain development will increase market access for vegetables and cash

TABLE 13: SCENARIO 3 - PRODUCTIVE WATER INFRASTRUCTURE AND FARMING PRODUCTIVITY		
Trends without implementing the options	**Option**	**Impact after implementing the options**
		crops in south western agricultural zones. The fruit factory in Soroti will create positive impact on markets for fruits which improve land and water management practices in the lower catchment and farm productivity. Agroforestry products such as neem will stimulate agricultural development in the upper catchment at zones. The negative trend of climate change should be countered not with improving productivity, but in restricting rain-fed farming in areas of high rainfall uncertainty.
Poverty will reduce the potential for farmers to find investment capital for seeds and land improvement to make small plots a success. Donor driven demonstration plots will only be sustainable as long as the donor is there, but the decreased donor interest in the catchment will reduce the potential. Climate change: erratic and patchy rainfall will affect the potential of small-scale irritation due to high or low inflow of small reservoirs. In the areas in the north the increased evaporation will further reduce the potential. O&M is a major obstacle; people cannot be supported forever to do O&M and desilting is a major issue. Increased dependency on external support renders this option less favourable in areas where donor dependency is a trend.	3.3 Micro-irrigation (<2ha)	Reservoirs for micro-irrigation do not have high impact on the water buffer. Not unless ponds or tanks are implemented at an enormous scale, will the impact on surface runoff also be limited. The lower catchment, around 5.9 Katakwi and 5.10 Soroti and Amuria have higher potential since people are increasingly resettling and appear entrepreneurial. Also in these areas, the evaporation may be less and water availability higher.
Poverty will reduce the potential for farmers to find investment capital for seeds and land improvement to make small plots a success. Donor driven demonstration plots will only be sustainable as long as the donor is there. Unless a popular form of tenure can be devised and an entrepreneurial form of O&M large irrigation projects will remain fully dependant on external support. In the current trend of reduced donor interest and further emphasis on self-perpetuation of development solutions the large-scale irrigation is unlikely to succeed.	3.4 Medium irrigation projects (>2ha)	If medium-scale irrigation should be considered from groundwater sources the impact will be negative on groundwater reserves. Medium-sized and large dams in the upper catchment will reduce inflow of water in the middle catchment. This is not necessarily good since the wetlands depend on these floods. Peak discharges during extreme rainfall events will possibly still enter the midstream wetlands. Another impact is the trampling of soil by cattle that come to drink. In all cases the principle on grassroots interventions and spreading of water sources should be the more sustainable initiative.
Much rain water which could be captured flows away unused and increases the surface runoff.	3.5 Road water harvesting	A typical no regret measure with positive, but small impact. Filling of borrow pits with water, diverting road drains, elevating culverts are all small measures which have a positive impact on agriculture, vegetation and the water balance. Increased security leading to increased transport is likely to lead to more roads. Investments in infrastructure by central government creates more potential for road water harvesting.
The population in many cases will continue to lack the knowledge and starting capital to set up small businesses.	3.6 Promote alternative sources of income	Some people get the opportunity to divert from agricultural or pastoral activtities. Diversification broadens the range of products and markets and attracts new customers. Existing activities can be technically improved and

TABLE 13: SCENARIO 3 - PRODUCTIVE WATER INFRASTRUCTURE AND FARMING PRODUCTIVITY		
Trends without implementing the options	**Option**	**Impact after implementing the options**
		extended which will increase the income. Value chains can be developed like in sorghum, fruit, beef and goat.

SWOT-analysis

- **Strengths.** The scenario that follows from these interventions typically strengthens the majority of the people in the catchment through the provision of support for their livelihoods. The options outlined above already focus on the sustainable increase of production, so the improvement of small-scale farming and the improvement of livestock are in line with the best possible option for the environment. This model is preferred above the other project interventions whereby farmers receive external support for free or where tracks of land are opened for irrigation for investors from outside the catchment and turned into monoculture cropping through mechanized agriculture. However, the scenario follows more closely the economic rationale whereby the increase of agricultural land, even with mono-cropping and mechanized agriculture, determines the surface runoff model.

- **Weaknesses.** From a catchment perspective, the increase of extensive agricultural land can lead to siltation of the wetlands downstream or downslope from the agricultural zones. Even the productivity of these lands will be reduced by the lack of soil and water conservation methods.

- **Opportunities.** The options focused primarily on the development of value chains, for instance in sorghum, fruit or beef and goat, these being the main sources of production in the catchment. Market improvement will lead to the development of viable numbers of cattle and more sales. It will also slowly move from a subsistence farming method to a more production oriented farming method. At the same time the opportunity to collaborate with cattle keepers on rangeland management, improving areas for fodder production will help to improve the situation of the cattle keepers in the area without negative effects on the catchment. Also in the upper catchment, the emphasis on water retention for livestock can keep the cattle herders longer in the upper catchment, so they do not need to travel in search of water. For the agricultural areas, the distinction is between the upper catchment whereby the best opportunity is in soil and water management interventions through conditional support in farm inputs. In the lower catchment, irrigation and alternative crops can give the push towards production which is less detrimental to the water balance.

- **Threats.** The scenario of increased agricultural production in the upper catchment can potentially threaten the productivity of the agricultural lands and also lead to siltation of the Lokichar wetland of Napak. The increased agricultural production of the lower catchment further threatens the ecology of the wetlands as well as leads to siltation. Medium-sized and large dams in the upper catchment reduce the inflow of water into the wetland and can lead to further encroachment into these wetlands by farmers.

5.2.4 Impact analysis scenarios 1, 2 and 3

Model set-up

The scenarios are incorporated in the Lokok-Lokere hydrological SWAT-model (Figure 29) to assess the impact of the combination of options on the water balance. Each scenario was compared to the benchmark model. The impact on the water balance was simulated using the 30-year climate data series (1984-2014) (sim 1) and a data series with climate change projections incorporated up to 2040 (sim 2) using the average projections from UK Met Office (2010).

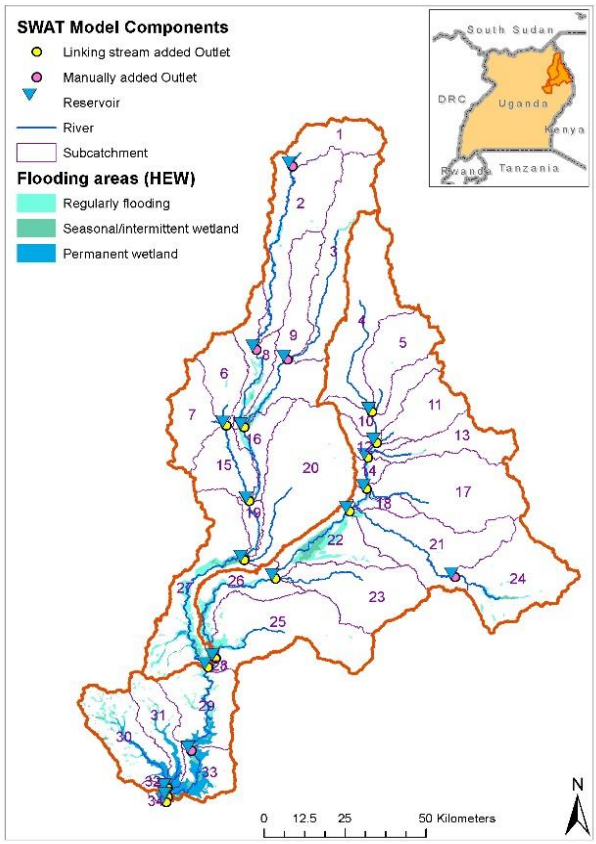


Figure 29 Lokok-Lokere hydrological model set-up

The following scenario models were compared:

- Benchmark model: Current situation (2016),
- Scenario 1: Ecosystem protection and restoration,
- Scenario 2: Improved water and sanitation services for people and
- Scenario 3: Water for production and agricultural productivity.

To simulate the water balance for the catchment the combination of options first has to be translated to model inputs. The options needed to be translated to the impact on the land cover, the extent in which soil and water conservation measures are applied, the projected condition of wetlands, water storage and abstraction rates, population growth and the volume of water for irrigation (Table 14).

As explained, each of the scenarios was run for two situations, one with and one without climate change. The model outputs were post-processed using Python-scripts into water balance tables, runoff-rainfall ratio maps, and graphs showing the river flow at different locations for low, normal and high outflow conditions.

TABLE 14: PROJECTED CHANGES FOR THE THREE SCENARIOS (INPUT TO THE HYDROLOGICAL MODEL)

Model	Land cover, wetlands, management practices	Water abstraction	Climate data input
Benchmark model	Current situation	Current water abstractions	1984-2014
Scenario 1: Ecosystem protection and restoration	All forest reserves fully covered by forest. Full soil and water conservation in all croplands. Bare soils into grasslands. Grasslands to shrub lands. Wetlands increased with 30%.	Water abstractions for water supply follows population growth, minimum coverage (20l/d rural, 35 l/d urban)	Simulation 1: 1984-2014 Simulation 2: Climate change up to 2040
Scenario 2: Improved water and sanitation services for people	Land cover in Matheniko and Bokora reserve remain the same. Land cover outside reserves will further deteriorate: grassland to cropland, shrubland to grassland, wetlands-grassland to cropland wetland-woodland to wetland-grassland, forest and woodland to grassland-shrubland. Result cropland increased 2.4 times, from 2,844km^2 to 67,00km^2.	Follows population growth + high water supply/capita: rural to 50 l/cap, urban to 100l/cap	Simulation 1: 1984-2014 Simulation 2: Climate change up to 2040
Scenario 3: Water for production and agricultural productivity	Similar to Scenario 2. In addition, shrubland (in benchmark) changes to cropland, wetlands (except swamp vegetation) to cropland. Large reservoirs (valley dams) are added in the model in each sub-catchment to	Water supply follows population growth. Irrigation abstractions: Irrigation with water-intensive cash crops, Lokere 14,700 ha = 87 Mm^3/year irrigation water needed. Lokok 6,000 ha = 35	Simulation 1: 1984-2014 Simulation 2: Climate change up to 2040

TABLE 14: PROJECTED CHANGES FOR THE THREE SCENARIOS (INPUT TO THE HYDROLOGICAL MODEL)			
Model	**Land cover, wetlands, management practices**	**Water abstraction**	**Climate data input**
	supply water for irrigation.	Mm^3/year.	

Land cover

The refined land cover map (refined using Landsat 8 satellite imagery of 2015, developed during this project) was adapted for the different scenarios. Together with soil and slope, land cover is one of the three static input parameters for the model. Figure 30 provides the land cover maps that were developed for the benchmark model and the scenarios. To project land cover change for each of the scenarios, first the autonomous land cover change was looked into. In the water resources assessment and strategic social environmental assessment, it was found that the agricultural lands in the catchment are expanding. Over the last 25 to 30 years the area covered by farmlands around Moroto and Lopei-Lokopo doubled. In the lower parts of the catchments farmlands grew into the wetlands and in northern direction. More recently new patches arose around Lorengedwat, Arecek and Lorengechorai. The condition of forests under the auspices of NFA deteriorated. Encroachment of wetlands is seen in many different locations. Only the areas under management of UWA remain more or less intact. These trends were used as the starting point for the projection of land cover for the different scenarios.

Under Scenario 1 “Ecosystem protection and restoration” the condition of the NFA-protected areas improves considerably. The tree density of the forest reserves increases, and farming is excluded. Farming is also no longer allowed in the wetlands. The expansion of agricultural lands is halted, while the productivity and sustainability are increased though the widespread application of soil and water conservation measures. Existing degraded lands are recovered. The condition of rangelands and woodlands improves as improved management techniques are applied in collaboration with communities.

Under Scenario 2 “Improved water and sanitation services for people” it is assumed that nothing is done to protect and/or improve vegetation cover, and address environmental degradation in general. Hence the existing trends will continue. The area covered by agricultural land will increase; the condition of forests, woodlands and rangelands deteriorate. Only the areas under UWA will remain unchanged.

Under Scenario 3 “Water for production and agricultural productivity” the trend towards crop farming will be stimulated. Hence by 2040, except for some protected areas, the whole catchment will be covered by rain-fed farmlands. Wetlands will have been encroached and only the permanently flooded ones remain in place.

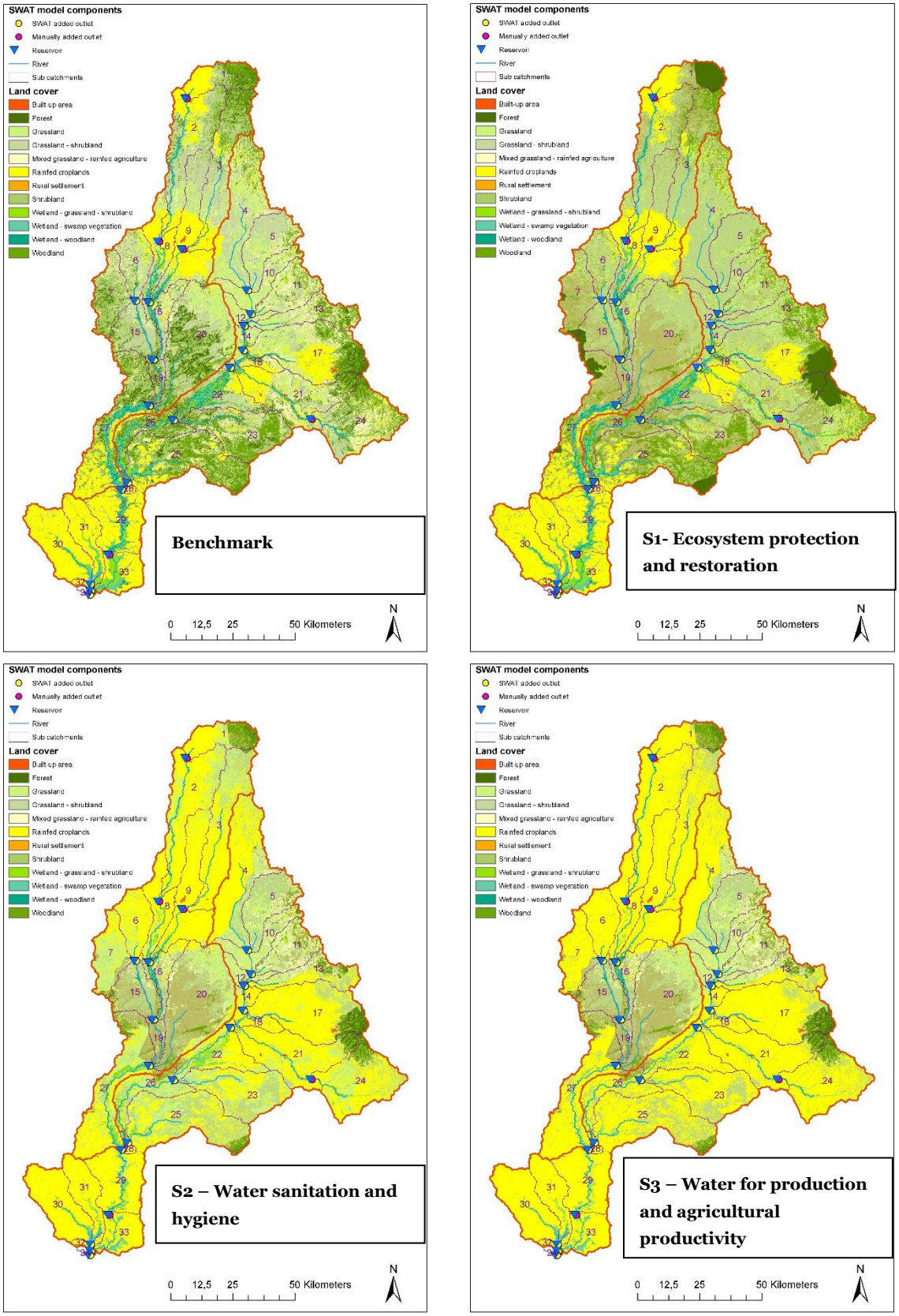


Figure 30: Projected impact of the different scenarios on the land cover in Lokok and Lokere Catchments.

Impact of climate change and land cover on the water balance

Climate change has a large impact on the water balance (Table 15 and Table 16). As one of the major drivers of the hydrological cycle, precipitation increases with almost 20% and becomes more erratic. The impact is non-linear: surface runoff rates triplicate and river outflow duplicates for all three scenarios. Such changes may lead to an aggravation of flooding in lower lying areas. On the other hand, the increase in rainfall also leads to more recharge of both shallow and deep aquifers.

The interventions have a huge impact on different aspects of the water balance. Under the current climate conditions average surface runoff equals 52 mm/year in the "ecosystem protection and restoration" scenario (Scenario 1), 68 mm/year in the "improved water and sanitation services for people" scenario (Scenario 2) and 68 mm/year in the scenario that focuses only on water for production and agricultural productivity (Scenario 3). In Scenario 3 "water for production and agricultural productivity" the high surface runoff is intercepted by dams and valley tanks. Ground- and surface water abstraction is the lowest element in model runs.

TABLE 15: LOKERE WATER BALANCE. ANNUAL AVERAGES IN MM/Y FOR THE THREE SCENARIOS, UNDER CURRENT CLIMATE CONDITIONS (SIM1) AND UNDER CLIMATE CHANGE (SIM2)

Scenario	Precipi-tation	Evapotrans-piration	Surface runoff	Shallow aquifer recharge	Deep aquifer recharge	Surface water abstraction	Ground-water abstraction	River outflow
Benchmark	766	613	69	100	5.3	0.7	0.2	87
Scenario 1 Sim1	766	617	52	105	5.53	0.52	1.39	89
Scenario 1 Sim2	991	683	126	206	10.8	0.52	1.39	205
Scenario 2 Sim1	766	614	68	99	5.22	0.52	3.48	94
Scenario 2 Sim2	991	679	155	211	11.1	0.52	3.48	226
Scenario 3 Sim1	766	616	68	107	5.62	25.8	1.39	71
Scenario 3 Sim2	991	680	155	201	10.6	25.8	1.39	202

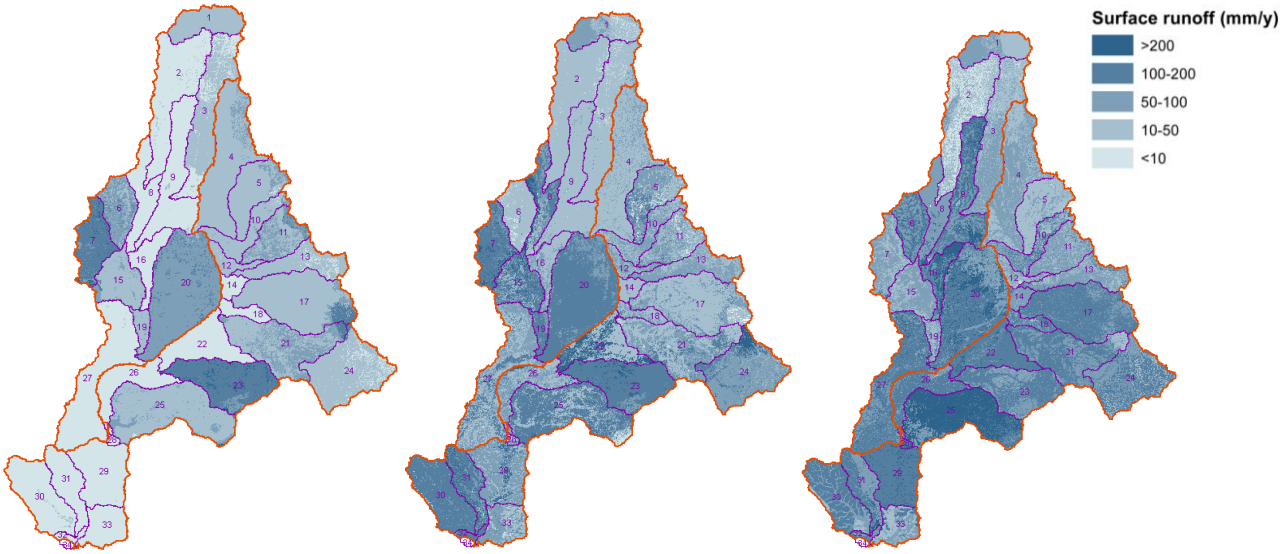
TABLE 16: LOKERE WATER BALANCE YEARLY AVERAGES IN MILLION M3/Y FOR THE THREE SCENARIOS, UNDER CURRENT CLIMATE CONDITIONS (SIM1) AND UNDER CLIMATE CHANGE (SIM2)

Scenario	Precipi-tation	Evapotrans-piration	Surface runoff	Shallow aquifer recharge	Deep aquifer recharge	Surface water abstraction	Ground-water abstraction	River outflow
Benchmark	10488	8393	941	1369	73	9.5	2.4	1190
Scenario 1 Sim1	10488	8455	710	1439	76	4.3	19	1225
Scenario 1 Sim2	13569	9354	1724	2820	148	4.3	19	2802
Scenario 2 Sim1	10488	8413	935	1359	72	4.3	48	1288
Scenario 2 Sim2	13569	9301	2121	2886	152	4.3	48	3088
Scenario 3 Sim1	10488	8432	936	1461	77	169	19	967
Scenario 3 Sim2	13569	9316	2122	2747	145	169	19	2765

Surface runoff

The scenario analysis clearly illustrates the impact of land cover change and land use practices on the water balance. Land cover changes can have a large impact on surface runoff, infiltration and streamflow and other water balance components, especially, when the vegetation cover is reduced, for example due to deforestation, wetland destruction and expansion of agriculture without adopting soil and water conservation measures.

In scenario 1 (Ecosystem protection and restoration) the impact of good vegetation cover and especially soil and water conservation measures in agriculture is obvious (Figure 31). Even when precipitation is high surface runoff is low to very low. In scenarios 2 (Improved water and sanitation services for people) and 3 (Water for production and agricultural productivity) rates are higher due to a combination of land degradation. Climate changes aggravate the situation. These figures indicate that particularly the hourly and daily water balance will be strongly affected. High runoff-rainfall ratios may result in high peak discharges and severe flooding, erosion and increased hydrological droughts.



Scenario 1 – sim 2 | Scenario 2 – sim 2 | Scenario 3 – sim 2

Figure 31: Surface runoff in mm/year for the three scenarios with climate change incorporated

Streamflow

River flow is much lower in scenario 3 under current conditions than in the other two scenarios. However, in conditions of climate change differences between the scenarios are very small.

Figure 32 provides the river outflow for different rainfall return periods. Although the peaks of scenario 1 (Ecosystem protection and restoration) are lower than those of scenario 2 (Improved water and sanitation for people), the total difference in catchment outflow is not much lower. This is due to the increased return flow in the model (flow from the shallow aquifer to the stream), much of the additional rainfall that infiltrates in scenario 1, becomes return flow. So the base flow of the rivers increases in scenario 1 (ecosystem protection and restoration). In the stream flow of scenario 3 (Water for production and agricultural productivity) the impact of the large reservoirs is clearly visible. Although the surface runoff comparable to scenario 2 and the benchmark situation, river flow is lower in all the presented return periods. Especially in the dry years, streamflow is low to inexistent for most of the year. Such developments could prove disastrous for downstream water users and wetland ecosystems.

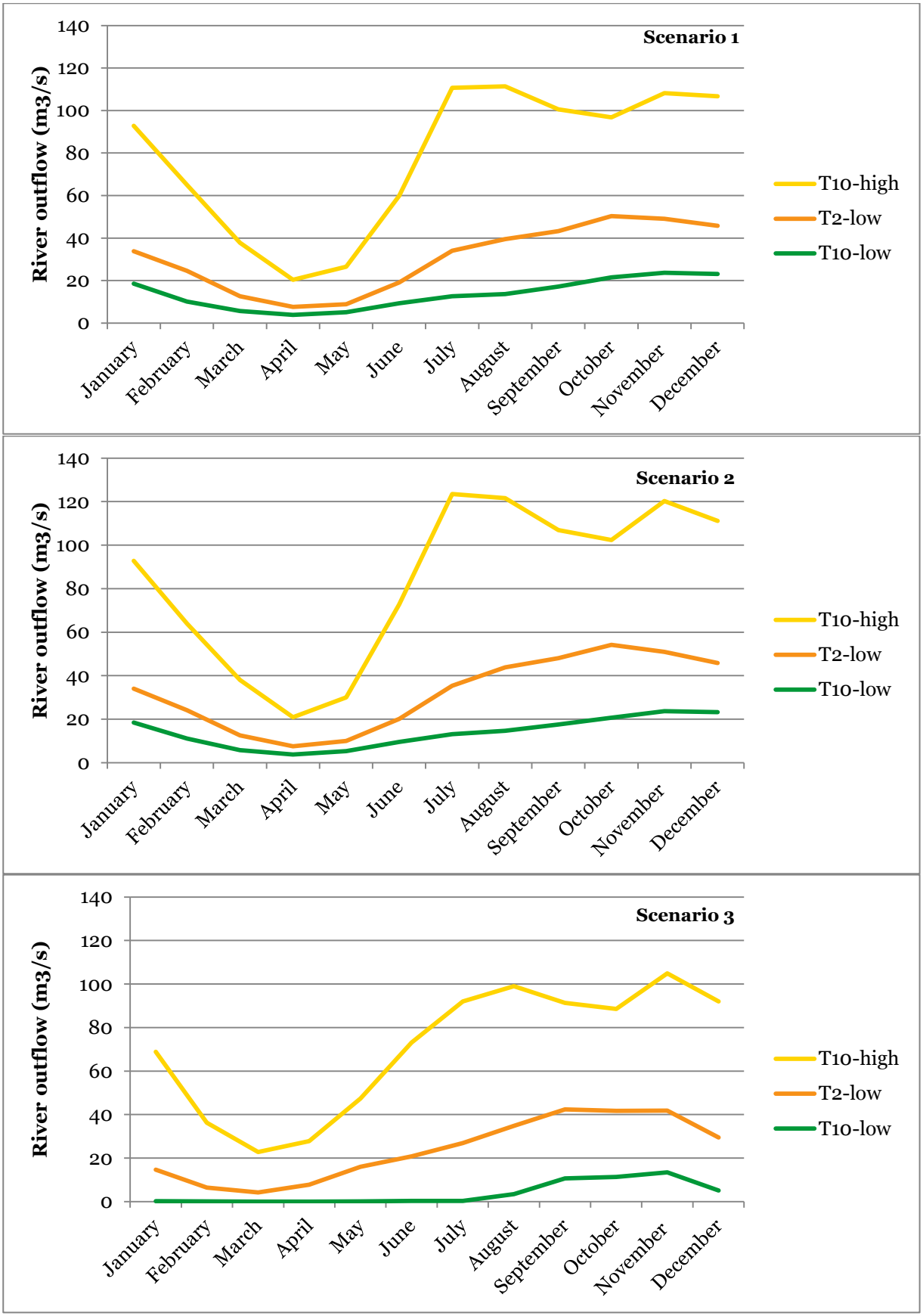


Figure 32: River outflow for months of high (T10), medium (T2) and low (T10) outflow, for three scenarios under current climate conditions

Conclusion scenario analysis

Scenario 1 provides the best results for water balancing in the catchment, while having a positive impact on the environment in the catchment. Water is retained throughout the landscape and the flow through the system is slowed down, although not to the level of scenario 3. This provides increased resilience to the main climate related hazards in the catchment (droughts and floods) in combination with other environmental and economic benefits.

Increased abstractions for water supply (excluding irrigation) have a very limited impact on the water balance. Even in scenario 2 (high abstractions) the 2040 situation, total abstractions only are 0.5% of precipitation. However, due to the absence of environmental protection efforts the water retention capacity of the system reduces. Hence in the short term the options included in this scenario may result in higher safe water coverage, but in the long term the water resources are undermined, and floods and droughts aggravate.

Scenario 3 results in very high runoff-rainfall ratios. The storage capacity of the soils and shallow aquifers is seriously reduced. At the same time storage in surface water reservoirs is invested in and this has quite a large impact on the water balance. The outputs show that Lokere Catchment is able to store quite a relative large amount of water.

5.2.5 Maximum benefit scenario

The scenario and SWOT analyses show that only a combination of options from the three different scenarios can address the water resources use and management issues in a manner that is sustainable in the long run. Options of the scenarios of “Ecosystem restoration and protection”, “Improved water and sanitation services for people” and “Water for production and agricultural productivity” have to be combined. Only then can effective and equitable economic development, the protection of water resources, and disaster and climate resilience be achieved in the catchment. Hence a maximum benefit combined scenario was formulated, based on discussions with the CSF in November 2016, the CMC in January 2017 and KWMZ in January-February 2017 as well as the results from the assessments.

In the maximum benefit scenario environmental protection and restoration is spearheaded. The forests managed by UWA are recovered, wetlands are protected and restored, and rangeland and woodland management has improved the condition of these lands (Figure 33). Instead of expanding farmlands, crop production is intensified in the existing areas whereby soil and water conservation measures are applied to increase both the water retention capacity of the soils, and the productivity. Water for production reservoirs are built as in the scenario on water for production and agricultural productivity, but care is taken that no facilities are small enough and well-distributed to avoid local environmental degradation. Since the impact of water abstraction for domestic use has barely an impact on the catchment’s water balance, in the maximum benefit scenario the investments in water and sanitation are taken as in scenario 2.

A model simulation of this maximum benefit scenario shows that runoff-rainfall ratios are lowered as in Scenario 1 (Figure 33). The widespread application of soil and water conservation measures on agricultural lands reduces to 0 to 10 mm/year. This very low surface runoff is one of the most effective ways to control soil erosion, while increasing the availability of water in the soil profile, and hence supporting an increase in agricultural productivity.

When taking into consideration changing climate conditions, average river outflow increases greatly, but much less than in any of the other scenarios.

Under the simulating conditions of the maximum benefit scenario the T10-lowest annual river outflow (i.e. dry year) equals 446 Mm^3/year, hence the minimum environmental flow of 20% of annual average river outflow (238 Mm^3/year) is guaranteed. However, there is a period of almost four months during which there is no-flow (Table 17 andFigure 34). Currently, there are no indications that this is a problem, but it is important to monitor the impacts of the changes closely as the system is fragile.

The maximum benefit scenario is suitable for Lokere Catchment. It enhances the productivity of rain-fed agriculture, provides the opportunity to expand irrigated agriculture and increases safe water coverage, while at the same time it ensures the availability of water resources in the long term. Yet it remains important to stress that the model includes a great number of uncertainties and focuses on the impacts at catchment level, while the effect of interventions at local level maybe considerable and it is unclear how the biological system will react to the changes in water flow. When planning, designing and constructing interventions (whether it is about protection, restoration or water infrastructure) it

is essential to assess also these changes. In addition, the figures show how important it is to establish functioning and reliable (surface water, groundwater, water quality and biological) monitoring systems in the short term, while at the same time investing in the further calibration of the hydrological model.

In the next chapter the findings of this options and scenarios chapter is translated to a interventions plan.

