Eldoret-Iten Water Fund
Pre-feasibility Study

DRAFT REPORT (V2)

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17 August 2019

EXECUTIVE SUMMARY

The Nature Conservancy (TNC) has developed the concept of a Water Fund which aims to bring stakeholders from within an urban metropolis together under a public-private partnership framework to establish a structure that enables collective action and investments in the water catchments to secure the water sources that serve the metropolitan area. The Water Fund is more than a payment for environmental services (PES) system in that it seeks to create a robust, effective and sustainable institutional structure that can support the catchment conservation efforts into the foreseeable future and through a period of dramatic changes in water demand, climate, and pressure on catchment areas for agricultural and industrial production. The need for collective stakeholder action is paramount and urgent. However, for the Water Fund concept to take root within a metropolitan area the stakeholders must see common cause to address the risks to the water sources and be willing to invest in the solutions. While the idea of a Water Fund for Eldoret has been mooted by stakeholders this Pre-Feasibility Report aims to provide stakeholders with detailed information to support the establishment of a Water Fund for Eldoret and Iten.

The report discusses the legislative and institutional landscape, water demands, water sources and their associated risks as well as stakeholders and their potential relationship to a Water Fund. The document also identifies and prioritises possible areas of intervention for the Eldoret-Iten Water Fund.

Eldoret is the main commercial centre in western Kenya (Population 289,380[1]) and the fifth largest in Kenya. It is reported to be the fastest growing urban centre in Kenya. It is located in Uasin Gishu County and is known as the "home of champions" given its long history of producing world class athletes. The city is located in a region well known for its agricultural production and, together with the neighbouring county of Trans Nzoia, is considered to be the bread basket of Kenya with extensive maize and wheat farms. A significant number of agribusinesses have been established. In addition, the city has a vibrant textile industry, an international airport, university and an ammunitions factory.

Iten is the capital of Elgeyo Marakwet County with a population of approximately 42,300 people. It is a gateway for traffic and trade to the Kerio Valley. The town is famous as a centre for athletic training camps which produce world famous athletes.

A. Policy, Legislation and Institutional Landscape

The analysis of the policy, legislative and institutional landscape indicates that there are strong policy drivers for engagement in catchment conservation. The institutional landscape is complex as the catchment conservation function is mandated to the county governments with various national level agencies holding mandates relevant to the management of the catchment areas, namely KFS, KWS, WRA and the KWTA. This complex institutional landscape reinforces the need for effective stakeholder collaboration and coordination that spans across national/county structures, county boundaries, and different sectors. A number of existing multi-stakeholder partnerships in other catchments, including the successful Upper Tana Nairobi Water Fund (UTNWF) provide some local experience on how a water fund can work within this institutional landscape. Various lessons learned

[1] KNBS, 2009

regarding multi-sectoral coordination and financial constraints should be taken into account and mitigated or managed from the onset.

B. Water Demand and Supply

Eldoret Water and Sanitation Company (ELDOWAS) is the registered water service provider for Eldoret. Existing infrastructure has the capacity to deliver 54,000 m^3/day although currently supply is closer to 48,000 m^3/day which is 80% of demand. The town has seen tremendous growth in water demand over the last decade. The main water source is the Moiben/Chebara Dam on the Moiben River which is located in Elgeyo Marakwet County.

The current surface water supply is sourced primarily from the Moiben Dam (55%), Two Rivers Dam (30%), and Ellegirini Dam (18%). The Kesses Dam provides an additional 1% of supply. This implies that the main catchments of interest are associated with the Moiben and Sosiani river systems.

The LVNWSB has planned future developments to increase the capacity of the Kipkaren Dam and to construct a new Two Rivers Dam to bring in an additional 24,000 m^3/day and 57,500 m^3/day respectively. These two developments are intended to meet the water supply deficit.

The 2009 census indicated that a significant portion of the population rely on groundwater, implying that groundwater recharge and resources should be carefully managed. However, the groundwater potential based on the information reviewed for this study is considered to be limited and is unlikely to form a significant water source in future nor provide a sufficient backstop to mitigate the effects of an extended drought. This implies that surface is and will continue to remain the primary water source for Eldoret going into the future

The Iten Tambach Water and Sanitation Company (ITEWASCO) is the registered water service provider for Iten, the county capital for Elgeyo Marakwet County. ITEWASCO currently produces approximately 2,600m^3/day from four different sources the largest being the Sabor intake (1,500m^3/day) on the Charama river in the Kaptagat Forest.

C. Water Resource Sustainability

The Moiben River flows from the Cherangany Hills Forest, specifically the Embobut forest block. The catchment was originally covered in indigenous forest but parts of the forest have over the years been cleared for settlement and farming with forest cover now accounting for 45% of the Moiben Dam catchment, with farmland representing 55%. More than 50% of the catchment has steeps slopes (12-40% slope) and where this coincides with tilled farmland the risk of erosion is high, given the lack of terraces, grass strips or other forms of soil conservation measures. The Masterplan for the Conservation and Sustainable Management of Water Catchment Areas in Kenya (MEMR, 2012) identifies a number of other challenges facing the Cherangany ecosystem including encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing and cultivation within the indigenous and plantation forest areas.

In addition there are potential sources of pollution that have been identified although these are primarily associated with the river reach below Moiben Dam. These include riparian farming, animal watering, bathing, laundry-washing and sand harvesting. These pollution sources may pose a future threat due to the increasing population in the catchment.

The general climate changes anticipated include a decreasing trend in rainfall with increasing intense rainfall which can lead to flash floods, severe erosion and landslides. Future climate change projections also predict an increase in drought stress, with projected delays in the onset of rains. Essentially the climate changes imply that the catchment condition and the hydrological services provided by the catchment will become even more important going into the future.

The land use and climate risks described for the Moiben catchment are similar to those anticipated for the Sosiani river catchment that feeds the Ellegirini and Two Rivers Dams and the Kipkaren river that feeds the Kipkaren Dam. The land slopes (5 – 12%) are generally less than for the Moiben catchment and so the erosion risks are lower. The Sosiani and Kipkaren catchments have a higher percentage of farmland and urban centres and so pollution from farmland and lack of adequate sanitation are important issues in these catchments.

D. Potential EIWF Target Areas

a) Farmland

The target areas for the Eldoret-Iten Water Fund should be on the Moiben, Charama, Sosiani, and Kipkaren catchments which combined cover an area of 1,012 km^2 with a population estimated to be 162,600 (2009). Within this area there are parts with steep sloped farmland (> 12% slopes), mainly in the Moiben catchment, that deserve immediate priority as the erosion risk is high (Erosion rates of 64 t/ha/yr in parts) and current land use norms have not involved adequate application of SLM practices. Other farmland areas with less steep land should also be targeted due to the risk of erosion and river pollution from agrochemicals. I

b) Forest areas

The forested areas within and outside the gazetted forests but within the target catchments account for 23% of the target area. The gazetted forest covers 31% of the catchment area but only 42% of this is actually forested. The forested areas within the catchments need to be properly conserved and in certain areas re-forested with indigenous species.

c) Riparian areas

The riparian and wetland areas play a significant role in the hydrology of the catchments, in terms of sediment transport, river bank protection, flood attenuation and groundwater recharge. The riparian and wetland areas should be targeted to reduce the risk of river pollution and to enhance the habitats and biodiversity.

E. EIWF Activities

a) Sustainable Land Management Practices

The most suitable interventions on the steep farmland areas to reduce erosion are terraces, grass strips and other forms of barriers that reduce slopes and slope length while improving soil

fertility and soil physical properties for better production. The collection of soil and water conservation technologies is referred to as Sustainable Land Management (SLM) Practices. These measures will improve the hydrological response from the catchments and reduce the silt load into the dams (estimated at a combined 2.6 million m^3/yr into Moiben, Ellegirini, Two Rivers and Kipkaren dams based on SWAT modelling), which is critical under the future climate scenarios where high intensity rainfall is expected in addition to longer and more intense dry periods.

b) Forest Conservation

Appropriate activities within the forested areas include re-forestation with indigenous tree species and other interventions to enhance/restore biodiversity and quality of the forests, restoration of riparian and wetland areas, and control of grazing, illegal logging, and charcoal burning. These activities are geared towards enhancing the hydrological response and improving the habitats and bio-diversity of the forest areas.

c) Riparian and Wetland Conservation

Riparian and wetland conservation includes pegging and demarcating the land so that the land user can adopt land use activities suitable for this zone. There are an estimated 2870ha of riparian land that can be targeted for conservation.

d) Agroforestry

Agroforestry is targeted on 15% of the farmland area. Agroforestry is a way to increase forestry products while increasing agricultural outputs.

e) Pollution Control

The Sosiani and Kipkaren catchments have an increasing number of rural/urban centres and so rural and urban sanitation and effective pollution control will be important for maintaining river water quality. Various activities to improve sanitation, unregulated water abstractions, and pollution from farmland will be required.

f) Alternative Livelihoods

In addition to the soil and water conservation efforts, and enhancement of bio-diversity, livelihood enhancement activities are important to enable forest adjacent households to have income sources independent of the forested areas. These livelihood activities would include honey production, high value crop farming under drip irrigation and farm ponds, production and use of fuel efficient stoves, and production of high value crops and products.

F. Stakeholder Mapping and Analysis

The stakeholder mapping, consultations and analysis identified a number of key stakeholders for the development of an Eldoret-Iten Water Fund, including:

a) **Water Service Providers in Eldoret and its environs**. Eldoret Water and Sanitation Company (ELDOWAS), Lake Victoria North Water Services Board, and the Iten-Tambach Water and Sanitation Company;

b) **Major Water users** – Chamber of Commerce (representing traders and urban dwellers), KAM (representing manufacturers), beverage and water bottlers;
c) **Catchment managers and users** – County governments of Uasin Gishu and Elgeyo Marakwet, WRUAs, CFAs, KVDA, LBDA;
d) **Transport Infrastructure Developers** – KERRA, KENHA, KURRA;
e) **Regulatory agencies** - Water Resources Authority (WRA), National Environmental Management Authority (NEMA);
f) **Agencies responsible for Protected Areas** – Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), Kenya Water Towers Agency (KWTA);
g) **Conservation enterprises in the catchment areas** – e.g. Cherengany Conservation Network, National Council of Churches of Kenya; Kenya Ordnance Company.
h) **Public Funding Agencies** – World Bank, County Governments of Uasin Gishu, Elgeyo Marakwet, and the National Government of Kenya, NOREB;
i) **Research Institutions** – University of Eldoret, Moi University, Rift Valley Technical Training Institute (RVTTI).

During the stakeholder consultations, stakeholders raised a number of issues that the Eldoret Water Fund needs to consider, namely:

- Non-revenue water. High NRW in ELDOWAS was seen potentially as an issue that could undermine stakeholder motivation to invest in the fund;
- Disjointed conservation initiatives. While many stakeholders indicate willingness to engage in conservation activities, and some are already engaged in such activities, it was recognised that the fund can play a positive role to coordinate stakeholders to gain more impact from collective efforts. However, the EIWF would need to encourage stakeholders to work collectively;
- Limited funding for water resource developments. Public attention is generally focused on water services and scant attention and resources are given to water resource conservation. This will require awareness raising to motivate stakeholders to invest in catchment conservation initiatives;
- Trans-boundary conditions. A significant portion of the catchment areas lie in Elgeyo Marakwet County and the ELDOWAS water consumers lie in Uasin Gishu County. This implies that inter-county collaboration will be important to the success of the EIWF;
- Private sector participation. Stakeholders felt that the private sector has a significant role to play, not only in providing financial support to the EIWF but also in providing leadership to ensure that the EIWF is fully accountable;
- Branding. Eldoret is known as the "Home of Champions" and has a strong history of providing world class athletes who can provide recognition in local and international settings to support the cause and fund raising efforts for the EIWF.

G. Economic Analysis

The report has provided an economic analysis based on a number of broad assumptions related to the nature and scale of interventions and the benefits that might be accrued from these interventions. The analysis assumes that a range of SLM practices applied within the Moiben and Sosiani catchments

(total investments US$14.4 million) would deliver significant benefits to the farmers (estimated at US$4.1 annually) as well benefits to the WSPs by way of increased flows (3%), extending life span of the dams, and delaying the onset of the next large investment for a dam. The package of investments would include support for alternative livelihoods (US$1.54 million). While the analysis at this point does not include all the potential benefits, the analysis does indicate that the net benefits of the EIWF interventions would have a positive NPV after 19 years. While it is important not to overplay the economic analysis it does provide a strong indication that the interventions can deliver a stream of economic benefits that exceed the cost of the investments, including the costs associated with setting up the EIWF.

H. Eldoret Water Fund Establishment

The registration and governance structure currently adopted by the Upper Tana Nairobi Water Fund provides a suitable model than can be adopted by the EIWF. Legal registration would be through the form of a trust governed by a Board of Trustees (BOT) whose membership would reflect key stakeholders and investors from both the private and public sectors. Governance of implementation activities would be guided and overseen by a Board of Management (BOM) which would reflect private and public sectors but would also reflect the skills and experience needed to oversee fund activities and accountability requirements. A lean and effective secretariat would be responsible for implementation activities, coordination with stakeholders, fund raising and implementing the M&E Plan.

Financing of the EIWF setup (US$0.27 million), annual operational (US$0.54 Million) and investments (US$15.7 million) costs requires a detailed plan which can make use of public and private sector financing, with strategic external funding to support start-up costs. There are various options within the legal framework for WRA and/or WSPs to raise revenue through targeted conservation levies that could raise funds to support the operations of the EIWF. The development of the financing plan would require detailed stakeholder consultations.

I. M&E Plan

The M&E Plan would need to be properly designed once the EIWF makes firm decisions on the target area(s) and activities. The desired impacts and outcomes can then be specified which will inform the selection of indicators. Baseline studies and a monitoring system will be required so that changes and impacts can be measured. The monitoring system is likely to require the measurement of streamflow, sediment, water quality, extent of riparian land conserved, farm/household productivity, farm income and household income sources.

J. Conclusion

In conclusion the pre-feasibility study finds that there is a compelling case for the Eldoret-Iten Water Fund in which the package of conservation investments into the farmland, forest, riparian and wetland areas can deliver a stream of economic and bio-diversity benefits. For example the on-farm soil and water conservation measures improves crop and animal production, forest conservation restores hydrological functions important for river baseflows and restored habitats enhance bio-diversity, lower sediment and pollution reduces water treatment costs and agroforestry and

reforestation increase the forestry proudcts. The public, private and civil society stakeholders have indicated a firm interest in the water fund which can be leveraged to develop an organisational structure with good governance and sufficient resources that can deliver significant conservation and economic impacts. Financing the EIWF will be a challenge. The

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ABBREVIATIONS

BCR	Borehole Completion Record
BH	Borehole
BOM	Board of Management
BWRC	Basin Water Resource Committee
CDD	Community Driven Development
CECM	County Executive Committee Member
CEO	Chief Executive Officer
CFA	Community Forest Association
CG	County Government
CIDP	County Integrated Development Plan
DDT	dichlorodiphenyltrichloroethane
EIWF	Eldoret-Iten Water Fund
ELDOWAS	Eldoret Water and Sanitation Company
EU	European Union
GPS	Global Positioning System
GM	General Manager
GR	Grid Reference (here the WGS84 datum is used)
HRU	Hydrological Response Unit
KAM	Kenya Association of Manufacturers
KERRA	Kenya Rural Roads Authority
KENHA	Kenya National Highways Authority
KURRA	Kenya Urban Roads Authority
KFS	Kenya Forest Service
KNBS	Kenya National Bureau of Statistics
KNCCI	Kenya National Chamber of Commerce & Industry
KWS	Kenya Wildlife Service
KWTA	Kenya Water Towers Agency
LVNWSB	Lake Victoria North Water Services Board
MUSLE	Modified Universal Soil Loss Equation
NEMA	National Environment Management Authority
NRW	Non-Revenue Water
PELIS	Plantation Establishment and Livelihood Improvement Scheme
PPP	Public Private Partnership
QEOSH	Quality, Environment and Occupational Safety and Health
RFL	Rural Focus Ltd
RVDA	Rift Valley Development Authority
RVTTI	Rift Valley Technical Training Institute
RVWSB	Rift Valley Water Services Board
SWAT	Soil Water Assessment Tool
SoK	Survey of Kenya
SRM	Sub-Regional Manager
TDS	Total Dissolved Solids
TNC	The Nature Conservancy
TOR	Terms of Reference

UFW	Un-accounted for water
WASREB	Water Services Regulatory Board
WRA	Water Resources Authority
WRUA	Water Resource User Association

UNITS OF MEASUREMENT

CO_2e	CO_2 equivalent
mamsl	Metres above mean sea level
m^3/d	Cubic metres per day
MCM	Million cubic metres
mg/L	milligramme per litre (parts per million)
T	Transmissivity; the rate of flow under a unit hydraulic gradient through a cross-section of unit width across the entire saturated section of an aquifer
µg/L	microgramme per litre (parts per trillion)
µS/cm	Microsiemens per centimetre
yr	Year

NOTE: all grid references are expressed as decimal degree coordinates based on the WGS84 datum. Where elevations are reported, they are expressed as metres above mean sea level (mamsl); the provenance of each elevation is given.

1. INTRODUCTION

1.1 Background

Eldoret is the main commercial centre in western Kenya (Population 289,380[2]) and the fifth largest in Kenya. It is reported to be the fastest growing urban centre in Kenya (Wikipedia). It is located in Uasin Gishu County at an elevation of 2100 metres. The city is located in a region well known for its agricultural production and, together with the neighbouring county of Trans Nzoia, is considered to be the bread basket of Kenya with extensive maize and wheat farms. There is an emerging export orientated horticultural and floricultural industry. A significant number of agribusinesses have been established. In addition, the city has a vibrant textile industry, an International Airport, university and an ammunitions factory.

Eldoret Water and Sanitation Company (ELDOWAS) is the registered water service provider for Eldoret. Existing infrastructure has the capacity to deliver 54,000 m^3/day although currently supply is closer to 48,000 m^3/day which is 80% of demand (Uasin Gishu CIDP 2018 – 2022). The main water source is the Moiben/Chebara Dam on the Moiben River which is located in Elgeyo Marakwet County.

Iten is the capital of Elgeyo Marakwet County with a population of approximately 42,300 people. It is a gateway for traffic and trade to the Kerio Valley. The town is famous as a centre for athletic training camps which produce world famous athletes.

The Iten Tambach Water and Sanitation Company (ITEWASCO) is the registered water service provider for Iten, the county capital for Elgeyo Marakwet County. ITEWASCO currently produces approximately 2,600m^3/day from four different sources the largest being the Sabor intake (1,500m^3/day) on the Charama river in the Kaptagat Forest.

The Nature Conservancy (TNC) has developed the concept of a Water Fund which aims to bring stakeholders from within an urban metropolis together under a public-private partnership framework to establish a structure that enables collective action and investments in the water catchments to secure the water sources that serve the metropolitan area. The Water Fund is more than a payment for environmental services (PES) system in that it seeks to create a robust, effective and sustainable institutional structure that can support the catchment conservation efforts into the foreseeable future and through a period of dramatic changes in water demand, climate, and pressure on catchment areas for agricultural and industrial production. The need for collective stakeholder action is paramount and urgent. However, for the Water Fund concept to take root within a metropolitan area the stakeholders must see common cause to address the risks to the water sources and be willing to invest in the solutions. While the idea of a Water Fund for Eldoret-Iten has been mooted by stakeholders this Pre-Feasibility Report aims to provide stakeholders with detailed information to support the establishment of a Water Fund.

[2] KNBS, 2009

1.2 Objectives of the Assignment

The main objective of the assignment is to provide stakeholders with information from a pre-feasibility level analysis to determine the viability and structure of a Water Fund for Eldoret-Iten.

The analysis has addressed key components of a water fund, namely:

a) **Need**. What systems, livelihoods, and economies are at risk and how are they threatened?
b) **Opportunity**. What interventions and investments are appropriate and can deliver the scale of impacts required to reduce the identified threats?
c) **Stakeholders**. Are the key stakeholders able and willing to engage with a Water Fund Model to address the threats?
d) **Governance**. Is there an enabling environment (policy, legislation, etc.) in which an effective water fund can be established? What governance structure is appropriate for the water fund?
e) **Sustainable Financing**. Is there a viable business case that justifies the investments required? What level of investments are required?
f) **Pathway to Establishment of the Water Fund.** What structure and process should be followed to establish the Water Fund?
g) **Monitoring Impacts**. What indicators need to be tracked to establish whether the interventions are delivering impact and value for money?

The Terms of Reference (TOR) for the assignment are presented as Appendix A. The TOR focuses on Eldoret and the water sources for Eldowas. However, after stakeholder consultations, it was evident that the focus of the water fund should be widened to cover both Eldoret and Iten to strengthen collaboration between Uasin Gishu and Elgeyo Marakwet counties on catchment conservation and to ensure a wider distribution of benefits from the impacts of the water fund.

1.3 This Report

This Pre-Feasibility Report captures the outcome of the various stages of the pre-feasibility assessment. Appendix B provides a set of relevant maps covering the location and description of the study area. Chapter 2 describes the approach and methodology adopted to carry out the assignment, followed by a brief overview of the Policy, Legislative and Institutional Landscape and its relevance with regard to establishment of the Eldoret-Iten Water Fund (Chapter 3). The report is further structured to provide a general overview of the water demand and supply situation in Eldoret and Iten (Chapter 4). This is supported by material on the Hydrogeology in Appendix E. Chapters 6 to 8 provide a deeper discussion of the water sources for Eldoret and Iten, their identified risks and potential mitigation measures. This is supported by Appendix F which provides information on the hydrological modelling. An economic analysis of possible interventions in the proposed target areas is discussed (Chapter 9) as well as an analysis of potential stakeholders and their respective roles (Chapter 10). Finally, strategies for the Water Fund establishment as well as for Monitoring & Evaluation are proposed (Chapter 11 and 12).

2. DESCRIPTION OF APPROACH AND METHODOLOGY

2.1 Approach

The aim of the study was to provide a concise report that can inform all stakeholders on the merits, challenges and viability of a Water Fund that can deliver desired impacts at the required scale to affect the sustainability of the water resources for Eldoret and Iten.

Our approach to the pre-feasibility study was to examine the different components critical to the establishment and sustainability of a water fund. These components are reflected in the key issues and questions posed in the Terms of Reference for this assignment (Appendix A) and have been summarised around the five themes below:

a) **Need**. This component aimed to identify the infrastructure (existing and planned), services, livelihoods, and business that are at risk from unreliable and insufficient water services. It also aimed to clarify the link (hydrological and hydrogeological) between upstream catchment and water resource management challenges to the downstream water resource (e.g. riparian environments, resource dependent communities) and water service dependent entities. This component highlighted the water supply gap, and related that gap to impacts on socio-economic development. It is important to note that future planned water resource developments and climate change may enhance and accelerate the threats and therefore the need for source protection measures;

b) **Opportunity**. This component focused on the nature, scale and cost of appropriate interventions across different parts of the upstream catchment that can deliver the scale of impacts required to reduce the identified threats;

c) **Stakeholders**. There is no doubt that stakeholder engagement is critical to any water fund. However, it is important to map out the stakeholders to distinguish roles, responsibilities, willingness and ability to engage with and support an Eldoret Water Fund. Through consultations with key stakeholders, the Consultant was able to gauge stakeholders' understanding of the linkages between upstream and downstream cause and effects, their understanding of the role that a water fund might play given existing institutional structures and mandates, their understanding of how best to address the upstream water and catchment management challenges and their willingness and ability to contribute resources to the fund. The sufficiency of stakeholders who see common cause and an opportunity for collective action to address upstream-downstream water resource and catchment challenges is discussed in subsequent sections of this report;

d) **Governance**. There are existing policies, legislation and institutions with defined mandates that include responsibilities for catchment and water resource management. These include public institutions (WRA, KWS, KFS, KWTA, NEMA, RVDA, WASREB, LVNWSB, BWRC and county governments), civil society groups (WRUAs, CFAs etc) and private enterprises (water service providers, commercial/industrial water users). This report seeks to respond to the question of whether there is space within the existing institutional landscape and comparative advantage for an Eldoret-Iten Water Fund. The existence of the Upper Tana-Nairobi Water Fund and other multi-stakeholder partnerships that are addressing water

resource management challenges (e.g. Imarisha Naivasha, Mount Kenya Ewaso Water Partnership, Stawisha-Mau) indicates that others have identified the need for, opportunity and institutional space for this type of organisation. This report provides a critical review with respect to the Eldoret situation, while also seeking to respond to the issue of the appropriate governance structure for the water fund, that ensures the fund can operate without treading on existing mandates or alienating itself from critical stakeholders;

e) **Sustainable Financing**. A fund without a strong financial foundation is likely to struggle. This report seeks to address the question of whether there is a viable business case that justifies the scale of investments required. Entities interested in supporting the fund may see this as a component of their Corporate Social Responsibility. However, to attract the private sector it is desirable to explore shared values between the fund and the commercial interests which will provide the private sector entity with a business interest in supporting the fund. Such opportunities have been explored during stakeholder consultations and are discussed in this document, as well as estimates of the scale of funding required for investments and operations.

2.2 Phase I – Inception

The key focus of the Inception Phase was on:

- Establishing a clear understanding of the water demand and supply situation and intended steps to meet future water demand;
- Establishing a clear understanding of the scope and boundaries of the study area;
- Obtaining sufficient information from desk review and stakeholders to identify the key water resource management issues;
- Obtaining key information to direct the stakeholder consultation phase, namely who are the key stakeholders both in the consumption area and in the catchment areas;

2.2.1 Desk Review

This involved a review of written material relevant to the study. A complete list of references used in this report can be found in the References section at the end of this report.

2.2.2 Preliminary Stakeholder Consultations

The Inception Phase included consultations with selected key stakeholders including:

- ELDOWAS – to better understand water supply reliability constraints and the water consumer /demand characteristics;
- LVNWSB – to better understand the bulk water supply system, threats and plans;
- Water Resources Authority (WRA) – to obtain information and relevant data on the water resource management issues;
- Consumers – to understand the water resources challenges within the study area.

2.2.3 Inception Report

The Inception Report provided an overview of the programme for implementation of the assignment. The report was submitted to the Client on 3rd April, 2019.

2.3 Phase II - Stakeholder Consultation Phase

The stakeholder consultation phase kicked off following the launch meeting held on 12th March, 2019. This phase was conducted between 13th and 15th March, 2019. Stakeholders were categorised as follows:

a) **Water service providers** in Eldoret, Iten and the environs. These include Lake Victoria North Water Services Board, Eldoret Water and Sanitation Company, Item-Tambach Water & Sanitation Company;
b) **Major Water users** – Chamber of Commerce, KAM, Almasi Bottlers, Flower Farms;
c) **Catchment users and enablers** – County governments (Uasin Gishu, Elgeyo Marakwet), WRUAs, CFAs;
d) **Transport Infrastructure Developers** – KERRA, KENHA, KURRA;
e) **Agencies responsible for Protected Areas** – KWS, KWTA, NEMA;
f) **Conservation Enterprises** in the catchment areas – e.g. Cherengany Conservation Network, National Council of Churches of Kenya;
g) **Public Sector Agencies** – WRA, LVNWSB, RVDA;
h) **Public Funding Agencies** – World Bank etc.
i) **Research Institutions** – University of Eldoret, Moi University, RVTTI;

A summary of stakeholders consulted and outcomes of the discussions are provided in Appendix C and D.

2.4 Phase III – Data Analysis

This phase of the assignment involved the review and detailed analysis of data obtained from field work and secondary sources. This phase was conducted in two stages, as described in the sections below.

2.4.1 Qualitative Analysis

This involved the collation and verification of data obtained from the stakeholder consultations and review of relevant literature. The outcome of this analysis was an understanding of the social and economic factors that will contribute to the successful development of the Eldoret Water Fund.

2.4.2 SWAT Model

The Soil and Water Assessment Tool (SWAT) is a widely used hydrological model that simulates hydrological processes including runoff, erosion and streamflow and can be used to test different scenarios of land use and climate change. A SWAT model was developed for the study area, which aimed to predict sediment yield and runoff into the reservoirs, establish the spatial distribution of sediment yield and to test the potential of watershed management measures to enhance streamflow and reduce sediment loadings from identified hotspot areas. The outcome of this analysis supported the identification and prioritisation of target areas where sustainable land management (SLM) interventions can be implemented by the Water Fund. Appendix F provides a summary of

assessments and simulations conducted for each of the priority catchments, the results and recommendations for interventions with the most impact.

2.5 Phase IV – Report Preparation

The report outline has been developed to accommodate the results of the field study and data analysis. The final report includes feedback from stakeholder consultations that provided an opportunity for validation of the key findings and recommendations. The Report was presented to stakeholders on 01 July 2019 for review and comments. A subsequent presentation was given to stakeholders on 02 September; the outcome of which was that the TOR was extended to include Iten and the draft report was edited to address various stakeholder comments on the draft report.

3. POLICY, LEGISLATION AND INSTITUTIONAL LANDSCAPE

3.1 Introduction

Development of this section involved review of relevant documents to the assignment. The study also draws heavily from a previous similar study conducted for the Mombasa Water Fund, from which it can be argued that national level policy and legislation apply for both scenarios. Review of existing County level legislation was also conducted as is presented in subsequent sections of this Chapter. In summary, this analysis focuses on:

- Identification of the enabling policies that promote catchment conservation and resource protection activities;
- Identification of key legislation that sets out institutional mandates. The water and environmental sectors are crowded with numerous public institutions with different and sometimes overlapping mandates. This landscape is further complicated by various civil society and private sector actors;
- Assessment of the effectiveness of existing institutions.

The aim of this analysis is to provide a concise description of the enabling environment to explain the institutional justification and comparative advantage that an Eldoret-Iten Water Fund would have to address the multi-county, multi-sector and multi-stakeholder challenges that relate to catchment conservation at a catchment scale.

The institutional analysis also provides a brief overview of other multi-stakeholder partnerships with similar aims to the Eldoret-Iten Water Fund to highlight lessons learned.

3.2 Policy Frameworks on Catchment Conservation

Since catchment conservation overlaps several sectors including; environment, water resources, land, agriculture, forest and wildlife, it is also governed through diverse policies and legislation in these sectors. This section briefly highlights some of the policies that promote catchment conservation.

