EAST AFRICAN COMMUNITY

LAKE VICTORIA BASIN COMMISSION SECRETARIAT

MARA RIVER BASIN-WIDE WATER ALLOCATION PLAN

Lake Victoria Basin Commission
Re- Insurance Plaza, 6th Floor
P.O. Box 1510-40100, Kisumu, KENYA
Tel: +254-57-2026344; Fax: +254-57-2026324
E-mail: lvbc@lvbcom.org
March 2013

EXECUTIVE SUMMARY

The Mara River Basin (MRB) is an important hydrologic system that not only serves the bordering countries of Kenya and Tanzania, but also exists as a valuable input to Lake Victoria, the world's second largest freshwater lake which forms the headwaters of the Nile River. Growing water demands and unsustainable use of natural resources within the Mara River Basin (MRB) is placing an increasing strain on the water resources and threatening the livelihood of the many populations that rely on the Mara River as their sole source of water. Water quantity is a major concern within the Mara River Basin (MRB), especially during the dry season when the threat of drought is high. Water of a desired quality is often scarce, and has to be carefully allocated to different uses among them human consumption, sanitation, food production, industrial use, energy production among others. The allocation process has to be carried out in a manner that achieves economic efficiency, social equity and environmental sustainability. As such, the prevailing system of uncoordinated water resources management in the Mara River basin (MRB) cannot sustain the ever-increasing water needs of the various expanding water use sectors. An all inclusive water allocation plan (WAP) therefore makes trade-offs between the priorities of various stakeholders, economic returns and profitability, reliability of water supply, equity, and ecosystem sustainability. The main purpose of this Mara River Basin-wide Water Allocation Plan (MRB-WAP) is to match or balance the demand for Mara River water with its availability, through an efficient water allocation arrangements involving a large number of conflicting water uses including; human/domestic, hydropower generation, livestock, irrigation, wildlife, tourism, mining and the environment (e.g. instream flow requirements) without forgetting the proper management of the catchment and ecosystem integrity. This necessitates a strategy that can be used to integrate the various sectoral needs against the available water resources in order to attain both economic and ecological sustainability. Current indications are that the Mara River is highly vulnerable as it is reported to have during some drought period attained dangerously low levels triggering massive deaths of the bigger animals such as hippos. The long term sustainability of the Mara River and indeed many other rivers feeding the Lake Victoria are at a risk of completely drying up. This would threaten the lives of communities, wildlife, livestock as well as aquatic life, and also interfere with economic activities on which the basin inhabitants rely.

This Mara River Basin-wide Water Allocation Plan (MRB-WAP) covered the entire Mara River Basin, both Kenya and Tanzania, including the feeder streams and tributaries that drain into the Mara River. The plan took into consideration the Mara River flow assessments, including amount of water and its quality in relation to the existing water demands within the Basin. Reserve flows as calculated by Environmental Flow Assessment studies conducted in Mara River Basin (MRB) were reviewed as were the existing procedures on water allocation in Kenya and Tanzania. The plan also forecasted on future demand of water uses from Mara River, while the technologies applied in water allocations, particularly to water abstraction; and legislations in Mara River were reviewed and explained and identification and quantification of gaps between the river flow, reserve flow and water demand was done. Scenario development for demand analysis was based on Water Evaluation and Planning (WEAP) Model. The Water Evaluation and Planning Model (WEAP) is a powerful but easy-to-use computer based tool for water management, planning and allocation, integrating information on water supply and demand. In this study it has been used for developing and testing options for matching water supply and

demand, and assessing the level of water sufficiency or un-met demand. The total human population on the Kenyan side of the Mara River as at 2009 was 564,266 majority (44.96%) of whom lived in Bomet District, while that on the Tanzanian side of the Mara River Basin as at 2002 was 231,614 and estimated to be about 275,316 by 2009. Using WEAP, different scenarios were built up based on data on water availability (in terms of surface water flows) and water demands for power, irrigation, domestic use including hotels, livestock, wildlife and mining. Plausible assumptions about future trends were made based on existing development plans and policies, discussions with key parties and stakeholders were used to predict the basin's future water water conditions.

During this study, it was noted that hydrological information including ground water yields, soil erosion, sediment transport, and water management practices was limited. Further studies will be needed to provide more precise data for river flows as well as environmental flows, water demand, water extraction, and permiting for review of the MRB-WAP in the future. The WEAP scenarios and water balance analysis in this MRB-WAP will provide a starting point for dialogue with interested parties about the various options for water resources allocation. Beyond this, determination of the unit costs of providing additional water may provide a basis for water charges and permits. The relevant ministries in both Kenya and Tanzania have expressed the need for this kind of information under their water reforms that value water as an economic good by the introduction of user water charges and permits, and decentralization of water resources management to the catchment level. The Catchment Management Strategies should also recognize the eco-hydrological, hydro-economic and socio-cultural information generated for different water management scenarios and embrace appropriate measures for informed and improved basin-wide water allocation.

The specific objectives of this MRB-WAP includes: to preserve the proportions of annual discharge from the Mara River and its tributaries' catchments including feeder springs and streams to maintain base flow in the Mara River and its tributaries. During drought years to maintain the drought reserve flow, and during normal or wet years to maintain the normal reserve flow as indicated and detailed in the program logic and scenarios in this report; and to protect ecosystem integrity and water quality within MRB watershed. Also, to protect water sources and the main Mara River and its tributaries against degradation through extraction, damning, or bore constructions, and unlicenced abstraction practices to be monitored and corrective measures taken. In all years except very dry years, MRB rural folk and domestic use to have access to sufficient water, plus additional amount should there be growth in lawful exercise of water rights. Bomet and Mulot towns, and other towns in the MRB, Tenwek hydropower dam and dependent services (hospital, etc), farm, livestock, wildlife, hotels and resorts, and mining activities, to have access to sufficient water; and to protect water quality within MRB and the integrity of the catchments including Mau forest against destruction and anthropogenic influences. At the 5 year review of MRB-WAP, or sooner if practicable, the aim should be to monitor current and projected water demands as per various scenarios in this report; to have sufficient water available from the consumptive pool to satisfy identified requirements; all water users permitted, bring existing users to compliance, and permits renewed/amended, metering of major uses done; environmental settings in MRB reviewed, original sites and present sites evaluated and new sites set up; water use and abstraction surveys carried out, and systems put in place to collect adequate hydrological data, including underground water distribution, levels, and other relevant information.

At the 5 year review, or sooner if practicable, the two countries of Kenya and Tanzania should aim to harmonize and enforce policies and legal requirements for supporting full implementation of MRB-WAP, including identification of existing gaps. The two countries and institutional bodies and stakeholders should set up new laws, revised laws, subsidiary legislation and by laws, where required, and ensure full enforcement, compliance, and roles of different parties established; continue partnership with WUAs and WRUAs, research organizations and other institutions to improve knowledge of ecosystem water requirements; undertake consultation and research to improve understanding of indigenous water issues and options to address them. The strategy is to involve all the stakeholders and donor communities and other regional institutions to fund the studies and surveys. Funds collected from water users can also be used. Also, funds from Payment of Ecosystem Services (PES), if frameworks can be set-up, can also be used; to have the two governments and their relevant institutions involved in the management of the MRB water resources in a manner agreed upon and acceptable by both countries.

ACRONYMS AND ABBREVIATIONS

BSAP	Biodiversity Strategy and Action Plan
CAAC	Catchment Area Advisory Committee
CBO	Community Based Organization
CBS	Central Bureau of Statistics
CFA	Community Forest Association (Kenya)
CMS	Catchment Management Strategy
DRSRS	Department of Resource Survey and Remote Sensing
EAC	East African Community
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
ESRI	Environmental Systems Research Institute
FAO	Food and Agriculture Organization
FIU	Florida International University
GCAs	Groundwater Conservation Areas
GCS	Geographic Coordinate System
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GoK	Government of Kenya
GPS	Global Positioning System
GW	Groundwater
ILRI	International Livestock Research Institute
IUCN	International Union for Nature Conservation
IWRM	Integrated Water Resource Management
KE	Kenya
KES	Kenya Shillings
KFS	Kenya Forest Service
KWAHO	Kenya Water for Health Organization
KWS	Kenyan Wildlife Service
LPD	Litres per Day
LVBC	Lake Victoria Basin Commission
MMNR	Maasai Mara National Reserve
MOU	Memorandum of Understanding
MRB	Mara River Basin
MUWASA	Musoma Urban Water & Sewerage Authority (Tanzania)
MWI	Ministry of Water and Irrigation
NBS	National Bureau of Statistics
NEMA	National Environmental Management Authority
NGO	Non-Governmental Organization
NMM	North Mara Mine
NORAD	Norwegian Agency for International Development
NWRMS	National Water Resource Management Strategy
PDOP	Position Dilution of Precision
PES	Payment for Ecosystem Services

PPP	Policies, Plans and Programmes
PSA	Pagos por Servicios Ambientales (Payment for Environmental Services)
RCMRD	Regional Center for Mapping of Resources for Development
RGS	Regular Gauging Stations
RQO	Resource Quality Objectives
SCMP	Sub-Catchment Management Plan
SEA	Strategic Environmental Assessment
SENAPA	Serengeti National Park (Tanzania)
SIDA	Swedish International Development Agency
SNP	Serengeti National Park
SW	Surface water
TANAPA	Tanzania National Parks
TOR	Terms of Reference
TMCC	Trans Mara County Council
TZ	Tanzania
UNCSD	United Nations Commission on Sustainable Development
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNO	United Nations Organisation
UNPFA	United Nations Population Fund
URT	United Republic of Tanzania
USAID	United States Agency for International Development
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
WAP	Water Allocation Plan
WGS	World Geodetic System
WHO	World Health Organization
WRM	Water Resource Management
WRMA	Water Resource Management Authority
WRUA	Water Resources Users Association (Kenya)
WSB	Water Service Board
WSP	Water Service Provider
WSRB	Water Services Regulatory Board (Kenya)
WSTF	Water Services Trust Fund
WUA	Water Users Association (Tanzania)
WWF	World Wide Fund (for Nature)

DEFINITION OF TERMS

Explanation of the various terms used to ensure a common understanding in the context of this report:

Allocatable water: refers to that water that can be allocated after special provisions have been met including the reserve, international obligations, inter-basin transfers, future contingency and water use of strategic importance.

Aquifer: is a geological formation containing sufficient saturated permeable material to yield significant quantities of water to boreholes or springs.

Base flow: refers to the part of **total flow** in a river or stream derived from groundwater discharge. **Base flow** means the part of streamflow derived from the natural discharge of groundwater into a watercourse, lake or spring. The term 'base flow' is usually used in relation to groundwater related flow in streams. Some plans refer to 'Seasonal base flow'.

Beneficial use: refers to benefits that derive from the use of the water resources. Beneficial use covers ecological, domestic, economic, recreational and other benefits.

Consumptive water use: is the water abstracted that is no longer available for use because it has evaporated, transpired, been incorporated into products and crops, consumed by man, livestock or wildlife or otherwise removed from freshwater resources.

Environmentally sustainable level of extraction: is the level of water extracted from a particular system which, if exceeded, would compromise key environmental assets, eco-system function, and productive use of the water resource.

Environmental flow: describe the regime (quantity, timing, and quality of water flows) required to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated.

Environmental flow objective for a water resource plan: means a flow objective for the protection of the health of natural ecosystems for the achievement of ecological outcomes.

Environmental watering requirements: means the environmental watering requirements of a priority environmental asset or priority ecosystem function. **Note:** "Environmental Flow", "EF", "Environmental Water Allocation", "Environmental Flow Assessment", "Environmental Water Requirement", "Instream Flow Requirement" and "Reserve" are terms commonly used interchangabley.

Extraction limit: refers to the volumetric limit of water made available for extraction from the system on an annual basis.

Flow regimes: are a range of streamflows having similar bed forms, flow resistance, and means of transporting sediment.

Gauging station: this is a location used by hydrologists or environmental scientists to monitor and test terrestrial bodies of water such a rivers.

Level of extraction: is the level of water extracted from a particular system which, if exceeded, would compromise key environmental assets, eco-system function or productive use of the water resource.

Non-consumptive water use: is the *in situ* use of a water body for navigation, instream flow requirements, fish survival, recreation, effluent disposal and hydroelectric power generation.

Permitting: is the process in which rights of water resource use are conferred by WRMA or other relevant bodies depending on a country or institutions to water users or various uses. For WRMA, the process is bound by the WRM Rule 2007.

Precautionary principle: means if scientific information is inadequate for decision making, this shall not prevent the implementation of measures to manage and conserve natural resources.

Recharge: is the entry of water into the ground from rainfall, streams, swamps, lakes or irrigation that eventually reaches an aquifer or aquifer system.

Reserve flow: is the quantity and quality of water required to satisfy basic ecosystem and human needs and health for all people who are or may be supplied from the water resource; and to protect aquatic ecosystems in order to secure ecologic sustainability, economic development and use of the water resource.

Right to use: is the right of a user to use water from any water resource. Water rights are conferred and regulated by laws governing water resources.

Transboundary: is a river that crosses at least one political border, either a border within a nation or an international boundary.

Water abstraction: is the process of removing water from a water resource (surface or groundwater source) for an intended use.

Water allocation: is the process of apportioning the total available water resource within a water management area to different users and uses.

Water allocation plan: is a method or scheme for allocating water to various users and uses based on clear considerations of reserve flows, permiting, ecosystem and quality requirements for current and future usage and demands of water as per institutional, regional, national and international obligations, policies and legal frameworks.

Water balance: is the quantitative characterization of all forms of water availability/supply and consumption in the atmosphere and on the earth's surface within a given area e.g. river basin and time frame.

Water demand: is the volume of water required by users to satisfy their needs.

Water supply: is the provision of water usually to public utilities, private companies, commercial organizations, community groups or to individuals through a system of pumps and pipes, for domestic or industrial use.

Water user: is any individual, association, government agency, or other entity that uses water from a river or any other natural water body.

Wetland: is a land area that is saturated with water, either permanently or seasonally, to the extent that it takes on the characteristics of a distinct ecosystem.

ACKNOWLEDGEMENTS

We wish to sincerely thank the Lake Victoria Basin Commission (LVBC) for providing the funds for this study. We highly acknowledge WRMA, KWS, WWF-Narok, Narok County Council, WWF – Tanzania, Serengeti National Park, Olerai farm, Fairmont Mara Safari Club, Ministries of livestock and agriculture - Longisa, Bomet District Water Office, MRWUA, and Lake Victoria Basin Water Office and the Regional Water Offices at Musoma, Tanzania among other institutions for their valuable time, material provision and support during the study. We also acknowledge Dr Claudia Baldwin of the University of the Sunshine Coast, Australia, for her critical review of our initial draft of this report. We also wish to sincerely thank all the respondents and key stakeholders who were interviewed and any other persons who may have participated in one way or another to the success of this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

1.0. INTRODUCTION

This section gives a brief overview of the study area, the problem statement, consultancy justification and terms of reference for the exercise. In addition, justification for the water allocation plan and scope of the consultancy are also given. Further, the objectives of the consultancy are clearly outlined.

1.1. Background Information

The Mara River Basin (MRB) covers 13,750 km² and is a trans-boundary basin shared between Kenya and Tanzania and forms part of the upper catchment of the larger Nile Basin. The River flows 395 km from its headwaters in the Mau Forest of Kenya to Lake Victoria, Tanzania and is also a major contributor of sediment and phosphorous to Lake Victoria. The Mara River Basin (MRB) is located roughly between longitudes 33° 47' E and 35° 47'E and latitudes 0° 38' S and 1° 52' S, with the upper 65% area (8,941 km^2) in Kenya and 35% in Tanzania. Originating from the Napuiyapui swamp in the Mau Escarpment in the highlands of Kenya, altitudes range from 2,932m at its source to 1,134m at Lake Victoria. Figure 1.1 shows the relief map of the Mara River basin.

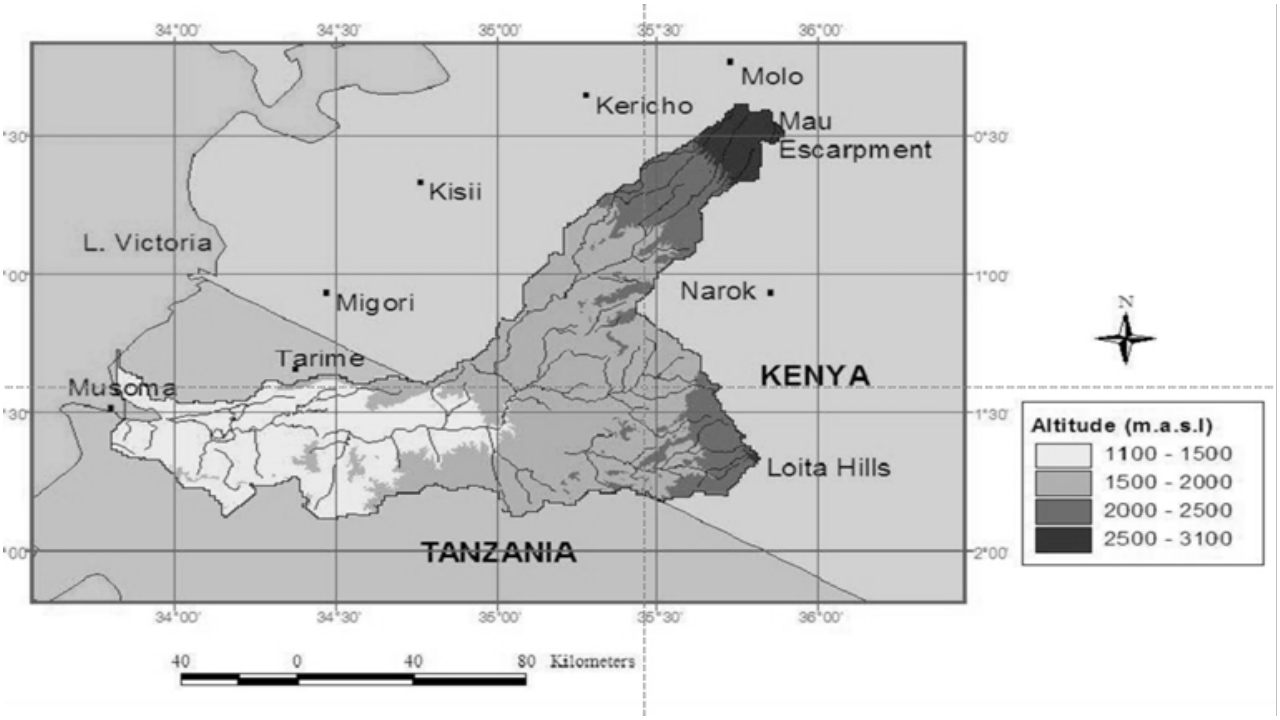


Figure 1.1. The relief map of the Mara River basin.

The Mara River is an important hydrologic system that not only serves the bordering countries of Kenya and Tanzania, but also exists as a valuable input to Lake Victoria; the world's second largest freshwater lake which forms the headwaters of the Nile River. The Mara River contributes approximately five percent of the total amount of water that flows into Lake Victoria. However, despite its minimal contribution in terms of water volume into Lake Victoria, the Mara

River is probably one of the most important rivers with regard to conservation for it supports both the Maasai Mara National Reserve (MMNR) in Kenya and Serengeti National Park (SNP) in Tanzania (Nile Basin Initiative, 2004). The basin comprises of a variety of wildlife, a significant livestock activity and agriculture with high potential for irrigation, rapidly growing mining activities and a uniquely attractive tourism industry with significant economic value. The biodiversity of the MRB is however threatened by habitat modification and fragmentation, over abstraction of water and the huge demand on water resources by the Mara River basin inhabitants. Its water resources management is therefore an issue of very high significance, because of great socio-cultural, ecological and economic values.

The rivers emanating from Mau forest complex are themselves natural assets due to their economic and ecological importance to the whole of East Africa region especially to Kenya and Tanzania. Indeed, the Mara River is the only permanent water source in the Maasai-Mara Game Reserve and the northern part of the Serengeti National Park in Tanzania (Gereta *et al*., 2001). Similarly, the Ewaso Ng'iro River is also the only permanent water source on the whole of northern front of Lake Natron that flows into the lake, while Sondu River, which is not trans-boundary, flows through major agricultural areas in Kenya before emptying its waters into Lake Victoria.

With increasing population in the MRB, demand for water in the MRB has also increased significantly in the recent years. For instance, water for livestock demands in the Mara catchment increased from 159m3/year to 190m3/year between the years 1990 and 2000 (JICA, 2000). Aboud (2002) and Hoffman (2007) note that over 50% of households within the MRB rely on Mara River for domestic and livestock needs. Therefore, this river is crucial to the survival of the people as well as wildlife and livestock. Domestic uses include cloth laundering, personal bathing, consumption and watering livestock. Many of the small-scale farms are rain fed while the large-scale farms are also irrigated via extractions from the Mara River. Urban water supplies to towns like Bomet and hydropower generation in the Tenwek region of Kenya are some of the major abstraction taking place. In the tourism industry, hoteliers are also abstracting water from the river for various domestic uses. The Barrick gold mines in Tanzania also extract substantial water for mining processes (Hoffman, 2007).

Climate change and variation in the recent years are expected to exacerbate water supply problems within the MRB. Consequently, competition in accessing and using water sources will intensify (Mwiturubani, 2010). The main competing interests for water resources in the Mara River include the large scale irrigation plantations on the Kenyan side, the Maasai Mara and Serengeti Wildlife protected areas, small scale farmers and pastoralists on both sides of the basin, the mining industry in Tanzania, small scale fishing activities, and urban and rural domestic water supplies.

In a Final Report on Mara River Basin EPWS Livelihood Study (November, 2011), it is stated that water use conflicts [herein referred to as disputes about social, economic, political and territorial-related issues] will likely ensue as water scarcity intensifies. Several levels and types of water-use conflict are likely to emerge. At the family level water-use conflicts relate to the gender division of labor where men, women and youths; and adults and the young have different roles. For instance, in the MRB, men are responsible for taking care of livestock and farming,

while women are responsible for household chores and farming (Onyango, 2007). Here the men wanting to utilize some water sources for livestock may be opposed to the women's uses, hence creating water-use conflicts. Furthermore, because of a water shortage, some family activities that require water may not be performed.

Depending on which group wields the greater power - men, women, the youth or adults, girls or boys - conflict is likely to occur between these groups in the use of the available water for gender-specific activities. For instance, because of water scarcity, women walk up long [up to 10km] return trips to collect water daily for domestic chores such as cooking and washing utensils and babies. In some instances, men may request some water for bathing at home, but when the women refuse to part with their water, given the long distance they walk to collect it, conflict may arise between spouses, particularly because the patriarchal system gives men the right of decision making in the family.

During the rainy season, when water is plentiful, members of one village can access water sources at another nearby village. However, as water becomes scarce owing to prolonged drought, villages may prohibit members from another village from using water sources located within their jurisdiction. This kind of restriction on water access and use has sometimes resulted in inter-village fighting, especially where members of the two villages are from different ethnic groups. Water access and use conflict at this level involves mainly livestock keepers who take their livestock for water at a nearby village. In some instances, livestock owners migrate with their livestock to areas with permanent water sources where they put more pressure on the resource. Conflicts arise when the local community feels that the immigrants are impinging on their resources.

Water scarcity may also force people to encroach on marginal lands and protected areas in search for water and pasture. Access to protected areas such as game reserves and national parks and their natural resources is prohibited. However, owing to the scarcity of resources, especially water resources, local people do encroach on protected areas for crop production and livestock keeping. This creates not only conflicts between the institutions that manage these protected areas and the encroachers, but those involving human and wildlife – not to mention transmission of zoonotic diseases from wildlife to livestock, and even humans. Water-access and water use conflict may also be caused by competition between groups of people practicing different economic activities, such as livestock keepers and crop cultivators. In some places, livestock keepers tend to encroach and use land and water meant for crop production. Similarly, crop cultivators may utilize pastoral land, hence reducing the pasture for the livestock, according to the Final Report on Mara River Basin EPWS Livelihood Study (November, 2011).

Water-access and water use conflicts at this level are more pronounced during the dry season when water is very scarce than during the wet season. This type of water-use conflict is also manifested between upstream and downstream users of water regardless of whether they practice the same or different economic activities. Users of the Mara River in Tanzania blame the users in Kenya for withdrawing great quantities of water for large irrigation schemes, thus leaving insufficient water to flow downstream. Downstream users of the Mara River also blame upstream users for polluting the water in the river, claiming that the brown water in the river is a result of cultivation along the river banks upstream. This, however, maybe mostly caused by the

loss of forest in the Mau complex, the main source of water for the Mara River. Since the Mara River is a trans-boundary water source, water-use conflicts between downstream and upstream water users on the Mara River, although they currently mainly affect individuals, can develop into an interstate [Tanzania and Kenya] conflict.

In most river basins, the effects of deforestation, water abstractions for livestock, agricultural irrigation and other industries are on the rise. The ever increasing abstractions especially from small rivers and streams are certain to at some point in the future, severely degrade the riverine ecosystems and even impinge upon the most basic water needs of people living along the river. Solutions to water problems depend not only on water availability, but also on many other factors, among which are the processes through which water is managed, competence and capacities of the institutions that manage them, prevailing socio-political conditions that dictate water planning, development and management processes and practices, appropriateness and implementation statuses of the existing legal frameworks, availability of investment funds, social and environmental conditions of the countries concerned, levels of available and usable technology, national, regional and international perceptions, modes of governance including issues like political interferences, transparency, corruption, national and transboundary issues, e.g., maintenance of minimum reserve in river systems, educational and development conditions**,** and status, quality and relevance of research being conducted on the national**,** regional and local water problems (Biswas, 2004).

The role of research findings as inputs to sound policy formation and implementation cannot be overemphasized. Scientific studies have also shown that reliable data that all parties can trust are crucial for the knowledge-based management of water resources (Timmerman and Langaas, 2005; Stokke, 2006), and related health issues. Human settlement in the LVB has been occasioned by the fast population growth rates. This has increased pressure on natural resources such as rivers, while human activities including agriculture and urbanization usually have effect on the quality of water and human health (UN Habitat, 2005).

Water quality and quantity is a major concern within the Mara River Basin, especially during the dry season when the threat of drought is high (Hoffman, 2007). The biodiversity of the MRB is therefore currently threatened by habitat modification and fragmentation, over abstraction of water and the huge demand on its water resources by the basin's inhabitants. Sustaining escalating water demands of the growing population within the basin, as well as meeting the requirements of the Mara-Serengeti ecosystem, is vital to the region. It is therefore important to carry out environmental flow assessments of the Mara River and also come up with a workable Mara River Basin-wide water allocation plan (MRB-WAP).

1.2. Problem Statement

The Mara River and other river systems in LVB are under increasing pressure due to land use changes and water abstraction for consumptive use. The change in land use in the upper catchment in the Mara River has resulted in higher peak flows during the rains and lower flows during drought (Mati *et al.*, 2005). Abstraction levels for consumptive uses are often highest during the dry season, putting additional strain on the river ecosystem during these critical low flows. Both the Government of Kenya Water Act (2002) and the United Republic of Tanzania

National Water Policy (2002) require protection of reserve flows to provide for basic human needs and to sustain ecosystems into the future (GoK, 2002).

The Trans-Boundary Mara River Basin Strategic Environmental Assessment (MRB SEA) was published by Lake Victoria Basin Commission (LVBC) in March, 2012. It seeks to engage stakeholders in open discussion about policy and planning options within the Mara River Basin in order to inform decision-makers about the social, environmental and economic consequences of different approaches to development and conservation needs. It discusses the current water resources situation within the basin and brings out strongly four key issues that require urgent attention. These are:

a) The need to reverse the current negative trends in terms of water allocation and use to ensure the sustainability of the Mara River basin.
b) The need to strengthen coordination at the local level amongst local governments, international organizations, NGOs and other stakeholders to harmonize their plans and programmes so as to manage the future changes in a holistic manner.
c) Need to review the legal framework and some of the relevant policies of both Kenya and Tanzania, for updating and harmonization in a trans-boundary context to guarantee commitment and ensure their implementation.
d) Need to establish mechanism for coordinating and managing the effort that is needed to reverse environmental degradation and improvement of livelihoods within the MRB.

In order to explore possible responses to change over the next twenty years (up to 2030), the SEA report has described three different scenarios; A, B and C in which scenario (A) assumes that the existing trends shall continue up to 2030, while scenario (B) proposes some events to arrest unfavorable trends and stabilize the basin's environmental, social and economic conditions by 2030. However scenario (C) achieves a reversal of unfavorable trends by 2030. This study has considered scenarios (A) and (B) for water demand estimation and introduced another scenario; the Reference Scenario. These scenarios are analyzed with regard to water availability and scarcity both monthly and annually over the years up to 2030 using WEAP model to assist in designing a workable MRB-WAP.