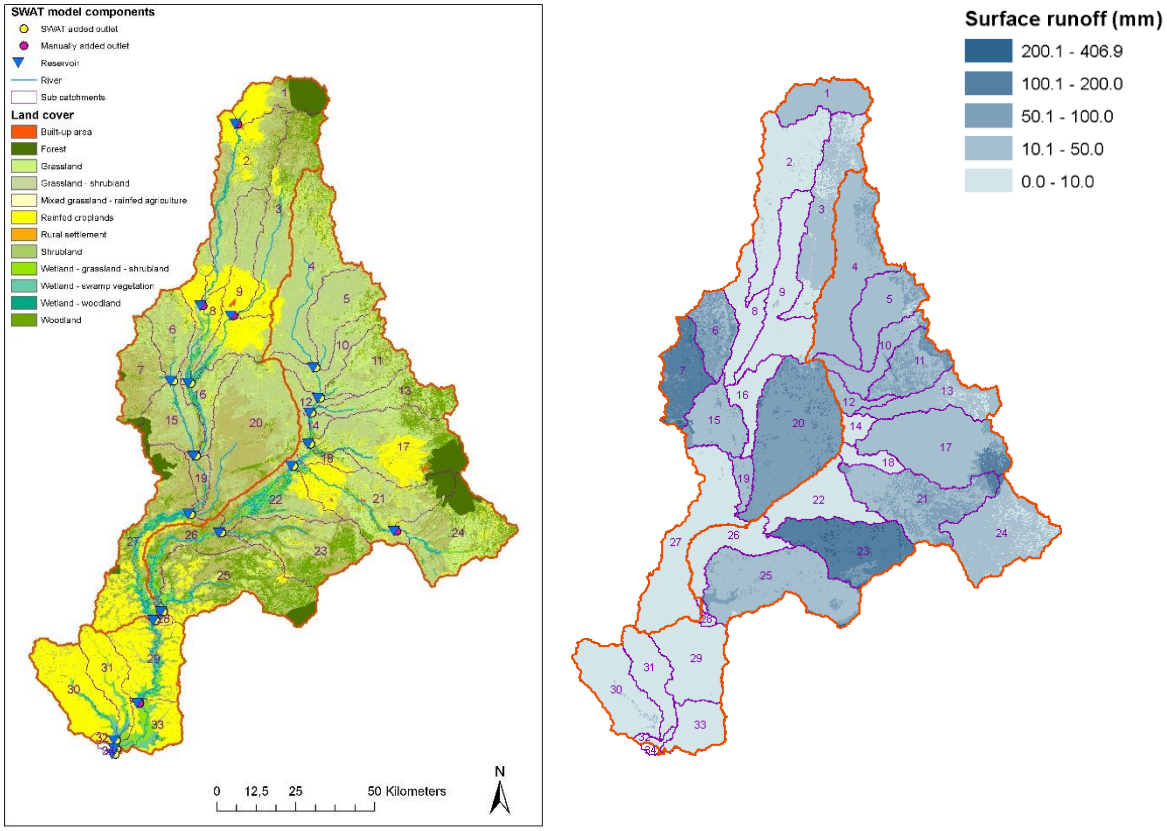


Figure 33: Left: Projected impact of scenario 4 on the land cover in Lokok and Lokere Catchments. Right: Surface runoff in mm/year for scenario 4 with climate change incorporated

TABLE 17: LOKERE WATER BALANCE ANNUAL AVERAGES IN MILLION M3/Y FOR THE THREE SCENARIOS, UNDER CURRENT CLIMATE CONDITIONS (SIM1) AND UNDER CLIMATE CHANGE (SIM2)

Scenario	Precipi-tation	Evapotrans-piration	Surface runoff	Shallow aquifer recharge	Deep aquifer recharge	Surface water abstraction	Ground-water abstraction	River outflow
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Scenario 2 Sim2	13569	9301	2121	2886	152	4.3	48	3088
Scenario 3 Sim1	10488	8432	936	1461	77	169	19	967
Scenario 3 Sim2	13569	9316	2122	2747	145	169	19	2765
Scenario 4 Sim1	10488	8453	711	1183	62	169	48	922
Scenario 4 Sim2	13569	9298	2122	1947	102	169	48	2785

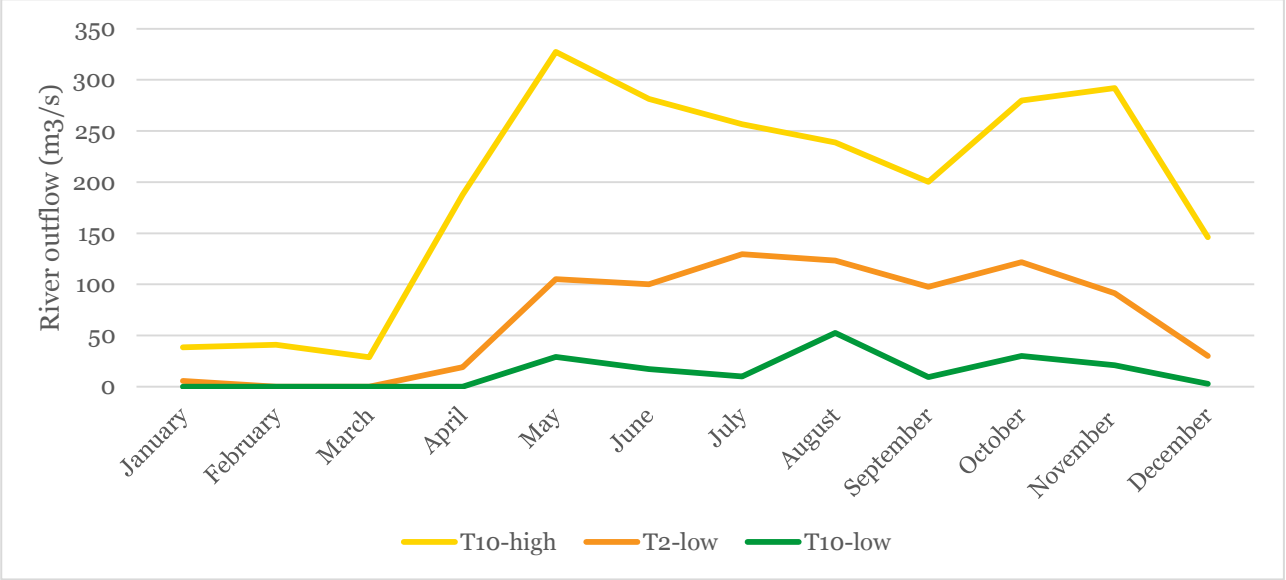

Figure 34: Lokere River outflow for different rainfall return periods, for the maximum benefit scenario, for different rainfall return periods, taking into consideration climate change.

6. INTERVENTIONS

Based on the biophysical and socio economic conditions in the catchment, the process of the assessment of issues, needs and opportunities, the developed vision and strategic objectives, and the analysis of options and scenarios, a catchment management plan has been compiled which presents the thematic areas with their options and corresponding interventions comprising of the maximum benefit scenario. These options and interventions address acquiring new and improved technologies and hardware / infrastructure, operation and maintenance, rules and regulations, administrative changes, economic instruments, research and social change instruments. The interventions contribute to the vision and objectives the stakeholders have developed for Lokere Catchment.

6.1 Thematic area of intervention A: Institutional strengthening

The enabling environment supports the functioning of all actors. It refers to the policies, laws, regulations, budgets, procedures, systems, structures, culture and power relations which are all critical factors for water resources management. They are about organizations, responsibilities, rights and relations. These formal and informal instruments at the level of national government, local authorities and communities support the creation of assets, determine access to systems and structures, facilitate participation and thereby determine the return from any chosen strategy to water resources management and related livelihoods. Through institutional strengthening the enabling environment is transformed to optimise the support of water resources management by policies, regulations, laws, budgets, procedures, systems, structures, culture and power relations. Thereby it lays the basis for a sustainable impact within the other strategic areas of intervention.

Through stakeholder participation and representation in the different CMO bodies as described above the given structure facilitates the institutionalisation of catchment management to the lowest levels. The planned activities under this thematic area will support the implementation and strengthening of these structures.

The Catchment Stakeholder Forum and the Catchment Management Committee have been established in 2016 and need to be further capacitated for their tasks in implementation, monitoring and evaluation of their Catchment Management Plan (CMP).

Further strengthening of the institutional environment includes planning, implementation capacity and knowledge management for all catchment stakeholders. This CMP links various stakeholders from the different levels of Water Resources Management as well as the administrative structures including the catchment, its sub-catchments and micro-catchments, the districts, sub-counties and communities and the WMZ as presented in the horizontal red and pink blocks in Figure 35. Catchment management furthermore requires integration of many sectors, including water, environment, farming, infrastructure and education to mention some. Collaboration between sectors should be strengthened and IWRM knowledge should be built in non-water departments. Development of plans to better manage rangelands, wetlands, forests or farmland requires these sectors to work together. All this cross-sectoral coordination is shown in the brown vertical blocks which also link again the different administrative and WRM levels. By working in multi-sectoral teams during collaborative planning, monitoring and review processes, learning visits and joint assessments, this integrated way of working will become institutionalised.

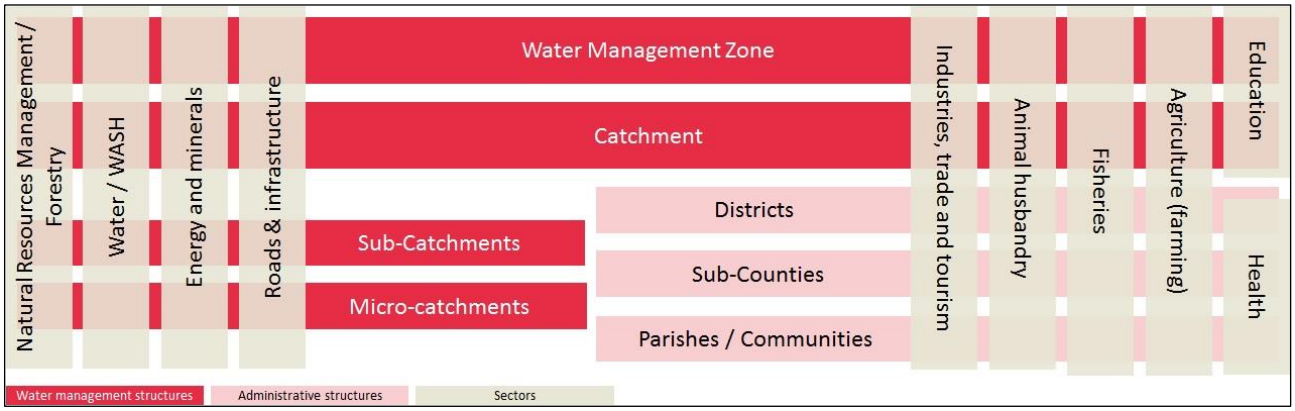

Figure 35: Integration of water management structure, administrative structure and sectors

Capacity strengthening to implement the CMP needs to address the funding constraints and skills shortages, as district technical offices currently operate with many vacant posts, and many of the CMP interventions attribute a major task to the districts and involve strengthening of extension services and local planning. With the additional responsibilities and implementation demands, the districts require strengthening by training and skills development of existing staff, but also recruitment of new staff. On top of that, sufficient funding needs to be ensured and systems and policies need to be in place. Whilst some extension services can be provided by NGOs or SMEs, District Government must be involved in planning and coordination in order to assure political legitimacy of the plans, so that the plans feed into and inform district planning processes. This requires district extension services to be expanded. Furthermore, the district capacity should accommodate their role in coordination and project supervision as well.

The interventions to strengthen the institutional capacities are grouped in 1) Strengthening of the Catchment Management Organisation, 2) Monitoring and evaluation of the CMP implementation, 3) Coordination at district level, 4) Sub-catchment, micro-catchment and community action planning, 5) Funding of the Catchment Management Plan and 6) Learning and knowledge management (Table 18).

TABLE 18: OVERVIEW OF INTERVENTIONS ON INSTITUTIONAL STRENGTHENING

Results		
■ Effective catchment management organisations ■ Collaborative and inclusive planning, implementation, monitoring and evaluation of the Catchment Management Plan ■ Coordination of activities across geographical scales, administrative units and sectors ■ Funding for CBWRM ■ Continuous learning and proper knowledge management for wider application ■ Upscaling of effective interventions through appropriate business models		
Interventions		
Strengthening the CMO: ■ Implementation of CMO governance system ■ Support and strengthen the CMC ■ Establish the CMS ■ Support and strengthen the CSF ■ Establish and support the CTC	District level coordination: ■ Prepare districts for CMP implementation ■ Cross-sectoral district operations ■ Guide lower level CMP implementation ■ Guide development partners	Learning and knowledge management: ■ Awareness raising on CBWRM and CMP ■ Capacity building ■ General stakeholder learning ■ Knowledge management
Monitoring and evaluation of CMP implementation: ■ CMP review ■ Policy development	Sub-catchment, micro-catchment and community action planning: ■ Sub-catchment management ■ Micro-catchment management	Funding of the Catchment Management Plan: ■ Proposal and partnership development ■ Innovation fund (basket fund)

6.1.1 Strengthen the Catchment Management Organisation

The Catchment Management Organisation (CMO) consists of the Catchment Stakeholder Forum (CSF), the Catchment Management Committee (CMC), the Catchment Technical Committee (CTC) and the Catchment Management Secretariat

(CMS) as mentioned above. The Catchment Stakeholder Forum (CSF) was established in the public consultation held in Kotido on 6th September 2016. The CMC was established in the CSF meeting in Soroti on 16th November 2016. The CMS and the CTC still need to be established. The following interventions will enable each of the CMO bodies to fulfil their task and from this position support the implementation of the Catchment Management Plan.

Implement CMO governance system

The guidelines for Catchment Management Planning and later interpretations describe the different roles and responsibilities in catchment management. These include DWRM, KWMZ, the CMO and its different bodies, the districts and other involved institutions. It should be clear how they relate to each other and how they collaborate with the other institutions involved in catchment management.

As part of a sustainable CMO it is recommended to explore opportunities how the CMO can create income as a structural minimal basis for their functioning. Opportunities to explore include contributions by districts and payment for ecosystem services by catchment actors. The exploration should also include the legal structure of the CMO in general and the CMC in specific. If the CMC is expected to earn income and manage funds the legal structure should allow this.

Strengthen and support the Catchment Management Committee

The compostion of the CMC is shown in Annex C. The members will be (re-)elected every 5 years.

The CMC has participated in the catchment management planning process through another consultation in February 2017 in which they were asked to give their input to the Implementation Plan including the selection of interventions, locations, implementing actors and budget. Through their participation in the different CSF meetings and the CMC meeting a basic understanding of CBWRM has been created. Further capacity strengthening is planned to address:

- IWRM: The process which promotes the coordinated development and management of water, land and related resources to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.
- Multi-stakeholder processes: The process to promote better decision making by ensuring that the views of the main actors concerned about a particular decision are heard and integrated at all stages through dialogue and consensus building.
- Collaboration: The CMC brings together different actors from different backgrounds and with different interests in the catchment. Collaboration enables the CMC members to work together to achieve a defined and common purpose. Working as a committee requires capacities on, among others, communication, openness, knowledge sharing, motivation, participation and trust.
- Conflict management: With all the stakeholders and their different interests it is inevitable that conflicts will arise at a certain moment. These conflicts can emerge within the CMO bodies or in the "field" as catchment management is a day-to-day business. The CMC should take up an active role to limit the negative aspects of conflict while increasing the positive aspects of conflict.
- Project management: Many interventions will require a project approach in which the criteria of the intervention are defined as well as the route for realisation, communication, reporting, resources, risk management, etc.
- Resource mobilization: Funding for implementation of the CMP can come from different sources including ministries, public, private sector and development partners. Each source requires its own approach to get access to the available funding.
- M&E: Tracking of progress and results and action in case of deviation from the plan or when new insights arise.
- Guiding implementing partners: All stakeholders of the catchment play a role in implementation of the CMP. The CMC will play an active role to coordinate and give guidance on priorities, approaches and activities to be implemented.

Establish Catchment Management Secretariat

The CMS provides administrative and support services to the CSF, CMC and CTC. The CMS will host and support meetings. The secretariat is the home (or one of the homes) for the catchment's knowledge resources and catchment data. The CMP provides a framework for learning, monitoring and evaluation. The CMS could further support the continuous catchment management planning cycle by the development of a CMP M&E framework and collection of baseline and monitoring data.

KWMZ will act as the CMS at the initiation stage of the newly established structures of the CMO and the implementation of the CMP. At a certain stage this function will be taken over by an individual or team in the catchment. The CMC could explore if the scretariat could be hosted at a CSO active in the catchment or if a new office should be created at one of the involved districts.

Box 2: Multi-stakeholder process facilitation

Effective participation of catchment stakeholders is central to the CBWRM approach. The ways in which stakeholders are involved, what they are involved in and how their inputs are used will be crucial in achieving the overarching CBWRM objectives[9] of:

- Increased awareness and appreciation of the resources systems and challenges and costs of managing them sustainably.
- Instituting sustainable and equitable approaches to IWRM through broadening the scope of knowledge and perspective involved in strategic planning.
- Assuring 'buy-in' to the objectives of water resources management strategies and plans and, therefore, greater ownership and cooperation in their delivery.
- Strengthening partnership-working and concerted action to produce better environmental management outcomes.
- Increased information and experiences sharing leading to enhanced transparency and accountability in resources utilization.
- Conflict management in resources utilization.

The catchment stakeholders are very diverse and range from, among others, water users, CBOs, NGOs and cultural leaders, to government agencies, district offices, politicians and private companies. These different groups have different interests in catchment management and have different influencing power to realise their visions. The CMP is a result of a process of intensive consultation of different stakeholder groups as well as interaction and collaboration of these different groups. Especially the Catchment Stakeholder Forum is the platform to support this process. As their representation at smaller scale, the CMC should be the driver of this multi-stakeholder interaction.

In the continuous catchment management process, the differences between stakeholder groups also require continuous attention. It is important to bring and keep on board the decision makers as these are the people who have power to make the changes which are needed to achieve the CBWRM objectives.The water users, identified as primary stakeholders, have a high interest but their power to influence is limited. By mobilising and empowering this group, their voices and interests can be brought forward and addressed. (i)NGOs and CBOs can be their allies and support them in this process. Regarding the institutions with high power, but with little interest in CBWRM, it is recommended to link up with them to get them on board and convince them of "what is in it for them". KWMZ should follow this process of inclusive participation closely and support the CMC to understand different views as well as to facilitate to the interaction.

Support and strengthen the Catchment Stakeholder Forum

The CSF brings together all stakeholders and creates a formal platform to provide input to the CMP, inform about changed conditions in the catchment and promote the implementation of the CMP interventions. The CMP is a living document and reviews should take place on a regular basis, including a re-assessment (scoring) of options for catchment management and update of the stakeholder assessment in order to timely include new actors and take out those actors which have pulled out of Lokere Catchment.

The CSF can function as a platform for information sharing.

Establish Catchment Technical Committee

The Catchment Technical Committee (CTC) is the technical arm of the CMO. The CTC is foreseen to be a pool of experts formed from the technical staff from stakeholders in the catchment (local governments, NGOs, private sector, etc.), and technical staff of other ministries and government agencies (refer to Annex B for the CMO membership). The CTC brings technical expertise and knowledge during the formulation and review of the catchment management plan, can be involved in the implementation of programmes / projects from the plan, and generally ensures that the different districts in a catchment collaborate to implement the plan.

[9] Source: Operationalisation of Catchment-based Water Resources Management (MWE/DWRM 2010)

Responsibilities:

- The CTC supports the CMC in the coordination of stakeholder driven definition of key water resources related issues in the catchment that require consideration.
- Support the CMC to promote coordinated planning and implementation as well as stakeholders driven decision making related to integrated and sustainable development and management of water and related resources in the catchment.
- Support the CMC in developing catchment management plans and their presentation to the Catchment Stakeholders Forum for endorsement.

The district technical officers will participate in the CTC as part of their regular task. It is of essence that the district resources accommodate for this.

6.1.2 Monitoring and evaluation of the CMP implementation

Developing a plan is just part of managing the catchment. After planning comes implementation and next to that a continuous review and adjustment process should be installed. Subsequently through structured dialogue on the implementation of the CMP, policy gaps are timely identified and the actors are available to contribute to policy development based on practice.

CMP review

The Planning Team of KWMZ has led the CMP development process. Now the CMC needs to take over the lead in the CMP implementation and review. The CMC will regularly discuss the progress of the plan (Figure 36). The CSF will annually discuss the progress of the implementation of the CMP. As part of the annual meeting, there is an opportunity to refine the options scoring framework, so that the whole plan or options within the plan are evaluated against the most relevant framework. An evaluation of effectiveness and efficiency of the CMP should take place on a 5-year cycle. This evaluation should also include the review of the strategic objectives. A mid-term review will be undertaken after 2,5 years.

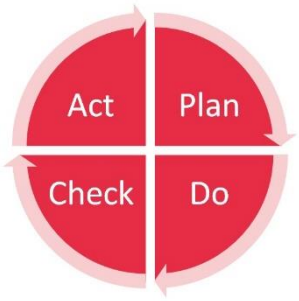

Figure 36: Act-plan-check- do-cycle

In a later stage, also management plans at sub-catchment and micro-catchment levels will be developed. These plans will be subject to a similar monitoring and evaluation process by sub-catchment management committees and micro-catchment management committees, each reporting to the next level of the catchment management structure.

Besides the continuous planning process, data must be collected in order to support fact-based decision making. A CMP M&E framework will support this process and will facilitate structured monitoring and evaluation of the CMP. NGOs and others should align their monitoring in order to facilitate data delivery for the CMP and DDPs. Availability of this knowledge base strengthens the impact measurement of development initiatives, fact-based decision making and thereby will increase the access to funds. The development of purposeful and effective interventions (and sourcing for their funding) is much easier when sufficient information is available to properly understand the problem and when there are clear systems for monitoring impact and learning lessons. Good M&E starts with strong baseline studies and collaborative planning so proposals should provide sufficient funding for this.

Policy development

Discussion of experiences with the CMP implementation and learnings collected through the M&E process will facilitate the identification of policy gaps. Policy development should be on the agenda of the regular CMC meetings. KWMZ and DWRM support policy development at national level and the required linkages to other sectors.

The CMP also requires several by-laws and ordinances as indicated under the thematic areas of ecosystem management and restoration, water and sanitation and agriculture and economic development.

6.1.3 Coordination at district level

District local councils have the legal mandate, technical staff and capacity to manage funds and activities within their district boundaries. As such, the districts play an important role in catchment management and CMP implementation through their own actions and by partnering with CSO actors. The CMP will guide their activities on water resources management and the related sectors. Furthermore, they are an important link towards other CMP implementers at the level of sub-counties, parishes and communities, as well as development partners, private sector and NGOs.

Prepare districts for CMP implementation

A first step in the implementation of the CMP is to get the political support and endorsement by the different district executive councils. Furthermore, in order to coordinate and lead the district IWRM agenda, the districts will appoint focal CMP points. (One of) the technical officer(s) representing the district in the CMC is best positioned as one of the focal points to transfer CMC discussions and developments to the districts.

Whilst the CMP guides water resources management at catchment level, the District Development Plan (DDP) guides development sector-wide at district level. It is therefore critical to align these two guiding documents. After a first intensive planning process at catchment level, the DDPs need to be aligned in order to adopt choices made and priorities set.

Subsequently, whilst the CMC coordinates CMP implementation across districts, districts will be responsible for the implementation of many of the interventions within their district. The districts thus must be equipped and strengthened in their capacity to coordinate, monitor and support partners to implement the CMP interventions within their respective districts. This requires a structured capacity building plan that looks at both human and financial resources required. Emphasis will be on strengthening extension services, sustainability and value for money Activities include, but are not limited to, Human Resource Development Planning, developing in-house courses, scholarships, etc.

Cross-sectoral district operations

By representation of all different sectors in the CSF, CMC and CTC, the CMO actively promotes sectoral coordination for integrated water resources management, meaning the integration of different district ministerial sectors in the planning process. The CMC should take a further facilitating role in regular sectoral coordination, like the promotion of joint planning, monitoring and evaluation meetings between technical officers within districts. District Planner, supported by DNRO and the technical officer who is member of the CMC, should lead quarterly cross-sectoral planning / coordination / learning meetings per district.

Districts report to the CMC and thereby link their district planning and monitoring cycle to the CMP PME cycle. Further sectoral coordination could be organised along similar lines like for example existing coordination structures as the WASH coordination meetings or the DRR platforms. These structures serve as a learning and knowledge sharing platform, as well as a structure for coordination and integrated planning. Under the other intervention areas specific acceleration platforms are proposed.

Box 3 Acceleration platforms

An acceleration platform is a selected group of people from the CMC who coordinate a larger group of service providers from different departments and connect existing programmes/initiatives – including value-chain programmes on forestry, beef, sorghum etc. Acceleration platforms create linkages between different providers and are active in developing service-packages, i.e. bundles of products, finance, advice and business linkages to help kick start enterprises of projects.

Guide lower level CMP implementation

Just as it is the role of the CMC to coordinate it is the role of the districts to repeat it at a more local level focussing on the technical delivery capacity of districts, sub-counties, parishes and development partners at the local levels. These partners may be NGOs, cultural or religious institutions, CBOs, women's groups, cooperatives or small businesses. The existing disaster management structure which goes down from national level to districts, sub-counties, parishes and communities may be suitable to serve very well to coordinate CBWRM.

The technical capacity on the one hand includes the implementation capacity of the district technical offices to deliver services itself or to manage the grants and contracts that enable others to deliver services. On the other hand, the districts require the capacity to supervise and support the work of others. This includes reviewing and approving proposals, as well as supervising, providing support to the delivery partner. Investment is required, so that districts can provide a more active supportive role to partners in implementation. The districts (budgeting by objectives / structured capacity building

plan) must be enabled to strengthen especially their extension services, as well as the collaboration between sectors and build IWRM in non-water departments.

Guide development partners

The CMP and CMC should encourage and support the districts to assess and approve or reject plans of development partners against the catchment management plans. The CMP and DDPs should be leading documents to guide development partners as well as NGO projects. A supportive tool can be a framework for project evaluation. Districts should instruct the development actors to collect data to feed CMP monitoring and further fact-based decision making. Development activities should be tracked by the districts.

Additionally, the districts can establish partnerships with development partners with relevant technical capacity to provide training or support on CBWRM to district officers. If a project involves bringing in external expertise, it should be a requirement that the project also seeks to strengthen the District Councils' capacity by active involvement in the project.

6.1.4 Sub-catchment, micro-catchment and community action planning

Closer to sub-counties, parishes and the water users are the levels of sub-catchment and micro-catchment (Figure 37). A sub-catchment and micro-catchment will specifically invite water users to participate and take action in their own living environment.

Sub-catchment management

Lokere Catchment hosts 5 sub-catchments: Nangaloapolon, Omanimani, Lockoman, Akokorio and Kapir (see also Figure 18). The process of sub-catchment based water resources management is part of the CBWRM process. Splitting up the catchment in smaller sub-catchments can make it easier to organise stakeholders' participation for the planning and implementation of the CMP, as it involves less people to get something done and it is closer to their homes. KWMZ or DWRM could support the CMC to lead the sub-catchment planning process by providing specific guidelines to sub-catchment management planning. After assessing the sub-catchment stakeholders, a sub-catchment management committee can be formed, which actively participates in the development of the sub-catchment management plan. Once the plan is available, implementation and monitoring could start at sub-catchment level, following the same regular meeting cycle.

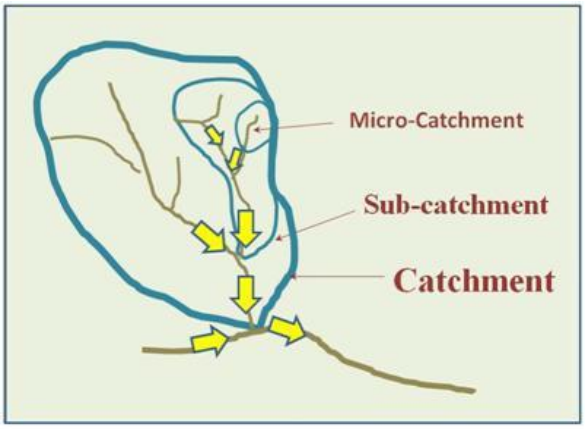

Figure 37: Different levels of catchment based planning

Micro-catchment management

Communities are the most important stakeholders to bring sustainable change. Their participation is very essential for the success of the Lokere CMP. The interventions will affect them directly and therefore their participation from planning to completion is paramount. To ensure full stakeholder participation it is important to involve stakeholders at a level relevant to them. Community engagement can be promoted best through micro-catchment management.

Micro-catchments are the smallest hydrological units. Their extent is defined by the location of the outlet. The location of this outlet is chosen in such a manner that the area is manageable by a micro-catchment management committee. Experience (for example from Tigray and Somali regions in Ethiopia) shows that units with an average area of 5 km^2 are suitable, as these are areas for which the hydrological system can be understood by the local population. Micro-catchment management is especially suitable for water management in populated areas. In areas with a very low population density, management at sub-catchment level is more appropriate and suffices. Indicative calculations show that it would be appropriate to set up micro-catchment management in the agricultural zones of Moroto, Lopei Lokopo and Soroti and Amuria, which cover approximately ¼ of the total catchment area. With a catchment area of slightly over 8000 km^2, this would come down to 400 micro-catchment management organizations.

The extension services system needs to align with the CBWRM approach. Thereby the extension services staff can support the micro-catchment management. The extension staff should facilitate and enable villagers to map their micro-catchment and plan water usage and water resources management. The micro-catchment management plan needs to be multi-sectoral including wetland planning, rangeland zoning, water safety and community managed disaster risk reduction. There is no need to set up a new structure for micro-catchment management. Existing structures like water users committees, dam management committees, valley dam committees or disaster management committees are well placed to be involved in a micro-catchment planning and management process.

Activities include:

- Development and dissemination of a manual on 'How to develop a micro-catchment management plan'.
- Development of micro-catchment maps and plans, which could include wetland/rangeland zoning and land use planning, water safety planning and community based disaster risk reduction As a first step simultaneously to the development of this catchment management plan a micro-catchment management plan has been developed for Omaniman Micro-catchment within Lokere.
- Through quarterly participatory review meetings, communities will have an opportunity to acquaint themselves with what is happening in the micro-catchments and their role in making the project succeed.

6.1.5 Funding of the Catchment Management Plan

Implementation of the CMP requires funding. It can come from different sources including government, private sector, local contributions and donors. Establishing partnerships for funding requires a preparation in proposal development and account management. Apart from project related funding, the catchment is recommended to establish an innovation fund, which is not easily done, but will give opportunities for research and piloting which again will help in acquiring further funding.

Proposal and partnership development

The richness of stakeholders active in the catchment or otherwise interested or involved in the catchment gives opportunities for partnerships to enrich development activities and work more efficiently by joining efforts. Partnerships can be developed with private sector, (I)NGOs or other international development partners, research institutions and academia. Each have their specific added value and sector of interest. Based on the stakeholder assessment, the CMC should identify strategic actors it wishes to collaborate with on specific parts of the CMP and engage with them. A list of stakeholders per sector and their possible contribution is included in Table 25 in chapter 8.2. A full list of identified stakeholders and their possible engagement in catchment management is included in the Stakeholder Assessment and Engagement report. A MoU (Memorandum of Understanding) can help to document these collaborations. Institutional donors are often interested in actions implemented by and bringing together different actors. As such, partnership development can support acquisition of funding for the implementation of the CMP.

In order to position oneself well among potential funders of the CMP, as well as to prioritise among the different possible interventions and to timely respond to funding opportunities, it is recommended to prepare for action through:

- Develop an evidence base of field and desk research, surveys and consultations to support the evidence base required for project proposals.
- Identify possible community-led activities which can be easily adopted by NGOs for inclusion in proposals for funding.
- Conduct feasibility studies and market research to test options and provide baseline data and evidence to support proposals.
- Develop and assess concept notes and business cases in order to select those initiatives for investment which are expected to be feasible and sustainable.
- Explore opportunities for funding of the implementation of the CMP through climate finance funds.
- Develop and implement a fund raising plan to explore possible public and private partners for the implementation of catchment management interventions, research, knowledge management, or funding. Establish a catchment donor platform (or through the Karamoja IWRM group) where donors, NGOs, business partners and other implementers/funders can discuss the opportunities to invest in Lokere Catchment.

Innovation fund

Limited access to credit, finance and technology to set up enterprises and to diversify livelihoods with the potential to improve the lives of the vulnerable communities is a big challenge faced within the catchment. Most funding will be granted to districts, NGOs or CBOs based on a specific plan listing one or more activities and targeting one or more locations. To address this issue, an innovation fund that provides subsidies or grants and supports exploration of potential and develops business cases for innovative interventions will be established. This will enable the CMC to freely investigate techniques and approaches which best fit the area and address the local needs in the most optimal way. Within given boundaries the CMC can decide itself what to use it for. A so-called innovation fund can facilitate the funding of studies, pilot projects, and demonstration projects by government, NGOs or others. Also small grants can be given to communities as an incentive to start and maintain environmentally friendly activities. The establishment of such an innovation fund needs further investigation on the possible governance structure, processes and procedures for the management of the fund, building on models for existing –albeit smaller- funds such as Village Savings and Loan Associations (VSLAs) and the Community Environment Conservation Fund (CECF) explained in Box 4. The CMS can provide administrative support to such a fund, while the CMC is the account holder and decides on which initiatives to fund.

The possible contributors to an innovation fund need further research, but examples include tourists and mining companies (both of whom may be willing to pay a small "catchment management tax"), cattle markets and donors. The CMC should think of a way to see if fees on livestock marketing can be brought back as investments into water for livestock facilities (valley tanks and valley dams). Similarly mining (sand, marble, gold) companies or individuals need to be charged a fee for their extraction activities and the revenue can be used for catchment restoration, improvement of piped water facilities or surface water storage in dams.

In order to attract outside sponsors there must be a clear plan with the objectives of the fund, criteria of eligible actions, accountability and reporting. It will require an active outreach strategy to attract sponsors to pool their funding in a catchment management innovation fund.

Box 4: The Community Environment Conservation Fund (CECF)

Developed by IUCN, the CECF is a mechanism for communities to access micro-credit for livelihood improvements in exchange for engaging in sound management of the natural resources. The fund is conditioned to the implementation of specific natural resources management activities and attainment of agreed communally set targets during for example a (micro) catchment planning process. As of 2014 the CECF had been implemented in Moroto district (Mogoth Parish, Rupa Sub-County) in Lokere Catchment, Kotido District (Naponga Parish, Rengen Sub-County) in Lokok Catchment, Lira, Alebtong, and Otuke of Aswa Catchment, and in Kiruhura District in Rwizi Catchment.
Source: IUCN (2013), IUCN (2014), Egaru (2014)

6.1.6 Learning and knowledge management

Within learning and knowledge management different levels can be distinguished starting from general awareness raising of the catchment stakeholders on the plan and on CBWRM in general. Targeted learning can be organised for highly involved stakeholders. Continuous learning starts with proper knowledge management including knowledge dissemination.

Awareness raising on CBWRM and CMP

Communities must be mobilized through their local political, administrative and cultural leaders in order to orient them about the plan, its objectives and the potential impact to their livelihoods (Table 19). A popularised version of the CMP will be made available. This will help to manage their expectations, settle their possible misinterpretation of the plan and influence their acceptance and participation in CMP implementation. The media can be used for sensitization, especially for the benefit of stakeholders with low interest in the catchment.

Besides awareness raising in the catchment among local stakeholders, one should also target national level stakeholders to promote the plan and ask attention for integrated planning and CBWRM. Relevant ministries to target include the Ministry of Agriculture, Animal Industries and Fisheries (MAAIF), the Ministry of Finance, Planning and Economic Development (MOFED), the Office of the Prime Minister (OPM), Ministry of Local Government (MLG), Ministry of Lands, Housing and Urban Development, Ministry of Tourism and Wildlife, Uganda National Roads Authority (UNRA)

and the Uganda Investment Authority. Presenting the plan will support their understanding of the catchment issues, the CMP objectives and catchment priorities.

TABLE 19: TOOLS AND CHANNELS FOR AWARENESS RAISING

Tool	Objective	Target group
Media campaign	Awareness raising on CBWRM and the CMP	All identified relevant stakeholders (groups)
Outreach materials	Knowledge dissemination on CBWRM, specific parts of the CMP and specific project activities and/or results	All identified relevant stakeholders (groups)
Community sensitization through local music, drama, community elders, extension services and CSF members	Knowledge on CBWRM, best practices, non-sustainable practices and gender	CBOs, community members and local resource user groups (farmers, bee keepers, cattle keepers, fisher men, firewood collectors and charcoal burners), cultural and parish based religious leaders
Local government sensitization	Knowledge on CBWRM and best practices	Local government departments
School course materials	Awareness raising on water source protection, catchment management, ecosystem restoration, etc.	Children at primary and secondary schools and their families.