3.2.1 Master Plan for Water Catchment Areas 2012

In 2012, the Ministry of Environment and Mineral Resources prepared the Masterplan for the Conservation and Sustainable Management of Water Catchment Areas in Kenya. The Plan describes the rationale and justification as well as the goal, objectives, strategies and actions that will facilitate the realization of restoration, conservation and sustainable management of water catchment areas over a 19-year period from 2011 to 2030 in line with the Kenya Vision 2030. The plan takes into consideration the variability and diversity of the country, the devolved governance system according to the Constitution of Kenya 2010 and other key actors directly or indirectly involved in catchment conservation. The Master Plan also advocates for the adherence to key environmental management principles such as the Payment for Ecosystems Services.

Some of the interventions for conservation and sustainable management of water catchment areas proposed in the plan include:

- partnerships and participation of stakeholders;

- governance of water catchment areas;
- capacity building;
- restoration and management of water catchment areas;
- water resources conservation and management.

3.2.2 National Environment Action Plan (NEAP)

The NEAP for Kenya was prepared in the mid-1990s. It was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of societal decision-making.

3.2.3 National Environmental Policy (2013)

The National Environmental Policy aims at integrating environmental aspects into national development plans and the broad policy objectives include:

- Optimal use of natural land and water resources in improving the quality of human environment;
- Sustainable use of natural resources to meet the needs of the present generations while preserving their ability to meet the needs of future generations;
- Integration of environmental conservation and economic activities into the process of sustainable development; and
- Meet national goals and international obligations by conserving bio-diversity, arresting desertification, mitigating effects of disasters, protecting the ozone layer and maintaining an ecological balance on earth.

The various Acts and Regulations addressing environmental management seek to make provisions that enable the achievement of the National Environmental Policy objectives.

3.2.4 National Water Policy

The National Water Policy Sessional Paper No. 1 1999 aims to achieve sustainable development and management of the water sector by providing a framework that guides the entire range of actions and synchronises all water related activities and actors. It sets out policy objectives covering water resources management, water supply and sewerage development, institutional arrangements and financing of the water sector and outlines the following policy direction: -

- Separation of functions in which water resource management and water and sanitation services are separated and handled by independent institutions;
- Stakeholder participation in any planning and development process;
- Environmental conservation to sustain ecosystem services from catchments;
- Realization of the economic value of water through the application of socially sensitive commercial approaches to water service provision;

A National Water Policy to replace the 1999 policy is currently under development and the draft sessional paper of 2018 on National Water Policy is currently being subjected to stakeholder and

public consultations. The draft policy recognizes the gains that have been made since 1999 particularly in relation to the institutional framework whilst also taking full cognizance of the fact that the sector is yet to attain its full potential which necessitated the need for review of the existing policy framework to revamp the sector service delivery and realign it with the constitutional environment as well as instil dynamism in the sector to respond to changing demands and environment.

3.2.5 Land Policy Sessional Paper No. 1 of 2017

The aim of the National Land Policy is to promote best land use practices for optimal utilization of the land resources in a productive, efficient, equitable and sustainable manner. The Policy provides the legal, administrative, institutional and technological framework for optimal utilization and productivity of land and land related resources in a sustainable and desirable manner at national, county, sub-county and other local levels. The guidelines, principles and strategies within the policy have addressed; surface and ground water bodies, agriculture environment management, information and knowledge gaps in natural resources, among others.

3.2.6 Vision 2030

The Kenya Vision 2030 is the country's development blueprint covering the period from 2008 to 2030. The Vision 2030 aims to transform Kenya into a newly industrialised, "middle-income country providing a high quality of life to all its citizens by the year 2030".

It is based on three pillars of development namely, economic, social and political. The economic pillar aims to achieve an average GDP growth rate of 10% per annum beginning in 2012. The social pillar seeks to build a just and cohesive society with social equity in a clean and secure environment while the political pillar aims to realise a democratic political system and protects the rights and freedoms of every individual in Kenyan society.

The national development targets in the Vision 2030 that have an implication on catchment conservation include:

- Water and sanitation - to ensure that improved water and sanitation are available and accessible to all by 2030,
- Agriculture - to increase the area under irrigation to 1.2 million ha by 2030 for increase of agricultural production,
- Environment - to be a nation that has a clean, secure and sustainable environment by 2030, and
- Energy- to generate more energy and increase efficiency in the energy sector.

3.3 Legislative Framework on Catchment Conservation

3.3.1 Constitution of Kenya (COK) 2010

The environment (which includes water catchment areas) and natural resources have been prominently addressed in the COK.

In the preamble, which provides the background within which the provisions in the constitution are to be interpreted and applied, the environment is underscored as Kenya's heritage which should be

sustained for the benefit of future generations: "*Respective of the environment which is our heritage, and determined to sustain it for the benefit of future generations*".

In the Bill of Rights (Chapter 4), Article 35 confers to every person the right to access information held by the State and that the state shall publish and publicize this information as it affects the Nation. Article 42 confers to every person the right to a clean and healthy environment which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures. Additionally, Article 43(d) confers to every person the right to clean and safe water in adequate quantities. The management of the environment and other natural resources is therefore geared towards achieving these constitutional rights.

Chapter 5 of the COK more specifically addresses Land and the Environment: -

Part one of the Chapter which addresses Land (Article 60), provides that land in Kenya shall be held, used and managed in a manner that is equitable, efficient, productive and sustainable and it further lays down the principles of land management, amongst them;

- The sustainable and productive management of land resources;
- The sound conservation and protection of ecologically sensitive areas.

Article 62 (1) (g) and (i) classifies government forests, water catchment areas, specially protected areas and all rivers, lakes and other water bodies as defined by an Act of Parliament as public land, vest in and are held in trust for the people of Kenya by the national government [Article 62 (3)].

Part Two deals with Environment and Natural Resources. Article 69 (1) provides that the State shall:

- ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
- work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
- protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
- encourage public participation in the management, protection and conservation of the environment;
- protect genetic resources and biological diversity;
- establish systems of environmental impact assessment, environmental audit and monitoring of the environment;
- eliminate processes and activities that are likely to endanger the environment; and
- utilise the environment and natural resources for the benefit of the people of Kenya.

Article 69 (2) obligates every person to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

Part 2 of the Fourth Schedule of the COK specifically assigns among other functions and powers to the county governments, the implementation of specific national government policies on natural resources and environmental conservation, including soil and water conservation; and forestry.

Finally, Article 2 of the COK that grants supremacy of the Constitution recognises any treaty or convention ratified by Kenya as part of the Laws of Kenya. Kenya is a state party to several conventions on environmental conservation including the African Convention on the Conservation of Nature and Natural Resources, the Langkawi Declaration on the Environment, the Rio Convention on Biological Diversity, UN Convention on Climate Change, UN Convention to Combat Desertification, Ramsar Convention on Wetlands, Convention on International Trade in Endangered species of Wild Fauna and Flora, among others. These conventions underscore environmental protection, conservation and sustainable use of natural resources.

3.3.2 Water Act 2016

The Water Act 2016 provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water. The purpose of the Act is to align the water sector (and the Water Act 2002) with the Constitution's primary objective of devolution and thus the Act recognizes that water related functions are a shared responsibility between the national government and the county government.

Other key provisions of the Water Act 2016 that are relevant to catchment conservation include:

- Water resources are a national resource vested in and held by the national government in trust for the people of Kenya (Section 5) and is to be regulated by a national body (Water Resources Authority (WRA) (Section 6);
- Water resources will be managed on the basis of hydrological catchment/basins (Section 24 to 29);
- WRA can levy a water use charge (Section 42). The revenue so derived is ring fenced for water resource management and catchment conservation (Section 132). However Section 42(3) makes clear that revenue from water use charges can be channelled to WRUAs for regulatory activities;
- A water service provider (WSP) can enter into agreements for the protection of sources of water it is authorised to take (Section 104, 1). The agreements could be with any person and with respect to the execution and maintenance of such works the WSP considers necessary or as the conditions of the license may require for the purpose of protecting the catchment areas, drainage of land, carrying out of soil conservation measures, the control of vegetation or effectively collecting, conveying or preserving the purity and quantity of water;
- The Water Services Regulatory Board regulates water service provision including the approval of tariffs (Section 72). Any fee levied by the WSP for catchment conservation would need to be approved by WASREB.

A point to note with regard to the Water Act, 2016 is that the function of conservation of water catchments is now vested on the county governments; whereas previously this was part of the mandate of WRMA (now WRA). The caveat to this would be if WRA, in delivering on its mandate, defines regulations that may impose requirements on how catchment management is executed by the county governments. The Act does give the WRA power to declare a stipulated area as a protected

catchment (Section 22) or a groundwater conservation area (Section 23) which is a way to proscribe good land use practices in water catchment areas.

There is a widely held view among stakeholders that the revenue derived by WRA from water use charges should be spent on catchment conservation, among other things related to water resources management. In reality this position is mis-guided as (i) WRA does not have any mandate under the Water Act 2016 related to catchment conservation investments except as the regulator and (ii) the justification for the water use charges was to provide resources to manage the water resources and not for investments in catchment conservation or water resource infrastructure. The question then arises as to how county governments are expected to finance catchment conservation efforts. It appears that county governments would be expected to allocated funds from general revenues. This implies that the application of a conservation levy on water tariffs, if approved by WASREB, would potentially provide a source of ring fenced revenue for source protection/catchment conservation efforts.

3.3.3 County Water Policies and Acts

County governments are expected to develop their own policies and legislation not inconsistent with national policies and legislation to establish county-based institutions and procedures to enhance delivery of services in regard to water and sanitation services, storm water drainage, soil and water conservation and environmental conservation. Various counties have passed their Water Acts which are now in force, while other counties have theirs at various stages of development. Uasin Gishu and Elgeyo Marakwet Counties do not have any legislation in place yet that deals with issues of water resources and catchment management, though activities that respond to these issues have been proposed in their respective County Integrated Development Plans (CIDP).

The County Government of Elgeyo Marakwet has developed the Elgeyo Marakwet County Charcoal Bill, 2017, which seeks to ensure enhanced and effective forest conservation and protection, and sustainable charcoal production. Objectives of this bill relevant to catchment conservation include to:

- Contribute to poverty reduction, employment creation and improved livelihoods through sustainable use, conservation and management of forests and trees;
- Contribute to sustainable land use through soil, water and biodiversity conservation and tree planting through the sustainable management of forests and trees;
- Promote the participation of the communities, private sector and other stakeholders in forest management to conserve water catchment areas, create employment, reduce poverty and ensure sustainability of the forest sector.

3.3.4 Environmental Management & Coordination Act 1999

The Environment Management and Coordination Act (EMCA) makes provisions for management of the environment. Its preamble recognizes that;

- it is desirable that a framework for environmental legislation be promulgated so as to establish an appropriate legal and institutional framework for the management of the environment;
- improved legal and administrative coordination of the diverse sectoral initiatives is necessary in order to improve the national capacity for the management of the environment;

- the environment constitutes the foundation of national economic, social, cultural and spiritual advancement.

It establishes NEMA (Section 7) whose object is to exercise general supervision and coordination over all matters relating to the environment (Section 9).

Environmental planning, protection and conservation of the environment and approval of development projects though the use of environmental and social impact assessments (ESIA) are some of the areas that the EMCA regulates. The Act has further made provisions for various environmental quality standards resulting in various regulations such as: The Water Quality Regulations, The Waste Management Regulations, Wetlands, River Banks, Lakes Shores and Sea Shores Management Regulations, among others.

3.3.5 The Forest Conservation and Management Act 2016

The Forest Conservation and Management Act gives effect to article 69 of the COK and provides for the development and sustainable management including conservation and rational utilization of all forest resources.

3.3.6 Wildlife Conservation and Management Act 2013

The Wildlife Act provides for wildlife protection, conservation and management in Kenya. The Act also designates national parks, national reserves, and local sanctuaries to facilitate wildlife conservation and management and further provides for protection and management of watersheds and designates Ramsar sites as protected areas.

3.3.7 Kenya Water Towers Coordination and Conservation Bill, 2019

The Kenya Water Towers Bill, 2018 proposes the establishment of the Kenya Water Towers Authority (Section 6 (1)) to succeed the current Kenya Water Tower Agency established under the State Corporations Act. Once passed as an Act of Parliament, it will repeal the Kenya Water Tower Agency Order Legal Notice No. 27 of April 2012 and the Act shall prevail in case of any inconsistency between it and any other legislation in matters relating to the protection, rehabilitation, conservation, and sustainable management of water towers (Section 3 (2)). With the exception of a few changes (highlighted in section 3.4.8 of this report), the overall functions of the Authority have been maintained as they were for the predecessor, KWTA.

The objects and purposes of the proposed Kenya Water Towers Conservation and Coordination Act is to:

a) provide an effective legal framework for the sustainable management of water towers for the purpose of fulfilling Articles 26, 42, 43 69 and 70 of the Constitution;
b) provide an institutional framework for the effective coordination of the various actors involved in the management of water towers;
c) provide an effective legal and institutional framework for the coordination and conservation of wetlands and biodiversity hotspots;
d) provide for the establishment of the Kenya Water Towers Authority and its functions;
e) promote public awareness about the need for the protection, rehabilitation, conservation, and sustainable management of water towers.

Schedule 2 of the bill has listed the Cherangany Hills, which form the catchment area for Eldoret Water supply sources, among the eighteen water towers.

Additionally, the bill provides that the Authority shall, in consultation with the national and county government, promote public awareness about the need for the protection, rehabilitation, conservation, and sustainable management of water towers through comprehensive nationwide educational and information campaigns and shall collaborate with relevant stakeholders to ensure the involvement and participation of individuals and groups affected by adverse use and management of water towers.

The Bill also confers on the Cabinet Secretary powers to declare any public, private or community land to be a water tower, wetland or biodiversity hotspot, upon meeting a set criteria, and upon recommendation by the Authority.

3.4 Institutional Landscape

As evidenced in subsection 3.2 and 3.3, governance of catchment areas is scattered across several sectors and legislation which establish diverse institutions all charged with specific aspects of or related to water catchment management, creating a complex institutional landscape as highlighted below.

3.4.1 National Government Ministries

The ministries responsible for agriculture, water, land, fisheries, forestry and wildlife all bear some level of responsibility for diverse aspects of water catchment governance with their role mainly being of policy formulation. Appreciating the fact that there are issues that transcend the mandate of any one ministry, inter-ministerial collaboration is common. Some examples include the Agricultural Sector Coordination Unit and the Mau Complex Rehabilitation among others which bring various ministries together for coordinated development and implementation of policies and strategies.

3.4.2 County Government Department

Relevant county government departments are currently charged with the implementation of specific national government policies on natural resources and environmental conservation, including soil and water conservation, and forestry.

3.4.3 National Environment Management Authority (NEMA)

NEMA was founded and mandated under EMCA to exercise general supervision and coordination over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the environment.

3.4.4 Water Resources Authority (WRA)

Established under the Water Act 2016, WRA has the following functions:

a) Formulate and enforce standards, procedures and regulations for the management and use of water resources and flood mitigation;
b) Regulate the management and use of water resources as well as enforce the regulations;
c) Issue water permits for water abstraction, water use and recharge, enforce the conditions of those permits;

d) determine and set permit and water use fees and collect water permit fees and water use charges;
e) provide information and advice for formulation of policy on national water resource management, water storage and flood control strategies.

The Water Act 2016, additionally makes provisions for the establishment of a Basin Water Resource Committee (BWRC) for each designated basin area (Defined area from which rain water flows into a watercourse), to advise WRA and County Governments at the respective regional offices concerning among other issues; the conservation, use and apportionment of water resources, protection of water resources and increasing the availability of water and any other matter related to the proper management of water resources.

3.4.5 Kenya Forest Service (KFS)

KFS was established by the Forest Act 2015 to develop and sustainably manage forest resources for the socio-economic development of Kenya. The overall mandate of KFS is to conserve, develop and sustainably manage gazetted forestry resources including the Water Towers.

KFS, in partnership with a number of stakeholders, has developed the Cherangany Hills Forest Strategic Ecosystem Management Plan (2015 -2040). The plan's strategic objectives are:

- To conserve water catchments and enhance the unique biodiversity of the forest;
- To contribute towards meeting subsistence needs and improving the livelihoods of forest – adjacent communities;
- To improve and develop the condition and potential for utilization of the forest.

3.4.6 Kenya Wildlife Service (KWS)

Established under the Wildlife (Conservation and Management) Act, KWS is mandate to formulate and implement policies for the conservation, management and utilisation of wildlife resources, national parks and reserves. Though KWS does not directly manage water resources it is charged with the responsibility to manage the water environment and ecosystems falling within their jurisdiction.

3.4.7 Kenya Forestry Research Institute (KEFRI)

KEFRI is established under the Science and Technology Act (Chapter 250) to carry out research in forestry and allied natural resources. The mandate is to conduct research in forestry, to disseminate research findings, and to co-operate with other research bodies carrying out similar research within and outside Kenya.

3.4.8 The Kenya Water Tower Agency (KWTA)

KWTA was established through the Kenya Water Tower Agency Order, 2012 contained in Legal Notice No. 27 of April 2012, of the State Corporation Acts (Cap 446). The functions of the agency as ordered in the Legal Notice include:

a) Co-ordinate and oversee the protection, rehabilitation, conservation, and sustainable management of water towers;
b) Co-ordinate and oversee the recovery and restoration of forest lands, wetlands and biodiversity hotspots;

c) Promote the implementation of sustainable livelihood programmes in the water towers in accordance with natural resource conservation;
d) Mobilize resources from the Government, development partners and other stakeholders as well as through payment for environmental services, including carbon reservoirs and sequestration;
e) In consultation with the relevant stakeholders, identify water towers and watersheds for protection;
f) Assess and monitor rehabilitation, conservation and management activities in the water towers.

The current establishment of KWTA via legal gazette is inferior to institutions established via Acts of Parliament (KWS, KFS, WRA, NEMA etc.) which challenges its ability to coordinate such institutions. The Kenya Water Towers Coordination and Conservation Bill 2019 is therefore seeking to strengthen the legal mandate of the Agency by making provisions for the establishment of the Kenya Water Towers Authority.

The functions of the Authority in the bill have been largely maintained with the exception of function (c) above, which has been rephrased as follows:

- Support and promote the implementation of sustainable nature-based enterprises and community livelihood improvement programs to ease pressure on water tower resources in accordance with natural resource conservation.

The following functions, among others, have also been added:

- establish a framework for payment for environmental services for the purpose of sustainable management of water tower ecosystems;
- undertake economic valuation of the water towers;
- periodically undertake a Water Tower Ecosystem Audit and make relevant recommendations for sustainability.

3.4.9 Established Government Funds relevant to Environmental Conservation

In addition to the key institutions mandated by various Acts of Parliament, provisions for establishing funds to advance the objects of the various acts have also been made while some funds have also been established by way of National Gazette based on emerging needs. Table 3.1 presents a brief summary of some of the existing government funds relevant to environmental conservation.

Table 3-1: Summary of Government Funds

Name of Fund	Establishment and Purpose of the Fund
Water Sector Trust Fund (WSTF)	Established under the Water Act 2016 (Part V: Section 113 – 118). The object of the Fund is to provide conditional and unconditional grants to counties, in addition to the Equilisation Fund and to assist in financing the development and management of water services in marginalized areas or areas considered to be underserved. The Water Act 2016 particularly extended the scope of the fund beyond water services, to also include financing of community level

Name of Fund	Establishment and Purpose of the Fund
	initiatives and research activities for the sustainable management of water resources (114 (a) & (d)). Since 2008, WSTF has funded water resources management activities through the WRUA Development Cycle (WDC) initially funding WRUAs to implement Sub-Catchment Management Plan (SCMP) activities and more recently Community Forest Associations (CFA) to fund Participatory Forest Management Plans (PFMP). Funding is provided in progressive levels based on performance with funds ranging from Ksh. 1.5 million for level 1 and up to Ksh.30 million for Level 4. There are also other donor specific projects such as the Joint Six Programme that is funding WSPs and the associated WRUAs.
Water Towers Conservation Fund	Established on 23 July 2010, as part of the Mau Complex Forest Interim Coordinating Secretariat's mandate "to develop the framework for long-term measures to restore and sustainably manage the Mau Forest Complex and other water towers".
Forest Management and Conservation Fund	Established under the Forests Conservation and Management Act 2016 for purposes of nurturing, promoting and supporting innovations and best practices in forest conservation and development including support of; community forestry programmes, re-afforestation and afforestation programmes and programs on PES. Operationalizing of the Fund is yet to be undertaken and therefore the fund is currently not functional.
National Environment Trust Fund (NETFUND)	NETFUND was established within the provisions of the EMCA 1999 to facilitate research intended to further the requirements of environmental management: capacity building, environmental awards, environmental publications, and scholarships.
National Restoration Fund	The National Restoration Fund was also established under EMCA 1999. The object of the Fund is supplementary insurance for the mitigation of environmental degradation where the perpetrator is not identifiable or where exceptional circumstances require the NEMA to intervene towards the control or mitigation of environmental degradation. This fund is currently not operational following the scrapping of NEMA charges and bonds, part of which were used to fund its activities. The fund worked through the District (post 2010 the County) Environmental Committees who together with the community would vet and identify activities of ecological importance to their respective area. Consultants would then be procured by the fund to implement the identified interventions.

3.4.10 Multi-Stakeholder Partnerships Engaging in Catchment Conservation

Governance of water resources remains a critical issue in Kenya and there is on-going debate regarding the most appropriate governance and institutional arrangements for the development, management and regulation of the nation's water resources, in light of the recent devolution process. While such public sector discussions continue, various examples (Mt. Kenya Ewaso Water Partnership, Stawisha Mau Trust, etc.) can be seen where local water stress is compelling civil society and the private sector actors to take on a more proactive role, alongside the public sector, to improve water resource and watershed management.

Such emerging Multi-stakeholder Partnerships (MSPs) have reported a number of positive outcomes from their activities. These are documented below:

- Better awareness of the mandates and roles of different organisations involved in water resource management;
- Improved sharing of information that has enabled collective prioritization of WRM issues, harmonization of interventions and reduced duplication;
- Mobilisation and engagement of stakeholders in water resource management decisions and activities at a local and regional level;
- Mobilisation of resources from diverse partners into water resource management activities;
- Integration of livelihood support approaches into water resource management activities;
- Empowerment of WRUAs and environmental conservation groups on critical environmental issues;
- Implementation of diverse water resource management activities that have included adoption and expansion of catchment and riparian conservation technologies, climate and water resource monitoring, adoption of water efficient and water storage technologies;
- Better information sharing and collective action has also helped to address and reduce the number of water use conflicts.

A number of challenges and constraints have also been reported. These include: -

- One of the roles of the emerging MSPs is to support the coordination of efforts in water resource management by stakeholders from private, public and civil society sectors. This requires co-ordination skills within the MSP and co-operation by the stakeholders to be co-ordinated or willingness to think and work outside the silos of their respective organisations. This is challenging as many organisations are unfamiliar with being coordinated and feel that their mandates are being usurped;
- Many of the MSPs face financial constraints. The intention to establish and need for an MSP does not automatically translate into financial resources. This is particularly difficult for emerging MSPs that have yet to prove their value to water resource management affairs.

One of the challenges that an Eldoret-Iten Water Fund would need to grapple with is thematic focus. As described above there is space for a multi-stakeholder partnership to engage in water resource and catchment conservation issues. There are however many issues within the water resource sub-sector

including catchment conservation, water resource allocation, governance, compliance, infrastructure, data, etc. The Water Fund will therefore have to consider whether or how to accommodate a level of flexibility regarding the scope of thematic issues it is willing and able to engage in.

3.5 Policy, Legislative and Institutional Space for Water Funds

Environmental protection, conservation and sustainable use of natural resources have been given prominence in various policies and legislations which provide the policy and legal context for the conservation activities of an Eldoret-Iten Water Fund.

Water has been underscored as a socio-economic right and its availability as a key enabler of development. Catchment conservation is also emphasized as critical to sustaining eco-system services from catchments. Therefore activities undertaken by a Water Fund would in essence contribute towards the achievement of basic rights protected by the constitution (right to clean and healthy environment and right to clean and safe water in adequate quantities).

In relation to the institutional landscape, the water and environmental sectors are crowded with numerous public institutions with different and sometimes overlapping mandates. This landscape is further complicated by various civil society and private sector actors. This forms the environment within which the Eldoret-Iten Water Fund would operate. More importantly, however, are the opportunities that a Water Fund can offer within the existing institutional landscape. Some of the most compelling opportunities include:-

a. Opportunity for Partnerships in Catchment Conservation Activities

Public participation in management, protection and conservation of the environment is adequately covered across the various legislations. Within the policy frameworks, partnerships have been cited as a key strategy to not only meeting the mandatory requirements for public participation but also as a way to leverage on knowledge, skills, innovation, finances and other resources. Additionally, the responsibility placed on government on environment matters is enormous and could greatly benefit from structured involvement and contribution of the private and civil society sectors. As such, the Eldoret-Iten Water Fund offers a unique PPP vehicle that could addresses catchment conservation for the Eldoret and Iten water sources.

b. Gaps in Adequate Financing of Catchment Conservation Activities

Achieving impact at scale on conservation is finance intensive, yet currently there does not exist any clear funding mechanism for catchment conservation. The Eldoret-Iten Water Fund thus has an opportunity to offer a mechanism that closes the catchment conservation funding gap.

c. Opportunity for collaborative action that includes the users at the tap

Water consumers for Eldowas and Itewasco are currently poorly informed and are disengaged from the source protection needs. An Eldoret-Item Water Fund presents an opportunity to leverage growing environmental interest within the public to inform and mobilize consumer interest in catchment conservation.

4. WATER DEMAND AND WATER SUPPLY

4.1 Introduction

Eldoret town is the administrative centre of Uasin Gishu County and one of the rapidly growing urban centres in Kenya. The town was founded in 1910 by white settlers in the area and became a municipality by 1958. Today, the town is the second largest urban centre in mid-western Kenya after Nakuru and the fifth largest urban centre in the country, with heightened industrial, scientific research and administrative activities hence access to adequate water is crucial to the economic development in the area. The town is under the Lake Victoria North Water Works Development Agency (LVNWWDA) (formerly the LVNWSB) with Eldoret Water and Sanitation Company Limited (ELDOWAS) as the main water service provider (WSP).

This section presents information on the water availability, supply and demand for Eldoret town and its immediate environs.

4.2 General Overview of Water Resources

The greater north rift region depends mainly on surface water sources to meet their domestic, irrigation and water requirements. Rivers flowing in the region drain into two basins, namely the Lake Victoria Basin (LVB) and Rift Valley Basin (RVB) defined by the water divide that runs along the Elgeyo Escarpment. For the purpose of this study, our interest will be in the rivers draining into the LVB.

Rivers that drain into the LVB include the Moiben, Chepkatit and Sabor Rivers in Elgeyo Marakwet County, as well as Chepkoilel, Sergoit, Kipkaren, Sosiani, Kesses in Uasin Gishu County and their tributaries. Water resources in the area of interest are transboundary, spanning both Uasin Gishu and Elgeyo Marakwet Counties.

Other abstractors exist within the study area including numerous community water supply schemes. A list of existing water projects supplying water to satellite towns around Eldoret is provided in Section 4.5.2. The Elgeyo Marakwet CIDP also identifies four main rural water supply schemes playing an important role in supplying water in Elgeyo Marakwet County, namely Ainabayat, Tala, Emsoo and Mukurgoin community water supply schemes.

Iten Tambach Water and Sanitation Company (ITWASCO) and Cherangany-Marakwet Water and Sanitation Company (CHEMAWASCO) are the two main water service providers in the Elgeyo Marakwet County. ITWASCO has one of its intakes on the Charama River, which also emanates from the Kaptagat Forest, but drains into a different catchment from the Sosiani.

Ground water potential varies within the two counties. In Elgeyo Marakwet, the average groundwater potential varies significantly in the highlands, escarpment and the low lands. The lower areas of Kerio Valley have boreholes with average yields of between 5 m^3/hr to 20 m^3/hr and depths of 50-120 meters. In comparison, the escarpment has even lower yields of water of between 1 m^3/hr to 7 m^3/hr with average depths of 110-200 meters and the highlands have the highest yields of up to 22 m^3/hr with average depths of between 80-220 meters (County Government of Elgeyo Marakwet, 2018).

For Uasin Gishu County, ground water potential has been described as moderate to high, with average borehole yield of 3.77 m^3/hr, ranging between 0.12 to 31.24 m^3/hr (MIBP, 2018). Notably, there is low groundwater development for commercial purposes in the area.

4.3 Water Demand in Eldoret and its Environs

In 2009, the municipality of Eldoret had a population of 289,380 with a growth rate of about 3.7% (KNBS 2012). The study by MIBP (2018) analysed the population growth and projection for Eldoret town on the basis of three growth variants and arrived at a plausible growth rate of 3.9% (2009-2040). According to the African Development Bank model the Eldoret town water demand was 26,000 m^3/day for the 2009 (AFDB WSS Model 2016). In 2018, the water demand for Eldoret town was estimated at around 60,000 m^3/d (County Government of Uasin Gishu, 2018), more than double in less than ten years. JICA/Nippon Koei (2013) adjusts the town population to 294,589 to account for demand within the same sub-basin but across the administrative boundary. Figure 4.1 below shows the Eldoret town population growth and water demand projection based on the Uasin Gishu growth rate of 3.7% and demand based on the ELDOWAS Master Plan (MIBP, 2018) and the AfDB model.