1.3. Consultancy Justification and Terms of Reference

The need for water demand and allocation plans for MRB stems from the fact that there is often not enough water of a desired quality to satisfy all the needs of different users or uses, therefore, decisions have to be made on how best the scarce resource should be shared between the users and uses that demand it. This is the practice of water allocation, which is a key universal function of water management whose objective is to maximize the societal benefits derived from the water resource. Dinar *et al*. (1997) classified societal benefits as economic, social and environmental, each with a corresponding principle - efficiency, equity and suitability, respectively. Economic efficiency dwells on the wealth that can be generated from the river water resource and in most cases, sectors generating highest returns are normally given the topmost priority. Social equity focuses on giving everyone a fair opportunity to access water resources and ensures that water for drinking and sanitation is made available to everyone including the poor who cannot pay for it, while the sustainability principle gives recognition to the environment as a user of water, with direct and indirect benefits for human beings and the ecological system.

The International Conference on Water and the Environment (ICWE) in Dublin, Ireland, in 1992 called for fundamental new approaches to the assessment, development and management of freshwater resources that can effectively reverse the present trends of over consumption, pollution, and rising threats from drought and floods. The recommendations for action at local, national and international levels were based on six guiding principles. The first principle was that, "fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment". The second was that, "water development and management should be based on participatory approach, involving users, planners and policy makers at all levels". The third principle recognized that water resources are *vulnerable* to over allocation, over abstraction and degradation, implying that there is a tangible *risk* to the environment, economy and social well being if the water allocation plan is not complied with. It is therefore in the public interest to adopt and comply with the water allocation plan to set in place a controlled mechanism for the allocation and abstraction of water resources. The fourth principle stressed the inclusion and central role played by women in the provision, management and safeguarding of water. The fifth '*precautionary principle'* implies that decisions can or indeed must be made even where information is incomplete in relation to: taking preventive action in the face of uncertainty; shifting the burden of proof to the proponents of an activity; exploring a wide range of alternatives to potential harmful actions; and providing for public participation in decision making. The sixth principle recognized water to have an economic value in all its competing uses and therefore recognized water as an economic good.

It is a known fact that water sustains life. The challenge lies on the effective management of water resources to ensure sustainability. The following needs to be considered in the planning and management of the water resources in any catchment if sustainability is to be achieved:

a) Water resources planning and management demands a holistic approach, linking social and economic development with protection of natural ecosystems.
b) Decisions on planning, management and implementation of related projects need to be taken at the lowest appropriate level, with full public consultation and involvement of users.
c) The pivotal role of women as providers and users of water and guardians of the living environment need to be recognized in the institutional arrangements, policy formulation and decision making for the development and management of the water resources.
d) It is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

Environmental sustainability is achieved when the productivity of life-supporting natural resources, such as water, is conserved or enhanced for use by future generations. Social sustainability is achieved when a given level of expenditure or operation can be maintained over time. Institutional sustainability is achieved when prevailing structures and processors have the capacity to continue to perform their functions over the long term. It is an immense task, but not an impossible one, provided, appropriate policies and programmes are adopted at all levels, local, nationals and international.

1.4. Justification for a Water Allocation Plan for Mara River Basin

The Mara River Basin currently experience severe degradation as a result of increased habitat modification and fragmentation, over abstraction of water for various uses and the huge demand on water resources by the Mara River basin inhabitants. Current indications are that the river is highly vulnerable as it has been reported to have attained dangerously low levels during certain drought periods triggering massive deaths of the bigger animals such as hippos. The prevailing system of uncoordinated water resources management in the basin cannot sustain the ever-increasing water needs of the various expanding water use sectors and will undoubtedly cause serious effects on the local socio-economic development, ecological systems and national economies of both countries. This dangerous trend has been blamed on destruction of riverine and catchment forests, soil erosion and siltation, climate change and over abstraction which have all contributed to low water levels, especially during the dry seasons. The basin's water resources management is therefore an issue of very high significance, and requires an effective strategy that involves all the conflicting water uses and interests within the basin to match or balance the demand for water with its availability through an accepted suitable water allocation arrangements resulting into Mara River Basin-Wide Water Allocation Plan (MRB-WAP). MRB-WAP outlines the process of apportioning water to different uses and users within the Mara River Basin by specifying each water use sectors respective water requirement of the mean average runoff with the absolute amount each is allocated tied to how much is available in a particular time interval (LVSCAMS, 2009). The main purpose of the Mara River Basin-wide water allocation plan (MRB-WAP) shall be:

1. To regulate and control the use of water resources within the Mara River basin.
2. To equitably allocate water for ecological, social and economic needs.
3. To encourage efficient, effective and economic use of water resource within the basin.
4. To promote the production of accurate data on water use and demand for both surface and ground water.

The benefits of MRB-WAP shall be:

1. Protecting biodiversity;
2. Protecting forest and rangeland resources;
3. Securing adequate water resources and maintaining the reserve flow;
4. Developing key sectors of the economy including tourism, agriculture and mining;
5. Improving human health and sanitation within the basin and beyond;
6. Reducing poverty and sustaining livelihoods for the basin's inhabitants;
7. Improving understanding and coordination of policy and planning activities within the MRB.

1.5. Scope of the Consultancy

The Mara River Basin-Wide water allocation plan (MRB-WAP) covered the entire Mara River Basin, both Kenya and Tanzania, including the feeder streams and tributaries that drain into the Mara River. The plan took into consideration the Mara River flow assessments, including amount of water and its quality in relation to the existing water demands within the Basin. In addition, the reserve flows as calculated by Environmental Flow Assessment study conducted in Mara River Basin (LVBC and WWF-ESARPO, 2010) were reviewed as were the existing procedures on water allocation in Kenya and Tanzania. The plan also forecasted on future

demand of water uses from Mara River, while the technologies applied in water allocations and abstractions, including water harvesting and storage technologies, and legislations in Mara River and its basin were reviewed and explained. Lastly identification and quantification of gaps between the river flow, reserve flow and water demand was done. All this culminated in the development of a Mara River Basin-wide Water Allocation Plan (MRB-WAP), which is expected to apply to all stakeholders and water users with respect to the allocation and use of the water resources derived from the Mara River Basin.

1.6. Objectives of the Consultancy

1.6.1. Overall objective

The overall objective of this consultancy was to develop the Mara River basin-wide water allocation plan (MRB-WAP), to be used by key stakeholders in Mara River Basin to sustainably allocate water to different uses while ensuring good health of the river and maintaining the reserve flow.

1.6.2. Specific objectives

The specific objectives included:

a) **Specific Objective 1:** To review and summarize water allocation policies and legislations in Tanzania and Kenya looking at the overall approach to allocation and the guiding principles. The tasks that were to be performed specifically included:

i. Review water allocation policies, legal and institutional framework in Tanzania and Kenya;
ii. Identify existing and potential water allocation technologies in relation to water uses and legislations in Mara River;
iii. Identify and explain existing best water allocation technologies;
iv. Assess the capacity of institutions mandated for water allocation and monitoring; and
v. Examine how existing allocation frameworks effectively address competing demands for water resources (current and future).

b) **Specific Objective 2:** To assess the existing permitting threshold / framework and database in both countries and how existing allocation frameworks respond to water resource management in Mara River;

Specific tasks included:

i. Examine and review the existing threshold levels of water permits for the Mara river; and
ii. Establish how existing allocation frameworks adequately provide for instream needs and ecosystem services.

c) **Specific Objective 3:** To assess the existing water allocations and their relations with water resources management in Mara River.

Specific tasks included:

i. Review existing water allocation plans in Mara River Basin if any;
ii. Identify key users and quantify their existing water demands in relation to water allocation permits;

iii. Quantify river flows in relation/ compare with the existing water demands in Mara River Basin;
iv. Review the reserve flows (Environmental flows) as calculated by Environmental Flows study conducted in Mara River Basin in 2009 (LVBC & WWF-ESARPO, 2010);
v. Forecast the future demand of water uses from Mara River; and
vi. Analyze and propose how water allocation can be integrated into existing catchment management planning to ensure that monitoring of water abstractions and monitoring is a part of ongoing watershed monitoring programmes;

d) **Specific Objective 4:** To develop Mara River basin wide water allocation plan (MRB-WAP) for five years.

CHAPTER TWO

2.0. LITERATURE REVIEW AND SITUATIONAL ANALYSIS

This chapter gives an in depth review of each study objective to identifying gaps which need to be addressed. In the chapter, a critical view of the study area is given including the zoning as was applied in the study. Hydrometeorological analysis, topography, population, climate and drainage of the Mara River Basin are also given. In addition, the land use and land cover changes within the river basin and their impacts on water balance, erosion and sediment yield are also highlighted. Likewise, the environmental flow assessment is presented as is the water quality, supply and demand. Finally, the governing systems, policies, legislations and institutional arrangements and their weaknesses are also reviewed.

2.1. Mara River, its Tributaries, the Basin and its Potential

The Mara River originates in the Mau Escarpment in Kenya's Nakuru District and flows approximately 395 km from its headwaters in the Mau Forest of Kenya to Lake Victoria, Tanzania, through the districts of Bomet, Narok and Transmara including the Maasai Mara National Reserve in Kenya before crossing the border into Serengeti National Park flowing through the administrative districts of Tarime, Serengeti and Musoma in Tanzania before discharging at Lake Victoria (see Figure 2.1).

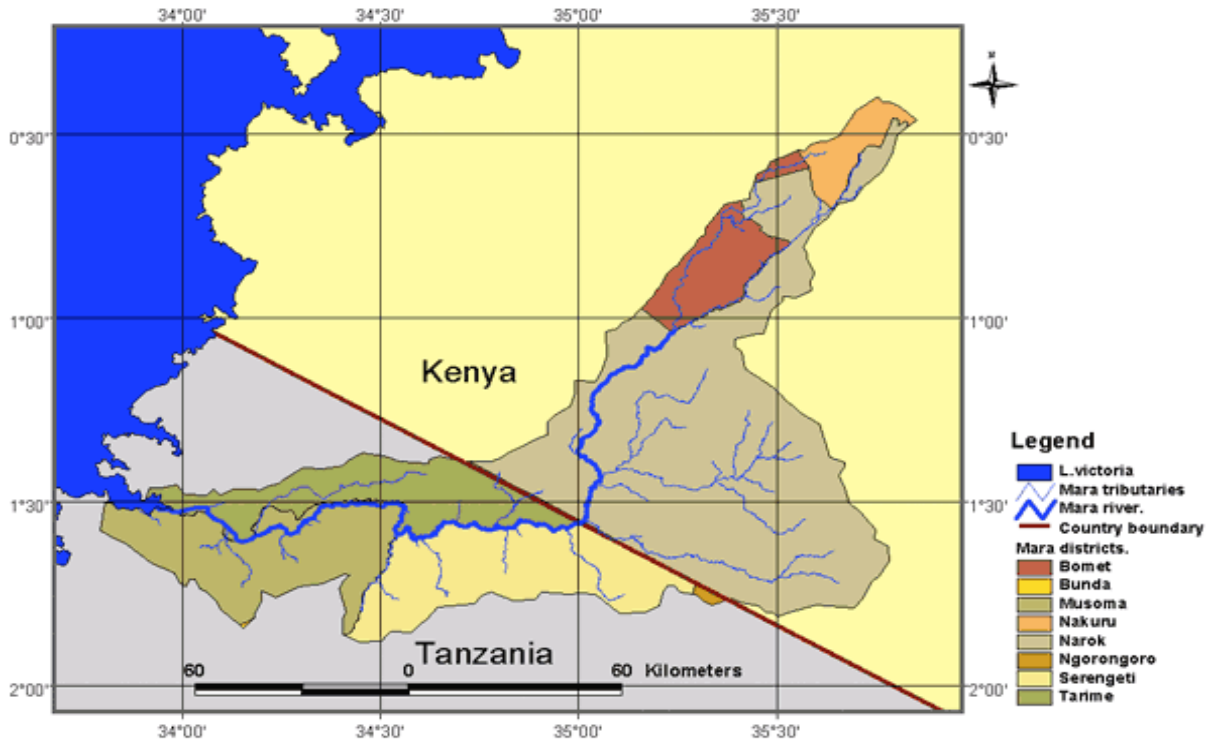


Figure 2.1. Transboundary Map of Mara River Basin, showing the districts within the basin in Kenya and Tanzania

The Mara River basin is bounded by the Soit Ololo Escarpment on the west, and the Loita and Sannia plains on the east. The altitudes in the basin range from 2,932 m at the source in the Mau Escarpment to 1,134 m around Lake Victoria (Krhoda, 2001). The Mara River is fed by several tributaries. However, the two main perennial tributaries are the Amala and Nyangores tributaries which originate in the Mau Escarpment and flow southwest. Other major tributaries of the Mara River include the Engare Ngobit, Talek and Sand Rivers. Both the Talek and Sand Rivers originate from the Loita Hills and drain the Sannia and Loita Plains, a major dry season grazing and watering area for both livestock and wildlife (Figure 2.2).

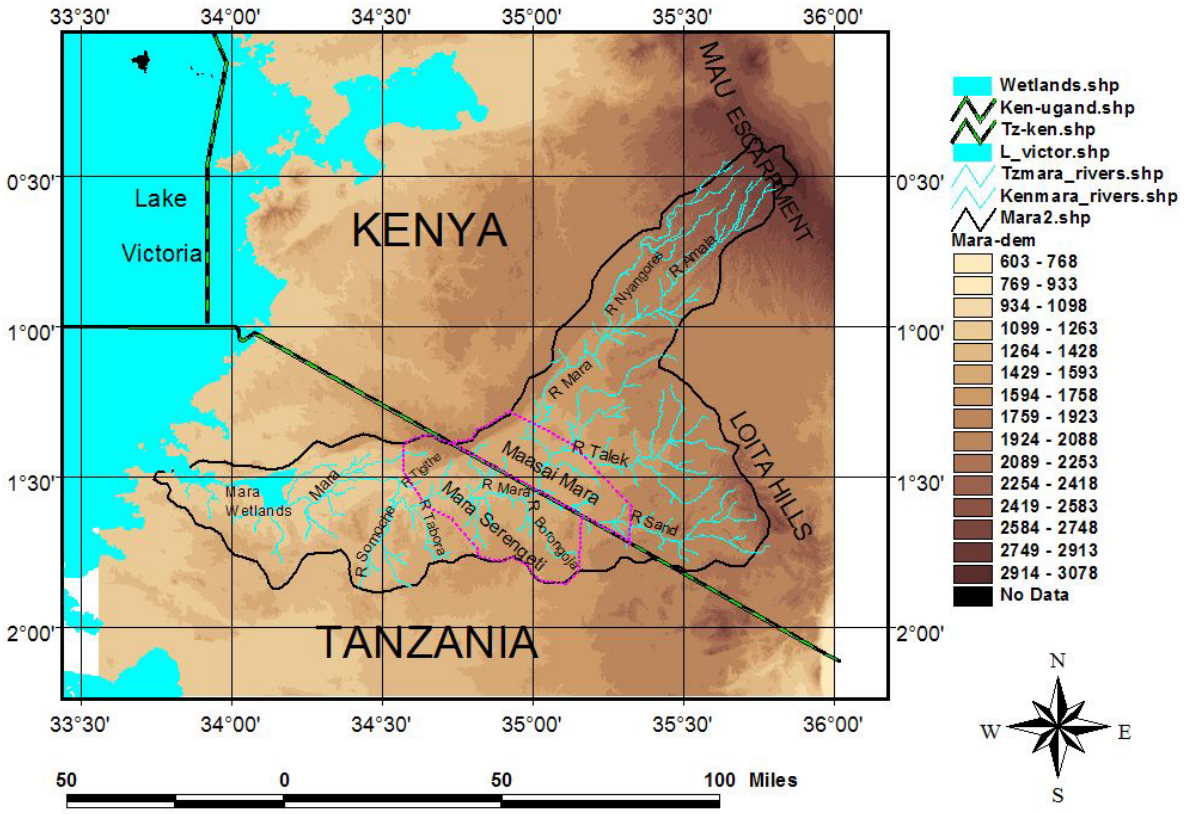


Figure 2.2. Map of Mara River basin showing tributaries to the Mara River

The source of the Mara River is at the Napuiyapui swamp in the Mau forest of Kenya. The Mau forest nestles Kenya's biggest forest block. It is a complex ecosystem that is the source of at least 12 rivers, draining westwards towards Lake Victoria and eastwards to Nakuru through Mau Narok, Lake Nakuru and the Mara-Serengeti ecosystem. It is also the single most important water catchments area in Western Kenya and a key source of water for Lake Victoria. The importance of the Mara River and its estuaries to agriculture, forestry and water supply, makes it strategic to the economies and ecology of both Kenya and Tanzania and hence to the survival of the Serengeti Maasai Mara Ecosystem (SMME). Most of the Maasai Mara National Reserve

(MMNR) and about 10% of the Serengeti National Park (SNP) are hosted in the Mara River basin (MRB). Together they make up a world wonder of biodiversity concentration. Proportionality aside, the internationally celebrated Wildebeest migrations would not take place without the existence and attractiveness of MRB and MMNR to wildlife at certain times of the year. It is a time of breeding before dispersal starts again into the southern part of the ecosystem. This creates a major attraction to the basin with tourist arrivals from different parts of the world.

In Kenya, a record number of tourists, making up 13.5% growth marked the first half of 2011 which stood at 549,083 compared to the previous (2010) year‘s 483,468. Subsequently, earnings from the sector grew by an estimated Ksh10 billion, standing at Ksh 40.5 billion compared to the previous (2010) year‘s Ksh 30 billion. The Jomo Kenyatta International Airport alone recorded 433,465 arrivals in this period compared to 114,643 arrivals at the Moi International Airport in Mombasa. This was a 13.3% growth for JKIA over the same period in 2010 in which 382,262 arrivals were recorded. Arrivals from China grew by 28% to stand at 15,139, while those from the Arab Emirates recorded a 50% growth to stand at 8,561. A 48% growth in arrivals was also recorded from the Russian market. The Ministry of Tourism is also keen in maintaining the traditional markets which according to the results continued to dominate arrivals into the country. The UK for instance constituted 14.3% of the total arrivals standing at 78,785 followed by the United States of America which constituted 9.3%, standing at 51,302 arrivals. Others included Italy at 7.9% (43,282), Germany 5.6% (31,016) and India 5.1% (27,917). In the year ending 30th June 2006, wildlife accounted for 70% of the gross tourism earnings of Kenya, 25% of the Gross Domestic Product (GDP) and more than 10% of total formal sector employment.

It is estimated that Tanzania earned USD 1,288,699,561 in 2008, while Zanzibar earned USD 160,258,272. These earnings accrued from 770,376 and 98,677 international visitor arrivals to Tanzania and Zanzibar, respectively. Survey results show that the overall average expenditure for holiday visitors who came under package arrangement was USD 209 per person per night, while that of non package was USD 186 per person per night. The result indicates that overall the package arrangement tours are relatively more expensive than the non package trips due to convenience during travel, safety and ease of reservation through travel agents.

The overall average length of stay for visitors to the United Republic of Tanzania was 10 nights. This is a lower average length of stay compared to an average of 12 nights recorded during the past three years. The main source markets for 2008 were: Italy, United States of America, United Kingdom, South Africa and Kenya. The survey results depict the dominance of Italy, the United States of America and the United Kingdom as major tourist source markets to Tanzania. This is largely due to enhanced promotional efforts in those countries.

2.2. Zoning of the Mara River Basin

The Mara River basin divides into four distinct zones based on landscape, land use and ecology. These are: upper catchments, middle rangelands, savannah plains, and lower basin (Nelson *et al*., 2012). For the sake of analysis of the hydrological conditions in this study the zones are defined more precisely as below;

Zone 1: Upper catchments
The Mau Escarpment forms the upper catchment of the Mara River from which the river originates. The main perennial tributaries are the Amala and the Nyangores, which drain from the western Mau Escarpment. This part of the basin supports besides forests, both small scale agriculture (less than 10 acres) and medium-sized farms (often tea farms up to 40 acres). In this area, the Amala and Nyangores rivers flow out of the Mau Escarpment and converge to form the Mara River which flows into Maasai Game Reserve.

Zone 2: Maasai Mara Game Reserve
In this section, the Mara River meanders through open savannah grasslands mostly governed by Maasai group ranches and used as pasture for livestock as well as for both small— and large-scale agriculture (more than 40 acres). The basins of three important tributaries to the Mara (the Talek, Engare, and Engito rivers) are also located in this area, together with some upland areas like the Loita Hills. Eventually the river flows into the world-famous Maasai Mara National Reserve (MMNR), where it merges with three of the four mentioned tributaries.

Zone 3: Serengeti National Park
This section falls on the Kenyan-Tanzanian border, where the Mara River flows into the Serengeti National Park (SNP) and is joined by the fourth major tributary; the Sand (or Longaianiet) River. In these wildlife parks, human activity is restricted to wildlife viewing.

Zone 4: Lower basin
This section forms the lower part of Mara River just after it flows out of Ikorongo Game Reserve (which borders Serengeti National Park) and meanders sharply northwards. At the location where the river meanders into the southwestern direction again the main channel is lost in different streams, which feed the downstream Mara wetlands. These streams and wetlands continue for about 70 kilometres downstream. In this part of the basin human and livestock densities are high and small-scale subsistence agriculture is the main land use activity.

2.3. Hydrometeorological Analysis of the Mara River Basin, Kenya/Tanzania

2.3.1. Climate

The mean annual rainfall in the Mara River basin varies from 1600 mm at the Upper Nyangores sub-basin to 600 mm in the south-eastern part (Figure 2.3). The Nyangores sub-basin receives more rainfall than Amala sub-basin. The basin has a bimodal rainfall regime with short rains occurring October-December and long rains in March-May. The average mean temperature is about 18º C in the highlands and 25ºC in the lowlands. The mean annual potential evapotranspiration is 1500 mm in the Upper Mara basin and above 1700 mm in the lowlands. Table 2.1 shows the rain and evapotranspiration at Amala and Nyangores sub-basins, and Figure 2.3 shows the mean monthly pattern of rainfall and potential evapotranspiration in Upper Mara basin.

Table 2.1. Rain and evapotranspiration at Amala and Nyangores sub-basins

Rainfall		Potential evapotranspiration		
Monthly Total	**Daily Average**	**Month**	**Monthly Total**	**Daily Average**
68	2.2	Jan	137	4.4
57	2.0	Feb	135	4.8
143	4.6	Mar	143	4.6
188	6.3	Apr	117	3.9
165	5.3	May	112	3.6
54	1.8	Jun	104	3.5
69	2.2	Jul	103	3.3
96	3.1	Aug	109	3.5
80	2.7	Sep	136	4.5
74	2.4	Oct	144	4.7
90	3.0	Nov	131	4.4
91	2.9	Dec	135	4.4
1175	**3.2**	**Total**	**1507**	**4.1**

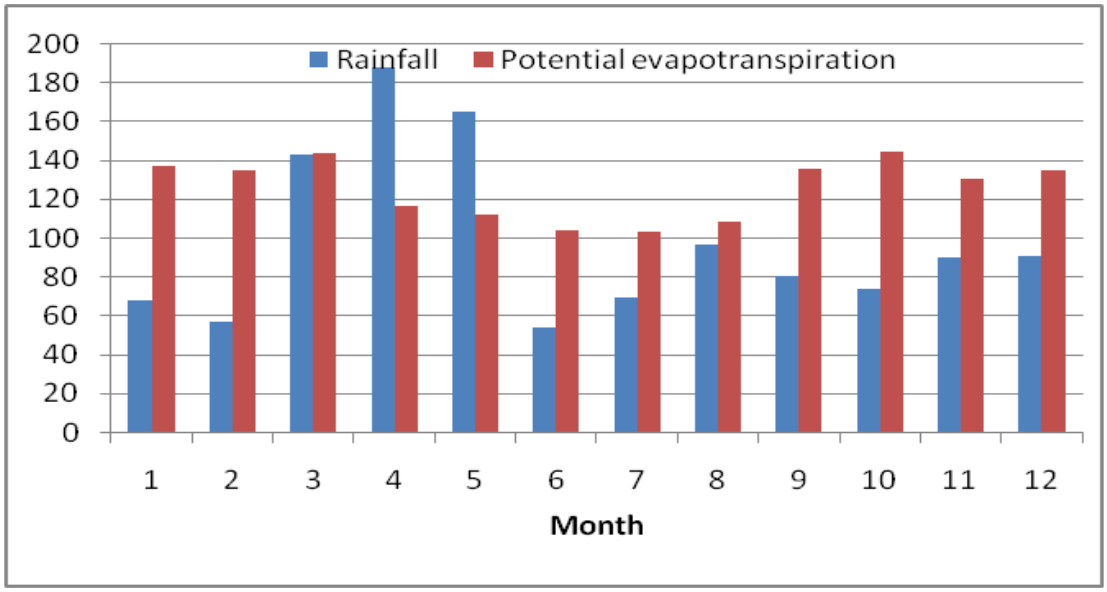


Figure 2.3. Mean monthly rainfall and potential evaporation

The amount of precipitation in the MRB varies according to altitude. The Mau Escarpment receives most rainfall with a mean annual rainfall of between 1,000 and 1,750 mm. The transboundary middle savannah grasslands receive an average between 900 and 1,000 mm, and the Kenyan lower Loita hills and the area around Lake Victoria only about 700 and 850 mm rain per year. In addition to this rainfall variability in space, the region is also known for its rainfall variability in time, which means that the different areas that form the LVB all receive variable amounts of rainfall over the year. The rainfall seasons are bi-modal, with the long rains starting in mid-March to June with a peak in April, while the short rains occur between September and

December (Krhoda, 2001). In the lower portion of the basin, the Mara River is the only perennial river flowing during the dry season, making it vital in supporting riparian communities and wildlife, including those within the Maasai Mara National Reserve in Kenya and Serengeti National Park in Tanzania.

During the dry season, other water sources in the lower portion of the basin dry up and form shallow, stagnant pools of water, which in a drought year can disappear completely (Gereta *et al*, 2002). Severe droughts within the MRB are estimated to occur once every seven years, but can occur at other times as well (Gereta *et al*, 2002). Between the 1950s and 2006, the seasonal water quantities in the Mara changed significantly in the sense that there are presently higher peaks and lows in the river flow during different seasons of the year. These dynamics are associated with changes in land use in the catchments area: decreasing vegetation covers which causes a swifter surface run-off of rainwater. Consequently, floods have become more common to the extent that large parts of the Tanzanian Mara wetlands have become largely permanent instead of temporary.

It is also important to note that as much as creation of wetlands in the Mara River basin is currently being looked at negatively as seen in the previous paragraph, wetlands in themselves should also be conserved and water actually allocated to them. According to the Ramsar Convention (2002), wetland ecosystems are adapted to the prevailing hydrological regime. The spatial and temporal variation in water depth, flow patterns and water quality, as well as the frequency and duration of inundation, are often the most important factors determining the ecological character of a wetland. Wetlands are often highly dependent on inputs of freshwater and associated nutrients and sediments from rivers. Impacts on wetlands can be caused both by human activities within them and, because of the interconnectedness of the hydrological cycle, by activities that take place within the wider catchment. Human modification of the hydrological regime, by removing water (including groundwater) or altering fluxes, can have detrimental consequences for the integrity of wetland ecosystems. Insufficient water reaching wetlands, due to abstractions, storage and diversion of water for public supply, agriculture, industry and hydropower, is a major cause of wetland loss and degradation. A key requirement for wetland conservation and wise use is to ensure that adequate water of the right quality is allocated to wetlands at the right time.

Many River basin authorities and water agencies have insufficient appreciation of the socio-economic values and benefits provided by wetlands in terms of their productivity, e.g. fisheries and livestock grazing, and their social importance (Ramsar Convention, 2002). There is generally a lack of awareness of the wide variety of services that wetlands can provide, including flood reduction, resource management, and water quality improvement, and of the fact that they can be a very positive asset at the disposal of water managers. As a consequence, wetlands frequently do not receive due consideration in water allocation decisions. In contrast to this view, the Ramsar Convention on Wetlands promotes the principle that wetland ecosystems are an integral component of the global water cycle from which water resources are derived. To

maintain the natural ecological character of a wetland, it is necessary to allocate water as closely as possible to the natural regime. The ecological character of many wetlands has adapted to past alterations of the water regime, yet they still provide important goods and services. A key step in any wetland conservation strategy is to define the desired ecological character of the most important wetlands. In any water allocation decision, it is then necessary to quantify the critical water needs of the wetlands, beyond which their ecological character will change in an unacceptable manner.