Capacity building

Capacity building has already been mentioned for the CMO bodies in the sections above and it will be mentioned as well in the other three areas of interventions. An in-depth capacity assessment has been undertaken by PROTOS. This study was not ready by the time of the development of this draft CMP. However, the outcomes of this study may lead to an adjustment of the present capacity strengthening activities. In addition to the earlier mentioned capacity strengthening, and anticipating the outcomes of the PROTOS study, capacity strengthening is recommended for the following:

- KWMZ: capacity to implement a CBWRM programme: e.g. M&E, project management, multi-stakeholder process facilitation, public private partnerships.
- District technical staff: capacity on water source protection, CBWRM, implementation of the CMP, role of the CMC and CTC, contract management, fact-based decision making, multi-stakeholder processes, etc.
- District extension services: capacity on CBWRM, water source protection, implementation of the CMP, role in knowledge dissemination, support to communities, etc.
- Environmental police officers and police officers in general: capacity on enforcement of by-laws, ordinances and regulations.

Any capacity building activity should start with a proper assessment of the current capacities in order to tune any training to the target group.

With all CMOs requiring similar training and capacity building and similar investments included in many of the CMPs, such as the development of manuals and delivery of training support, KWMZ has a critical role to play in promoting collaboration and learning between CMOs within the zone and delivering technical assistance. In other words, for example, where 2 or more CMOs plan to develop a manual on micro-irrigation, the zone can bring people together to develop the resource together: thus saving money and pooling knowledge.

General stakeholder learning

Although learning is embedded in all options through trainings, learning visits, assessments, acceleration platforms and so forth, this activity builds the capacity of the wider catchment stakeholders. This includes:

- CSF learning events, including e.g. cross-catchment exchange visits.
- Trainings, exchange visits and project reviews for water user groups, for example through farmer-to-farmer learning.
- Prepare and disseminate booklets with simplified explanation of relevant laws, policies and guidelines.
- Develop and disseminate training and technical guidance manuals on IWRM/CBWRM, water harvesting and micro-catchment management.

Knowledge management

Issues are more easily brought onto the regional, national and international agenda when data is available to support their claims. Also, the development of purposeful and effective interventions is much easier when sufficient information

is available to properly understand the problem. Knowledge centres must build on existing resources such as NAADS and the GIZ RUWASS knowledge centre. The CMP and all knowledge collected as part of the CMP development process is an important basis of data for the catchment.

To facilitate knowledge and information management it is planned to:

- Establish a library/learning/knowledge centre under the management of the secretariat.
- Ensure that data and learning from the different projects, assessments, pilots and so forth is documented and managed.
- Put in place a knowledge dissemination plan (including use of radio, etc.) that makes this knowledge accessible to as many learners as possible. This will involve adapting learning resources and extension materials to the context and language of learners (through translation or concise summaries and videos).

Initially the library for Lokere Catchment will be established at KWMZ. However, it is highly recommended to bring the information as close as possible to the users. Therefore, when a local CMS has been established, the catchment library will be located there. Alternatively, putting information online is the easiest and quickest way of knowledge dissemination. However, one should be sure that the information will be accessible by all catchment stakeholders, including the fishermen, cattle herders and farmers.

6.2 Thematic area of intervention B: Ecosystem protection and restoration

Ecosystems within Lokere Catchment are increasingly being threatened by various anthropogenic activities increasing the vulnerability of communities. Degradation of ecosystems is manifested by erosion (mostly sheet and gully), degraded wetlands, river banks and flood plains, siltation and flooding. This degradation reduces the ability of the various ecosystems to deliver ecosystems services and results in higher disaster risks.

The progressive, systematic and induced unsustainable management of fragile ecosystems has caused declining resource productivity and resilience, resource scarcities and inequitable access, breeding conflicts, population displacements and increased human vulnerability. Coupled with an inadequate enabling environment within the catchment to support sustainable ecosystem management including institutional systems and structures, the ecosystems are barely capable of ensuring that the communities are resilient to shocks which are commonly experienced in the region. As such, ecosystem management and restoration is key for enhancing land productivity, reducing poverty and improving the quality of life for communities within and around the catchment. This includes the implementation of interventions geared towards sustainable rangeland and micro-catchment management and the promotion of healthy and resilient ecosystems.

The interventions presented under the thematic area “Ecosystem protection and restoration” focus on the following: 1) Productive and protected forests and woodlands, 2) Promoting productive and sustainable rangelands, 3) Protecting wetlands and flood plains, 4) Protecting rivers and river banks, 5) Flood management systems and infrastructure, 6) Regulation and enforcement (Table 20).

To achieve the outcomes, the interventions will focus on developing and accelerating natural resource enterprises, improving natural resource management systems, creating an enabling environment by improving access to knowledge, technical and business support where relevant as described below.

TABLE 20: OVERVIEW OF INTERVENTIONS ON ECOSYSTEM PROTECTION AND RESTORATION

Results	
■ Increase in tree cover and forest based enterprises, ■ Improved natural resource management systems ■ Enhanced awareness and capacity on sustainable forest and wetland management ■ Improved livestock management e.g. grazing, disease control and watering ■ Enhanced public awareness and capacity on sustainable rangeland management ■ Reduced unplanned grazing and rice cultivation in wetlands and improved wetland management systems in general	■ Reduced flood and river bank erosion in risk areas and reduced damage to assets ■ Improved agricultural and investment conditions ■ Increased flood protection of towns and settlements ■ Enhanced awareness and capacity on flood mitigation techniques ■ Effective enforcement of regulations ■ Increased monitoring of impacts of development interventions ■ Enhanced awareness on the importance of natural resources and regulations governing them

Interventions		
Productive and protected forests and woodlands: ■ Improve management of Central Forest Reserves ■ Improve tree cover in degraded areas ■ Regulate charcoal production and firewood use ■ Promote use of alternative sources of energy	Productive and sustainable rangelands: ■ Promote collaborative rangeland management with traditional rangeland management institutions and other stakeholders ■ Protect and rehabilitate rangelands	Protect wetlands and flood plains: ■ Sensitize and create awareness on the value of wetlands ■ Develop and implement community based wetland management plans ■ Restore degraded wetlands
Protect rivers and river banks: ■ Promote river bank management	Flood management systems and infrastructure: ■ Construct flood and waterlogging management infrastructure	Regulation and enforcement: ■ Support enforcement of regulations ■ Regulate gold and sand mining ■ Regulate marble mining

6.2.1 Productive and protected forests and woodlands

Promoting productive and protected forests and woodlands is expected to yield the following results:

- Increased tree cover and forest based enterprises: For most people living in the catchment, especially the poor, forests and trees are the sources of food, fuel, fodder, medicines, and building materials as well as income. In order to improve the productivity of the forests, while conserving the surrounding ecosystems, the development of income-generating and forest product enterprises will incorporate components of incentives to sustainably manage these resources. These enterprises will be designed with the help of participatory forest management plans, enabling all stakeholders to be part of the decision-making.
- Improved natural resource management systems: There is need to strengthen institutional systems and structures on natural resource management, and where there are none, establish them in a participatory manner. This includes creating and training forest management committees, improving local knowledge and resource management and promoting innovation platforms for improved resource management. It further encompasses the use of interlocking stabilised soil blocks, which ultimately reduces the amount of fuel wood used in kilns for brick-making.
- Enhanced awareness and capacity on sustainable forest management: Access and capacity to use diverse methods of generating, acquiring and using forest management information will be developed. For example, the CMC with the support of the NFA will lead the process of developing guidelines, by-laws and ordinances for the sustainable management of forests. Sensitisation campaigns to relevant stakeholders, including the public will also be conducted.

Improve management of Central Forest Reserves

Sustainable forest governance is one of the key approaches towards improving forest management and solving the environmental, social, economic and political issues among forest users and managers, including governments and communities. The CMC will liase with the NFA to promote Collaborative Forest Management (CFM). This approach will reduce resource use conflicts between communities and the government, including addressing the rampant charcoal burning occurring within the catchment. The goal of CFM is to work in partnership with all stakeholders in decision making processes to ensure the sustainable management of forests reflects the diverse interests of all forest users.

Improve tree cover in degraded areas

Increased tree cover has direct impacts on water resources. Moderate tree cover can increase ground water recharge, especially in the dry seasons which are experienced within the catchment. This will be achieved by establishing wood lots of fruit trees and native species in schools, and tree planting on bare land, including along the boundaries of protected areas and roads. In addition, where steep land or land with erosive soils has been cleared for farming, farmers will construct water and soil conservation structures. Moreover, an enabling environment where communities, including forest management committees and extension service officers are trained on collaborative forest management will be promoted. A fund for woodland/forest protection will also be created. This fund will provide subsidies or grants and support to explore the potential and develop business cases for innovative tree species and tree based products which will be established.

Regulate charcoal production and firewood use

Forest management committees will be formed as part of the development of CFM plans. These committees will play a key role in supporting NFA in compliance and enforcement of forest regulations. It is, therefore, necessary to strengthen their capacity on community forestry on public and private forest enclaves through meetings, fora and training on monitoring and evaluation. In addition, the development and implementation of guidelines for charcoal production, which will regulate this destructive activity, and the formation and implementation of by-laws at the local level are recommended. Examples include promoting trees on farms and community woodlots, reducing the demand for wood through the use of improved stoves and live fencing and reducing the demand for charcoal by promoting alternative sources of energy in the major urban markets.

Promote use of alternative sources of energy

Forests contribute, often significantly, to rural income and quality of life, and in a number of ways: directly, as a user of land and resources to transform assets into a range of outputs, and indirectly, through linkages with processing sectors downstream and the provision of non-market benefits. Forests around Mount Moroto, Napak and Kangole are exploited for both forestry and non-forestry related business activities. Strategies that reduce pressure on natural resources will also be assessed and promoted. For purposes of sustainability, CFM will need to adapt to the changing needs by establishing energy plantations of forests preferred for firewood or charcoal, conducting training on briquette production from agricultural residue, promoting the use of improved cook stoves, and supporting start-up businesses around briquetting such as fabrication of briquette presses.

6.2.2 Promoting productive and sustainable rangelands

Implementing interventions that support productive and sustainable rangelands will have the following benefits:

- Improved natural resource management systems: There is need to strengthen institutional systems and structures on natural resource management, and where there are none, establish them in a participatory manner. This includes creating and training rangeland management committees, mapping and demarcation of rangelands, improving local knowledge and resource management and promoting innovation platforms for improved resource management.
- Improved livestock management e.g. grazing, disease control and watering: This will be achieved through increased sensitisation efforts on the value of rangeland protection, and the development and implementation of rangeland management plans, which will include guidelines for bush burning and controlled grazing.
- Enhanced public awareness and capacity on sustainable rangeland management: Exchange programmes for herder associations will be encouraged. Visits to locations where sustainable rangeland management has been effectively practiced is important for horizontal learning and sharing.

Promote collaborative rangeland management

Policies are recognizing the value of pastoralism regarding the sustainable and productive use of the rangelands and that in fact, the pastoral system does not interfere with the rangelands ecosystem, but sustains it. Facilitating dialogue between rangeland users is thus key in improving the management of rangelands. The community and tribal elders who traditionally were instrumental in managing cattle migration, controlling of bush burning and managing conflict, but whose influence is reportedly reduced, should be involved in developing solutions for rangeland management including the extent of rangelands, cattle migration routes, watering points, markets, cattle dips, cattle density including seasonal patterns and document trends in migration and land use patterns; current stocking rates and carrying capacity of all rangelands (all which have been mapped and validated as part of the CMP process) and develop a plan to maintain animal numbers at optimum levels. Alternative strategies for pest control and soil and water conservation measures should be included in the plan. Consequently, an enabling environment where communities can strengthen their skills and enhance their awareness on sustainable rangeland management needs to be created. This can be done through the preparation and dissemination of rangeland management manuals and development of collaborative rangeland management plans; expansion and strengthening of livestock and natural resources management extension services including training/ guided learning, learning visits and catchment livestock network coordination meetings. There are several good rangeland management practices and models adopted in the region with similar landscapes.[10]

[10] Examples are rangeland rehabilitation in the MaMaSe project in Serengeti, Kenya/Tanzania, minimal grazing in Ethiopia and irrigated commercial farms in Kenya. Assessments will be informed by a programme of learning visits to examples of these good practices.

Protect and rehabilitate rangelands

Rangelands in Uganda are a target for investment, including mining and large-scale crop production. In the catchment area, rangelands are used collectively, thus they are vulnerable to grabbing and unsustainable use. By supporting communities to obtain certificate of titles, communities can monitor and bring attention to critical issues on the ground. A secure land tenure policy framework that supports the pursuance of sustainable economic and land use practices that are in tune with people's socio-cultural systems would go a long way towards sustaining livelihoods, promoting biodiversity conservation, and reducing poverty and landlessness in rangelands. Strategies that reduce pressure on natural resources will also be assessed and promoted. Examples include promoting the control of tick-borne diseases by insecticide dips and spraying; sustainable collection of fuelwood (using enclosures, farmer managed natural regeneration, community woodlots, coppicing and lopping); and alternative livelihood options for charcoal producers, promotion of live fencing of kraals and villages and the establishment of fire lines including the use of fire resistant species. There is need to review and document existing by-laws on rangeland management including bush burning and charcoal production practices, which have far reaching impacts on the environment. CMC will support the capacity strengthening efforts to improve stakeholder awareness on regulations and their enforcement.

6.2.3 Protecting wetlands and flood plains

Promoting wetlands and flood plain protection is expected to yield the following results:

- Improved wetland management systems: Activities that can be conducted with, in, and around wetlands, both natural and man-made, to protect, restore, manipulate, or provide for their functions and values will be encouraged. This includes use of natural wetland protection measures and wetland restoration.
- Sustainable utilisation of wetland resources: There is need for inclusive policies, plans and guidelines, and enforcement mechanisms to achieve a marked improvement in the sustainable utilisation of wetlands. Collaborative wetland management plans need to be developed and formal and informal enforcement systems strengthened. As a no-regret measure a wetland management plan was developed for Kokorio wetland in Kapujan Parish, Kapujan Sub-County, Katakwi District.
- Enhanced public awareness and capacity on sustainable wetland management: Effective wetland management requires knowledge on wetlands and their values. Sensitisation and awareness interventions will form an integral part.

Sensitise and create awareness on the value of wetlands

An enabling environment where communities can strengthen their skills can be achieved through improving access to knowledge, improving availability of and access to high quality, affordable local technical services. Trainings and technical guidance/manuals are critical in creating an enabling environment where stakeholders can implement sustainable wetland management interventions.

Develop and implement community based wetland management plans

Approaches towards wetland protection and restoration should pursue strategies that maximise outcomes for catchment management. This includes mapping and demarcation of vulnerable sites and habitats, improving the institutional framework will also contribute to healthy wetlands. Issues of flood management and flood plain protection are also included in the plan. Effective collaborative wetland management will reduce resource use conflicts between communities and the government, including addressing the rampant rice growing in the lower catchment area. Experience from a previous project indicates that for successful implementation communities (e.g. elders, farmers, men and women) have to be involved in planning, demarcation and approaches to reduce the demand for products that destroy the wetlands, e.g. promote the consumption of upland rice instead of paddy rice.

Restore degraded wetlands

Limited access to credit, finance and technology to set up enterprises and diversify livelihoods with the potential to improve the lives of the vulnerable communities is a big challenge faced within the catchment. To address it, an innovation fund that provides subsidies or grants and support to explore the potential for agri-business and sustainable wetland products will be established. Strategies that reduce pressure on natural resources and restore degraded wetlands will also be assessed and promoted. Examples include the demarcation of wetland zones, promotion through training of wetland management committees, awareness raising on the value of wetlands goods and services, promotion of good fishing habits in wetlands and support of traditional leaders to declare some wetlands as traditional shrines and set up community by-laws. Regulation and enforcement of national laws and by-laws can be achieved by strengthening

community and formal enforcement systems where it is appropriate to outlaw unsustainable and unplanned expansion of rice production. The enforcement of the NEMA regulations on rivers and wetlands, including by-laws on grazing and implementation of zoning plans is essential. Creating alternative businesses as well as strict law enforcement on trespassing and unchallengeable demarcation will be fundamental to wetland protection.

6.2.4 Protecting rivers and river banks

River bank protection will ultimately lead to reduced flood and river bank erosion in risk areas: Flood and river bank erosion has direct negative consequences on communities living along the river banks. In order to address this challenge and reduce damage to assets, several interventions are proposed.

Promote river bank management

River bank erosion is evident in the Omanimani and Lokere rivers, where activities such as artisanal mining and cultivation along the river banks are rampant. The seasonal wetlands in Lokichar and Lopei sub-county experience flash floods during erratic rainfall. In order to effectively address the flood issue, there is need to implement interventions to restore degraded river banks and buffer zones through tree planting and grassing. The severely eroded streamlines of rivers in the lower catchment need to be stabilised by the use of techniques such as the vetiver system, construction of gabions and protection of riparian forested areas. Stabilising the loose soil helps to promote plant growth, prevents the loss of land or damage to utilities, reduces sediment loads and maintains the capacity of the river channel. Areas where mining can sustainably take place should be identified together with the communities, mining associations and regulatory authorities.

6.2.5 Flood management systems and infrastructure

- Flood mapping and early warning: In order to effectively address the flooding issue, there is need for a decision support system that provides forecasting data for flood warning and monitoring. This includes collaborative flood plain delineation and hydrological modelling, in order to identify the best suited intervention for flood management.
- Increase in flood protection of towns and settlements: Better monitoring, planning and communication will ultimately lead to increased flood protection for people, their assets and the ecosystem
- Enhanced awareness on flood mitigation techniques: There is need for individuals, institutions and communities to develop abilities to solve the flooding problem. This includes interventions such as sensitisation meetings, creating an enabling environment and building social capital.

Construct flood and waterlogging management infrastructure

Flooding of areas in the Lower Lokere tends to happen because of the saturation of upstream wetlands and agricultural lands which are quickly waterlogged and cause high surface runoff. Measures to increase water infiltration and the storage capacity of upstream wetlands need to be explored. In areas with more permeable deeper soils simple measures as infiltration pits have been very effective in draining excess water. Similarly, roots of trees can break the impermeable soils and allow more water to drain. Treelines along the contours can stimulate infiltration and reduce the negative impact of flooding. Interventions will include training for communities to develop their capacity to operate and maintain identified structures and to manage flood and erosion risks at the community level. The community capacity development will be combined with livelihood improvement support. In addition, unplanned road construction is one of the major reasons aggravating waterlogging problems. While road construction is one of the development indices, the construction has become a problem, calling for systematic planning and adoption of rehabilitation measures to improve road drainage systems.

Box 5: How to construct an improved flood resistant hut?

From the Partners for Resilience programme[11] in Apac, Otuke and Katakwi districts implemented by Uganda Red Cross Society, CARE and TPO Uganda (2015):

Three simple steps to construct a flood resistant hut:

1. Lay building material, locally known as 'kaveera' or black plastic sheeting, on a 1.5 feet raised foundation floor.
2. Build a special soil brick mound to make a conical wall, plastered with a mixture of dung and mud, for termite control.
3. Roof with grass or iron sheets.

6.2.6 Regulation and enforcement

Effective regulations and enforcement are important as a means for the public to build confidence in the planning system. Several institutions are mandated to enforce regulations. However, they face many challenges including inadequate resources (financial and human) and limited awareness on the subject and scope. Some of the interventions that will lead to effective enforcement of regulations are described below.

- Increased monitoring of impacts of development interventions: As detailed in Chapter 5, development interventions, including mining have a negative impact on ecosystems. In order to adequately protect and restore the vulnerable ecosystems, there is need for strict monitoring to ensure compliance.
- Enhanced awareness on the importance of natural resources and regulations governing them: There is need to intensify natural resource governance and management by making information on the laws governing them easily available and accessible. Communities with enhanced awareness on the importance of regulations and legislations have been proven to be more engaged in conservation and protection efforts, leading to better natural resource systems.

Support enforcement of regulations

While numerous policy frameworks relevant for the conservation of the catchment areas exist, what has become apparent from discussions in the catchment stakeholder fora is that enforcement has led in certain cases to duplications, overlaps, inconsistencies, and a system of very weak penalties. Moreover, there is inadequate awareness on the importance of ecosystems and poor enforcement of relevant regulations to protect them. To address this, it is important to document and disseminate existing regulations on sustainable ecosystem management to stakeholders with the CMC taking an active role in this.

Regulate gold, sand and marble mining

The mineral extractive sector in the region is growing. Artisanal and small-scale mining (ASM) of gold, marble and sand provides livelihoods to thousands of individuals. However, the sector is under-regulated and hazardous, evidenced by the use of mercury in small-scale gold production for example in Chapkaraat in Amuria and Acherer and Wutut in Nakapiripirit, with disastrous impacts on water bodies which drain into the catchment. A collaborative approach to sustainable ASM prohibits the use of mercury through the provision of alternatives. Sensitisation and awareness raising targeting the ASM associations and supporting environmental conservation initiatives such as tree planting in the mining areas and collaborative designation of mining areas become important tools. NEMA officials should conduct site supervision and monitoring visits to ensure compliance with set regulations.

[11] The Partners for Resilience alliance consist of Netherlands Red Cross, Care Netherlands, Cordaid, Wetlands International and Red Cross / Red Crescent Climate Centre. In Uganda, the programme implemented resilience measures in the Districts of Amuria, Katakwi, Nakapiripirit, Napak, Otuke and Apac from 2011 until 2015. Implementing partners included Uganda Red Cross Society, Cordaid Uganda, TPO Uganda, Socadido, Caritas Moroto, ECO Uganda and Caritas Uganda and Care Uganda.

6.3 Thematic area of intervention C: Water and sanitation

This thematic area primarily focuses on improved water and sanitation services for people and relates to household WASH, which encompasses potable water, sanitation and hygiene. With safe water coverage below the national average and microbiologic contamination being a major concern in Lokere Catchment, there is a huge task for all responsible institutions at all levels – from MWE to the CMC, and including the Water and Sanitation Development Facility East (WSDF-E), the Karamoja Umbrella of Water and Sanitation (KUWS) and the Umbrella of Water and Sanitation East (UWS-E) – to improve WASH services at household level within the catchment. Moreover, rapid population increase and settlement of pastoralists in transition to agro-pastoralism will cause a dramatic increase in need for water and sanitation services, especially in urban areas such as Amuria, Moroto and Katakwi. For the Catchment Management Organisation (CMO) issues will be the main focus areas under this thematic area of interventions when strategizing water and sanitation services in Lokere Catchment (Table 21).

The first set of interventions focuses on strengthening the capacity of stakeholders on the sustainable utilization of water resources. The second set of interventions focuses on the monitoring and planning capacity for WASH both at CMO and district level. It sees monitoring, data management and modelling capacity strengthened for informed, evidence based planning. The third set of interventions focuses on the management of piped systems which are mostly found in towns and larger settlements and areas designated as growth centres. The fourth set of interventions focuses on rural water supply schemes which largely consist of shallow wells and hand pumps. The reason to separate piped and rural systems is because the complexity of managing piped systems is significantly higher than that for rural schemes from a technology and operational point of view, with maintenance often being sub-contracted to a water utility or contractor. Rural schemes are technically simpler and are managed by committees made up of end users. In rural areas, there is particularly low functionality of the water points, and management committees require significant strengthening and back-up services. The fifth and last set of interventions aims at reducing water contamination and water-borne diseases through improved sanitation and hygiene. The presented interventions will target areas close to and upstream of water points and urban/peri-urban areas where poor sanitation has greater impact than in scattered settlements.

TABLE 21: OVERVIEW OF INTERVENTIONS ON IMPROVED WATER AND SANITATION FOR PEOPLE

<table>
<tr><th colspan="3">Results</th></tr>
<tr><td colspan="2">■ WASH knowledge strengthening of the Catchment Management Organisation (CMO) through capacity building
■ Abstraction and pollution management systems
■ Water resource model, maps and data management systems
■ Potable water planning and design capacity
■ Efficient and effective management of piped water supply schemes</td><td>■ Effective and efficient management of rural water systems
■ Entrepreneurial well and pump mechanics
■ Availability of products and back-up services
■ Increased latrine usage
■ Improved hygiene awareness and practice
■ Increased availability of products and services</td></tr>
<tr><th colspan="3">Interventions</th></tr>
<tr><td>Access to knowledge:
■ Promote capacity building
■ Support extension services
■ Improve knowledge management</td><td>Monitoring and planning:
■ Reinstate climate monitoring
■ Establish groundwater monitoring
■ Strengthen surface water monitoring
■ Establish water quality monitoring
■ Establish sediment monitoring
■ Establish flood monitoring
■ Enforce the water abstraction permit system</td><td>Management of piped water supply systems:
■ Extend and rehabilitate water supply systems
■ Construct new water supply systems</td></tr>
<tr><td colspan="2">Management of rural water schemes:
■ Rehabilitate and close non-functional water points
■ Improve operation and maintenance
■ Promote water harvesting for domestic use
■ Improve deep borehole drilling
■ Promote shallow groundwater development</td><td>Sanitation and waste management:
■ Upscale sanitation programmes
■ Promote waste management</td></tr>
</table>

Coordination of intervention planning and implementation is required at horizontal level among different sectors and vertically at different scales of planning (i.e. catchment, district, sub- and micro-catchment and village). The different types of coordination are presented earlier in Figure 35.

6.3.1 Access to knowledge

Access to knowledge and skills is fundamental to work towards more sustainable water resources management. Thus within the context of learning and knowledge management it is fundamental that integration at institutional levels takes place, so as to best support stakeholders on the ground. That means that DWRM, DWD and KUWS have to work closely together.

Promote capacity building

In regard to capacity building and training to enhance the (access to) knowledge of stakeholders in the catchment the following interventions have been identified:

- Develop and disseminate training and technical guidance manual for district technical staff on supervision of borehole drilling, especially in basement areas and including supervision.
- Strengthen capacity of drilling contractors to site, drill, develop and equip new boreholes.
- Design and implement a capacity building programme for hand pump mechanics associations on wind pumps, solar pumps, maintenance hand pumps, electromechanical systems, source protection, community skills, and other relevant subjects.
- Train local artisans on manual drilling and hand dug well construction, and relate this to water source protection.
- Design, develop and disseminate a practical training programme and technical guidance manual for Water User Committees (WUCs) and other stakeholders on water source protection, repair of infrastructure, financial management and other relevant subjects.

Support extension services

Build capacity of extension services on water sources protection by making the technical DWRM guidelines more practical. Through two-day trainings the extension services will discuss the significance of source protection and how this can be enforced. Biennial refresher trainings will keep both the guidelines and the knowledge of extension services up to date.

Improve knowledge management

Organize a training for KWMZ and local government technical staff on the access to and application of DWRM's data management systems (Aquarius and WIS).

6.3.2 Monitoring and planning of water services and resources

The pressure and demand for water resources is increasing, but water resources and climate monitoring systems are in many cases non-functioning or even absent. For monitoring and evaluation purposes it is important to rehabilitate and expand these systems, and improve on data storage, analysis and dissemination.

Reinstate climate monitoring

UNMA should continue with the rehabilitation of meteorological stations for each district within the catchment. Likewise, a programme will be developed and implemented to re-instate basic weather monitoring (rainfall gauges, wind vans, barometers) at primary and secondary schools, which will be included in the regional weather monitoring plan. Furthermore, mechanisms should be established to promote the transfer of weather monitoring stations installed during road construction to UNMA. Additionally, the CMC (through KWMZ) should lobby at MWE that the measured data and information needs to be sent and disseminated through water bulletins, UNMA or district website(s) or other means. Stakeholders requested to revive the website developed by WFP in partnership with UNMA some years ago. The development and implementation of a management system for transfer and dissemination of weather data and information, including weather forecasting, will enhance effective regional weather dissemination and knowledge. The management system could be expanded and supplemented with the establishment of a database on traditional weather monitoring and forecasting systems, and this local knowledge can be integrated in the weather bulletins and on the UNMA-databases and website. Simultaneously, the states of the current weather monitoring network need to be assessed, and a regional weather monitoring plan should be developed and implemented, including an operation and maintenance plan of the meteorological stations. Existing monitoring stations in Soroti DHQ, Katakwi Kapujan Sub-county, Napak DHQ and Nabuin Nasari should be rehabilitated, and new stations should be established at the district head quarters of Moroto and Amuria. The weather monitoring plan should also foresee to formalize weather focal points at district level – in general this is the Natural Resources Management (NRM) officer -, including the training in roles and responsibilities of these focal points. The relevance and application of weather data will be promoted by technical

district staff (DNRO, DWO, DEO, DIO) and media houses through sensitization programmes (e.g. radio, TV, smart phones, etc.).

Establish groundwater monitoring

KWMZ should upgrade its deep groundwater monitoring network plan, including the operationalization and implementation of it. Existing monitoring wells should be rehabilitated, while new groundwater monitoring wells should be allocated to strategic, high water demand locations, such as: abstraction and infiltration areas of water supply systems (WSS) and intensive irrigation areas (fruit plantations and processors). Like for the deep groundwater monitoring network a shallow groundwater monitoring network should be established for Lochoman and Lokochar wetlands to test the hypothesis on the relationship between floods and storage level of wetlands. For both monitoring networks activities will include, but are not limited to: the identification of existing monitoring wells (currently: four in Lokere Catchment), capacity building to staff on groundwater monitoring, development of a data collection system (software if sensors are used) for storage, validation, analysis and dissemination of monitoring data, an investment and operation plan of the monitoring network, clearly described coordination and support responsibilities to the districts, and instalment of the monitoring stations. For the shallow groundwater monitoring network, new monitoring wells and stations should be installed after the confluence of Nangoloapolon and Omanimani Rivers, in Lochoman Wetlands and in Akokorio Wetlands.

Alongside with the establishment of groundwater monitoring plans, there should be a periodic update of regional deep and shallow groundwater potential mapping at district level. On a yearly basis, all recent studies should be reviewed and include (e.g. Lahmeyer studies, groundwater potential maps of DWRM (2012), national borehole database, etc.), sustainable abstraction rates of water points updated, and shallow groundwater potential re-assessed. Furthermore, a periodic (biennial) re-assessment of the spring functionality, discharges and locations will be performed, to increase the understanding of the impact of environmental degradation of springs, the possible mitigation measures to recover the functionality of springs, and the implementation of such measures. Focus should be on Mount Moroto, Napak Hills and Lower Lokere, where historically most springs are reported. All this should be accompanied by an awareness raising campaign directed to the local government (primarily the district water office), drilling companies and consultants to report the status of boreholes as well as dry borehole drillings. Lastly, it is important that a groundwater model will be built to estimate sustainable abstraction rates to support technical advisory services from KWMZ.

Strengthen surface water monitoring

To advance surface water monitoring a data collection plan needs to be developed, which includes the instalment and operation of gauge readers, and how data and information will be stored, validated, analysed (including calibration curves) and disseminated, to make it easier accessible for interested stakeholders. Currently the measured data is sent to the DWRM head office in Entebbe for interpretation, while beneficiaries are only informed about events of rain, flooding or droughts after the event already took place. Therefore, also flow gauging stations in the main streams (Akokorio and Kapir stations) should be rehabilitated and expanded by DWRM in order to make better predictions of surface runoff, flooding events and water availability. At present under-monitored streams are the Nangololapolon and Omanimani Rivers, especially before they merge with the Lochoman River. Significant attention should be paid to the operation and maintenance (O&M) of the surface water monitoring system, which can be achieved through capacity building and training.

Based on improved river gauging data a surface hydrologic modelling programme can be designed and implemented. This can be built on and continue from the current SWAT model, which will require additional capacity building to hydrologist staff of KWMZ. Furthermore, roles and responsibilities regarding the modelling should be formalized, so that effective operationalization will be achieved. With increased modelling capacity and new validated data from the Akokorio and Kapir gauging stations in KWMZ, the SWAT model for Lokere Catchment can be further calibrated and optimized. For this it is important that the CMP is updated with recent water balance and allocation data.

Establish water quality monitoring

Environmental water quality is currently poorly monitored and the monitoring should be reviewed. KWMZ should develop an operational plan for an environmental water quality monitoring network plan to ensure regular monitoring is taking place. The monitoring plan should include:

- Sediment analysis on heavy metals in streams of urbanizing areas.

- Sediment analysis on mercury and syenite in the upper reaches of rivers Dopeth and Loyoro, i.e. downstream of artisan gold mining sites.
- Ugandan standard water quality analysis downstream of wastewater discharge points (see also wastewater discharge permit system).
- Monitor COD and BOD in Lower Lokere Wetlands.
- Storage, validation and analysis aspects of the collected data.

Surface water will always be microbiologically contaminated, and hence microbiological analysis of surface water in Lokere Catchment is not useful. Likewise, parameters in seasonal rivers differ strongly and rapidly depending on the season and moment in time (first 'flush', moment during rain event, dry – wet season, etc.). Taking water samples periodically at fixed moments does therefore not make much sense, either.

With regard to monitoring of groundwater quality for drinking water purposes a sustainable funding plan should be developed and implemented by KWMZ in collaboration with DWD, district water offices, KUWS and UWS-E, so that – following the national water supply guidelines – 80% of the boreholes in each district are monitored each year. For this equipment, consumables and water quality testing kits should be made available to each district, and supported by water quality analysts from KWMZ office Mbale. Water quality monitoring should be executed according to the national water supply guidelines. Furthermore, an in-depth study on fluoride and salinity parameters in volcanic areas needs to be conducted. These parametres should be included in the monitoring plan and guidelines as well as in the widespread water quality analysis of boreholes.

Microbiological analysis of water is only useful for treated water and water for domestic use. Surface water and therefore environmental water quality monitoring will always be microbiologically contaminated, making microbiological analysis of surface water in Lokere Catchment not useful. Likewise, parameters in seasonal rivers differ strongly and rapidly depending on the season and moment in time (first 'flush', moment during rain event, dry – wet season, etc.). Taking water samples periodically at fixed moments does not, therefore, make much sense, either.