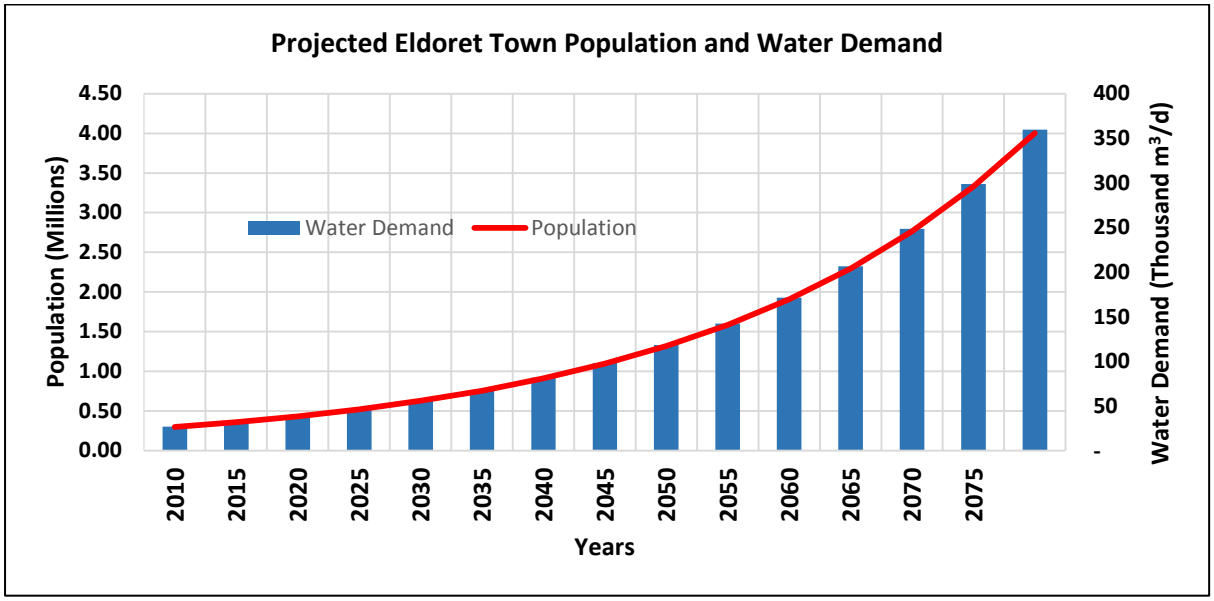


Figure 4-1: Eldoret Town Water Demand and Population Projection

The County Government of Uasin Gishu is the principle shareholder in ELDOWAS. However, there are other small schemes such as Turbo, Moi's Bridge, Sosiani, Sambut, Kipkabus, Burnt Forest and Ngeria that provide water services to smaller centres.

4.4 Current Water Sources

The water sources within the study area are either operated by ELDOWAS, Uasin Gishu County Government or by local community groups. The main water resources for Eldoret town and its environs include dams, rivers, boreholes, shallow wells and springs. However, 90% of water demand is met by surface water sourced from rivers draining the area, namely; Moiben, Sosiani, Sergoit, Kipkaren and a tributary of Yala River in Kesses. Table 4.1 and Table 4.2 show water supply schemes, managed by ELDOWAS (4) and Uasin Gishu County Government (7) respectively.

Table 4-1 : Current Surface Water Sources for Eldoret operated by ELDOWAS

No.	Water Sources	River	Max. Capacity (m^3/day)	Treatment Plant	Current Production m^3/day	Served Area
1	Moiben Dam	Moiben	28,000	Chebara	24,200	Eldoret & Chebara Pipeline
2	Two Rivers Dam	Sosiani	14,950	Sosiani	14,200	Eldoret Municipality and its Environs
3	Ellegirini Dam	Ellegirini	9,000	Kapsoya	7,000*	Eldoret & its Environs
				Naiberi	2,000*	Eldoret Municipality and its Environs
4	Kesses dam	Kesses	600	Kesses	600	Kesses & Lessos
TOTAL			**52,550**		**48,000**	

Sources: MIBP (2018), ELDOWAS

* Not supplying Eldoret town

The current supply to Eldoret Town from surface sources is 48,000 m^3/d. The current town water demand (60,000 m^3/day) outstrips the surface water supply. A portion of the water supply deficit may be met by groundwater sources. The description of the current water resources infrastructure for Eldoret and its surroundings are detailed in the subsequent sections (Also see the Maps in Appendix B).

4.4.1 Moiben Dam

The dam is located about 55 kilometres North East of Eldoret in Elgeyo Marakwet county and draws water from Moiben River (Tributary of Nzoia River) and other streams that originate from Kipkunur and Embobut forests, which form part of the larger Cherangany water tower. Moiben Dam has a designed storage capacity of 6.5 Mm^3 and drains a catchment area of about 177 km^2. It was commissioned in 1998 with a 98% reliable yield of 28,300 m^3/day. Currently, the dam supplies about 26,000 m^3 daily to ELDOWAS for Eldoret town (24,200 m^3/day) and other users (1,800 m^3/day) along the pipeline via Chebara Treatment Works (MIBP, 2018). This is an intra-basin water transfer facility from Moiben Dam to Eldoret and Iten as included in the NWMP 2030 (2013) to satisfy future domestic water demands in the area. The dam supplies about 50% of Eldoret town current total water supply.

4.4.2 Ellegirini Dam

Ellegirini dam is located about 11 km upstream of Two Rivers Dam on the Ellegirini River that originates from Kaptagat Forest. The dam was constructed in 1987 as a reserve dam for recharging the Two Rivers Dam during dry periods (MIBP 2018: MIBP and Watson 1981). It was designed with a yield of 14,000 m^3/day and designed storage capacity of 2 Mm^3. The reservoir drains a catchment area of about 55 km^2. Currently it supplies about 9,000m^3 daily to ELDOWAS for Eldoret town via Kapsoya Treatment Works (7000 m^3/day), serving Eldoret Town and Naiberi Treatment Works in Cherunya (2000 m^3/day) which serves the areas of Naiberi -Cherunya, Kipkorgot and Islamic Centre. The two treatment plants were recently expanded and constructed respectively (2018) by Lake Victoria North Water Service Boards (LVNWSB).

4.4.3 Two Rivers Dam

Two Rivers dam is located on the Sosiani River at the confluence of two tributaries (Endorot and Ellegirini Rivers) at the outskirts of Eldoret, originating from Kaptagat forest. The dam drains a catchment area of about 270 km^2 (50% Ellegirini and 80% Endorot) and was constructed in 1962 and 1963 with effective storage of 4.5 Mm^3. However, the estimated current storage is bout of 3 Mm^3. It supplies about 14,950 m^3 daily to ELDOWAS (30%) for Eldoret town via Sosiani Treatment Works. The existing Two Rivers Dam is heavily influenced by anthropogenic agricultural activities including subsistence and large-scale farming (MIBP, 2018) hence the reduced storage capacity due to sedimentation emanating from the catchment.

4.4.4 Kesses Dam

Kesses dam is located on Sambul River, a tributary of Yala River, which originates from Burnt forest and Ainabkoi. The dam is located in Kesses Village, Eldoret West Sub-County off the Kesses-Lessos Road and it drains an area of about 161 km^2. The dam was constructed in 1948 by colonialists for recreational purposes but later adopted as a water source for Municipal Water Supply to Kesses and Lessos Towns.

Currently, the dam supplies about 600 m^3/day via Kesses treatment work to Moi University and the area of Kesses and Lessos. Moi University has a private offtake from the dam with their own treatment system. MIBP 2018 proposed dredging, spillway rehabilitation and construction of a new intake structure.

4.4.5 Groundwater

Groundwater resources are not currently used for public water supply, but are understood to be a supplementary water resource for farms, informal settlements, individuals, commerce and industry. The significance of groundwater compared with surface water use is unknown, though data from the 2009 Census suggest that up to 30% of Eldoret residents rely on groundwater sources to meet their water demand.

The deep, confined groundwater resource that underlies Eldoret lies in lavas of Miocene age (the Uasin Gishu Phonolite) is almost universally distributed and occurs at depths of 120 to 150 mbgl. Groundwater flows from the highlands east of Eldoret (which host the recharge zone for these aquifers), west/north westwards towards and beyond Eldoret.

Yields are comparatively poor (the 50^{th} percentile test discharge rate is 2.3 m^3/hr, and only 10 of 101 pumping tests exceed 10 m^3/hr). The Miocene aquifer system is unsuitable for large-scale water supply.

4.5 Other Water Supply Schemes in the Study Area

4.5.1 Iten-Tambach Water and Sanitation Company

The Iten Tambach Water and Sanitation Company supplies water to the residents of Iten town. The scheme has four main sources, namely:

- Sabor Weir – this is a gravity system, whose source is the Charama River, with a design production of 4,200 m^3/d, and actual production of 1,500 m^3/d;

- Yagot Dam – this is a pumped system with a design production of 1,100 m^3/d and actual production of 900 m^3/d;
- Tambach Springs – a pumped system with design yield of 150 m^3/d and an actual yield of 120 m^3/d;
- Kamarir weir – a pumped system with design production of 120 m^3/d and actual production of 80 m^3/d, though not currently in operation;
- Chebogokwa borehole – also currently not in operation;
- Total daily production of 2,600m^3/day.

Though ITWASCO and ELDOWAS have different water resources, they share a common catchment area, Kaptagat Forest, and consequently, face similar water resource challenges, including deforestation, encroachment, competition from community abstractors and water quality issues such as turbidity and contamination. However, the main risk to the sustainability of the WSP is the development of the NIB owned Lower Sabor Irrigation Project upstream of the Sabor intake. The development of the irrigation project has been reported to affect flows available to the scheme.[3]

4.5.2 Other Water Supply Schemes in the Study Area

A number of water supply projects exists within the satellite towns surrounding Eldoret. Some are operated by the County Government of Uasin Gishu and others are community owned and operated, as summarised in Table 4.2 and Table 4.3.

Table 4-2 : Water Supply Schemes Operated by the County Government in the Study Area

No.	Schemes	Town	Source	Capacity (m^3/day)	Status
1	Burnt Forest	Burnt Forest	Nabkoi Stream	600	Operational
2	Mois bridge/Matunda	Moi's Bridge/Matunda	Nzoia River	2,000	Operational
3	Soy	Soy	Navillus Dam/Chepkoilel River	600	Operational
4	Sambut	Kamagut & Juakali	Sambut Dam	600	Not Operational
5	Lumukanda-Kipkaren	Kipkaren	Kipkaren River	1,200	Operational
6	Kipkabus	Kipkabus Wonifor	Kipkabus Dam	720	Operational
7	Turbo	Turbo	Kipkaren River	2,000	Operational

[3] http://www.kenyanews.go.ke/cdicc-to-address-the-sabor-iten-tambach-water-project/

Table 4-3 : Water Supply Schemes Operated by the Community in the Study Area

No.	Schemes	Town	Source	Capacity (m^3/day)	Status
1	Bayete	Bayete	Bayete Dam	No data	Under construction
2	Ziwa Rural	Ziwa	1 no. borehole	No data	Operational
3	Sergoit	Sergoit	Offtake from Chebara line	No data	Operational
4	Chepkorio	Flax	Oltoroita River	No data	Operational
5	Boiboyet	Plateau	Kipsinende River	No data	Operational
6	Arangai	Ainabkoi	Arangai River	No data	Operational

Source: MIBP, 2018

4.6 Projected Water Source Developments

Although the current water demand far outweighs developed water resources, LVNWSB's current investment plans involve the development of additional water sources infrastructure to meet the ever-growing demand, with project preparations and designs already underway prior to the master plan development for Eldoret town and its satellites (MIBP 2018). Key water infrastructure under scenario A1 of the master plan include the development of Kipkaren Dam by 2020 and a proposed New Two Rivers Dam by 2025 for an additional 24,000 m^3/day and 57,500 m^3/day respectively. These two investments have been scheduled under the immediate and medium-term work plan, with the procurement already underway for the construction of Kipkaren Dam treatment and distribution works and the final design preparation for Two Rivers Dam by August 2018 (MIBP, 2018). The full implementation of the two-infrastructure development will turn the current water deficit to a surplus by 2020 all the way to 2040.

Table 4-4 : Planned Water Resource Infrastructure Development

Scenario A1	Horizontal Planning (Year)					
	2016	2020	2025	2030	2035	2040
Existing developed capacity (m3/day)	46,200	49,200	49,200	49,200	49,200	49,200
Total Water Demand (m^3/day)	54,951	61,277	72,915	86,365	101,694	118,908
Deficit/Surplus based on existing sources (2016) (m^3/day)	**- 8,751**	**-12,077**	**-23,715**	**-37,165**	**-52,494**	**-69,708**
Proposed Supply from existing Kipkaren Dam (m^3/day)	0	24,000	24,000	24,000	24,000	24,000
Construction of New Two Rivers Dam (m^3/day)	0	0	28,750	28,750	57,500	57,500
Total Supply Capacity (m^3/day)	46,200	73,200	101,950	101,950	130,700	130,700
New Deficit/Surplus (m^3/day)	**-8,751**	**11,923**	**29,035**	**15,585**	**29,006**	**11,792**

* Initially treatment works capacity for New Rivers Dam will be 28,750m^3/day; it will be extended to full capacity of dam in 2035.
Source: MIBP, 2018

4.6.1 Kipkaren Dam

Kipkaren dam is located on the Kipkaren River which originates from Kaptagat and Burnt forest draining a catchment area of about 545 km^2. It is reported that the dam was constructed in the 1920's and was privately owned.

The current dam has a designed capacity of 3 million m^3 with a dam wall of 30 m high. Currently, it supplies water to Eldoret International Airport. However, plans are underway to construct a water treatment plant with a capacity of 24,000m^3/day to augment ELDOWAS supply.

4.6.2 Proposed New Two Rivers Dam

According to the Eldoret Water Supply Master Plan under recommended water resources development strategy, plans are underway to construct a New Two Rivers Dam 700m downstream of the current Two Rivers Dam location by 2025 to inject an additional 57,500m^3/day to ELDOWAS capacity (MIBP 2018). It is understood that LVNWSB has procured a consultant for the Final Design, Tendering and supervision. This will also see the construction of a new Treatment Plant at Sosiani, with a capacity of 28,750 m^3/day. A further 28,750 m^3/day capacity treatment plant will be constructed in 2035.

4.6.3 Other Proposed Water Resource Infrastructure Development

According to Water Supply Master Plan for Eldoret town and its environs prepared by MIBP (2018) and the National Water Master Plan 2030 ((JICA)/Nippon Koei Co Ltd (2013), about 13 dams were proposed (yield and reliability to be determined) to increase the water resources to ELDOWAS (Table 4-5).

Table 4-5 : Proposed Dams and their Potential Net Yield

No.	Name	River	Catchment Area (km^2)	Max. Practical Capacity (m^3x10^6)	90% Net Yield (m^3/day)	98% Net Yield (m^3/day)
1	Sergoit 1	Sergoit	636	28.5	87,800	74,700
2	Sergoit 2	Sergoit	423	5.5	29,500	26,000
3	Onyokie	Kipkaren	879	27.4	94,000	75,100
4	Nureri	Nureri	-	15.2	61,500	51,500
6	Endorot	Endorot	46	1.1	6,300	5,600
7	Kisongi	Kisongi	42	5	8,600	7,200
9	Nderuguti	Nderuguti	43	5	12,300	10,000
8	Kerita	Kerita	93	15	18,100	16,200
10	Endaragwa	Endaragwa	43	40	22,200	21,500
13	Kibolo	Soisani	-	-	-	-

Sources: Eldoret WSMP (MIBP 2018) & NWMP 2030 (2012)

In the master plan the Kerita and Endaragwa dams have been identified and designed as future water sources to increase supply beyond 2040 for Eldoret and the surrounding satellite towns. The proposed

Kerita dam is located on the Kerita River in Tarakwa Village, Kesses Constituency in Eldoret South Sub-County. The proposed location of Endaragwa dam is on the Endaragwa River (River Tumbo) near Burnt Forest Town.

4.7 Water Supply and Distribution to Eldoret

Water supply and distribution in the study area is the responsibility of ELDOWAS licensed by Lake Victoria North Water Service Board (LVNWSB). ELDOWAS achieved 100% metering in 2009 (WASREB, 2009) and was able to achieve a dramatic improvement in non-revenue water (NRW) from 52% to 25% shortly thereafter[4]. However, current data indicates a rise in NRW to 43% as at 2016/17. Trends in NRW are shown in Figure 4.2.

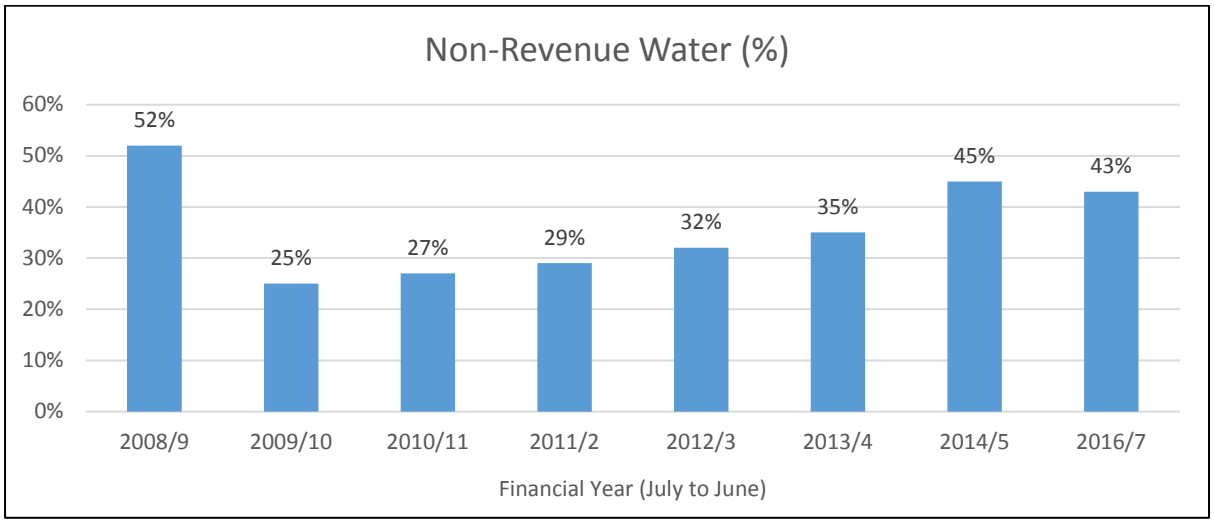


Figure 4-2 : Trends in Non-Revenue Water for ELDOWAS

From 2012 onwards, the water supply coverage has been steady with a general slight increase from 71% to 74%. Total water production has increased steadily over time (barring the total water production in 2008/9, which requires further investigation). Consumption per capita, more accurately described as mean billed consumption shows a substantial drop around 2013 which appears to be partly due to an increase in NRW.

4.7.1 Cost of Production

ELDOWAS's cost of production has been relatively consistent and close to the average for very large utilities (defined by WASREB as those with > 35,000 connections) throughout the period for which figures are available (from FY2011/2 to FY 2016/7), as can be seen in Table 4.6. ELDOWAS's tariffs was just below the cost of production for all water produced since 2012/3, a situation that has been resolved with a KSh 25 (40%) tariff hike in 2016.

[4] Prior to the 2008/9 WASREB Impact Report, Unaccounted for Water, UFW, was reported instead of NRW, so that the results from the first two Impact Reports are not directly comparable.

Table 4-6 : Cost of Production Indicators for ELDOWAS

Performance measure	Financial Year (July to June)				
	2011/2	2012/3	2013/4	2014/5	2016/7
Unit cost of water produced, ELDOWAS	N.D.	40	49	42	42
Unit cost of water produced, mean for very large utilities	N.D.	N.D.	37	38	75
Unit cost of water billed, ELDOWAS	55	59	61	62	62
Unit cost of water billed, mean for v. large utilities	N.D.	N.D.	60	63	81
Average tariff, ELDOWAS	58	57	59	59	87
Average tariff, mean for very large utilities	N.D.	N.D.	60	61	50

Source: WASREB (Impact Reports from various years)

4.7.2 Water Quality and Water Treatment

Raw water treatment process may vary slightly at different locations depending on the technology of the plant and the water it needs to process. However, the basic principles are largely the same. This section describes water treatment processes with reference to ELDOWAS Water Treatment Facilities for Eldoret and its environment. Raw water abstracted from the sources (Moiben, Two Rivers, Ellegirini and Kesses) is treated at the water treatment plants (Chebara, Sosiani, Naiberi, Kapsoya and Kesses) to remove sediments, bacteria, and other impurities through conventional water treatment processes (Screening, Coagulation, Flocculation, Sedimentation, Filtration, Disinfection, Storage and Distribution).

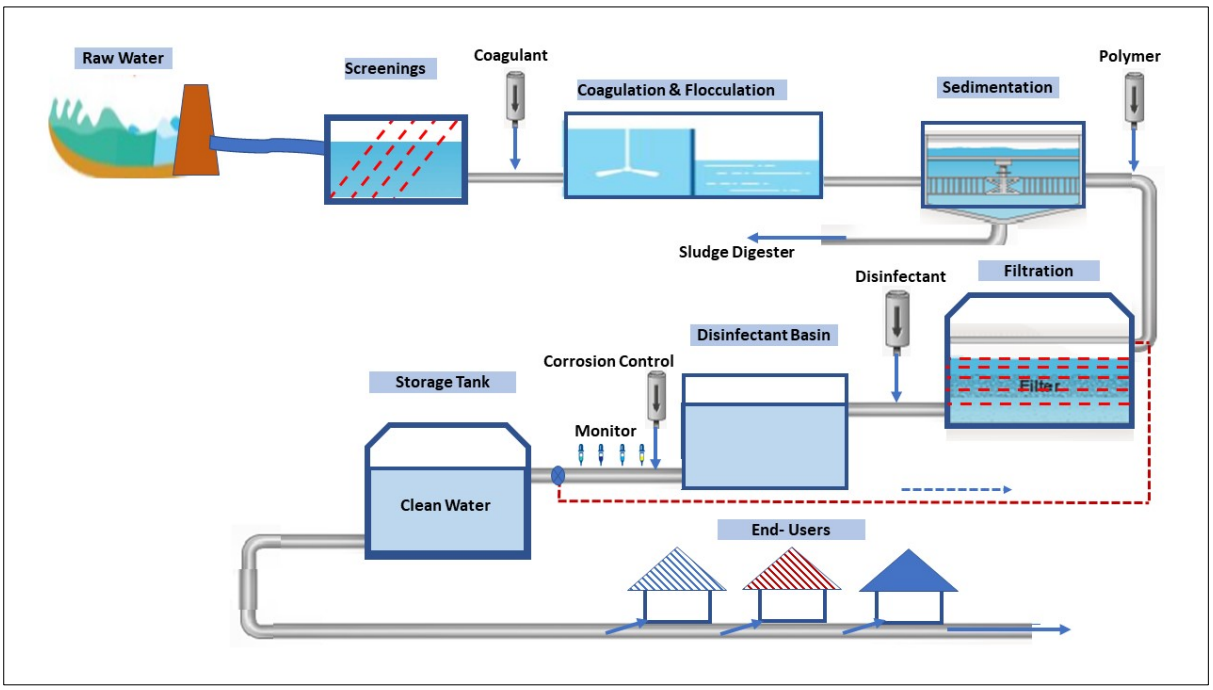


Figure 4-3 : Schematic Diagram of the Treatment Work Process.

Coagulation and flocculation are employed to separate suspended solids from water. ELDOWAS uses coagulants such as liquid Aluminium Sulphate (Alum) ($Al_2(SO_4)_3.18H_2O$) and/or polymer to

cause the tiny particles in the raw water to coagulate (stick together) and flocculate (form larger particles called “flocs") for easy settling during sedimentation and filtration.

During sedimentation the heavy floc particles settle to the bottom due to the lowered water velocity, and are removed as sludge to drying lagoons. The remaining clarified flocs are removed by filtration where water flows through a series of filter layers consisting of sand, gravel and crushed anthracite. The filters are routinely cleaned by backwashing. The filtered water is then disinfected before it enters the distribution system to ensure that any disease-causing bacteria, viruses, and parasites are destroyed.

ELDOWAS uses liquid chlorine as a disinfectant due to its effectiveness and residual concentrations can be maintained to guard against possible biological contamination in the water distribution system. After disinfection, pH correction is undertaken to adjust the pH and stabilise the naturally soft water in order to minimise corrosion in the distribution system, and within customers’ plumbing. After the final treatment, the water quality is monitored by a series of sensors and the clean water leaves the treatment works and is stored in contact tanks (Storage Tank) before being released through the ELDOWAS distribution network of pipes of various sizes to the customers in Eldoret Town and its environs.

ELDOWAS has a Quality Assurance and Control mechanism for each treatment plant to ensure that the quality of water supplied to the consumers meet the required standards (KEBS and WHO standards for compliance).

Currently, there are plans to develop a new water treatment plant at Kipkaren that will provide an additional 24,000 m^3/d (County Government of Uasin Gishu, 2018), taking source water from the existing Kipkaren Dam mentioned above. The project is co-funded by the National government and the African Development Bank.

The 2018 Impact Report (WASREB, 2018) scored ELDOWAS’ drinking water quality at 93%, slightly below the recommended 95% score for utility KPIs.

4.7.3 Water Supply Disruptions

ELDOWAS identified several causes of water supply disruptions which included normal maintenance operations, breakdowns on treatment works and pipelines, water quality issues (algal blooms in the reservoirs), and rationing as a result of dry spells and vandalism.

More recently, the utility faced a major challenge in water supply during the December – April 2019 dry spell, where it was reported that the Sosiani, Kapsoya and Naiberi treatment plants were facing a shut-down in operations due to extremely low flows from the Ellegirini River[5].

4.7.4 Competition for Supply

ELDOWAS currently enjoys a monopoly over its supply area, as there are no other competing water service providers in the town. Alternative water sources available within the supply area include shallow wells and boreholes; the former being more common in the informal and peri-urban areas.

[5] https://www.standardmedia.co.ke/article/2001322358/thousands-face-water-shortage-as-rivers-dry-up

Very few privately owned boreholes have been developed within the supply area for use by commercial users and institutions. However, groundwater is reported to be saline in the region and is therefore not a popular option for users, hence the low development.

4.8 Economic Impact of Water Deficits

Uasin Gishu County contributed 2.3% of the national GDP over the period 2013 – 2017 (KNBS, 2019). The major contributors to the county's economy are agriculture, wholesale and retail trade, and transport and storage[6]. Industries present in Eldoret include Rivatex East Africa, the Kenya Ordnance Factories Corporation among others.

Plans are underway to establish a Ksh. 200 Billion industrial and manufacturing business hub in Plateau region of Eldoret town, known as the AEZ Pearl River Industrial Park. It is anticipated that upon completion the park's annual production output will be Ksh. 309 trillion, about 5% of the country's GDP.

However, water quality and reliability issues have forced industries and large water consumers to invest in alternative water sources. Almasi Beverages, a bottling company based in Eldoret, was one of the stakeholders visited during the stakeholder consultation phase. During the discussion it emerged that the bottling plant was facing some challenges with the reliability and quality of water supplied for their operations, and had resorted to drilling a borehole for their water use.

Water availability and accessibility in the informal settlements around Eldoret Municipality is also an area of concern. The status of these settlements further hinders the expansion of municipal services including the water supply and sewer network to serve the population living in this area. Water deficits for a large population dependent on a specific water source, such as ELDOWAS in this case, may have negative impacts on livelihoods and the economy. Such issues as increased rates of water borne diseases, deterioration of sanitation, conflicts over the limited water supplies and water use conflicts at the resource level have been identified as impacts linked to water scarcity, which in turn affects productivity (Kimutai, *et al*, 2018).

[6] Based on KNBS (2019) Gross County Product by Economic Activities, 2017.

5. MOIBEN CATCHMENT

5.1 Baseline Conditions

The Moiben catchment is located in Elgeyo Maraket County, and is the source of the Moiben River, which through the Chebara Dam, supplies 50.4% of water for Eldoret town. The Moiben River flows from the Cherangany Hills Forest, specifically the Embobut forest block (L.N No. 25/1954). The river is fed by a network of seasonal and ephemeral tributaries.

5.1.1 Demographics

The catchment has a population of 11,749 (KNBS, 2009). Population density varies from 23.21 to 188.35 persons per km^2 in the rural and urban areas. The county intercensal population growth rate is 2.7% p.a.

5.1.2 Administrative Areas

Moiben catchment traverses both Elgeyo-Marakwet and West Pokot Counties. It covers Kapchemutwa, Kapyego, Sambirir, Kapsowar and Moiben/Kesurwo sub-counties of Elgeyo Marakwet as well as Lelan sub-county of West Pokot County. The catchment covers a total area of 123.93 km^2.

5.1.3 Rainfall and Climate

The region experiences two rainfall seasons; the long rains occurring between the months of March and July while the short rains fall between August and November (County Government of Elgeyo Marakwet, 2013). The catchment experiences the dry season from December to February. Annual rainfall varies from 800mm to 1400 mm (Kagombe. J, *et al,* 2015).

5.1.4 Vegetation, Land Use and Land Cover

The catchment was primarily under forest cover but has been cleared for settlement and farming over the past few decades, especially sections of the Cheboit and Sogotio Forests despite these being gazetted forests vide Legal Notice 102/1941. Google Earth imagery from 1984 to 2019 shows a slight decrease in tree forest cover along the eastern region of the forest complex. However, the overall forest cover is seen to be relatively intact. Forest cover is estimated to be 49.50% within the Moiben Dam catchment, with farmland representing 50.5% constituting both agricultural land and pasture. 47% of the catchment has high sloping land (12-40% slope) of which nearly 50% is farmland as shown in Plates 1 and 2. The distribution of slope and landcover within the catchment is given Table 5.1.

Table 5-1 : Slope and Landcover Distribution for Moiben Catchment

		Slope Class (%)				
Land Use	**Total Area (km^2)**	**Low (km^2)**	**Moderate (km^2)**	**High (km^2)**	**Very High (km^2)**	**% Area**
		<5	**5 to 12**	**12 to 40**	**>40**	
Built-up Areas	0.02	0.02	0.00			0.01
Farmlands	89.77	12.96	37.09	39.71	0.01	50.49
Forest	88.02	9.39	34.89	43.73	0.00	49.50
Water Bodies	-					-

Total	**177.82**	**22.37**	**71.99**	**83.45**	**0.01**	**100.00**
% Area		12.6%	40.5%	46.9%	0.0%	

Plate 1: Bare land from farming in Moiben catchment

Plate 2: Steep slopes without SLM interventions

Plate 3: Land Use and Land Cover in Moiben Catchment

5.1.5 Protected Areas and High Value Environments

The Cherangany Hills Forest ecosystem hosts important biodiversity. The forest complex is home to the rare Da Brazza's monkey and is also classified as an Important Bird Area (IBA) (KEFRI, 2017).

Specifically, the indigenous Embobut Forest hosts several forest animal species and regionally threatened species such as the Lammergeyer, African Crown Eagle, Red Chested Owlet, Sitatunga and the Thick Billed Honey Guide (KHRC, 2014).

The Embobut Forest is also home to the indigenous Sengwer, Ndorobo and Kimala people who have been grappling with issues of eviction and relocation from the forest since 2010 (KHRC, 2014).