Flowing from the high mountains of the Mau escarpment in Kenya to the Mara Bay of Lake Victoria in Tanzania, Mara River is one of the most ecologically significant rivers in the region. Meeting the water demands of the different sectors while maintaining a healthy environment requires understanding of the hydrology (water flux), and the major hydrometeorological processes responsible for the changes in the water balance. A study to understand the hydrometeorological trends of the basin's precipitation and flow was reported by Melesse *et al*. (2008a). Low flow and flood frequency analysis for three selected sub-basins with distinct feature in terms of land-use change and precipitation regime was studied. Historical analysis of the rainfall information showed that the seasonal and monthly distribution varied over the study period. The upper basin showed little variability in the monthly average rainfall amount. Analysis of the flow records during the month of March, one of the low flow months of the basin, indicated that the minimum flow at the Amala gauging station showed a decline over the period of time. On the other hand, flows at the Nyangores gauging station did not show any significant changes for the available records. Maximum flows at Amala were much higher than the adjacent Nyangores basin of a similar drainage area. The study concluded that low dry flows and high wet season flows can be attributed to less vegetation cover and reduction in recharge in the head waters of the river system.

The study by Melesse *et al*. (2008b) also showed that mean annual rainfall in the upper Mara did not change significantly over the period 1961-2003. Minimum flows at Amala gauging station declined with time while at Nyangores there was no change. Peak flows at Amala were much higher than at Nyangores even though both sub-catchments have the same area (700 km^2). Historical records of rainfall and flow data for the Mara River basin was acquired and analyzed for seasonal and annual variability, spatial and inter-station variations in this study. Monthly flow duration curves and recurrence interval of low flows were analyzed. The analysis showed that Amala River showed a high wet season and a low dry season flows than that of the adjacent Nyangores River with similar drainage area. High wet season and low dry season flows can be attributed to less vegetation cover leading to low recharge in the headwaters and also flashy runoff due to less infiltration associated with less vegetation cover. Further studies on the actual cause of the flow reduction in the basin will require consideration of not only rainfall and flow analysis but changes in land and water use activities.

2.3.2. Topography

The upper half of Mara River basin lying above 1700 m above sea leval (ASL) is mountainous and hilly; the lower half consists of gently sloping plains. Mara River flows down the escarpment, into the plains and finally enters Lake Victoria (Figure 2.4). At approximately 50

km before reaching Musoma, the river passes through an expansive wetland measuring about 20 km in length (Figure 2.5).

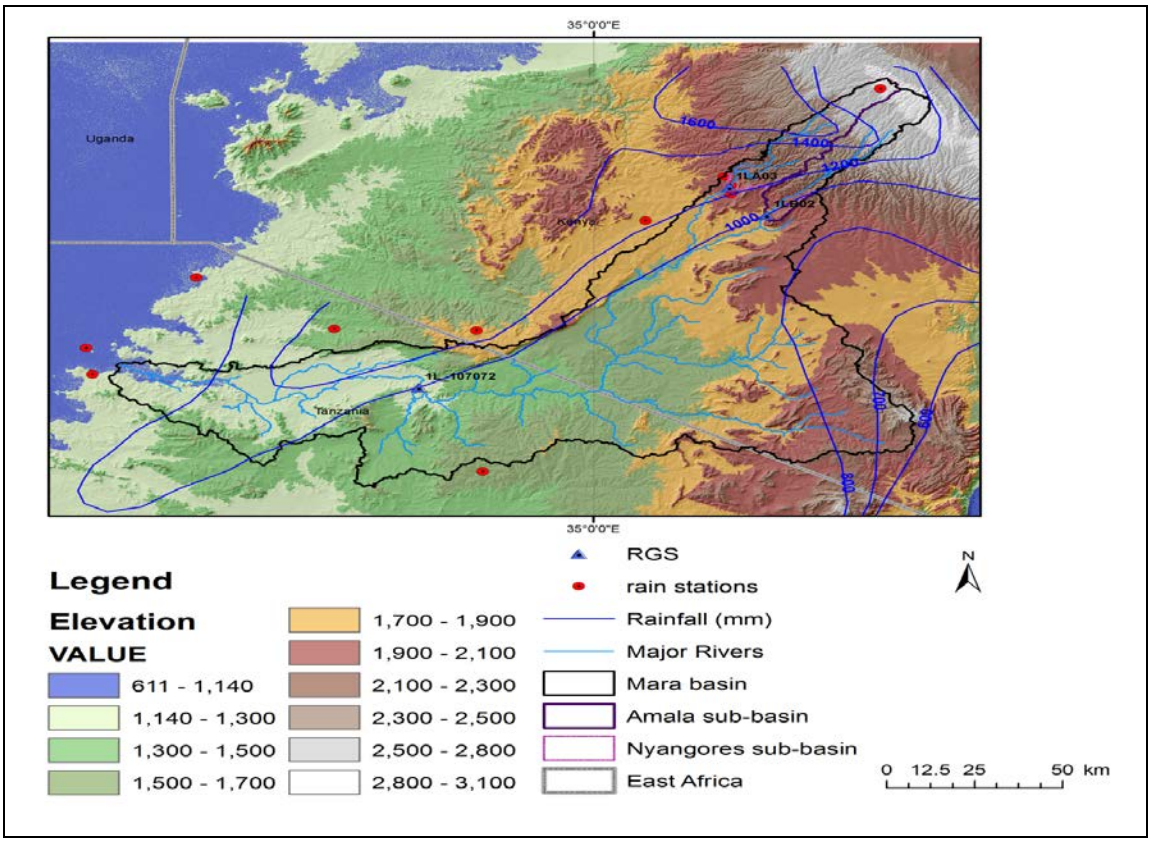


Figure 2.4. Digital Elevation Model of Mara basin showing the Amala and Nyangores sub-basins, the river gauging stations, the rainfall stations and the mean annual rainfall distribution over the basin.

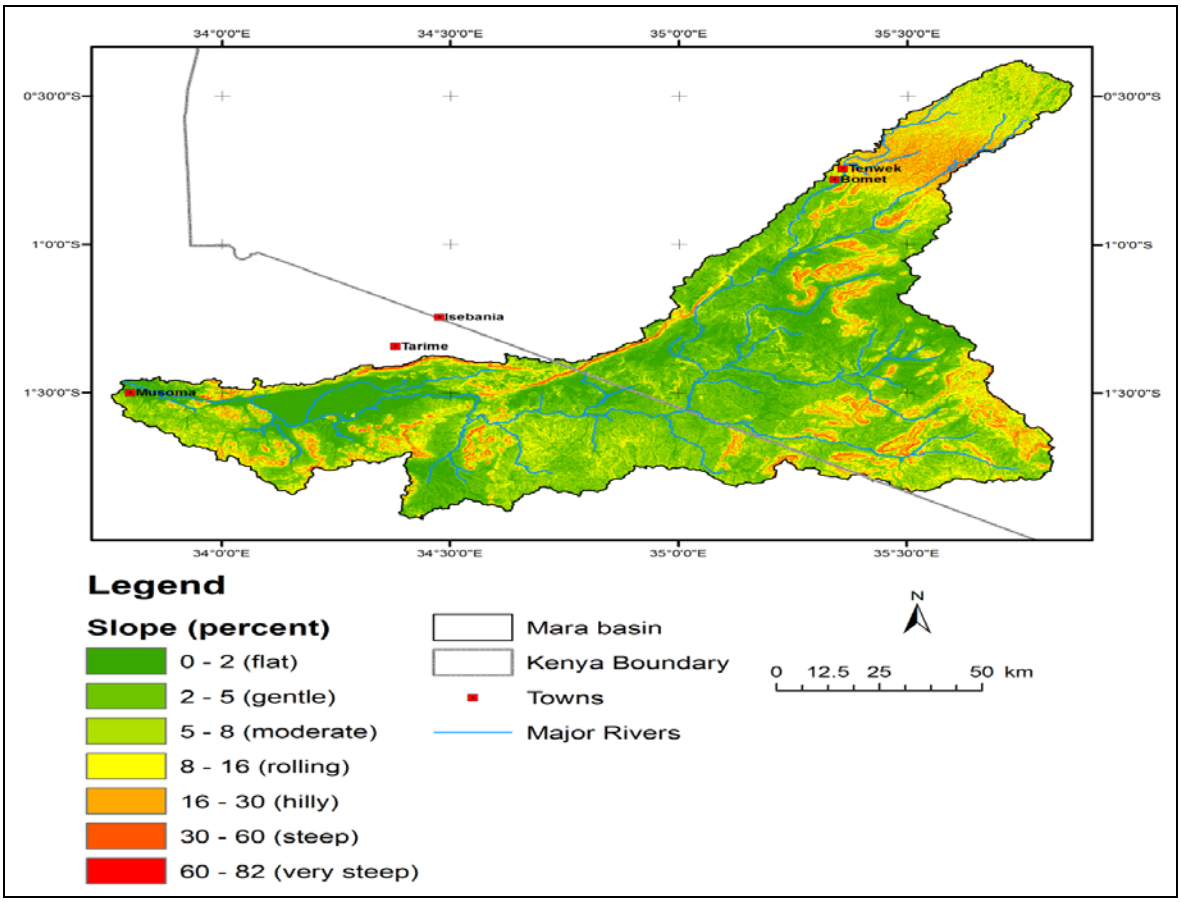


Figure 2.5. Slope classes in percent

2.3.3. Drainage, soils and erosion

On the highlands, the Amala and Nyang'ores tributaries from the Mau forest join to form Mara River. Rivers Talek and Sand are seasonal tributaries in the middle part of the basin originally from semi-arid areas, Figure 2.6.

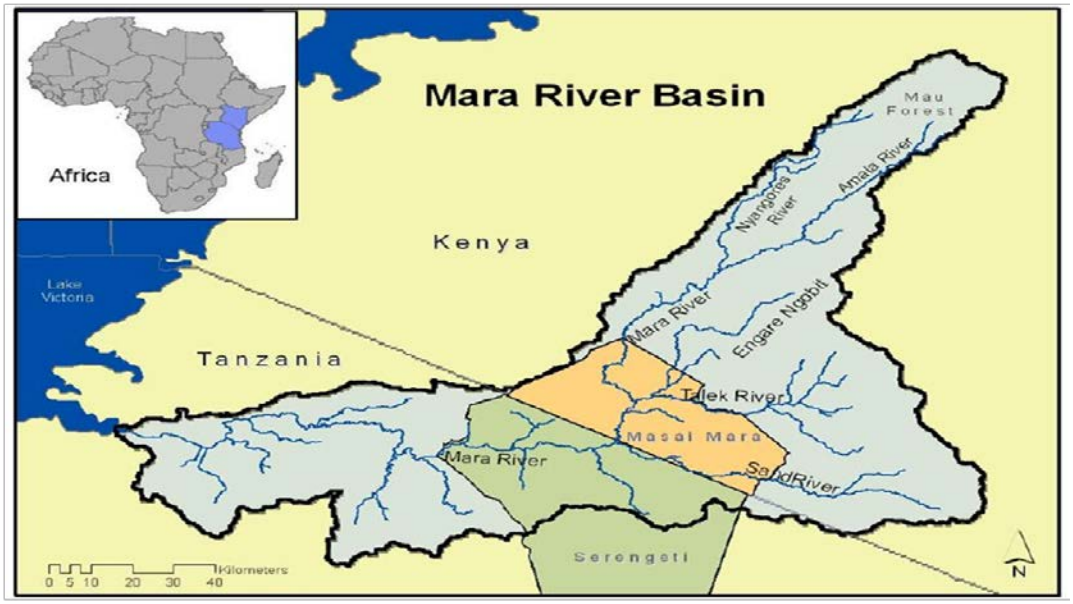


Figure 2.6. Drainage network in Mara basin (Source: Hoffman, 2007)

According to De Pauw (1984) the southern part of the MRB comprising of Mara region of Tanzania is a flat sheet of dark grey basalt associated with metavolcanic rocks. These rocks are pre-cambrian, hence young. Soils within the MRB on the Tanzanian side have been classified into three portions (De Pauw 1984): (a) *The Northern highland*s in Tarime, Serengeti and Musoma districts consisting of granite granodiorite foliated gneisses and magnetite, (b) The Southern highlands of Serengeti and Bunda district, respectively that are mainly volcanic rocks of alkalinic origin and (c) The Meta-volcanic soils of mainly Serengeti and parts of Bunda and Musoma. They also dominate in southern side of the Mara River. By and large, these soils are good for agriculture (Majule, 2010).

On the Kenyan side of the basin, the soils are predominantly cambisols in the upper and middle region and vertisols in the lower downstream part (Davies, 1996). The cambisols are characterized by structural stability, high porosity, good water retention and moderate to high fertility, all of which make them suitable for agricultural activities. Vertisols are high in clay content and dark in color. Though they have good water holding potential, they require specialized techniques for agricultural use (Mati, 2008). The underlying bedrock of the region consists of quartzite, gneisses and schists (Lamprey, 2004). The upper watershed is comprised of steep slopes and, historically, was densely forested. The considerable deforestation of the upper region and other forms of land degradation increased soil compaction, resulting in runoff and erosion.

Andosols are found in the forested highlands of the watershed on the Kenyan side. Andosols are deep, well drained fertile soils of volcanic origin and generally form good aquifers. They are however highly erodible if they do not have vegetative cover. Nitisols are dominant soils in the midlands and lowlands. Other soils present in the watershed are Planosols, Cambisols, Fluvisols, Leptosols, Phaeozems and Vertisols. Planosols, Vertisols and Phaeozems are common in the lowlands of Tanzania and Kenya. Planosols and Vertisols are poorly drained soils that cause flooding and waterlogging during wet seasons.

Figure 2.7 shows the agricultural areas in upper Mara where slopes exceed 16%. These areas have erodible soils (Andosols) which makes them susceptible to soil erosion.

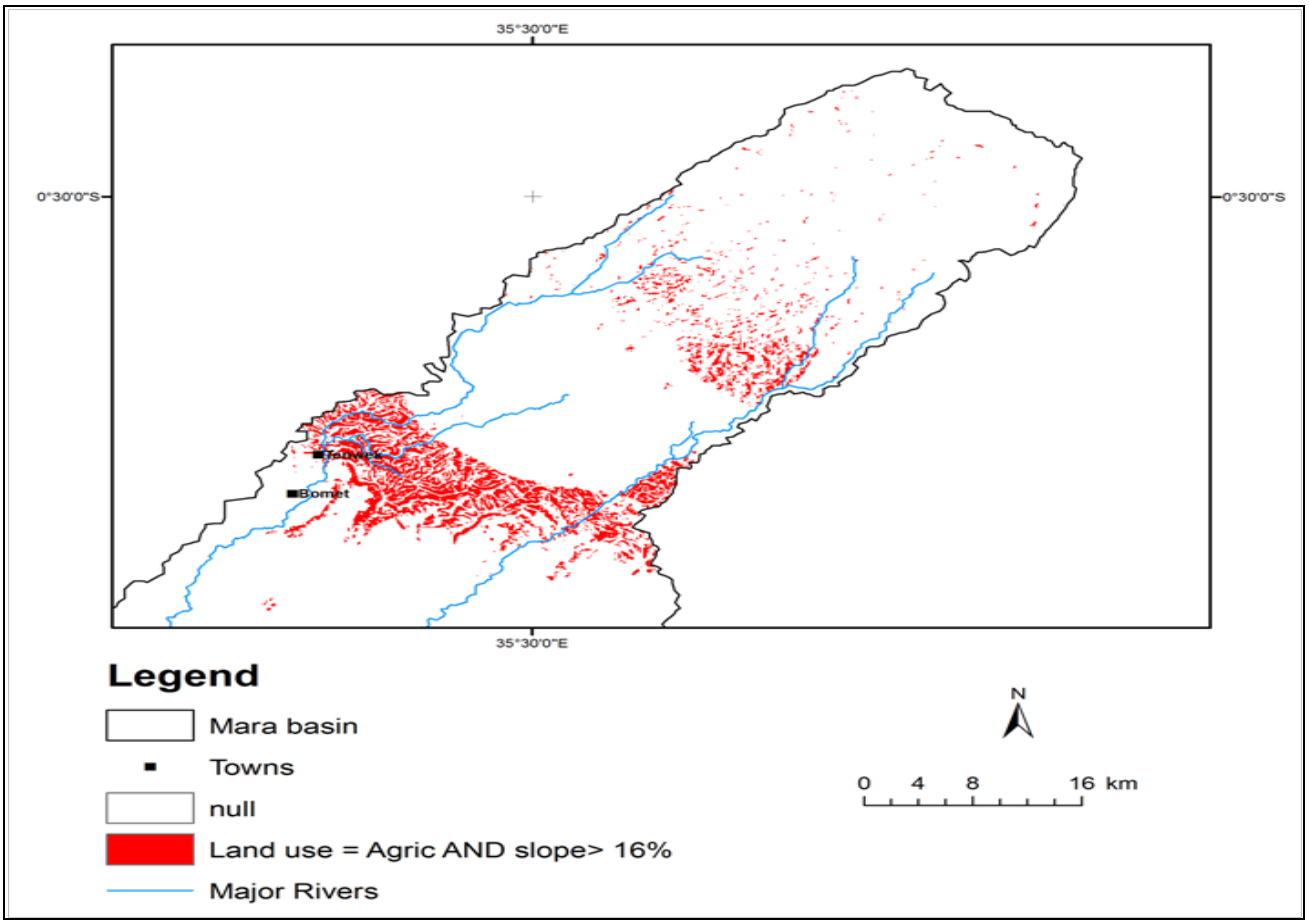


Figure 2.7. Agricultural areas of upper and under MRB having slopes above 16%. These areas are vulnerable to soil erosion by water.

Erosion risk in Mara Basin was calculated using the Revised Universal Soil Loss Equation (RUSLE). The Revised Universal Soil Loss Equation (RUSLE) is the most widely used empirical model for assessing sheet and rill erosion (Lu *et al*., 2004). It was developed first as USLE by Wischmeier and Smith (1978) to assess sheet and rill erosion caused by raindrop impact on gently sloping agricultural lands and later modified to RUSLE by Renard *et al*. (1991) for application on a broader range of land covers and to include erosion caused by associated overland flow. RUSLE was developed by United States Department of Agriculture, Agriculture Research Service (USDA, ARS) to guide conservation planning in the USA but it has been applied in Europe (Van der Kniff *et a*l., 2000), Asia (Fu *et al*., 2005, Zhang *et al*., 2006), Africa (Mati *et al*., 2000, Onyando *et al*., 2005) and South America (Lu *et al*., 2004).

In the upper Mara River, intensive cultivation is carried out in areas with slopes exceeding 16% that were formerly under forest cover. In upper Mara (Amala and Nyangores sub-basins), soil erosion exceeds tolerable rates of 11.2 tonnes/year in the hotspots. In 2007, the sediment concentration for Nyang'ores ranged from 35.5 mg/l to 268.5 mg/l (mean daily concentration of 95.16 ± 12.68 mg/l) while the sediment loading for the Amala River ranged from 26.4 mg/l to 258.0 mg/l (mean daily concentration of 97.43 ± 12.46 mg/l). River Nyangores had a mean sediment yield of 128.47 ± 20.15 tonnes/day while River Amala had 131.70 ± 38.56 tonnes/day. While these rates are not alarming, there are indications of an increasing trend. Erosion hotspots are concentrated in the small scale farms next to the forest in the upper Mara Basin.

Soil erosion, increase turbidity of water and sedimentation leads to increased cost of water treatment, loss of landscape beauty and degradation of aquatic ecosystems. Since Mara River is important for supporting tourism, decreased water quality would lead to losses in earnings from this sector affecting livelihoods of many people in Kenya and Tanzania. There are no major water supply projects in MRB but recently a project to supply Bomet township with water and sanitation was launched. From the EPWS study, it is estimated that a reduction of soil erosion by 10% would result in savings on water treatment costs of Ksh. 4 million per year.

Although efforts to rehabilitate the watershed focus mainly on reforestation, increasing the forest cover to 100% would reduce the water yield by 37%. This is due to the higher evapotranspiration rates under forest cover compared to agricultural crops. There are a number of sustainable land management technologies that are effective in controlling soil erosion without affecting water balance. The ones recommended for MRB are contouring, grass strips, terraces and grassed waterways. Contouring is effective for low slopes and it can reduce soil erosion by 50%. Terraces are suitable for steep slopes up to (60%) and have an effectiveness of 93%. Grass strips are suitable for slopes not exceeding 15% and their effectiveness is 40%. Grass strips can be applied in combination with technologies such as terraces.

The current level of soil conservation in MRB cannot sustain flows of ecosystem services. An EPWS scheme in MRB would provide incentives to the farmers in upper MRB to implement sustainable land management practices to a level where the flow in the river is maintained and the quality of water is improved. The farmers cultivating erosion hotspots in Upper Nyangores and Amala sub-basins would be the ecosystem stewards. Their land use activities will determine if soil erosion is checked or continues unabated. The proprietors of the lodges and tented camps would be a potential beneficiary group. There are simple soil conservation technologies that if used would reduce soil erosion by more than 40%. As mentioned up these include contouring, grass strips, terracing and grassed waterways.

2.4. Population, Land Cover Changes and Land Uses in the Mara River Basin

2.4.1. Population

The latest population census in Tanzania was carried out in 2012, though the results were not yet ready at the time of this study. However, ArcGIS shapefiles with population data per administrative unit were available. In Kenya, the latest population census was done in 2009 and results have been released but they were not available in GIS format. The 1999 population data

was available in GIS format and the total population for 2002 was projected based on an annual growth rate of 2.5%. Therefore the analysis to determine spatial distribution of population density and total population was done based on the 2002 population estimates (Figure 2.8). The results show that most of the basin has population density below 50 persons/km^2. The highest population densities of up to 500 persons/km^2 are found around Bomet, Isebania and Musoma. Bomet and Musoma are the biggest towns in the basin. The areas with low population density are in the conservation areas (Mara and Serengeti) the large scale farms adjoining the conservation areas. Based on the two available datasets, the total population in 2002 was estimated at 805,000 people and based on an annual growth rate of 2.5% the population at the end of 2010 was 981,000.

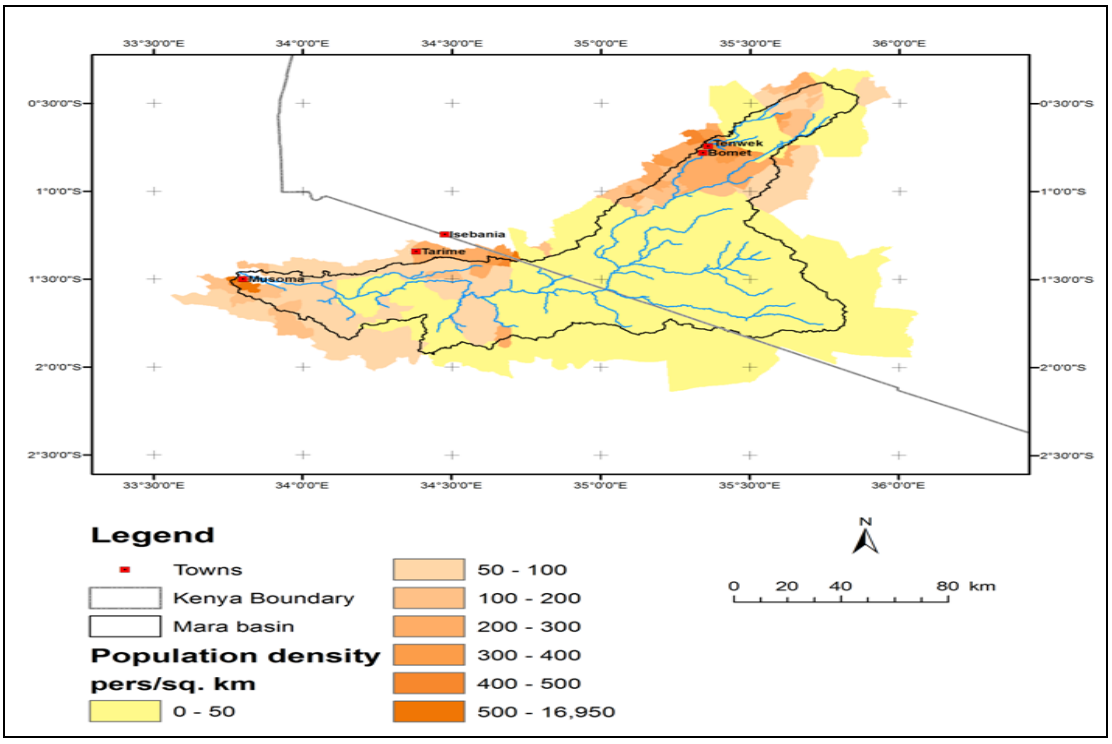


Figure 2.8. Estimated 2002 population density in Mara basin

The Mau Forests lie on the western highlands of Kenya, which are located on the south-western part of Kenya and include the South-west Mau, West Mau, East Mau, Transmara and Ol Posimoru forest. This forest complex is protected as a water catchment since the colonial times in 1902. South-west Mau, West Mau and Transmara forests lie on the steep slope of the Mau escarpment which forms part of the western slope of the Rift Valley. To the east, the slope of the Mau escarpment falls sharply to the floor of the Rift Valley and to the west, it slopes less sharply south-westwards and southwards onto the Lake Victoria plateau. This implies that the forests play a role of preventing soil erosion and downstream siltation and sedimentation.

The Mau Forest complex is dissected by numerous rivers, tributaries, and streams. The rivers flow almost in a parallel pattern from north-east to south-west and southwards down the steep slope of the escarpment and either in the Mara and Sondu Rivers basins, which finally drain into Lake Victoria. Mara River passes through north-western Tanzania or southwards into Ewaso

Ng'iro River that flows into Lake Natron. This Mau forest complex play an important role in preserving and maintaining the water balance of the rivers, especially Mara and Ewaso Ng‟iro by regulating infiltration and run-off, thus limiting downstream siltation, sedimentation and flooding (Dwasi, 2002; Ayieko, 2007).

The upper part of Mara basin consists of protected forest and woodland within the gazetted area of Mau Forest Complex. Some of the areas which were originally forest have been cleared for cultivation. The middle part consists of grassland and bush land which is in the Maasai Mara National Reserve in Kenya and Serengeti National Park in Tanzania. Some of it is also under large-scale farming or ranching or small scale agriculture. The lower part in Tanzania also consists of agricultural land. Wetlands are found in the area close to Lake Victoria. Figure 2.9 shows land cover of MRB.

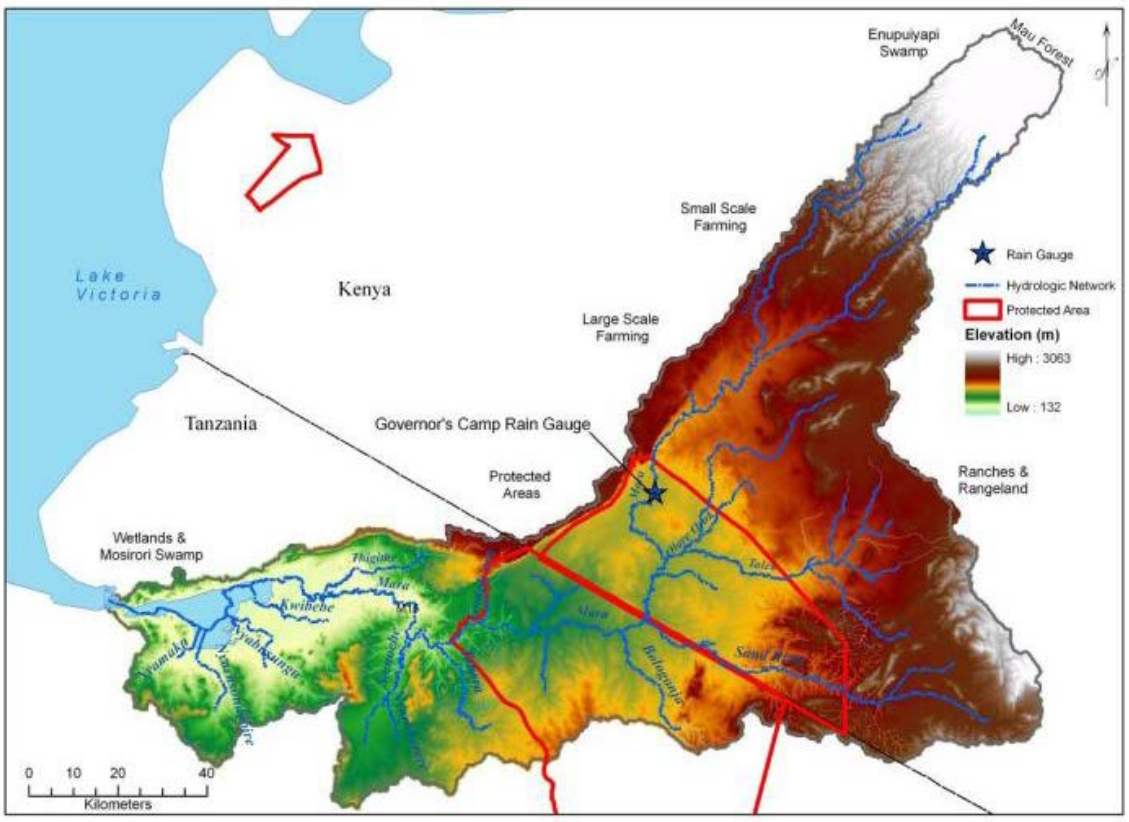


Figure 2.9. Land cover and land use types within the Mara River Basin.