Establish sediment monitoring

A sediment monitoring plan, including data collection, storage, validation, analysis and dissemination as well as the operationalization and maintenance of it should be developed and implemented. The exact method of monitoring still needs to be determined, but can be either the measurement of sediment accumulation in a deposition area or by developing a mechanism to monitor solid matter content. Monitoring of sediment transport through streams and rivers is important to predict siltation of water pans, dams and wetlands, which impacts the functioning and sustainability of (water) infrastructure and the fertility and usability of agricultural areas and (aquatic) ecosystems. To get sediment monitoring in place it is important to request support from MWE at national level during the preparation of the plan, since mandates in this regard are unclear and the analysis capacity is limited.

Establish flood monitoring

Regarding this intervention, it is most important to conduct an in-depth assessment of flooding processes and to implement a flood monitoring network. The flooding processes' assessment should include a detailed remote sensing analysis, statistical analysis of regional climate data of UNMA, river flow data from the Akokorio and Kapir gauging stations, and long-term water level time-series of Lake Kyoga and Bisina. Among communities living in flood-prone areas in Lokere Catchment – and as part of the flood monitoring network – awareness about flood risks should be raised, re-settlement to upland areas promoted, and a household-level flood protection programme designed and implemented. The latter should include the excavation of trenches and infiltration pits, the identification of evacuation routes, and the construction of flood resistant houses. Based on the aforementioned sub-activities a flood early warning system (FEWS) can be developed and implemented, including a corresponding communication plan and identification of what type of flood monitoring has to be in place and where.

Enforce the water abstraction permit system

KWMZ should take the lead in designing and operationalizing an enforcement plan for a water abstraction licensing system. KWMZ can relate to the latest policy developments in this regard at national level. The implementation of a licensing system will contribute to a better, regulated management and more sustainable use of the water resources. Additionally, it should take into consideration different user and use groups, and the periodically abstracted volumes. Therefore, the following activities should be undertaken:

- Review, complement and optimize the set-up of the KWMZ water abstraction permit database, and include coordinates, characterization of wastewater, obligatory monitoring of water levels, etc.;
- Design and operationalize an enforcement plan of the improved water abstraction permit system.

6.3.3 Management of piped water supply systems

Piped water is the safest source of water supply, and is particularly important in towns and rural growth centres where microbiological pollution is increasingly a problem due to poor sanitation practices. To improve the coverage of piped water supply schemes in a sustainable manner it is fundamental that DWD, NWSC, WSDF-E and DWRM work closely together.

Extend and rehabilitate water supply schemes

Firstly, the status of existing piped water supply schemes (including volumes of non-revenue water) needs to be assessed. Refer to Annex G for an overview of the water supply schemes identified during this project. The CMC should take the lead in the revision and completion of a database of all (urban) piped water schemes. Based on this an extension and rehabilitation plan should be developed, while the current operation and maintenance system needs to be revised and complemented with source protection and monitoring of water levels. If this is in place rehabilitation and extension of existing water supply systems (WSSs) can be planned and executed.

DWRM should agree and formalize within its own governing body a licensing system wherein the CMC has the mandate to veto large-scale projects in line with the CMP when they are at the scale of catchment level. This mandate does obviously not apply for overarching projects at regional or national level. All districts in Lokere Catchment should receive extra support from the DWD to repair and extend their piped town WSSs, review utility contracts and enforce improved O&M by the operator.

Construct new water supply systems

For the planning and construction of new water supply systems, rural growth centres need to be mapped and the current water demand without a WSS in place be assessed. After feasibility studies have been conducted plans can be developed to implement new WSSs, which should also encompass the establishment of sustainable (ground) water abstraction rates, design, operation and maintenance (O&M), capacity building and source protection of the newly proposed system.

6.3.4 Management of rural water supply systems

Due to poor sanitation and sharing of water points with livestock, contamination with e-coli is very common in Lokere Catchment. At the same time, district governments lack the (financial) resources and capacity to combat the poor sanitation situation as well as the causes of water-borne diseases. DWD should allocate additional resources to the district governments to effectively reduce negative impacts of poor sanitation in rural areas and set up a water quality monitoring system.

Rehabilitate and close non-functional water points

There are several sub-activities that can be executed as part of this intervention. Firstly, the domestic water gap analysis and maps should be updated upon each new population census. Furthermore, the functionality of all water points should be periodically (annually) re-assessed. Based on this assessment it can be decided and planned which water points to rehabilitate and close those that will no longer be used. Water points should only be rehabilitated if community contribution is in place: 1) else it undermines the district water point rehabilitation system and 2) it will create a sense of ownership among the community. The water point data collection forms should be adjusted and aligned so that it is possible to create a comprehensive report of all water points. Attached to this system optimization is the capacity building of the district water (DWO) and district production (DPO) officers, and the implementation of a long-term funding plan to ensure that all resources are in place to monitor the water points. KUWS could support in this regard. A sensitization campaign on water source protection and the contamination potential of old non-functional boreholes should be included. In line with this, an awareness campaign for communities and hand pump mechanics should be implemented by the respective district water offices to report non-functional hand pumps. DWRM should assist the district water offices in the establishment of feedback mechanisms which provide an analysis and summary of the collected borehole data.

Improve operation and maintenance

Improved and effective operation and maintenance (O&M) of water sources and water source protection in accordance with the water source protection guidelines (refer to MWE 2013) is an important aspect of catchment based water resources management (CBWRM). In this regard DWD, DWRM and KUWS should work closely together. The development of effective water source protection measures can be in cooperation with the CMC of Lokere Catchment and in conjunction with the Lokok CMP. Improved and more effective O&M can be achieved through:

- Design and commence WUC pilots. The number of WUC-members is reduced to three, while they are paid for their activities. Raise awareness in the community that they should hold the WUC accountable for their performances.
- Support the deconcentration of hand pump mechanics associations to the lowest levels (i.e. as close to the source and the water point as possible), request the legalization of these associations in the Water Act, and advocate for adjustment of the Public Procurement and Disposal of Public Assets Act, so that repair and rehabilitation works can be commissioned to handmpump mechanics associations, which is less expensive for local governments and users, and makes the associations more viable.
- Support (through subsidies) ventures that sell spare parts for boreholes, pumps etc locally.
- Assess the success of WATESO and upscale the establishment of water cooperatives. Identify factors of success, main challenges and opportunities, and stakeholders to be involved.
- Design and commence a pilot on pre-paid water supply. NWSC has initiated a pilot in the outskirts of Kampala.
- Assess success, main challenges and opportunities, and main stakeholders to be involved in the "Borehole as member of the VSLA" approach by TEDDO. Adapt this approach for upscaling to other areas in the catchment.
- Set up a pilot in which a percentage of the VSLA is allocated to water point maintenance, such as is being piloted in Agago district.

Promote water harvesting for domestic use

Regarding (rain) water harvesting for domestic use the following sub-activities were established:

- Develop a manual and simple guidelines on rainwater harvesting, including operation and maintenance (O&M) systems.
- Determine locations for rock catchments for water for domestic use. Assess potential for water storage from rocks at Mount Moroto, Napak Hills and scattered granite inselbergs in Lokere Catchment. Subsequently, verify the different options with local water demand, surrounding communities and the DWO. Set up a management plan and construct the water harvesting infrastructure.
- Assess the potential for water storage in river beds through the implementation of sand and sub-surface dams. Conduct a feasibility study and assess river beds, map settlements along the river and their current water needs. Discuss the findings with the DWDs and communities. Agree on an operation and maintenance system, and construct the water harvesting infrastructure. Especially the river bed of the Nangaloapolon River looks promising, therefore locations close to villages like Lokanavona, Lomenona, Toroi and Toro Central should be assessed.
- Design and commence a sensitization campaign on rooftop water harvesting. Promote roof water harvesting for all building with tiles, metal sheets or plastic roofs within Lokere Catchment.
- Identify appropriate schools, health centres and other institutional buildings and equip them with rooftop water harvesting systems. Ensure that the respective institutions contribute to the construction to build a sense of ownership.
- Design and start several pilots on compound rainwater harvesting for domestic water use. Establish the conditions of such pilots as well as areas for pilot implementation.

Improve deep borehole drilling

The CMC should coordinate, under auspices of KWMZ, DWD and KUWS and with support of development partners, the provision of training to district technical staff in supervision and contract management regarding deep borehole drilling, so they better know what to look for in terms of the contract as well as during the actual drilling. Improved understanding of deep borehole drilling, technical supervision and contract management will increase both the success rate as the sustainability of boreholes significantly.

Promote shallow groundwater development

In areas of shallow groundwater, there are business opportunities for local artisans (including existing pump mechanics) in manual drilling and hand dug well construction. This will require training in manual drilling and hand dug well construction to local artisans at district level, while the capacity of local contractors needs to be developed to site, drill, develop and equip new boreholes. The artisans will be supported at catchment level to establish SMEs and their work

assessed for quality assurance, through re-directing external willingness to invest, for example through the development of guidelines, in water infrastructure.

Such a niche market can be boosted through the establishment of pilots. The proposed pilots should focus on shallow groundwater development through manually drilled shallow wells in river banks for domestic use, supplementary irrigation and livestock watering. Periodically the results of the pilot should regionally be disseminated, while in general awareness should be raised on the opportunities, potential and need for development as well as protection of shallow groundwater wells.

6.3.5 Sanitation and waste management

Especially in rural areas, sanitation coverage is low and open defecation high. This can result in contamination of water points and prevalence of water-borne illness. It is difficult to state to what extent water points are contaminated by human or animal faeces due to the lack of water quality testing, but it is likely to be greatest in the rainy season, in areas of shallow groundwater especially if the well head is cracked or lacks a sanitary seal. In promoting greater latrine use, the water point mapping will identify water points which are contaminated or at risk. Priority will be given to water safety planning which involves safeguarding sufficient, safe water throughout the year.

Upscale sanitation programmes

Detailed information about the current hygiene and sanitation status and practices in Lokere Catchment is still lacking. Therefore, contextualized sanitation plans and approaches need to be implemented with village elders and community leaders. Dissemination materials on simple hygiene and water treatment options have to be developed. Also the capacity of village health teams should be improved and scaled up to implement several hygiene and sanitation programmes, such as:

- Community Led Total Sanitation.
- Child Hygiene and Sanitation Training.
- Participatory Hygiene and Sanitation Training (through schools).
- Village Environmental Sanitation Teams.
- Elder-related sanitation approaches.

Furthermore, the intervention should focus on raising awareness of the benefits of improved sanitation and hygiene. For dissemination of the message of a sanitation awareness campaign, radio, churches, district health clinics and departments, NGOs, community leaders and school teachers will prove to be effective media. In close co-operation with village elders and WUCs, a joint plan and approach for improved education about hygiene and sanitation will be developed. By promoting awareness in schools, children can be encouraged to promote behaviour change at home. While DWD should support the development of improved WASH facilities, the Ugandan Ministry of Health, together with locally active NGOs, should:

- Develop a WASH education package for schools.
- Support WASH community awareness programmes.
- Develop dissemination materials on simple hygiene and water treatment options.

Likewise, for domestic use, for pastoralist communities an awareness raising campaign should be implemented to sensitize kraal leaders on the importance of WASH and the need for stricter separation between livestock watering points and those for domestic use.

District governments – with support of KWMZ and development partners and in line with the National Health and Environment Act – should implement programmes to enforce latrine construction when constructing a house. Respective district departments (DWD and DHD) should monitor that distances between water points and depths as stated in national guidelines are respected. Water points should only be rehabilitated and boreholes drilled in conjunction with latrine construction at sufficient distance from the abstraction point and a hand washing facility in place. In regard to new sanitation facilities, significantly more latrines should be built in towns, at markets, near churches, health centres, and close to valley tanks and dams. The overall objective should be to elevate people from open defecation to at least improved or shared sanitation facilities, which is linked to the sanitation ladder (WHO/UNICEF).

Promote waste management

In regard to waste management two types of waste management can be distinguished: 1) solid waste (including electronics and batteries) and 2) sewerage. For both a waste management system needs to be developed, strengthened and implemented by the district governments for urban and rural growth centres. Therefore, current waste management practices need to be assessed and a plan developed, which should also include the processing, funding, design and implementation of such waste management systems. Ventures that invest in reuse and recycling need to be encouraged and emphasized.

6.4 Thematic area of intervention D: Agriculture and economic development

The economic developments which have an impact on the water balance mostly revolve around subsistence agriculture and pastoralism:

- No large industrial facility has yet entered the catchment or has any significant impact on the water balance.
- The majority of the people live in rural areas of the catchment where they derive their livelihood mainly from crop farming or livestock and increasingly from exploitation of mineral resources through small-scale gold mining.
- Tree cutting for firewood, brick making and charcoal increases, especially during the dry season.

Because the main limitation in agricultural productivity is uncertain rainfall, the key to increasing profitability and resilience to climate shocks is to improve soil moisture availability and conserve soil and water. Poverty and absence of sustainable alternative livelihoods seem to fuel a dependence on the exploitation of natural resources and discourage sound resource management. Improving the profitability of farming can reduce poverty and improve health and nutrition of the poor while at the same time encouraging natural resources protection. Furthermore, at present there is little protection in communal land ownership that may help the population in the catchment to be engaged in decision making for more intensive agriculture.

The interventions presented in the next sections seek to increase the production and sustainability of subsistence agriculture while making steps towards the development of environment-conscious cash crop farming. The interventions focus on farmer-led, market based solutions that create profit whilst sustainably using the natural resources. The opportunity to earn cash and build businesses is a primary driver of change especially for interventions that can be adopted by individuals or small groups. These interventions combine the development of business opportunities with the maintenance and recovery of healthy and climate resilient ecosystems.

Agricultural production can have a high impact on the environment and the water balance. When developing the agricultural sector, appropriate measures have to be taken to mitigate the effects of projected climate change, including the more erratic and higher intensity rainfall events. The interventions selected to boost economic development in Lokere Catchment seek to demonstrate the potential and profitability of commercial farming, and provide support to farmers in the form of knowledge, products, services, finance and business. The interventions include support to livestock farming and rangeland management, rain-fed farming, promotion of micro-irrigation, medium-scale irrigation, road water harvesting, and inward investment (Table 22).

TABLE 22: OVERVIEW OF INTERVENTIONS ON AGRICULTURE AND ECONOMIC DEVELOPMENT

Results		
■ Reduced soil erosion ■ Increased incomes and more (climate) resilient livelihoods ■ Improved agricultural and livestock production which results in increased food security, health and nutrition status ■ Improved ecosystem services from farmlands, which amongst others contribute to water security ■ Increased availability of farming products and services, which augments the productivity and profitability of farming ■ Business development, which supports entrepreneurial farmers, and small- and medium-scale farming enterprises ■ Inward investment support programme		
Interventions		
Improve livestock farming: ■ Research into livestock value chains ■ Develop and implement a plan to improve access to water for livestock (and irrigation) ■ Improve access to pasture and rangeland management	Improve rain-fed farming: ■ Promote sustainable and productive rain-fed farming	Promote micro (<0.5 ha) and small-scale (<2 ha) irrigation: ■ Promote micro- and small-scale irrigation

Promote medium-scale irrigation: ■ Promote medium-scale irrigation	Promote road water harvesting: ■ Implement road water management and harvesting	Promote alternative sources of income: ■ Promote alternative economic activities

6.4.1 Livestock farming

Livestock farming is by far the most important source of income in the catchment, but productivity, profitability and sustainability can be further improved.

Research into livestock value chain development (beef, dairy, horns, skins, goats etc,)

The research focuses on the current and upcoming programmes in the livestock value chain development such as beef and hides. Several NGOs, ministries (MAAIF and research institutes (Nalirri) are working on livestock value chains and there is a risk that development partners do the same projects or parallel programmes on similar topics. The priority of the research should focus on the opportunities to develop the beef sector and cattle related products (hides, horns, bones) whereby the researchers explore existing best practices or elaborate proposals to increase the strength and profitability of livestock breeds. With existing best practices also the livestock breeds which are best adapted to the catchment need to be selected.

The research on the livestock markets needs to take into account:

- The specific dynamics of a pastoralist livelihood (mobility depending on pasture and water).
- Opportunities of new markets can lead to a reduction on the pressure on pasture during the dry season.
- Alternative national and international markets. The closure of the Juba market leads to the overstocking of certain areas in Karamoja. Alternative markets can help to reduce the pressure caused by international dynamics.

Other alternative outlets that need to be researched are the the profitability of a privately held slaughterhouse in Moroto. Currently the slaughterhouse is believed to be publicly held and the production limited. In the study on the beef value chain (Annex D) an outline can be found whereby private sector development (chilled transport to offset markets) facilitates the marketing of cattle. This means that business studies should be made on existing markets in order to understand better the conditions under which pastoralists will decide to market their cattle (and at which time of the year). It would be ideal for market development if pastoralists can be organized as groups such as livestock cooperatives or following the Alomar. These can be then more easily approached by slaughter houses, markets, impact financiers or other interested parties to engage into improved stock breeding, product diversification (skins, horns) etc.

Develop and implement a plan to improve access to water for livestock

Interviews with pastoralist groups in the catchment revealed that decisions to migrate to new pasture were mostly motivated by a reduced availability of water for livestock. For instance, in the areas to the east of the catchment (the Moroto grasslands north of Mount Moroto) and particularly the Pokot areas south of Mount Moroto, pastoralists move to the west as soon as the water sources deplete while there may still be reasonable pasture in the dry season, but not enough water to support the cattle. Medium-sized dams exist in the area, which cater for vast numbers of livestock. Especially around these dams overgrazing occurs in the dry season, causing pastoralists to move further away in search of pasture (Figure 38). At the same time the overgrazing around the dams and the trampling of the soil increase siltation of the dam reservoirs. In many cases cattle move freely into the dam reservoirs and consequently the bare soil around the dam is easily picked up by surface runoff. In some areas pastoralists resort to borehole water, thereby putting pressure on underground water reserves, thus overusing the infrastructure and in general reducing the availability of water and endangering the water pumping technology for domestic use.

To amend this situation a study should be conducted to improve rangeland management strategies, taking into consideration the livestock migration routes, current and expected conflicts over natural resources and changing land use, and community land rights. The study should preferably be done with the pastoral groups relevant for the catchment by mapping with them the areas, the pasture and the water facilities used. This could be the first step towards an integration of pastoralists in catchment land use planning, managed burning and improved pasture management. It is highly recommended that the study is done on an optimal distribution of the water sources and planning is undertaken in close collaboration with the Lokok Catchment. The study on the carrying capacity can further build upon results of the water resources assessment (s. separate report) and the migration route maps developed by Acacia Water and by GIZ CPS. The same assessment should assess the numbers of incoming livestock from Kenya and South Sudan in wet, normal

and dry years in collaboration with IGAD. Ideally the assessment comes up with a rough idea on what the catchment can sustainably cater for and what this means for incoming groups of pastoralists. Thereby the study can provide a platform to start a dialogue on cross-border water supply for livestock between Uganda, Kenya and South Sudan and explore the feasibility of payment for incoming cattle from Kenya and South Sudan (in kind or in cash). The cross-border inter tribe deliberations could follow the same communication lines which delivered the Nabilatuk agreement which ended the cattle raiding in 2012. In new meetings among the same stakeholders agreements can be made whereby water and pasture management is taken into account and the authority of local cattle keepers is respected. At the same meeting, it could be discussed whether compensation for pasture and land in kind or in cash is an option to insure fairer access.

The primary goal of the activity is to find the right locations for water facilities for livestock to support a viable stock reserve in areas where pastoralism is a preferred option and pasture is underutilized during the dry season. The study should take into account that the spreading of water sources guides pastoralist movements and has the potential to reduce the pressure on existing grazing lands. Another study has already indicated some of the locations of existing valley dams and tanks. Figure 39 shows these dams and tanks as well as proposed locations for new facilities.

Figure 38: Seasonal valley tank east of Kaabong. When the tank dries the herders go south (RAIN 2016)

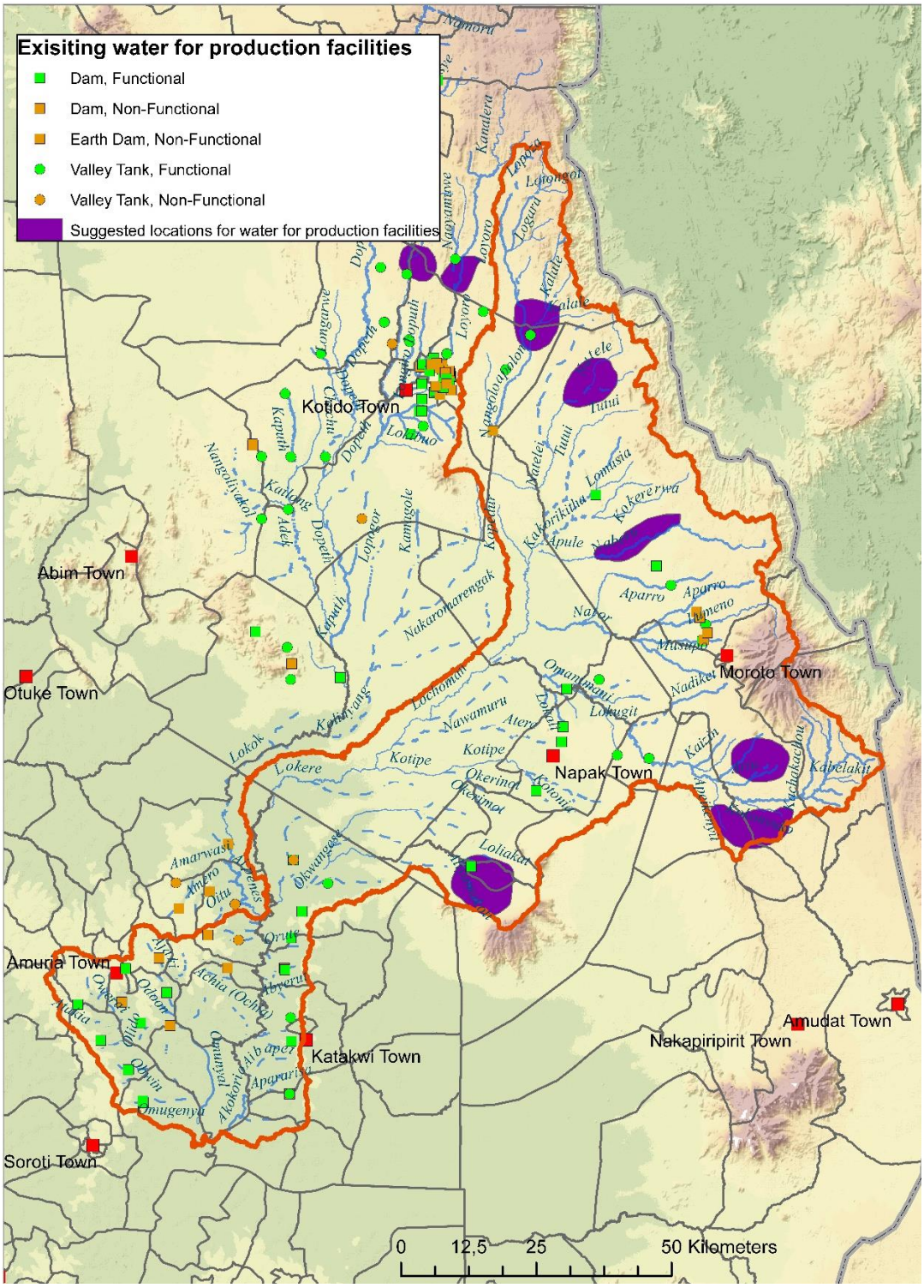

Figure 39: Priority location for rehabilitation and construction of new water for production facilities (list of existing facilities in Annex F)

This map comes with a number of disclaimers: If planned without consulting stakeholder groups the water points can be ignored or contribute to further overgrazing. The activity includes building more facilities, but should also look at where existing facilities can be improved. The involvement of cattle keeper groups should be the first step towards co-management of the facilities whereby pastoralists can feel entitled to collaborate or take the initiative in operation and maintenance. Together with these groups the existing water facilities should be assessed in regard to the functionality status of the valley dams and tanks and if rehabilitation/desilting is a sustainable solution in the long term.

A number of options should always be considered to increase the functionality of the dams and valley tanks:

- Plant trees around the smaller tanks to reduce evaporation of the tanks and create wind breaks.

- At medium-sized and large dams always create drinking places (cattle troughs) separated from the main water reservoir.
- Prevent cattle from getting into the water.
- Look for opportunities to implement silt traps before the water reaches a tank or catchment improvement in the form of upstream soil and water conservation measures (for instance exclosures).
- Make sure there is a maintenance plan.

Improve access to pasture and work on rangeland management

Bushland and grassland in the catchment can be further developed through improved water facilities to increase the number, but also the distribution of water sources which allows underutilized pasture to be kept short and reduces the pressure on overstocked areas. As has been shown in the options and scenarios chapter, the main challenge is the distribution and drying of water sources (see also Mugerwa et.al 2014). Additionally, the improvement of fodder facilities and rangeland management for pasture can prevent overgrazing and random burning causing soils and pasture to deteriorate. Again, in very close collaboration with pastoralists groups, or even led by pastoralist groups through the Alomar (Figure 40), management plans should be developed that focus on long-term sustainability for all users. The Alomar is an organizational layer higher than the kraal (*ngawuyoi*) led by someone who is known to support the best interest of the kraals.

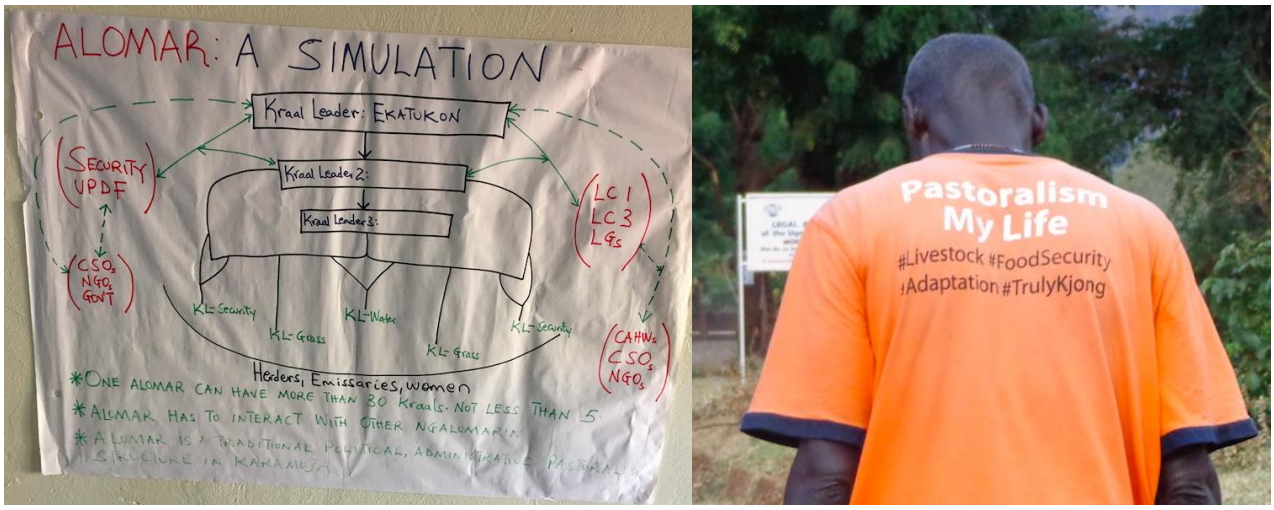

Figure 40: Simulation of the Alomar (Left). Message on the value of pastoralism to the Karamojong (Right) (Source: RAIN)

The primary focus should be on mechanisms to work out the location of underutilized pasture, (in combination with the erosion maps), plan for reduced or controlled burning and controlled/rotational grazing. It is proposed that the CMC collaborates with the Alomar to enable them to create management plans, possibly mediated by NGOs such as KDF to mainstream the development and interpretation of planning. IGAD needs to be included in cross-border management to back up the KWMZ and DWRM since they already work in 14 districts and cross-border. Furthermore, the KWMZ should look for an organsation that has the mandate to come up with one common resolution in the cattle corridor putting together early warning systems, payments as a community and rearing animals across-border. The same organisation should seek to establish a memorandum of understanding between the pastoralist communities of Karamoja, Teso and Turkana.

During such planning the CMC should also research the opportunities to increase the productivity of rangelands through the creation of food banks, enclosures in which grass is allowed to grow, live fencing and the establishment of fire lines. In other areas, such as Kenya, these food banks support livestock in times of distress. They also give degraded areas the time to become productive again and as such reduce erosion. The CMC and Alomar could visit areas in Maasai land in Kenya or South African best practices of rangeland management.

Other economic potential can be found in the improvement of fodder for zero grazing or the cut and carry system. Particularly in combination with wetland management, the cut and carry system can be promoted in the lower parts of the catchment such as the Ochorioramunyait wetlands. This system keeps the root system and low vegetation intact and removes nutrients from the wetland thereby producing a more diverse ecosystem.

Production of hay at some scale needs to be researched. Vast areas of grasslands in the middle catchment show high potential for this such as 3.5 the Nakichumet grasslands and around zone 3.4 Iriri up to Kapelebyong Tutotoko and Morulinga, but that they are currently used as commons. Improved soil and water conservation in flood zones could lead to good grass for hay and silage production. That means that in the areas of vertisols a small amount of water retention can already go far to produce a lot of grass.

The main sustainability principle that should be adhered to is that areas for grass production should not be taken away from (mostly women) subsistence cereal production or small-scale commercial cereal production. The main focus should be to designate bush or grassland that can be excluded from grazing and cereal production and closed off for grass in community or cooperative schemes.

All these interventions should be preceded by the development of rangeland management plans. Recently such a rangeland management plan has been developed for Omaniman which guides on the development of the rangelands in that area.

6.4.2 Rain-fed farming

The business case of rain-fed agriculture in combination with household and community based land and water management interventions has high environmental, economic and social priority because a large portion of the population is (seasonally) engaged in rain-fed agriculture, the activities influence land cover more than any other activity which currently takes place in the catchment. Different approaches to rain-fed agriculture are proposed in different locations in the catchment.

Promote sustainable and productive rain-fed farming

1. North Eastern agricultural zones (5.2, 5.3 5.4):

The area of highest priority is the Lopei area close to the wetlands where an increased silt load in the surface runoff may prove detrimental to the whole catchment. Current practices of cereal production in the arid agricultural zones around Lopei, Moroto and Lorengedwat can increase the profitability with improved species of sorghum. Two varieties of sorghum have been proposed by research institutes. One is named SESO 3 and does well for subsistence agriculture and the other one is SESO 1 for commercial beer production. Both species propagate in a similar way as indigenous species and can be supported. For SESO 3 the Ministry of Agriculture can support the distribution of the seeds. When it comes to SESO 1, a trail at a demonstration farm may be more appropriate to test its responses to the climate and assess the yields.

The expansion of agricultural land comes with a risk of increased soil erosion, encroachment into the wetlands and the river banks and therewith further degeneration of the ecosystems. The models show that this is a major threat to the water balance. Therefore, a number of checks and balances are recommended:

- All interventions which provide farmers with additional input should come with conditions of climate smart agriculture like soil and water conservation measures: contour ploughing, terracing, live fences and contour bunds. Not only will these measures decrease the soil erosion, they also increase the yield and therefore reduce the need to open up land for production.
- Demonstration farms for improved sorghum should also show improved soil and water management such as contour ploughing, bench terracing, vetiver grass or stone bunds and a test plot where these measures are not carried out should also be set up.
- Villages should set up their own soil and water conservation measures and promote increased tree cover such as fencing of areas for natural regeneration (exclosures and Farmer Managed Natural Regeneration generating firewood and soil stability by not cutting completely, but by coppicing and lopping). Hedgerows of preferably useful trees should be promoted.

A more entrepreneurial spirit can be promoted and the CMC needs to investigate which NGOs are working on loans and Village Savings and Loan Associations and are willing to support sustainable business models in agriculture, such as value chain development.

Besides the emphasis on the main crops of the eastern and middle area of the catchment there could be additional income through farm products more associated with agroforestry. There is need to map opportunities, conduct pilot

studies and develop the business case for the following products: moringa, shia nut, gum arabica, balanite, tamarinde, cashew nut and desert date. It is proposed to map opportunities and conduct pilot studies particularly in the areas around the agricultural zones in of the upper and middle catchment.

It is suggested to popularize best practices of soil moisture retention, erosion prevention and fertility improvement i.e. climate smart agriculture. Current good practices should be supported, such as the development of community woodlots and farmer managed natural generation practices, and additional techniques, such as the plantation of hedgerows and vetiver bunds, the use of soil bunds and mulching, tree belts and deep trenching.

The problem with these interventions is not so much their usefulness, but the methods through which the government or NGOs can make these interventions popular. One of the models has been through demonstration sites, but these see very little spin off. In other areas of Uganda similar interventions led to a 50% increase in production, but due to the extra work and the donor dependency few farmers pick up these measures. The main setback seems to be the lack of markets or market interest of farmers, abundance of available land to open up and shortage of labour availability to improve land. Hence, the need to identify, assess, demonstrate and develop business cases in rain-fed farming while at the same time seeking to establish methods towards the improved management of farmland. One of the business cases to be developed is the production of improved sorghum for seeds as mentioned above.

2. Scattered agricultural zones in rangelands (zone 5.5 to 5.8)
These areas are increasing in size at the expense of rangelands. They will become more susceptible to burning and land and water conflicts between pastoralists and farmers. The main issue with these areas is whether they should be receiving increased attention in the form of micro-irrigation (which requires some form of social organization) or if agricultural growth will be too risky in the light of reduced rangeland availability and increasing variability of rainfall. The rainfall maps show that these areas are in the highest variability of rainfall, closest to the wetlands and in areas often burned. Best practices could be to seek intensification of rangelands by fencing off areas, or at least making clear boundaries. Other options include agriculture through small-scale irrigation (see below), crop diversification (including cassava) and soil and water conservation.