5.1.6 Economic Activities

Agriculture was identified as the key economic activity taking place within the Moiben catchment. The CIDP (Elgeyo Marakwet, 2018) states that 80% of the population engage in farming and related activities. Food crops produced include maize, beans, wheat, bananas, green grams, groundnuts,

sorghum, millet and cowpeas. Cash crops include Irish potatoes, avocado, passion fruit, mangoes, tea and pyrethrum. It was reported that a significant change in land use was associated with the switch from sheep farming (which requires grassed paddocks) to potato farming which requires tilled land which exposes the soil to erosion.

5.1.7 Water Supply and Sanitation Services

Limited centralised water and sanitation services exist within the catchment which constitutes a predominantly rural setting. There are two main WSPs in Elgeyo Marakwet county, namely Iten Tambach Water and Sanitation Company which serves the Iten and Tambach areas, while Cherangany-Marakwet Water and Sanitation Company serves the residents of Kapsowar and Kapcherop Towns. Rural communities and residents upstream of the Moiben Dam rely on community water projects for water supply, such as Murkoin and Mosongo Water Projects. The County CIDP provides plans to construct new water projects and expand existing water projects in Moiben Ward. The majority of the residents downstream of the Moiben Dam and towards Eldoret town are served from the pipeline to Eldoret town.

There are no sewerage systems in the catchment; septic tanks are the common wastewater management option in town centres and institutions. Latrines are more commonly used in the rural areas. Latrine coverage is estimated to be 80 to 86% for wards within the catchment area (County Government of Elgeyo Marakwet, 2013). The WSP County Sanitation Profiles (2014) indicate that only 26.2% of the population in Elgeyo Marakwet County had access to improved sanitation while 32.9% used unimproved sanitation methods. Shared sanitation and open defecation stood at 22.2% and 18.7% respectively. The sanitation deficits is likely to have an impact on the water quality in the dam (and hence treatment costs) although the impact may be small due to the low population density. The pathogen load and nutrient load (primarily nitrogen and phosphorus compounds) being washed into the reservoir from such a small population will be significant enough to increase the amount of alum or chlorine needed for effective water treatment. On the other hand, leaching of waste from latrine pits can lead to contamination of the shallow aquifers with pathogens (and compounds such ammonia and/or nitrates).

5.1.8 Water Resource Infrastructure

The Moiben Dam is the largest reservoir in Elgeyo Marakwet County and was completed in 1998 at a cost of KSh 1.2 billion. The off-take pipeline has a capacity of 26,000 m^3/d and supplies the Chebara Treatment Works. Chebara Treatment works was constructed in 1995 with a capacity of 26,000 m^3/d but is currently supplying 18,000 m^3 of water per day. The dam has a total storage capacity of 6.2 MCM (27.5m height) made up of 1.2MCM dead storage and 5.0MCM live storage (MIBP 2018).

The treated water from Chebara Treatment Plant serves various centres upstream of Eldoret, resulting in the latter not receiving the entire planned allocation of water. Therefore, a second pipeline has been proposed that will convey water to Eldoret Town alone, with no upstream off-takes, and have a separate water treatment plant.

Plate 3 (left) and 4 (right): Moiben Dam, showing draw off tower and spillway, which was overflowing at the time of site visit

Plate 5: Chebara Treatment Works

5.2 Risks to Water Resource Sustainability

5.2.1 Land Use Change

Several risks to the watershed and water resources have been identified. Clearly, the impact of sedimentation due to soil erosion from change in land cover poses the greatest risk to water resource sustainability in the Moiben catchment. The results of the SWAT modelling (Appendix F) indicate that the Moiben catchment has the potential to generate approximately 0.65 MCM/yr [7]with erosion rates as high as 63.5 tons/ha/year in places which if left uncontrolled will significantly reduce the life time of the reservoir.

The MEMR 2012 Masterplan identifies a number of challenges facing the Cherangany ecosystem associated with land use change including encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing and cultivation. A local newspaper article reported that Embobut Forest has been reduced to 5,000 hectares from a cover of 21,000 hectares due to illegal settlement[8].

[7] Sediment density of 1.3 T/m^3

[8] https://www.standardmedia.co.ke/article/2001276756/alarm-over-declining-water-level-in-rivers-as-forest-shrinks

The Elgeyo Marakwet County CIDP estimates about 688 squatters are living within the forest reserves (County Government of Elgeyo Marakwet, 2013). These activities have resulted in reduced dry season flows from the Moiben River and its tributaries, with some streams being recorded as completely dry up during the dry seasons.

5.2.2 Communities Living in Embobut Forest

The presence of communities in forests poses the risk of land degradation due to land use change and increased pressure on natural resources. However, there has been debate about the impact of indigenous communities living in forests on sustainability of water resources, and natural resources in general.

According to the Amnesty International Report (2018), it was argued that the Sengwer people, having lived in the Embobut Forest for generations, had conserved it successfully, before the arrival of other communities created greater pressure on natural resources due to increased population. Conversely, findings from the 2018 Taskforce into Forest Resources Management and Logging Activities in Kenya argue that the indigenous communities themselves have changed their way of life, adopting different livelihood activities that are not compatible with forest conservation (MoEF, 2018).

Effort has been made to resettle the indigenous Sengwer people from the Embobut forest since 2009 (Amnesty International, 2018). However, the manner in which the eviction of the Sengwer community in 2017 was conducted led to the suspension of Ksh. 3.6 Billion in funding for conservation assistance from the European Union.

5.2.3 Climate Change

The Climate Risk Profile for Elgeyo Marakwet County (MoALF, 2017) identifies a decreasing trend in rainfall in the county, with the low-lying eastern part of the county having lower and less reliable rainfall and is more at risk of drought. However, the central and western parts of the county are reported to experience intense rainfall often leading to flash floods, severe erosion and landslides, which have been reported in Sambirir and Kapsowar wards within the sub-catchment (DRSRS, 2017).

Future Climate change projections also predict an increase in drought stress, with projected delays in the onset of rains. It is also anticipated that there will be an increase in the amount and intensity of rainfall for the county (MoALF, 2017).

ELDOWAS identified increasing temperature as a current risk to their water resources;

"Reservoirs are losing 12-15mm per day to evaporation. Temperatures are rising to 30°C against the norm of 23°C to 27°C"

5.2.4 Abstractions

The WRA identified other abstractors in the upper catchment including Kapsabet-Nandi Water Company, Iten-Tambach Water and Sanitation Company and Moi University. A number of community water projects exist – or are proposed - within the catchment, such as the Moiben-Kesurwo and Nerkwo Water Projects.

Competition for water resources may not pose a current threat but should not be underestimated as future demands increase.

5.2.5 Pollution

Pollution in Moiben catchment is currently seen as a minor risk, in view of the outcome of the stakeholder consultations and secondary data. The Moiben Dam itself is relatively well secured and fenced. However, the potential for pollution should not be overlooked, owing to increasing farming activities within the catchment.

Masese, *et al* (2009) identified a number of activities taking place along the Moiben River basin which negatively impacted on the river's invertebrate population and water quality. These included riparian farming, animal watering, bathing, laundry-washing and sand harvesting. While these activities are prevalent along the lower reaches of the river downstream of Moiben Dam, they may pose a future threat due to the increasing population in the catchment.

Sedimentation, though a major risk to water resources on its own, was identified as an issue with regard to water quality at Moiben Dam, as mentioned by the WRA Eldoret sub regional office;

"There is a lot of siltation in Moiben areas where irrigation is practiced".

5.3 Mitigation Options

5.3.1 Catchment Conservation

In view of the fact that 50% of the catchment is under forest cover, selection of relevant catchment conservation interventions for this catchment would more likely focus on the remaining 50% area under farmland, and more specifically on those areas that are moderate to steeply sloped (77 km^2).

For farmland with slopes between 12% to 40% (40 km^2), the most appropriate SLM interventions investigated for this study include filter strip farming, contour farming and terracing. Further details on these interventions are discussed in Chapter 9.

Catchment conservation practices documented to be on-going within the Embobut Forest include reforestation, afforestation, farm forestry, monitoring and tree nursery establishment (Rotich, 2019).

The forested area within the Moiben Dam catchment (88 km^2) should be conserved through controlled grazing and reforestation where appropriate. Focus should be on the areas with steeper slopes. The efforts in the forest should be undertaken through KFS and the local community.

The success of catchment conservation interventions implemented especially in the forest areas is dependent on how best the issue of relocation and management of indigenous communities is handled.

5.3.2 Regulating Activities in Groundwater Recharge Areas

From a practical standpoint, recharge areas should be maintained in as near a pristine, natural state as possible. 'Recharge areas' are ill-defined at present, at least in terms of details. The pragmatic approach would call for the declaration of a 'groundwater conservation area' (GCA) covering all the

Forest Reserves north east, east and south east of Eldoret (from Tambach in the north east to Kipkabus in the south east). GCAs are provided for in the Water Act, 2016 (Section 23, Conservation of ground water). The surface water equivalent ('protected areas') is provided for in S. 22 of the Act (Protection of catchment areas).

Establishing protected areas or GCAs covering the forested zones is not a trivial exercise; the WRA has been instituting GCAs in the areas recharging the Kikuyu Springs (Athi Basin) and Lamu Shela Dunes (Tana Basin) aquifers since the early 2010s. It requires exhaustive stakeholder consultation, public education and technical studies, as well as political goodwill.

Prohibited activities would include deforestation, and any industrial activities that result in toxic or intransigent wastes (such as volatile organic compounds, or arsenic, chromium and similar salts).

5.3.3 Water Allocation and Abstraction Control

In order to allocate and manage water resources, it is necessary that water resource availability is understood both spatially and temporally. This report highlights the fact that there are significant gaps in our knowledge of the necessary details of the hydrological cycle in the study area, particularly with respect to water use and groundwater resources.

The WRA has made considerable progress in bringing order to what was a chaotic and essentially unworkable water allocation and water permit system prior to its genesis as the Water Resources Management Authority after the 2002 Water Act entered into force. However, much more needs to be done; one of the ways in which an EIWF could support water resources sustainability for Eldoret and Iten is supporting the WRA's efforts to capture actual water use by publicising the need for groundwater abstraction surveys, and even by directly supporting them.

Once a clear understanding of actual abstraction is available, then Water Permits can be vetted and amended or enforced, as necessary. At this stage, a formal water allocation plan can be developed as per the updated WRA Allocation Guidelines (Rural Focus Ltd, 2018).

5.3.4 Biodiversity Enhancement

The Sustainable Development Goal 15 seeks to *"protect, restore and promote sustainable use of terrestrial ecosystems, combat desertification, and halt and reverse land degradation and halt biodiversity loss*". The County Government of Elgeyo Marakwet has proposed a number of activities aligned with SDG 15 in its CIDP, including:

- Supporting the development of conservancies around protected areas as alternative land use practice;
- Promotion of agroforestry;
- Development of greening as a means of increasing tree cover and other climate smart production strategies;
- Protection and rehabilitation of wetlands;
- Tree planting;
- Rehabilitation of degraded sites.

These strategies are not catchment or area specific but are designed to contribute to improved agricultural productivity in the County while concurrently responding to the SDGs.

6. SOSIANI CATCHMENT

6.1 Baseline Conditions

The Sosiani Catchment spans both Elgeyo Maraket and Uasin Gishu Counties, and is the source of the Sosiani River which feeds the Ellegirini and Two Rivers Dams. The Ellegirini and Endorot Rivers flow through the catchment and drain into the Two Rivers Dam, from which they join to form the Sosiani River.

6.1.1 Demographics

The catchment has a population of 45,348 (KNBS, 2009). Population density varies from 47.76 (Kiptulos sub-location) to 767.46 (Kapsoya sub-location) persons per km^2 in the rural and urban areas. The county intercensal population growth rate is 2.7% p.a. The catchment has significantly more settlement and human activity taking place than the Moiben catchment.

6.1.2 Administrative Areas

Sosiani catchment lies within Chepkorio, Kabiemit, Kaptarakwa and Soy South sub-counties in Elgeyo Marakwet County as well as Kaptagat and Cheptiret/Kipchamo sub-counties in Uasin Gishu County. The catchment covers a total area of 268 km^2.

6.1.3 Rainfall and Climate

The region experiences two rainfall seasons; the long rains occurring between the months of March and July while the short rains fall between August and November. Rainfall in the region is moderate ranging between 900 mm and 1400 mm (Omukuba, W, 1998). The catchment experiences the dry season from December to February.

6.1.4 Vegetation, Land Use and Land Cover

Vegetation in the Sosiani catchment ranges from forests in the highland region of Kaptagat to shrubland and grassland in the lower reaches of the catchment. Farming is the dominant land use activity in the catchment, with farmlands occupying 72%. Forests cover 27.82% of land while built up areas account for 0.05%. There are a number of swamps in the catchment, which have been discussed further in Section 6.1.5. The catchment exhibits much gentler slopes than in the Moiben region. 94% of the catchment has slopes at 12% and below. A summary of the catchment slope profile is provided in Table 6.1.

Table 6-1 : Slope and Land Use Distribution in Sosiani Catchment

		Slope Class				
Land Use	**Total Area (km^2)**	**Low (km^2)**	**Moderate (km^2)**	**High (km^2)**	**Very High (km^2)**	**% Area**
Slope (Percent)		**<5**	**5to12**	**12to40**	**>40**	
Built-up Areas	0.14	0.12	0.02			0.05
Farmlands	193.50	135.96	49.70	7.84		72.13
Forest	74.63	35.14	32.39	7.10		27.82
Water Bodies	-					-
Total	**268.27**	**171.22**	**82.11**	**14.95**	**-**	**100.00**
% Area		63.8%	30.6%	5.6%	0.0%	


Plate 6 and 7: Land Use and Land Cover in Sosiani Catchment.

Plate 6 above shows the upper zone of the Sosiani catchment and the start of the Ellegirini River, where tea buffer zones have been established. Plate 7 shows the middle zone of the catchment which is the Ellegirini Dam site.

6.1.5 Protected Areas and High Value Environments

Two swamps exist on the Sosiani River, namely Chepkongony and Lesiru Swamps. These are permanent riverine swamps that play important ecological and economic roles in the catchment. The main human activities within the swamp include vegetable farming and harvesting of wetland plants for fodder, firewood and other products such as thatching material and traditional herbs. The swamps are also a source of domestic water supply and cattle watering and grazing points, especially during the dry season (Mulei, *et al*, 2014). Limited information is available to confirm if these wetlands are protected areas.

6.1.6 Economic Activities

Agriculture is the mainstay of the catchment, and county in general. The catchment lies within the lower midland agro-ecological zone (LH3), where maize and wheat farming are prominent (MoA, 1987).

Eldoret town, the capital of Uasin Gishu County, also falls within the Sosiani catchment. Eldoret, which started as an agricultural centre, has rapidly grown with the establishment of infrastructure, industries and institutions (Badoux, 2018). The town has vibrant flour milling, fruit processing and textile manufacturing plants. Other economic activities include small scale businesses, *boda boda* business, casual labour and domestic work (NCPD, 2017).

6.1.7 Water Supply and Sanitation Services

Water supply and sanitation services are the mandate of ELDOWAS. It is reported that the WSP sewerage service within Eldoret town is currently at 60% coverage. There are plans underway to expand and rehabilitate the sewer network. Residents living outside of the ELDOWAS supply area depend on community water projects such as Lessos Water Supply Project and Ngeria Kesses Water Project for the water supply, as well as septic tanks and pit latrines for their waste management.

6.1.8 Water Resource Infrastructure

Ellegirini and Two Rivers Dams are the major reservoirs in the catchment. Ellegirini also doubles up as a reserve reservoir for recharging the downstream Two Rivers dam during low flows, and helps manage silt loading in to the latter dam. The Two Rivers Dam (height 27.8 m, max storage 12.7MCM) was constructed in 1960, along with a 6,100 m^3/d-capacity gravity pipeline. The Ellegirini Dam was constructed upstream of the Two Rivers Dam, and was completed in 1987 with an outlet pipeline capacity of capacity of 9,000 m^3/d. The Ellegirini Dam has a height of 19.5 m and a maximum storage capacity of 2MCM (MIBP 2018).

There also exists the old Ellegirini (Pombo) intake on the Ellegirini River at the edge of the Kaptagat Forest. It was developed in 1928 and had an initial installed capacity of 2,300 m^3/d. The intake has since been decommissioned and is no longer used by ELDOWAS. It has been handed over to the local community for their water supply.

Plate 8: Old Ellegirini (Pombo) Intake

Plate 9: Springs in the Kaptagat Forest, believed to be the source of the Ellegirini River.

Plate 10: Ellegirini Dam

Plate 11: Two Rivers Dam

Three treatment works exist within the ELDOWAS water supply system. The Kapsoya Treatment Works, constructed in 1928, treated the water from the Ellegirini intake prior to distribution. The treatment plant was upgraded in 1981 and treats water from the Ellegirini Dam. It has a design capacity of 7000 m^3/d. The Kapsoya site also handles 16,000 m^3/d of storage from the Chebara treatment plant on transit to Eldoret town. In addition, the Naiberi/Cherunya Treatment works has a

design capacity of 2,000 m^3/d and also treats water from the Ellegirini. Dam. The Two Rivers Dam supplies the Sosiani Treatment Plant with a 14,950 m^3/d design capacity.

6.2 Risks to Water Resource Sustainability

6.2.1 Land Use Change

The Sosiani catchment has a higher population density as land has been divided for settlement and farming activities. This exposes the catchment to a higher risk of degradation, and loss of ecosystem functions such as water retention and erosion control due to the loss of soil cover. Barasa and Perera (2018) in their study of the Sosiani catchment assessed the impacts of land use changes on flood occurrences. They found that there was a 59.9% increase in farmland and a corresponding 59.4% reduction in grassland between 1973 and 2013. Urban areas were also found to increase from 2.52 km^2 to 67.93 km^2 during the same period. Consequently, this was found to have a marked increase in river discharge, which will generate negative impacts including flooding in the catchment's downstream areas.

Land use change has impacted negatively on wetlands and wetland resources. Land reclamation for agriculture and urbanization has been observed in areas surrounding the wetlands, which may result in depletion of the resource and loss of biodiversity.

6.2.2 Climate Change

The MoALF Climate Risk Profile for Uasin Gishu County (2017) identifies variations in rainfall patterns, with increased rainfall intensity during the two rainy seasons, accompanied by longer dry spells in between. These variations can have a great impact on infrastructure, soils, agriculture and livelihoods.

6.2.3 Abstractions

Limited abstraction information is available for the Sosiani catchment. Aerial imagery shows that major abstractors, mostly commercial flower farms, are downstream of the two dams and would therefore not pose a threat to flows into the dams.

A study of the Sosiani sub-catchment by Masika (2018) attempted to simulate the spatial and temporal availability of water resources in the catchment. The study identified 124 abstractors, and the results found that current water withdrawal is less than 10% of available water. The study also found that future demand projections can be adequately met by the available resources, and that no future deficits are expected. However, reserve flows will need to be enforced in the catchment.

Nonetheless, an abstraction survey would provide a clearer understanding of the levels of abstraction upstream of the Two Rivers and Ellegirini dams.

6.2.4 Pollution

The two dams are exposed to non-point pollution from agrochemicals used on farms within the catchment. This is exacerbated by the lack of adequate land cover, exposing soils to erosion, which is ultimately washed into river channels. Ontumbi, et al (2015) established that the Sosiani River was stressed by nutrients originating from agricultural activities. In his assessment, he found that levels of nitrates, phosphorous and dissolved solids tend to increase during the rainy seasons, with samples

recording maximum values of 1.160 mg/l (NO_3), 1.24 mg/l (PO_4) and 142 NTU (TDS) compared with 0.18 mg/l, 0.76 mg/l and 26 NTU respectively in the dry season.

Lack of adequate sanitation coverage may also contribute to pollution in the catchment. Masakha, et al (2017) in their study of the water quality of Sosiani River, found that samples of water taken from the Two Rivers Dam contained total coliforms at 6.9 CFU/100ml and faecal coliforms at 6.5 CFU/100ml, above NEMA standards of nil CFU/100ml. These results indicate a low/normal level for a raw water source at present but this may change going forward due to additional settlement with inadequate sanitation.

Groundwater is also at risk of contamination within the catchment. A study conducted in 2003 by Drangert and Cronin of groundwater in Eldoret found that leaking dug latrines and sewers contribute to the contamination of groundwater in Eldoret.

6.3 Mitigation Options

6.3.1 Catchment Conservation

The Uasin Gishu CIDP identifies protection and conservation of water towers as one of the County's strategies to improve access to clean and adequate water combined with development of quality sanitation services (CIDP 2018-2022).

Options for catchment conservation will be designed in consideration of the dominant land use activity in the catchment and slope characteristics (Section 6.1.4). Results of the SWAT analysis have found that adopting farm appropriate strategies such as terracing and strip farming can result in a significant reduction in sediment yield within the catchment.

6.3.2 Regulating Activities in Groundwater Recharge Areas

Much of the Sosiani catchment is not considered to be a groundwater recharge area. However it is appreciated that localised lateral infiltration contributes to much of the shallow aquifer recharge in the area. Consequently, ground water quality will be affected by the nature of activities taking place within the catchment. Settlement and urbanisation are seen to influence groundwater availability and quality in the catchment.

Land use planning in the area should also include waste management and disposal to control the issue of groundwater contamination.

6.3.3 Water Allocation and Abstraction Control

As detailed in Section 5.3.3 there is need for additional information on water use (surface and groundwater abstraction) to provide a better understanding of the water allocation and abstraction situation in the Sosiani catchment, and the study area as a whole.

6.3.4 Biodiversity Enhancement

Despite its environmental, social and economic importance of wetlands in the catchment, limited information is available on activities taking place in the catchment geared towards conservation of wetlands. The Kibirong Integrated Wetland Management Plan (2014-2018) identified a number of interventions that may be relevant to the Chepkongony and Lesiru swamps. The Plan adopts a

participatory approach in the identification of wetland goods and services, stakeholder identification and prioritisation, risks facing the wetland and finally potential interventions, which may be implemented by the benefitting communities around the wetland.

7. KIPKAREN CATCHMENT

7.1 Baseline Conditions

7.1.1 Demographics

The catchment has a population of 105,484 (KNBS, 2009). Population density varies from 50.22 (Ndanai sub-location) to 634.66 (Burnt Forest sub-location) persons per km^2 in the rural and urban areas. The county intercensal population growth rate is 3.7% p.a. The catchment has significantly more settlement and human activity taking place than the Moiben catchment.

7.1.2 Administrative Areas

Kipkaren catchment traverses both Elgeyo Marakwet and Uasin Gishu County. It covers Chepkorio, Kabiemit, Metkei and Soy South sub-counties in Elgeyo Marakwet County, as well as Ainabkoi/Olare, Kaptagat, Megun, Ngeria, Simat/Kapsaret, Cheptiret/Kipchamo, Tarakwa and Tulwet/Chuiyat sub-counties in Uasin Gishu County. The catchment covers a total area of 590.93 km^2.

7.1.3 Rainfall and Climate

The region experiences two rainfall seasons, the long rains occurring between the months of March and July while the short rains fall between August and November. The catchment has a mean annual rainfall of 1500mm and mean annual temperature ranging from 18°C to 24°C (Ochieng', 2014). The catchment experiences the dry season from December to February.

7.1.4 Vegetation, Land Use and Land Cover

Vegetation in the Kipkaren catchment ranges from forests in the highland region of Kaptagat to shrubland and grassland in the lower reaches of the catchment. Farming is the dominant land use activity in the catchment, with farmlands occupying 88.5%. Forests cover 11.45% of the catchment area while built up areas account for 0.05% . The catchment exhibits mostly gentle slopes; 96.6% of the catchment has slopes at 12% and below. A summary of the catchment land use and slope is provided in Table 7.1.

Table 7-1 : Slope and Land Use Distribution in Kipkaren Catchment

		Slope Class				
Land Use	**Total Area (km2)**	**Low**	**Moderate**	**High**	**Very High**	**% Area**
Slope (Percent)		**<5**	**5to12**	**12to40**	**>40**	
Built-up Areas	0.28	0.26	0.01			0.05
Farmlands	482.65	375.43	99.03	8.20		88.50
Forest	62.46	26.04	25.79	10.63		11.45
Water Bodies	-					-
Total	545.38	**401.73**	**124.83**	**18.82**	**-**	**100.00**
% Area		73.7%	22.9%	3.5%	0.0%	

7.1.5 Protected Areas and High Value Environments

Limited information is available on protected areas within the catchment. Google Earth imagery indicates the presence of wetlands to the East of the Eldoret International Airport. It is also seen that the land surrounding the wetlands has been settled, with portions of land averaging two to three acres. The Singilai Swamp (a Ramsar Site) is located in the Kesses catchment, about 26 km south east of the Kipkaren Dam.

7.1.6 Economic Activities

The economic activity in Kipkaren catchment is predominantly smallholder mixed farming with maize as the major crop and finger millet and beans as minor crops, as well as some livestock rearing (Imo, *et al*, 2004). The catchment also hosts the Eldoret International Airport. Micro and small businesses also exist within the catchment.

7.1.7 Water Supply and Sanitation Services

Kipkaren Dam currently supplies water to the Eldoret International Airport. The dam will be included in the ELDOWAS supply system with an anticipated supply of 24,000 m^3/day, and the potential to increase yield from the dam to 25,100 m^3/d by raising the dam wall (MIBP, 2018).

Other WSPs in the catchment area include Lumakanda – Kipkaren Water Supply, with a capacity of 1,200 m^3/day and whose source is the Kipkaren River. It supplies Lumakanda and Kipkaren trading centres. The scheme is operated by the County Government of Uasin Gishu. Lelmokwo Water Supply Project in Nandi County also abstracts water from this source. The catchment does not have a centralised sewage system. Residents adopt localised wastewater management option such as pit latrines and septic tanks.

7.1.8 Water Resource Infrastructure

Kipkaren Dam is the major reservoir in the catchment and currently supplies water to the Eldoret International Airport as well as Lelmokwo Water Supply Project in Nandi County. It has an earth embankment 30.8 m high, 25MCM storage and a concrete tower offtake. Limited information is available on the history of the Kipkaren Dam, but it is believed to have been a private reservoir originally constructed in the 1920s to supply irrigation water for the then colonial farm lands.

Plate 12 and 13: Kipkaren Dam

The National Government in conjunction with the African Development Bank (AfDB) has funded the expansion of the Kipkaren Dam water supply project which is expected to pump an additional 24,000 m^3 of water daily to boost supply to Kapseret, Langas and Kipkenyo Wards. The project will include construction of a new treatment works with a design capacity of 24,375 m^3/d, a 595 m steel gravity main line from the dam to the new treatment works and a 13.75 km rising main from the treatment works to a 10,000 m^3 GMT at the high point near the Mariot Hotel area.

7.2 Risks to Water Resource Sustainability

7.2.1 Land Use Change

The Kipkaren catchment has a lower population density than that of the Sosiani catchment, though in both cases, land has been divided for settlement and farming activities. As a result, much of the catchment is exposed to a higher risk of degradation, and loss of ecosystem functions such as water retention and erosion control due to the loss of soil cover. In his hydrological study of the Kipkaren Catchment, Ochieng' (2014) stated that land degradation due to reduced forest cover and increased agricultural activity in the upper parts of the catchment contributed to frequent flooding in the lower reaches.

7.2.2 Climate Change

Specific literature that discusses climate change in the Kipkaren catchment is not available. This pre-feasibility assessment attempted to conduct climate change scenario analysis for the three main catchments, and results indicate that climate change will have an impact on the availability of water resources, with an anticipated decrease in dry season flows and an increase in rainy season flows. The Uasin Gishu Climate Risk Profile also anticipates that regions to the south and east of the county (which includes the Kipkaren catchment) are more at risk of drought and extended dry periods. There also exist future risks of flooding due to increasing rainfall intensity.

7.2.3 Abstractions

The Eldoret Water Master Plan identifies other water users and abstractors within the study area, including county and community managed water supply projects. The total abstraction from permitted abstractors upstream of the Kipkaren Dam is 960 m^3/d (4% of dam yield). Though this may be a small value compared to the dam yield, this does not include unpermitted abstractors. Future demands will also increase upstream abstractions and it is important that this be monitored.

7.2.4 Pollution

Limited information on pollution issues in the Kipkaren Dam is available. However, the predominant land use activity (i.e. agriculture) may be identified as a potential non-point source of pollution, which may affect the quality of water that flows into the Kipkaren Dam. In addition, the lack of centralised waste management facilities and the use of pit latrines can contribute to contamination of the shallow aquifer.

7.3 Mitigation Options

7.3.1 Catchment Conservation

The Kipkaren catchment characteristics are comparable to the Sosiani Catchment, owing to the similarities in land use and terrain. At least 90% of the catchment has slopes at 12% and below, and therefore such interventions as terracing and strip farming are applicable here.

The Lake Victoria Environmental Management Programme has also been promoting tree planting in the greater lake basin, of which the Kipkaren catchment is a part, to improve vegetation cover, provide sustainable wood supply and reduce pressure on wood products in the catchment areas (Imo, 2004).

7.3.2 Regulating Activities in Groundwater Recharge Areas

As is the case in the Sosiani Catchment, the Kipkaren catchment is also found to have a low to medium groundwater potential. It is also not considered a significant groundwater recharge area. However, the use of shallow wells speaks to the importance of shallow groundwater reserves as an important water source in the catchment. It is therefore necessary to regulate activities taking place within the catchment that may affect groundwater quality, including agriculture, urbanisation and settlement.

7.3.3 Water Allocation and Abstraction Control

As detailed in Section 5.3.3 there is need for additional information on water use (surface and groundwater abstraction) so as to provide a better understanding of the water allocation and abstraction situation in the Kipkaren catchment, and the study area as a whole.

8. GROUNDWATER

8.1 Introduction

This section discusses current groundwater conditions with respect to development, risks and potential mitigation measures. Further details on the hydrogeological characteristics of groundwater in Eldoret and its immediate environs are discussed in Appendix E.

8.1.1 Groundwater Development

The significance of groundwater as a water supply source in Eldoret is uncertain; the 2009 Census finding that 30% of Eldoret residents rely on groundwater to meet their water needs suggests that it is important at the local level, even if it is not used as a public water supply source. The WRA confirmed that there are more than 100 BHs, concentrated in the Eldoret area, typically yielding 2 to 4 m^3/hr; this is broadly consistent with our findings (Appendix E). However, the number of functional BHs, the volumes of water pumped per day and the number of people served are not known. ELDOWAS stated that private BHs are used as alternative sources of water for larger commercial users and institutions, but that "salinity issues influenced by rock quality" are prevalent.