The Mara River basin has been subject to rapid changes in land cover over the last 50 years. Several reports give estimates of conversion rates of forests and bush and shrub land to agricultural land. Mutie (2006) reports that forest and shrub land decreased by 32% and 34%, respectively, during the period between 1973 and 2000. Water bodies reduced by 47% while agricultural land, tea and open forest increased by over 200%. The MRB has undergone significant land use changes driven mainly by increasing population pressure. The main changes in land cover is conversion of natural forests, savannah grassland and bush land to agricultural

land. Assessment of satellite images shows that the area under natural forest has declined by almost 60% over the last 25 years between 1975 and 1999. The area under natural forest was 3,223 and 1,411 km^2 in 1975 and 1999, respectively.

The major land-use activities of the Mara River basin include forested areas in the upstream watershed, mixed agriculture (small-scale and commercial farms) in the upper central part of the basin, grassland and protected areas for the Serengeti National Park and Maasai-Mara Game Reserve in the lower basin. Evidence of land use change in the basin, which can lead to a long-term impact on the hydrology and the sustainability of other resources, is shown in Ottichilo *et al* (2000), Gereta *et al* (2002), Serneels *et al* (2001) and Onjala (2004).

Mango (2010), reported findings of a study on modeling the effect of land use and climate change scenarios on the water flux of the upper Mara River flow, Kenya, in an MSc thesis, FIU. Results showed that deforestation of Amala and Nyangores catchments makes the river flow more erratic and the peak flows and sediment loading higher, actual ET decreases.

The Mau Forest Complex covers 400,000 ha. Despite its critical importance for sustaining current and future economic development, the Mau Complex has been impacted by extensive illegal, irregular and ill planned settlements, as well as illegal forest resources extraction. Degazettement of forest reserves (excisions) and continuous widespread encroachments have led to the destruction of some 104,000 hectares representing over 24 per cent of the Mau Complex area over the last 10 years. In 2001, 61,023 hectares of forest in the Mau Complex were excised. In addition, people have encroached into some 43,700 hectares in the remaining protected forests of the Mau Complex (UNEP, 2008). The report of UNEP (2008) on Mau Complex and Marmanet forests: Environmental and economic contributions Current state and trends, show that in 2007, the revenue from the entry fees alone amounted to Kshs 650 million for the Maasai Mara and the annual indirect revenues from tourism are estimated to be in excess of Kshs 3 billion, pointing to the need to conserve the Mau Complex water catchment. Homewood *et al*. (2001) reported a study on long-term changes in Serengeti-Mara wildebeest and land cover. They found that the major changes in land cover and dominant grazer species numbers are driven primarily by private landowners responding to market opportunities for mechanized agriculture, less by agro-pastoral population growth, cattle numbers, or small-holder land use.

Significant changes in land use have occurred between 1973 and 2000; forests, shrub land, grassland and savanna reduced by 32%, 34%, 45% and 26%, respectively, while agricultural land increased by 203%. Peak flows have increased e.g. from 827 to 878 m3/s for 1973 and 2000 respectively at the outlet, as has been reported by Mati *et al*. (2008) in a study entitled, impacts of land-use/cover changes on the hydrology of the transboundary Mara River, Kenya/Tanzania. Wamalwa (2009), in an MSc Thesis, Lund University, on prospects and limitation of Integrated Watershed Management in Kenya: A case study of Mara Watershed, reported that issues identified by local stakeholders and water managers/policy makers as facing Mara watershed are change in temperature and rainfall, reduction in forest cover, drying of rivers, erosion of river banks, increase in surface runoff, increase in soil erosion, sedimentation of rivers, reduction in water infiltration, ground water decline, pollution of the river, wildlife reduction and decline in fish catches. The local community sees poverty, corruption, landlessness, population growth and

political influence as being the major causes of deforestation. Managers however viewed illegal encroachment as being a major contributing factor.

2.4.2. Land use change and land degradation

The land use change in the basin was assessed using Landsat images of 1975, 1986 and 1999. The land cover maps of 1975 and 1999 were used for hydrological modelling using SWAT and the land cover classes and land use change obtained using images of the two years is shown in Figure 2.10. The areas under natural forest and shrub lands reduced significantly in favour of agriculture, grasslands and wetlands. The area under forest cover in upper Mara River basin has been systematically transformed to agricultural land. For instance, in 1975, 1986 and 1999, the area under natural forest was 3,223 km^2, 2,704 km^2 and 1,411 km^2, respectively, representing a drop of almost 60% over 25 years. During the classification, areas that were under large scale agriculture from those under grasslands especially where grass like crops such as wheat are involved were not distinguished in the study. It can also be noted that the 1999 image had some cloud cover in the upper side of the basin. However even with these uncertainties, it is clear that the land degradation is taking place rapidly in the basin. Apart from the conversion of forest to farmland, there is a tendency towards increased intensification of agriculture. The hotspot of land degradation is the areas of upper Mara adjacent to the protected areas on the Kenyan side where population densities are very high (Figure 2.10). In 2002, the estimates of population density exceeded 500 persons/km^2. Apart from demographic pressure, this area has suffered from years of poor governance as far as forest resources are concerned. Part of the forest was allocated to farmers without due regard to environmental sustainability.

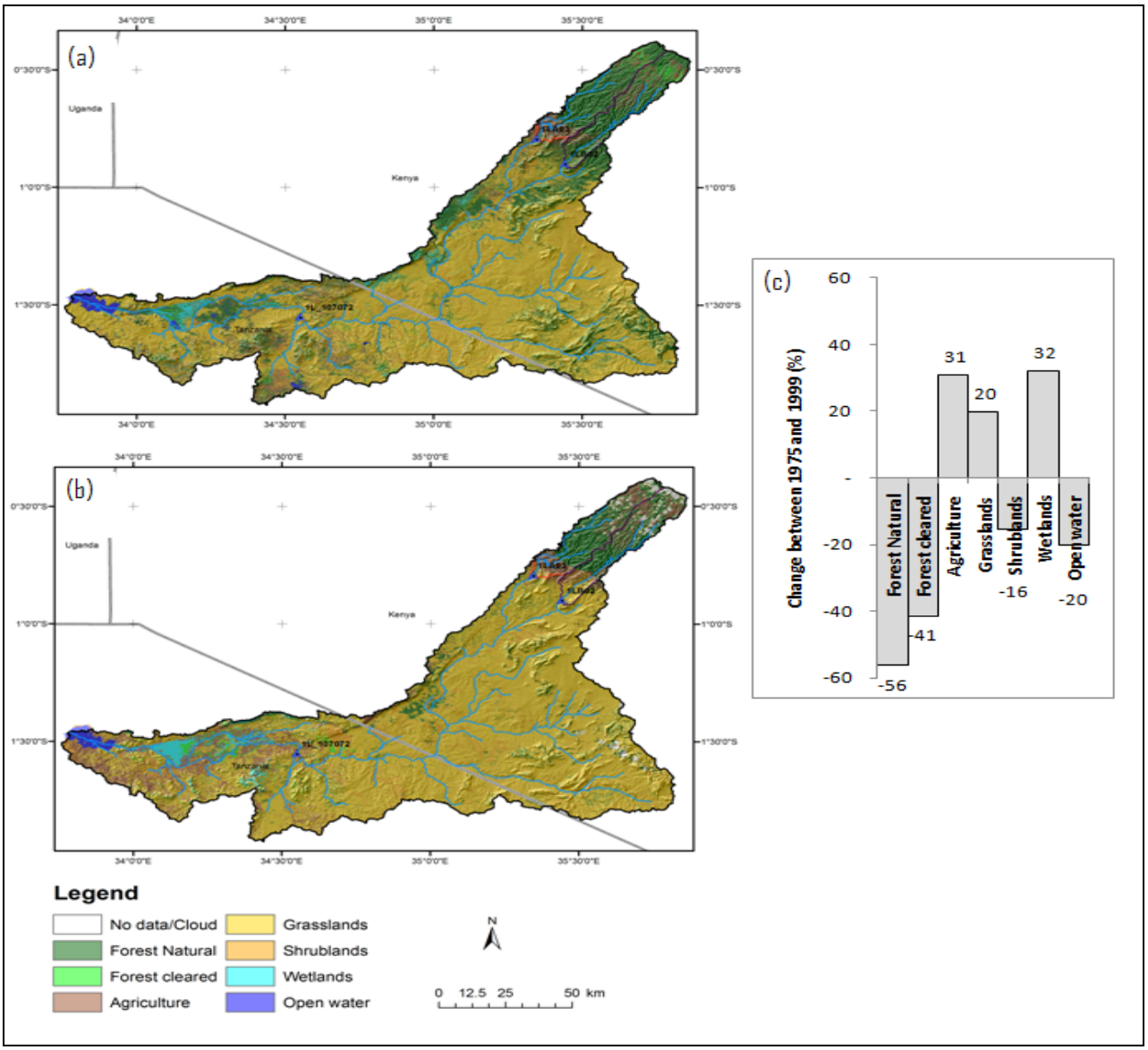


Figure 2.10. Land use change in Mara basin between 1975 and 1999 determined using supervised classification of Landsat images

2.5. Environmental Flow Assessments

Environmental flows describe the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well being that depend on these ecosystems (http://www.eflownet.org). Through implementation of environmental flows, water managers strive to achieve a flow regime, or pattern, that provides for human uses and maintains the essential processes required to support healthy river ecosystems. Rivers are parts of integrated systems that include floodplains and riparian corridors. Collectively, these systems provide a large suite of benefits. However, the world's rivers are increasingly being altered through the construction of dams, diversions, and levees. More than half of the world's large rivers are dammed (Nilsson *et al*, 2005), a figure that continues to increase. Dams and other river

structures change the downstream flow patterns and consequently affect water quality, temperature, sediment movement and deposition, fish and wildlife, and the livelihoods of people who depend on healthy river ecosystems (Postel and Richter, 2003). Environmental flows seek to maintain these river functions while at the same time providing for traditional offstream benefits.

Flow regime influences the water quality, energy cycles, biotic interactions, and habitat of rivers (Naiman *et al*, 2002). Not only will the flow regimes influence water physico-chemical parameters, it can also influence the concentration of toxic wastes including pollutant chemicals and pesticides and their metabolites in the water and also its microbial contamination (e.g. faecal coliforms, *Salmonella* and *Vibrio*), and abundance of vectors of human and animal diseases such as mosquitoes and snails. Environmental Flow Assessments (EFAs) are becoming the global standard for determining the amount of water required to sustain aquatic ecosystems and satisfy basic human needs, accounting for both components of the reserve. The reserve refers to both the quantity and quality of river flows, and it has highest priority in water allocation plans. Thus, allocations of water for agriculture, industry, and municipal supplies exceeding 25 litres per day per person should be made only from the portion of flow in excess of the reserve. Under severe low-flow conditions, allocations for these uses may need to be curtailed or temporarily halted in order to maintain the reserve flow.

In most river basins, the effects of deforestation, water abstractions for livestock, agricultural irrigation and other industries are on the rise. The ever increasing abstractions especially for small rivers and streams are certain to at some point in the future, severely degrade the riverine ecosystem and even impinge upon the most basic water needs of people living along the river. It will also have an impact on human health by lowering flow regimes, creating mud pools and riverside stagnant waters which become suitable breeding habitats for mosquitoes and even schistosomiasis and fascioliasis snails as our previous studies in the Mara River basin indicated (Ofulla *et al*, 2012, in unpublished LVBC report).

Water resources management, with its inherent multilateral relations and under poorly predictable hydrological cycles coupled with unpredictable natural processes, imposes serious challenges for the national economic development and the existence of human society in general (Dukhovny and Sokolov, 2000). The rate at which the use of water resources has occurred in the past few decades has taken its toll on the environment in terms of increased pollution, destruction of wetlands, depletion of fish species and numbers, and endangerment of marine life in estuaries and also terrestrial lives that depend on the river among other ills in both the developed and developing economies (Assaf, 2009). With dramatic rise in water demand, water development has adversely impacted on environmental conditions and consequently, human health, socio-economic development and security. These effects have awakened human race all over the world to respond through an assessment of the discourse on water resources development and has led to the introduction of the main principles of Integrated Water Resources Management (IWRM) (Agarwal *et al.*, 2005).

Integrated water resources management (IWRM) is defined as the holistic and integrated approach based on involvement of all stakeholders and their partnership, to regard water as an economic good, etc (Agarwal *et al.*, 2005). It lays emphasis on the trio of economic efficiency, social equity, and environmental sustainability. The holistic and system-oriented approach

considering three spheres affected by water use and relations (socio-economic, environmental, and political) should include both the integration of different components and the subdivision of complicated systems to simplify their analysis. The sectoral approach in water resources management strengthens the complexity in coordinating different interests, and therefore, IWRM is the natural response to the water quality and quantity problems, and is important consideration in water allocation plans.

Water resource governance by means of political, legal, social, economic and administrative methods creates infrastructure, laws, the system of political, financial and social regulation and economic stability – a set of rules and limitations that should be used by managers and for their orientation at all levels spanning from the local to the international platforms. Effective management and governance in this respect can only be attained if sound policies and clear frameworks are laid down and only if these are implemented to the letter.

Both the Government of Kenya Water Act (2002) and the United Republic of Tanzania National Water Policy (2002) require protection of reserve flows to provide for basic human needs and to sustain ecosystems into the future (GoK, 2002). An Environmental Flow Assessment (EFA) was conducted in 2007 by WWF, to determine how much water is available in the river during different times of the year and how much is needed to maintain reserve flow, Figure 2.11. The reserve flow for the Mara River was determined by a team of Kenyan, Tanzanian, and international scientists using a structured, science-based approach to determine how much water must be left in the river to protect the aquatic ecosystems and meet resource quality objectives. The Building Block Methodology was applied.

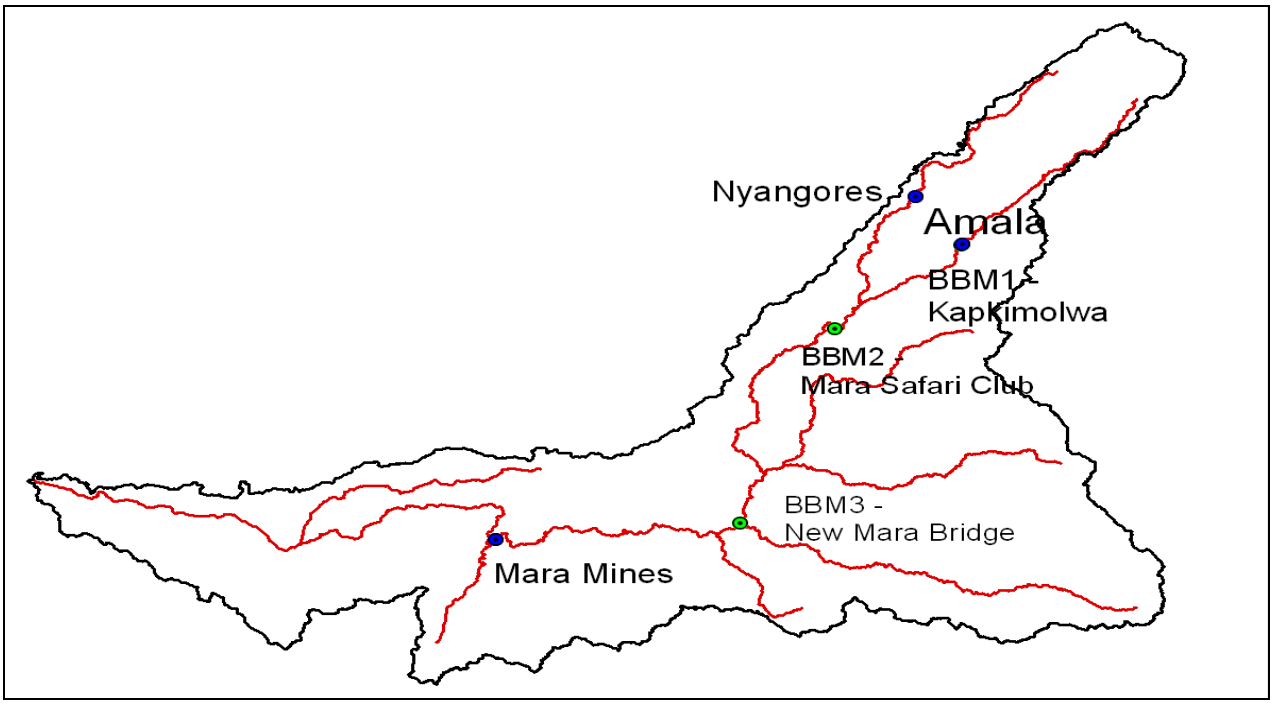


Figure 2.11. EFA Stations on the Kenyan side of the Mara River

Environmental Flow Assessment (EFA), Mara River Basin: Proceedings of the Final EFA Workshop. 2007. 83 p.

Key:

BBM 1: Kapkimolwa
BBM 2: Mara Safari Club
BBM 3: New Mara Bridge

2.6. Water Quality, Water Supply and Demand in the MRB

2.6.1. Water quality

Mara River plays an important role in the economy of Kenya and Tanzania as it supplies water to support tourism, agriculture, pastoralism, mining and town centres. The head waters of the Mara River comprise of Amala and Nyangores tributaries which are permanent and are fed by sources in the humid forest covered highlands within Mau Forest. The two rivers have a mean combined supply of approximately15 m^3/s. The flow during the months of January to March and November to December are low and in less than average years, the demand may not be met. Over the years, there has been a systematic conversion of forests and bush land to agriculture and grassland. The main drivers are growing population pressure and mismanagement of natural resources. These land use changes have affected especially the Upper Mara and there are indications that mean annual rates of soil erosion exceed tolerable soil erosion rates and may be as high as 25 tons/ha. The measurements of Total Suspended Sediment (TSS) show an increasing trend of sediment loading in the rivers. The sediment load increases downstream. Although the ongoing initiative to plant trees may reduce erosion and sediment loading substantially and stabilize the flows, the total water yield will most likely decline due to increased evapotranspiration. In agricultural land, measure to conserve the soil by enhancing infiltration or filtering eroded materials are recommended.

Kiragu (2009) reported on the assessment of suspended sediment loadings and their impact on the environmental flows of Upper transboundary Mara River, Kenya. In an MSc. Thesis of JKUAT, Kenya. Based on measurements made in 2007, Kiragu concluded that suspended sediment loads in Upper Mara were low compared to other rivers in Kenya indicating that catchment in upper Mara is still in pristine conditions. The highest sediment concentration recorded was 258 mg/l and 268 mg/l for Amala and Nyangores sub-basins. However comparing his measurements with those made between 1980 and 2003 Kiragu (2009) noted that sediment load is increasing with time.

Based on a water quality sampling campaign carried out in May 2005, it was found that the total suspended sediment (TSS) load and turbidity for the region downstream of the confluence of Amala and Nyangores (Emarti Bridge) and upstream of Kenya-Tanzania border is 15 times higher compared to the values obtained upstream of Emarti bridge. This suggests that the large scale farms as well as Maasai Mara National Reserve could be heavy contributors of water pollution. However this was a short term measurement period. The TSS values were 0.1 g/l and 1 to 3 g/l upstream and downstream of Emart Bridge respectively. The corresponding turbidity values were 50-100 and 1000-2000 NTU (GLOWS, 2005). In a water quality baseline assessment of Mara River basin of Kenya and Tanzania, Singler and McClain (2006) reported

that the mineral concentrations increase downstream. Nutrient concentrations are highest in agricultural areas, while pesticides and PCBs were detected in some areas.

2.6.2. Water supply and demand in the MRB

Mara River basin has an area of 13,835 km^2. A study by Melesse *et al*. (2008b) showed that the tributaries Amala and Nyangores in upper Mara River generate most of the water flowing into the middle and lower reaches of Mara River. The combined mean flow of these two rivers is approximately 15m^3/s or 473 million m^3 per year. Based on the basin's human population of roughly 1 million and a per capita consumption of 50 litres per day, the annual water demand is 18.25 million m^3. Assuming that wildlife, livestock lodges and camps, large scale irrigation and mining consume 4 times as much as human population, the total estimated demand would be 90 million m^3 per year which is approximately 20% of the water produced by Amala and Nyangores tributaries. This analysis however ignores the fact that the distribution of flow over the year is not constant and there are dry months such as January, February and March when available flows are minimal. The proportion of people served with piped water is low and the current water demand for human population does not reach 18.25 million m^3 per year. The estimated total water demand for 2007 stood at approximately 24 million m^3.

The results of SWAT modelling show that the mean annual flow at Amala 1LA03 and Nyangores 1LB02 is 7.0 m^3/s and 7.8 m^3/s respectively. Based on analysis of available flow data from 1955 to 2007, Kiragu (2009) found that the flow in Nyangores is double that of Amala and that Nyagores is the main contributor of flow to the downstream reaches of Mara River (Figure 2.12). Figure 2.13 shows the mean monthly river discharge for upper Nyangores river (source: Hoffman, 2007), while Figure 2.14 shows the mean monthly river discharge for upper Amala river (source: GLOWS http://glows.fiu.edu/). Amala and Nyangores sub-catchments have similar areas of approximately 700 km^2. The rainfall in Nyangores is higher than in Amala. The difference in flow between Amala and Nyangores may not be as high as Kiragu suggests. A good estimate of the mean flow of Amala and Nyangores combined would be 15 m^3/s. This is equivalent to 475 million m^3 per year.

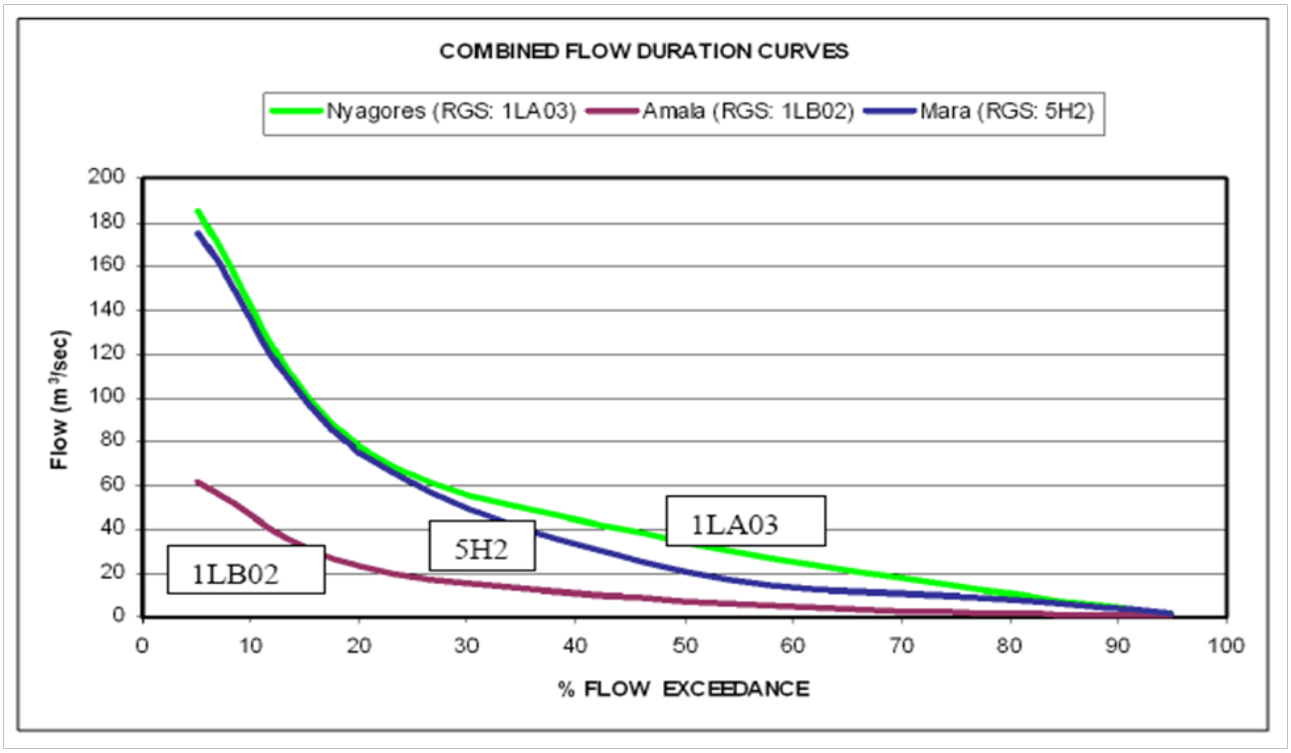


Figure 2.12. Flow duration curves for Nyangores (1LA03), Amala (1LB02) and Mara at Mara Mines (5H2)
(Source: Kiragu, 2009).

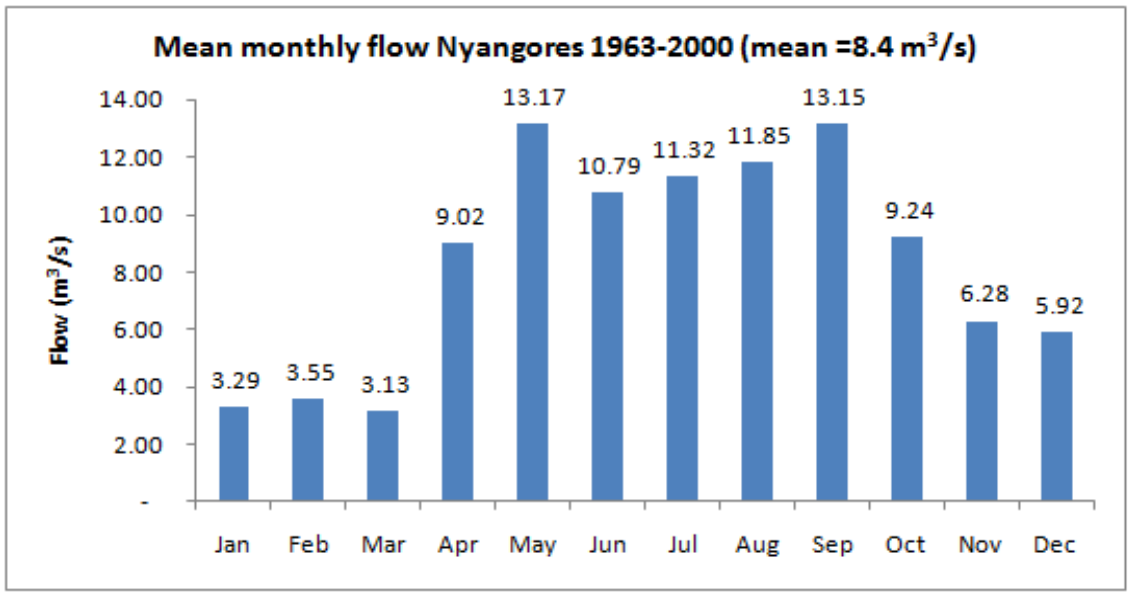


Figure 2.13. Mean monthly river discharge for upper Nyangores River
(Source: Hoffman, 2007)

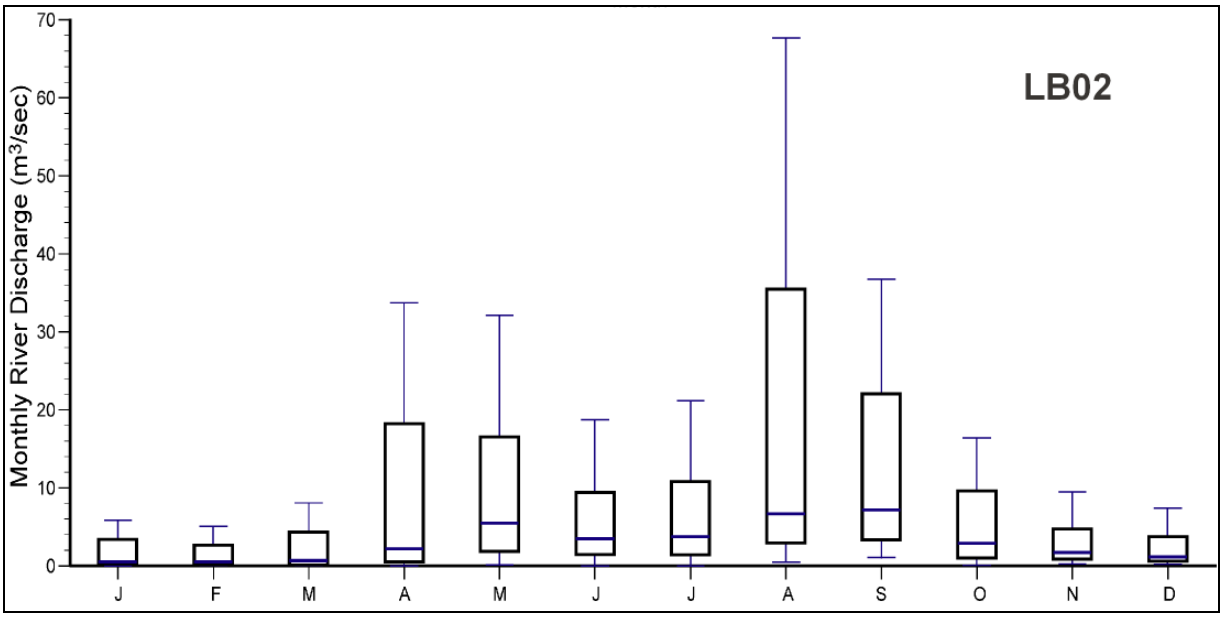


Figure 2.14. Mean monthly river discharge for upper Amala River (Source: GLOWS http://glows.fiu.edu/)

The Mara River is very important to the economy of Kenya and Tanzania. It supports the multi-billion tourism sector by supplying water for Maasai Mara National Reserve and Serengeti National Park. These two conservation areas are world famous for large game, birds and for the annual phenomenon of wildebeest migration that attracts many tourists each year. Serengeti is a World Heritage Site. For instance, the Kenyan tourism sector experienced impressive performance in 2010. The sector contributes immensely to the Kenya's economic performance accounting for 11% of the Gross Domestic Product (GDP). In October 2010, it was projected that tourism earnings would hit Kshs. 100 billion by the end of 2010. Provision of water for animals and tourists to Maasai Mara National Reserve is therefore an important goal that would affect Kenyan economy if it was not met. The same applies to Serengeti National Park in Tanzania. Hoffman (2007) reported that there are over 65 lodges and tented camps in and around Mara basin. The main ones that were found to have relatively high water demands were 29 and it was estimated that the water demand for these would be about 155,000 m^3 per year. Based on Hoffman (2007), the water use for lodges and camps is approximately 0.03 % of the annual yield of Amala and Nyangores combined. A recent government audit revealed that there are 108 camps and lodges of which only 29% are registered (Daily Nation, 2010). The value of Mara River in the tourism sector goes beyond the value of water supplied to these lodges and camps. Most tourist facilities are found near Mara River and there is an aesthetic value that is derived from the river that would obviously be lost if the flow is reduced or the water quality deteriorated. The wildlife that the tourists come to view relies on the river not only for drinking but also for habitat. The river also supports large scale irrigation, the Tanzanian Mining Industry as well as pastoralist and farming communities in Kenya and Tanzania and towns such as Bomet and Musoma.