3. The southern agricultural zones (5.9 and 5.10)
In these areas, there are fewer issues with erosion and drought than in the upper zones, but a lot more problems with waterlogging and flooding as well as poor market development for crops and reliance on subsistence crops occurs. Also unlike the upper zones, labour is less an issue with families settling in new areas to open up land and communities being more acquainted with cropping opportunities. As has been established in the water resources assessment and the options and scenarios, a lot of the flooding events can be led back (at least partially) to local surface runoff that stagnates in the wetlands or in the villages when soils are saturated. With the increase of sediments into these wetlands it can be expected that this type of flooding will increase. Furthermore, the trend of increasing population densities in these areas and remigration can trigger new conflicts between pastoralists and farmers. However, in combination with water and rangeland development upstream these conflicts may reduce.

In the southern agricultural zones it is critical to provide alternatives to wetland rice (paddy rice). This crop has already proven to be destructive for the ecology and hydrology of wetlands with large parts of the pristine wetlands being burned and partially drained to grow rice. The CMC and KWMZ through the districts should look for means to prevent the encroachment of the wetland with rice. At the same time a viable alternative is available in the promotion of upland rice in floodwater recession zones. Activities to expand on this can be promoted by way of include awareness raising, demonstration sites and learning visits.

Other alternatives include the promotion of fruit tree orchards, such as oranges, mangos and papayas, which also include trainings on grafting and soil and water conservation in community schemes, hospitals and schools. Mango tree seedlings that sustain dry condition such as Kapule should be promoted. The factory that is set up in Soroti to process fruit can have a good influence in the profitability of fruit trees. If demonstration sites can combine fruit trees with soil and water conservation measures known from climate smart agriculture the profitability will go up and the surface runoff from the land which causes flooding can decrease. In the agricultural zones of Amuria it was found that many orange trees planted in burned lands without shade or soil and water conservation dry up during extensive dry seasons. A pilot with open trees (gravilea), terracing and oranges can provide the necessary input on how to make orchards more resilient to drought. There are good examples in Uganda that combine fruit trees with mulching and mixed cropping (e.g. pulses). Such

gardens or orchards often combine 10 different crops with different growing cycles, thus providing products all over the year.

6.4.3 Micro- and small-scale irrigation

Micro- and small-scale irrigation can boost agricultural productivity at large. By using low-cost, simple and effective technologies households can adopt them easily, and start producing more and better quality.

Promote micro- (<0.5 ha) and small-scale (<2 ha) irrigation

Irrigated horticulture is already practiced close to rivers and ponds, even in the upper catchment around Omaniman. There is huge potential to expand micro-irrigation (<2 ha) further in the areas with limited evaporation and improve the profitability, food security and climate resilience of small-holder farming. This option promotes the adoption of micro-irrigation by small-holder farmers, that are both individuals and in small groups or cooperatives. This intervention supports the irrigation supply chain developing service bundles of knowledge, equipment, finance and back-up support. It considers irrigation horticulture, greenhouse horticulture, irrigated orchards and woodlots and irrigated arable and fodder farming. The potential and impact of small-scale irrigation will be large on the productivity of the individual farmers. However, other than the in situ measures the interventions need a programme approach which combines NGO, government and community investment and planning.

1. Eastern agricultural zones

In the eastern areas (around Lopei, Moroto, Omanimani and Lokopo) a programme to promote irrigation from shallow groundwater from river beds needs to be established. Small plots, 10 meter away from the river banks need to be supported with shallow groundwater facilities. It is proposed to focus on lined wells or scoop holes from which bucket or treadle pump irrigation can take place, preferably in combination with drip irrigation to reduce water losses. There should be a business case behind this, unless people want to invest in a shallow well and pumps and drip kits themselves the project cannot be viable. In promoting micro-irrigation particular attention should be paid to the viability of the water source. Near seasonal rivers people can draw on the shallow groundwater reserves, but these may not be large enough to support many small farmers. Preferably the promotion of irrigation is done in combination with water harvesting structures such as sand dams or sub-surface dams which push up the water table around rivers. These structures are viable in Omaniman river.

Before a farmer can apply for a reduced price or loan for a pump or a drip kit a farmer has to fulfil a number of conditions building terraces or bunds and establishing good practices on mulching and organic fertilizers. The interventions need a programme approach which combines NGO, government and community investment and planning.

The establishment of small valley tanks or ponds can provide access to water for bucket irrigation to extend the growing season of crops as ocra, tomatoes and cabbages. Currently WeltHungerhilfe is working to establish these small ponds with community labour. This could still provide a small business opportunity for a small excavator, something that can be contracted out from the MAAIF at the district.

2. The southern agricultural zones

Flood water can also be a good option for the areas bordering the wetlands in Amuria and Katakwi on the condition that extra measures are included to prevent siltation and erosion. This kind of irrigation is called floodwater recession agriculture. Upland rice can be propagated in areas close to the wetlands which sometimes flood, but whereby water can be stored behind small bunds or banks to keep the soil wet for longer.

Box 6: Sand dams and sub-surface dams

Sand dams and sub-surface dams are technologies for seasonal rivers in arid lands where the sand in the river bed can serve as a reservoir for underground water. A sub-surface dam is built in the sand bed of the river where it blocks the underground flow of the river to retain the water in the sandy river bed. A sand dam adds an extra dimension to this principle and is build to increase the level of the sand. It makes this sand bed function as a reservoir of water from which it can be accessed with scoopholes or shallow wells. Course river sand can contain almost 30% of its volume in water. Water stored in the sand does not evaporate and cannot contain water-borne diseases. One of the additional benefits of sand dams and sub-surface dams is that they retain only a very small percentage of the flow of the river (only 1 or 2%). They do this at a time when that water is not needed downstream and thereby only have positive environmental impact.

Unfortunatly the implementation of sand dams is not easily done from a manual and several examples of dams can be found in the catchment that were implemented in the wrong place or with the wrong dimensions. The sand dam in the picuture to the left for instance appears to function, but because there is no stilling basin or apron at the downstream side to reduce the turbulence of the water, the water flowing over the dam will continue to deepen the hole and can in some cases destroy the dam.

6.4.4 Medium-scale irrigation

Medium-scale irrigation is particularly interesting for cash crops. Crop production with supplementary irrigation or all-season irrigation allows to produce cash crops and reduces crop failure.

Promote medium-scale irrigation (>2 ha)

There is potential to develop medium-scale irrigation schemes by either developing new groundwater sources or using existing surface reservoirs such as tanks and dams. One priority is the testing of the water quality before embarking on a scheme. To the west of Moroto town a scheme was developed with solar power irrigation, but the water turned out to be too salty. There are significant risks associated with large irrigation such as weak performance due to weak management and negative social and environmental impacts such as groundwater depletion, increased salt levels in the soil and the potential risk of land grabbing. Medium-scale irrigation can encounter similar problems. To mitigate these risks, rigorous economic, social and environmental risk assessment studies and management plans are required to test feasibility.

Ideally this research should establish the business case for irrigation by checking if a tenure system is possible whereby farmers lease land and water for a year. The research should also ascertain the quality and quantity of available water and look for these areas where surface water storage is possible.

6.4.5 Road water harvesting

Roads have a significant impact on the hydrology, concentrating flows and interrupting surface and groundwater flows. Roads can increase soil erosion especially downstream of culverts, landslides, flooding and water scarcity. They (especially unpaved roads and road-river crossings) are vulnerable to flood damage which accounts for most maintenance costs. However, roads also provide opportunities to harvest water from roads and turn a problem into a solution leading to more local water availability. A road water harvesting demonstration project to show the impact of road water harvesting on water recharge and water availability can help to stimulate innovation.

Implement road water management and harvesting

Together with the Uganda Roads Authority and the districts an expert organization should be engaged to pilot road water harvesting to show the increased availability of water and demonstrate how the technology reduces road repair and rehabilitation costs (Figure 41). Rural access roads such as the road from Kotido to Moroto have a lot of opportunities to store water in borrow pits or other small ponds. Additionally, the strengthening of bridges and elevation of drifts (Irish bridges) or culverts in the upper and middle catchment will make bridges function as water retention structures, temporarily retaining water.

Figure 41: Road near Arecek Dam during the rain. Roads transport a lot of water that could be turned to good use.

6.4.6 Alternative sources of income

Alternative sources of income provide opportunities for communities to abandon environmental degrading activities, such as agriculture in wetlands, and can boost the local and regional economy, which in turn contributes to the availability of funds to protect and develop water resources.

Establish alternative economic activities

Inward investment describes the development of enterprises and market revenues in the catchment. With the improved security situation and investment in roads and rural electrification, there are business opportunities opening that were not feasible 10 or 15 years ago.

This includes tourism, especially small-scale tourism based on the appreciation of the catchment's unique cultures and ecosystems and establishment of hotels and conference centers and mining. Currently Moroto can be a good entry point for trips up Mount Moroto, and the upper part of the catchment can be a site for cultural activities. Kraals and villages can be visited or people can even stay for the night, but capacity of community groups needs to be improved to handle revenue from these activities and distribute it equaly between villagers. Such tourism or ecotourism is not directly beneficial to the catchment, or could even be negative because of the increased water demands and wastewater from hotels. The negative effects can be avoided through taxes on tourism and hotels which are invested into the maintenance of infrastructure or into innovation funds which stimulate sustainable growth.

Alternative livelihoods and alternative business opportunities include fish, poultry and beekeeping. These are not at the core of catchment management, but these alternative livelihoods can prevent people from resorting to charcoal or goldmining. As a by-product of agricultural production the prospects of fish farming need to be recognised in the bigger dams. The CMC can take an active role in the promotion of economic activities that are in line with the catchment objectives and priorities. This includes the decrease of dependency on natural resources for income generation

specifically targeting the youth. Poultry or beekeeping can be income generating activities which offer an alternative for non-sustainable businesses which harm the ecosystem health and service provision.

The CMC can actively support the establishment of small enterprises by offering low-cost trainings on how to develop a business, collaboration, governance, financial management skills and marketing. These trainings should target, among others, local artisans like hand pump mechanics, manual borehole drillers, constructors of shallow wells and constructors of rooftop rainwater harvesting systems. The District Production Officer and also NGOs often have experience in offering this kind of support.

Furthermore, SMEs and newly established enterprises can highly benefit from formal financial services. The CMC together with the existing financial sector, NGOs and development partners, should explore financial products for this target group, including value-chain financing.

Box 7: VSLA to support alternative business

With support from Cordaid and in partnership with GIZ, SOCADIDO formed and trained 20 village savings and loan association groups in Amero Parish, Acowa Sub-County, Amuria District. Each group was supported with savings kit. Members were self-selected and each group has 30 members. To date, groups have saved up to around UGX 45,000,000 and this money is revolving among members through lending. As a way of improving the monthly savings, group members access small loans, i.e. twice their savings for furnishing their businesses. Some of them have started businesses such as buying vegetables e.g. tomatoes, onions, cabbages, that they retail and make a small profit from which is used at household level for necessities, buy seeds (ground nut, cow peas, green grams etc.) for re-planting when the rains return and for paying stipulated interest for the loan borrowed.

A member of the Apopong VSLA states: "starting alternative businesses is now an alternative means to fishing in River Kirik and rice growing in the small wetlands of Kobuin that feed into the Lokok Catchment in Amuria District, Acowa Sub-County. This is gradually contributing to the re-generation process of the wetlands."

6.5 Catchment transcending interventions

During the assessments, identification of issues and development of options a number of interventions have been identified which exceed the borders of Lokere Catchment and are more applicable to water resources management in Uganda in general or deal with issues that are not the responsibility of a Catchment Management Organization, but rather a higher-level institution within the Ministry of Water and Environment and other ministries. As such, these interventions are listed here, but are not further developed in the catchment management plan for Lokere.

- The country-wide IWRM expertise is insufficient to cover the capacity needs at the (lower) institutional level. Stakeholders indicate that the number of graduates is below what is needed to implement the plans. Suggestions are to have a critical look at the curricula of engineering schools/universities, and adjust in line with the IWRM approach where possible, and allocate funds to have more students involved in specific water management programmes. Educating water professionals and training experts at all levels, and employing them for water management and water services in the wider sense is the key for a sustainable CBWRM.
- Charcoal production is a root cause of deforestation, which in turn is a serious threat to long-term water availability. The supply chain for charcoal goes far beyond the border of Lokere Catchment. It is, hence, advised to develop a national strategy to reduce the demand for charcoal, in which the Ministry of Energy and Mineral Development should be involved.
- Safe water coverage is low. Boreholes and piped supply schemes are expensive in terms of construction, operation and maintenance. At the same time, shallow groundwater wells are currently banned from construction with ministerial funds by MWE, because the water quality is not as good as from deep groundwater and because the technology can be drought sensitive. As a consequence, many communities revert to the bad practice of using low quality surface water for domestic uses. Since the quality of shallow groundwater is much better than that of surface

water and the costs are relatively low, it is recommended to lift the "ban" on shallow wells, and instead promote best site selection, design and construction practices.

- Many boreholes are non-functional, polluted or dry due to poor siting, design and construction, and operation and maintenance. The recent decision of MWE to have all hydrogeology consultants and drillers registered is a huge step forward in this regard. It is, however, recommended to be even stricter, assess the capacity of these professionals, and strengthen the supervision during construction, and offer them the required trainings as part of lasting skills development.
- Operation and maintenance of water infrastructure is poor to a large extent because of the poor performance of the water user committees (WUCs). Various stakeholders indicated that this is in part because the guidelines do not match the reality in the field. It is unclear to what extent this is the case, but it is nonetheless recommended to consider a review/revision of the current guidance to check whether improvements can be made. Assess also whether it is possible to change the volunteering positions into paid ones, as this is probably the only manner in which WUCs could ever become really functional.
- Currently maintenance of water points is more expensive than needed. Often hand pump mechanics could repair or rehabilitate water points at a much lower cost, but this is not possible due to their legal position. It is recommended to check whether it is possible to legalize hand pump mechanics associations in the Water Act, and to adjust the Public Procurement and Disposal of Public Assets Act accordingly so that simple works can be commissioned to these associations.

7. SOURCES OF FUNDING

7.1 Traditional funding streams: government and civil society organizations

In Uganda, funding for natural resources management, livelihood improvement and developing public water related infrastructure in the catchment currently comes from government (both central and local) budgets and development partners for instance NGOs and UN agencies. For the financial year 2016, the Water and Environment Sector Performance Report MWE (2016) indicates that 62% (i.e. UGX bn 560.95) of the funding for the water and environment sector was from the government budgeting process. Of the remaining 38% a large proportion (UGX 285.04 bn) was from revenues generated by the National Water and Sewerage Corporation. Civil Society Organisations (CSOs) in the sector mobilised UGX 59.13 bn. Such traditional funding streams can continue to finance implementation of (part of) the CMP.

Line ministries and agencies of government can finance some of the interventions especially the large ones. Such projects include large valley tanks and valley dams, roads if carefully designed to harvest water, etc.

In addition, districts in the catchment can use their own budgets to implement some interventions especially if the DDPs and the CMP are aligned. For this funding source to be fully exploited, the CMP must always address the catchment issues/challenges affecting the districts and must be aligned with the development priorities of those districts. Further, the districts in the catchment must commit themselves to implement the CMP when they become a member of the CMO; this commitment is best secured if districts (are supported to) develop and sign a binding document for instance a partnership agreement or MoU that spells out the rights, roles and responsibilities of each district. Additionally, at a later stage, arrangements could be made by the central government requiring that districts use the CMP as a basis for district planning and budgeting.

NGOs and other development partners can continue to mobilize funding (from donors etc.) for implementing interventions in their areas of interest. This funding stream could be focussed more on the CMP, for instance by district councils conditioning their development partners and NGOs to align activities to the CMP and DDPs. Additionally, the development partners and NGOs have to prove that they have the requisite technical capacities, they must demonstrate that the activities they propose to implement are supported or recommended by the CMP or otherwise present evidence that those activities are appropriate even if not recommended by the CMP. These agencies should comply to certain conditions e.g. sharing with the CMO (through the constituent districts) data, for monitoring purposes.

7.2 New funding streams

Similar to the previous years, the Uganda water and environment sector performance report 2016 (MWE, 2016) identifies limited funding as a key challenge which the water and environment sector faces in pursuit of the national and sector targets. Generally, the cost of managing water resources to achieve social, economic and environmental goals is increasing because of population and economic growth, urbanization, food needs and the threats of droughts and floods (EUWI-FWG, 2012). The consequence is that traditional funding streams (such as government budget and CSOs) will increasingly become inadequate for implementing the CMPs. New funding opportunities have to be pursued. Examples of such new funding sources, suitable for the catchment, are suggested below including ways of positioning the CMO and districts to attract and secure these funding streams.

7.2.1 Programme / project development and fundraising by the CMO

The CMC can source funding from donors for implementing (parts of) the CMP. It needs a good resource mobilization officer who writes proposals –this officer can be stationed at the CMS or, before establishment of the CMS, at the KWMZ. Further the CMC needs an officer who can manage finances, but the finance department of the KWMZ can, in the meantime, play this role. When grants and funding is secured, implementation is done by districts (or depending on the kind of activity and mandates, other ministries like MAAIF, other departments of MWE like WfP, NGOs/CBOs/CSOs, UN-agencies, INGOs) and, if needed, consultants and/or technical personnel from the MWE. In addition, the CMS

should have the legal mandate to source and manage funds. Generally, donors prefer to fund legal entities, therefore it is necessary for the CMC to have some sort of legal status for it to be able to attract external (i.e. non-government) funding. The CMO needs a good resource mobilization strategy (to attract funds from sources within and outside of the catchment or country) and a sound financial management strategy (incl. guidelines on transparency and accountability) with which to build and secure the trust of potential funders. Table 23, extracted from Claasen (2015) gives different sources of funding that could potentially finance interventions in the CMP.

TABLE 23: INTEGRATED LAND AND WATER INITIATIVES RELATED FUNDS

Fund	Source of capital	Investment focus	Investment tools	Investment size	Engagement period
Althelia Ecosphere, Althelia Climate Fund	EIB, Finnfund, FMO and others	Forest protection and sustainable land use	Private equity in PPP framework	EUR 10 million	8 years
Eco Enterprises Partners II Fund	Divers, among others, TNC, FMO, IADB, EIB	Organic agriculture, eco tourism, sustainable forestry	Long-term mezzanine finance in assets, growth and working capital	EUR 0.5 to EUR 3 million	5-8 years
GEF IAP on fostering sustainability and resilience for food security	GEF related investors	Land rehabilitation, governance, policy development	Grants to 12 sub Saharan African countries	EUR 3-9 million per country	5 yearts
IDH ISLA	Dutch Ministry of FA	Large-scale land rehabilitation	Grants and contributions from private sector	EUR 1 million per landscape	4 years
Livelihoods Fund for Family Farming	Danone and MARS	Sustainable agriculture	Mutual fund in PPP framework	EUR 120 million (size of fund)	10 years
Moringa Fund	French based investors and others	Large-scale agro forestry projects	Private equity and a grant programme	EUR 4-11 million	6-10 years
Land degradation neutrality fund	Divers	Large-scale land rehabilition	Private equity	TBD	5-20 years
Commonland	Dutch based investors and NGOs	Land rehabilitation	TBD	TBD	20 years

7.2.2 Local taxes and the LED strategy

Linking catchment management to the water dependent economic activities (e.g. cattle markets) in the catchment creates a business case for (parts of) the CMP to be financed through Local Economic Development (LED). The local government development planning guidelines for Uganda (MFPED, 2014) recognises LED as one of the pillars of decentralisation. The Agency for International Development (undated) defines LED as follows:

> *Local Economic Development is a process of strategic planning through partnerships between local government, the business community and NGOs. It aims at encouraging investments that will promote sustained high growth in a local community. LED focuses on the region's potential and identifies specifically what local stakeholders can and need to do to ensure their local community reaches its potential. (Agency for International Development, undated)*

In 2012 Uganda launched the LED policy whose goal is "*A transformed local government system linked to stakeholders at local and national levels that facilitates effective business-oriented locality development with a focus on poverty reduction and sustainable wealth creation.*" Therefore, it is imperative to integrate the CMP in the district LED strategies if water dependent economic enterprises and business development services are to get the visibility and due attention.

It is expected that district LED strategies will support the implementation of private sector-led economic interventions that will, for example, maximise the utilization of water for production infrastructures in the districts, tackle unemployment and enable Local Governments to generate their own revenue.

LED strategy at district levels will serve as a framework for resource mobilization and capacity development for the local governments and municipal authorities to offer business development services to enterprises dependent on water for production such as cattle production. Cattle depend on water and pasture. Therefore, well-maintained water infrastructure (dams, valley tanks, ponds) and properly managed rangelands are vital to the sustenance of cattle production and consequently of cattle markets. There is a clear link between water and rangeland management and taxes from cattle markets. Without water (and pasture) there would be fewer (and lower quality) cattle to be sold in cattle markets and thus less tax for the districts. At present, it is understood that districts charge cattle markets a tax with which they for instance finance district council meetings. For the districts to sustain this important source of taxes, it would be logical to consider investing back a portion of the taxes into the establishment of maintenance of the water infrastructure and in promoting proper rangeland management.

For this funding stream to work effectively, the different stakeholders in the water sector need to be organized in such a way that they can offer business development services to the local communities who are organized into savings for investment groups and then use their savings at group level to capitalize their own cooperative societies or local private companies to act as investment vehicles on their behalf. The cooperatives and local private companies will need capacity building services in business development, to be able to deliver the services to the savings for investment group members. The CMO (through constituent District Local Governments and CSOs) should work closely with the business organizations (e.g. cooperatives and local private companies) owned by the local savings for investment groups to identify the appropriate business enterprises and business development needs of the people in their locality and offer them the services.

This source of funding includes permits, but also users' investments to improve conditions on their own plots of land. With regard to permits, arrangements that are applicable include abstraction permits for ground water, surface water and waste disposal (which go to central government at present), a proportion of which could be allocated to catchment protection. Also, tourists (domestic and foreign) could be charged a small percentage fee for the protection of tourist attractions. Private companies (from instance mining companies) deriving raw materials from the catchment could also be charged a small “catchment management/development” tax. Similarly, hotels and guesthouses in the catchment could be encouraged and required to charge their guests a small tax for protecting the catchment from which the hotels obtain water or discharge waste. Funds generated through this pathway could contribute to the consolidated “Catchment Innovation Fund” proposed and explained under section 6.2.5 as well as lessons learned from other (similar) funds for instance the Community Environment Conservation Fund.

Furthermore, the practice of users of a borehole, for example, contributing money for its maintenance could be extended to other water infrastructure like dams, valley tanks, and ponds. An example exists in the Teso Region (Lower Lokok Catchment), implemented by the NGO TEDDO, whereby borehole maintenance is combined in the portfolio of Village Saving and Loan Associations (VSLAs). The borehole is made a member of a VSLA. All the user fees collected (on monthly or weekly basis) are saved in the VSLA under the name of that borehole.

Another approach would be to assign the management of water infrastructure (especially dams, valley tanks) to cooperative societies or private entrepreneurs that would charge from the users of the infrastructure a “user fee” while adhering to certain conditions as agreed with the districts. Livestock owners would be required to pay for the water their cattle drink from water for production facilities. More than 2 decades ago, the International Conference on Water and the Environment, in Dublin, adopted a statement (called the “Dublin Statement”) stating the guiding principles for managing water and the environment. Principle number 4 of the statement is that "*water has an economic value in all its competing uses and should be recognized as an economic good*" (WMO, undated). Principle 4 is based on the realization that “*past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource*” (WMO, undated). In practice, this means that water service providers (at the time of implementing, and later managing water infrastructure) must aim at running their business at full cost recovery and this must include payment by all users, including agriculture and the livestock sector. The different modalities of payment, which are suitable and applicable to the context of the catchment, should be studied further.

Added to the user fees, permits and fines, there are interventions that the users can implement in their gardens or plots to improve, for example, the yields of crops or pastures. These interventions, if done on a sufficient scale, have an impact on the water balance in the wider catchment. The prerequisite would be capacity building to the users to enable them implement such interventions. Capacity building can be through demonstration sites, learning visits and practical trainings.

8. TOWARDS IMPLEMENTATION

Part of the Catchment Management Plan is an Implementation Plan (IP). The IP is organised as a practical tool indicating interventions per thematic area, options linked to their activities and sub-activities which need to be implemented in order to achieve the catchment's vision along the four strategic objectives. An overview of this is given in Annex H. Additionally, the IP specifies locations (where applicable), project lead, possible partners for implementation, priorities and budget for implementation as well as structural operation and maintenance on sub-activity level. Some of these aspects are further introduced in the following paragraphs.

8.1 General prioritization of intervention

The CMP includes four thematic areas of interventions in order to achieve the vision and objectives developed by the stakeholders during the planning process. The thematic areas contain the options which are again sub-divided into activities and sub-activities. In its Implementation Plan the activities are prioritised according to the urgency of implementation. The priority does not indicate the relevance, but rather an order of implementation in time. The priority is defined along the following timeframe:

- Critical: Implementation should start immediately. The activities are conditional to any further implementation and key for sustainable catchment management. These most critical activities can be implemented within 1 year from CMP approval and are mainly related to institutional strengthening.
- High: The activities are of high relevance to key issues and with expected high impact on improving water resources management and stopping harmful practices. The activities should be implemented at short term, meaning within 3 years from CMP approval.
- Medium: Activities that are planned to be implemented at intermediate term, within 3-5 years from CMP approval.
- Low: Activities which can be implemented in the longer term, meaning within 5 to 10 years[12] from CMP approval.

8.2 Roles and responsibilities

The Catchment Management Planning Guidelines (2014) describe the roles of stakeholders during the implementation of the interventions of the catchment management plan (Table 24).

TABLE 24: ROLES OF STAKEHOLDERS IN CATCHMENT MANAGEMENT PLAN IMPLEMENTATION

KWMZ	■ Coordinate all implementation activities ■ Facilitate and support DWRM coordination of central level implementation and financial resource mobilization ■ Facilitate implementation of catchment management plan projects by central departments ■ Identify modalities for zonal and catchment level implantation among its public and private sector partners ■ Mobilize funds (Medium Term Expenditure Framework, budget, donors, private sector) with the assistance of DWRM for implementation of zonal and catchment level projects ■ Coordinate, manage and undertake project preparation for zonal and catchment level plan projects ■ Assess water use permit applications under existing regulations ■ Facilitate implementation and installation of upgraded and expanded monitoring network and WIS, and operate system within the zone ■ Monitor hydrologic and meteorological conditions, compliance with regulations, implementation of catchment plans and source protection plans ■ Support and facilitate the increasing role the CMC and other stakeholder groups including keeping all stakeholders informed of implementation progress ■ Undertake secretarial functions for the CMC.
CMC	■ Facilitate and promote implementation of catchment management plans ■ Coordinate implementations from the CMP ■ Include interventions from the CMP into the respective District Development Plans ■ Monitor CMP implementation ■ Review the CMP regularly ■ Mobilise resources for the implementation of the CMP interventions

[12] The CMP objectives are aligned to the Uganda vision 2040.

TABLE 24: ROLES OF STAKEHOLDERS IN CATCHMENT MANAGEMENT PLAN IMPLEMENTATION	
	■ Carry out meetings with the CSF
MWE - DWRM	■ Organize and coordinate the technical review of planned project proposals and assign implementation to the appropriate department ■ Mobilize funds for the implementation of the CMP and WMZ support ■ Review policy, identify needs for legal and regulatory revisions based on plan recommendations and manage the process for updating and revision
MWE - NEMA	■ Review the environmental regulatory needs (actions, new or revised regulations) based on the adopted final CMP ■ Issue required regulations, notices, and permits in accordance with legal and regulation requirements
MWE – Line departments	■ Undertake preparation of projects and investments within their area of responsibility that are proposed in the adopted final CMP (feasibility studies) ■ Supervise and manage project implementation (designs, tender documents, procurement, construction) ■ Operate the completed project in accordance with the permit and operating rules agreed with KWMZ
Line departments in the concerned sector Ministries	■ Undertake preparation of projects and investments within their area of responsibility that are proposed in the adopted CMP (feasibility studies) ■ Supervise and manage project implementation (designs, tender documents, procurement, construction) ■ Operate the completed project in accordance with the permit and operating rules agreed with KWMZ
District government	■ Facilitate and support implementation of the adopted CMP ■ Incorporate priority projects and programmes into the District development plans as appropriate
Donor partners and NGOs	■ Implement priority projects and programmes in collaboration with KWMZ and other stakeholders in accordance with agreements and Memoranda of Understanding (MOUs)
Private sector	■ Facilitate and support implementation of the adopted CMP
Source: Uganda Catchment Management Planning Guidelines (MWE/DWRM 2014)	

In the implementation plan the roles of project leads and implementing partners are differentiated. A project lead takes the initiative or guides an activity that will be implemented. The project lead is not necessarily the funder or the actual implementer on the action. KWMZ/DWRM and the CMC are the only possible project leads. However, many other actors can be involved in implementation and support.

The project lead should:

- Direct the project implementer to carry out those interventions which are planned for in the CMP.
- Guide the project implementer in stakeholder involvement.
- Provide the project implementer with applicable guidelines and check use.
- Guide the project implementer to set up O&M systems for sustainable use.

Project implementers are implementing partners contributing to the implementation of the activity. Project implementers can again be KWMZ/DWRM, the CMC, the district councils, but also other stakeholders. All stakeholder groups, from the water users as primary stakeholders up to development partners and corporate sector can collaborate or contribute resources to the implementation of specific interventions included in the CMP. Table 25 gives guidance on potential partners. This table is existracted from the stakeholder matrix which is included in the Stakeholder Assessment and Engagement report. Involved implementers or partners for each specific activity are included in the implementation plan.

TABLE 25: PROPOSED STAKEHOLDER CONTRIBUTION TO CBWRM FOR LOKERE CATCHMENT

Category	Stakeholders	Envisioned contribution
Planning and development	■ District Land Boards ■ District Planning Units ■ Urban Councils Works departments. ■ CAOs ■ Local Community Associations ■ LC5s ■ LC3s ■ Area based NGOs e.g. Caritas Kotido, SOCADIDO, TEDDO	Collaboration and leveraging of funds for: ■ Land planning ■ Pollution control (waste management, wastewater & storm water drainage) ■ Sustainability and disaster risk mitigation planning
Environment & natural resources	■ Regional Wetlands Technical Support Units (RWTSUs) ■ District Natural Resources Departments (NRDs) ■ District Environment Committee (DEC) ■ Local Environment Committee (LEC) ■ District Production Department (DPD) ■ District Land Board ■ Urban Councils Works Departments ■ Uganda Wildlife Authority ■ National Forestry Authority ■ Area based NGOs e.g. Caritas Kotido, SOCADIDO, KDF, TEDDO, Arid Land Dev't Programme, Warrior Squad ■ Development partners: GIZ, IUCN, FAO, Mercy Corps, Conserve Uganda	Collaboration and leveraging of funds for: ■ Awareness creation and stakeholder mobilization ■ Ecosystem preservation and catchment protection ■ Improving land use planning, practices, and soil and water conservation ■ Wetlands management and boundary demarcation ■ Permits compliance monitoring and enforcement ■ Revenue generation from environment services
Water services	■ NWSC area offices ■ WSDF ■ TSUs ■ UWS ■ District Water Office (DWO) ■ District Health Depts. (DHDs) ■ District Water & Sanitation Coordination Committees (DWSCC) ■ District Works Depts. ■ Health Services Depts. ■ Town water boards ■ Area based NGOs e.g. Caritas Kotido, SOCADIDO, KDF, TEDDO ■ Development partners: UNICEF, UWASNET, UN FAO, GIZ, C&D, Mercy Corps, Goal	Collaboration and leveraging of funds for: ■ Awareness creation and stakeholder mobilization ■ Catchment/water sources protection ■ Public health and hygiene improvement ■ Water supplies quality monitoring and general resource monitoring ■ Water resources demand management ■ Compliance monitoring and enforcement ■ Revenue generation and collection ■ Pollution control (waste management)
Community services	■ District Community Based Services Depts. ■ Community Based Organisations ■ Water User Associations ■ Cultural and religious institutions ■ UWASNET ■ Area based NGOs e.g. TEDDO, Caritas Kotido, SOCADIDO, Arid Land Dev't Programme, DADO, Warrior Squad, KDF, WEDA ■ Radio stations e.g. Etop, Karamoja FM, Nena FM, Kyoga Veritas ■ Print media e.g. Etop	Collaboration and leveraging of funds for: ■ Awareness creation and public sensitization and mobilization ■ Advocacy
Capacity development	■ District Technical Departments. ■ Development partners: GIZ, UNICEF, IIRR, UN FAO, IUCN, Cordaid ■ OPM	Collaboration and resource mobilization for: ■ Human resources development ■ Institutional capacity development ■ Sensitization and awareness within the work-force
Research, data collection and monitoring	■ DWO ■ UN FAO, C&D, ■ NaSARRI, Nabuin ZARDI	Collaboration for: ■ Monitoring changes in the ecosystem ■ Data collection on existing water sources ■ Monitoring ground water levels ■ Environment conservation

TABLE 25: PROPOSED STAKEHOLDER CONTRIBUTION TO CBWRM FOR LOKERE CATCHMENT

Category	Stakeholders	Envisioned contribution
Advisory	■ NEMA, NWSC, DEA, DWD ■ LC5s, CAOs, District Technical Heads ■ Research institutions ■ Development partners: RAIN, Acacia Water, WE Consult	Collaboration for: ■ Policy and legal framework guidance ■ Compliance with CBWRM guidelines ■ Collaboration in building political will and acceptance
Enforcement and Compliance	■ Uganda Police Force (based in the region) ■ Tourism Police ■ Environmental police	Collaboration for: ■ Enforcement of regulations including by-laws and ordinances
Livelihoods enhancement and peace building	■ DAO, DPO, NUSAF (OPM) ■ Religious and cultural Institutions ■ Operation Wealth Creation ■ Area based NGOs e.g. TEDDO, Caritas Kotido, SOCADIDO, Arid Land Dev't Programme, DADO, Warrior Squad, KDF, WEDA ■ Development partners: Mercy corps, GIZ, CIDI, UNICEF, Goal, WFP, UNFAO, Cordaid, Save the Children, ACDI-VOCA, IIRR, IUCN, ACTED, World Vision	Collaboration for: ■ Food and income security ■ Resilience building ■ Conflict resolution ■ Employment ■ Health

8.3 Financial planning

As indicated before the CMP is a living document and part of a continuous management process. The CMP should be reviewed and updated periodically as described under the monitoring and evaluation activities and at least every 5 years in line with national and district planning cycles. The CMP is both an end and a beginning. It marks the end of the planning process and a beginning to the realisation of actual catchment management. The implementation of the CMP requires financial resources. Potential sources for the finances have been suggested in Chapter 7 as well as recommendations on positioning the CMO to secure funding from those sources. The implementation plan provides guidance on the budget for the implementation of the plan as well as structural funding for "running costs" and operation and maintenance. In this section an indication of the total budget required to implement this CMP is given (Table 26). Categories of costs included are staff, consultancies, travel, offices, meetings/conferences/trainings, as well as construction or "hard ware".