Shallow groundwater use may be limited to the Langas, Huruma and Munyaka areas, where it is exploited by shallow wells, though the shallow aquifer is likely to be more widely distributed than this. As described above, these waters are polluted and not suitable for use as drinking water; they are separate from and probably not in hydraulic continuity with the Miocene volcanic groundwaters described in detail in Appendix E. ELDOWAS stated that shallow wells in informal settlements and peri-urban areas producing acceptable quality water are used as alternative water supplies. No information on the number of wells, volumes abstracted or people served are available, although a 2012 study stated that there were 100 shallow wells in Langas alone (Muruka *et al*, 2012).

Almasi Beverages Ltd, producers of Coca Cola drinks, are planning to construct a BH; they expect to have to treat the water to meet their stringent water quality requirements using reverse osmosis and ultrafiltration; they need approximately 2,000 m^3 of water per week. Questionnaire surveys carried out with stakeholders in Eldoret confirmed that while groundwater was considered an alternative water source, it does not appear to be in very widespread use by commerce or industry.

Iten water demand has formerly been met or partly met from one or more BHs (the production BH at Chebogokwa is currently 'not producing'). Groundwater resources (unreliable shallow wells and unprotected springs) are used as emergency water supply by individuals. An academic study of Iten water use found that 11.6% of water users relied on shallow well or spring water to meet their water demand (Ngetich *et al*, 2018).

8.2 Risks to Water Resource Sustainability

Groundwater performs three key roles in the human and natural environment: it provides a source of water for various uses; it provides baseflow into rivers, particularly significant in a strongly seasonal climate such as Eldoret's; and it maintains the quality of surface waters (Lerner *et al*, 2006). Changes in natural conditions influence groundwater availability and sustainability; the influence of land use, climate change, abstraction and pollution on groundwater are examined here in the context of the Eldoret area.

8.2.1 Land Use Change

Land use is a key influence on groundwater recharge (GWP, 2014). Groundwater is connected to the landscape and land uses in it. Land use changes affect recharge and groundwater abstraction. The effects of land use change on water resources in the Njoro catchment have been studied (Baker *et al*, 2013); the Njoro study found that wet season surface water flows increased and dry season flows had fallen significantly as a consequence of deforestation. Groundwater recharge fell because of the flashier surface water response to rainfall and the reduced period across which recharge could be maintained.

In this context, Eldoret is probably similar and similar types of land use change can also be assumed. In the Eldoret context, groundwater recharge and flow can only be sustained if recharge to the Miocene volcanic aquifer system is assured. The reduction in forest coverage of the formerly fully-forested highland areas east of Eldoret is therefore a matter of concern, as forest is cut down and converted to farmland. Conversion of forest to minimally destructive land uses – such as permanent pasture – will have the net effect of increasing groundwater recharge, provided that soil is preserved and not lost to erosion. Eroded catchments, on the contrary, can reduce recharge through the loss of soils and enhanced rates of surface water runoff.

Forest conservation maintains the *status quo* and is the most desirable land use in the recharge zone for Eldoret groundwater, for reasons other than maintaining groundwater recharge; maintaining surface water flows, ensuring water quality stays good and retaining natural ecosystem values.

However, conversion of natural deciduous woodland to monoculture non-deciduous woodland will reduce groundwater recharge, other things being equal.

In the absence of a more detailed study, we can only very roughly estimate the average daily aquifer through-flow for the deep aquifer using Darcy's Law (Darcy, 1856). Assuming a groundwater gradient of 0.00168 and an average transmissivity of 6.0 m^2/d, mean daily flux is approximately 20,000 m^3/d (7.3 MCM/yr) through the volume of aquifer that is 20 km wide (i.e. north to south), with flow from SSE to NNW. Despite the rough nature of this estimate, it does somewhat underscore the limited capacity of the Miocene volcanics aquifer system.

8.2.2 Climate Change

Climate in Kenya is expected to change significantly in the remainder of this century; in practical terms, wet seasons will become more intense and annual rainfall totals will rise, while dry seasons will be longer and drought periods deeper. Eldoret has a mean annual rainfall of 1053.3 mm (range 619.2 to 1615.3 mm/yr: Ayugi *et al*, 2016, for the period 1971 - 2013); this can be expected to rise over the remainder of the century. Groundwater recharge is largely a function of total rainfall, but more particularly of rainfall intensity (Taylor *et al*, 2012).

What the future balance will be between longer dry seasons (and more pronounced catchment desiccation) and more intense wet seasons (with recharge occurring once soil moisture deficits are satisfied), is unclear. A study carried out for the Kenya Water Security and Climate Resilience Project suggests that changes in recharge by the year 2050 will be small but negative (<2%; Aurecon

AEMI Ltd, 2018). This percentage change is small enough to be within the margin of error of the recharge estimation method.

8.2.3 Abstractions

As we have made clear above, we have not been able to obtain any data that indicate the magnitude or distribution of current groundwater abstraction. If we assume that the 2009 Census is correct and that 30% of water demand for Eldoret is satisfied by groundwater, this infers that approximately 18,000 m^3 is pumped daily (from both shallow and deep aquifers).

A very crude abstraction estimation method can give an indication of what could be pumped. The WRA operates a "rule of thumb" that calculates the maximum water permit allocation for a groundwater from the pumping test data (or, in our case, the figure given in early BCRs). This assumes that not more than 60% of the final test yield may be pumped for not more than 10 hours per day. Our database lists 101 successfully-pumped BHs in the Miocene volcanics, and gives an aggregate discharge of 352 m^3/hr. Applying the rule of thumb gives an estimate of 2,110 m^3/d, which falls far short of the 2009 estimate; However, we also know that the actual number of BHs drilled in the Miocene volcanics aquifer system is far greater than this.

This disparity begs the question; assuming 18,000 m^3/d of groundwater is indeed being pumped, how many BHs would this require? Calculation suggests that >850 BHs would be needed, and while we acknowledge that the database collected for this study falls short of the true number of BHs constructed, we rule out the possibility that over 800 BHs have been constructed in the study area.

8.2.4 Pollution

The susceptibility of pollution to the deep, confined Miocene aquifer is limited, unless polluting activities are allowed in the recharge zone (the Forest Reserves and highlands north east, east and south east of Eldoret). However, these groundwaters do occasionally contain natural contaminants (fluoride, iron and possibly manganese).

We remarked above that the shallow aquifer system in the immediate Eldoret area is already polluted in the three informal settlements from which water samples have been tested. It is entirely possible that elsewhere, where the shallow aquifer occurs and where there is high-density land use, that these waters would be similarly contaminated.

It is unlikely that there is any hydraulic continuity between the shallow and deep aquifer systems; However, if a poorly-constructed BH has been drilled in or near a polluted part of the shallow aquifer, then vertical seepage of polluted water into the deeper aquifer system could occur.

8.3 Mitigation Options

Future groundwater sustainability requires a number of mitigation measures, all of which are required for maintaining surface water sustainability. Key measures are discussed here. On a point of clarity, however, all of these measures need to be adopted, not just some of them.

8.3.1 Catchment Conservation

Land degradation in the upper catchment in particular, but also in the entire riparian zone, must be reversed as a matter of urgency. The necessary measures have been discussed exhaustively in

previous sections discussing surface water. Groundwater sustainability will be enhanced by all of these recommended activities.

8.3.2 Regulating Activities in Groundwater Recharge Areas

From a practical standpoint, recharge areas should be maintained in as near a pristine, natural state as possible. 'Recharge areas' are ill-defined at present, at least in terms of details. The pragmatic approach would call for the declaration of a 'groundwater conservation area' (GCA) covering all the Forest Reserves north east, east and south east of Eldoret (from Tambach in the north east to Kipkabus in the south east). GCAs are provided for in the Water Act, 2016 (Section 23, Conservation of ground water). The surface water equivalent ('protected areas') is provided for in S. 22 of the Act (Protection of catchment areas).

Establishing protected areas or GCAs covering the forested zones is not a trivial exercise; the WRA has been instituting GCAs in the areas recharging the Kikuyu Springs (Athi Basin) and Lamu Shela Dunes (Tana Basin) aquifers since the early 2010s. It requires exhaustive stakeholder consultation, public education and technical studies, as well as political goodwill.

Prohibited activities would include deforestation, and any industrial activities that result in toxic or intransigent wastes (such as volatile organic compounds, or arsenic, chromium and similar salts).

8.3.3 Water Allocation and Abstraction Control

In order to allocate and manage water resources, it is necessary that water resources availability is understood both spatially and temporally. This report highlights the fact that there are significant gaps in our knowledge of the necessary details of the hydrological cycle in the Eldoret area, particularly with respect to water use and groundwater resources. One way to improve our understanding of groundwater resources is discussed further in S.8.3.4 below; here we discuss the importance of knowing what actual groundwater abstraction is.

The WRA has made considerable progress in bringing order to what was a chaotic and essentially unworkable water allocation and water permit system prior to its genesis as the Water Resources Management Authority after the 2002 Water Act entered into force. However, much more needs to be done; one of the ways in which an EIWF could support water resources sustainability for Eldoret and Iten is supporting the WRA's efforts to capture actual water use by publicising the need for groundwater abstraction surveys, and even by directly supporting them.

Once a clear understanding of actual abstraction is available, then water permits can be vetted and amended or enforced, as necessary. At this stage, a formal water allocation plan can be developed following WRA Guidelines (Rural Focus Ltd, 2018).

8.3.4 Modelling

Planning and managing water resources use requires a reasonably robust understanding of the hydrological cycle. The surface water resources are reasonably well understood, as described elsewhere in this report.

Ideally, a groundwater model of the aquifer system should be developed; some of the data needed to develop a numerical simulation may already exist, but we did not see any. However, aquifer

geometry is reasonably clearly understood, and groundwater abstraction surveys would clarify actual abstractions. Climate and soils data, and land use changes over time are similarly reasonably well understood. What remains uncertain is whether there are any groundwater level time series data sets for the Miocene aquifer system available (covering a period of at least four years). Time series are needed for the calibration of groundwater models.

If there are none, then the EIWF should advocate for the establishment of at least three dedicated monitoring BHs; one in the upper catchment (such as the Kaptagat area); one in the middle part of the catchment (about the Two Rivers Dam) and a third in the Eldoret area itself. These should be located as far from existing abstraction BHs as possible and equipped with digital loggers that collect water level data once a day.

9. ECONOMIC ANALYSIS

9.1 The Nature of Threats

Land use change and its associated impacts are identified as the major threat to water resources in the study area. Deforestation, poor farming practices and river bank encroachment lead to increased soil erosion which reduces soil fertility and crop yields, increases sedimentation of reservoirs (loss of storage capacity) and reduces water quality (high turbidity) and hence increased treatment costs.

Deforestation impacts groundwater recharge due to the increase in surface runoff from the lack of ground cover that encourages percolation and infiltration. The key threats are elaborated below.

9.1.1 Uncontrolled runoff, Erosion and Dam Sedimentation

Uncontrolled runoff from steeply sloped land leads to erosion of farmland and riparian areas. In addition uncontrolled runoff from rural roads can concentrate runoff which can lead to gulley erosion. The eroded soil eventually reaches the water courses and the dams. The sediment is typically deposited at the upstream end of the reservoir area, reducing the capacity of the dam. The consequence is that the reliable yield of the dam is reduced once the dead storage in the dam is filled with sediment.

In order to properly understand the impact of sedimentation on the supply from a dam one must have the design (dead and live storage, sediment release options), and yield curves which have been derived through a reservoir modelling exercise.

It is important to recognise that the impact of sedimentation of a dam on the reliable yield (assuming the same reliability level) is non-linear. The dead storage is a function of the design whereby the dead storage is expected to fill with sediment during the life span of the dam without any impact on the reliable yield. Once the sediment starts to reduce the live storage then the reliable yield will reduce or if, the same yield is maintained, then the reliability will decrease. In effect reducing the rate of sedimentation of a dam can extend the life of a dam and delay the onset for the next infrastructure development. For example, KenGen has proposed raising the spillway and crest height of Masinga Reservoir to compensate for the loss of storage capacity from sedimentation.

The information available at the moment on the dams of interest in this study is presented in Table 9-1. It is recognised that additional information is available but this has not been forthcoming as yet. Without a full set of information one can only speculate on the levels of dead storage and potential impact of sedimentation on dam yield. We note that the Eldoret Water Master Plan (MIBP 2018) assumes that the current supply will be sustained to at least 2040 which is the planning horizon for the Masterplan. There is no mention in the Masterplan of reducing dam yields on account of loss of live storage. Indeed the Masterplan makes no mention of catchment conservation to protect the existing or proposed investments. The future infrastructure developments proposed in the Masterplan have assumed a design life of 40 years for dams.

Table 9-1: Summary Dam Information

Dam	Height (m)	Reservoir Capacity (MCM)	Reported Yield at 98% reliability (m^3/day)	Reliability (%)	Net Yield (m^3/day) X = storage (MCM)
Moiben	27.5	6.2 (1.2 dead storage) (5.0 live storage)	N/A		N/A
Ellegirini	12.5	2	10,700	98%	$Y=-1200X^2+7840X-200$
				90%	$Y=-1500X^2+9250X-75$
Two Rivers	29.0	12.5	14950	98%	$Y = -133.39X^2+5951.2X+7679.2$
				90%	Y=-155.87X2+5876.7X+8215.2
Kipkaren	30.8	25	66,000	98%	$Y=-87.143X^2+4144.3X+18500$
				90%	$Y = -70.286X^2+4252.6X+18240$

The SWAT model (Appendix F) was used to estimate the sediment yield from each of the basins and the respective sub-basins. The current (Baseline) sediment yields are as shown in Table 9-2. The Moiben catchment has the highest sediment yield rate which is expected given the higher proportion of steeply sloped farmland. The SWAT model was used to test the impact of different SLM technologies on sediment yield (Table 9-2). The catchment conservation efforts imply an average of 12 years being added to the life of the existing reservoirs. The next new reservoir expected under the Eldoret Water Masterplan is a new Two Rivers Dam expected to cost Ksh4.87 Billion to come online in 2025.

Table 9-2 : Sediment Yields by Catchment under baseline and Conservation Scenarios

Catchment	Area (km^2)	Baseline Sediment Yield (m^3/yr)	Sediment Yield (m^3/yr) with conserved catchment	Dam Volume (MCM)	Trap Efficiency (%)	Year to fill (yrs) baseline	Year to fill (yrs) with conserved catchment
Moiben Dam	175.81	647,737	370,140	6.2	95	10.08	17.63
Ellegirini Dam	54.70	117,869	63,591	2	90	18.85	34.95
Two Rivers Dam	267.09	543,328	329,211	12.5	95	24.22	39.97
Kipkaren Dam	545.67	1,068,856	771,324	25	95	24.62	34.12

The impact of sedimentation on reservoir yield for the ELDOWAS water supplies merits further analysis with more complete data.

9.1.2 Soil Erosion and Water Treatment

Water with a higher sediment load and higher turbidity requires more effort to remove the sediments. Typically this means that more chemicals (coagulants) are used to remove the sediment and more

water is wasted to backwash the filters. In the case of the ELDOWAS water supply the water sources are drawn from dams where much of the sediment is deposited in the dams with the resultant turbidity at the drawoff points being less affected by the sediment inflow than by the soil physical properties. Data on coagulant and polymer usage for Chebara and Sosiani Water Treatment Works was reviewed to see whether chemical usage was correlated with rainy season (Figure 9-1 and Figure 9-2). However there was no clear correlation with rainy season. This implies that the water turbidity may fluctuate in response to other factors (e.g. wind causing turbulence in the reservoirs, riparian usage and conditions) rather than rainy season per se. This result appears to be different to the results obtained for the Upper Tana Nairobi Water Fund where turbidity at the Ngethu Treatment Works showed a distinct seasonal pattern. This can be explained by the fact that the inflows to the Ngethu Treatment Works are not exclusively from dams and so the natural sediment/turbidity is less modified by dams than is the case for the Chebara and Sosiani Treatment Works. However additional information and further analysis may yet clarify the factors influencing water turbidity and treatment costs.

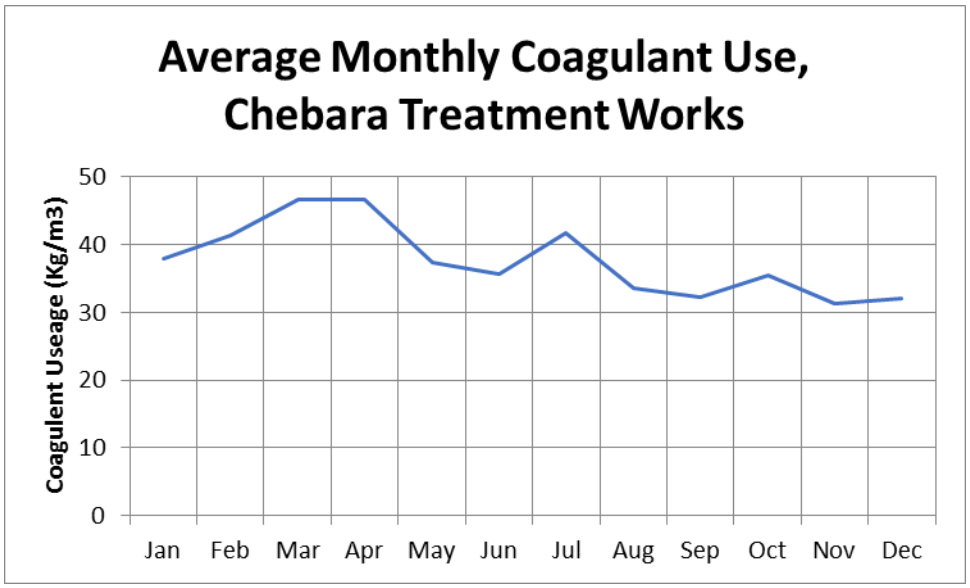


Figure 9-1 : Average Monthly Coagulant Use, Chebara Treatment Works

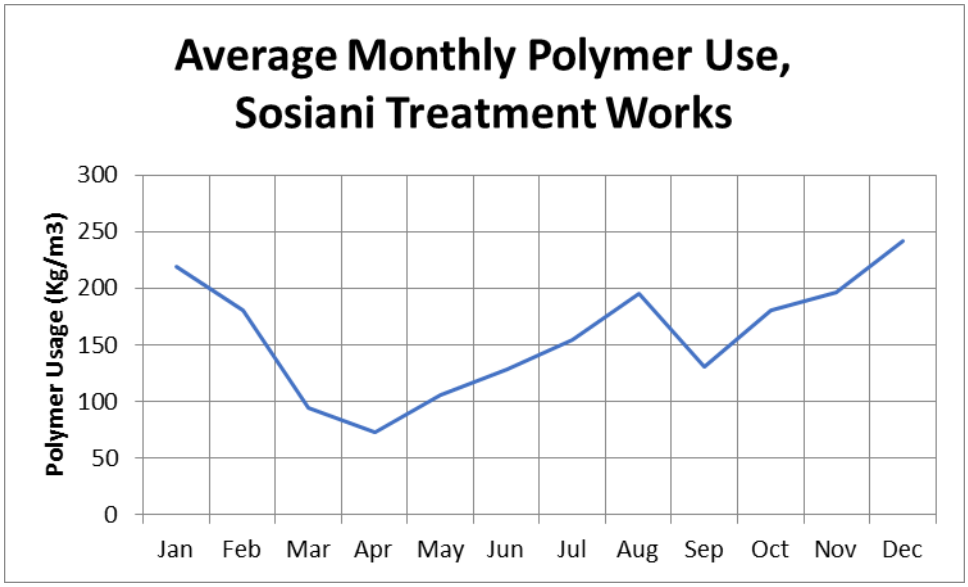


Figure 9-2 : Average Monthly Polymer Usage, Sosiani Treatment Works

9.1.3 River bank encroachment

River bank encroachment refers to the nature and scale of activities that take place on the river bank or riparian area. Riparian areas play a disproportionate role in controlling river bank erosion and sediment entry into water courses. Riparian areas form a buffer that can protect river banks and impede sediment from entering the water course. For this reason riparian conservation should be given priority. The WRA and WRUAs consulted during the course of the study reported concern regarding the level of river bank encroachment.

9.1.4 Uncontrolled Runoff from Rural Roads

Roads impose a synthetic drainage pattern on the natural drainage system because they intercept and concentrate runoff, in addition to providing an near impermeable surface which itself induces a high rate of runoff. The runoff that concentrates in the drains along the road needs to be disposed of safely to the water course. Typically the road authorities restrict their activities to the road reserve as to do otherwise may involve construction of lined water ways and drop structures on private land. The net result is that Kenya has many cases in which poorly controlled road runoff has induced significant gulley erosion and even land slips. The problem appears to be more pronounced on rural roads which do not receive the same level of design attention as for major highways and urban roads. MoWI (2015) states that 25-50% of total sediment may be derived from roads and trails. This implies that proper road drainage and runoff disposal are critical to reducing total sediment yields. A more detailed survey to identify the “hotspots” for road drainage will be required going forward.

9.1.5 Soil Fertility and Crop Productivity

Erosion of farmland means that the top soil is being removed. The top soil generally has a higher carbon and plant nutrient content plus better soil physical properties for water retention and crop growth. Loss of top soil can therefore lead to loss of crop productivity thereby affecting yields and household revenues, nutrient and food security. Conversely soil and water conservation measures can result in better crop yields which can be as much as a 50 – 60% improvement depending on baseline conditions.

9.1.6 Deforestation

Deforestation is as a result of communities clearing forests for farmlands. In the Moiben catchment, catchment degradation has been on-going over the past few decades, as the forest cover is cleared for settlement and farming, especially sections of the Cheboit and Sogotio forests despite these being gazetted forests (Legal Notice 102/1941). Current forest cover in the Moiben catchment is estimated to be 50.5% of the dam catchment, with farmland representing 49.5% (See photo plates 1 to 3 in Section 5.1.4). Deforestation and charcoaling, while increasing the risk of erosion, also reduce the quality of the forests.

9.1.7 Pollution within Moiben, Charama, Sosiani and Kipkaren catchments

Pollution sources within the catchments of interest potentially include:

- Agro-chemicals (fertilizers, pesticides) from farmland applications and poor chemical handling practices (e.g. washing containers in the river);
- Human sewage from poor sanitation facilities and practices and proximity of latrines to the water courses;
- Livestock sewage from watering livestock directly in the rivers and from grazing livestock within the riparian areas;
- Solid waste from rural centres due to poor solid waste management practices.

At present the level of risk from pollution is anecdotal evidence based on visual observation of the nature and extent of sanitation facilities, livestock watering practices and solid waste management practices within the catchments. The increasing number of and population within the rural centres implies that these risks are likely to increase over time based on a scenario of business as usual.

9.2 Selection of Target Areas and Intervention Measures

The catchment areas for the ELDOWAS water sources (Moiben, Charama, Sosiani, and Kipkaren) should be selected for targeted intervention measures based on their importance to Eldoret and Iten water supplies and the level and nature of the threats to the water sources.

9.2.1 SLM Interventions in Targeted Farmland Areas

Within the Moiben catchment (177 km^2, population 18,311[9]) the 77 km^2 of farmland which is moderate to steeply sloped (>5%) should form the highest priority, although the entire farmland area of 90 km^2 should be targeted. Within the Sosiani catchment (268 km^2, population 45,351) the 58 km^2 of farmland with slopes greater than 5% should be prioritised, although the entire farming area (194 km^2) should be targeted for appropriate SLM interventions. The Charama catchment (20km^2, population 2,717) has 13.5 km^2 of farmland (Kaptarakwa area) of which 66% has slopes greater than 5%. While the steeper area should be prioritised, the entire catchment should be targeted. Within the Kipkaren catchment (545 km^2, population 95,958) the 483 km^2 of farmland should be targeted and the 107 km^2 of farmland with slopes greater than 5% should be prioritised. Table 9-1 provides a summary of the targeted farmland areas. The population within the total catchment area is estimated at 162,350 (2009) or approximately 32,500 households.

[9] (2009 Census)

Table 9-3 : Targeted Farmland Areas

			Slope Category Units km^2				
Catchment	**Total Catchment Area (km^2)**	**Farmland Area (km^2)**	**Low**	**Moderate**	**High**	**Very High**	**% Area**
			<5	**5 to 12**	**12 to 40**	**>40**	
Moiben	177.8	89.8	13.0	37.1	39.7	0.0	12%
Sosiani	268.3	193.5	136.0	49.7	7.8		25%
Charama	20.9	13.5	4.5	7.5	1.4		2%
Kipkaren	545.4	482.7	375.4	99.0	8.2		62%
Total	**1,012.4**	**779.4**	**528.9**	**193.4**	**57.2**	**0.0**	**100%**
% Area			67.9%	24.8%	7.3%	0.0%	

The most appropriate SLM technologies for steeply sloped land include mulching and minimum tillage, terracing (e.g. fanya juu) and grass strips (preferably 5 m wide). In addition control of concentrated runoff along pathways and rural roads will be required. This can be achieved through grass or stone lined water ways, drainage infrastructure such as culverts, drop structures, and gabions.

For the farmland with more gentle slopes, mulching and minimum tillage, grass strips, contour farming, agro-forestry, and tree or hedge lined plot boundaries are some of the options to reduce erosion and improve soil water retention and soil fertility.

These activities should be promoted by the county government soil conservation and agricultural extension staff working with local farmers. Ultimately farmers can be persuaded of the merits of SLM technologies through developing demonstration farms (farmer field schools) with "champion farmers" in which careful records are kept to show the yield and revenue benefits derived from adopting the SLM technologies. Ultimately whether farmers actually adopt the SLM technologies is a function of numerous factors such as education, financial motivation, culture, health, etc.

The maintenance of the SLM technologies is undertaken by the farmer. The economics of improved yields and revenues should be adequate justification to motivate the maintenance of the SLM technologies. However it should be recognised that well conserved farms provide economic benefits to downstream water consumers which implies that financial support to farmers to develop and maintain the SLM technologies can be justified.

9.2.2 Riparian Conservation on Moiben, Charama, Sosiani and Kipkaren Rivers

Appropriate interventions for riparian conservation include grassing, afforestation with indigenous trees, bamboo, fruit trees, and potentially gabions where river banks are vulnerable to collapse.

Table 9-3 provides an estimate of the river length for the different catchments of interest. These distances include the tributaries. It should be noted that the length should be doubled when considering both banks of a water course.

Table 9-4 : River Lengths for Different Catchments

Catchment	River Length (km)
Moiben Dam	161.96
Ellegirini Dam	79.11
Two_Rivers Dam	264.36
Kipkaren Dam	418.66
Sabor Intake	32.93
Total	**957.02**

9.2.3 Controlling Road Runoff

Road runoff can be controlled by implementing proper drainage structures. These typically include:

- Mitre drains;
- Cross drains and culverts;
- Drop structures and lined waterways;
- Bridges.

The need for and application of these measures will require a detailed road survey by KURRA and county government road departments. Where safe disposal road runoff requires infrastructure through private land then community members should be sensitised on the need for and involved in the construction of the drainage structures.

9.2.4 Forest Conservation in Kaptagat and Embobut Forests

The catchment areas for Moiben, Sosiani and Kipkaren rivers are located within the wider Cherangany forest system, more locally described as the Embobut and Kaptagat Forests. However the specific areas within the river catchments of interest are shown in Table 9-5 which shows forest cover which includes forest cover outside of the gazetted forest areas.

Table 9-5 : Targeted Forest Areas

			Slope Category Unit km^2				
Catchment	**Total Catchment Area (km^2)**	**Forest Area (km^2)**	**Low**	**Moderate**	**High**	**Very High**	**% Area**
			<5	**5 to 12**	**12 to 40**	**>40**	
Moiben	177.8	89.77	12.96	37.09	39.71	0.01	38%
Sosiani	268.3	74.63	35.14	32.39	7.10		32%
Charama	20.9	7.40	2.45	3.90	1.05		3%
Kipkaren	545.4	62.46	26.04	25.79	10.63		27%
Total	**1,012.4**	**234.3**	**76.6**	**99.2**	**58.5**	**0.0**	**100%**
% Area			33%	42%	25%	0%	

Table 9-6 presents the land use specifically within the gazetted forest areas that lie within the targeted catchments. There are nearly 1000km^2 of gazetted forests but only 312 km^2 lie within the catchment

areas. Of this area only 42% registers as forest as per the GIS analysis of the remotely sensed Sentinel 2016 Land Use data. Clearly the forest cover within the gazetted forest areas can be improved.

Table 9-6 : Land Use in Gazetted Forest Areas within the Targetted Catchments

Forest Name	Builtup Areas	Farmlands	Forest Cover	Water	Total
Cheboit	0.0	7.5	8.8		**16.3**
Chemurokoi		1.9	1.7		**3.6**
Kaisungor		6.4	2.1		**8.5**
Kaptagat	0.0	58.7	43.0		**101.7**
Kerrer		7.0	8.1		**15.1**
Kipkabus(Uasin Gishu)		41.0	11.4	0.2	**52.6**
Kipkunurr		6.0	18.3		**24.3**
Northern Tinderet		51.2	37.9	0.0	**89.1**
Sogotio		0.4	1.2		**1.5**
Total(km^2)	**0.0**	**180.0**	**132.5**	**0.2**	**312.7**

The management of the forests fall under the jurisdiction of the Kenya Forest Service, although the County Governments, Kenya Wildlife Service and the Kenya Water Towers Agency have significant roles as well in the government programs within the forested areas, with the collaboration of the Community Forest Associations (CFAs).

The management of the plantation forests falls under the PELIS system and in some areas the forest has been allocated to private concessionaires (e.g. Raiply). The GIS analysis for this study indicates that as much as 50% of the gazetted forest area within the target catchments is currently being farmed (under PELIS) or is grassland. The question that the Water Fund needs to address is how to support and influence the forest management so that beneficial soil, water and economic outcomes can be achieved and improved.