Geo-spatial mapping and analysis of water availability-demand-use in an MSc thesis, Florida international University, Hoffman (2007) reported that the six main water use sectors are human water consumption, livestock, wildlife, hotels and lodges, irrigation and mining. The water

demand varies from month to month and the total demand was estimated at 23,812,454 m^3. Hoffman (2007) compared the monthly demand with the monthly flows of river Nyangores. A comprehensive analysis of Mara Basin water demand has been done by Hoffman (2007). She identifies six major water users and uses (Table 2.2 and Figure 2.15) in the basin and estimates the demand for each use and does projections until 2030. The monthly variation in water demand and supply is shown in Figure 2.16.

Table 2.2. Estimate of 2007 water demand and supply

	Water user	Water demand, m^3/year *	Proportion of supply (%)
1	Human population	4,820,336	1.02
2	Livestock	4,054,566	0.86
3	Wildlife	1,836,711	0.39
4	Lodges and camps	152,634	0.03
5	Large scale irrigation	12,323,400	2.61
6	Mining	624,807	0.13
	TOTAL DEMAND	23,812,454	5.03
	TOTAL SUPPLY**	413,900,457	
	SURPLUS	390,088,003	

*Water demand data taken from Hoffman (2007) **Supply estimated from results of SWAT modeling

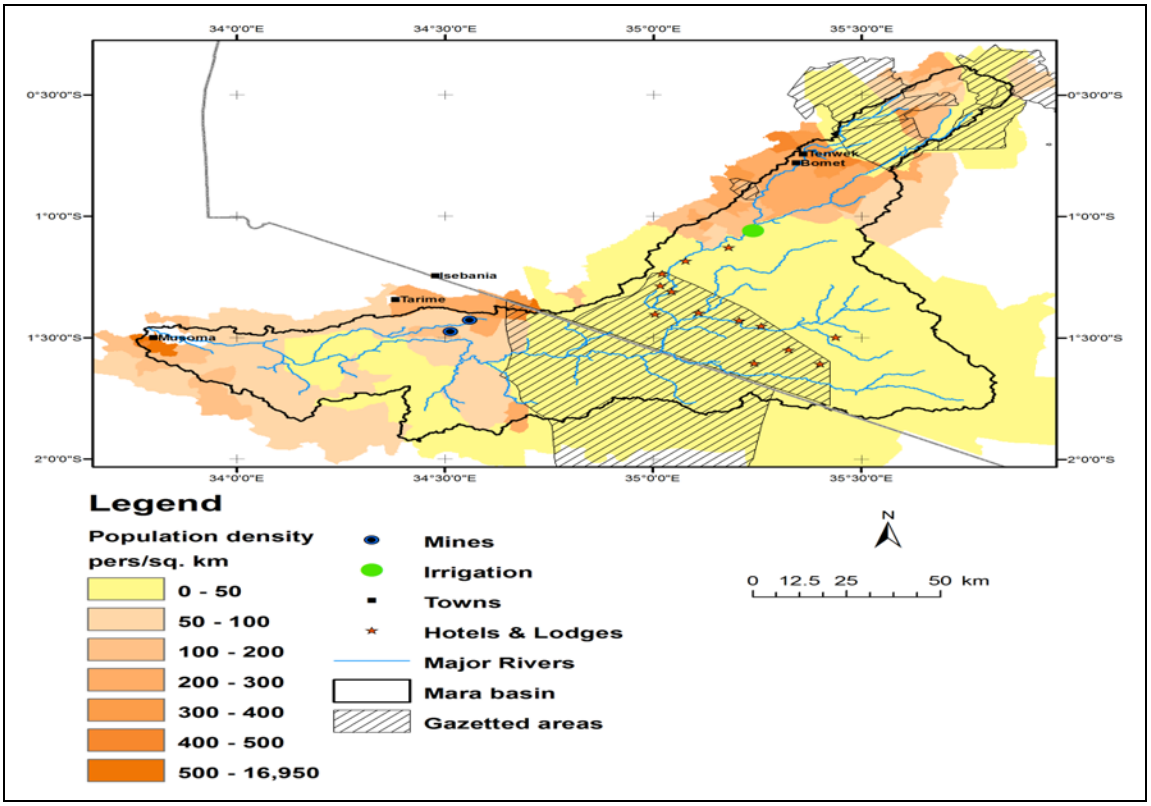


Figure 2.15. Water demand for rural areas, towns, wildlife in conservation areas, hotels and lodges, irrigation and mines.

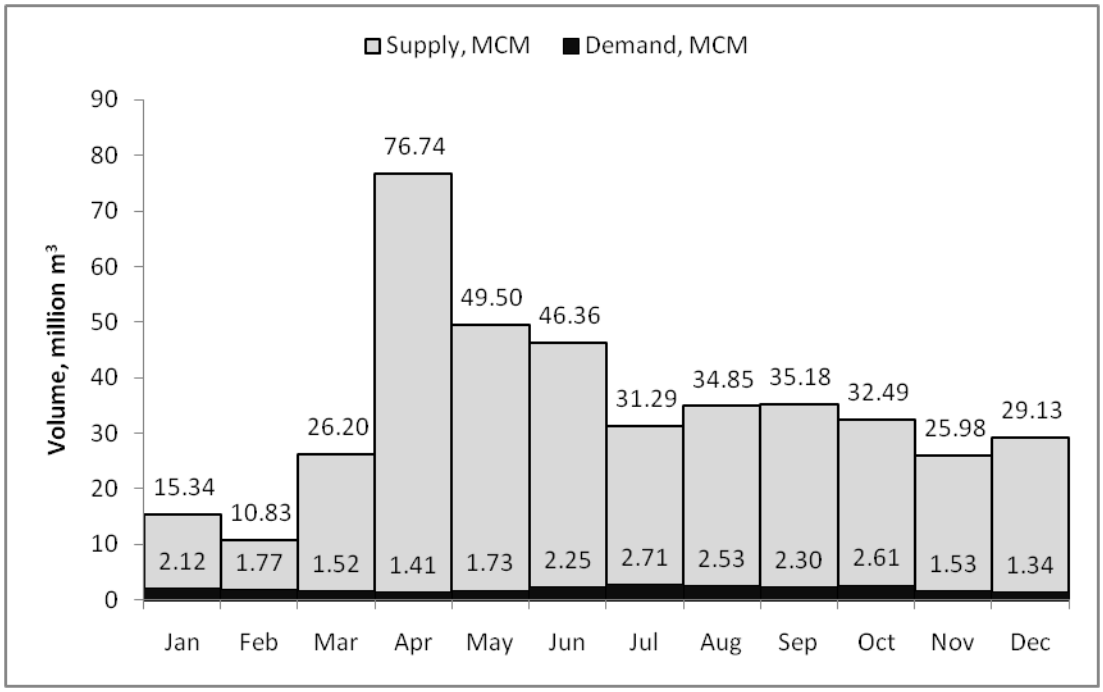


Figure 2.16. Estimate of 2007 monthly water supply and demand in million cubic metres (MCM)

Mara is a transboundary river that has great significance to the peace and stability of the East African region. It is therefore important to manage the river wisely. Conflicts between Kenya and Tanzania could be sparked by mismanagement of Mara River water resources. Mara River is also a contributor to the Nile River and hence its significance to other Nile Basin countries such as Uganda, Sudan and Egypt.

2.6.3. Typical domestic water supply and consumption levels

Depending on climate and workload, the human body needs about 3-10 litres of water per day. The amount and purpose varies widely, and is greatly influenced by the type and availability of the water supply. The per capita water consumption in the rural areas of developing countries as given by IRC (1983), in Table 2.3 as follows:

Table 2.3. Typical domestic water supply and usage

Types of Water supply	Water consumption Litres/person/day	Range in L/person/day
Communal water point (e.g. village well, public standpoint) at a distance more than 1000m at between 500-1000m	 7 12	 5-10 10-15
Village well at less than 250m	20	15-25
Communal standpipe at less than 250m	30	20-50

Yard connection with a tap	40	20-80
House connection -single tap -multiple tap	 50 150	 30-60 70-250

It can be noted that water for drinking purposes range from 3-10 litres per day while for general domestic uses it varies between 5-250 litres depending on distance and type of source or mode of withdrawal.

2.7. Water Allocation and Management Strategies and Technologies

Water allocation management and projections provide an important planning tool for adapting to changes in the availability of water. An assessment of environmental water requirements is necessary so as to reserve a minimum flow to sustain ecosystem services (including water purification, and the actual continued flow of clean water). However, although there are policy frameworks governing an integrated approach in managing natural resources in the Mara River basin, it is evident that in practice there is a lack of coordination in planning and management of natural resources (Majule, 2010). These growing pressures require increasingly sophisticated mechanisms to ensure that a delicate balance is maintained between conservation and human development in the Maasai Mara – Serengeti Region (LVBC and WWF ESARPO, 2010). In addition, for a water allocation plan to work, there needs to be a permitting system in which all the water users (or atleast the major users) are identified and registered, including their respective share of water allocated for abstraction or storage (and the conditions under which the water is allocated). Such a permitting system allows for implementation and monitoring of the water allocation system.

An effective permitting system has the following characteristics: (i.) is time bound with legal certainty, (ii.) describes the extreme conditions (such as droughts) where special rules apply, (iii.) defines fees for different users and different volume categories and (iv.) for each permit, the volume abstracted, abstraction rate and time, point (geographical) of abstraction and source of water use is made known (United Nations, 2000).

The following underlying principles form the basis on which MRB-WAP should be developed and therefore provide guidance to decision making with regard to water allocation.

a) Integrated water resources management (IWRM) as a process that promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems.
b) Existing trends are damaging to the sustainable development of the MRB and should be reversed.
c) There is a need for a coordinating mechanism in the Mara River Basin to implement the recommendations of the MRB-WAP under LVBC or EAC.
d) Water allocation must promote the beneficial use of water in the public interest. This includes commitment to the fair and equitable allocation of water to all within the basin.

e) The underlying concept of the reserve flow is that as long as minimum standards are met in each month, any surplus water is potentially available for abstraction for other uses. Otherwise, only basic needs and protection of the ecosystem shall be provided for.
f) It is important to define clearly the reserve flows that need to be maintained in the Mara River within major reaches in both countries.
g) Dublin Principles adopted by the 1992 Dublin International Conference on Water and the Environment, affirmed the notion that water is an integral part of the ecosystem, and that it is a social and economic good whose quantity and quality should determine the nature of its utilization.
h) Sustainability as a goal in that adequate water with suitable quality should be provided to meet demand where and when needed.
i) Clarity of process by which decisions are made on the allocation of water should be clear to all stakeholders.
j) There is need for equity in participation and decision-making for different stakeholders in their participation in water allocation decisions.
k) Scientific methods used to support water allocation decisions should be credible and must be based on appropriate hydrological and ecological data.
l) Transparency in implementation should be upheld in that procedures for water allocation decisions should be defined and agreed, it is important that they be seen by all interested parties to be implemented correctly.
m) Flexibility of management is essential as an adaptive management strategy to be adopted, which requires plans that can be easily changed as new information or understanding comes to light.
n) Accountability for decisions in that the decision-makers should be accountable, while stakeholders should have recourse to an independent body if they feel that procedures have not been followed.
o) Promotion of water demand management to ensure efficiency and equitable use of water as well as a number of water conservation measures.

2.7.1. Water allocation technologies and strategies

A mechanism enabling communities to make appropriate choices of technologies is important especially for water allocation and usage from various available sources: river, streams, lakes, ponds, wells, bores, and from rainwater catchment, etc. Failure of some of the water supply schemes has been attributed to inappropriate technology and location of facilities, and lack of social acceptability and affordability. Water supply is the provision of water usually to public utilities, private companies, commercial organizations, community groups or to individuals through a system of pumps and pipes, for domestic or industrial use. This water must come from river systems, springs, lakes, the ground (aquifers, wells and boreholes), ponds and man-made dams, roof catchment or from other sources, as already mentioned.

According to The United Republic of Tanzania National Water Policy – July 2002 document:

(i) Communities will be empowered and facilitated to make appropriate technology choices that suite them, particularly which require low investment costs and are least costly in operation and maintenance,

(ii) Use of environmentally friendly technologies including gravity, solar and wind power for pumping will be promoted.

With respect to irrigation, more efficient production can be made using efficient irrigation application systems (hydroponics, dripping water to root zone), applying irrigation water when a plant needs it (i.e. using soil-water tensiometers) and generally being much more scientific about the quantity and timing of irrigation applications. There can also be water storage technologies in dams, tanks, etc, to store water during wet seasons (high flows) for use during drought seasonds (low flows). Other technology based strategies include; self regulating and metering devices to measure water flows, recycling of water to reduce water abstracted, encouragement of conjunctive use of water, application of efficient water use technology in agriculture and industry and making everyone aware of the state of water resources and the expected actions to be taken by the individual users or organizations.

No matter how well designed a water abstraction (or collection) and distribution system, if it is not technically efficient, it will not deliver or perform the anticipated functions, and most times there will be wastages. Many projects, particularly in the rural areas, are not sustainable or cannot be replicable due to inadequate technical interventions, appropriate pumps, weirs, piping and distribution systems, dams, ponds, protected springs and wells. Construction of roof catchment systems, shallow wells, tanks, etc, requires detailed technical instruction for effective implementation and management. The absence of such technical instructions at various levels implies inadequate project implementation and technological transfer, and poor project management resulting in a high failure rate or wastage in the end.

2.7.1.1. Alternative water harvesting and management technologies

Alternative water harvesting and management technologies include damming (including water pans, ponds, sand ponds), storage tanks, rain water harvesting, and waste water treatment, etc. For example, a 1998 survey by Kenya Rainwater Association of 16 community based water projects indicated that lack of technical interventions is the major cause of project failures. Assessment of the infrastructure shows that the communities were not fully involved in the planning and technology selection. The method of fixing gutters, taps, tank construction, valves and operation and maintenance guidelines are not fully understood nor issued to the community on the commissioning of the project.

Wanyonyi (1998) of Kenya Rainwater Association (KRA) wrote a paper which examined the possibilities and challenges of rainwater harvesting in both rural and urban areas of Kenya. The problems of water shortage in urban areas and the high costs of developing new surface water sources, the scarcity of ground water supplies in arid and semiarid lands (ASALs) and the unmanageable operation and maintenance costs of large piped water supplies are alarming. Therefore, the willingness of the people, particularly in arid and semiarid areas, to embrace low cost initiatives like rainwater harvesting is important.

Rainwater harvesting technology is an old established art in Kenya and even in Tanzania, whose abundant knowledge has not been applied to its full potential, especially in urban informal settlements and its neighborhoods due to various challenges and constraints experienced by community based organisations. Observations in most of our urban centres show that rainwater-harvesting structures are not integrated into the building but are added as an afterthought. This is

due to the existing by-laws and lack of awareness by planners, policy makers, beneficiaries and many engineers.

The high potential of rainwater harvesting in Kenya and Tanzania lies in three factors namely: - reliable seasonal rainfall, the quality of roofing materials, and the high demand for clean water supplies. This combined with high costs of conventional water sources makes rainwater harvesting a viable alternative water source particularly in developing urban centres and rural areas. The Kenya Rainwater Association (KRA) in conjunction with community based organizations have identified some of the challenges and constraints that commonly affect replicability and sustainability of rainwater harvesting technologies and through group discussions suggest some possible solutions (KRA 1998a, 1998b, HRWH Reports Review).

Technology selection by a community means acceptance, implying an understanding and willingness to be associated with it, irrespective of some shortcomings in community participation. For example in rain water harvesting projects, technical challenges facing many local initiatives particularly were identified as follows: inadequate construction guidelines for tanks, gutters, filters, etc.; inadequate technological transfer to the beneficiaries; lack of suitable training programmes in rainwater harvesting; poor technical selection and usage of local materials; sizing of storage tanks, with respect to rainfall data and costs; lack of water quality improvement structures and control; inappropriate guttering system in design, construction (support) and maintenance.

Technological challenges in rainwater harvesting could be turned into realities by adopting pragmatic approaches like creating awareness through exposure (CATE), involving other stakeholders, use of appropriate designs in the rainfall data, guttering systems, sizing of storage tanks and use of locally available resources. It is estimated that about 60% of the failures in Kasaye Rainwater Harvesting project were attributed to inappropriate guttering systems (KRA Report 1999). If rainwater harvesting were considered a supplementary source of water supply in small urban centre and arid and semi-arid lands (ASALs) of Kenya, then accessibility and coverage of safe drinking water would increase to over 74%. Presently, it is estimated that only 32.5% of households in rural parts and 93.3% in urban centres of Kenya have access to safe drinking water. But accessibility does not in any way mean availability and reliability (CBS 1994).

Modern technologies for obtaining and using water are concerned chiefly with expensive exploitation of river systems and ground water resources by means of wells and boreholes. This is due to supply responsive approaches propagated by External Support Agencies (ESA). For example, if rainwater harvesting is adopted by small scale or household domestic water users in the MRB especially for urban areas, this will somehow relieve the burden on the Mara River and also improve human health due to use of quality rain water.

In rainwater harvesting, large surface areas (catchments) and the storage tank is required to provide sufficient supply for the dry seasons. Cultural habits, pattern and standard of living, methods of withdrawal, cost and quality of water will greatly influence the use of rainwater for domestic purposes. As already seen in Table 2.4, a rainwater tank will be the same as a yard connection with added advantages of extra storage to balance demand vs. supply, hence increasing per capita consumption to the benefit of consumers.

Sand dams are small structures built in ephemeral rivers to store excess water of the rainy season to overcome the following dry period. Sand dams are impermeable concrete structures constructed across ephemeral rivers with the purpose to harvest water. The sand dams differ from traditional dams by not only storing water in upstream reservoirs, but storing this water within the sand and gravel particles (up to 600 _m) accumulating against the dam and forming an aquifer. Coarse gravel and sand can store and retain up to 35% of their total volume as water. The sub surface reservoir is recharged through flash floods following rainstorms. When the reservoir is filled, surplus water passes the dam without infiltration. The stored water is captured for use by digging a scoop hole, or constructing an ordinary well or tube well. By storing the water in the sand, it is protected against high evaporative losses and contamination (Tuinhof *et al*., 2003; Guiraud, 1989). As water flows through the sand it is also filtered and biological threats, like bacteria, are reduced (Huisman & Wood, 1974). Another advantage of sand dams compared to regular dams is that less mosquitos are present in the area, due to a of lack of surface water. Hydrological research has shown that the dams store only up to 3% of the yearly runoff produced in the catchment area between two dams (Borst & de Haas, 2006), supplying an extra amount of water of 8,000 m3 a year to the on average 150 people that use a dam. This water is used to bridge the dry periods during the year.

A multi criteria analysis study of water management in Kitui district, Kenya, looked at two levels of management. The first level was the level of the farmers and how water management measures influenced their income, the environment and the water resources downstream. The second level was the subcatchment level, which is the level of the water manager. The study analysed how the construction of more sand dams influenced the farmers, environment and water resources. This approach was chosen because both levels are highly important for the conditions of the farmers, and because the Kenyan partners were interested in both scales. More information on the hydrological background of the studied area of Kitui district is described in the WatManSup Working Paper No.1 (Van Loon *et al*., 2006) and Report No.2 and 3 (Van Loon & Droogers, 2006 and 2007), which were written in the context of the project. Ralph Lasage (May 14, 2007) reported the results of the multicriteria analysis of water management strategies in Kitui, Kenya; in a Research Paper 4 within the WatManSup project, Report W-07/14. The WatManSup project was formulated to explore the possibilities of combining hydrological models (WEAP and SWAT) and multi criteria analysis (MCA) tools, to support water managers in making decisions on water management strategies. The Kitui district local water harvesting project was carried out concerning the construction of small scale sand dams by communities. For this analysis information from the WEAP and SWAT model as well as information acquired during field visits and a workshop were used. It was an explorative analysis, because the goal of thevproject was to explore the possibilities of using Integrated Water Management Support Methodologies (IWMSM) to support water management decisions, not to solve problems.

The outcome of this preliminary analysis was that the management strategy of constructing an extra 500 sand dams was beneficial to the inhabitants and had no large negative impact on the environment and people living downstream, they even benefited from increase in base flow. This strategy was compared to the situation with approximately 500 sand dams in place and the past situation with no dams in place. Furthermore, the best strategy for farmers was to have diversified activities, because this reduced their vulnerability to variation in precipitation. This strategy had a higher score than the strategy where all water was used for brick production, or the

strategy where farmers shifted to one crop instead of a mix of crops. Though more in depth research was recommended before making the real decision, this case study showed that the combination of hydrological models, local knowledge, and a multi criteria tool is a good approach to support local (water) managers to evaluate the effects of different management strategies.

2.7.2. Water management strategies and technologies

Few decisions have a single objective. The very idea of making decisions suggests the need for considering multiple aspects and achieving a successful blend of performances. Management of water resources is no exception to this general rule. Multiple stakeholders participate in management of water resources. This leads to multiple objectives to be considered by any decision maker involved in water management. Examples are: a) Selection of a management strategy for a freshwater lake: Objectives are water quality, water quantity, biodiversity, recreational quality, residential quality, cost, etc.; b) Selection of a flood management strategy: Objectives are risk of flooding, biodiversity, visual quality, land use, and cost; c) Selection of a strategy for river basin management: Objectives are water quality, flood risks and navigation, but also visual quality of the landscape and biodiversity. These situations are different from each other. Nevertheless, they share important similarities. First, individuals evaluate a set of alternatives, which represent the possible choices. The objectives to be achieved drive the design (or screening) of candidate alternatives and determine their overall evaluation. Attributes are the measurement rods for the objectives and specify the degree to which each alternative matches the objectives. Factual information and value judgements jointly establish the overall qualities of each option and highlight the best solution.

Providing water supply to a community involves tapping all sources of water available, ensuring that it is fit for human consumption and supplying it regularly and in adequate quantities. The per capita quantity of water used by a family varies with physical and socio-economic conditions and consequently, varies widely between and within a neighbourhood. The level of service provided has also been found to have a marked influence on water usage. Where water has to be carried over long distances e.g. in ASAL's district, or when waiting for too long hours at water kiosks especially in developing urban centres before being served, the daily consumption may be as low as 5 litres per person.

The kiosks and water vendors sell water at rates that are much higher than the normal tariffs levied by the water undertakers. This contributes generally to the low levels of water consumption, hence making many slum dwellers in urban centres vulnerable to water related diseases. People in these areas are thus forced to resort to unhygienic sources such as polluted shallow wells, burst pipes, unprotected open dams, etc, with high incidents of water borne diseases. Reasons for not meeting expectations include inadequate managerial and technical skills, lack of tools and qualified personnel and inadequate policy guidelines in operation and maintenance, and lack of funds due to donor dependency (Ladu, 1993).

In many parts of Kenya and Tanzania, people cannot be expected to improve their current living conditions without adequate water supply. For any development, be it industrial, commercial or agricultural; water is needed for it to succeed. Governments and local leaders cannot be indifferent to these situations; it is up to them, at all levels in society, to act fast in their respective areas of jurisdiction.

Rainwater harvesting is just one of the solutions in the provision of supplementary water sources in the coming millennium. Therefore rainwater harvesting should be introduced as a by-law in the building guidelines and any new development should be encouraged to explore and apply the rainwater harvesting technologies, not withstanding policy managerial and technical challenges. Various challenges and possibilities in making rainwater harvesting a viable alternative to conventional water supply sources were identified by Kenya rainwater association (KRA) during the household rainwater harvesting district workshop (HRWH) and could broadly be classified as: - *policy issues, technical challenges and managerial constraints (KRA 1998).*

The KRA carried out a preliminary survey in 6 districts (Bungoma, Kiambu, Taita Taveta, Siaya, Kakamega and Kajiado) of low cost individual and or small community based water projects i.e. springs, shallow wells and rainwater harvesting. Results showed that compared to the existing piped water supply in most of those districts, household community-based water supplies were much more efficient than centrally controlled large piped water schemes. There was a sense of ownership, community participation and contribution in the management of community based water projects unlike in the government projects where the water managers have little or no enthusiasm in the management affairs. The managerial issues of major concerns that were raised included among others: a) Limited use of local resources; b) Inadequate community participation and contribution – due to approaches; c) Inadequate project management skills, by community organisation; d) Poor financial management and bookkeeping resulting in financial loss; e) Lack of proper water usage and control measures; f) Lack of awareness and unwillingness to obtaining legal status due to taxation; g) Donor dependency syndrome; and h) Political interference within the community projects.

Experience in low-income housing areas show that it is relatively easy to arouse people's interest in rainwater tank construction; since they are perceived as desired improvements to their homesteads and a symbol of status particularly in the rural areas. For example for the Kasaye Water and Sanitation Project, one criterion used to select a beneficiary for RWH tank construction is to have an iron sheet roofed houses (KRA, 1999). This has led to the community members improving their housing and consequently improving general community development. New housing schemes in urban areas should be encouraged to incorporate RWH tanks for emergency supply and other general usage of water.

The large government owned water projects have a high potential in overcoming managerial challenges of low cost community based water projects. Legally formulated by-laws and registration of self -help water projects, improvement of financial and management skills through local training will enhance effective and proper water usage and control. Solutions to managerial issues as suggested by various communities based organizations included: a) Increased community mobilization at project levels; b) Awareness creation through exchange visits; c) Community training in project management; d) Use of demand responsive approaches in project initiation and technology selection. The essence of appropriate technology is that equipment and techniques selected particularly in RWH should be relevant to local resources and needs, feasible to organize and suitable for the local environment and above all more efficient than the one existing.