TABLE 26: BUDGET SUMMARY (2017 – 2040)

Thematic area of intervention	Options	Budget Implementation	Budget for O&M
A. Institutional strengthening	A1. Strengthen the Catchment Management Organisation	668,875,000	264,000,000
	A2. Monitor and evaluate implementation of the CMP	82,250,000	214,250,000
	A3. Coordinate at district level	25,120,000	80,000,000
	A4. Sub-catchment and micro-catchment planning	986,250,000	2,140,000,000
	A5. Funding of the Catchment Management Plan	649,000,000	-
	A6. Learning and knowledge management	1,022,075,000	586,000,000
SUB-TOTAL		**3,433,570,000**	**3,284,250,000**
B. Ecosystem protection and restoration	B1. Productive and protected forests and woodlands	2,994,316,453	152,100,000
	B2. Promoting productive and sustainable rangelands	1,448,572,172	44,850,000
	B3. Protecting wetlands and flood plains	1,327,363,583	73,150,000
	B4. Protecting rivers and river banks	369,900,003	-
	B5. Flood management systems and infrastructure	452,875,000	-
	B6. Regulation and enforcement	135,542,858	28,900,000
SUB-TOTAL		**6,728,570,069**	**299,000,000**
C. Water and sanitation	C1. Access to knowledge	353,635,714	76,161,429
	C2. Monitoring and planning of water services and resources	1,013,925,000	195,900,000
	C3. Piped water supply systems	66,148,500,000	3,299,400,000
	C4. Rural water schemes	9,829,611,250	64,987,500
	C5. Sanitation and waste management	946,392,857	65,610,000
SUB-TOTAL		**78,292,064,821**	**3,702,058,929**
D. Agriculture and economic development	D1. Improve livestock farming	19,688,651,667	270,000,000
	D2. Improve rain-fed farming	1,265,750,000	219,000,000
	D3. Promote micro-irrigation (<0.5 ha) and small-scale irrigation (<2ha)	321,000,000	-
	D4. Promote medium-scale irrigation (>2 ha)	107,500,000	-
	D5. Promote road water harvesting	222,250,000	43,500,000
	D6. Promote alternative sources of income	570,750,000	-
SUB-TOTAL		**22,175,901,667**	**532,500,000**
Grand total	**UGX**	**110,630,106,557**	**7,817,808,929**

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APPENDICES

ANNEX A – NO-REGRET IWRM MEASURES

TABLE 27: PERCEPTIONS ON THE SUCCESSES OF THE NO-REGRET IWRM MEASURES

CODE	ACTIVITY	LOCATION	EXPLANATION	RECOMMEDATION FOR UPSCALING / DOWNSCALING
DOPETH SUB-CATCHMENT, KOTIDO AND KAABONG DISTRICTS			**IMPLEMENTED BY: CARITAS KOTIDO CONTACT PERSON: DR. PAUL LOCHAP (DIRECTOR), 0772 605 387, KOTIDOCARITAS@GMAIL.COM**	
1.1.1	Support to Develop Wetland Management plan and ensure the restoration and demarcation of depleted wetlands.	Kaelemuye and Kangorok in Kotido District	It is very important to understand the community perspective towards wetland management process. Appealing communities and their leadership to participate in a planning process enhances communal responsibility and ownership of the entire process of development of a wetland plan.	This should be scaled-up
1.1.2	Facilitate the adoption and enforcement of controlled grazing in 4 riverine areas.	Kakamar, Loyoro in Kaabong District Rengen and Kotido in Kotido District	Requires an in-depth understanding of grazing areas and map out over grazed areas. This needs continuous engagement with kraal leaders, institution of elders at different levels for the herders to fully appreciate the need for controlled grazing.	Requires upscaling especially in areas where by-laws have been owned.
1.1.3	Promotion of integrated pasture production and management (Chloris gayana and Bracharia Mulato 1) for enhanced livestock production.	Lokatap and Kamoru in Kotido District	Pastures were planted and watered. Some splits dried up as a result of the dry spell. The strategy/approach on this has been to replace those that have dried.	Needs to be up scaled and replicated else where
1.1.4	Training on Improved pasture management of the model villages' representatives.	Lokatap and Kamoru in Kotido District	The trained community members were able to understand how to plant, and manage the newly introduced pastures.	It should therefore be up scaled and replicated
1.1.5	Facilitate the development of community by-law to help the restoration of ecosystems and habitats.	Lodiko in Kaabong District Rengen in Kotido District	Engaging local communities and authorities on the development of community by-laws, creates ownership and leads to the restoration of ecosystems and habitats.	This needs upscaling and strengthening
1.1.6	Support the functionality of 4 environmental Management Committees, PMCs, and Environmental Savings Clubs.	Lodiko in Kaabong District Rengen in Kotido District	This activity is on going.	A good one to upscale and replicate once completed
1.2.1	Establish community managed tree nurseries to promote the propagation and planting of indigenous tree species.	Loputuk in Kaabong District Nakapelimoru in Kotido District	Community participation ensures that these facilities are not only established and fenced, but also managed and owned by themselves. Procurement of the seeds for establishment of tree nurseries is complete and training is planned for mid-March.	Needs upscaling.
1.2.2	Development of 4 community woodlots in the catchment. This	Loyoro, Lomusian, Lodiko in Kaabong	4 community woodlots were established and planted with neem, Terminalia, Macamia Acacia Senegal tree seedlings involving community participation.	Needs upscaling

TABLE 27: PERCEPTIONS ON THE SUCCESSES OF THE NO-REGRET IWRM MEASURES

CODE	ACTIVITY	LOCATION	EXPLANATION	RECOMMEDATION FOR UPSCALING / DOWNSCALING
	will include trainings, procurement of seedlings and establishment of PMCs.	Rengen in Kotido	Survivability of all the seedlings has not been easy due to the dry spell. However, Caritas is planning to replace those that dried up.	
1.2.3	Promotion of live fencing with kei apple in 4 model villages: This will involve fencing of manyattas and gardens.	Rengen Sub-County	Communities have been re-engaged in replanting of the Kei apple in the target villages.	This activity needs to be up scaled not only in the project area but throughout the entire upper Lokere Catchment.
1.2.4	Promotion of farmer-managed natural tree regeneration practices (FMNTR) within the catchment. This will involve trainings, establishment fire lines, establishment of 4 Project Management Committees (PMCs) and 4 informal management structures. Four demonstration sites will be established.	Panyangara Sub-County	Community sensitization demands a good understanding of the importance this approach towards regeneration of ecosystems by the community. This is when communities can be able to appreciate and value their own ecosystems.	The approach should be promoted / up scaled
1.2.5	Promote the planting of Fidebia species woodlots in the riverine ecosystems to restore soil fertility and water conservation mechanisms within the catchment. Two demonstration sites will be established in Kotido and Kaabong.	Kaekar in Rengen Sub-County	This engaged communities in planting the tree species along degraded parts of river Dopeth in the area of Kaekar. This particular tree species has been noted to be one of the best in soil conservation especially along the riverine areas.	This needs upscaling and replicating in all entry points for livestock to the rivers.
1.2.6	Promote and provide training and enable access to information on alternative sources of energy and promote the adoption of energy saving practices/tools. This will involve construction of improved energy saving stoves and biogas production in institutions etc.	Loputuk, Nazareth in Kaabong Kotyang in Kotido	Majority of community members appreciate the importance of alternative energy practices. The biggest challenge is low adoption of some of these technologies especially in the villages as it is a new concept for the communities.	Need to be up scaled and replicated
2.1.1	Construction of the Sand Dams	Loyoro Sub-County in Kaabong District	Although most of the community members in Loyoro have not yet recognized the importance of this technology, being the first of its kind. Having communicated to the community on the importance and how the dam works, communities were able to take up the excavation work. The construction works are ongoing.	This particular approach of the 3R needs to be up scaled.

TABLE 27: PERCEPTIONS ON THE SUCCESSES OF THE NO-REGRET IWRM MEASURES

CODE	ACTIVITY	LOCATION	EXPLANATION	RECOMMEDATION FOR UPSCALING / DOWNSCALING
2.1.2	Construction of shallow well	Rengen Sub-County in Kotido District	The community in Napeet was fully engaged in the excavation work. Currently, the well is nearing completion.	Requires up scaling in other areas with high potential.
2.2	Introduction of quick maturing and drought tolerant seeds to 40 model HHs	Kaelemuye and Kangorok in Kotido District	This was done by procuring of the seeds from certified agricultural inputs shops/ suppliers and distributed to target HHs in the hot spot area around the wetland.	This particular activity has minimal impact in the community since it promotes dependency. Requires down scaling
2.3.	Promote beekeeping in 24 HHs	Kaelemuye and Kangorok in Kotido District	A local service provider from within was engaged to make the hives and later distributed to target HHs in the hot spot area around the wetland.	Requires scaling up in forested areas. This has a good potential to improve incomes of households.
2.4.	Promote local poultry keeping in 66 HHs	Kaelemuye and Kangorok in Kotido District	The chicken was procured locally from the community following the community procurement guidelines. Each HH received 4 birds and 1 improved cockerel.	Needs to be scaled down as the activity is sensitive to failure because of diseases.
3.1.	Rehabilitation of 8 non-functional water hand pumps	Kaabong Town Council and Nakapelimoru Sub-County in Kotido District	Some of the target boreholes need major repairs which cost a bit more money. This was the justification for re adjustment of this particular budget line. The community is to contribute for labour of the hand pump mechanics.	There is need for up scaling this activity
3.2	Fencing off 5 water ponds and 14 hand pumps using vegetative materials (Ekadeli, Sisal)	Kaabong Town Council and Nakapelimoru Sub-County in Kotido District	Labour and local fencing materials were sourced from the community.	Requires scaling up since its 1 way of water harvesting.
AWOJA SUB-COUNTY, AMURIA DISTRICT			**IMPLEMENTED BY: SOCADIDO** **CONTACT PERSON: FATHER SILVER OPIO (DIRECTOR), 0772 683 899, SOCADIDO@YAHOO.COM**	
1.1	Develop Wetland Management plans		Engaging local communities and authorities on wetland management planning, enhances learning, ownership and limits frictions during implementation process of the wetland plan.	Should be up scaled and replicated
1.2	Promote Buffering and Zoning of Wetlands	Achanga, Ajesai, Ikobatum, Obureiteng, Amugei Apopong, Kokorio and Moruisiru villages	Tree seedlings have been locally raised and managed by communities. They (communities) expect to continue buffering & zoning when rains return. This serves as Pro-active measure for the likely to be encroached wetlands. The raised tree species include: Grevelier, Makhamia, White teak. The seedlings will first be distributed to the households free of charge, but in 2018, the tree nursery attendants will sell them to well-wishers for sustainability of the nurseries.	It should therefore be up scaled and replicated
1.3	Establish tree nursery sites	Achanga, Ajesai, Ikobatum, Obureiteng, Amugei Apopong, Kokorio and Moruisiru villages	Tree nursery sites are locally managed; however, some loss is experienced due to the long dry spell that has dried up all the nearby water sources to the nursery sites, the nursery bed attendants have to walk for long distances in search for water which in some cases is not adequate. Ferro-cement tanks and roof water catchment systems are used to collect water to support farmers during dry	This activity is cost-effective, and increases access to tree seedlings by farmers especially during rainy seasons. It needs to be up scaled.

TABLE 27: PERCEPTIONS ON THE SUCCESSES OF THE NO-REGRET IWRM MEASURES

CODE	ACTIVITY	LOCATION	EXPLANATION	RECOMMEDATION FOR UPSCALING / DOWNSCALING
			seasons.	
1.4	Construct shallow wells	Ikobatum and Apopong villages	Siting deep wells is quite challenging in Amuria district and in the event of a long dry spell some of the boreholes also dry up. Hydrological reports indicate that there is low water table in some parts of Acowa S/C.	It should be down scaled and government up scales extension of piped water to communities
2.1	Form & Train Wetland Management Committees	Achanga, Ajesai, Ikobatum, Obureiteng, Amugei Apopong, Kokorio and Moruisiru villages	The trained wetland management committees play a very critical role in sensitizing the communities and leading the implementation of the community wetland action plan.	Should be up scaled
2.2	Train communities on alternative energy and adoption of energy saving practices	Achanga, Ajesai, Ikobatum, Obureiteng, Amugei Apopong, Kokorio and Moruisiru villages	Although most of the community members recognize the importance of alternative energy practices, there is still low adoption of some of the technologies.	Need to be up scaled and replicated
2.3	Form and train Village Savings and Loans Associations (VSLA) groups	Achanga, Ajesai, Ikobatum, Obureiteng, Amugei Apopong, Kokorio and Moruisiru villages	This activity brings communities together and enhances community sensitisation sessions due to the fact that in most cases these groups meet regularly on weekly basis, it's easy to pass information to them and this has scaled up the dissemination of information on integrated risk management at community level.	Need to be up scaled and replicated
KATAKWI DISTRICT			**IMPLEMENTED BY: TPO UGANDA CONTACT PERSON: EMMANUEL ENGABIRANO (KNOWLEDGE MANAGER, 0772 577 086 / 0703 516 728, ENGABIRANO@TPOUG.ORG**	
1.1	Support participatory development of wetland management plans and ensure restoration and demarcation of degraded wetlands	Adodoi, Akwakera and Damasiko in Kapjan Sub-County	Participatory development of wetland management plans helps the community to appreciate the benefits of wetland services they enjoy as a community and the importance wetlands play in averting climate change and its negative effects. It also enhances ownership of the project since the plans are derived from the community themselves. It also ensures full participation of the entire community during the wetland demarcation process and taking keen responsibility community on the encroachers after demarcation.	Should be up scaled and replicated
2.1	Establish community managed tree nurseries, creation of woodlots, live fencing and promote planting of tree species.	Adodoi, Akwakera and Damasiko in Kapjan Sub-County	The woodlots were successfully established in the community and are fully under the management of the community. However, some of the trees succumbed to prolonged dry spell currently experienced in the region, but nevertheless, the community is watering the trees in a bid to ensure that the trees survive through the dry spell.	Should be scaled up and replicated
2.2	Provide training and enable access to information on alternative sources of energy and promote the adoption of energy saving practices/tools	Adodoi, Akwakera and Damasiko in Kapjan Sub-County, Katakwi Town Council	40 community members benefited from the training on alternative sources of energy saving stoves and briquette making. This will ensure reduction in tree cutting hence conserving the environment. The other benefit is that the community's level of income generation will be enhanced through the sale of the energy saving stoves and briquettes hence reducing on their dependence on	Should be scaled up

TABLE 27: PERCEPTIONS ON THE SUCCESSES OF THE NO-REGRET IWRM MEASURES

CODE	ACTIVITY	LOCATION	EXPLANATION	RECOMMEDATION FOR UPSCALING / DOWNSCALING
			natural resources for survival.	
2.3	Introduce/promote practices that allow regeneration of natural resources	Adodoi, Akwakera and Damasiko in Kapjan Sub-County	Community sensitization meetings were conducted and these meetings were very helpful in building on local community's knowledge on environmental conservation. The community came up with by-laws "(declarations) that regulates activities that degrade the environment. These by-laws/declarations were endorsed/approved by the local council leaders and the sub-county technical staff. This will play a big role in reducing the level of environmental degradation since it penalizes those found to be engaging in activities that are destructive to the environment.	Should be scaled up and replicated.
2.4	Construct 2 shallow wells	Akwakera and Damasiko in Kapjan Sub-County	TPO Uganda managed to re-allocate some of the funds saved from different budget lines for the drilling of one borehole in Okii village. This was after consultations with the district water officer who advised that the Ministry of Water and Environment guidelines on the water source protection policy are followed. This policy bans the construction of shallow wells due to their susceptibility to contamination. The service provider has already been identified and engaged. This borehole will ensure access to clean and safe water by over 130 households.	Should be up scaled
2.5	Train 10 communities in green management technologies alternative energy and adoption of energy saving practices	Adodoi, Akwakera and Damasiko in Kapjan Sub-County	50 participants were trained in conservation agriculture and the training was especially targeting methods that prevent soil erosion, Promotion of cover crops, restoration of soil fertility and retention of soil moisture. The participants appreciated the level of the knowledge passed to them. However, the level of adoption shall be determined when rains return. The demonstration gardens for the conservation agriculture are to be set on the onset of the rains early match. These demos will act as reference/learning points where community members will access better farming practices that does not deplete the soil.	Need to be up scaled and replicated

ANNEX B – CMO MEMBERSHIP

TABLE 28: CMO MEMBERSHIP AND RECOMMENDATION FOR ENGAGEMENT

Institution	CMO membership	Recommendations for engagement
LOCAL RESOURCE USERS		
Farmers	No	The local water users are the primary beneficiaries and their engagement is of great importance in order to take the right decisions to their vision, objectives and needs. Though their interest in potential benefit from CBWRM is very high, it is difficult to involve the water users as individuals. ■ The local resource users will not be invited to be part of a CMO body at individual level. They are represented in the CMO through different civil society organisations including CBOs, cultural and religious leaders. ■ NGOs can further support the local users by emphasizing their interests and strengthening their capacity and local NGOs. ■ Massive sensitization of primary stakeholders, through their community based organizations and groups, trainings, media and sensitization workshops about catchment management to enable them to actively participate in the planning process and later in the implementation stage. The project and the need for participatory environmental conservation will motivate the involvement of local resource users in project implementation. ■ Sensitize the resource users about the government laws and policies through the government departments, the CSOs, local traditional structures (for the case of Karamoja) and other change agents like politicians. ■ Adopt participatory project implementation strategies.Mobilize and sensitize the respective resource users about the project objectives, impact and the relevance of their participation in conserving the water catchments. Involve them at all stages of project implementation. ■ Focus on increasing livelihood alternatives / options towards reducing the stress on the environment and its resources.
Miners		
Fishing folk		
Firewood collectors / charcoal burners		
Bee keepers		
Cattle herders		
GOVERNMENT MINISTRIES		
Ministry of Agriculture, Animal Industry and Fisheries	No	■ Ministry officials can form part of a National Technical Advisory Committee (NTAC) or other zonal representation and will work closely with KWMZ. KWMZ will communicate or facilitate their advice and input through the Catchment Stakeholder For a (CSF), CMCs or CTCs at catchment level. ■ Consultation and advice on policies, visions and objectives.
Ministry of Lands, Housing and Urban Development	No	■ Participation in a NTAC or through other zonal representation. ■ Consultation and advice on policies, visions and objectives. ■ Need to broaden their scope and knowledge in CBWRM.
Ministry of Tourism and Wild Life	No	
OPM	No	
Ministry of Local Government	No	The local government sets policies and standards for decentralised service delivery. Thus, they can assist in the catchment planning and resources alllocation in collaboration with MWE.
DIRECTORATES		
Directorate of Water Development (DWD)	No	■ Directorate officials have an important advisory and guiding role. They can form part of a National Technical Advisory Committee (NTAC) or other zonal representation and will work closely with KWMZ. KWMZ will communicate or facilitate their advice and input through the CSF, CMC or CTC at catchment level. ■ Consultation and advice on policies, visions and objectives.
Directorate of Environmental Affairs (DEA)	No	
STATUTORY BODIES		
National Environment Management Authority (NEMA)	No	The statutory bodies should become part of a National Technical Advisory Committee (NTAC), or other regional representation, and will work closely with KWMZ. KWMZ will communicate or facilitate their advice and input through the

TABLE 28: CMO MEMBERSHIP AND RECOMMENDATION FOR ENGAGEMENT

Institution	CMO membership	Recommendations for engagement
National Water and Sewerage Corporation (NWSC)	No	CSFs, CMCs or CTCs at catchment level.
National Forestry Authority (NFA)	Yes	The local NFA and UWA representative can be part of the CMC.
Uganda Wild Life Authority (UWA)	Yes	
REGIONAL WATER INSTITUTIONS		
Water Sector Development Facility (WSDF) East	No	■ The regional bodies and regional umbrella organizations will be part of a Zonal Advisory Committee (ZAC) as provided for in the DWRM guidelines and framework. ■ Participation in catchment stakeholder forums ■ Provision of technical expertise to the catchment
Umbrella Organizations for Karamoja		
DISTRICT DEPARTMENTS / OFFICES		
Natural Resources Department.	Yes	■ For optimal sectoral expertise and vision, all district departments should be represented in all CMO bodies. ■ Equally the CMC should represent the different sectors thus district representation is recommended. ■ Technical officers should represent the district line departments in the Catchment Technical Committee (CTC). ■ Build the capacity of the local government officials in CBWRM through partnership with technical capacitated multi-national agencies and (i)NGOs. ■ In the context of limited resources, there is need for coordination and synergy building among the different secondary stakeholders. This will facilitate optimal use of the limited resources for the good of community development and environment conservation. ■ The district departments in Lokok and Lokere could work with CSO advocacy institutions like UWASNET for purposes of lobbying for more resource allocation from the line ministries to the different district departments. ■ Reduce bureaucracy in service delivery. ■ Central government should consider increasing budget allocation to districts especially the natural resources departments. ■ Districts should scale up resource mobilization from other organizations and improve local revenue. ■ Employ more staff to fill up the gaps especially technical staff. ■ Address issues of corruption and conflict of interest. ■ Improve coordination between ministries and statutory authorities, district technical staff and the political system. ■ Improve the enforcement of laws and policies on CBWRM.
a) District Environment Office		
b) District Forestry Office		
Community Based Services Department.		
District Water Department		
Production Department.		
a) Agriculture Office		
b) Livestock Office		
c) Fisheries Office		
Planning Department.		
Information Department.		
Health Department.		
Engineering and Works Department.		
Chief Administrative Officers (CAO)	Yes	■ The CAOs together with representatives of other stakeholder groups will form the Catchment Management Committee (CMC). ■ They can play a role as influencers and change agents, important for community acceptance of the project. ■ Involve them in planning and engagement meetings, CSFs and in CBWRM trainings. ■ Sign MoUs to lay down commitments to the objectives and principles of CBWRM ■ CAOs need to be oriented about the project and can play an important role in the inception phase of the project. However, their roles must be explicitly spelled out and their expectations levelled.
District Police Commander	No	Participation in the CSF meetings for regular updates. Identifies areas where security is much more paramount.
POLITICAL LEADERS		

TABLE 28: CMO MEMBERSHIP AND RECOMMENDATION FOR ENGAGEMENT

Institution	CMO membership	Recommendations for engagement
Local Council Leader (LC5)	Yes	■ Political leaders (LC5) together with representatives of other stakeholder groups will form the Catchment Management Committee (CMC). ■ They can play a role as influencers and change agents, important for community acceptance of the project. ■ Involve them in planning and engagement meetings, CSFs and in CBWRM trainings ■ Sign MoUs to lay down commitments to the objectives and principles of CBWRM ■ Political leaders need to be oriented about the project and can play an important role in the inception phase of the project. However, their roles must be explicitly spelled out and their expectations levelled. ■ Sub-county and lower level political leaders will take up similar roles at their respective sub or micro-catchments.
Local Council Leader (LC3)		
Local Council Leader (LC1)		
Resident District Commissioner (RDC)	No	In an engagement meeting the specific roles for the RDC, the expectations and their commitment to CBWRM should be spelt out in a MOU.
UN AGENCIES		
UN FAO	No	■ Catchment Management is firstly a local issue which should involve all local stakeholders. However, development partners like UN agencies have important capacities which can be of benefit of catchment management and CMP implementation. Therefore, specific catchment based technical people should be consulted by the CMC or CTC. ■ KWMZ is advised to work closely with UN FAO as their activities are directly in line with the project to be implemented. ■ The multi-national agencies should harmonize their programmes with the District Local Governments and other development actors in terms of project sites and approaches through multi-stakeholder coordination. ■ They should prioritize natural resources management integration into their development programmes. ■ They have technical capacity and can support in capacity building of different stakeholders ■ They can mobilize resources jointly for long-term project implementation. ■ They should develop long-term development projects that can realize outcomes. ■ They should provide employment to local communities. ■ They should involve communities in all phases of their project cycles. ■ They reduce indirect costs of the projects to increase impact. ■ They aim at project impact rather than well written and nice reports.
UN WFP	No	
UNICEF	No	
DONOR AGENCIES / FUNDERS		
DFID	No	Consultation and advice on policies, visions and objectives
INTERNATIONAL NGOS		
GIZ	No	■ Catchment Management is firstly a local issue which should involve all local stakeholders. However, development partners like UN agencies have important capacities which can be of benefit of catchment management and CMP implementation. Therefore, specific catchment based technical people should be consulted by the CMC or CTC. ■ Otherwise, GIZ should be part of a National Technical Advisory Committee (NTAC), or other regional representation, and will work closely with KWMZ. KWMZ will communicate or facilitate the advice and input from NTAC through the Catchment Stakeholders Forums, or CMCs and CTCs at catchment level.
IUCN	No	■ KWMZ is advised to work closely with IUCN and C&D as their activities are directly in line with CBWRM and the Catchment Management Planning process. As active actors on CBWRM with high influence and high interest, IUCN and C&D should be consulted by the CTC and should be invited to CSF meetings. ■ The iNGOs should harmonize their programmes with the District Local Governments and other development actors in terms of project sites and approaches through multi-stakeholder coordination.

TABLE 28: CMO MEMBERSHIP AND RECOMMENDATION FOR ENGAGEMENT

Institution	CMO membership	Recommendations for engagement
C&D	No	■ They should prioritize natural resources management integration into their development programmes. ■ Those with technical capacity can support in capacity building of different stakeholders. ■ They can mobilize resources jointly for long-term project implementation. ■ They should develop long-term development projects that can realize outcomes. ■ They should provide employment to local communities. ■ They should involve communities in all phases of their project cycles. ■ They reduce indirect costs of the projects to increase impact. ■ They aim at project impact rather than well written and nice reports.
Mercy Corps	No	■ As significant development actors in the catchments, these iNGOs should be invited to CSF meetings. Through this forum they can bring forward the community perspective on catchment development vision, planning objectives and key issues, options and alternative scenarios. ■ They need to broaden their scope and knowledge in CBWRM.
World Vision	No	
Goal	No	
IIRR	No	With their in-depth knowledge and experience in the catchment, their advisory services can be used for specific issues on request of the CMO or KWMZ.
Cordaid	No	With their in-depth knowledge and experience in the Catchment and their capacities on multi-stakeholder processes, their advisory services can be used for specific issues on request of the CMO or KWMZ.
NATIONAL NGOs		
Teso Diocesan Planning and Development Office (TEDDO)	Yes	■ Local NGOs can represent the community interests and should be therefore represented in the CMC. ■ Catchment based water resources management is quite a new development concept to many of the local NGOs. KWMZ is therefore advised to build the capacity of these stakeholders on orientation on the national environmental laws and policies.
Community Integrated Development Initiative (CIDI)		
Caritas Kotido		
Caritas Moroto		
SOCADIDO		
TPO Uganda		
Ecological Christian Organization (ECO)		
Arid Lands Development Programme		
Dodoth Agro Pastoral Development Organization (DADO)		
Warrior Squad Foundation		
COMMUNITY BASED ORGANIZATIONS		
WATESO	Yes	■ CBOs can represent the community interests and should be therefore represented in the CMC. ■ Catchment based water resources management is quite a new development concept to many of the CBOs and CSOs. KWMZ is therefore advised to build the capacity of these stakeholders in the two aspects: a. Orient the CBOs and CSOs on the national environmental laws and policies. b. CBOs and CSOs are conveniently located in communities, as such they could be used by KWMZ as change agents and early adaptors. They play an important role in community mobilization, sensitization and data collection.
Abim Women Together in Development	Yes	
Hand Pump Mechanics Association (all districts)	Yes	
Amuria District Farmers' Forum	Yes	
Amuria Fish Farmers Association	Yes	

TABLE 28: CMO MEMBERSHIP AND RECOMMENDATION FOR ENGAGEMENT

Institution	CMO membership	Recommendations for engagement
Abim Youth Association	Yes	
WERA Women Development SACCO	Yes	
Morungole / Ikitoyan Conservation Group	Yes	
TIMU Environment Conservation Group	Yes	
Karamoja Miners Association	Yes	Karamoja Miners Association is the institution which regroups the large number of small mining associations. As such they can represent the mining associations in Catchment Management in the CMC.
CULTURAL INSTITUTIONS		
Akiriket Council of Elders	Yes	■ Cultural institutions are important change agents, influence community attitudes and project acceptance. KWMZ is therefore advised to involve them in the project through sensitization and to work closely with those located in the project areas. ■ A cultural leader could be represented in the CMC. ■ Capacity building in CBWRM, data collection and documentation. ■ Facilitate traditional institutions for sensitization and information dissemination including mobilization regarding CBWRM. ■ Promote education among cultural leaders and their subjects.
Iteso Cultural Union		
Ametho Cultural Gathering		
RELIGIOUS INSTITUTIONS		
Catholic Church	Yes	■ Religious institutions are important change agents, influence community attitudes and project acceptance. KWMZ is therefore advised to involve them in the project for sensitization and to work closely with those located in the project areas. ■ A religious leader could be represented in the CSF. ■ Build the capacity of the religious institutions in CBWRM and sensitize them on the national environmental laws and policies.
Church Uganda		
Islamic Faith		
MEDIA		
Etop Radio	No	Use media to disseminate information for awareness raising within the catchments on CBWRM and sensitisation on the project objectives.
Nena FM		
Karamoja FM Radio		
MTN	No	■ Use telecommunications to disseminate information for awareness raising within the catchments on CBWRM and sensitisation on the project objectives. ■ Explore opportunities for funding CBWRM projects / interventions.
PRIVATE COMPANIES		
Enterprise Uganda	No	As their interest is not so much related to catchment management, there is no need to actively involve them in the CMO.
Tororo Cement	Yes	■ As actors with high interest in the natural environment of the catchment and as potential blockers for implementation of CBWRM in fear of restriction of their operations and economic outlook, the mining companies should be brought on board of the CMO.They should be invited to CSF meetings and be represented in the CMC. ■ Private institutions have resources that can be tapped into for the benefit of Lokere Catchment. There is therefore need to mobilize and orient them about CBWRM, its benefits and its intentions. They can support the project initiatives in resource mobilization and any other relevant support as part of their corporate social responsibility. ■ Through the CMOs in the two catchments stakeholders can dialogue with them on better natural resources management, mobilize and involve them in trainings on CBWRM to make them appreciate its importance.
DAO Marbel Limited		
Africa Miners Limited		

TABLE 28: CMO MEMBERSHIP AND RECOMMENDATION FOR ENGAGEMENT

Institution	CMO membership	Recommendations for engagement
RESEARCH INSTITUTIONS, ACADEMIA & LEARNING CENTRES		
NARO-NABUIN ZARDI	Yes	It is recommended to engage them in the CMC to develop their research interest in CBWRM, for synergy building and optimal resource utilization.
NASSARI		
Makerere University	No	Several departments of Makerere University are potential partners for research and knowledge sharing. The CMC should further explore the most relevant partners for knowledge management.
CONSULTANCY FIRMS		
WEConsult	No	■ These consultants with technical capacity can support in capacity building of different stakeholders. ■ They can take up specific assignments as part of CMP implementation.
Acacia Water		
RAIN		
Wetlands International		

ANNEX C – CATCHMENT MANAGEMENT COMMITTEE MEMBERS FOR LOKERE CATCHMENT

TABLE 29: LOKERE CATCHMENT MANAGEMENT COMMITTEE (as per March 2017)

	Stakeholder group	Position	Name	District	Telephone	Email
1.	Chairpersons (LC5)		Hon. Okitoi Robert *CMC Chairperson*	Amuria	0774 364 892	okitoierisatrobert@gmail.com
2.			Hon. Lomonyang Joseph	Napak	0772 909 020	kaligoi1971@gmail.com
3.			Hon. Elakas Walter Okiring	Katakwi	0772 929 210	cassavarepublic@live.com
4.			Hon. Napaja Andrew	Moroto	0772959269	napajaandrew@gmail.com
5.	CAO			Kotido		
6.			Olaboro Franco	Nakapiripirit	0772 469 767	francoolaboro2014@gmail.com
7.			Joseph Balisanyuka	Soroti	0772 612 244 / 0705 722 8509	balisanyukaj@gmail.com
8.			Otai Charles	Kaabong	0772 640 638	otai.charles@yahoo.com
9.	Technical officers	DNRO	Apolot Elizabeth	Katakwi	0772-372 389	lizapolot@yahoo.com
10.		DWO	Nasur Charles	Kaabong	0782 875 674 / 0776 196 071	nasurcharles123@gmail.com
11.		DCDO	Jenipher Longoli	Moroto	0782 786 707	jenipherlongoli@gmail.com
12.		Production Officer	Lodungokol John	Napak	0772 491 230	lodungokoljohn36@yahoo.co.uk
13.		District Planner	Oboi Richard	Soroti	0772 636 872	richardoboi72@gmail.com
14.		DFO	Egelu Paul	Amuria	0773 539 155	pegelu@gmail.com
15.		DWO	Lokiru Charles *CMC Secretary*	Nakapiripirit	0782974201	lokiruc@yahoo.com
16.		Fisheries		Moroto		
17.		District Health Officer	Kibwota Godfrey Achilla	Kaabong	0782 928 728	godfreyachilla@gmail.com
18.		District Information Officer	Joseph Orisa	Kotido	0772579 170 / 0755 579 170	diokotido@gmail.com orisajoe@yahoo.com
19.	Cultural institutions / elders		Opolot Gabriel Ononge - (ICU)	Amuria	0779 044 066	Newafrika@gmail.com
20.			Lemuja Mary Magdalene	Napak	0773 201 901	
21.	Research			NABUIN ZARDI		

TABLE 29: LOKERE CATCHMENT MANAGEMENT COMMITTEE (as per March 2017)

	Stakeholder group	Position	Name	District	Telephone	Email
22.	institution / academia	Director	Dr. Micheal Ulgen	National Semi Arid Resources Research Institute - NASARRI	0772 446 739 / 0756 446 739	
23.	Media	Journalist	Elton Edeket	Kyoga Veritas	0778 209 104 / 0700 475 410	eltykvr@gmail.com
24.	CBOs	Farmer	Oboot Osigire Charles	District Farmers Forum Amuria	0772 580 412	obootosigirecharles@gmail.com
25.		Fisherman	John Etyang	Amuria Farmer's Association	0779 063 330 / 0751 201 404	tesodevelopmentagency@gmail.com
26.		Miner	Namugit Musilimo	Kaabong community mineral mining association	0780 367 633	
27.		Cattle herder	Vacant			
28.	NGOs		Kocho Justin Bob	Ecological Christian Organisation (Nakapiripirit)	0782 646 043 / 0751 646 043	bob@ecouganda.org
29.			Ngabirano Emmanuel	TPO Uganda (Katakwi)	0772 577 086 / 0703 516 728	engabirano@tpoug.org
30.	Government agencies	Principal warden incharge of Pian Upe wildlife reserve	Chris Oryema	UWA	0777 281 277 / 0751 649 800	chrisoryema@yahoo.com
31.			Vacant	NFA		
32.	Private sector		Oryokot Mary Immaculate	Water Welfare Agency and Transformational Economics and Sustainable Social Organisation – WATESO	0772 608 178	
33.			Vacant			

ANNEX D – DEVELOPMENT OF THE BEEF VALUE CHAIN

Background to the beef sector in the catchment

The meat sector of Uganda is dominated by small-scale enterprises and agro-pastoralists. Cattle account for 60-70% of the sector turn-over and livestock is mainly concentrated in the southern and western part of the country, accounting for about 80% of all cattle. The sector is becoming export oriented at a slow pace, spearheaded by the growth in the export of hides and skins. An estimated 90% of the national cattle herd is kept under pastoral and mixed small holder farming systems and commercial beef ranching accounts for less than 10% of the national herd. The main sources of meat are the culled animals and excess steers in the various farming systems.