There are certain voices within the forestry sector that are critical of the current management practices arguing that economic returns are minimal except to a few individuals, soil and water outcomes are not achieved and biodiversity is severely compromised. These same voices argue that alternative management approaches can deliver greater economic returns, better soil and water outcomes, better forest infrastructure and terms of service for forestry labour and professionals and enhanced biodiversity. The alternative management systems anticipate a stronger role for private and regulated concessionaires, and alternative forestry crops such as bamboo which can be pruned leaving continuous canopy and minimal soil disruption. It is argued that these alternative forest management models can use the value of the existing standing plantation timber to finance the investments needed to replant, control access, improve infrastructure, improve terms of service for forestry staff and basically rejuvenate the forestry sector while delivering better outcomes in terms of fuel wood, timber, biodiversity, etc.

Clearly the forestry management approach is a much wider policy issue that must involve many stakeholders, including the indigenous forest communities, CFAs and an honest and open debate on strengths and weakness of the existing system versus alternative forestry management models. For

the purposes of this report it is relevant to recognise that alternative models could be explored where policy and stakeholder interests align or existing systems strengthened for better soil, water, biodiversity and economic outcomes. Whichever forestry management models are used the following activities can help to ensure beneficial outcomes for downstream water supply:

- Controlled or restricted grazing to allow natural regeneration along riparian areas and in open areas;
- Control of illegal logging which degrades the quality of the indigenous forest;
- Prevention of charcoaling which can be a source of destructive forest fires;
- Improvements to forest infrastructure including staff housing, offices, roads and bridges;
- Adoption of low impact forest harvesting techniques;
- Afforestation with indigenous trees and bamboo (it is said that restricted grazing is sufficient to enable natural regeneration of indigenous trees and bamboo);
- SLM technologies where PELIS is practiced (e.g. terraces, vegetated plot boundaries, runoff control on pathways)

9.2.5 Pollution Control within Moiben, Charama, Sosiani and Kipkaren catchments

Appropriate activities to address the pollution sources will need to be site specific but may include:

- Controlling livestock watering through providing livestock water points away from the rivers. This will require detailed community sensitisation, working with WRUAs and local community environmental groups;
- Working with farms and livestock keepers to graze livestock away from the riparian areas;
- Working with business enterprises, environmental youth groups, school groups etc. to setup solid waste management facilities;
- Working with farmers to use mulch and minimum tillage to improve soil fertility rather than relying on synthetic fertilisers;
- Working with farmers on chemical handling;
- Working with county government public health departments to address sanitation practices;
- Raising awareness among farmers, livestock keepers, businesses and school populations on environmental health practices.

9.3 Effectiveness of Proposed Catchment Conservation Interventions on Sediment Reduction

Since most of the targeted catchment areas are farm lands, proposed conservation measures are basically cross slope barriers. These barriers are measures on sloping lands that may be in the form of earth or soil bunds (terraces), stone lines, and/or vegetative strips. These are aimed at reducing runoff velocity and soil loss, thereby contributing to soil, water and nutrient conservation as a result of reduced steepness and/or length of slope.

For farmland with slopes between 12% to 40%, the most appropriate SLM interventions investigated for this study include filter strip farming, contour farming and terracing. For lower slopes (5 – 12%) vegetative strips and contour farming are appropriate.

A combination of cross slope barriers has been proposed as follows:

- ***Filter strip farming:*** Two systems can be implemented i.e. either at 2m intervals or at 5m intervals. Smaller spacing is proposed for the steeper areas in the upper parts of the catchments;
- ***Contour farming.*** Contour farming, the practice of tilling sloped land along lines of consistent elevation in order to conserve rainwater and to reduce soil losses from surface erosion. It is a sustainable way of farming where farmers plant crops across or perpendicular to slopes to follow the contours of a slope of a field. This arrangement of plants breaks up the flow of water and makes it harder for soil erosion to occur. Two types (Type A and Type B) have been proposed. Type A involves increasing land cover by 5% and Type B by 10%.
- ***Terrace farming.*** Ideally, terraces are not usually constructed, but rather develop gradually behind earth bunds, vegetative strips (usually grass) or stone barriers, due to soil movement from the upper to the lower part of the terrace. But in some instances, *fanya juu* terraces can be used to form bunds that will latter form into terraces.
- ***A combination of terracing and strip farming***. This involves introducing a vegetative cover on top of the bund created from the terrace.

Using the SWAT model, an estimation of the potential benefits based on the amount of sediment reduction from each of the catchments was carried out. Overall a combination of terrace farming and 5m strip farming was found to be most effective as this would reduce the sediment yields by 45.0% on average. Terracing alone would reduce the sediment yield by 40.1% on average while contour farming would reduce the sediment yield by between 33.3% and 36.8% depending on the contour type. Filter strip farming in a 5m formation would reduce the sediment yield by 19.2% on average while the 2m formation would reduce the sediment yields by 13.0% on average. The reduction rates from each of the sub-basins would vary considerably.

The target is to realise a 30% reduction in the sediment yield by targeting the priority catchment areas with SLM interventions as indicated by the SWAT modelling. The priority catchment areas for SLM interventions are as shown in Table 9-6.

Table 9-7: Agricultural Land Sizes in Priority Catchments

Catchment	Slope (5-12%) (ha)	Slope (12-40%) (ha)
Moiben	3,710	3,970
Two rivers	4,970	780
Charama	750	140
Kipkaren	9,900	820
Grand Total	**19,330**	**5,710**

To achieve the sediment yield reductions, interventions such as contour farming, terracing and a combination of terracing and strip farming have been proposed. A combination of terracing and strip farming is proposed for the higher risk areas (slopes 12-40%) while contour farming and strip farming are preferred for land with gentler slopes (5-12%). For areas with slopes higher than 40%, afforestation is proposed while river bank pegging and protection is proposed along the whole length of both the Moiben and the Kaptagat/ Kipkaren River.

9.4 Impact of Proposed Catchment Conservation Interventions on River Discharge

The objective of SLM interventions is to reduce erosion by reducing land slope, increasing ground cover, and improving soil physical properties. The net effect on the hydrological cycle is to reduce surface runoff and enable more infiltration which can result in higher river baseflows which are important during the dry seasons. However the hydrological changes do not necessarily result in higher mean annual discharge. The impact of the different SLM interventions on discharge is shown in Table 9-7. This indicates that the SLM interventions are likely to have a neutral or slightly positive result on mean annual flows with an area weighted average across all the rivers of 2.88%.

Table 9-8: Impacts of SLM Interventions on River Discharge

	% Change on Mean Annual Flow		
Intervention	**Moiben**	**Ellegirini**	**Two Rivers**
Terracing + 5m strip	0.48	6.00	1.80
Terracing	-2.81	2.53	1.65
Contour B	-0.89	1.05	1.01
Contour A	0.19	0.23	0.21
Filter Strips 5m	-0.05	0.23	0.20
Filter Strips 2m	-0.06	0.12	0.16
Average	**-0.52**	**6.00**	**1.80**

9.5 Cost of Proposed Interventions

Table 9-8 shows the average costs in US$ per hectare for the proposed interventions. Costs are based on case studies of SLM interventions implemented globally (WOCAT, 2017) and vary depending on the type of intervention and the preferred arrangement or spacing.

Table 9-9 : Cost per Hectare for Proposed Interventions

Activity	**Description**	**Unit Cost (USD)/ Ha**
Afforestation	Including establishment of nurseries for indigenous and exotic tree species as well as transplanting and maintenance labour	US$ 950- US$ 1,100 (Average – US$ 1,000)
Terracing	Including *fanya juu* terraces, bench terraces etc on slopes >12% Costs also vary depending on the spacing configurations of the terraces	US$ 250- US$ 350 (Average 10m spacing –US$ 250 Average 5m spacing - US$ 300)
Agro-forestry	Borderline, pure or mixed fruits or fodder trees mainly in crop lands/ cultivated lands	US$ 950- US$ 1,100 (Average – US$ 1,000)
Filter strips	A 1-meter wide strips of different grasses including fodder grasses such as *Bracharia, Nappier* etc. For 2m configuration the average costs are up to US$ 200 while for 5m spacing, the costs average US$ 100 per hectare	US$ 100- US$ 200 (Average US$ 150)
Riparian conservation	Includes borderline protection/fencing off, pegging, for an average of 15 meters from the natural water	US$ 950- US$ 1,100 (Average – US$ 1,000)

	bodies including rivers, streams and springs	
Reforestation	Reforestation with indigenous species within forest areas that should be forested	US$ 950- US$ 1,100 (Average – US$ 1,000)
Farm ponds/reservoirs	Small ponds of up to 500m^3. Including cost of digging, levelling and lining materials	US$ 5,000 (per unit)
Water pans/river weirs/sand dams	Water pans of up to 5,000m^3. Including cost of digging, levelling and clay lining	US$ 20,000/ Unit

The overall costs for the proposed interventions are estimated at nearly US$15 million as summarized in Table 9-9. Various assumptions have been made regarding the area targeted for each type of intervention.

Table 9-10: Overall costs for proposed interventions

Intervention	Area covered (ha)	Condition	Unit cost (US$)/ ha	Total costs (US$)
Terrace + 5m Strip Farming	5,710	12-40% sloped farmland	250	1,427,500
Contour Type B (5m spacing)	19,330	5-12% sloped farmland	150	2,899,500
Filter strips/strip farming	19,330	5-12% sloped farmland	150	2,899,500
Riparian & Wetland Conservation	2,872	15m either side watercourse	1,000	2,871,600
Agroforestry	2,504	15% of targeted farmland	1,000	2,504,000
Afforestation	1,800	10% of farmland in gazetted forests	1,000	1,799,844
Total costs	**32,215**			**14,401,944**

9.6 Alternative Livelihood Activities

In addition to catchment conservation initiatives, the following alternative livelihood alternatives are proposed with a view to reduce pressure on land and water resources:

a) **Reforestation program for the dam buffer zones:** Whilst the part of the Moiben, Ellegrin and Two Rivers dams are fenced off, they lack a proper buffer zone that would reduce the risk of erosion and siltation of the dams. The role of establishing buffer zones needs to be primarily the role of ELDOWAS, by virtue of owning the land, as well as the neighbouring farmers. This could be carried out in partnership with the WRUAs. Reforestation with indigenous tree species and fruit trees would provide various livelihood options (tourism, fishing, beekeeping, fruit harvests, etc) while reducing the risk of sedimentation.
b) **Alternative livelihood options with less pressure on land and water resources:** Currently, a number of households within the catchments are engaged in extensive livestock grazing within the forested areas as well as collection of firewood from the forests. In some sections of the Kaptagat forest, the *shamba* system is practised but is not well controlled. In some instances, farmers are involved in irrigated agriculture along the river banks. All these

activities put pressure on the forestry, land and water resources causing increased erosion, sedimentation and general degradation of the catchment.

To lower the reliance of such livelihood activities on the forest and water resources, the following alternative livelihood improvement activities are proposed.

- Improved irrigation technologies and high value crop production;
- Improved livestock enterprises with low pressure on land resources including bee keeping, poultry keeping and dairy goats rearing etc;
- Plant fodder fields and promote zero-grazing approaches for high value dairy production; and
- Promotion of alternative energy sources including energy saving *jikos* and below ground bio-gas digesters.

9.6.1 Costs of recommended alternative livelihood options

The total costs for proposed alternative livelihood activities are estimated at US$ 1.54 million as presented in Table 9-10.

Table 9-11: Cost Estimates for Alternative Livelihood Options

Interventions	Costs of proposed livelihood alternatives		
	Cost/unit (US$)	Number of households	Total Cost US$
Dairy goats farming	150	2,000	300,000
Energy saving jikos	50	4,000	200,000
Poultry farming	1.2	10,000	12,000
Bee keeping	30	1,000	30,000
Plant fodder fields	250	1,000	250,000
Bio gas units	1,500	500	750,000
Total			**1,542,000**

9.7 Operations and Maintenance Costs

The total operations and maintenance costs includes both the Eldoret water fund setup costs as well as annual operation costs. The total fund set up costs including establishing and equipping the physical office as well as initial meetings is estimated at US$ 270,000 as shown in Table 9-11.

Table 9-12: Indicative Setup Costs

Item	No.	Qty	Unit	Rate	Cost
Office set up	1	1	LS	10,000	10,000
Equipment	1	1	LS	30,000	30,000
Transport	1	1	LS	50,000	50,000
Recruitment	1	1	LS	20,000	20,000
Fund establishment	1	1	LS	10,000	10,000
M & E system setup	1	1	LS	150,000	150,000
Total					**270,000**

In addition to the set-up costs, costs are estimated for the annual operations and maintenance of the fund. These amounts exclude the fund activity budgets estimated in the sections above. The total annual operations costs are estimated at US$575,100 as shown in Table 9-12.

Table 9-13: Indicative Annual Operational Costs

Item	Detail	No.	Qty	Unit	Rate (USD)	Cost (USD)
EIWF Staff	EIWF Manager	1	12	Months	7,000	84,000
	Project Officer	1	12	Months	5,000	60,000
	Resource Mobilisation Officer	1	12	Months	5,000	60,000
	Field Coordinator	2	12	Months	2,500	60,000
	M & E Officer	1	12	Months	5,000	60,000
	Sub-total					**324,000**
Governance	Board Meetings	1	4	No	500	2,000
	Auditor	1	1	LS	5,000	5,000
	Sub-total					**7,000**
Logistics						
Transport	4WD	2	2000	Km	1.1	4,400
	Flights	1	1	LS	5,000	5,000
DSA	Project Staff	1	12	Months	1,000	12,000
	Sub-total					**65,000**
Total						**396,000**
Admin					15%	59,400
Annual M&E costs					20%	79,200
GRAND TOTAL						**534,600**

9.8 Evaluation of Potential Impacts

9.8.1 ELDOWAS and Other WSPs

Catchment improvement will have the following intermediate and long-term impacts on the WSPs.

A. Intermediate Impacts

- Lower/ reduced siltation in the dams which extends the life of the dam and delays the need for addition storage infrastructure or the need to de-silt the dams;
- Better quality/ less turbid water which reduces the cost of water treatment;
- Lower variations on water supply through improved dry season flows;
- Minor increase in mean annual flow.

B. Long Term Impacts

The WSP will realize the following impacts:

- Increased water supply to their customers (No/lesser rationing);
- Reduced cost of water treatment (coagulant/chemical costs);
- Cost savings on electricity/power;
- Increased number of supply areas/ customers;

- Increased revenues;
- Increased profits;
- Increased customer satisfaction, in turn leading to higher willingness to pay, which can contribute to efforts to combat UFW/NRW.

One method to evaluate the economics of reduced sedimentation of the dams is to use the opportunity cost approach of sediment removal which is estimated at USD3.5 per cubic metre of soil based on prevailing contractor rates for soil excavation and transport to spoil. Table 9-13 provides an estimate of the annual value of the sediment reduction based on this approach.

Table 9-14: Estimated Benefits Accruing to ELDOWAS from reduced sediment yield

Catchment	Area (km^2)	Baseline Sediment Yield (m^3/yr)	Sediment Yield (m^3/yr) with conserved catchment	Reduction in Sediment (m^3/yr)	30% Target sediment Reduction (m^3/yr)	Value ($/yr)
Moiben Dam	175.8	647,737	370,140	277,597	83,279	291,477
Ellegirini Dam	54.7	117,869	63,591	54,279	16,284	56,992
Two Rivers Dam	267.1	543,328	329,211	214,117	64,235	224,823
Kipkaren Dam	545.7	1,068,856	771,324	297,532	89,260	312,409
Kesses Dam	159.5	225,075	202,936	22,139	6,642	23,246
Total	**1,202.8**	**2,602,866**	**1,737,202**	**865,664**	**259,699**	**908,948**

While we recognise the limitations of the economic analysis due to paucity of information, it should be recognised that delaying the construction of a new dam has a positive economic benefit. For example, let us say the investment cost of the proposed new Two Rivers Dam is KSH 5Billion (2020) If this construction can be delayed by 10 years (2030) then the capital required now would only be KSH2.32Billion (discount rate of 5%) or a cost saving of KSH1.93Billion. The savings increase with higher discount rates. These savings benefit the taxpayer and/or water consumers as the capital investments are likely to be funded through national government funds or secured against water revenues.

The current combination of dams delivers 48,000 m^3/day at an average tariff of Ksh 66/m^3 or USD11.56Million annually. If we assume that the sediment reduction in the dams has enabled this supply to continue uninterrupted for an additional 10 years, then the net present value of this revenue is USD89.3Million (5% discount rate).

The proposed SLM interventions will lead to at least a 3% increase in water availability. If it is assumed that this translates into a 3% increase in water sales by ELDOWAS, then ELDOWAS would earn an additional US$ 177,000 in annual turnover.

As was shown in Section 9.1.2, there is no straight forward way to anticipate the economic impacts of sediment reduction on the water treatment costs for ELDOWAS although it is well known that lower turbidity leads to lower treatment costs.

Table 9-15: Estimated Benefits Accruing to ELDOWAS from increased flows

Item		Result	Units
CURRENT CONDITIONS			
Current water supply		43,000	m^3/day
UfW	43%	18,490	m^3/day
Revenue water	57%	24,510	m^3/day
Average tariff		66.00	Ksh/m^3
Annual incomes		590,445,900	Ksh
Value in US$		5,904,459	USD
FUTURE CONDITIONS			
Potential increase in water available	3%	1,290	m^3/day
Future water supply	103%	44,290	m^3/day
Future revenue water		25,245.30	m^3/day
Average tariff	66.00	1,666,190	Ksh/m^3
Annual incomes		608,159,277	Ksh
Value in US$		6,081,592.77	USD
Change in Annual Revenues		**177,134**	**USD/Yr**

Note: Exchange rate: 1 US$= Kshs 100

9.8.2 Consumers

Key consumers are both domestic and commercial water users. Among the commercial consumers in Eldoret are the Chamber of Commerce (representing traders and urban dwellers), KAM (representing manufacturers), beverage and water bottlers as well as several flower farms within the catchment. With improved water supply, consumers will experience reduced disruptions in water supply/ reduced rationing while new consumers will have improved access to water. In addition, better quality water means that consumers have less exposure to water borne diseases and thus households are likely to reduce the cost of treatment of waterborne diseases which may be brought on by accessing alternative water sources of poor quality. The cost of water is also likely to decrease especially for new customers who currently get water from alternative sources, say purchased from water vendors. It is noted that the construction of the Kipkaren water supply, which will be a pumped system, may increase operational costs which might induce a tariff hike. However, this potential tariff increase is not associated with the deteriorating catchment conditions.

9.8.3 Farmers

Proposed catchment activities especially in the farmlands are likely to result to the following outcomes:

- Reduction in soil erosion/land degradation;
- Reduced production costs;
- Increased crop productivity;
- Improved access to food and better nutrition; and
- Improved incomes from farming activities.

Hunink and Droogers (2015) in their report for TNC provide a summary of research findings across a variety of technologies and climate conditions related to yield improvements derived from conservation measures. The results range from a 105% to 160% improvement in yield. MKKL (2013) indicates an annual gross return of Ksh 10,000 – 90,000 per acre (average Ksh 30,000) for smallholder rainfed farming which can be doubled (200%) with the adoption of conservation agriculture. If we assume that the conditions in the Eldoret-Iten water fund areas are slightly better (average annual gross return Ksh40,000 per acre and the conservation benefits are similar but lower (say 130% increase in gross return) then it could be stated that a farmer adopting conservation agriculture may realise an additional Ksh30,000 per hectare per year which implies a total of USD4.1 Million annually across the 13,692 hectares of targeted farmland on the steeper sloped land.

9.8.4 County Governments

A thriving government is anchored on the social wellbeing and security of its people. An environment that allows for healthy business establishment and growth has direct and indirect benefits for the county government, including increased revenue, reduced investment in treatment and management of water-borne and water related diseases as well as improved productivity. A county lacking adequate, good quality and reliable water supply will have a poor investment climate, poor health of its population, high costs of health services and a disfranchised public.

9.8.5 KWTA, KFS, CFAs

KWTA, KFS and CFA stand to benefit by having a partner that can support reforestation activities. Fuelwood, timber and other forest products are benefits that derive from a thriving forestry industry. The initial economic analysis targets 10% of the gazetted forest within the target catchments for reforestation (1800 ha). This should also provide hydrological benefits to other water users. No effort has been made at present to evaluate the benefits of the additional forest cover as it is unclear whether it would be planted with indigenous or commercial trees.

9.8.6 Private Sector

The mind map in Figure 9-3 captures the relationship between poor water quality and reliability and productivity at the business level and illustrates the way in which a poor water supply can affect demand, the health of the workforce and disruptions in production. The poor water supply poses not only a production risk but a profitability risk for businesses. Insufficient quantity and quality of water supply leads to high cost of production as businesses will need to invest in alternative water supply sources.

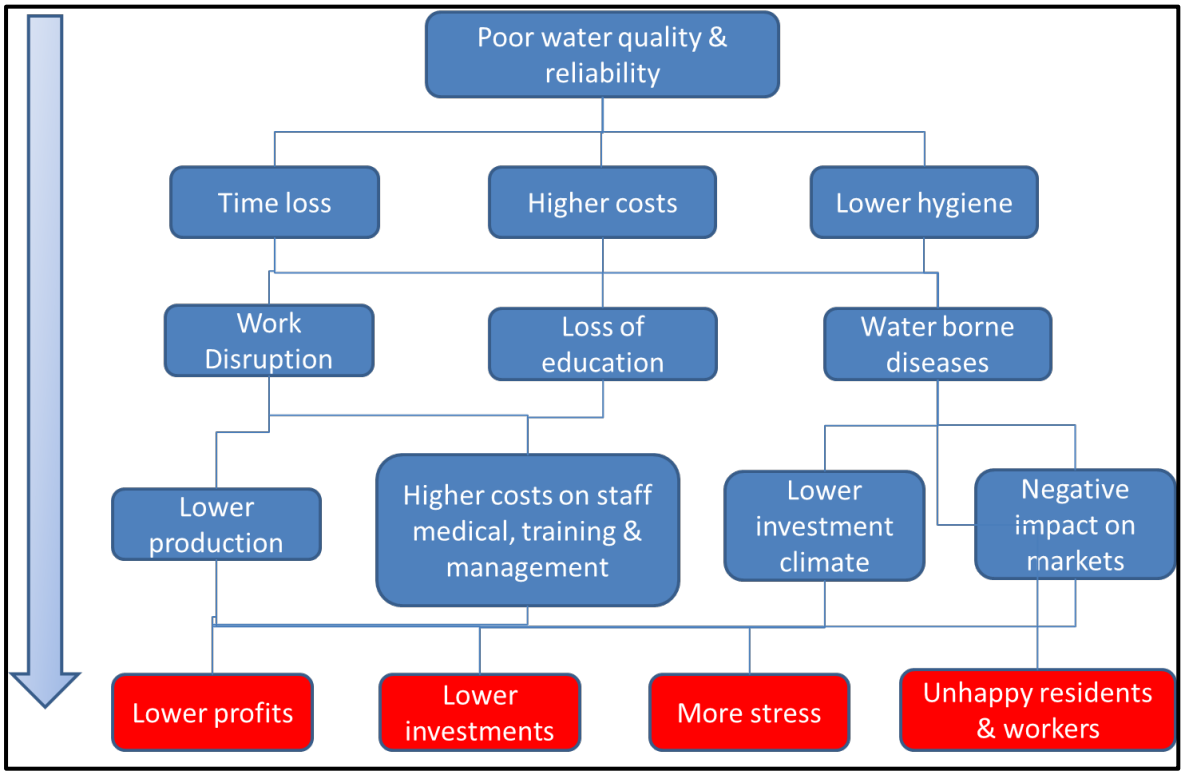


Figure 9-3: Schematic of the Relationship between Water Supply and Productivity

Improved water quality and quantity, which when achieved by the interventions proposed above, will have a positive impact on productivity at the business level.

9.9 Benefit Cost Analysis

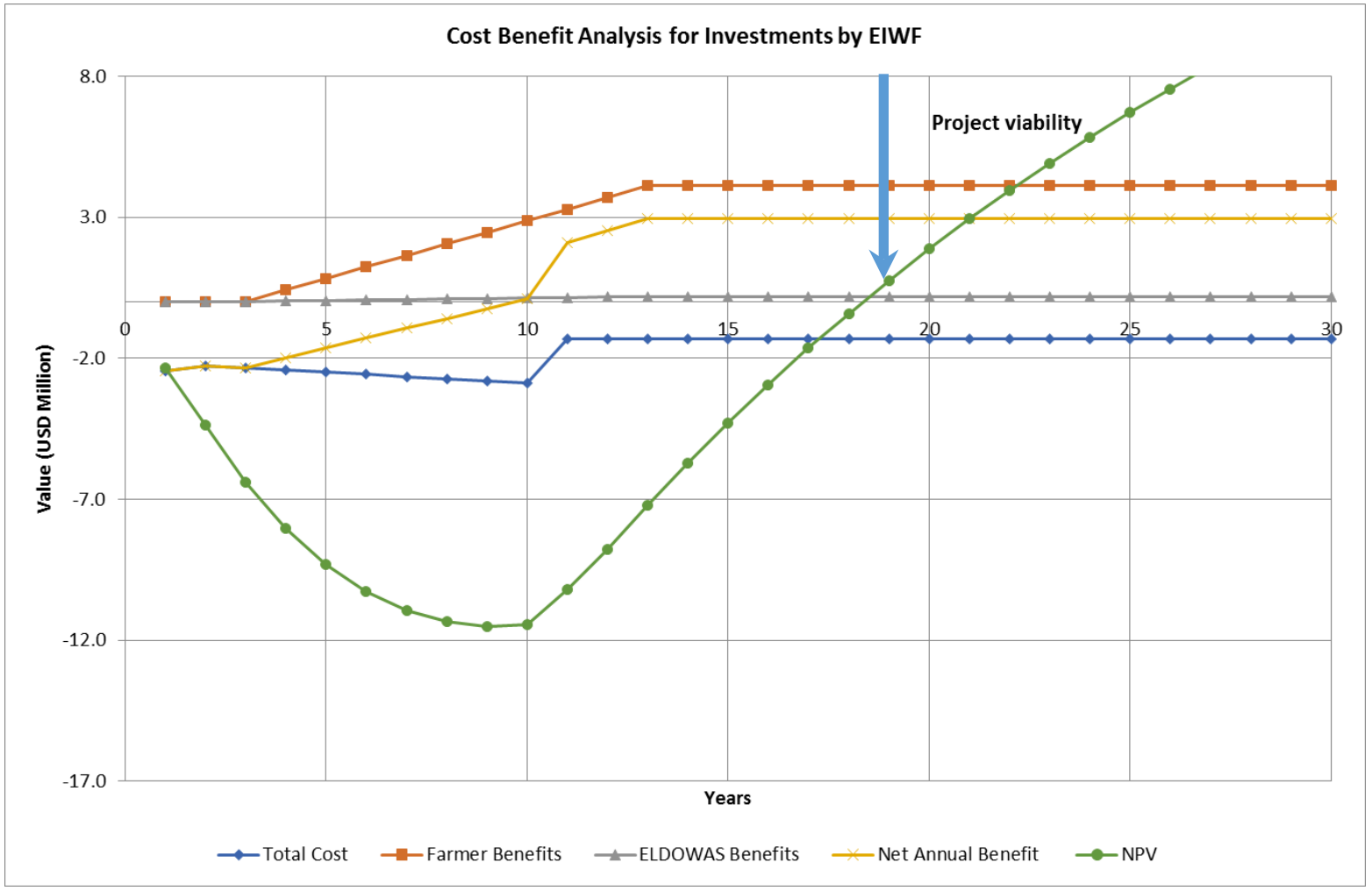
Various assumptions are made to simplify the benefit-cost analysis, namely:

1) The package of investments is as described in Table 9-9;
2) The proposed catchment improvement interventions and alternative livelihood investments will be spread out uniformly over 10 years or 10% per year.
3) The maintenance cost associated with these investments is 5% of total investment. This maintenance cost is likely to be a cost incurred by farmers/ or organisations undertaking maintenance activities of the green investments;
4) These investments will deliver a range of benefits accruing to various groups of beneficiaries but only the increase in agricultural returns to farmers and the additional revenue to ELDOWAS is evaluated;
5) Farmers will realise an additional Ksh 30,000 per hectare per year across 13,692 targeted hectares of farmland from soil and water conservation measures;
6) ELDOWAS will realise additional revenue from a 3% increase in water supply as a result of improved hydrological services in the catchment areas;
7) A discount rate of 5% (net of inflation);
8) Maintenance, setup and operational costs have been estimated and are included in the analysis.

The analysis is presented in Figure 9-4 for a 30-year timeframe. For a 5% discount rate viability is achieved in year 19. A higher discount rate reduces the viability period. The results are sensitive to the rate of benefits derived to farmers from the SLM interventions. However it is noted that the cumulative NPV continues to increase into the future as the impact of the SLM interventions continues to deliver benefits year on year.

It should be noted that this benefit-cost analysis does not include the significant economic benefit derived by delaying the schedule for the next large water reservoir investment nor the additional revenues gained by extending the life of the existing revenues, as described earlier. In addition the analysis has not included the economic benefits of re-forestation, riparian conservation and agro-forestry. Despite excluding certain benefits in the analysis, the results shows that there is a compelling economic argument for catchment conservation with benefits accruing to farmers, ELDOWAS, ITEWASCO, water consumers and tax payers.

Figure 9-4 : Cost Benefit Analysis for SLM Investments under Eldoret Water Fund



10. STAKEHOLDER MAPPING AND INTERESTS

10.1 Overview

The principles of Integrated Water Resources Management (IWRM) require that water resources are planned along hydrological rather than administrative boundaries and further that this be done in consultation with all sectors and persons who might be affected by the plans. This implies stakeholder engagement is required within administrative and across administrative boundaries.

Stakeholder engagement begins at the conceptualization of a project when stakeholder identification begins. The project planners need to be very clear with the communications about the project, be open and honest with all the related people about what can or cannot be achieved by the project. As this is done, the stakeholders consulted even at the preliminary stages should provide feedback on their expectations and this should be taken into account.

In mapping of stakeholders, it is necessary to categorise them according to their level of interest and influence with regard to the proposed activity. This is determined during interactions with the potential stakeholders, and understating what their role would be in the development and implementation of the proposed project. The outcome of this exercise will inform the stakeholder engagement process during the entire project cycle.

Figure 10-1 summarises categorisation of stakeholders, as described by Edward Freeman (1984).