2.7.3. Waste water management and industrial practises

Pricing and regulatory strategies, when used as policy instruments to manage water resources, presuppose that all individual firms will follow the same behavioural pattern. However, there can be as much discussion and debate about whether firms respond mainly to self-interest, whether incentives are more effective than disincentives, and about the role of norms vis a viz government policies. In many cases none of the industrial firms may fit the image of an omniscient rational producer who attempts to optimize the benefits to costs of using an input. Firms may even be unaware of effluent standards or have no idea of the technological engineering and organizational prospects for upgrading their production system i.e. to use less water, abate wastewater treatment, or of the costs involved in responding to price and regulatory pressure (Braadraart, 1995). In the absence of a general pattern of behaviour, only policy prescriptions unique to each firm would be desirable. On the other hand, in some cases, like the Porter hypothesis (1991), environmental (wastewater) regulation (and by implication – water pricing) has been mis-construed to imply a free lunch (or even “a paid lunch"), that is, regulation (and pricing) induce innovation or practices whose benefits exceed its costs, making regulation (and pricing) socially desirable, even ignoring the environmental (or resource use) problems it was designed to solve.

In a Ph.D dissertation study entitled Managing Water Scarcity in Kenya: Industrial Response to Tariffs and Regulatory Enforcement, submitted by Joseph Oginga Onjala (Kenya), of the Department of Environment, Technology and Social Studies of Roskilde University, Denmark in 2002, was designed to discover the broad statistical and qualitative relationships that exist among pricing and wastewater regulatory levels and the behaviour of industrial firms in Kenya, in order to understand the way in which the industries choose to exploit resources as well as provide the means of minimizing and managing adverse impacts on the environment which can significantly alter the development process in any economy.

Any short-term achievements of long-term sustainable goals must therefore be preceded by a critical focus on the activities of the industrial sector. This need arises because the industrial sector can immensely contribute to sustainable development especially since it is well positioned to transfer sound practices and habits to the rest of the economy and in the process play a key role by functioning simultaneously as a major engine of development and as a means to improving the national environment. However, the industrial sector, especially in the developing world is rarely the repository of scarce technical skills for preservation and enhancement of the environmental resources while they continue to conduct their activities in a sector that has known severe impact on the natural resources and environment. This adverse phenomenon is compounded by the fact that little is currently known about the effect of policies on practices of the industries in general with regard to natural resource exploitation issues. The policy response study was proposed in order to determine the current patterns of behaviour as well as the potential of the industrial sector in fostering sustainable water use in Kenya.

There are two critical aspects of industrial water practices, these are (i) demand, and (ii) wastewater discharges. Efficient management of industrial water resource has to integrate both,

water use and the management of wastewater resources. While all the conventional (existing) studies focus on only one aspect of these industrial water practices, the study by Joseph Oginga Onjala was unique in the sense that it analysed both issues in the same study in order to capture the synergies that exist between the two practices in the industry. From the study findings, it is hoped that an integrated and broader understanding of industrial practices could foster water resource management by realising the benefits beyond choice of selective policy (regulatory and economic) instruments. It is also hoped that industries not yet as engaged in water conservation will be inspired to incorporate water resource concerns into their decision making process. The study examined the policy response in 60 firms surveyed using semi-structured questionnaires - and indepth interviews.

2.8. Governing Systems, Policies, Legislations and Institutional Arrangements Relevant to Ecosystem Management and Water Allocation Plans in Kenya and Tanzania

2.8.1. The role of policies, laws and institutions

Habitat loss and/or modification due to human overpopulation, deforestation, farming, overgrazing, and settlements are well known major threats to ecosystem management. Global warming and climate change are thought of as emerging threats for most habitats as evidenced by changes in quantity of rainfall and water flows in the rivers. These and other key impediments to achieving a sustainable balance between conservation, ecosystem management and development efforts can be minimized if the weak bilateral cooperation in conservation efforts are strengthened as ecosystem management institutions, and the non-transboundary policies, laws and institutional arrangements can be strengthened. Institutional barriers can lead to inadequate use of the vast amount of scientific information, generated by researchers in decision-making processes while weak trans-boundary legal/policy frameworks between Kenya and Tanzania may impede coordinated and concerted natural resource management. There may also be minimal scaling-up and applications of best practices for integrated management of natural resources as a result of such weaknesses. These barriers can and must be lifted. The modalities of lifting these barriers that emanate from two sovereign countries need to be worked.

A preliminary examination of available data and report suggests that there is an overall lack of coordination in the way that different policies for development, environmental protection and nature conservation in the Mara River Basin are developed and implemented. This characteristic is found to varying degrees in many other regions and countries but it is particularly critical in the Mara which has some of the most important biodiversity and tourism interests in both Kenya and Tanzania. The March review of the 2008 SEA report (The Mara SEA, July 2011) concluded that there are likely to be a number of contributing factors to this lack of coordination: a) The MRB lies within two separate countries each with its own legislation, culture and practices; b) There are a large number of different interest groups working independently within the area; c) Policies apply to different areas, some of which are defined by administrative boundaries like District Councils, some by geography and terrain (like the basin itself) and others by biophysical and eco-regions like the Serengeti Plain; d) Different types of management and funding regime are applied, often overlapping with each other; including: - Regional and Spatial Land Use Planning, Development Planning, Integrated Water Resource Management, Environment and

Natural Resources Management; e) The level of resources available to cover all the needs of the area is generally inadequate.

2.8.2. Mitigation measures to weaknesses in ecosystem management

Efforts should be made to make the local people perceive direct benefit coming to them from utilization of natural resources because only then can they be its custodians. The communities should be seen as natural resource conservationists and not its destroyers. The concept of participatory approach to natural resources conservation and co-management have been explored and emphasized by many countries including Kenya and Tanzania. Adequate safeguards are needed to control consumptive use of natural resources.

An Action Plan has been developed as a comprehensive intervention to improve natural resource management of SMME which can be applied to the entire Mara River Basin and allocation of water as the most important resource. A combination of appropriate policy, legal, environmental, technical (investment), socio-economic, political, applied research and ecosystem/regional approaches will provide the needed thrust and complementarities to manage the resources of the ecosystem. The need for education in its widest possible meaning as related to ecosystem management is another area which needs urgent action. Communities need to be made aware of the value of natural resources, their appreciation and willingness so as to take action and manage them wisely. The need to develop a system that would maintain an interaction between the different stakeholders is paramount. In this respect, the community members need continuous updates on the benefits of their actions to themselves and to ecosystem integrity.

A key tool to management is research. Each and every relevant sector should undertake applied research to answer some management questions that arise from time to time. Research Output should inform policy formulation and review processes if conservation goals are to be attained. Tourism activities in protected areas, including the much publicized eco-tourism ventures on private lands, community conservancies and Wildlife Management Areas (WMA), not to mention the key Mara River and its tributaries water resource and the ecosystem, urgently need to put problems of ecological integrity and biodiversity loss up front. The case of Maasai Mara National Reserve in which huge declines of wildlife and changes in vegetation have been documented needs special attention directed at matching the SNP in status. The Mau Forest Reserve (MFR) may need more serious attention than it is getting now since it is the key driver of the MRB ecosystem integrity. Resettlement schemes to meet short term political interests must be stopped and in its place a long-term plan developed to meet the needs of the current and future generations.

The MRB ecosystem is now being managed by Kenya and Tanzania separately and has therefore experienced a number of constraints to conservation. Investigations undertaken over many years show that the constraints include: (i) mismanagement of the resources of the ecosystem of which are many, both flora and fauna; (ii) human population pressure on the ecosystem; (iii) diversification of land use in the investment domain with tourism and the establishment of conservancies increasingly getting more attention to the detriment of biodiversity; (iv) Encroachment on the basin by human settlements, where small businesses are established to gain from tourism in support of their livelihoods. All these are antagonistic forces working against sustainability of the ecosystem, unless better management mechanisms are invoked. Good

management starts with a review of management instruments, followed by concerted action to cover identified gaps as has been done or proposed in this chapter and report.

The policies, legislations and institutions reviewed are those directly linked with the management of MRB ecosystems and therefore cover those related to water, forests and land, and also importance to wildlife as summarized in Table 2.4. The review of the policy and institutional framework undertaken has focused on several goals namely; (i) synthesizing and analyzing the effectiveness of existing instruments in the light of the mandates and tasks to be accomplished; (ii) identifying gaps in performance and loopholes that are used by adversaries to diminish the expected accomplishments; and (iii) re-examining the achievement of objectives of the original setup or plan.

Table 2.4. Summary of Policies, Legislations and Institutions of Kenya and Tanzania

COUNTRY	FRAME WORK	COVERAGE	ENTITIES
Kenya	Policies	Global	UNCBD, UNFCCC, CPUTW&IL, UNCCD, and CMS
		Regional	EAC Vision and Mission; LVBC Vision and Mission; EAC Treaty; EAC Development Strategy; Shared Vision & Strategy Framework for Management and Development of LVB; Protocol on Environment and Natural Resources Management; Protocol for Sustainable Development of LVB; LVBC Draft Strategic Plan (2010-2016); and MRB–TWUF (2008)
		National	The Constitution of the Republic; Kenya Vision 2030; National development plan 1994-1997; Sessional Paper No: 1 of 1994; Sessional paper No. 6 of 1999; NBSAP; National Water Policy; National Tourism Policy; Sessional Paper no. 3 of 1975; Sessional Paper No. 3 of 2009 on National Land Policy
	Legislation	National	Environment Management and Coordination Act 1999; Water Act; Agricultural Act of Kenya as revised in 1986; The Wildlife Conservation Act; Wildlife (Conservation & Management Amendments) Act; Forest Act 2005; Land planning Act; Lake Basin Development Authority Act; Land Act; Land Planning Act.
	Institutions	Platforms	EAC; LVBC, EALA
		Ministries	Ministry of Local Government; Ministry of Energy; Ministry of Environment and Mineral Resources; Ministry of Water and Irrigation; Ministry of Tourism; Ministry of Wildlife and Forestry; Ministry of Lands
		Agencies & Parastatals	NEMA; KWS; KFS; Water Sector Institutions (WRMA, WSBs, WSRB & WSTF); Mara Basin – TWUF; Mara Regional Secretariat (MRS)
			IUCN, CARE, IUCN, WWF, Earthwatch Institute,

COUNTRY	FRAME WORK	COVERAGE	ENTITIES
		Non-State Actors	Wetlands International, Global Water Partnership, CGIAR Centers (including ILRI, the World Agroforestry Centre, IFPRI, and CIFOR-Centre), AWF, Farm Africa, EAWLS, the Green Belt Movement (GBM), Maji na Ufanisi, the Forest Action Network (FAN), the Ecotourism Society of Kenya, Nature Kenya, Africa Now, Green Africa Foundation, the Kenya Organization of Environmental Education (KOEE) and the Kenya Private Sector Alliance (KEPSA).
		Development Partners	ADB; EU, GEF, NORAD, SIDA, UNDP, UNEP, USAID, World Bank,
Tanzania	Policies	Global	UNCBD, UNFCCC, CPUTW&IL, UNCCD, and CMS
		Regional	EAC Vision and Mission; LVBC Vision and Mission; EAC Treaty; EAC Development Strategy; Shared Vision & Strategy Framework for Management and Development of LVB; Protocol on Environment and Natural Resources Management; Protocol for Sustainable Development of LVB; LVBC Draft Strategic Plan (2010-2016); and MRB–TWUF (2008).
		National	Constitution of the URT; Tanzania Development Vision 2025; Wildlife Policy, 1998; National Parks Policy, 1994; Forest Policy, 1998; National Environmental Policy, 1997; Tourism Policy 1999; Water Policy, 2002; Agriculture and Livestock Policy, 1997; Land Policy, 1995
	Legislation		Wildlife Conservation Act, No. 12 of 1973; Wildlife Acts, No 12 of 1974; National Environment Management Act, 1983, 2004; Forest Act, 2002; Tourism Act, 2008; Agriculture and Livestock Acts, 1997; Lands Acts, 1999; Village Land Act, 1999
	Institutions	Platform	EAC; LVBC, EALA
		Ministries	The President's Office (PC); Vice President's Office (DoE); Ministry of Lands, Housing and Human Settlements Development; Ministry of Natural Resources and Tourism; Ministry of the East African Community; Prime Minister's Office-Regional Administration and Local Government; Ministry of Water and Irrigation
		Agencies and Parastatals	Tanzania National Parks (TANAPA); National Environmental Management Council (NEMC); National Land Use Planning Commission (NLUPC); Water Basins
		Non-State Actors	Tanzania Forest Conservation Group (TFCG); African Conservation Foundation (ACF); African Wildlife

COUNTRY	FRAME WORK	COVERAGE	ENTITIES
			Foundation (AWF); Wildlife Conservation Society of Tanzania (WCST); IUCN, Farm Africa, EAWLS CARE, IUCN, WWF
		Development Partners	DFID; GEF; FAO; World Bank; USAID; UNDP; UNEP, SIDA, NORAD

2.8.3. Policies and legal frameworks

The Mara River Basin (MRB) and its Ecosystem is covered by policies of a global/international nature adopted by Kenya and Tanzania. The trans-boundary resource is also covered by treaties, protocols and strategies of the East African Community (EAC) to which the two countries are signatories. On the ground, the ecosystem is however managed by national and local polices of Kenya and Tanzania that may or may not be in harmony. Current interventions in environmental and biodiversity management in Tanzania and Kenya are directed at combating desertification, biodiversity conservation, environmentally friendly production practices and abatement of pollution, and strengthening both human resources and governance institution including the management of Mara River. In this regard the governments have been party to several global conventions, and protocols relevant to ecosystem management as discussed below.

2.8.3.1. International conventions and protocols

The review in this section addresses the UN Convention on Biological Diversity (UNCBD), Convention on Wetlands, UN framework Convention on Climate Change (UNFCCC), Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes, UN Convention to Combat Desertification (UNCCD), and the Convention on the Conservation of Migratory Species (CMS).

(a) **United Nations Convention on Biological Diversity**

The three goals of the CBD are to promote the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilization of genetic resources. The convention calls for the adoption of national strategies, plans and programmes for the conservation and sustainable use of biological diversity into their relevant sectoral and cross-sectional plans, programmes and policies. Article 6 of the CBD obliges parties to the CBD to prepare National Biodiversity Strategies and Action Plans (NBSAP) to guide implementation of the requirements of the CBD at national level, and both Kenya and Tanzania have developed NBSAPs. The NBSAP of Tanzania's was prepared in 1998 while that of Kenya was developed in 2003. Cooperation in the management of trans-boundary biodiversity resources of the MRB is guided by the provisions of the CBD and by the NBSAPs of the two countries. This convention is of utmost importance to the management of the MRB and the most relevant articles in this convention are therefore provided further below:

(i) One of the tools that are prescribed for the management of biodiversity is environmental assessment. Article 14 of the Convention deals with the impact, assessment and minimizing the

adverse impacts of activities that are likely to cause significant adverse effects on biological diversity. The adversities have been discussed briefly in section (1.1).
(ii) The Convention contains provisions of particular importance to indigenous peoples. These provisions are contained in Articles 8(j), 10(c), 17.2 and 18.4. Of these, Article 8(j) is regarded as the core provision. It calls upon Contracting Parties to respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities relevant to the conservation and sustainable use of biodiversity, subject to national legislation. In this regard, it is noted that both the MRB are home to indigenous peoples who have adapted themselves well to the environment, though diversifying livelihoods in response to exogenous forces. Article 8(j) also requires that benefits arising from the application of traditional knowledge, innovations and practices should be shared equitably with the indigenous communities concerned.

(iii) Article 10, which deals with the sustainable use of components of biological diversity, requires that each Contracting Party protect and encourage the use of biological resources in accordance with traditional cultural practices that are compatible with conservation and sustainable use requirements. This Article has important implications for cultural survival, since particular species form the spiritual and economic focus of many indigenous cultures. The continued customary use of such species is therefore essential to the existence of such cultures (GoK, 2008). Management practices of the MRB are expected to conserve biodiversity, especially the rare and endangered species.

(b) **Convention on Protection and Use of Trans-boundary Watercourses and International Lakes**

The Convention on the Protection and Use of Trans-boundary Watercourses and International Lakes (Water Convention) is intended to strengthen national measures for the protection and ecologically sound management of trans-boundary surface waters and groundwater. Of particular concern here, is the Mara River that serves MMNR and the northern part of the SNP.

The Convention obliges Parties to prevent, control and reduce water pollution from point and non-point sources. The Convention also includes provisions for monitoring, research and development, consultations, warning and alarm systems, mutual assistance, institutional arrangements, and the exchange and protection of information, as well as public access to information. Article 3 of the convention calls for the application of environmental impact assessment, and other means of assessment to the prevention, control and reduction of trans-boundary watercourses and international lakes.

(c) **United Nations Convention to Combat Desertification**

The objective of the United Nations Convention to Combat Desertification (UNCCD) is to mitigate the effects of droughts in seriously affected countries, especially those in Africa. It seeks to achieve this objective through integrated approaches to development, supported by international cooperation and partnership arrangements, in affected areas. It lays emphasis on long term strategies to focus on improved productivity of land and the rehabilitation,

conservation and sustainable management of land and water resources, leading to improved living conditions, in particular at the community level.

(d) **Convention on Wetlands**

The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an inter-governmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently Contracting Parties to the Convention, with 1508 wetland sites. Though there are no Ramsar sites in the MRB and SMME, there are wetlands around that could qualify to be cited as a Ramsar sites or wetlands of international significance. Kenya and Tanzania are signatories to this convention and are required to promote the wise use of wetlands in their territories and to take measures for their conservation by establishing nature reserves in wetlands, whether or not they are included in the Ramsar list. It is expected that the activities of the LVBC will strictly adhere to the Ramsar Convention's principles of wise use of wetlands and advise parties not to convert wetlands into agricultural fields as developments in the lower reaches of MRB show.

(e) **United Nations Framework Convention on Climate Change**

The United Nations Framework Convention on Climate Change (UNFCCC) provides the basis for global action "to protect the climate system for present and future generations". The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by emissions of greenhouse gases. The Convention enjoys near universal membership, with 189 countries having ratified.

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to changes in climate. Under the Convention, governments: (i) Gather and share information on greenhouse gas emissions, national policies and best practices; (ii) Launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and (iii) Cooperate in preparing for adaptation to the impacts of climate change. Both Kenya and Tanzania have developed National Adaptation Action Plans (NAPA) to guide these processes.

(f) **Convention on the Conservation of Migratory Species**

The Convention on Migratory Species (CMS) was adopted to conserve migratory species of wild animals. Such species may be terrestrial or marine in nature. The member states of this convention endeavour to conclude agreements for the protection and management of migratory species whose conservation status are unfavourable and of those whose conservation status would substantially benefit from international cooperation deriving from an agreement.

The Convention's Agreement on African Eurasian Migratory Water birds is specific on the need to protect the migratory water birds' feeding, breeding and wintering habitats, the main ones being the wetlands and open water bodies. The Wildebeest and Zebra in the SMME are prone to

annual migrations that cover a large part of the Serengeti and MMNR, crossing the national boundary between the two countries. This convention ensures that the border remains open to enable the migration to proceed unimpeded. And all species on either side of the border remain free to disperse.

2.8.3.2. Observations on global conventions

a) The Government of Kenya and Tanzania are signatories to the six conventions presented above.
b) Of particular note is that the signed international conventions have the necessary provisions for management of ecosystem including the SMME, had they to be internalized into national and cross-border policy frameworks.

2.8.4. Vision, charter, protocols, and strategic frameworks of the East African Community

Kenya and Tanzania are party to Visions, the Charter and Management Frameworks passed by the East African Community (EAC) as briefly discussed below.

2.8.4.1. Visions and Missions

The Vision of the East African Community is "to have a prosperous, competitive, secure and politically united East Africa." The Mission is "to widen and deepen economic, political, social and cultural integration in order to improve the quality of life of the people of East Africa through increased competitiveness, value added production, trade and investment".

The Vision of the Lake Victoria Basin Commission (LVBC) is to have "A prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits." The Mission of LVBC is to "promote, facilitate and coordinate activities of different actors towards sustainable development and poverty eradication of the Lake Victoria Basin".

2.8.4.2. Treaty for the establishment of the East African Community

The treaty was signed on 30th November 1999. Of greater relevance to this study and report are Chapters 19 and 20 that provide for cooperation on the environment and natural resources management.

2.8.4.3. The EAC development strategy

The EAC Development Strategy 2006-2010 was prepared in 2005-06 and is the third in the series. The first Strategy covered the period 1997-2000 and the second covered the period 2001-2005. The key tenets of the third Development Strategy are: (i) Political and socio-economic development; and (ii) Deepening and accelerating integration.

2.8.4.4. Shared vision and strategy framework for management and development of Lake Victoria basin

This is a strategic framework that is to guide the work of the LVBC and all its stakeholders. The EAC Council of Ministers has recommended that Partner States, civil society organizations, development partners and other stakeholders adopt this framework as a development guideline in the sustainable management and development of the Lake Victoria Basin. The Strategy Framework is clustered into five Policy Areas. Of greater relevance to this study is the policy area-1 that covers Ecosystems, Natural Resources and Environment. The ultimate developmental objective of policy area-1 is attainment of ***"****a prosperous livelihood and enhanced management of ecosystems, natural resources and a clean and healthy environment"*.

2.8.4.5. Protocol on environment and natural resources management

The most relevant articles of the protocol to this study are articles 3, 5, 9, and 12 and are thus restated hereunder.

Article 3: Scope of the Protocol: This protocol is a protocol of general application and shall apply to all activities, matters and areas of management of the environment and natural resources of the Partner States, including the following: (i) Sustainable environmental and natural resources management (a); (ii) Management of trans-boundary resources (b); (iii) Conservation of biological diversity (c); (iv) Management of wildlife resources (e); (v) Management of rangelands (o); (vi) Mitigating the effects of climate change (q); and (vii) Tourism development(s).

Article 5: Objectives: Objectives of the Protocol shall be to:
(d) Promote shared responsibility and cooperation in the management of environment and natural resources including those that are trans-boundary in nature among Partner States,
(e) Promote development and harmonization of policies, laws and strategies for environment and natural resources management to support sustainable development.

Article 6: Commitment of Partner States: Sub-article (1) is pertinent, i.e. The Partner States commit themselves to ensure sound environment and natural resources management in the community and to co-operate among themselves in realizing this obligation.

Article 9: Management of Trans-boundary Resources: *Sub-articles 1(a) and 1(b) are important and state that:*

1. The Partner States shall;

a) Develop mechanisms that will ensure sustainable utilization of trans-boundary ecosystems; and
b) Jointly develop and adopt harmonized common policies and strategies for sustainable management of Trans-boundary natural resource

Article 12: Management of Wildlife Resources: This article streamlines the Terms of Reference (ToR) of this study and is therefore hereby reproduced in full.

a) The Partner states shall develop, harmonise and adopt common policies, laws and strategies for the conservation and sustainable utilization of wildlife resources in and

outside protected areas in the Community and integrate such management into national development plans.

b) The Partner States shall:
   (i) Assess and control activities which may significantly affect the conservation and sustainable use of wildlife so as to avoid or minimize negative impacts to wildlife resources;
   (ii) Manage wildlife and wildlife habitats to ensure the maintenance of viable wildlife populations
   (iii) Promote sustainable utilization of wildlife resources;
   (iv) Restrict the taking of wildlife, including but not limited to restrictions on the number, sex, size or age of specimens taken, locality and season;
   (v) Strengthen capacity for compliance to international trade agreements;
   (vi) Promote community-based wildlife management and incorporate indigenous knowledge;
   (vii) Raise public awareness on issues of conservation and sustainable use of wildlife;
   (viii) Take measures to build national and regional capacity for wildlife management and enforcement of wildlife laws;
   (ix) Promote research and exchange of information in conservation and sustainable use of wildlife on regular basis; and
   (x) Develop common guidelines for the management of wildlife resources.

c) The Partner States shall harmonise and enforce national policies, laws and programmes to promote sustainable wildlife management.

d) The partner States shall adopt common national policies and programmes that allow local communities to effectively participate in wildlife management activities and to benefit from wildlife resources;

e) The Partner States shall cooperate, and where necessary, enter into agreements or other arrangements, in the management of trans-boundary wildlife ecosystems and protected areas.

f) The Partner States shall cooperate in promoting management of shared wildlife resources and wildlife habitats across international borders including the conservation of species and populations, marketing of their products and development of trans-boundary conservation and management programmes.

g) The Partner States shall cooperate in promoting economic and social incentives in the conservation and sustainable use of wildlife resources.

h) That Partner States shall adopt common national policies and programmes that allow local communities to effectively participate in wildlife management activities and to benefit from the wildlife resources

2.8.4.6. Protocol for sustainable development of Lake Victoria basin

The following articles are important;

Article 3: Scope of Cooperation: The Partner States have agreed to cooperate in the areas as they relate to the conservation and sustainable utilization of the resources of the Basin including the following:

a) Environmental protection and management of the Basin;
b) Promotion of wildlife conservation and sustainable tourism development;

Article 6: Protection and Conservation of the Basin and its Ecosystem:

a) Where appropriate with participation of all stakeholders to protect, conserve and where necessary rehabilitate the Basin and its ecosystem in particular by;
b) Conserving migratory species of wild animals; and
c) Conserving endangered species of wild fauna and flora;

The Partner States shall through the institutional framework established under this protocol, take steps to harmonise their laws and policies in relation to paragraph 1 of this Article.

Article 10: Tourism Development

The Partner States shall undertake to develop a collective and coordinated approach to the promotion of and marketing of sustainable tourism within the Basin in accordance with the provisions of Article 115 and 116 of the Treaty.

Article 27: Management Plans

Each Partner State shall;

a) Develop national strategies, plans or programmes for conservation and sustainable use of resources of the Basin or adapt for this purpose existing strategies, plans or programmes which shall reflect, *inter alia*, the measures set out in this protocol; including the development of infrastructure, commerce and trade, tourism, research and development; and Integrate, as far as possible and as appropriate, the conservation and sustainable use of the resources of the Basin into relevant sectoral or cross-sectoral plans, programmes and policies The Commission shall develop a management plan for the conservation and sustainable utilization of the resources of the Basin. The management plan shall be harmonised with National Plans developed under paragraph 1 of this Article and approved by the Council.

2.8.5. LVBC draft strategic plan (2010-2016)

Provides for promotion of environment and natural resources management strategies: The strategic intervention aims at facilitating development of mechanism for ensuring sustainable management of trans-boundary ecosystems/resources; facilitating review and harmonization of laws, policies and guidelines for land use and trans-boundary ecosystems. Further, the strategic intervention is aimed at the implementation of relevant provisions of the EAC Climate Change Policy.

2.8.6. MRB –TWUF (2008)

The Mara River Basin (MRB) Trans-boundary Water Users Forum (TWUF) is a forum for water users from both Kenya and Tanzania aimed at planning and management of the water resources of the MRB in a holistic way. The water resource is key to the biodiversity of the basin and the

SMME lying in the basin and as such the TWUF serves as a platform for dialogue on development and conservation.

2.8.7. Agriculture and rural development policy and strategy for the East African Community (2005-2030)

The policy and strategy recognize that about 80% of the rural population of East Africans live in the rural areas and 75 percent of them are engaged in agriculture. Agriculture is the key enterprise of the rural economy in the EAC countries complimented with artisanal activities, tourism, quarrying, mining, forestry, fishing, small-scale trading and manufacturing. Agriculture policy and strategy provide therefore a framework for improving rural life over the longer term through increased productivity and production of food and raw materials, improved food security, provision of an enabling climate for improvement of trade, provision of social services and fight against poverty. The framework is a road map for partner states to define interventions that will lead to attaining improvements in the rural economy. It provides a pillar for the development of shared regional vision for sustainable development and to take advantage of opportunities arising from global and regional integration.

The challenge in the EAC is to cover all economic sectors. In this regard, the objective of the agriculture and rural development framework is to: (i) attain food security, (ii) liberalize the cross border trade in agricultural products; (iii) harmonize policies and regulations of partner states; (iv) increase production of crops, livestock, fishery and forest products; (v) develop markets and marketing infrastructure; (vi) attain sustainable utilization of natural resources; (vii) reduce post harvest losses; (viii) promote value addition through agro processing; and protect human, animal, plant and environmental safety. Biodiversity conservation and management are a part of objectives (iv), (vi), and (ix) of this EAC policy and strategy.

2.8.8. Observations on EAC frameworks

Once again it is noted that the Vision, Charter, Protocols, Strategies and National Policies and Strategic Frameworks of the East African Community Relevant to Ecosystem Management have factored adequate provisions that can successfully enable sustainable SMME and the entire MRB management if these were adopted and enforced by the two countries.

2.8.9. Review of national policies

The key policies of the Republic of Kenya and the United Republic of Tanzania on the management of natural resources in general and the MMNR part of the SMME are outlined, and which can be applicable to the entire MRB are anchored in the Constitutions and the Development Visions of the respective countries. The reader should take note that Natural Resources are not union matter in The United Republic of Tanzania and are therefore not covered by policies that bind the Revolutionary Government of Zanzibar to the Union Government.