TABLE 30: ESTIMATED NUMBER OF LIVESTOCK PER DISTRICT IN SOME PARTS OF NORTHERN AND EASTERN UGANDA BY 2014

No	Location	Cattle	Goat	Sheep	Pigs	Chicken	Turkey	Ducks
1	Eastern Uganda	11,408,750	12,449,670	3,410,370	3,184,310	37,385,800	348,330	1,458,250
2	Abim	13,635	37,229	8381	17354	61330	2213	3373
3	Amuria	171375	113110	35942	41318	545388	467	5703
4	Kabong	518465	525389	424729	33829	506583	1551	16849
5	Katakwi	136966	104932	25511	19381	286229	3423	4902
6	Kitgum	38457	54815	11509	38444	139286	1234	31949
7	Kotido	694247	535138	555688	1318	219598	3863	12737
8	Moroto	352867	380172	307028	5534	260997	3075	18834
9	Nakapiripit	674746	547365	389676	322	314308	1095	15653
10	Pader	57087	57087	6298	39430	150317	1144	43197

Source: National Livestock Census report 2014 (UBOS)

As can be seen in the table above, Kotido, Nakapiripirit and Kabong feature top in the estimated livestock numbers. However, this does not mean that the marketing of beef from these districts is also highest. Unfortunately, statistics of how much beef is marketed from these districts is not available. Statistics on the meat consumption are available. According to Uganda Investment Authority (UIA), consumption of beef products, both in absolute terms and on a per capita basis, is very low in Uganda (TABLE 31). However, prospects for increased demand, hence increased production, are good as per capita purchasing power continues to increase. Household expenditure on animal products ranges between 20 - 30% of total expenditure and the price elasticity of demand (% change in quantity demanded as a proportion of % change in price of commodity) for meat is very high. The meat sub-sector grew by 3% (from Shs. 267 to Shs. 275 billion) between 2008/2011 (MAAIF, 2011).

TABLE 31: PRODUCTION OF MEAT PER YEAR

Source of meat	2011	2012	2013	2014	2015
Cattle meat	160,000	174,150	169,950	175,049	180,300
Pig meat	18,000	20,250	18,540	19,096	19,669
Goat meat	29,870	30,766	31,689	32,640	33,619

Source: Uganda National Beef Producers Association report (2015)

Regardless of the researches that have taken place over the past years it appears to be impossible to get good statistics on livestock sales from the catchment region (IGAD 2016). An assessment from Mercy Corps (2011) showed that the livestock market in Kotido, held on Wednesdays outside Kotido town, is the largest. More than 200 cattle and many

smaller ruminants and poultry were sold there each week. The market has seen a dramatic decline in sales in the around 2010 as livestock numbers have fallen due to disease, raiding, and confiscation. In previous years, the market dealt in up to 700 cattle each week. Cattle are primarily sold to traders from outside Karamoja, including Pader, Lira, and Gulu. Given the migratory nature of pastoralism in the catchment it can be expected that cattle from the catchment will be sold on markets outside the catchment during times of distress when cattle keepers migrate to the south and south west. There is also some export trade to South Sudan, but this destabilized recently due to the conflicts. Figure 42 shows the markets from the catchment area

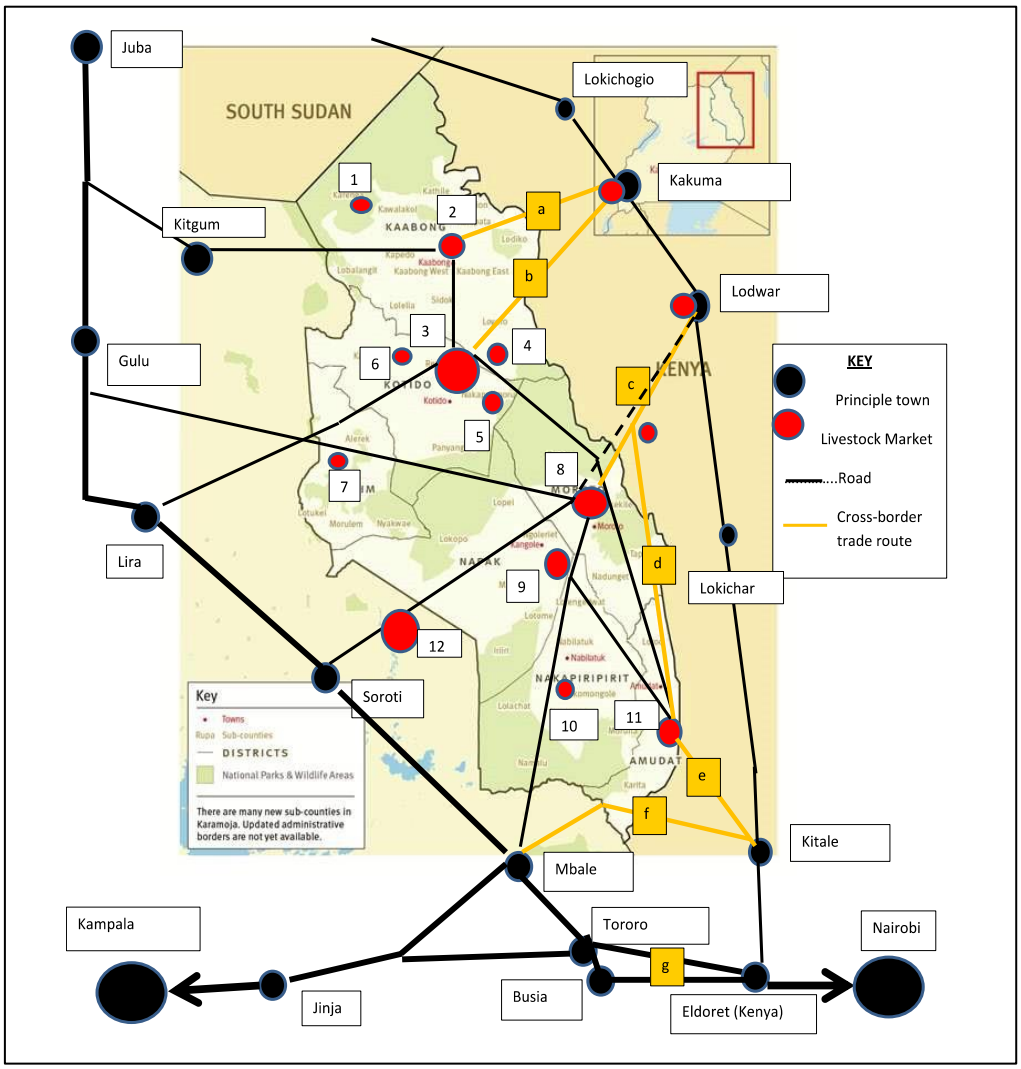

Figure 42: Main livestock markets around Karamoja (Source: IGAD 2016)

Transactions occur through individual negotiations and are often facilitated by a translator. Sellers accept cash or barter, particularly for sorghum. However, a shift towards a preference for cash has been observed in recent years as it is more flexible. Most cattle are sold for immediate slaughter and wholesale to butchers, though some traders are vertically linked to butchers themselves. A few young-stock are sold for fattening elsewhere (Mercy corps 2011 Uganda conflict and Economic development assessment Karamoja). The number of commercial investors in the beef sector is yet very few all concentrated within the Kampala City area that includes Quality Cuts, Top Cuts, Fresh Cuts, Kampala Meat Packers and Egyptian Foods in Bombo. Most of the population is served by un hygienic butcheries in the urban and peri-urban areas of Uganda, so leaving a considerable market share of over 70%with unmet needs in terms of quality meat products, which gives an adequate space a meat enterprise that draws from the catchment.

The beef market

Market constraints

There is a long misunderstanding that the pastoralist communities in the catchment do not sell cattle according to an economic logic and these constraints the market of livestock in the area. A recent study by IGAD (2016) outlined this as follows:

Karamojong (and other pastoralist) households do not tend to manage their herds/flocks to maximize productivity and profit. Rather, they tend to manage them like an investment portfolio with a variety of assets. Their primary objective is to increase the value of the portfolio (in this case, the herd/flock). The income received from the portfolio is in the form of capital gains: a combination of increased asset values, and dividend income. Essentially, Karamojong pastoralists do not derive income from the sale of animals. Instead, the sale of animals merely monetizes their income, converting capital gains into cash for one of two principal reasons:

- **To meet immediate cash needs**. Karamojong pastoralists sell animals to obtain cash for the purchase of staple grains, the payment of school fees, family obligations, and unanticipated expenditures such as medical expenses. This behaviour is well described in the literature. Livestock sold to meet immediate cash needs are generally surplus males and cull females (assets with limited future growth potential) whose sale has the least impact on the total value of the portfolio.
- **To "trade up".** Although not described in the literature, this is readily observable in the market. Karamojong pastoralists take advantage of opportunities to sell assets with low growth potential (slaughter bulls), and use the proceeds to purchase assets with high growth potential (heifers). This investment behaviour increases the overall growth potential of their livestock portfolio.

What this means is that the cattle market from the pastoralist areas in the catchment needs to be understood not from a maximizing profit perspective but from a market logic that trades in livelihood products and trades off low growth potential assets. Furthermore, the market should focus on periods when prices for beef are low since these are the times when people want to sell a lot of cattle. It definitely does not mean there is a problem at the market from the supply side, but there are production and marketing constraints

- Inadequate infrastructure for marketing of beef and its other products at the primary, secondary and tertiary market levels.
- Lack of information on local and international markets which leads to lack of continuity, sustainability and scaling up in the production and marketing trends.
- Limited investment has been directed to value addition, quality and standards of beef products so as to attract better prices;
- Weak enforcement of policies, laws, regulations and standards has led to spread of diseases and production of sub-standard products. This has limited access to highly integrated and competitive international markets.

Market potential

Market segmentation for a meat enterprise is based on the market opportunity in greater Kampala area. This market is growing while the export from the catchment tends to go to other areas (Figure 43) and some of these markets proved insecure such as the Juba market.

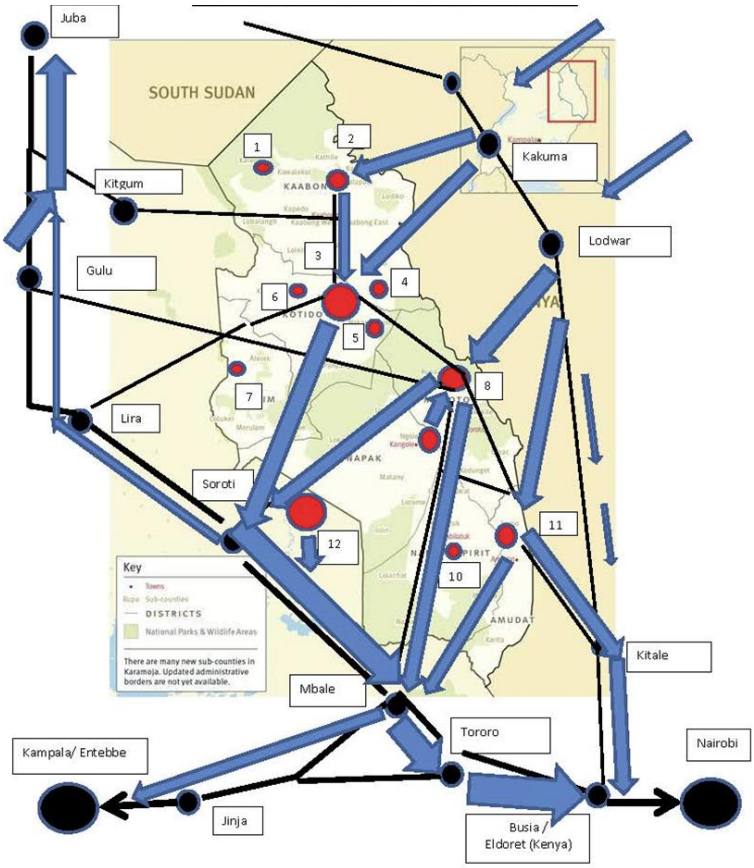

Figure 43: Movement of slaughter ready cattle across Karamoja (Source: IGAD 2016 Karamoja Livestock Market Assessment Report January 2016)

The following analysis can be made for the markets in Kampala and the growth rate.

TABLE 32: MARKET ANALYSIS FOR MEAT PRODUCTS IN KAMPALA

Potential Customers	Growth	Year 1	Year 2	Year 3	Year 4	Year 5	CAGR
High Income Kampala households	3%	9,000	9,225	9,456	9,692	9,934	2.50%
Medium income Kampala households	3%	25,000	25,625	26,266	26,923	27,596	2.50%
Neighbouring towns High Income households	3%	25,000	25,625	26,266	26,923	27,596	2.50%
Caterers	4%	25	26	27	28	29	3.78%
Restaurants	5%	60	63	66	69	72	4.66%
Total	**2.50%**	**59,085**	**60,564**	**62,081**	**63,635**	**65,227**	**2.50%**

Competition

Competitions for proposed meat enterprise fall into the following categories:

- Butcher shops
- Grocery stores
- Big box retailers

The proposed meat enterprise will establish its competitive edge through the taste of beef from Karamoja and Teso regions in Uganda and could be marketed as such. A company set up to market beef from the catchment also needs to employ competent workers and managers who will come with the best existing relationships of the best suppliers of meat such Quality Cuts, Top Cuts as well as understanding of the craft of butchering. Coupled with the understanding of food services management, sales record in business to business sales, and financial acumen, the employees and the Board of

Directors of the company will have an edge over the markets' other butcher shops and grocery stores within its niche markets in Kampala and other surrounding towns in Uganda.

The Kampala market

- To further the market of beef from the catchment to the Kampala market, an enterprise needs to be promoted which can:
- Establish its retail location by signing a rent lease in Kampala once funding is secured
- Begin by targeting high income residents of Kampala and the surrounding towns, as well as medium income residents of Kampala, and business customers (upscale caterers and restaurants)
- Business customers and retail customers will be grown as separate revenue streams, but will reinforce each other.

The business will also sell to Wholesalers, Hotels and restaurants, and Supermarkets. This way of distribution is chosen for the following reasons:

- There unmet demand for packaged beef by the Wholesalers like Top Cuts, Quality Cuts and Kampala Meat Packers stands at 35%. This implies that they can still buy over 60% of the beef to be produced by the proposed enterprise.
- There is also high level of unmet demand for quality beef by Supermarkets and Hotels spread across Soroti, Mbale, Lira, Gulu and even Kampala due to the inadequate number of meat processing plants in the county despite the increasing population of the middle-income earners in the country.

TABLE 33: PRODUCT, SERVICE OR RANGE OF PRODUCTS

	Beef	Goat meat
Quality	Quality grades of the cattle beef shall primarily be determined by: ■ Prime maturity defined as those from 30-42 months of age. ■ Intramuscular fat percentage level of 2.54 %/ 2.2%	Quality grades of the goat beef will be determined by: ■ Prime mature of 15-20 months ■ Superior carcass shall be: high proportion of muscle (lean), low proportion of bone and an optimal level of fat cover.
Colour	Red beef	Red beef
Size	1 Kg per unit	1 kg per unit
Packaging	Metal cans, which are made of sheet steel with a coating of tin welded closed at the seams shall be used to deliver beef to Wholesalers Consumer plastic wraps and bags made from three major categories of plastics: polyethylene (PE), polyvinylidene chloride (PVCD), and polyvinyl chloride (PVC) shall be used to pack beef to be delivered to Supermarket and Hotels	As for beef
Price	10,000/=@Kg UGX	12,000/=@Kg UGX
Reasons for setting this price	To be able to meet customer expectations, make profits and also meet operational costs	As for Cattle beef

Source: NEFIMA LTD 2016

Location

The business can have two sites, with one for butchering the live animals and another one for selling the packaged fresh meat in Kampala. The enterprise field office and store site is recommended to be located in Abim Town Council in Karamoja opposite to the modern Abim Town Council Abattoir constructed with funding from United Nations Capital Development Fund through the Ministry of Local Government. This location is chosen due to its being near the Abattoir so supply of meat to the processing plant will be easily accessible and cost effective. This location is also along the main cattle routes from the catchment to the west and can serve as a good outlet for cattle in times of drought.

Financial considerations

Funding for the launch of the business can be provided by the equity from the many saving for Investment Club members especially of the middle-income class in the region who will contribute in agreed shares from their savings to launch the

business. The remaining financing will be made up of grants from impact investors, equity investors and temporary credit taken from the banks.

References

IGAD 2016 Karamoja Livestock Market Assessment Report January 2016 (USAID East Africa Resilience Learning Project)

Mercy Corps 2011 Cattle raiding in Karamoja, A conflict and market assessment (Karamoja June 2011)

ANNEX E – MAP OF CATCHMENTS IN KWMZ

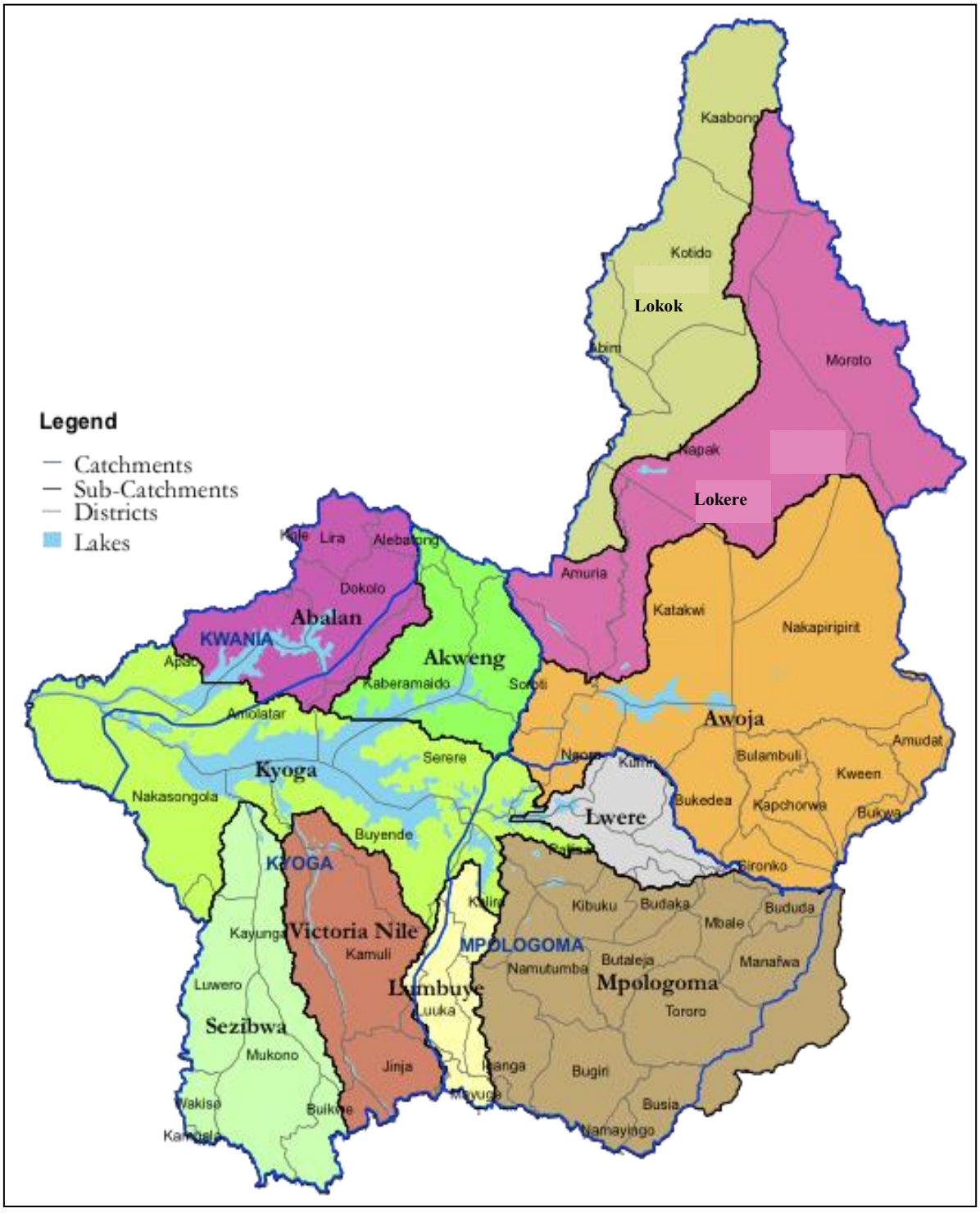

Figure 44: Catchments in Kyoga Water Management Zone (MWE)

ANNEX F – LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

TABLE 34: LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

No	Catchment	District	Source type	Name	Longitude	Latitude	Year of Construction	Functionality	Volume (m³)
1	Lokere	Napak	Dam	Arecek dam	649915	255543	2011	Functional	2,500,000
2	Lokere	Moroto	Dam	Kobebe dam	660934	310355	2011	Functional	1,500,000
3	Lokere	Napak	Dam	APEIMONG SAND DAM	655575	274428	2013	Functional	15,000
4	Lokere	Moroto	Dam	LOKETELAKAPETH	679538	288677	2008	Non-Functional	5,000
5	Lokere	Moroto	Dam	KANAKOI	680177	287638		Non-Functional	
6	Lokere	Amuria	Dam	ALECER	573932	222607	1952	Functional	
7	Lokere	Katakwi	Dam	ORBOI DAM	604975	242731	1965	Functional	
8	Lokere	Katakwi	Dam	ONGUNGA	604655	228255	1940	Functional	
9	Lokere	Amuria	Dam	OJONAI	580161	224559	1949	Non-Functional	
10	Lokere	Amuria	Dam	DOKOLO DAM	573250	216391	1940	Non-Functional	
11	Lokere	Soroti	Dam	TELAMOT-ABOKORO	577253	197751	1947	Functional	
12	Lokere	Moroto	Dam	LOUCOLE	680896	283522	2004	Non-Functional	7,000
13	Lokere	Amuria	Dam	APARISA	581590	218140	1940	Functional	
14	Lokere	Katakwi	Dam	ADAI DAM/AKWORO	603360	222674	1950	Non-Functional	
15	Lokere	Amuria	Dam	AJOLON	582194	211983	1932	Functional	
16	Lokere	Moroto	Dam	LOKWALIKWALIT	681578	284791	2008	Non-Functional	5,000
17	Lokere	Soroti	Dam	Elweu DAm Arabaka	574529	203898	1932	Functional	

TABLE 34: LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

No	Catchment	District	Source type	Name	Longitude	Latitude	Year of Construction	Functionality	Volume (m^3)
18	Lokere	Amuria	Dam	OBUR	576763	212522	1951	Functional	
19	Lokere	Soroti	Dam	Atacai	565131	215927	1960	Non-Functional	750,000
20	Lokere	Soroti	Valley Dam	Dakabela	569378	209269	1961	Functional	250,000
21	Lokere	Soroti	Valley Dam	Arabaka	574439	203814	1960	Functional	394,000
22	Lokere	Soroti	Valley Dam	Telamot	577147	198090	1960	Functional	120,000
23	Lokere	Katakwi	Valley Dam	Aadai dam	603434	222356		Non-Functional	35,000
24	Lokere	Katakwi	Valley Dam	Ongunga	604599	228300		Non-Functional	30,000
25	Lokere	Katakwi	Valley Dam	Abela	604643	209123		Non-Functional	4,000
26	Lokere	Katakwi	Valley Dam	Akwamor	606600	233190		Functional, needs rehabilitation	20,000
27	Lokere	Kotido	Dam	Kalongolemuge	641905	322283	2005	Functional	30,000
28	Lokere	Amuria	Earth Dam	Alecer	573983	222585		Silted and bridged	15,000
29	Lokere	Amuria	Earth Dam	Ojorai	580163	224561		Empty	200,000
30	Lokere	Amuria	Earth Dam	Asolo dam	582172	212013		Silted and bridged	45,000
31	Lokere	Amuria	Earth Dam	Inyangat	589219	228824		Silted, absence of abstraction system	18,000
32	Lokere	Amuria	Earth Dam	Acia	592819	222715		Silted, absence of abstraction system	10,000
33	Lokere	Katakwi	Valley Dam	Acuna	604286	199361		Non-Functional	
34	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665336	269723	1998	Functional	18,000
35	Lokere	Napak	Rainwater Harvest Tank	CATCHIST CENTRE	665504	269437	2009	Functional	10,000
36	Lokere	Napak	Rainwater Harvest Tank	MORULINGA HC II	663157	266870	2012	Functional	25,000
37	Lokere	Napak	Rainwater Harvest Tank	MOTANY HOSPITAL	655134	270158	2005	Functional	200,000

TABLE 34: LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

No	Catchment	District	Source type	Name	Longitude	Latitude	Year of Construction	Functionality	Volume (m^3)
38	Lokere	Napak	Rainwater Harvest Tank	KALOKENGEL P/S	669025	259916	2008	Functional	10,000
39	Lokere	Napak	Rainwater Harvest Tank	MATANY P/S	655280	266620		Non-Functional	10,000
40	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665300	269834	1995	Functional	10,000
41	Lokere	Napak	Rainwater Harvest Tank	LOKUPOI	662464	270060		Non-Functional	
42	Lokere	Napak	Rainwater Harvest Tank	KALOKENGEL P/S	669043	259868	2005	Functional	6,000
43	Lokere	Napak	Rainwater Harvest Tank	KALOKENGEL P/S	669014	269936	2005	Non-Functional	10,000
44	Lokere	Napak	Rainwater Harvest Tank	KANGOLE	665306	269846	1998	Functional	10,000
45	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665281	269796	1998	Functional	30,000
46	Lokere	Napak	Rainwater Harvest Tank	KANGOLE BOYS P/S	665167	269676	2005	Functional	10,000
47	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665347	269858	1998	Functional	10,000
48	Lokere	Napak	Rainwater Harvest Tank	KALOKENGEL P/S	663617	271148	2006	Non-Functional	6,000
49	Lokere	Napak	Rainwater Harvest Tank	PILAS P/S	640786	232762	2007	Non-Functional	
50	Lokere	Napak	Rainwater Harvest Tank	KANGOLE BOYS P/S	665190	269666	2004	Functional	6,000
51	Lokere	Napak	Rainwater Harvest Tank	KAPUAT P/S	636955	234006	1993	Functional	10,000
52	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665360	269878	1992	Functional	10,000
53	Lokere	Napak	Rainwater Harvest Tank	NACHUKA	670989	259221	2009	Non-Functional	8,000
54	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665385	269840	2009	Functional	10,000
55	Lokere	Napak	Rainwater Harvest Tank	KANGOLE GIRLS S.S	665294	269676		Functional	18,000
56	Lokere	Napak	Rainwater Harvest Tank	LOTOME BOYS P/S	670878	260877		Functional	6,000
57	Lokere	Soroti	Rainwater Harvest Tank	ARABAKA H C II	573279	202568		Functional	10,000
58	Lokere	Napak	Rainwater Harvest Tank	KANGOLE BOYS P/S	665187	269662	2000	Functional	20,000

TABLE 34: LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

No	Catchment	District	Source type	Name	Longitude	Latitude	Year of Construction	Functionality	Volume (m^3)
59	Lokere	Soroti	Rainwater Harvest Tank	Arabaka P/S water tank	574641	203528	2004	Functional	
60	Lokere	Napak	Rainwater Harvest Tank	KAPUAT P/S	636955	234006	1993	Functional	10,000
61	Lokere	Napak	Rainwater Harvest Tank	KALOKENGEL P/S	669031	259902	2008	Functional	10,000
62	Lokere	Napak	Rainwater Harvest Tank	KALOTOM	663692	271085	2009	Non-Functional	10,000
63	Lokere	Napak	Rainwater Harvest Tank	KAUTAKOU P/S	668796	271823	2005	Non-Functional	10,000
64	Lokere	Napak	Rainwater Harvest Tank	PILAS P SCH FCT	640800	232708	2014	Functional	10,000
65	Lokere	Napak	Rainwater Harvest Tank	KALOTOM P/S	663622	271132	2000	Non-Functional	20,000
66	Lokere	Napak	Rainwater Harvest Tank	LORENGECORA P/S	639621	245545	2014	Functional	10,000
67	Lokere	Moroto	Rainwater Harvest Tank	MOROTO HIGH SCHOOL	685115	280177	2009	Non-Functional	10,000
68	Lokere	Soroti	Rainwater Harvest Tank	TELAMOT P/S	576061	196126	2001	Non-Functional	10,000
69	Lokere	Moroto	Rainwater Harvest Tank	KALOLIYE P/S	683753	279113	2008	Non-Functional	10,000
70	Lokere	Moroto	Rainwater Harvest Tank	NAKAPELIMEN P/S	684860	279204	2005	Non-Functional	10,000
71	Lokere	Napak	Rainwater Harvest Tank	KAUTAKOU P/S	668775	271836	2008	Non-Functional	10,000
72	Lokere	Moroto	Rainwater Harvest Tank	MOROTO HIGH SCHOOL	685122	285122	2009	Functional	10,000
73	Lokere	Katakwi	Rainwater Harvest Tank	TOROMA HC	606416	193977	1995	Functional	30,000
74	Lokere	Katakwi	Rainwater Harvest Tank	CENTRE USUK	607258	221867	1987	Functional	
75	Lokere	Soroti	Rainwater Harvest Tank	Tukum P/S	575485	205111		Non-Functional	
76	Lokere	Moroto	Rainwater Harvest Tank	NASINYONOIT	680540	270789	1985	Non-Functional	10,000
77	Lokere	Moroto	Rainwater Harvest Tank		684395	280282		Functional	10,000
78	Lokere	Katakwi	Rainwater Harvest Tank	SCHOOL TANK ATOROMA PSC. SCH.	606189	193933	2007	Functional	
79	Lokere	Katakwi	Rainwater Harvest Tank	AKOBOI P/S	604187	193256	2007	Non-Functional	

TABLE 34: LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

No	Catchment	District	Source type	Name	Longitude	Latitude	Year of Construction	Functionality	Volume (m³)
80	Lokere	Soroti	Rainwater Harvest Tank	awaliwal p/s	579014	200017	2004	Functional	
81	Lokere	Moroto	Rainwater Harvest Tank	NAKAPELIMEN P/S	684916	279200		Non-Functional	10,000
82	Lokere	Katakwi	Rainwater Harvest Tank	ORIMAI P/S	600823	191737	2003	Non-Functional	
83	Lokere	Soroti	Rainwater Harvest Tank	Dakabela H/C 111 out patient D	569678	205310	2004	Functional	
84	Lokere	Katakwi	Rainwater Harvest Tank	TOROMA HC	606458	194039	1995	Functional	10,000
85	Lokere	Moroto	Rainwater Harvest Tank	KIDEPO	680177	284221	2006	Functional (not in use)	8,000
86	Lokere	Katakwi	Rainwater Harvest Tank	KAPUJAN S/C	600518	191179	1963	Non-Functional	
87	Lokere	Napak	Rainwater Harvest Tank	LORUNGET COMMUNITY SCHOOL	658798	278803	2009	Non-Functional	10,000
88	Lokere	Napak	Rainwater Harvest Tank	KAURIKIAKINEI P/S	635573	239802	2014	Non-Functional	10,000
89	Lokere	Katakwi	Rainwater Harvest Tank	APUUTON P/S	606708	211692	2002	Non-Functional	
90	Lokere	Moroto	Valley Tank	LOKISILEL	674843	293626	2015	Functional	
91	Lokere	Moroto	Valley Tank	PUPU	681244	286318		Functional	
92	Lokere	Napak	Valley Tank	LONGOOR VALLEY TANK	661539	276146	2014		10,000
93	Lokere	Napak	Valley Tank	NAITAKOSUWAN	670787	261555	2014		18,000
94	Lokere	Napak	Valley Tank	NANGIRONGOLE	664900	262159	2014	Functional	10,000
95	Lokere	Kotido	Valley Tank	NANGOLOL APOLON	644278	333600	2014	Functional	10,000
96	Lokere	Amuria	Valley Tank	Ocodio	594866	227877		Mechanical Problem and silted	22,500
97	Lokere	Katakwi	Valley Tank	Ariamiriam	604284	199370	1940	Partially Functional	30,000
98	Lokere	Katakwi	Valley Tank	Owaya	604487	213498		Partially functional	2,000

TABLE 34: LIST OF EXISTING WATER FOR PRODUCTION FACILITIES IN LOKERE CATCHMENT

No	Catchment	District	Source type	Name	Longitude	Latitude	Year of Construction	Functionality	Volume (m^3)
99	Lokere	Katakwi	Valley Tank	Oroboi	604984	242720	1960	Non-Functional	2,500
100	Lokere	Katakwi	Valley Tank	Aumoi	611386	238387	1960	Partially functional	3,000
101	Lokere	Katakwi	Valley Tank	Awaya	604482	213500		Functional	
102	Lokere	Katakwi	Valley Tank	Oroboi	604984	242720		Functional, needs rehabilitation	
103	Lokere	Kotido	Valley Tank	Lomogol	648847	339996	2012	Functional	
104	Lokere	Kotido	Valley Tank	Lokaale-Nongololapolon	644278	333600	2014	Functional	

ANNEX G – EXISTING PIPED WATER SUPPLY SYSTEMS

TABLE 35: EXISTING PIPED WATER SUPPLY SYSTEMS

S/No	Location of piped water system	Parish	Sub-County	District	Functionality Status	Remarks
1	Moroto Municipality		North & South Divisions	Moroto	Functional	National power grid / Generator; Underground (borehole) water source. Managed by NWSC.
2	Nadunget Trading Centre	Nadunget	Nadunget	Moroto	Functional	Solar powered; funded by UNICEF. Underground (borehole) water source.
3	Musas Village	Musas	Katikekile	Moroto	Functional	Source: Gravity flow scheme from a rock catchment south-west of Mt Moroto. Solar powered; funded by UNICEF.
4	Kodonyo Village	Kodonyo	Tapac	Moroto	Functional	Gravity flow scheme. Solar powered; funded by ASB
5	Kaakingol and Nakiloro villages	Kaakingol	Rupa	Moroto	Non-functional	Source: Gravity flow scheme, north of Mount Moroto. GIZ is planning to revamp the system.
6	Nadiket Village	Nadiket	Katikekile	Moroto	Functional	Source: Gravity flow scheme, south-west of Mt Moroto. There is a plan to extend the water west of Nadiket to Loputuk Village located in Loputuk Parish, Nadunget Sub-County.
7	Lorukumo Village	Lorukumo	Rupa	Moroto	Not yet commissioned	Solar powered; funded by UNICEF. Underground (borehole) water source.
8	Adulae and Lopelipel villages	Nakwanga	Tapach	Moroto	Functional	Source: Spring / Gravity flow scheme, east of Mt Moroto. Funded by ASB.
9	Lopei	-	-	Napak	Unknown	-
10	Lotome	-	-	Napak	Unknown	-
	Kodike	-	-	Napak	Unknown	-
	Longariama	-	-	Napak	Unknown	-
	Micholko	-	-	Napak	Unknown	-
11	Lorengedwuat Trading Centre	Lorengedwuat	Lorengedwuat	Nakapiripirit	About 50% functional	Solar powered. Some pipes that were destroyed during road construction have not been replaced. Funded by Nakapiripirit District Local Government. Underground (borehole) water source.