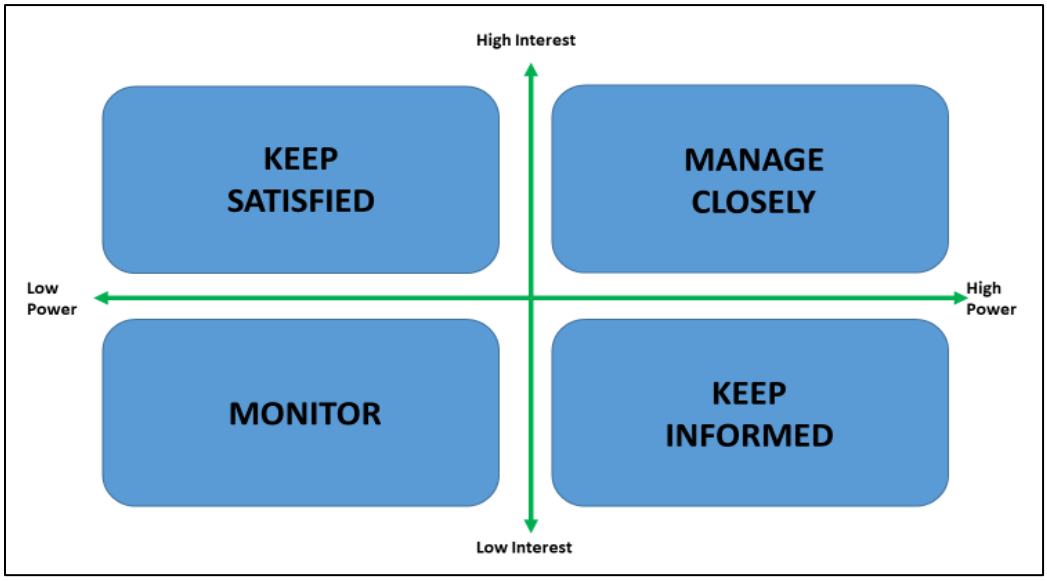


Figure 10-1 : Stakeholder Categorisation

Stakeholders are divided into four groups as shown in Figure 10.1 with the top right quadrant representing stakeholders with high interest and high influence which an organization should engage with closely.

10.2 Stakeholder Consultations

The invitation to the launch meeting and subsequent consultations with stakeholders was to establish first if there is an appetite for a Water Fund within the potential stakeholders, and if so, who would be the stakeholders, their interests and their potential level of influence on the establishment and running of such a fund.

The stakeholder consultations that followed the launch on 12th March, 2019 identified the following stakeholders and stakeholder categories:

a) **Water Service Providers in Eldoret and its environs**. Eldoret Water and Sanitation Company (ELDOWAS), Lake Victoria North Water Services Board, and the Iten-Tambach Water & Sanitation Company;
b) **Major Water users** – Chamber of Commerce (representing traders and urban dwellers), KAM (representing manufacturers), beverage & water bottlers;
c) **Catchment managers and users** – County governments of Uasin Gishu and Elgeyo Marakwet, WRUAs, CFAs, KVDA;
d) **Transport Infrastructure Developers** – KERRA, KENHA, KURRA;
e) **Regulatory agencies** - Water Resources Authority (WRA), National Environmental Management Authority (NEMA);
f) **Agencies responsible for Protected Areas** – Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), Kenya Water Towers Agency (KWTA);
g) **Conservation enterprises in the catchment areas** – e.g. Cherengany Conservation Network, National Council of Churches of Kenya; Kenya Ordnance Company.
h) **Public Funding Agencies** – World Bank, County Governments of Uasin Gishu, Elgeyo Marakwet, and the National Government of Kenya, NOREB;
i) **Research Institutions** – University of Eldoret, Moi University, Rift Valley Technical Training Institute (RVTTI).

10.3 Stakeholders Mapping and Analysis

Since the consultation on Eldoret Water Fund is in the preliminary stages, it was not possible to get deeper into issues such as pollution, water allocation and other concerns except for the fact that Eldoret still lacks an adequate sewerage system; a fact that undermines efforts towards water quality control. The following stakeholders were identified and engaged as part of the conversation towards setting up of the Water Fund and establishing the different roles that each can play.

Preliminary findings from the stakeholder mapping and analysis suggest that the private sector environment in Eldoret is robust, but not of sufficient scale to sustainably support a water fund without external support. It will be important that implementation of the Eldoret Water Fund secure the support of the KNCCI and KAM Eldoret Chapters. It was also well noted that the Athletics fraternity in Eldoret is very influential. A number of stakeholders engaged identified several athletes as potential stakeholders and drivers of the establishment of the Water Fund. Stakeholders have been categorised as shown in Figure 10.2

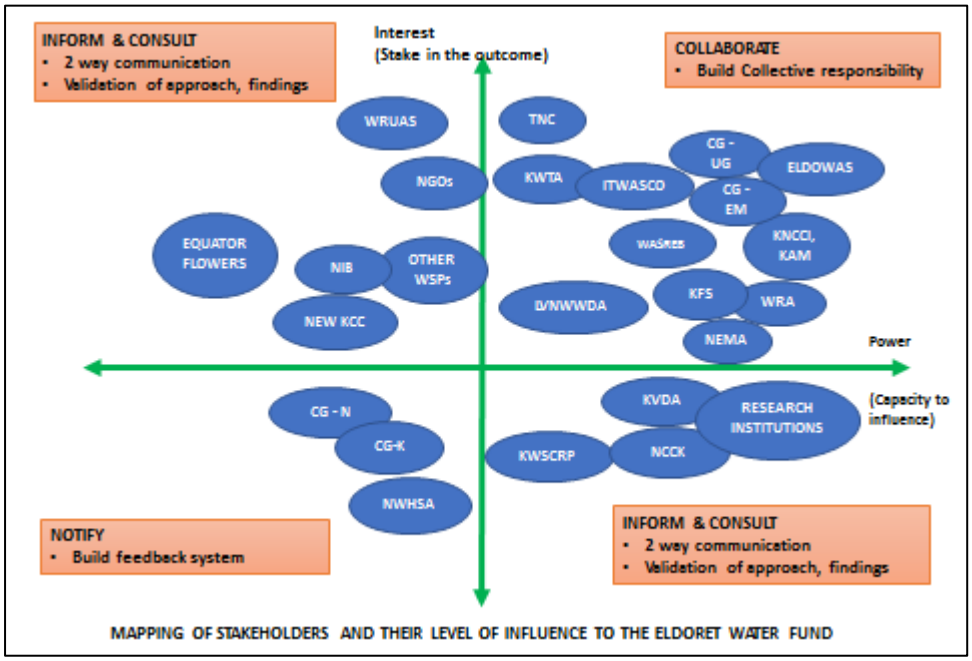


Figure 10-2 : Mapping of Stakeholders in Eldoret and Its Environs

10.4 Stakeholder Involvement in Catchment Conservation

Several institutions have been active in the greater LVB in conducting catchment conservation work, including bi-lateral and multi-lateral organisations and Non-Governmental Organisations. Table 10-1 provides a summary of past and present interventions implemented within the LVB.

Table 10-1 : Summary of Catchment Conservation Programmes within LVB

Organisation	Programme	Amount of Funding	Implementation Period
SIDA, MoA	NSWCP	Not available	1974 - 2000
WB, GEF	LVEMP	US$ 77.7 M	1996- 2005 (Phase 1)
SIDA	NALEP	US$ 166.7 M	2000 – 2005 (Phase 1)
ICRAF	TransVic	N/A	1999 - 2004
World Bank, GEF, KARI, ICRAF	WKIEMP	US$ 4.1 M	2005 -2010

Both Elgeyo Marakwet and Uasin Gishu Counties have made provisions in their CIDPs for catchment conservation activities in areas of interest to the study. In their 2018 - 2022, CGUG had provided for Ksh, 50M for the protection and rehabilitation of Sosiani, Moiben and Chepkoilel Rivers, and the conservation of major wetlands. This is to be implemented over 36 months by the Directorate of Environment.

A number of institutions met during the stakeholder engagement phase also mentioned activities that they had or have been carrying out aimed at catchment conservation, as listed in Table 10-2.

Table 10-2 : Potential Stakeholders Conducting Catchment Conservation Work

Organisation	Activities	Amount of Funding
Kenya Ordnances Factories Corporation	Seedling propagation – 20,000 seedlings per year	Not specified
Iten Integrated	Catchment protection – - Fencing - Indigenous tree planting - Tree seedling propagation	Not specified
WRA	SCMP development and review Ecosystem management for Elgeyo Hills water tower	Not specified
ITWASCO	Tree planting Sensitisation through athletics	Ksh. 100,000
Sosiani WRUA	Sosiani river bank rehabilitation – 60km	Not specified
ELDOWAS	Kaptagat forest protection Seedling propagation – 150,000 cypress and eucalyptus tree seedlings	Not specified
Almasi Beverages	World Water Day, Chebara Marathon	Part of Ksh. 1.5 M CSR budget

10.5 Emerging Issues

The consultation process derived a number of common issues that were brought up by the stakeholders which have been summarised in the following sections.

10.5.1 Non-Revenue Water

An issue of concern that was raised repeatedly during the stakeholder consultations was the high Non-Revenue Water experienced by the utility. Stakeholders were of the opinion that any effort made to manage the catchments should be matched with efforts by the utility to bring down their NRW. The utility recognises this issue and identified a number of factors that led to increased NRW; these include an increase in illegal connections, faulty meters, faulty billing and an inefficient revenue collection system. ELDOWAS on their part have initiated a number of strategies to address the cause of high NRW, including upgrading and improvement of the water supply network, adoption of meter reading technologies, replacement of old and faulty meters as well as sensitisation of water users and the general community.

10.5.2 Disjointed Conservation Initiatives

Individually many companies undertake or indicate willingness to undertake catchment conservation activities but currently each company prefers to do it on their own rather than as members of the Chamber of Commerce or through a collective effort.

Overall conservation efforts of the water catchments for Eldoret town are disjointed with organizations doing piecemeal work in different areas. These efforts have proved inadequate to forestall the challenges posed by climate variations and destructive human activities such as charcoal

production in the escarpments of Elgeyo Marakwet County where most rivers emanate, logging and deforestation in the water sources such as Kaptagat Forest. The EIWF will need to structure a collaboration framework for conservation organizations working in the area such as NCCK, KWTA, CCN and various conservation CBOs in the study area.

10.5.3 Impediments to Stakeholder Collaboration

It was observed by the Kenya Ordnance Factory Corporation who are involved in conservation work that coordination and legal framework to engage various actors remains a challenge and while individual organizations may have goodwill and resources to contribute to the overall conservation goals, the legal framework to allow such participation may be limiting and stakeholder engagement will require further efforts to create an enabling environment to bring organizations such as the Department of Defence and the Kenya Red Cross on board. Furthermore such a conservation goal will need champions to drive the vision. This is currently lacking and so everyone appears to engage in piecemeal efforts with limited impact.

10.5.4 Limited Funding for Water Resources Development

Limited funding for water resources work has meant that the catchment conservation work is largely not done while the public and government are focused on water services, which poses the challenge that the resource becomes degraded even though the Lake Victoria North Basin (where the city lies) is not generally considered to be a water stressed basins as compared to other basins in Kenya.

10.5.5 Private Sector Participation in Conservation

An additional challenge is that certain members of the Eldoret business community are associated with problems of riparian encroachment and river pollution. This complicates the engagement with these stakeholders and makes it hard to get enthusiastic support from them as regulatory agencies treat them as perpetrators of the problems rather than potential partners in the solution.

10.5.6 Pollution and Water Quality

All stakeholders consulted were concerned about the poor quality of river water due to effluent discharge and poor catchment management leading to massive soil erosion in some of river catchments. It was also noted that although the water table is quite high, most ground water is saline and households are not used to rainwater harvesting leading to overdependence on surface water.

10.6 Roles and Responsibilities

The success of the Eldoret Water Fund will be defined by how best the roles and responsibilities of stakeholders are assigned, which may depend on specific strengths and capacities and how best they fit into the functions of the water fund. The main functions of the water fund may be categorised as governance roles and implementation roles. A third and important function is that of resource mobilisation. Figure 10.4 gives a general proposal of potential roles that may be assigned to stakeholders. Further discussion on stakeholder roles and responsibilities, as well as a proposed governance structure is provided in Section 11.5.

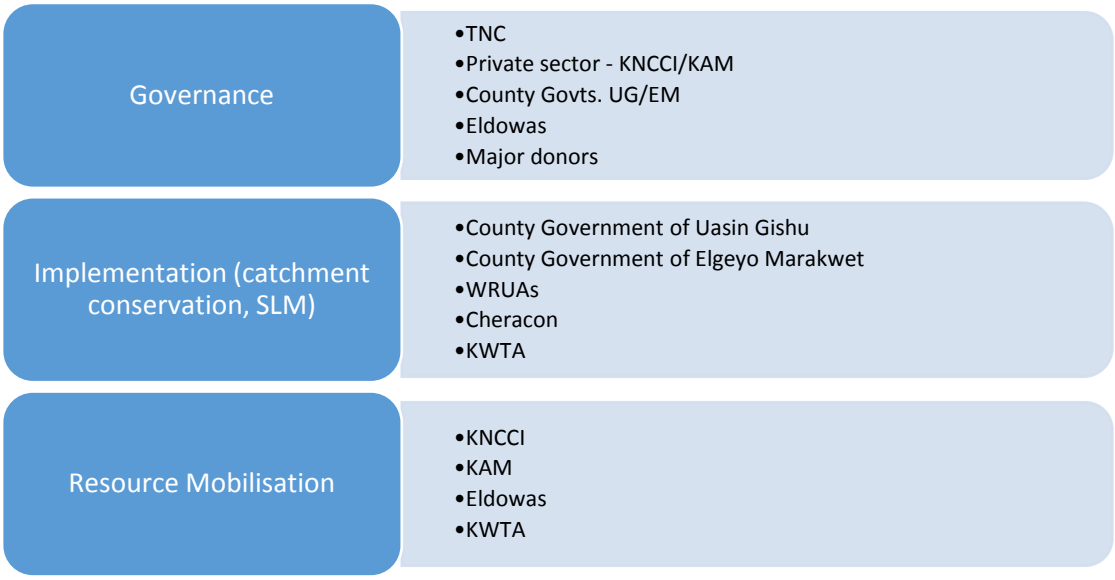


Figure 10-3 : Potential Stakeholder Roles and Responsibilities

11. ESTABLISHING THE ELDORET WATER FUND

11.1 Introduction

Adequate financing, proper organization and management as well stakeholder collaboration and participation are key aspects to the sustainability of a water fund.

The first step is therefore to establish the structure of the fund while putting into consideration the role to be played by the various stakeholders. The second step is to estimate the approximate costs of operating the Eldoret Water Fund. The third step is to identify the appropriate models of fundraising for the water fund.

11.2 Strategic Focus

11.2.1 Selected Target Areas

The stakeholder consultations and analysis of the threats on the water sources indicated that the target areas in order of priority are:

i) The Moiben River catchment, especially the catchment area for the Chebara/Moiben dam and within this area the priority is the steeply sloped farmland;
ii) The Sosiani and Charama river catchments with a particular focus on:
    a. The settled/farmed areas on the upper part of the catchment s(Kaptarakwa);
    b. Kaptagat forest;
    c. Riparian and buffer areas for Ellegirini and Two Rivers dams;
    d. Wetland areas.

11.2.2 Catchment Conservation Activities

The potential activities for the Eldoret water fund should include the following:

- Catchment conservation activities in farmlands including soil and water conservation interventions (terracing, vegetation strips, agro-forestry, conservation agriculture, etc.), with a particular focus on steeply sloped land;
- Forest conservation in indigenous and plantation forest areas which would include controlled access, controlled grazing, re-forestation, rewilding, protection against charcoaling and illegal logging, improvement of forest infrastructure (roads, offices, housing);
- Riparian and wetland restoration which would include demarcation of riparian areas, re-afforestation with indigenous trees, fruit trees, bamboo, etc. On-farm water storage should be promoted to reduce the need to abstract and water livestock in the rivers;
- Livelihood enhancement activities including small scale irrigation, high value crops, energy saving *Jikos* honey production, etc;
- Conducting catchment studies including risk mapping and impact assessments;
- Stakeholder mobilization;
- Information dissemination;
- Fund raising.

Due to the fact that water resources for Eldoret are transboundary, it will be important to engage institutions in both Uasin Gishu and Elgeyo Marakwet Counties in all the catchment conservation activities. Among the stakeholders consulted who could undertake conservation activities such as river pegging, tree planting and soil conservation are: the Kenya Water Towers Agency, Cherengany Conservation Network, The National Council of Churches of Kenya; Kenya Ordnance Factory Corporation, indigenous communities (e.g. Sengwer) as well as Water Resources Users Associations and county governments of Uasin Gishu, Elgeyo Marakwet and Nandi Counties. The details of works to be undertaken, as well as terms of engagement will be discussed and agreed later as the stakeholders discuss and agree on priorities, roles and responsibilities.

Among other proposed activities was the introduction of on-farm water storage at household level which would reduce the number of residents collecting water from the rivers and provide better water security for farmers. Stakeholders also proposed building capacity of technical extension workers to develop creative ways of increasing farm income in a sustainable manner. They also noted that developing communal water pans and introducing and promoting alternative livelihoods in specific forest areas such as Kapagat, Kapchemutwa, Lelan and Embobut forests will help reduce logging and provide water away from the water sources.

During the stakeholder consultations, KWTA mentioned a number of activities that the organisation would be willing to support the Water Fund in, including support in capacity building on catchment conservation and support in establishing alternative livelihoods.

11.2.3 Implementation Approach in Target Areas

For effective implementation partnerships with relevant stakeholders is recommended. Some of the critical stakeholders include ELDOWAS, ITEWASCO, the County governments of Uasin Gishu and Elgeyo Marakwet, the various Water Resource Users Associations (WRUAs), various Community Forest Associations (CFAs), Kenya Water Towers Agency (KWTA), Water Resources Authority (WRA), indigenous forest communities and Kenya Forest Services (KFS). For ease of implementation, it was noted that KWTA and WRA are currently working with WRUAs and CFAs in the target catchment areas while a number of NGOs are already involved in different conservation activities in the two counties.

County governments are particularly important because catchment conservation falls under the mandate of the county government although other organisations such as KWTA, KFS, and WRA can play a critical role in supplementing the role of the county governments. The county governments will therefore be the key implementing partner based on their mandate, presence and involvement in particular activities relevant to the water fund.

11.3 Stakeholder Mobilisation

For a well operating water fund, stakeholder mobilization should consider on-boarding stakeholders who can play the following critical roles:

- ***Championing organization.*** This will be the organization responsible for pushing forward the agenda of the water fund by playing a critical role in stakeholder mobilization and information dissemination. In the case of the Eldoret-Item Water Fund, TNC or a local well established NGO such as SNV could perform the role of the championing organization given

their neutrality, experience and relevant. The championing organisation would need to have convening power to draw stakeholders together;

- ***Host organization***. This will act as the home of the water fund. The host organization must therefore be a widely acceptable organization to the majority of the stakeholders. The host organization should be ready to provide physical space at least for the initial stages of the fund until a particular point in time when the water fund can stand on its own. As a start collaboration between SNV and ELDOWAS could form the host organization;
- ***Implementation agency***. The implementing agency would take on the role of organising or coordinating the implementation activities. Implementation would be undertaken through county government, local NGOS, WRUAs, CFAs etc. The implementation agency would need to have organisation and technical capacity and jurisdiction across all the targeted areas. A well established NGO (such as SNV) would provide a good candidate for this role.
- ***A brand ambassador***. This could be an individual or an organization who commands respect by virtue of what they do and are well known and easily accepted by the community, at the national level or at the international level. They are responsible for selling the ideals of the water fund by sending key conservation messages to the targeted respondents as well as for fund raising. It was also well noted that the athletics fraternity in Eldoret is very influential. A number of stakeholders engaged identified several athletes as potential ambassadors of the Water Fund.
- ***A funding agency***. This is a critical component of the water fund. There needs to be financial support to the water fund especially in the establishment stage. Funding is a critical factor that must be considered when looking at the sustainability of the water fund. The funding agency would take on responsibility for fund raising for the Eldoret-Iten Water Fund. The agency could be a local business willing to mobilise other local businesses or an independent organisation with good communication skills and a strong network among local stakeholders. Various local organisations that may be willing to support the Water Fund financinally if approached with a strong business case include: Raiply, KenKnitRupa, Rift Valley Bottlers (Almasi Bottlers), New KCC, Jamii Millers, Dola (Eldoret Grains), Rakeiel Plastics, Gulap Lochab, Biocorn EPZ, Mediheal, Eldoret Hospital, Reale, MTRH, Boma Inn, EKA Hotel, AEZ DL Group, RVVTI, Universities and Colleges (Eldoret University), Eldoret Club, KPC, Hindu Community, Sikh Union, Eagle Hardware (Mahindra Patel), Suswa Farm (Boit), CGA, C Millers Association, and the Private Schools Owners Association.

11.4 Organisational Structure

The Fund's organization structure should be one that meets the following criteria:

- **Credibility**: This implies that the organisational structure can reliably deliver impacts;
- **Efficiency:** This implies that the structure is not overloaded with bureaucratic complexity and resources can be channelled to effective implementation activities;
- **Effectiveness**: The structure should ensure sufficient technical competence to be able to confidently direct activities in a way that delivers the desired impacts.
- **Inclusiveness**: The structure should be able to leverage key stakeholder engagement for more effective implementation;
- **Independence**: The structure should ensure that the Water Fund is independent of any one organisation and can reflect and respond to collective decisions by many stakeholders;

- **Accountability**: The structure should ensure accountability systems to reassure investors that the resources are properly accounted for and well managed.

The options for the legal registration of the Water Fund should be considered to ensure that the selected legal format supports criteria mentioned above. Various options include:

- A Trust. This means that trustees would need to identified and beneficiaries specified. The beneficiaries can be the wider public. Registration of a Trust is a relatively simple matter. The appointed trustees have a significant role to play in ensuring accountability and credibility of the Trust. A Trust probably has a reasonable chance of being approved as a not-for profit for tax purposes. This format has been adopted by the UTNWF;
- Non-governmental organisation. This registration status means that the organisation would need to comply with the NGO Act. NGO registration can be quite a tedious affair. The NGO Board essentially provides oversight on the activities of the NGO;
- Private company limited by guarantee. This option is essentially a not-for profit company in which the shareholders do not receive any dividend. The shareholders appoint directors and the board of directors manages the affairs of the company. While it is easy to register a not-for-profit company the not-for-profit tax status is determined by the Kenya Revenue Authority and this is less obvious under this form of registration;
- No legal registration. This option means that the Water Fund would remain as an ad-hoc group. It is felt that this option would restrict the ambition and effectiveness of the Water Fund.

Eldoret-Iten Water Fund stakeholders should consider the different options and seek detailed legal advice to inform the decision making. The process of initiating the Water Fund can proceed while stakeholders consider the merits of the different options.

There is no unique organisational model that meets these criteria. However the experience from UTNWF provides a structure that can be considered. This provides a structure with three tiers of governance with different roles and responsibilities (See Figure 11-2). A host organization can provide other support services in the initial stages which help in cost reduction and creating trust amongst stakeholders.

11.5 Governance Structure

The governance structure of the fund will be one that (1) engages and utilises stakeholder capacity and resources and (2) enables a well governed and thriving fund.

11.5.1 Board of Trustees (BOT)

Potential representation on the board of interested and influential organizations in water resource and catchment management is presented below. The structure of the Board of Trustees (BOT) has been designed to support BOT functions including oversight and policy development. It is expected that key investors will be represented at the BOT level.

The mandate for the BOT covers:

- Custodian of the Trust Deed;

- Governance framework (Constitution) with Terms of Reference for the BOT, BOM, sub-committees and senior management positions, provisions on meetings, quorum, replacement of members, etc. Essentially this framework provides the governance structure for the Water Fund;
- Custodians of the Endowment Fund;
- Establishment of the governance policy that covers the management and use of the endowment fund;
- Replacement / rotation of members;
- Overall accountability to donors;
- Long term sustainability and governance.

EIWF President	• Influential, familiar, inspiring leader • Preferrably known in investment circles
EIWF Chair	• Influential, inspiring leader • Preferrably from the Eldoret community
County Governments	• Uasin Gishu • Elgeyo Marakwet
NGO representative	• Buck - stopping • Strategy and implementation support
Main Donors	• GEF • World Bank
Eldowas & Itewasco	• High beneficiary • Resource mobilisation
Private Sector Representative	• Resource mobilisation

Figure 11-1 : Proposed Board of Trustees Representation

11.5.2 Board of Management (BOM)

The Board of Management (BOM) will also need to be established. The mandate of the BOM is to provide guidance and oversight on the operations of the water fund. The BOM can be expected to set out the framework that directs the operations of the water fund, namely:

- HR policy;
- Resource mobilisation strategy;
- Communication strategy;
- Green investment strategy;
- M & E policy.

The structure of the BOM should be one that accommodates the skillsets required for the operation and running of the fund. The skillset can be drawn from within the pool of organisations that should be represented on the BOM with the final outcome that the required skillset is attained and the key

organisations represented. A sample Board of Management structure is proposed in Table 11-1. The board officials will be elected from the membership on an agreed rotational basis.

Table 11-1: Proposed Composition of Board of Management

Skill Set	Proposed Representation
Financial management	Private sector representative
Investment management	Pearl River AEZ
Fund raising	NGO representative
Legal services	KNCCI
Risk management	KAM
Human resource management	County Government of Uasin Gishu
Marketing	Almasi Beverages
Communications	KFS
Accountancy	ELDOWAS
Technical services: • Rural livelihoods / soil & water conservation	KWTA
• Environmental conservation	County Government of Elgeyo Marakwet
• Water and sanitation	LVNWWDA
• Agricultural value chain	SNV/ NGO representative
• Monitoring and Evaluation	University of Eldoret

Private sector representatives (Kenya Association of Manufacturers and the Kenya National Chamber of Commerce and Industry) indicated that the Fund should be private sector led as this may ensure better accountability which is crucial to ensure financial support flows to the Fund. The proposed governance structure is as shown in Figure 11-2:

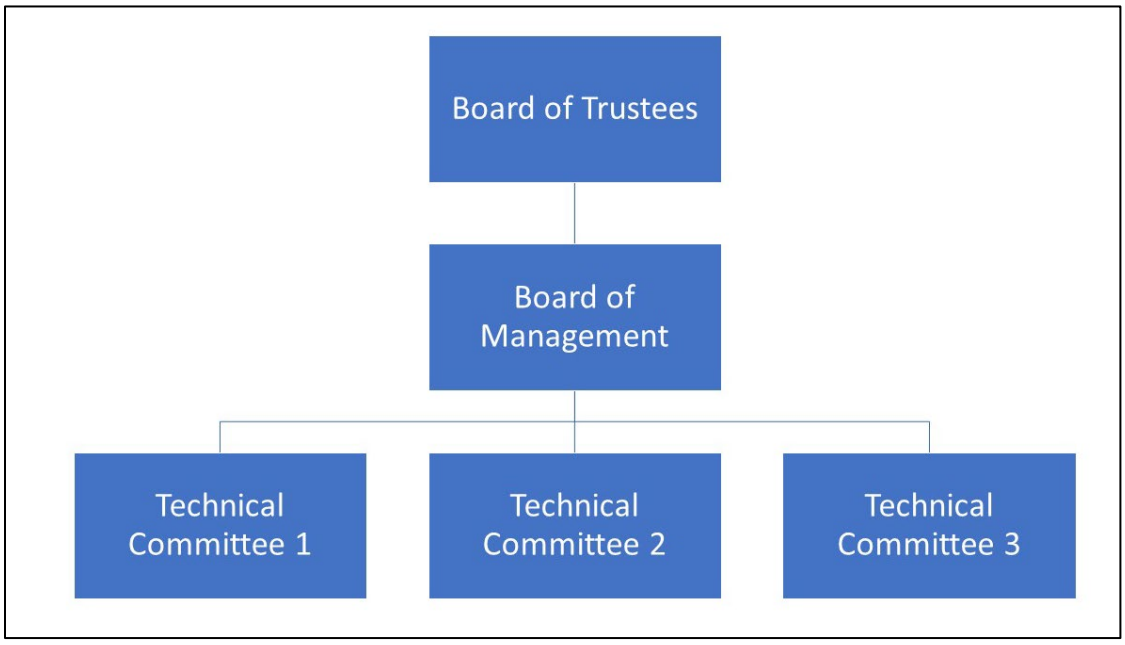


Figure 11-2 : Proposed Eldoret-Iten Water Fund Governance Structure

11.5.3 Secretariat

It is anticipated that the EIWF would have an arrangement similar to that of the UTNWF, which has a lean administrative staff and implementation activities are outsourced to partner organisations. An indicative staffing arrangement for the Eldoret-Iten Water Fund has been established to identify operational costs. This anticipates the following staff:

- EIWF Manager;
- Project Officer;
- Resource Mobilisation officer;
- M & E Officer;
- 4No. Field coordinators (potentially seconded from County Governments);
- Administrative staff (finance, procurement, etc.).

These staff would be supported by technical staff from the counties and/or other partner organisations.

11.6 Indicative Set Up and Operational Budget

Indicative costs for the establishment and operation of the fund are presented in Table 9-11 and Table 9-12. These indicate that approximately US$ 270,000 may be needed to establish the EIWF office (transport, computers, furniture etc.), including US$150,000 to setup the M&E system (river gauging stations, water quality monitoring etc.). The total annual operational budget is estimated at US$ 534,600 cover staff, logistics, governance and administration. This also includes 20 % of the operational costs which is the estimated cost for M&E amounting to US$ 85,200 annually.

11.7 Financing Operational Costs and Investments

This will involve finding the most appropriate financing options based on the structure and the needs of the water fund. Some of the possible funding sources are discussed below.

11.7.1 Catchment Conservation Levy

The question faced by stakeholders, whether within or external to the EIWF is how is catchment conservation expected to be financed within the current policy and legislative landscape and whether the EIWF can exploit this avenue to acquire funds for a coordinated catchment conservation effort in the Moiben, Charama and Sosiani river catchments? At present there is no specific mechanism to raise revenue for soil and water conservation. County governments with the mandate for soil and water conservation are expected to finance these activities from general funds.

Forest related activities are expected to be financed by the Kenya Forest Services although revenue from logging licenses does not cover all the KFS operational costs so KFS obtains addition funding from the exchequer. This implies that KFS does not have funds that can be set aside to support the operation of the EIWF. The same applies to WRA.