2.8.9.1. National policies of Kenya

The Constitution of the Republic of Kenya: The Kenya Constitution establishes the structure of the Kenyan government, and also defines the relationship between the government and the citizens of Kenya. The current Kenyan constitution was enacted on 27th August 2010, replacing the older one that had been in place since Independence in 1963. The Kenyan Constitution is comprised of 18 Chapters. Chapter 5 is specific to Land and the Environment. Sections 60 to 68 deal with land and assert that land in Kenya is either public, communal or private. Public land is vested and held by either the County Government or the Government of Kenya in trust for citizens in the County or Kenya as per relevant clauses prescribed. In the context of the new Constitution of Kenya, Land in Kenya shall be held, used and managed in a manner that is equitable, efficient, productive and sustainable, and in accordance with the following principles: (i) equitable access to land; (ii) security of land rights; (iii) sustainable and productive management of land resources; (iv) sound conservation and protection of ecologically sensitive areas; and (v) elimination of gender discrimination in law, customs and practices related to land and property.

Already a land policy has been passed that conformed to provisions of the new constitution. Under the new Constitution the State shall, among other things: (i) ensure sustainable exploitation, utilisation, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits; (ii) work to achieve and maintain a tree cover of at least ten percent of the land area of Kenya; (iii) encourage public participation in the management, protection and conservation of the environment; (iv) protect genetic resources and biological diversity.

Kenya Vision 2030: Vision 2030 is based on three "pillars": the economic, the social and the political. The economic pillar aims to improve the prosperity of all Kenyans through an economic development programme, covering all the regions of the country and aiming to achieve an average Gross Domestic Product (GDP) growth rate of 10% per annum beginning in 2012. The six key sectors described below are being given priority as the key growth drivers for achievement of the economic vision: (i) Tourism; (ii) Increasing value in Agriculture; (iii) A better and more inclusive wholesale and retail trade sector; (iv) Manufacturing for the regional market; (v) BPO; and (vi) Financial Services.

The social pillar seeks to build a just and cohesive society with social equity in a clean and secure environment. Through this strategy, Kenya aims to build a just and cohesive society with social equity in a clean and secure environment. This strategy makes special provisions for Kenyans with various disabilities and previously marginalized communities. These policies are anchored on an all-round adoption of science, technology and innovation (STI) as an implementation tool. Key sectors for this pillar are: (i) Education & Training; (ii) The Health System; (iii) Water and Sanitation; (iv) The Environment; (v) Housing and Urbanisation; (vi) Gender, Youth and Vulnerable Groups; and (vii) Equity and Poverty Elimination.

The political pillar aims to realise a democratic political system founded on issue-based politics that respects the rule of law, and protects the rights and freedoms of every individual in Kenya.

The vision is to be implemented in successive five-year Medium-Term Plans, with the first such plan covering the period 2008 - 2012.

National development plan 1994-1997: This was the first plan prepared after passing Agenda 21 in Rio de Janeiro in 1992. It is dedicated to integration of environmental concerns in all development activities towards the sustainable development objective.

Sessional Paper No: 1 of 1994: Recovery and Sustainable Development to the Year 2010 (GoK, 1994) in which the government addressed the emerging issues on environment and development. Since most policies were Sectoral, the government identified the need to develop a specific policy addressing environmental issues.

Sessional paper No. 6 of 1999: Policy Paper on environment and Development. (GoK, 1999). This policy paper attempts to provide guidelines **for** achieving sustainable national development. It was also catalytic to the development of the Environment Management and Coordination Act.

National Biodiversity Strategy and Action Plan (NBSAP) (GoK 2000): The document identifies the necessary steps to conserve biodiversity in conformity with requirements of the CBD. Kenya's National Biodiversity Strategy and Action Plan (NBSAP) were prepared in 1993. This strategy specifies the trends and priority goals of environmental management and protection, and sets the main short-term and long-term tasks to be achieved. The priorities presented in the strategy are taken into account when planning environmental activities, developing international co-operation and allocating national funds.

National Water Policy (GoK 2000): The policy provides a framework for sustainable water resources management in Kenya. The policy directions include:

a) Preservation, conservation and protection of available water resource;
b) Sustainable, rational and economical allocation of water resources;
c) Supplying adequate amounts of water meeting acceptable standards for the various needs;
d) Ensuring safe wastewater disposal for environmental protection;
e) Developing a sound and sustainable financial system for effective water resources management, water supply and water borne sewage collection, treatment and disposal

National Tourism Policy (GoK 2006): The policy was developed to cater for the increase concern for environmental protection, following the adoption of Agenda 21 for the water sector including conservation, control, apportionment and use, monitoring of river regimes, pollution control and water quality.

Sessional Paper no. 3 of 1975: This is a statement of future wildlife management policy in Kenya. It stipulates that it is important to protect critical habitats and secure migratory routes of animals outside protected areas (GoK 1975).

Sessional Paper No. 3 of 2009 on National Land Policy: The Sessional Paper provides an overall framework and defines the key measures required to address the critical issues of land administration, access to land, land use planning, restitution of historical injustices, environmental degradation, conflicts, unplanned proliferation of informal urban settlements,

outdated legal framework, institutional framework and information management. It also addresses ***constitutional issues***, such as compulsory acquisition and development control as well as tenure. It recognizes the need for security of tenure for all Kenyans (all socio-economic groups, women, pastoral communities, informal settlement residents and other marginalized groups).

The Sessional Paper designates all land in Kenya as Public, Community or Private. Most significantly, it recognizes and protects customary rights to land. It also recognizes and protects private land rights and provides for derivative rights from all categories of land rights holding. Through the Sessional Paper, the government is to ensure that all land is put into productive use on a sustainable basis by facilitating the implementation of key principles on land use, productivity targets and guidelines as well as ***conservation***. It encourages a multi-sectoral approach to land use, provide social, economic and other incentives and put in place an enabling environment for investment, agriculture, livestock development and the exploitation of natural resources.

2.8.9.2. National policies of Tanzania

The following policies and strategies of the United Republic of Tanzania are important to the management of natural resources including the Serengeti as a part of the SMME

The Constitution of the United Republic of Tanzania: Land and the Environment are not union matters in the United Republic of Tanzania (URT) but, have been touched upon by provisions of the Republic Constitution with regard to citizen rights. This is the only commonality and further down the vertical each of the two parties in the union has own framework for land matters and Environmental Management. Since the Serengeti is a national resource of mainland Tanzania, reference henceforth is made to Tanzania mainland and in no way does it refer to Zanzibar. The bundle of basic rights and duties of Tanzanians in the Constitution of the United Republic of Tanzania of 1997 section 24 states:

a) Subject to the provision of the relevant laws of the land, every person is entitled to own property, and has a right to the protection of his property held in accordance with the law.
b) Subject to the provision of sub-article (1) it shall be unlawful for any person to be deprived of property for the purposes on nationalization or any other purposes without the authority of law which makes provision for fair and adequate compensation.

Article 27 (1) underscores that “Every person has the duty to protect the natural resources of the United Republic, the property of the state authority, all property collectively owned by the people, and also to respect another person’s property.” Details on the two policy areas have been left to sector policies and laws.

Tanzania Development Vision 2025: The basic issues in the development Vision are elaborated in six areas. First is the concept and scope of national development vision. This part describes attributes Tanzania’s expectations by the year 2025. These include people having attained a high

quality of life; peace, tranquillity and national unity; good governance; an educated society imbued with an ambition to develop; and an economy which is competitive with sustained growth for the benefit of all people. Secondly, is a brief analysis of approaches of previous national development visions pursued since independence. This analysis spells out the observed successes and problems encountered which justified the need to formulate the new Development Vision.

The three principal objectives of the Vision 2025 - which are; achieving quality and good life for all; good governance and the rule of law; and building a strong and resilient economy that can effectively withstand global competition - have been described in detail in section three. These objectives not only deal with economic issues, but also include social issues such as education, health, the environment and increasing involvement of the people in working for their own development. The thrust of these objectives is to attain a sustainable development for the people. The fourth section deals with important issues which must be borne in mind during the implementation of the vision's objectives. It outlines the basic pillars with which the society at large will be guided in order to ensure a successful implementation of the Vision. These implementation driving forces or pillars, include among others, the need for Tanzania society as a whole to treasure a competitive development mindset as well as nurturing a self-reliance culture. The fifth section offers basic guidelines on the implementation of the Vision which include noting the importance of undertaking reviews and reforms of existing laws and structures of various institutions in order to ensure that they meet the requirements of implementing the objectives of this Vision. The participation of the people in preparing and implementing plans for their own development is also emphasized, including putting in place an appropriate framework for coordinating and evaluating the implementation of the Vision. It is stressed that only through participatory processes can the Vision be able to promote people's development and its management by people themselves.

Wildlife Policy, 1998: The Tanzania wildlife policy vision for the wildlife sector is to promote conservation of biological diversity, administer, regulate and develop wildlife resources, involve all stakeholders in wildlife conservation and sustainable utilization, as well as in fair and equitable sharing of benefits, promote sustainable utilization of wildlife resources, rise the contribution of the wildlife sector in country’s Gross Domestic Product (GDP) from about 2% to 5%, contribute to poverty alleviation and improve the quality of life of the people of Tanzania, and promote exchange of relevant information and expertise nationally, regionally and internationally.

National Parks Policy, 1994: This policy establishes the national parks and encourages their protection for the enhancement of conservation and tourism.

Forest Policy, 1998: The policy details the manner in which the forest and tree resources would be managed sustainably to meet the needs and desires of the society and nation. It provides for biodiversity conservation and community forest management. Biodiversity protection is included throughout the Act. Provision is made for establishment of a fund which includes the purpose of assisting Tanzania to benefit from international initiatives and fund for biodiversity conservation. Environmental impacts assessments are required in forested areas and watersheds for certain developments. National forest reserves may be declared as nature forest reserves to maintain and

enhance biodiversity and genetic resources. Outside the reserves, conservation of trees includes both protection of wild plants and animals listed in the Government gazette. Sovereignty over "biological resources their derivative products and intangible components" is also affirmed.

National Environmental Policy, 1997: The policy provided the frame work for making fundamental changes that are needed to mane environmental considerations into the main stream of decision making in Tanzania. It seeks to provide policy guidelines, plans and give guidance to the determination of priority actions, and provides for monitoring and regular reviews of policies, plans and programs. It further provides sectorial and cross-sectorial policy analysis in order to achieve compatibility among sectors and interest groups and exploit synergies among them.

Tourism Policy 1999: The policy ensures sustainable tourism development in Tanzania; here includes the establishment of Tanzania Tourist Board, improvement of private sector participation, and the approval of tourism related sectors and projects.

Water Policy, 2002: The policy aims at ensuring that beneficiaries participate fully in planning, constructing, operation, maintenance and management of community based domestic water supply schemes. This policy seeks to address cross-sectoral interests in water, watershed management and integrated and participatory for water resource planning, development and management. Also, the policy lays a foundation for sustainable development and management of water resources in the changing roles of the Government from service provider to that of coordination, policy and guideline formation and regulation.

Water Sector Development Programme: Tanzania's Development Vision 2025 aims at achieving an absence of abject poverty and attaining a high quality of life for all people by 2025. Water supply, sanitation and water resource management features prominently in the Development Vision. Intrinsic to these overall targets, are the objectives of equity of access, water management capacity, and proper maintenance of water and sanitation systems, use of environmentally sound technologies, and effective water tariffs, billing and revenue collection mechanisms.

Agriculture and Livestock Policy, 1997: The policy goal is the improvement of well-being of the people whose principal occupation and way of life is based on agriculture and livestock. Most of these people are small holders and livestock keepers. The extent to which the ALP-1997 is consistent with the sector's challenges and aspirations can be assessed by the following quotation from the policy itself.
"……..the ultimate goal of the ALP-1997 is the improvement of the well being of the people whose principle occupation and way of life is based on agriculture…….therefore the focus of this policy is to commercialise agriculture so as to increase income levels." The subsequently formulated sub-sector *National irrigation policy, Agricultural Marketing Policy and the National Livestock Policy* have more refined goals and objectives, which support the achievement of the overarching ALP goals and objectives.

Land Policy, 1995: The 1995 National Land Policy of Tanzania has upheld the leasehold system introduced in the country by the Germans and retained by the British colonial systems. Under

this system therefore, the land outside village land "cannot be owned" but leased from the State for a specified number of years. It is vested in the Presidency and availed to users through a mechanism that is centred in the Minister responsible for lands, Commissioner of Lands and the land administration system centred around that office.

Land should be used productively and such use complies with the principal of sustainable development, that land has value, amount of land to be granted to any person or company be regulated, full, fair and prompt compensation be paid to owners in the event that, land is acquired for public purposes, facilitate the operation of market in Land, to provide for an effective, economical and transparent system of Land administration and people of all sexes be represented in all decisions on land issues.

2.8.9.3. Observations on national policies

Each of the two countries has put in place policies for guiding the management of natural resources. It is acknowledged that issues of the environment are relatively new when emerging issues such as climate change adaptation and mitigation are considered. Also, the cost of both measures is prohibitive. Hence policies on ecosystem management are incomplete at the national level. Of greater concern is policy enforcement – an area in which ecological issues need more attention. Greater emphasis is placed on issues of security and rewards through tourism.

2.8.9.4. Kenya: conservation related laws

Several laws have been passed by the legislature in Kenya aimed at providing the legal ground and enforcement of policies on natural resources management and utilization. These are:

Environment Management and Coordination Act 1999: The Environmental Management and Coordination Act (EMCA) of Kenya was enacted in 1999 **and** came into effect on 14th January 2000. It was enacted to harmonize environmental legislation previously scattered among 77 national laws. As the principal environmental legislation in Kenya, EMCA sets the legal framework for environmental management. Its core elements are as follows:

Creation of a National Environmental Management Authority (NEMA): EMCA 1999 allows for formation of the National Environmental Management Authority (NEMA) as the body charged with the overall coordination of environmental protection in Kenya, mainly through setting and harmonizing standards for environmental quality. To facilitate coordination of environmental matters at a District level, EMCA 1999 allows for the creation of District Environmental Committees chaired by respective District Commissioners, and the appointment of a District Environmental Officer who oversees environmental coordination and is also secretary to the DEC.

Environmental Assessments: Section 58 of EMCA requires that an Environmental Impact Assessment precedes all development activities proposed to be implemented in Kenya. This requirement was operationalized by NEMA through its publication of the Guidelines for the Conduct of EIAs and Environmental Audits (Kenya Gazette Supplement No. 56 of 13th June 2003). The framework for environmental assessment in Kenya and a description of types of

development that should be subjected to environmental impact assessment are outlined in Legal Notice 101 and the Second Schedule of EMCA respectively.

Environmental Audits: Under Sections 68 and 69, EMCA requires that all ongoing projects be subjected to annual environmental audits as further expounded in Regulation 35 (1) and (2) of Legal Notice 101 of June 2003.
Sectoral Coordination in Environmental Protection: Among other functions, EMCA mandates NEMA to regularly review and gazette standards and regulations for environmental quality as a way of guiding activity in all sectors.

Preparation of a State of the Environment Report: State of the Environment' Reports are issued annually for the entire country and also for each individual district. They are tools for environmental monitoring, and outline progress made in environmental management via existing policy goals and strategies and through the publication of emergent environmental concerns, especially those pertaining to unsustainable utilization of natural resources.

The Water Act: *T*his was enacted for the coordination of all development activities in the water section including conservation, control, apportionment and use, monitoring a river regimes, pollution control and water quality. The Water Act 2002 forms the principal legislation governing protection and management of water resources in Kenya. This legislation provides diverse safeguards to regulate water development as follows:

Ownership of Water Resources: In an effort to control abuse and irrational allocation, Section 3 of the Water Act vests the entire national water resource base to the State, which then authorizes utilization. Abstraction is regulated under Section 25 of the Water Act 2002 with the Water Resource Management Authority (WRMA) assuming responsibility of issuing Water Permits subject to conditions as specified in Sections 27 to 43 and the Second Schedule of the Act.

Requirements for Environmental and Social Impact Assessment: It is a requirement under Section 29(4) of the Water Act "for all proposed water projects to be subjected to public consultation and possibly an Environmental Impact Assessment Report" for review by NEMA through Lead Agencies including District Environmental Committees. Further, in order to complement the Water Act, NEMA sets guidelines for waste disposal into natural waters and the environment and also spells out penalties for the pollution of water.

Service Provider Agreements (SPAs): Section 73(1) of the Water Act 2002 requires Water Service Boards (WSBs) and other Licensees of the Water Services Regulatory Board to make rules for provision of water services and tariff levels. The WSBs are required to enter into SPAs with water service providers, which specify the approved tariff levels and performance targets for the project. This includes measures to ensure that those unable to pay for water are not denied access to clean water.

Agricultural Act of Kenya as revised in 1986: This act promotes and maintains stable agriculture, provides for soil and water conservation and good land husbandry and management. Biotechnology in agricultural development is the key to increased food production and food security. The Agriculture Act Cap 318 of the Laws of Kenya seeks to promote and maintain a

stable agriculture, to provide for the conservation of the soil and its fertility and to stimulate the development of agricultural land in accordance with the accepted practices of good land management and good husbandry. This act provides legislative control over soil conservation and land management. According to the agricultural land-use rules, which are enforceable under Cap 318, any activities that may destabilize river beds are prohibited and the Ministry of Agriculture can impose land conservation orders to control cultivation, grazing and clearing of vegetation. Many of the activities of this project will trigger the implementation of the legislation as they are concerned with promoting agricultural development through irrigation and use of chemicals.

The Wildlife Conservation Act: This Act provides for the protection, conservation and management of wildlife in Kenya. Nature Reserves and National Parks are controlled by the Kenya Wildlife Service under the Wildlife (Management and Co-ordination) Act of 1976. The common feature with all land reserved for use by wildlife is that its conversion to any other form must be approved by Parliament.

Wildlife (Conservation & Management Amendments): Act No. 16 of 1989, Cap 376 Laws of Kenya provides for the protection, conservation, management and utilization of wildlife (fauna and flora) in all places of Kenya.

Forest Act 2005 replacing the 1979 Cap 385 Laws of Kenya: Gazetted forest land is reserved using the Forest Act 2005. Under the Forest Act, a piece of forest land can be de-gazetted and converted to other uses. However, the Forest Act requires all such decisions of forest land to be discussed and approved by Parliament following preparation of a comprehensive EIA Report. All de-gazetted land then reverts to the Commissioner of Lands who then proceeds to allocate the land in accordance with the Land Control Act. Under the Forest Act 2005, forest land can also be leased for use for other purposes provided that such use does not contradict conservation goals. The same Act also allows for Participatory Management of Forests and thus guarantees communities rights to access and utilize certain forest goods and services including citing of water supply intake works in forest areas.

The Forests Act was created to provide for the establishment, development and sustainable management including conservation and rational utilization of forest resources for the socioeconomic development of Kenya. The Act also establishes the Kenya Forest Service (KFS). Utilization of forests is outlined in section 39, and this grants concessions in which case KFS may license the grantee the same subject to EIA in accordance with EMCA.

Land Planning Act: This Act provides for the preparation and implementation of physical development plans for connected purposes. It establishes the responsibility for the physical planning at various levels of Government in order to remove uncertainty regarding the responsibility for regional planning. A key provision of the Act is the requirement for Environmental Impact Assessment (EIA). This legislation is relevant to the implementation and citing of sewerage plants in pilot urban centres as identified in the project document. It provides for a hierarchy of plans in which guidelines are laid down for the future physical development of areas referred to in a specific plan. The intention is that the three-tier order plans, the national

development plan, regional development plan, and the local physical development plan should concentrate on broad policy issues.

Land Acts: In Kenya, statutory land tenure systems has been governed and operated under the following laws: (a) Registration of Titles Act (Cap 281); (b) Government Lands Act (Cap 280); (c) Land Titles Act (Cap 282); (d) Registered Land Act (Cap 300); (e) The Land (Group Representatives) Act (Cap 287); (f) The Trust Land Act (Cap 288); and (g) Sectional Properties Act No.21 of 1987. Other relevant laws are: the Land Acquisition Act, Land Control Act and Land Planning Act. However, the rules governing the setting apart of trust land are contained in the Trust Land Act. The power of compulsory acquisition provided in the Land Acquisition Act, provides the state with a useful instrument for the conservation of environmental resources, this being in the public interest.

The Land Control Act provides for the control of transactions in agricultural land, especially the machinery of the Land Control Boards. However of interest in this report is the consideration in granting or refusal of consent by the Board based on the impact the transaction is likely to have on the maintenance or improvement of standards of good husbandry within the specific agricultural area. Government land is land owned by the government of Kenya under the Government Lands Act (Cap. 280). This includes, for example, forests, gazetted national parks and reserves. The Government Lands Act allows the president, through the commissioner of lands, to allocate any unalienated government land to any individual. In practice, such allocations have often been made without proper regard to social and environmental factors.

Trust land is land held and administered by various local government authorities as trustees under the constitution of Kenya and the Trust Land Act (Cap. 288). National reserves and local sanctuaries as well as county council forest reserves, are in this category. Individuals may acquire leasehold interest for a specific number of years in trust land and can (in theory) be repossessed by the local authorities should the need arise. Local authorities should retain regulatory powers over trust land. Private land is land owned by private individuals under the Registered Land Act (Cap. 300). On registration as the landowner, an individual acquires absolute ownership on a freehold basis. The use of private land may, however, be limited by provisions made in other legislation, such an Agriculture Act (Cap. 318). For instance, to protect soils the clearing of vegetation may be prohibited or the planting of trees required. Land preservation orders issued by the director of agriculture can cover a whole range of other measures.

Lake Basin Development Authority Act: The Act provides for the establishment of Regional Development Authorities (RDAs) and empowers them to undertake planning for the proper use, conservation and development of natural resources at catchments level and to coordinate development in their respective catchments areas. The main functions of the RDAs are primarily to plan for and coordinate the development of the respective areas in the country and to initiate development activities identified through such planning.

2.8.9.5. Tanzania: conservation related laws

Following hereunder are legislations of the United Republic of Tanzania that have been enacted to govern the conservation, management and utilization of natural resources of Tanzania and are therefore relevant to the SNP as a part of the SMME when viewed as a continuous ecosystem.

Wildlife Conservation Act, No. 5 of 2009: This Act makes provision for the protection, conservation, development, regulation and control of Fauna and Flora products and for matters incidental thereto and connected with this Act.

Wildlife Acts, No 12 of 1974: This Act restricts the grazing of any livestock in game reserves without permission of the Director

National Environment Management Act, 1983, 2004: The National Environment Management Council was created to advise government on all environmental matters, formulate environmental policies, coordinate institutions and evaluate proposed policies and environmental standards. The EMA 2004 provides for a legal and institutional framework for sustainable management of the environment, prevention and control pollution, waste management, environmental quality standards, public participation, environmental compliance and enforcement. Furthermore, it gives NEMC mandates to undertake enforcement, compliance, review and monitoring of environmental impacts assessments, research, facilitate public participation in environmental decision-making, raise environmental awareness and collect and disseminate environmental information.

Forest Act, 2002: Not only replaces the 1957 Forest Ordinance, but also the export of timber Ordinance (Cap 288) and Grass Fires Ordinance (Cap 135). The most significant changes are concerned with biodiversity conservation and community forest management. Biodiversity protection is included throughout the Act. Provision is made for establishment of a fund which includes the purpose of assisting Tanzania to benefit from international initiatives and fund for biodiversity conservation. Environmental impacts assessments are required in forested areas and watersheds for certain developments. National forest reserves may be declared as nature forest reserves to maintain and enhance biodiversity and genetic resources. Outside the reserves, conservation of trees includes both protection of wild plants and animals listed in the Government gazette. Sovereignty over "biological resources their derivative products and intangible components" is also affirmed

Tourism Act, 2008: The Act provides institutional framework, administration, regulation, registration and licensing of tourism facilities and activities for related matters

Agriculture and Livestock Acts, 1997: This act provides laws to implement policy whose goal is the improvement of the well-being of the people whose principal occupation and ways of life is based on agriculture and livestock

Lands Acts, 1999: On 11th February 1999 the Tanzanian Parliament passed The Land Act, 1999 and The Village Act, 1999. The first deal with general land, including urban areas and private estates outside the customary sector, and the second deal was with the village lands, the main objectives of these laws are to provide the basic laws in relation to the land, management of land,

settlement of dispute and related matters. Act No. 4 deals with Land other than village land and Act No. 5 concerns Village Land.

The Water Resources Management Act: The regulatory and institutional framework for water resources management is provided for under the water utilisation (Control and Regulation) Act. No.42 of 1974, referred to as the Principal Act and its Amendment Act No.10 of 1981 and written Laws (Miscellaneous) Act. No. 17 of 1989 and General (Regulations) Amendment. The Act as amended, declare that all water in the country is vested to the United Republic of Tanzania, sets conditions on the use of water and authorises the Principal Water Officer with authority, to be responsible for setting policy and allocation of water rights at the national level. For designated water drainage basins with established Basin Water Offices, the responsibilities are under the Basin Water Officer.

Land Use Planning Act, No. 6 of 2007: Government has attempted to regulate and organise which land areas are used for which purpose by enacting the National Land Use Planning Commission Act and the Town and Country Planning Ordinance. Basically, these two laws require land uses to be organized in a planned fashion, with certain approvals required by the government. They divide land planning into two categories: Regional land planning areas and land planning for certain specific areas, such as towns and urban areas.

To date, no additional land use standards have been made pursuant to the Act. Any business operating in a rural area will be expected to follow the conditions of the regional physical land use plan for the particular region. Zonal physical development plans include the Uhuru Corridor (1975-1978) Plan covering Coast, Morogoro, Iringa and Mbeya regions, Lake Zone (1978-82) Plan covering Mwanza, Mara, Kagera and Shinyanga regions and the Northern Zone (1992) covering Tanga, Kilimanjaro and Arusha regions. District plans prepared so far are those for Kiteto, Urambo, Masasi, Babati and Kondoa. The requirements of the Ordinance are discussed extensively in section 4.4, but are also important for agricultural and livestock businesses. For example, the Minister responsible for Lands is given the authority to make provision for agricultural uses within land use planning schemes. Therefore, an agricultural user must determine whether the area intended for use is within a declared "Planning Area" and whether the use is permitted under the zoning requirements and the specific use classifications

2.8.9.6. Observations on national laws

a) It is noted that: these laws were enacted without consultations or input from the other Government and are therefore responding to national concerns only. Where congruency exists it is pure chance.
b) Further, the Enforcement Mechanisms are independent of each other and no enforcement Mechanism exists except through INTERPOL which deals with very serious crimes and in circumstances where the culprit has evaded justice and resides in the neighbouring country.

2.8.10. Review of institutional arrangements

Ecosystem Management and particularly issues of wildlife, water, forestry, the environment and tourism have attracted the creation of both government and non-government institutions pooling resources together for the cause. These institutions are the subject matter of this sub-section.

2.8.10.1. Relevant institutions of Kenya

a). Government Ministries

Ministry of Local Government: The Ministry has a mandate to plan for the management of natural resources in their jurisdiction on behalf of the resident local community. It is also the Ministry in charge of implementing the BSAP.

Ministry of Energy: The Ministry of Energy is responsible for mineral-based energy and renewable energy in the country. The Ministry plays a major role in management of natural resources since about 80% of the rural population depends on fuel wood for their domestic energy requirement.

Ministry of the Environment and Mineral Resources: This is the focal point Ministry for the EAC is in charge of implementing the BSAP in cooperation with the technically relevant sector ministries and agencies. The Functions of the Ministry are: Environment Policy; Mining Policy; Forestry Development Policy; Inventory and Protection of Natural Resources; Lake Victoria Environment Management Programme (LVEMP); National Environment Management Authority (NEMA); Development of Forests, Reforestation and Agro forestry; Water Catchments Area Conservation, Control and Protection; Mineral Exploration and Mining; Kenya Forestry Research Institute; Kenya Meteorological Department; and Kenya Meteorological Training College.

The Ministry of the East African Community (MEAC)*:* This as the responsibility to coordinate, facilitate and oversee the affairs relating to the East African Community (EAC) in Kenya. The Ministry has the added responsibility of facilitating sensitization and awareness campaigns on matters of EAC integration. It is comprised of three directorates: (i) Directorate of Economic Affairs: The Director will be responsible to the Regional Integration Secretary for the coordination of EAC activities, including, Trade and Customs; Fiscal and Monetary Affairs; Industry as well as Investment and Private Sector Development; (ii) Directorate of Political Affairs**:** The Director will be responsible to the Integration Secretary for the coordination of EAC activities, including Political Federation Matters; Interstate Security, East African Legislative Assembly (EALA), Defence, Civil Society, Labour and Immigration, Foreign Affairs, Legal and Judicial Affairs, and; East African Court of Justice (EACJ); and (iii) Directorate of Productive and Services Sector: The Director will be responsible to the Integration Secretary for the coordination of EAC activities such as, Environment and Natural Resources Management; Agriculture and Food Security; Transport, Infrastructure and Communication; Tourism and Wildlife Management; Lake Victoria Basin Commission and Energy.