TABLE 35: EXISTING PIPED WATER SUPPLY SYSTEMS

S/No	Location of piped water system	Parish	Sub-County	District	Functionality Status	Remarks
12	Usuk Town	Abwokodia	Usuk	Katakwi	Unknown	Coordinates E603434 N222356
13	Soroti, Kaberamaido, Amuria, Kalaki, Otuboi, Atiriri and Gweri.	-	-	Soroti and Amuria	Functional	The facility is managed by the National Water and Sewerage Corporation (NWSC).

SOURCE: Compilation of databases and information from discussions with KUWS, District Water Officer of Napak and the attendants of the CSF March 2017, website NWSC, inventory by Caritas Moroto and TPO Uganda during this project, assessment report water supply services by DARK for GIZ (2016) and interviews with district water offices.

ANNEX H – OVERVIEW OF THE THEMATIC AREAS, OPTIONS, ACTIVITIES SUB-ACTIVITIES

TABLE 36: OVERVIEW OF THE THEMATIC AREAS, OPTIONS, ACTIVITIES AND SUB-ACTIVITIES

Option	Activity	Sub-activity
A. Institutional strengthening		
Strengthen the CMO organisation	**Implement CMO governance system**	- Clearly indicate mandate, tasks, responsibilities, accountability and compliance, reporting, and administration procedures - Arrange leadership (chair, vice-chair, secretary) - Instruct on downward accountability towards the Catchment Stakeholder Forum and wider public - For CMO institutions (CSF, CMC, CMS, CTC) establish statutes, register corporate identity, organize endorsement by MWE - Define communication tools
		Explore opportunities for minimal structural funding and mechanisms to facilitate external contributions to cover CMO running costs. E.g. contribution from districts.
	Support and strengthen the CMC	Build capacity of the CMC on: - IWRM - multi-stakeholder process facilitation - collaboration - conflict management - project management - resource mobilization - M&E - guiding implementing partners
		Organize quarterly CMC meetings, including M&E field visits.
	Establish Catchment Management Secretariat	Establish CMS at KWMZ office
		Develop hand-over strategy to permanent and dedicated CMS for the catchment
	Support and strengthen the CSF	Inform the CSF members about their roles and responsibilities towards their support base and towards the CMC
		Organize yearly CSF meeting to review and update the CMP (more often if there is a need)
		Update the stakeholder matrix with active actors (yearly)
	Establish and support the CTC	Establish CTC: - Select CTC members based on CMP indicated expertise. This could become a pool of experts to support specific activities through working groups. - Technical officers of 1 district can be facilitated to support other districts.
		Strengthen CTC capacity on: - knowledge of laws, policies, CMP, guidelines, etc. - how to support CMC, districts and CMP implementers - how to develop proposals - gender - climate change - multi-stakeholder process facilitation
		Provide technical support to CMP implementation.
Monitor and evaluate implementation of the CMP	**CMP review**	Develop and implement a CMP M&E framework (indicators) including adherence of all stakeholders to CMP and O&M for implemented activities. - 1st phase: catchment level - 2nd phase: sub-catchment and micro-catchment levels

		Carry out structural CMP monitoring, evaluation and review, which includes baseline and post-action data collection by all implementers to feed the CMP M&E framework for fact-based decision making - carry out quarterly monitoring per catchment / sub-catchment / micro-catchment by Management Committees including quarterly field verification missions - carry out yearly monitoring and CMP review by CSF - carry out 2-yearly evaluation
	Policy development	Use experiences to address policy gaps, thereby contribute to national policy/laws/ordinances development to promote and implement CBWRM.
		Support formulation, implementation and enforcement of by-laws at catchment level.
Coordinate at district level	**Prepare districts for CMP implementation**	Obtain political support for the CMP through approval of the CMP by the District Executive Councils (through a resolution) so that the CMP can provide the overall guidance to district planning. - first orient DEC on CBWRM and CMP
		Organise CMP focal points per district: - The CMC appoints for each district one of the district technical officers (member of the CMC) as a focal point to guide on CMP implementation. - Each district appoints their District Natural Resources Officer as focal point within the district for CMP implementation in the district.
		Align DDPs with CMP.
		Develop a plan to strengthen human and financial resources and organise these required structural resources to intensify activities (including tools, materials, equipment and transport).
	Suppport cross-sectoral district operations	Organize joint planning, monitoring and evaluation meetings between technical officers within districts. District Planner to lead regular cross-sectoral planning / coordination / learning per district supported by DNRO on CBWRM and CMC dedicated member on CMP. Districts report to CMC. - quarterly monitoring - yearly planning
	Guide lower level CMP implementation	Support sub-counties to implement CMP, sub-catchment management plans and micro-catchment management plans.
		Support parishes and communities to implement and monitor micro-catchment management plans.
	Guide development partners	Organize workshop(s) for districts to discuss how to guide development partners, e.g. how to use the CMP and IP, framework for proposal assessment, instructions for data collection, etc.
		Track activities and collect data from (public and private) development partners to feed into CMP monitoring and fact-based decision making.
Sub-catchment and micro-catchment management	**Support sub-catchment management**	Develop specific guidelines for sub-catchment planning (based on the CMP planning guidelines) to guide for the assessment, planning, implementation and monitoring of sub-catchment plans
		Set up Sub-Catchment Management Committees for coordination and sub-catchment management planning (stakeholder engagement plan).
		Support the development of sub-catchment management plans
		Organise sub-catchment management plan monitoring: - quarterly monitoring per sub-catchment
	Support micro-catchment planning	Develop specific guidelines for micro-catchment planning (based on the CMP planning guidelines) to guide for the assessment, planning, implementation and monitoring of micro-catchment plans
		Set up (or support existing) structures for CMP coordination and local action planning (community --> parish chief --> LC3 --> sub-county ACDO --> District Community Development Officer)
		Support the development of micro-catchment management plans.

		Organise quarterly participatory reviews for communities on the micro-catchment management plans or community action plans. Report to DNRO.
Funding of the Catchment Management Plan	**Support proposal and partnership development**	Explore opportunities for climate funding for the implementation of the CMP
		Identify possible community-led IWRM activities for proposals for funding
		Develop and implement a fund raising plan to explore possible public and private partners for implementation of catchment management interventions, research, knowledge management, funding
		Set up a Catchment platform (or through Karamoja IWRM thematic group) where donors, NGOs, business partners and other implementers/funders can discuss the opportunities to invest in the catchment - Link to annual District Budget Conference to identify funding gaps - Bi-annual review meeting to indicate gaps.
		Develop concept notes and business cases in order to select those initiatives for investment which are expected to be feasible and sustainable.
	Promote an innovation fund (basket fund)	Explore structures to stream resources and pool funding to support innovation.
		Establish an Innovation Fund to fund studies, pilots and demonstration projects. Including governance structure, processes and procedures for the management of the innovation fund.
		Conduct a feasibility study on taxing tourism, and ploughing back the revenues into catchment protection
		Conduct a feasibility study on taxing mining (sand, marble, gold) companies for their extraction activities
Learning and knowledge management	**Raise awareness on CBWRM and CMP**	Popularize the CMP at higher government levels (e.g. parliament, ministries: Ministry of Agriculture, Animal Industries and Fisheries, the Ministry of Finance, Planning and Economic Development, the Office of the Prime Minister, Ministry of Local Government, Ministry of Lands, Housing and Urban Development, Ministry of Tourism and Wildlife, Uganda National Roads Authority and the Uganda Investment Authority)
		Prepare a popularised version of the CMP and distribute among catchment stakeholders.
		Set up a local/regional media campaign to inform stakeholders in the catchment about the CMP (local radio, newspapers). Stakeholders should be invited to participate in the multi-stakeholder process, bring forward their views, possible contributions and benefits to the CMC or their local leaders.
		Develop outreach materials (posters) to sensitize, inform, educate all catchment stakeholders and development partners about the CMP including the routes/instructions for implementers to consult CMC.
		Set up a water source protection, catchment management, ecosystem restoration awareness programme (schools, religious institutions, media). Advocate for inclusion in curriculum at primary and secondary schools.
	Support capacity building	Assess current capacity of KWMZ, and implement capacity building programme (e.g. on M&E, project management, multi-stakeholder process facilitation, public private partnerships)
		Establish mechanisms to ensure that learnings from different projects, assessments, pilots, etc. are documented, included in the library and disseminated.
		Build capacity on the environmental police officers, and police officers in general, on enforcement of by-laws, ordinances and regulations
		Build capacity of district extension services on: CBWRM, water source protection, implementation of the CMP, role in knowledge dissemination, support to communities, etc.
	Promote general stakeholder learning	Organise CSF learning events, including e.g. cross-catchment exchange visits
		Organize trainings, exchange visits and project reviews for water user groups, for example through farmer-to-farmer learning

		Prepare and disseminate booklet with simplified explanation of relevant laws, policies and guidelines
		Develop and disseminate training and technical guidance manuals: - IWRM/CBWRM - water harvesting - micro-catchment management
	Promote knowledge management	Create a library (in Mbale or a website) which holds information and data (research, surveys, databases, etc) relevant to the catchment and catchment management in general. Raise awareness on the existence of such library amongst development partners, technical officers and other relevant stakeholders. Extension services to actively disseminate new knowledge to water users.
		Establish mechanisms to ensure that learnings from different projects, assessments, pilots, etc. are documented, included in the library and disseminated.
		Develop and put in place a knowledge dissemination plan
B. Ecosystem protection and restoration		
Productive and protected forests and woodlands	**Improve management of Central Forest Reserves**	Liaise with NFA to promote CFM
	Improve tree cover in degraded areas	Build capacity and create awareness on the value and importance of trees
		Strengthen capacity of extension services on collaborative forest management
		Create and train forest management committees to discharge their duties
		Establish tree nurseries (mostly for indigenous trees and fruit trees)
		Establish tree nurseries in schools, especially fruit trees
		Establish forest stands and woodlots / Consultation with NFA on high-value alternative and native species, site identification, inputs and labour
		Expand and protect traditional shrines (*Akiriket*)
		Plant trees along the boundaries of protected areas
		Plant trees along roads
		Establish exclosures to promote tree regeneration in collaboration with communities and traditional leaders
		Promote the use of interlocking soil stabilised blocks
		Establish a fund for woodland/forest protections (community environment conservation fund)
	Regulate charcoal production and firewood use	Sensitize charcoal producers on more efficient charcoal production techniques
		Support charcoal producers to form and register associations at sub-county level
		Develop and enforce guidelines for charcoal production indicating, for example, tree species and age/size, and charcoal production methods allowed
		Promote improved cookstoves (for firewood, charcoal) and improved charcoal production methods (e.g. cassamance kiln, retorts)
		Support formation and implementation of by-laws and ordinances (for example "cut 1 tree plant 5", "at least 3 trees at your home")
	Promote use of alternative sources of energy	Establish energy plantations; (of trees preferred for firewood or charcoal)
		Conduct training on briquette and biogas production from agricultural residue (e.g. sorghum straws, rice husks etc)

		Support start up of businesses around briquetting (e.g. fabrication of briquetting presses, selling briquettes)
Promoting productive and sustainable rangelands	**Promote collaborative rangeland management with traditional rangeland management institutions and other stakeholders**	Conduct sensitisation on value of rangeland protection (in collaboration with traditional leaders) including regulations
		Map and demarcate extent of communal rangelands
		Set up an exchange programme for herder associations and district natural resources officers to visit successful rangeland management programmes abroad
		Support communities to obtain formal registration documents for their communal rangelands (certificate of title) incl. sensitisation on land rights. All districts land boards to liaise with Uganda Land Alliance
		Develop and implement rangeland management plans including bush burning and controlled grazing. Establish a forum for elders
	Protect and rehabilitate rangelands	Establish exclosures of degraded rangelands to promote regeneration
		Promote grazing and bush burning regulation through rotational grazing, in collaboration with traditional leaders
		Promote live fencing of kraals and villages (e.g. kei apple, cactus)
		Establish fire lines including use of fire resistant tree species (e.g. milky bush, cactus)
		Map invasive alien species and develop and implement a management strategy (e.g. eradication/control, utilisation)
		Rehabilitate gullies
Protecting wetlands and flood plains	**Sensitize and create awareness on the value and protection / management of wetlands including regulations**	-
	Develop and implement community based wetland management plans	Verify and update existing maps for wetlands
		Establish wetland management committees
		Develop community based wetland management plans including bush fire management
		Demarcate and zone wetlands (critical zones, protection, buffer zone, production zone for cultivation and settlement)
		Develop by-laws and ordinances for wetland protection
		Implement by-laws and ordinances
	Restore degraded wetlands	Demarcate protected zones (e.g. using trees and/or pillars) in the wetlands and decide/agree permitted activities for the zone
		Enforce regulations on unsustainable activities (environmental degradation) in the protected zones
		Support traditional leaders to declare some wetlands as traditional shrines and set up traditional/community by-laws
		Establish a fund for wetland protection (e.g. community environment conservation fund)
		Promote good fishing habits in wetlands i.e. good netting
		Protect important biodiversity (e.g. shoebill) and breeding grounds for fish
Protecting	**Promote river bank management**	Identify, map and designate sites where sand or gold mining can sustainably take place

rivers and river banks		Demarcate buffer zones along rivers using live markers
		Restore degraded river banks and buffer zones (tree planting, grassing)
		Stabilise river banks e.g. by use of gabions
		Build capacity of extension services on soil and water conservation measures (demi lunes, mulching, composting, manuring), good agricultural practices, pest/disease control
Flood management systems and infrastructure	**Establish flood and waterlogging protection infrastructure**	Investigate and/or outscale interventions for flood and waterlogging management (e.g. flood resistant housing)
		Construct flood diversion and drainage ditches
		Improve road drainage systems
Regulation and enforcement	**Support enforcement of regulations**	Document and disseminate existing by-laws on rangeland management
	Regulate gold and sand mining	Designate areas for sand and gold mining collaboratively
		Prohibit use of mercury including provision of alternatives
		Support sustainable artisanal mining
	Regulate Marble Mining	Ensure environmental conservation, including tree planting, erosion control at the mining area
C. Water and sanitation		
Access to knowledge	**Promote capacity building**	Develop and disseminate training and a technical guideance manual for district technical staff on borehole drilling, especially in basement areas and including supervision
		Strengthen the capacity of hydrogeologists to site and drilling contractors to drill, develop and equip new boreholes
		Design and implement a capacity building programme for hand pump mechanics associations on different pump technologies, electromechanical systems, water source protection and community skills
		Train and certify local artisans on manual drilling and hand dug well construction in combination with water source protection
		Design, develop and disseminate a training programme a technical guidance manual on water source protection, repair of infrastructure, financial management and other relevant subjects
		Set up a training programmefor Water User Committees (WUCs) and other stakeholders on water source protection, repair of infrastructure, financial management and other relevant subjects, involve traditional and religious leaders
	Support extension services	Build capacity of extension services on water source protection
	Improve knowledge management	Carry out a training on access and application of DWRM data management systems (Aquarius and WIS) to technical officers of KWMZ and local government
Monitoring and planning of water services and resources	**Reinstate climate monitoring**	Set up a regional coordination office of the Uganda National Meteorological Agency, including responsibility to coordinate data collection, storage and analysis, and dissemination
		Assess the status of the current weather monitoring network. Develop and implement a regional weather monitoring plan, including O&M of weather stations
		Formalize and capacitate weather monitoring focal points at district level on their roles and responsibilities
		Carry out a sensitization programme directed to local government and media houses on the relevance and application of weather data

		Rehabilitate existing weather stations
		Install new weather stations
		Design and implement a programme to reinstate basic weather monitoring (rainfall gauges, wind vans, barometers) at primary and secondary schools and at UWA outposts, and include them in the regional climate monitoring plan
		Establish mechanisms to promote the transfer weather monitoring stations installed during road construction to Uganda National Meterological Agency
		Design and implement a management system for the transfer from Uganda National Meterological Agency to stakeholders and dissemination of climate data and information, including weather forecasting
		Establish a database on traditional weather monitoring and forecasting systems and integrate these in weather bulletins, including on UNMA-website
	Establish groundwater monitoring	Establish a deep groundwater monitoring network plan, including the operationalization and implementation of it
		Establish a shallow groundwater monitoring network in wetlands to test the hypothesis on the relation between floods and storage level of wetlands, including the operationalization and implementation of it
		Carry out an awareness raising campaign directed to local government, drilling companies and consultants to report dry borehole drillings to MWE
		Refine the regional deep and shallow groundwater potential mapping at district level, including the inclusion of recent studies, sustainable abstraction rates, and assessment of shallow groundwater potential
		Carry out periodic assessments of spring functionality, discharges and location to further the understanding of the impact of environmental degradation and (implementation of) possible mitigation measures
		Build a groundwater model to estimate sustainable abstraction rates to support technical advisory services from KWMZ
		Conduct a feasbility study on artificial groundwater recharge opportunities
	Establish surface water monitoring	Develop a surface water data collection plan, including O&M, gauge readers and storage, validation, analysis, calibration and dissemination of data. Rehabilitate existing monitoring stations and establish new ones
		Design and implement a surface hydrological modelling programme, including operationalization and required application training.
		Optimize and calibrate the SWAT-hydrological model after validating the flow gauge data from Akokorio gauging station and respective calibration curve
	Establish water quality monitoring	Review the environmental water quality monitoring network plan, including storage, validation and analysis aspect
		Develop a long-term funding plan to ensure frequent monitoring of water quality issues, preliminary with a focus on water quality in boreholes and wellls
		Build capacity of ditrict technical officers on water quality monitoring, avail testing kits
		Investigate whether it is possible to mark water points (e.g. with a color) when they are not fit for human consumption
		Conduct an in-depth study on fluoride and salinity parameters in volcanic areas, including widespread water quality analysis of boreholes
	Establish sediment monitoring	Develop and implement a sediment monitoring network plan, including O&M, data collection, storage, validation, analysis and dissemination
	Establish flood monitoring	Conduct an in-depth assessment of flooding processes and implementation of a flood monitoring network

		Raise awareness amongst communities living in flood-prone areas and promote re-settlement to upland areas
		Design and implement a flood protection programme at household level, including preventive and mitigating measures
		Develop and implement a flood early warning system (FEWS), including the corresponding communication plan
	Enforce the water abstraction permit system	Review and complement the design of the water abstraction permit database, established at KWMZ
		Design and operationalize an enforcement plan for the water abstraction permit system
Management of piped water supply systems	**Extend and rehabiltate piped water supply systems**	Assess status of piped water supply schemes, develop an extension and rehabilitation plan, revise O&M systems, build capacity staff, sensitize users
		Rehabilitate and extend existing piped water supply systems
	Construct new piped water supply systems	Map rural growth centres, assess water demand without piped water supply systems, conduct feasibility studies, develop plans to implement piped water supply systems
		Construct new piped water supply systems (including several opportunities for relatively low-cost gravity flow schemes in Moroto and Napak)
Management of rural water supply systems	**Rehabilitate and close non-functional water points**	Update domestic water gap maps upon each new population census (parish level)
		Design and implement a water point monitoring and rehabilitation programme, including a sensitization campaign on water source protection. Raise awareness amongst politicians about the important of users contributing to O&M
		Pilot with a water board (inc DWO, town clarks, sub-county chiefs and technnicians) responsible for O&M
		Implement awareness raising programmes for communities and hand pump mechanics to report non-functional hand pumps
		Design and implement a borehole drilliing programme, including a sensitization campaign on water source protection
		Align data collection forms with reporting and develop a funding plan to ensure that all resources are in place to monitor water points
		Recommend the establishment of feedback mechanisms that provide an analysis/ summary of the borehole data collected by the DWOs (inc. drilling logs and reulsts of water quality monitoring by KWMZ)
	Improve operation and maintenance	Design and commence a pilot wherein the number of WUC members is reduced (to three) and WUC members are paid for their actvities. In that pilot raise awareness in the community that they should hold the WUC accountable
		Support the deconcentratation of hand pump associations to water source level
		Request the legalization of hand pump mechanics associations in the Water Act and ajdustment of the Public Procurement and Disposal of Public Assets Act so that public works can be commissioned to hand pump mechanic associations
		Support (through subsidies) the local establishment of ventures that sell spare parts for repair and rehabiltation of boreholes, pumps etc
		Assess the success of WATESO and upscale the establishment of water cooperatives. Identify factors of succes, main challenges and opportunities, and stakeholders to be involved
		Design and commence a pilot on pre-paid water supply
		Assess the success, main challenges and opportunities, and main stakeholders to be involved in the "Borehole as member of the VSLA" approach by TEDDO. Upscale the approach to other areas in the catchment

		Set up a pilot in which a percentage of the VSLA is allocated to water point maintenance, such as is being piloted in Agago districts
	Promote water harvesting for domestic use	Develop a manual on rainwater harvesting
		Assess and determine potential for rainwater harvesting, especially rock catchments, and verify the different options with local water demand, surrounding communities and the DWO. Set up a management plan and construct the facilities.
		Construct rock catchments
		Assess potential for water storage through implemenation of sand and sub-surface dams. Conduct a feasibility study and assess river beds, map settlements along the river and their current water needs. Discuss the findings with DWOs and communties. Agree on operation and maintenance.
		Construct 30 sand/ sub-surface dams
		Design and carry out a sensitisation campaign on rooftop water harvesting. Promote roof water harvesting for all buildings with tiles, metal sheets or plastic roofs
		Equip schools, health centres and other institutional buildings with rooftop water harvesting systems. Focus on inclusive participation and own contributions to build a sense of ownership
		Design and carry out a number of pilots on compound rainwater harvesting for domestic use
	Promote deep borehole drilling	Offer supervision and contract management training
	Promote shallow groundwater development	Establish pilots with manually drilled shallow wells in river banks for domestic use, supplementary irrigation and livestock watering including training of local artisans
		Raise awareness on the opportunities, potential and need for the protection of shallow wells
Sanitation and waste management	**Upscale sanitation programmes**	Implement contextualized sanitation plans and approaches with community leaders, develop dissemination materials and scale up capacity of village health teams to implement sanitation programmes
		Set up a sanitation, safe water and hygiene awareness raising campaign, including the development of by-laws and ordinances, enforcement and reward system. Encourage leaders to be role models
		Implement a programme to enforce latrine construction when constructing a house and that associated rules on water source protection are complied with
		Implement a programme to enforce latrine construction when constructing a house and that associated rules on water source protection are complied with
		Build latrines facilities in towns, at markets, churches, health centres, and close to valley tanks and valley dams
	Promote waste management	Pilot a solid waste collection and management system in a rural growth centre / town. Enforcement in collaboration with districts.
		Encourage and support ventures that can utilize (reuse or recycle) solid waste
		Conduct a feasibility study on the development of a sewerage system
D. Agriculture and economic development		
Improve livestock farming	**Research the livestock value chain development (beef, dairy, horns, skins, goats, ostriches, chickens, camel, cow dung)**	Research on the presence of development partners with plans to support livestock
		Conduct a study on indigenous good livestock rearing practices
		Develop the business case for each of the value chains, map opportunities, conduct pilot studies, include research on alternative markets to prevent overstocking during market fluctuations

		Develop and implement a programme to facilitate access of improved livestock breeds.
		Develop and implement a programme (incl. technical support through trainings) on the establishment of livestock (incl. diary and skins) cooperatives, local investment organisations and companies. Link cooperatives to external impact financiers. There used to be the Jie pioneers which was a successful model
		Create market associations to support private sector development in butchery and transport
	Develop and implement a plan to improve access to water for livestock	Organize and consult cattle herders on the water for livestock needs
		Assess numbers of incoming livestock from Kenya and South Sudan in wet, normal and dry years.
		Conduct cross-border tribe dialogue on water and pasture management in the catchment for livestock between Uganda, Kenya and South Sudan. Meetings between Karamojong - Turkana - Toposa, discussing inclusion of water/pasture management into the Lokichogio (alco called Nabilatuk) Declaration. Teso should also be included
		Conduct a feasibility study on payment for incoming cattle from Kenya and South Sudan
		Assess (visit!) functionality status of dams and tanks. Evaluate (reasons for) non-fucntionality. Set up and implement a programme to desilt and rehabilitate existing valley tanks and valley dams.
		Re-instate and train water user management committees (on water source protection, operation and maintenance) for each and every valley tank and valley dam that is to be rehabilitated or newly constructed
		Conduct feasibility studies on valley tanks and valley dams, following the outputs of the previous assessments. Design and construct valley tanks and valley dams. Plant trees around them to reduce evapotranspiration. Cover normal dry season water for livestock gap (2 Mm^3 of storage)
	Improve access to pasture and work on rangeland management	'Conduct a study on the carrying capacity of the landscape, taking into consideration the livestock migration routes, current and expected conflicts over natural resources and changing land use, and community land rights. Build upon results of the water resources assessment and the migration route maps developed by GIZ CPS.
		Set up a programme to promote cut and carry system and commercial fodder production (hay making, production of sillage)
		Gather information on traditional weather monitoring and forecasting systems (use of content intestines of goats, swirling of cornbills, wind direction) and integrate them in weather bulletins, incl. on websites of organisations and other institutions in the catchment
		Set up and implement a programme to train animal health workers in soil and water conservation measures, good agricultural practices, etc
		'Build capacity of extension officers, veterinary officers and animal health workers on animal husbandry, disease control, fodder production, breeding and other livestock related subjects
Improve rain-fed farming	**Promote sustainable and productive rain-fed farming**	Set up and implement a programme to provide improved seeds (for example SESO 3 sorghum, maize, green gram, bull rush, millet) on condition that farmers have implemented soil and water conservation measures.
		Investigate which NGOs are working on loans and VSLAs and are willing to support sustainable business models in agriculture, such as value chain development
		Develop the business case for moringa and shea value chains, map opportunities, conduct pilot studies
		Develop the business case for gum arabica, balanites, tamarind, cashew nut, desert date. Develop the value chains, map opportunities, conduct pilot studies
		Set up and implement a programme to promote upland rice in floodwater recession zones, include awareness raising, demonstration sites and learning visits

		Set up and implement a programme to promote fruit tree orchards, such as oranges, mangos and pawpaws, which includes trainings on grafting and soil and water conservation in community schemes
		Set up and implement a pilot for the production of Seso 1 Sorgum to increase supply to breweries
		Establish demo sites to demonstrate increased rain-fed agricultural production when doing contour trenching, fanya juu, and grass strips of vetiver and napier grass. Close to Moroto for easy access and reference, ensuring that farmers are actively involved in the planning and implementation
		Set up and implement guly rehabilitation programmes for agricultural lands, in which gully plugging is combined with micro-catchment management
		Set up and implement a programme for villages to set up there own soil and water conservation and increased tree cover plans (enclosures, FMNR, coppicing and lopping). Promote hedgerows of preferably useful indigenous trees incl. fruit trees like the "Kapule" mango.
		Set up and implement a farmer-to-farmer exchange and peer-to-peer learning programme on good agricultural practices. This can include visits to model farmers
		Set up a programme to review the trainings at agro-pastoral field schools. Establish an integrated demo farm at three agro-pastoral field schools
		Build capacity of extension services on soil and water conservation measures (demi lunes, mulching, composting, manuring), good agricultural practices, pest/disease control
		Set up and implement a support programme to farmer cooperative schemes to get market and input advantages
Promote micro-irrigation (<0.5 ha) and small-scale irrgation (<2ha)	**Prormote micro and small-scale irrigation**	Set up and implement a programme to promote irrigation from shallow groundwater from river beds at small plots close to the river banks but ensuring that soil erosion is prevented, combined with different pumping mechanisms (treadle pumps, hip pump) and drip irrigation
		Set up and implement a programme to promote suplementary irrigation from scoop holes, ponds, charco dams, sub-surface and sand dams. Establish demosites, using different pumping mechanisms (treadle pumps, hip pumps, etc), combined with drip irrigation
		Conduct a feasibility study on and promote compund runoff harvesting and wastewater reuse for small-sclae irrigation
		Create and implement a subsidy programme to promote investment in drip irrigation technologies
Promote medium-scale irrigation (>2 ha)	**Promote medium-scale irrigation**	Study feasibility and where feasible set up demos on medium-scale irrigation around water reservoirs
Promote road water harvesting	**Implement road water management and harvesting**	Pilot road water harvesting to show increased availability of water and demonstrate how the technology reduces road repair and rehabilitation costs
		'Set up and implement a programme to provide technical assistance to District Councils to embed roads water management in their plans
Promote alternative sources of income	**Establish alternative economic activities**	Set up and implement a programme to stimulate eco-tourism based on appreciation of the catchment's unique cultures and ecosystems and paleontological sites. Liaise with tourism board, UWA, link hotels, develop promotion materials, set up community eco-tourism camps that also provide accomodation to tourists wishing to experience the traditional way of living etc. Programme should include training community groups on how to manage eco-tourism centres
		Set up and implement a programme to promote fish farming in combination with ponds and cages and crafts making from wetland vegetation
		Set up and implement a programme to promote apiary activities (beekeeping, honey, wax, etc)

	Promote CMP proof businesses	Stimulate adoption of CMP proof businesses and promote exit strategies for non-sustainable businesses
	Re-inforce SME business development	Offer low-cost trainings on how to develop businesses, collaboration, governance, financial management skils and marketing. - including targeting local artisans (hand pump mechanics, manual borehole drillers, constructors of shallow wells, constructors of rooftop rainwater harvesting systems)
		Explore together with finance sector options to develop financial packages for SMEs, including value-chain financing