WRA charges water abstractors such as ELDOWAS and ITEWASCO with raw water use charges currently fixed at Ksh0.5 per cubic metre. For ELDOWAS (daily production 48,000m^3/day) and ITEWASCO ((daily production 2,600m^3/day) this amounts to USD92,345 per year. These funds are collected by WRA to be used by WRA to fulfil its mandate which is regulating the use and

management of the water resources. There is a widely held erroneous misconception that the water use charges imposed by WRA should be used for catchment conservation. In order to clarify this situation the draft 2019 WRM Regulations proposes to impose a 5% levy on abstraction charges to be collected by WRA and remitted to WSTF for administration and disbursement to WRUAs for catchment conservation[10]. In addition, the draft WRM regulations propose to raise the raw water use charges to Ksh5/m^3. If these revised regulations are gazetted as proposed, then ELDOWAS and ITEWASCO will pay collectively an additional USD 46,173 for catchment conservation (Table 11-2). However, even if WRA collects these revenues there is no guarantee that these revenues will be disbursed for catchment conservation in areas where the water abstracted. WRA and WSTF are yet to structure an allocation framework for these funds. Furthermore these funds may be disbursed directly to WRUAs and so would not be eligible to support the operational costs of the EIWF. In addition, the sum involved is only a portion of the EIWF operational costs and additional sources of income would be required to support EIWF. It should also be stated that the draft WRA Regulations have not been subjected to public consultation and the proposed increase in raw water abstraction charges is likely to face stiff resistance from WSPs and other abstractors.

An alternative approach is for the WSPs to consider imposing a levy on the water consumption. This is legally possible and would require WASREB approval. Clearly local stakeholders would also need to support such a move. However it is informative to see what revenue could be derived from such an arrangement. Clearly a levy of Ksh3/m^3 would raise sufficient revenue to cover the annual operating costs of the EIWF or to put USD 550,000 towards investments in catchment conservation and livelihood improvement programs undertaken by the EIWF.

Table 11-2 : Options for Catchment Conservation Levies

Item	Unit	Sum			
Annual water produced by ELDOWAS	m^3/yr	17,520,000			
Annual water produced by ITEWASCO	m^3/yr	949,000			
Total Annual Water Produced	m^3/yr	18,469,000			
Water Use Charge rate	Ksh/m^3	0.5	0.5	5	5
Water Use Charge	USD/yr	92,345	92,345	923,450	923,450
WRA Conservation Levy	%	5	10	5	10
WRA Catchment Conservation Levy Revenue	USD/yr	4,617	9,235	46,173	92,345
WSP Catchment Conservation Levy	Ksh/m^3	1	2	3	4
Revenue	USD/yr	184,690	369,380	554,070	738,760

11.7.2 Grants and Donations

Grants and donations can be solicited from local industries and stakeholders or from external partners. The willingness of local industries and stakeholders to provide grants would be affected by the imposition of a catchment conservation levy as discussed above. Stakeholders would rightfully recognise that they have already paid for catchment conservation through the levy. However, if the levy option is not adopted, then water consumers, industries and stakeholders can be approached for

[10] Pers. Comm. Prof. Albert Mumma (Oct 2019). The option of increasing the levy to 10% has also been mooted by WRA.

donations. This requires a lot of continuous effort and can result is a rather ad-hoc arrangement. Any arrangement whereby consumers are making payments on a regular basis has merit as this provides a more predictable income. For example the Mount Kenya Ewaso Ngiro Partnership has agreed a voluntary Ksh5,000/- per acre per year donation from commercial flower growers.

Grants can be sought from external partners. Again this requires development of technical proposals and extensive and continuous outreach to potential donors. While this approach can result in significant funds, typically for investment activities, the flow of funds can be lumpy and tied to specific outputs which restricts the EIWFs ability to use the funds for operational costs.

The ideal situation is where un-tied funds are provided to the EIWF. These funds could be placed in an endowment fund from which interest can be used to finance EIWF operations and investments.

11.7.3 Carbon Markets

There are a number of programs that link organisations involved in carbon sequestration to markets where industries typically in industrialised countries are seeking to offset their carbon emissions. These programs are quite complicated to set up and require detailed studies on baseline conditions and monitoring to establish actual sequestered carbon. In addition the carbon market has seen significant fluctuation in the value of carbon offsets. We recommend a detailed study to elaborate the merits and potential of using the carbon markets as a potential source of financing EIWF investments.

11.7.4 Co-sharing capitalization

The concept of co-sharing or cost-sharing is that a certain portion of the required investment funds are provided by the beneficiaries. For example a cost-sharing arrangement for construction of farm ponds and drip kits may be that the labour costs are provided by the beneficiary and the material costs are financed by the EIWF. This means that the EIWF is able to support the development of an output without having to pay 100% of the costs. In addition this approaches ensure that the beneficiary has some “skin in the game” or ownership of the investment. This arrangement can help to deliver the portfolio of investment activities but is not generally a route to raising funds to cover operational costs.

Another source of co-financing is from county governments and other government agencies that commit their own resources to finance the targeted investments. For example the county governments make commitments in their CIDP regarding investments in environmental conservation that can be used to finance the intended activities in the targeted catchments.

As stated earlier, both Elgeyo Marakwet and Uasin Gishu Counties have made provisions in their CIDPs for catchment conservation activities in areas of interest to the study. In their 2018 - 2022, CGUG had provided for Ksh. 50M for the protection and rehabilitation of Sosiani, Moiben and Chepkoilel Rivers, and the conservation of major wetlands.

11.7.5 Loans

Businesses with a secure business plan typically finance their capitalisation through loans. Loan repayments and operational costs are made from business revenues. This arrangement basically enables businesses to obtain capital on the expectation of future revenues, rather than having to wait to accumulate the required capital. Loans can be provided by a range of institutions such as banks or

private investors. The critical ingredients are a reliable business plan, credibility as a borrower, and confidence in the future operating environment.

With respect to the EIWF there are certain development agencies and commercial banks that may be interested in funding green investments through a loan product that targets socially responsible investments. The loan repayments would need to be made from other funds generated by the Water Fund or from interest on an endowment fund.

11.8 Endowment Fund

The ideal arrangement for the EIWF would be to set up an endowment fund with sufficient principal so that the interest covers the annual operational and investment costs. For example an endowment fund of USD10Million, earning 10% interest annual would provide USD1Million which would be sufficient to cover USD0.5Million operational costs and USD0.5Million investments. Financial endowments are typically structured so the principal amount (capital) invested remains intact, while investment income (interest) is available for use to keep a non-profit organisation operating, potentially indefinitely.

There are three primary components of endowment funds are as follows:

- ***The investment policy***. This policy lays out what types of investments a manager is permitted to make and dictates how aggressive the manager can be when seeking to meet return targets;
- ***The withdrawal policy.*** Establishes the amount the organization is permitted to take out from the fund at each period or instalment. The withdrawal policy is usually based on the needs of the organization and also takes into account the amount that remains in the fund;
- ***The usage policy***. This policy explains the purposes for which the fund may be used and also serves to ensure all funding is adhering to these purposes and being used appropriately and effectively.

These policies will need to be developed as part of the establishment of the fund.

12. MONITORING AND EVALUATION PLAN

This pre-feasibility study reveals pollution, land use changes, sedimentation and climate change as some of the risks to the sustainability of the Eldoret Town water resources. It further identifies sediment retention and flow regulation as the two main ecosystem functions that most require improvement in order to enhance the Eldoret's town water source sustainability and achieve broader environmental benefits such as climate change resilience and enhancement of biodiversity.

The goal of the Eldoret Water Fund will therefore be to build collective action and increase investments for source protection and catchment conservation with a view to secure and improve water quality and quantity of the Eldoret Town water sources for the benefit of nature and upstream and downstream communities. The fund will thus be designed on the assumption that its interventions will lead to the following key outcomes: -

- A well conserved catchment(s) with regular flow of water throughout the year and enhanced eco-systems;
- Improved water quality and quantity for downstream residents and commercial activities in Eldoret town;
- Improved human well-being and quality of life for up-stream communities;

The Eldoret Water Fund will therefore require a robust M & E Framework with clear indicators, baseline information, targets and a well thought out monitoring system to aid the Fund to assess if it is meeting its targets and objectives. This information will be useful to show that interventions are achieving intended outcomes and will aid the Fund to demonstrate its benefits of watershed management (results) to its key stakeholders. The information will also enable correction of management strategies and thus provide an opportunity for adaptive management for the Fund Managers.

At this pre-feasibility phase, information available is not sufficient to prepare a detailed M & E Plan. This chapter therefore sets out the preliminary outline of the M & E Plan which can provide a basis for the Terms of Reference and costing for the detailed M & E Plan at the design phase of the Eldoret Water Fund.

12.1 M & E Framework

Monitoring involves the systematic and continuous collection and analysis of data and use of resulting information to examine outcomes of management actions, measure implementation progress and guide management decisions.

Evaluation is a systematic, objective and periodic assessment of an on-going or completed project, its design, implementation and results to determine the relevance and fulfilment of objectives, developmental efficiency, effectiveness, impact and sustainability.

While monitoring mainly focuses on measuring implementation (Input and output) indicators evaluation focuses more on impact (outcome) indicators and monitoring information provides the basis for evaluation.

The Eldoret Water Fund's M & E framework should therefore: -

1. Specify outputs and outcomes indicators based on the interventions it has spelt out to address the identified ecosystem functions that it is seeking to enhance;
2. Spell out socio-economic indicators to measure impact on well-being of communities;
3. It may also be important to consider institutional related indicators to monitor the establishment and growth of the Water Fund including indicators to show progress in securing project inputs.

Table 12.1 provides a number of indicators that can be considered during design of the M&E Plan for the Eldoret Water Fund.

Table 12-1 : Potential Indicators for M&E Framework

Outcome	**Indicator**	**Means of Verification**
Sediment yield reduction	Annual sediment yield	Sediment monitoring data
Increase in river discharge	Annual specific yield	Discharge data
Improvement in river water quality	Trend in WQ for specific parameters	WQ sample data
Increased farm production	Farm Production	Farm production logs
Increased farm income	Farm income	Farm revenue logs
Outputs	**Indicator**	**Means of Verification**
SLM Interventions	Km of terraces, grass strip	Quarterly Progress Reports
	Ha of land under conservation agriculture	Quarterly Progress Reports
	Soil fertility	Quarterly Progress Reports
	% area of erosion hot spots conserved	Quarterly Progress Reports
	Km riparian land conserved	Quarterly Progress Reports
	Ha of land under	Quarterly Progress Reports
Rural Livelihoods Improved	Milk production	Farm logs
	Meat production	Farm logs
	No. of operational apiaries	Farm logs
	Farm income	Farm logs

The development of the M & E Framework for the Eldoret Water Fund should additionally be guided by the following general considerations

- A Cause-effect logic that has the ability to show that the assumptions made and direction taken are correct and the strategies and resources used resulted in the desired outputs and outcomes;
- Owing to complexity of ecological monitoring, the Fund's M&E framework should primarily be focused on measuring specific trends of interest that are related to the Fund's interventions

(Strategic Effective monitoring primarily focused on checking if conservation actions are meeting desired results (Ervin et al, 2010)) as opposed to absolute values (Status Monitoring);
- Involvement of key stakeholders in the identification of relevant indicators and the preparation of the M & E Plan;
- Indicators should include a mix of environmental, socio-economic and institutional factors;
- Identification of indicators and sampling regime should make due consideration of existing monitoring programs and available data sets;
- Adequate resource allocation including budgets, institutional capacity, clear responsibilities and reporting mechanisms.

Based on the aforementioned key consideration, the Fund's M & E Framework will thus endeavour to clearly detail the following: -

- Clear M & E Objective;
- Suitable and meaningful output and outcome indicators;
- What monitoring activities will take place, when and by who;
- Estimated cost for M & E;
- Capacity building needs and plans for staff and institution(s) to be responsible for the M & E;
- Intended audiences for evaluations;
- How monitoring information will feedback into management decisions e.t.c.

12.2 Establishing Monitoring System

Ability to measure changes and trends over time in the catchment of interest as well as establishment of linkage of those changes to the Eldoret Water Fund is pegged on availability of reliable information on the output and outcome indicators.

The Fund's M & E Plan should consider what, how, where, when monitoring data will be obtained, stored, analysed and results presented and should thus spell out the following: -

- Fund's Monitoring Objective which may include;
    1. Track environmental and economic effects of the funds interventions;
    2. Ensure investments are achieving anticipated impacts;
    3. Enable correction of management strategies;
    4. Provide necessary data for evaluation and learning;
    5. Provide accountability to donors, investors, stakeholders, partners and participating communities.
- Output Indicators to be monitored that explicitly relate to the management objectives and desired condition/outcome;
- Where each of the data on the output indicators will be sourced from (Could be from existing monitoring programs and in the absence of such the M & E Plan should factor in establishment of necessary monitoring programs);
- Sampling strategy and design;
- Data collection methods, data handling, maintenance and organization;
- Means to be used to ensure data quality (Check accuracy, validity, reliability and integrity);
- Reporting requirements and dissemination plan of the monitoring information.

12.3 Evaluation & Learning

The M & E framework for the Eldoret Water Fund provides a primary mechanism for accountability, knowledge generation and learning. Monitoring data assists in evaluation and learning from the effects of management actions and allows adjustment to achieve ecological, social and economic outcomes.

To amplify its benefits, the Eldoret Water Fund evaluation strategy will be focused on showing what changes (Outcomes) have occurred after application of its various interventions. To guide the evaluation, an overall evaluation question that captures the goal of the water fund will therefore need to be framed and outcome indicators that answer the evaluation question developed. In line with this, three groups of outcome indicators are critical to the Eldoret Water Fund:

- Environmental Function (Watershed Protection, Water quality and Quantity) indicators;
- Socio-Economic (Human well-being) indicators;
- Institutional (Water Fund Growth) indicators.

In addition to the evaluation question and outcome indicators, it is expected that the M&E Plan for the Eldoret Water Fund will spell out the data sources and data collection methods for the outcome indicators. To aid the illustration of before and after changes, it will be critical to undertake baseline surveys and the M&E plan will thus also give details of the outcomes of such surveys.

Finally, the M&E Plan will indicate the frequency of evaluations, how the stakeholders/consultant will be engaged and additionally show how learning knowledge will be identified, captured, documented and shared.

12.4 Risks

Financial, institutional and technical resources are needed to implement an effective M & E Plan and insufficiency of any of these poses risks to the M&E activities of the water fund. M & E activities of a Water Fund are also subject to external factors that could derail the achievement of the M & E Plan. The M & E Plan should thus also include a risk analysis and recommendation of mitigation measures. Additionally, environmental issues are dynamic and as such, the M & E Framework for a water fund should also be a living document that should be updated as new research and monitoring information becomes available with a view in ensuring that the M&E Plan remains focused and relevant.

12.5 Exit Strategy

It is aspired that once established, the Eldoret Water Fund's interventions will continue to deliver benefits to nature and upstream and downstream communities for many years to come and that the fund will also be ecologically, socially and financially self-sustaining.

The nature of conservation activities requires not just the priority interventions but also maintenance activities to protect the interventions. The fund should therefore contemplate how it will continue to engage with stakeholders to ensure that it protects the gains made by the fund.

Sustainable financing is also particularly crucial to ensure that the fund meets its goals and objectives within the timeframes agreed by stakeholders. As such, Chapter 11 has contemplated the setting up of

an endowment fund to support activities post the water fund incubation period as a way of ensuring financial sustainability and continuity of intervention.

Nevertheless, the fund still needs to remain alive to changing circumstances that may require an exit strategy. This situation may arise if the enabling environment ceases to remain supportive, or if the desired impacts cannot be achieved due to external factors. The M&E plan will thus also contemplate the need for and composition of an exit strategy including what will be the trigger and who will initiate the foreseen exit process if need be.

13. CONCLUSIONS

13.1 Policy, Legislation and Institutional Landscape

The analysis of the policy, legislative and institutional landscape indicates that there are strong policy drivers for engagement in catchment conservation. The institutional landscape is complex as the catchment conservation function is mandated to the County Governments with various national level agencies holding mandates relevant to the management of the catchment areas, namely KFS, KWS, WRA and the KWTAs. This complex institutional landscape reinforces the need for strong stakeholder collaboration and coordination. A number of existing multi-stakeholder partnerships in other catchments provide some local experience in how a water fund can work within this institutional landscape. Various lessons learned regarding multi-sectoral coordination and financial constraints should be taken into account and mitigated or managed from the onset.

13.2 Water Demand and Supply

In 2009, the municipality of Eldoret had a water demand estimated at 26,000 m^3/day. This has grown to around 60,000 m^3/d in 2019 reflecting the dramatic growth in the town population and commercial activity. The growth pattern is expected to continue with water demand expected to reach 132,000 m^3/d by 2050.

The current surface water supply of 50,550 m^3/day provided by ELDOWAS which meets 84% of demand is sourced primarily from the Moiben Dam (55%), Two Rivers Dam (30%), and Ellegirini Dam (18%). The Kesses Dam provides an additional 1% of supply. This implies that the main catchments of interest are associated with the Moiben and Sosiani river systems.

The LVNWSB has planned future developments to increase the capacity of the Kipkaren Dam and to construct a new Two Rivers Dam to bring in an additional 24,000 m^3/day and 57,500 m^3/day respectively. These two developments are intended to meet the water supply deficit.

The 2009 census indicated that a significant portion of the population rely on groundwater, implying that groundwater recharge and resources should be carefully managed. However, the groundwater potential based on the information reviewed for this study is considered to be limited and is unlikely to form a significant water source in future nor provide a sufficient backstop to mitigate the effects of an extended drought. The future outlook is therefore that ELDOWAS will rely heavily on flows from the Moiben, Sosiani and Kipkaren rivers into the future.

13.3 Water Resources Sustainability

The most important catchment for ELDOWAS is the Moiben catchment as this source accounts for 50.4% of the water supply for Eldoret town. The Moiben River flows from the Cherangany Hills Forest, specifically the Embobut forest block. The catchment was originally covered in indigenous forest but parts of the forest has over the years been cleared for settlement and farming with forest cover now accounting for 45% of the Moiben Dam catchment, with farmland representing 55% of the area. More than 50% of the catchment has steeps slopes (12-40% slope) and where this coincides with tilled farmland the risk of erosion is high, given the lack of terraces, grass strips or other forms of soil conservation measures. The erosion results in sedimentation in the Moiben dam which will shorten the productive life of the dam. The conversion of farmland from grassed paddocks for sheep

production to tilled land for potato production (last 10 – 15 years) is a relatively recent phenomenon and adequate soil conservation measures have not been implemented as part of these land use change. The MEMR 2012 Masterplan identifies a number of other challenges facing the Cherangany ecosystem including encroachment, high water use, illegal logging, charcoal burning, firewood collection, illegal grazing and cultivation within the indigenous and plantation forest areas.

In addition there are potential sources of pollution that have been identified although these are primarily associated with the river reach below Moiben Dam. These include riparian farming, animal watering, bathing, laundry-washing and sand harvesting. These pollution sources may pose a future threat due to the increasing population in the catchment.

The Climate Risk Profile for Elgeyo Marakwet County (MoALF, 2017) identifies a decreasing trend in rainfall in the county, with the low-lying eastern part of the county having lower and less reliable rainfall and is more at risk of drought. However, the central and western parts of the county will experience increasing intense rainfall which can lead to flash floods, severe erosion and landslides. Future climate change projections also predict an increase in drought stress, with projected delays in the onset of rains.

The land use and climate risks described for the Moiben catchment are similar to those anticipated for the Sosiani river catchment that feeds the Ellegirini and Two Rivers Dams. The difference is that a larger portion of the Sosiani catchment is farmed (72%) with 28% being forest (primarily plantation forest) and the catchment has generally lower slopes with 94% have slopes less than 12%. Consequently the erosion risk is less although the farmed area is larger. However, the risk of pollution associated with farming activities is greater.

The Sosiani catchment has also seen significant changes from forest cover to farmland over the last 30 years and significant urbanisation in the lower reaches as Eldoret town and satellite centres expand. This poses an addition risk of pollution to the river system from poor solid waste management.

The Kipkaren catchment will become more important to Eldoret Town water supply in the future after the development of the Kipkaren supply to Eldoret. The Kipkaren catchment is similar to the Sosiani catchment with 88% under farmland and 11% under forest. The Kipkaren catchment generally has gently slopes with 97% of the catchment with slopes of 12% or less. The main risks within the Kipkaren catchment arise from unregulated abstractions, pollution from farmland, poor sanitation and solid wastes associated with an increasing urban population.

13.4 Selection of Target Areas and Potential Water Fund Activities

The primary focus of the Eldoret Water Fund should be on the farmland areas within the Moiben and Sosiani catchment, especially the areas with steep slopes (> 12% slopes). While the majority of this targeted area lies within the Moiben catchment, there are sections within the upper part of the Sosiani catchment that fall within this target criteria. In addition, the forested areas within both catchments need to be properly conserved and in certain areas re-forested with indigenous species.

The most suitable interventions on the steep farmland areas to reduce erosion are terraces, grass strips and other forms of barriers that reduce slopes and slope length while improving soil fertility and soil physical properties.

The Kipkaren catchment will also become important in future and efforts in this catchment need to focus on riparian encroachment, unregulated water abstractions, and pollution from farmland and poor sanitation facilities.

13.5 Eldoret-Iten Water Fund Activities

The EIWF activities should focus on catchment conservation activities within the targeted areas composed primarily of farm and forest land. Of immediate importance would be the soil conservation measures on the steep slopes sections of the Moiben and Sosiani river catchments with terraces, grass strips and other SLM practices to reduce soil erosion. Additional efforts are needed to conserve the riparian and wetland areas which play a significant hydrological function in terms of reducing sediment ingress and transport in the rivers, protecting river banks from erosion, attenuating floods and enabling groundwater recharge. The tree cover can be increased through agro-forestry which provides forestry products while enhancing agricultural production.

Within the forested areas, conservation efforts to re-forest with indigenous species and to reduce charcoal burning, illegal logging, encroachment, and cultivation are required.

In addition to the conservation efforts, livelihood enhancement activities are important to enable forest adjacent households to have income sources independent of the forested areas. These livelihood activities would include honey production, drip irrigation, and production of high value crops and products.

13.6 Stakeholder Mapping and Analysis

The stakeholder mapping, consultations and analysis identified a number of key stakeholders for the development of an Eldoret Water Fund, including:

j) **Water Service Providers in Eldoret, Iten and its environs**. Eldoret Water and Sanitation Company (ELDOWAS), Lake Victoria North Water Services Board, and the Iten-Tambach Water & Sanitation Company;
k) **Major Water users** – Chamber of Commerce (representing traders and urban dwellers), KAM (representing manufacturers), beverage & water bottlers;
l) **Catchment managers and users** – County governments of Uasin Gishu and Elgeyo Marakwet, WRUAs, CFAs, KVDA;
m) **Transport Infrastructure Developers** – KERRA, KENHA, KURRA;
n) **Regulatory agencies** - Water Resources Authority (WRA), National Environmental Management Authority (NEMA);
o) **Agencies responsible for Protected Areas** – Kenya Wildlife Service (KWS), Kenya Forest Service (KFS), Kenya Water Towers Agency (KWTA);
p) **Conservation enterprises in the catchment areas** – e.g. Cherengany Conservation Network, National Council of Churches of Kenya; Kenya Ordnance Company.

q) **Public Funding Agencies** – World Bank, County Governments of Uasin Gishu, Elgeyo Marakwet, and the National Government of Kenya, NOREB;
r) **Research Institutions** – University of Eldoret, Moi University, Rift Valley Technical Training Institute (RVTTI).

During the stakeholder consultations, stakeholders raised a number of issues that the Eldoret Water Fund needs to consider, namely:

- High non-revenue water. High NRW in ELDOWAS was seen potentially as an issue that could undermine stakeholder motivation to invest in the fund;
- Disjointed conservation initiatives. While many stakeholders indicate willingness to engage in conservation activities, and some are already engaged in such activities, it was recognised that the fund can play a positive role to coordinate stakeholders to gain more impact from collective efforts. However, the EIWF would need to encourage stakeholders to work collectively;
- Limited funding for water resource developments. Public attention is generally focused on water services and scant attention and resources are given to water resource conservation. This will require awareness raising to motivate stakeholders to invest in catchment conservation initiatives;
- Transboundary conditions. A significant portion of the catchment areas lie in Elgeyo Marakwet County and the ELDOWAS water consumers lie in Uasin Gishu County. This implies that inter-county collaboration will be important to the success of the EIWF;
- Private sector participation. Stakeholders felt that the private sector has a significant role to play, not only in providing financial support to the EIWF but also in providing leadership to ensure that the EIWF is fully accountable;
- Branding. Eldoret is known as the "Home of Champions" and has a strong history of providing world class athletes who can provide recognition in local and international settings to support the cause and fund raising efforts for the EIWF.

13.7 Economic Analysis

The economic analysis is based on a number of assumptions, namely:

- SLM interventions are focused on the steep farmed parts of the Moiben, Sosiani and Kikpkarren catchments. The SLM interventions were modelled using SWAT to determine the sediment reduction that arises from the SLM intervention;
- A combination of terrace farming and 5m strip farming was found to be most effective as this would reduce the sediment yields by 45.6% on average. Other SLM measures generated sediment reduction rates of 13 – 35%, implying that a target of 30% reduction is reasonable;
- Overall costs for the proposed SLM, agroforestry and reforestation interventions are estimated at US$14.4 million and US$1.542 million for livelihood support programs. These interventions would be spread out evenly over a 10 year period;
- Total fund set up costs including establishing and equipping the physical office as well as initial meetings is estimated at US$ 270,000;
- The total annual operations costs are estimated at US$ 534,600;

- These benefits start to accrue after a 4 year lag. Benefits from these interventions are estimated at US$2.965 annually, once all the SLM interventions have been implemented;
- Discount rate of 5% (net of inflation).

The net result is that the EIWF shows economic viability in year 19 when the net present value of the benefits minus the costs becomes positive.

13.8 Establishment of the EIWF

The registration and governance structure currently adopted by the Upper Tana Nairobi Water Fund provides a suitable model than can be adopted by the EIWF. Legal registration would be through the form of a trust governed by a Board of Trustees (BOT) whose membership would reflect key stakeholders and investors from both the private and public sectors. Governance of implementation activities would be guided and overseen by a Board of Management (BOM) which would reflect private and public sectors but would also reflect the skills and experience needed to oversee fund activities and accountability requirements. A lean and effective secretariat would be responsible for implementation activities, coordination with stakeholders, fund raising and implementing the M&E Plan.

Financing of the EIWF operational and investments costs requires a detailed plan which can make use of public and private sector financing, with strategic external funding to support start-up costs. There are various options within the legal framework for WRA and/or WSPs to raise revenue through targeted conservation levies that could raise funds to support the operations of the EIWF. The development of the financing plan would require detailed stakeholder consultations.

13.9 M&E Plan for the EIWF

The M&E Plan would need to be properly designed once the EIWF makes firm decisions on the target area(s) and activities. The desired impacts and outcomes can then be specified which will inform the selection of indicators. Baseline studies and a monitoring system will be required so that changes and impacts can be measured. The monitoring system is likely to require the measurement of streamflow, sediment, water quality, extent of riparian land conserved, farm/household productivity, farm income and household income sources.

13.10 Overall Conclusion

In conclusion the pre-feasibility study finds that there is a compelling case for the Eldoret Water Fund and, with sufficient mobilisation of stakeholders, a good likelihood of committed stakeholders who can ensure an organisational structure with good governance and sufficient resources that delivers significant conservation impacts.

14. RECOMMENDATIONS

14.1 Selection of Target Areas and Potential Water Fund Activities

The water resource analysis clearly indicates the importance of the Moiben and Sosiani river catchments for the Eldoret Town water supply, with the Kipkaren catchment becoming important going into the future. The upper parts of the Moiben and Sosiani catchments that have steep slopes and are farmed should form the most urgent target areas for conservation investments with the forested parts that have important bio-diversity value also being targeted for conservation. The most appropriate SLM interventions include terracing and grass strips to reduce erosion and the likelihood for landslips.

Conservation activities should be coupled with livelihood enhancement activities to give forest adjacent households income sources independent of the forest.

14.2 EIWF Business Case and Financing Plan

A detailed study is required to elaborate the EIWF business case and a financing plan, taking cognisance of the suggestions offered in this study. The business case can be strengthened with detailed information on the dam designs to evaluate the impact of the sedimentation on the life span of the dams and the impact on water supplies. Furthermore the economic benefits of SLM interventions, riparian conservation, agroforestry and additional reforestation can be better quantified.

The financing plan for the EIWF operations and investments will require a combination of funding sources. The desire is to ensure that the EIWF has reliable funding for operations. Various options in terms of conservation levies generated by WRA and/or WSPs should be explored with the relevant stakeholders. Funding for conservations investments can be sourced from public sector funds through co-financing arrangements. External funding may be required to support start-up costs. A concerted effort will be required by EIWF champions and stakeholders to develop and implement a sustainable financing plan.

14.3 EIWF Establishment

It is proposed that the EIWF adopt an organisational structure similar to the UTNWF as this meets the criteria of accountability, efficient decision making, involvement and responsibility of key stakeholders. Essentially there should be two tiers of governance with a Board of Trustee (BOT) responsible for fund sustainability, policy, oversight, and accountability and a Board of Management (BOM) responsible for oversight of program implementation, resource mobilisation and monitoring and evaluation. Proposals have been made regarding possible institutional membership to the BOT and BOM. However, additional stakeholder consultations are recommended to firm up roles and responsibilities within the governance structure of the EIWF.

The EIWF will require a secretariat responsible for daily operations. This will require staffing, an office, and logistical support. The EIWF will need to establish an office which can be independent or hosted within an existing stakeholder's facilities as is currently adopted by the UTNWF where TNC hosts the secretariat.

The EIWF will need to involve local stakeholders in the delivery of the proposed intervention measures. The principle stakeholder is the County Government as catchment management is a devolved function. Arrangements will need to be established regarding how the technical officers from the County Government can be facilitated to work and focus on the selected target areas.

14.4 Next Steps

The general conclusion is that there is a compelling case for an Eldoret Water Fund. The next steps to advance the establishment of the fund would be to constitute a task force or steering committee to nurture the development of the fund going forward.

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