Ministry of Water and Irrigation: The functions of the Ministry are: Water Resources Management Policy, Water and Sewerage Services Policy, Water Quality and Pollution Control, Dam Construction Schemes, Flood Control and Land Reclamation, Waste Water Treatment and Disposal Policy, National Water Conservation and Pipeline Corporation, Kenya Water Institute, National Irrigation Policy, National Irrigation Board (NIB), Water Services Regulatory Board, Water Resources Management Authority, Water Appeal Tribunal, Water Services Boards, Water Services Trust Fund, and Public Water Schemes and Community Water Projects.

Ministry of Tourism: The Ministry of Tourism is responsible for promoting Kenya as an attractive tourist destination and conserving and managing wildlife. The Ministry creates a conducive environment for tourism growth through extensive public relations exercises, provision of access from tourism entrepreneurs to short medium and long-term financing, and promoting foreign and local investments in the tourism sector. The Ministry's other role of conserving wildlife is not only interlinked with maintaining Kenya's prominence in wildlife tourism but is for national heritage and posterity.

Ministry of Wildlife and Forestry: The functions of the Ministry are: Forestry Development Policy, Development of Forests, Reforestation and Agro forestry, Water catchments area conservation, Kenya Forest Services, Kenya Forest Research Institute (KEFRI), Wildlife conservation policy, Conservation and protection of national wildlife heritage, Kenya wildlife service, Wildlife Clubs of Kenya and Marine parks. Ministry is seeking enhanced government funding for conservation in order to reduce human wildlife conflicts. This will involve fencing some of the parks regarded as conflict hot spots and increasing the number of watering points for the communities and wildlife.

The Wildlife (Conservation Management) Bill 2010 which is being reviewed in line with the new Constitution will be tabled in Parliament the earliest possible. This Bill holds the promise for radical improvement of strategies aimed at enhancing wildlife management. The Bill proposes stiff penalties for wildlife crime offenders with the aim of reducing poaching and providing higher compensation for destruction of property by wildlife. This will increase tolerance in human-wildlife conflict areas as well as encourage more communities to give up their land in favour of wildlife conservancies for more benefits.

The country needs Kshs 7.6 billion annually in order to purchase 384 million seedlings required to meet the United Nations' requirement of a 10 percent forest cover by the year 2030, and the ministry will begin the preparation of the National Forestry programme to provide a clear strategy for the implementation of the forest policy over the coming ten-year period. The programme will also provide a framework for the government and the development partners to align their support, leading to the establishment of a sector-wide approach.

Ministry of Lands: The Ministry of Lands' role is to efficiently administer and manage Kenya's land resource. The Ministry: (i) Formulates and implements land policy; (ii) Is a manager and custodian of land records; (iii) Administers government and trust lands; (iv) Registers titles and various land transactions; (v) Values land for various purposes; (vi) Resolves land and boundary disputes; (vii) Ascertains customary land rights and interests; and (viii) Surveys and maps land. In achieving its aims of maintaining access, equity and optimality in land use, the Ministry,

works within a variety of stakeholders. They include public and private organizations, NGOs and foreign investors.

b). Government Agencies/ Parastatal Organisations

National Environmental Management Authority: The National Environmental Management Authority (NEMA) was established through the Environmental Management and Coordination Act (1999). NEMA plays a coordination role between Government, Ministries, departments and other relevant institutions as they relate to the environment. Its other functions include developing strategies, monitoring and evaluation of development activities. Environmental Impact Assessment (EIA) is mandatory under the Act for all new projects which impact in some way on their surroundings. NEMA is the custodian of all international conventions and protocols. The Department of Resource Survey and Remote Sensing (DRSRS), which falls under NEMA, is mandated to gather information, including data on livestock, wildlife, infrastructure, agriculture, forestry and other vegetations, and various land uses.

Kenya Forest Service (KFS): KFS is established by the Forest Act, 2005. The Act establishes Kenya Forestry Service (KFS) with the mandate of management and development of forest resources in Kenya. The KFS is headed by a director and section 12 establishes forest conservancy areas and forest conservation committee. Among other functions of the forest conservation committee is to regulate the management of forests at local level and assist local communities benefit from forests.

Forestry Sector Institutions: The Forests Act 2005 and draft Policy have their origins in the Kenya Forestry Master Plan which was developed between 1990 and 1994, and which called for reforms in forestry policy and legislation to facilitate development of the sector over the next 25 years. Those reforms were implemented in varying measures in the 2005 Act, and the NRM project has been shaped by ensuing institutional reforms. Broadly, the reforms are aimed at improving efficiency in the forestry sector's contribution to social and economic development and environmental sustainability. They include new institutional arrangements for forest sector regulation and forest management, replacement of the Forestry Department with a parastatal (the ***Kenya Forest Service***): has greater involvement of local government and local communities in forest management, and provisions for forest industry involvement in timber production. The forest department has recently commissioned a study to provide a roadmap towards institutionalizing the legal reforms.

The Kenya Forest Service (KFS) will be administered based on new boundaries that do not follow government administrative boundaries. The KFS proposes to divide the country into regions called conservancies with 32 divisions based on ecosystem structure and functions. There will be an administrator for each conservancy and each division. As result, upon the establishment of the KFS, District Forest Offices will be transferred to the new system of conservancies and divisions.

The draft Forest Policy addresses indigenous forest management, farm forestry, industrial forest development, dry land forestry, forest health and protection, private sector involvement and participatory forest management. It recognizes that there are benefits arising from involvement of local communities and other stakeholders in forest management. The new policy also calls for

mainstreaming the sector economic development and recognizes the potential of the forestry sector in contributing to poverty alleviation in Kenya. Most importantly, the new policy emphasizes the importance of forests for water and biodiversity conservation and for the provision of wood fuel, cost and benefit sharing.

***Water Sector Institutions*:** The enactment of the Water Act 2002 has driven the implementation of the national water policy. Towards this, a National Water Resources Management Strategy (NWRMS 2005- 2007) was released in December 2004 to provide a clear, accountable and transparent roadmap for assessing, maintaining, enhancing, developing and managing the limited available, renewable, freshwater resources using an integrated approach and on a sustainable basis. In line with the Water Act 2002, new institutions have been formed to take responsibilities formerly held by the Ministry of Water. These new institutions include:

The Water Resource Management Authority (WRMA): A body corporate charged (under Section 8(1) of the Water Act 2002) with the overall responsibility of managing the water resources of the country. WRMA has divided the country into 6 regions and 25 sub regions based on catchments. Each region has a regional officer and each sub-region has a sub-regional officer. In addition, the Ministry of Water and Irrigation (MWI) is currently working to realign and rationalize the institutional functions and responsibilities based on the 2002 National Water Act so as to eliminate duplications and overlaps of roles and responsibilities among different institutions. The MWI has been downsized and many of the district water offices' responsibilities and tasks have already been taken by the WRMA and the Water Services Board.

Water Service Boards (WSBs): The WSBs are responsible for ensuring adequate access to water and sanitation services within their jurisdictions. Where government assets exist they will be owned by the WSBs and operated by Water Service Providers (see below). The WSB is the primary agent of service quality oversight.

Water Services Regulatory Board (WSRB): is mandated as the national regulator with responsibility for providing guidelines on tariff setting and quality standards. The WSRB also is responsible for issuing licenses to WSBs;

Water Services Trust Fund (WSTF): is responsible for providing financial support to the rural water sector through grant finance for capital investments; and ***Water Service Providers*** to provide water services to consumers, ranging from public urban utilities, small private network operators in rural areas and community managed self supply through water users' associations.

The **Mara Basin Trans Boundary Water Users Forum** (TWUF) was established in 2008, in order to provide a forum for discussion between water users in both Kenya and Tanzania and encouragement to participate in planning and management of the water resources of the MRB.

The **Mara Regional Secretariat** (MRS) has also been proposed as a body which could encourage dialogue between all stakeholders in the MRB 'including representatives from tribes living in the Mau Forest, small and large scale farmers, the tourist lodges, mining and other industries, and artisan fishers amongst others.'

Research Institutions: Kenya research and academic institutions (e.g. national universities) are mandated to carry out research in their area of specialization.

c). International Partners and NGOs

Many international intergovernmental organizations, NGOs and development agencies with an interest in the long term development and conservation of natural resources in the MRB are identified. These include: the African Development Bank (ADB), African Wildlife Foundation (AWF), European Union (EU) Global Environment Facility (GEF), Norwegian Agency of International Development (NORAD), Swedish International Development Agency (SIDA), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United States Agency for International Development (USAID), World Bank, World Conservation Union (IUCN) and WWF.

Also, CARE, IUCN, WWF, Earthwatch Institute, Wetlands International, Global Water Partnership, CGIAR Centers (including ILRI, the World Agroforestry Centre, IFPRI, and CIFOR-Centre), African Wildlife Foundation (AWF), Farm Africa, the East African Wildlife Society (EAWLS), the Green Belt Movement (GBM), Maji na Ufanisi (Water and Development), the Forest Action Network (FAN), the Ecotourism Society of Kenya, Nature Kenya, Africa Now, Green Africa Foundation, the Kenya Organization of Environmental Education (KOEE) and the Kenya Private Sector Alliance (KEPSA).

WWF is actively engaged in protection of the Mara-Serengeti ecosystem. Its mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by; conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption. WWF has played a key role in initiating a number of major studies including the Biodiversity Strategy and Assessment of Reserve Flows in the MRB. The programme initiative started in 2003. The main project is funded by NORAD and WWF Norway. Key project components have been funded by the USAID and the BMZ through WWF Germany. It has also implemented the WWF Mau Forest Conservation.

2.8.10.2. Relevant institutions of Tanzania

As is in all countries institutions are comprised of state and non-state actors. The list below discusses Government Ministries and Departments, Parastatal organisations and Government Agencies as well as non-governmental organizations, community based organisations and development partners active in the natural resources sector.

a). Government Ministries

The President's Office - Planning Commission: The planning Commission has been established as a government agency for Strategic Thinking (***Think Tank***) on the National Economy, providing advice to the Government on medium and long-term strategies for socio-economic development focusing on the big picture. The Commission is also responsible for monitoring and analyzing development trends and providing advice on macro and sectoral policies as well as broad socio-economic development issues. Consequently, the Commission focuses on strategic policy analysis on issues and problems of great public importance with a view to proposing appropriate solutions.

As a Think Tank, the Planning Commission works as a network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or area of concentration. The Planning Commission is responsible for monitoring; analyzing and providing advice on the big picture and long term sectoral policies and socio-economic developmental issues, as well as, focus on the needs of policy makers on current policy issues. Consequently, the Planning Commission conduct creative insightful and counter intuitive policy analyses on problems of great public importance to provide solutions to be implemented by the Government.

Vice President's Office - Department of the Environment (DoE): The office of the Vice President in Tanzania oversees union matters between Tanzania mainland and Zanzibar. In addition to this mandate VPO is responsible for the environment. The three divisions of the VPO include the Department of the Environment (DoE) that has the mandate over environmental and climate change policy in Tanzania. Most of its activities are operationalized through the National Environmental Management Council (NEMC), the Climate Change Secretariat and the REDD task force.

***Ministry of the East African Community*:** The Ministry of East African Cooperation (MEAC) was established in 2006, following a decision by Heads of State of the EAC to establish Ministries that would be solely responsible for EAC Affairs in their Government organization structures. The Ministry aims at accelerating the region's integration process as a sign of its commitment towards enhancing EAC regional integration. MEAC plays the linkage role between the Government, private sector, CBOs, people and other stakeholders on issues pertaining to EAC regional integration. It oversees the implementation of the EAC Treaty and its Protocols and facilitates participation of Tanzanians in the emerging market and investment opportunities emanating from the EAC. MEAC is charged with the following Mandates: (i) Implementation of East African Community Treaty and its protocols; (ii) Negotiations of East African Customs Union, Common market, and Political Integration; (iii) Extra-Ministerial Departments and projects under the Ministry; (iv) Performance improvement and Development of human resources under the Ministry; and (v) Government Agencies falling under the Ministry.

Ministry of Lands, Housing and Human Settlements Development: The Ministry of Lands, Housing and Human Settlements Development has been mandated to administer land and human settlement in Tanzania. It therefore provides various land related services to individuals and institutions in the country. Functions of the ministry include improving land delivery services,

multipurpose survey information systems and creating an enabling environment for human settlements development. The mandate of the ministry is to facilitate an effective management of land and human settlements development services for the betterment of social and economic well–being of the Tanzanian society.

In fulfilling its mission, the ministry works in close collaboration with the local government that covers district and village councils, Regional Administration offices, city and municipal councils. The Ministry of Local Government and Regional Administration which is under the Prime Minister's office have fully fledged offices, which deal with land administration matters. Land regulation is of fundamental importance to agricultural production, land and environmental management, addressing effects of climate change and to the governance and conservation of Tanzania's natural resources, among others. It is for this reason that Tanzania has designed a land regulatory framework to back-stop land administration. The mechanism is primarily comprised of the National Land Policy of 1995 and its legal instruments.

Ministry of Natural Resources and Tourism: The Ministry of Natural Resources and Tourism Tanzania (MNRT) has a wide range of stakeholders both local and International. Following Government's redefinition of its roles in 1995, the Ministry devolved some of its responsibilities to local government authorities and communities. The Ministry is now charged with the tasks of ensuring sustainable conservation of natural and cultural resources and development of the tourist industry by promoting and enhancing participation of different stakeholders.

These roles and functions are assigned to four sectoral divisions namely: Antiquities, Tourism, Wildlife, Forestry and Beekeeping, accompanying with two supportive divisions (Policy and Planning, and Administration and Personnel) and six units (Accounts, Legal, Internal Audit, Procurement, ICT and Communications). The Ministry's mission is to conserve natural, cultural resources sustainably and develop tourism for national prosperity and benefit of mankind through development of appropriate policies, strategies and guidelines; formulation and enforcement of laws and regulations; monitoring and evaluation of policies and laws.

b) Government Agencies and Parastatal Organisations:

Tanzania National Parks (TANAPA): The primary role of Tanzania' fifteen national parks, many of which form the core of a much larger protected ecosystem is conservation. In addition, these preserve the country's rich natural heritage, and provide secure breeding grounds where its fauna and flora can thrive, safe from the conflicting interests of a growing human population. The existing park system protects a number of internationally recognised bastions of biodiversity and World Heritage sites, thereby redressing the balance for those areas of the country affected by deforestation, agriculture and urbanisation. The gazetting of Saadani and Kitulo National Parks in 2002 expanded this network to include coastal and montane habitats formerly accorded a lower level of protection. Tanzania National Parks (TANAPA) is also currently acquiring

further land to expand certain parks, and to raise the status of traditional migration corridors connecting protected areas.

TANAPA is working to ensure that local communities have a sense of ownership and a vested interest in the future of the parks by sharing the rewards of conservation and delivering tangible benefits. A percentage of park revenues is used to assist community development initiatives, such as schools, health dispensaries, water schemes and roads. Villagers are encouraged to develop cultural tourism projects to cultivate their own financial returns from park visitors. Many locals are employed within the parks by lodges and tour operators - and by TANAPA, particularly in the fight against poachers who desire to steal from the parks for profit or subsistence. Poaching is seen to involve not only the commercial hunting of elephants and rhinoceroses for ivory and rhino horn, but also subsistence activities such as honey collection, illegal fishing and hunting for the pot, felling trees for construction or firewood, and picking traditional medicinal plants that have become scarce in unprotected areas.

The National Environmental Management Council - NEMC: The National Environment Management Council (NEMC) is an arm of the government of Tanzania on the environment established by an Act of parliament - the National Environment Management Act No. 19 of 1983. NEMC was established with a broad mandate in response to the national need for such an institution to oversee environmental management issues and also implement the resolutions of the Stockholm conference (1972), which called upon all nations to establish and strengthen national environmental Councils to advise governments and the international community on environmental issues. The NEMC Act was followed by the enactment of the Environmental Management Act No. 20 of 2004 (EMA, 2004) by Parliament in October 2004, repealing that of 1983 and re-established NEMC.

The National Land Use Planning Commission: The National Land Use Planning Commission was established to harmonise and co-ordinate all land use related policies, legislation and as well as promote effective protection and enhancement of land quality with the aim of ensuring sustainable utilisation of land so that it can provide optimal production to foster socio-economic development and maintenance of land quality for long-term productivity.

The National land use planning commission coordinates the preparation and implementation of land use plans for the country, guided by various policies and laws in particular, the Land Use Planning Act of 2007. In addition, the commission is the prime advisor to Government and other institutions on land use planning. It is the mandate of the Commission to build capacity for land use planning at all levels of Government starting at the village to the national level. Land use planning at the District and Village levels employs a participatory process assisted by the District Land Use Planning Authorities. The goal of the commission is to ensure the availability of sustainable planning systems to prevent land degradation and other unacceptable land use

practices. In this regard, the Commission engages with development partners and non-Governmental Organizations such as GTZ of Germany, Oxfam, Irish Aid, Concern, etc.

Water Basins*:* Tanzania is endowed with numerous and diverse water resources in the form of rivers, lakes, wetlands and productive aquifers. In order to manage the water resources in a sustainable manner, the Ministry has adopted a river basin as a planning unit. The objective of the river basin approach is to manage water resources in an integrated and comprehensive manner, which ensures equitable, efficient and sustainable development of the resources. In 1989, through the Water Utilization (Control and Regulation No. 42 of 1974, Amendment No. 10 of 1981) Act, the Minister for Water gazette nine (9) water basins for the purposes of water resources administration and management. The Government established Basin Water Offices in the Pangani River Basin (1991), Rufiji River Basin (1993), Lake Victoria (2000), Wami-Ruvu (2001), Lake Nyasa (2001), Lake Rukwa (2001), Internal Drainage Basin to Lake Eyasi, Manyara and Bubu depression (2004), Lake Tanganyika (2004), Ruvuma and Southern Coast (2004). Six of these basins are international drainage basins.

Staffs in these basins are engaged in water resources management, surface and groundwater resources assessment and exploration, Water Resources Planning and Research, Regulatory, Enforcement and Environment. The Mara River basin (MRB) is not managed as such. It is, like the Kagera, a trans-boundary resource yet to receive an international status.

c). Non-State Actors

Tanzania Forest Conservation Group (TFCG)*:* TFCG focuses on Tanzania's most important forests: the Eastern Arc Mountains and Coastal Forests. The forests and the plants and animals that they support provide many ecological services including capturing and storing greenhouse gases that might otherwise contribute to climate change; water catchments; biodiversity; pollination; and soil protection. The Tanzania Forest Conservation Group is a team of professional foresters, biologists and communicators determined to improve the way Tanzania's forests are managed and to support the livelihoods of those living close to the forests. TFCG employs Participatory Forest Management (PFM) that ranges from a consultative approach where communities have little decision making power but are given opportunities to comment on management to the other extreme where communities are made the owners and managers of the forest resource. TFCG has promoted different forms of PFM depending on the individual context of each forest.

African Conservation Foundation (ACF): African Conservation Foundation (ACF-Tanzania) based in Arusha, supports and links African conservation initiatives, groups and NGOs, with the aim of strengthening their capacity, building partnerships and promoting effective communication and co-ordination of conservation efforts.

African Wildlife Foundation (AWF): African Wildlife Foundation (AWF) based in Dar es Salaam. This is a scientific and educational charitable organization. With objectives to (i) Education and Training Africans and support to wildlife Conservation programmes; at grassroots

level, school children, farmers, ranchers, etc. Cooperating organization include Tanzania's national parks. Wildlife Conservation Society of Tanzania, College of Wildlife Management Mweka, and Malihai Clubs.

Wildlife Conservation Society of Tanzania (WCST): Wildlife Conservation Society of Tanzania (WCST) based in Arusha works towards the conservation of the flora, fauna and environment of Tanzania for the benefit of mankind.

NGOs and CBOs: The government of Tanzania has committed itself to environment conservation and management and poverty eradication with full support of individuals, CBOs, NGOs and Donor Agencies. These efforts have raised public awareness, interests and actions as more than 159 Community Based Organisations (CBOs) and non-Governmental Organisations (NGOs) have been formed to engage with the issues. The private sector and individuals have also joined the process. Furthermore, the government and other collaborating institutions and agencies such as CBOs / NGOs are implementing various programmes both in rural and urban areas.

Development Partners: Environmental management has received attention from many donor agencies than any sector in Tanzania due to its importance to the economy. Donor agencies contributing financial and technical resources are: DFID; IUCN, GEF; WWF; FAO; WB; USAID; UNDP; UNEP, CARE, as well as the Governments of Finland, Norway, Denmark, the Netherlands and Sweden.

2.8.10.3. Observations on institutions

a) All relevant institutions are in place both in Kenya and Tanzania.
b) However these need to be harmonized, if so possible, so that they have similar roles and functions at the same levels of Government to enhance dialogue and decision making.
c) Policy making Institutions should not deal with implementation at the same time.

2.8.11. Policies and legal framework for MRB natural resources management

The legislation of Kenya and Tanzania both give context for the setting of a vision for the Mara. In Tanzania, the Water Resources Management Act (2009 Part VIa. Water Resources Classification and Reserve) provides for protection of water resources which includes water resources classification and reserve. This includes that the Minister can Gazette the classification of a resource, specify the resource quality objectives of the class to which the resource belongs, and the requirements for achieving these objectives. There is thus a clear requirement to set a class to which the resource should be managed and to describe this by way of resource quality objectives.

Other initiatives have also described visions for the basin which could be synchronized with the above legislative requirement: the goal for the Biodiversity Strategy and Action Plan (BSAP) for the Mara River Basin (LVBC, 2009) is based on the shared vision of the Lake Victoria Basin which aims at having: "A Prosperous population living in a healthy and sustainably managed

environment providing equitable opportunities and benefits". Also the overall Goal for MRB is to have "a region rich in biodiversity which benefits the present and future generations and ecosystems functions".

The objective of the BSAP for aquatic habitats is to improve water and other aquatic resources management in the basin, and to balance resource conservation with resource use and development through the following specific objectives:

a) Prevent or mitigate land degradation in order to minimize sediment and organic pollutant loads; b) Promote improvement in water management schemes; c) Enhance linkages for improved water resource management; d) Utilize natural fish stocks while sustaining the biodiversity of the water bodies; e) Utilize fish farming for protection of endangered fish species and biotopes; and f) Mitigate and avoid negative impacts of fish farming.

The BSAP provides a number of activities designed to meet the objectives for Aquatic Habitats (LVBC, 2009). A sub-set of those that have relevance to environmental flows include:

Objective (a): Prevent or mitigate land degradation in order to minimize sediment and organic pollutant loads: i). Establish and implement the Reserve Flow to ensure that water needs of habitats and species are met; ii). Monitor water quality, quantity and impact of sediment and organic pollutants on biodiversity.
Objective (b): Encourage improvement in water management schemes: i). Conduct a full evaluation of the hydrological balance of the Mara River System;
Objective (c): Utilization of natural fish stocks while sustaining the biological diversity of water bodies: i). Develop monitoring indicators of aquatic biodiversity and include them in the MRB monitoring program;

Objective (d): Application of fish farming for protection of endangered fish species and biotopes: i). Undertake an inventory of the fish community and their environmental needs; ii). Create a database and monitoring plan for introduced and invasive fish species.

The water quality report (GLOWS, 2007) documents a Vision for the Mara River basin that has been developed in conjunction with stakeholders. This vision makes reference to environmental flows *"Water allocation decisions are based on accurate knowledge of environmental flows, and allocations are guaranteed to support the renowned natural ecosystems of the basin, including the Mau Forest, Mara-Serengeti ecosystem, and Musoma swamps of Lake Victoria"*.

The project supported by the Nile Basin Initiative (NBI, 2008c), Mara River Basin Policy, Legal, and Institutional Cooperative Framework, provides a number of scenarios for the development of policy by the two countries, and on how the transboundary water management could be facilitated. These include; Maintain the *status quo*; Bilateral agreement between Kenya and Tanzania; Arrangement under the East African Community; a Management scheme under the NBI; a Hybrid of the EAC and NBI schemes.

The project notes that it is up to the two countries to agree on an appropriate approach. While the above statements provide context for maintenance of EF, they do not actually provide a measurable objective. One such objective is noted in the LVBC (2010) report i.e. the default standard for determining the Reserve in Kenya (this does not appear to have been stated for Tanzania and is now regarded as being largely outdated and due to be replaced by EF estimations (Doris Ombara *pers com*), is the flow level that is exceeded 95% of the time, or Q95 (LVBC, 2010).

According to this report, Q95 levels are often very low flows that may be unable to sustain many components of a healthy ecosystem. This type of standard has been used internationally in data poor situations where there is no supporting information but this one is certainly not conservative as it should be. It is recommended that the reserve should rather be estimated as outlined in the Building Block Methodology (BBM) approach, and that a "standard" such as the Q95 may not be a useful objective to use.

The main objective of the Mara EFA was to determine the necessary Reserve for the Mara River, as defined in the Kenya Water Act (2002) and Tanzania Water Resources Management Act (2009), from near where the river exits the Mau forest to the protected areas of the Serengeti-Mara Ecosystem. This included the setting of Ecological Management Categories (EMC) for each site i.e. the category towards which the site should be managed. The determination of these categories was done on a purely ecological basis, and represents a category which the ecologists on the team felt would sustain the river ecosystem and would not be an unreasonable objective to implement. Unfortunately what this EMC does not do, is take into consideration all of the other demands on the system, which may make this EMC unreasonable. A process to determine the needs of all stakeholders and the wider basin requirements, needs to be included in this process.

2.8.12. Gaps in institutional arrangements concerning management of natural resources in MRB

The gaps are:

a) Lack of Counterpart Institutions in the Management of SMME. Tanzania has set up a parastatal organisation to manage SNP headed by a Director General who reports directly to the Minister for Natural Resources and Tourism. Narok County Council manages MMNR with several Ministries as overseers and the Ministry of Tourism being the lead Ministry.
b) Ministries in charge of Wildlife: In Kenya only policy is addressed, in Tanzania both policy and its enforcement is under the Director of the Wildlife Division, who is also in charge of game controlled areas in Tanzania (GCA).
c) Wildlife research in Tanzania is institutionalised through a special research institution but no equivalent organisation exists in Kenya.

d) The management of the SNP is governed by a management plan for the park whilst MMNR is yet to approve one such plan.
e) Trans-boundary management of the SNP and MMNR does not exist. The two are managed as game sanctuaries within a territory that ends at the border. The need for cross-border animal security operations is overwhelming but yet to be institutionalized. Security enforcement is attempted by the Park Wardens, on both sides, but without legal mandate to do so across a closed border.
f) Wildlife management does not include ecological issues, i.e. there is very little interaction on Wildlife management, let alone biodiversity conservation, between Kenya and Tanzania at Government level except efforts being attempted through the EAC.
g) Current management issues of cross-border interests include the Rhino and Elephants monitoring programmes only. Other species are not covered. An integrated ecosystem management plan does not exist in either of the countries.
h) Pastoralists encroachment on both sides of the SMME, particularly during the dry season when pasture is scarce, goes on unabated spreading and carrying diseases to and from the ecosystem.
i) Both livestock and wildlife grazing areas have been taken up by cultivation and more areas are being converted to farming and nowhere in SNP and MMNR has the reverse been witnessed.
j) A collapse of the migration of wildebeest in MMNR has been observed, due to land fragmentation and blockage of migratory routes and declines of resident population in the Mara.
k) Kenya is promoting irrigation agriculture out of the same resource that traditionally supported wildlife and biodiversity downstream the Mara River.
l) Livestock density has increased. A warning has been sounded that the increase in livestock will defiantly compete with wildlife and the MMNR will increasingly be used by pastoralists during the drought.
m) SNP has not been able to enforce the law preventing pastoralist encroachment due to the vastness of the park area, lengthy court procedures and tactics used by pastoralists.
n) In 2005 Tanzania, through TANAPA, developed the management plan for the Serengeti without consultations with Kenya or KWS. Similarly, in 2007 the Kenya government developed the management plan for the MMNR without consultations with Tanzania. The plan for MMNR has not been implemented. There is no formal mechanism of exchanging scientific findings between KWS and TANAPA.
o) Pastoralists are allowed to use waters of the Mara River in Kenya. This is at the expense of water discharge levels downstream serving both SNP and MMNR.
p) Tanzania resents the attempt of Kenya in pushing the MMNR to be viewed as of the same importance as SNP at the international level when it is far from it. It also resents the inclusion of the SNP in the Mara River Basin when only ten percent of its park area is

actually in the basin and asserts that managing the MRB is not tantamount to managing the SNP.

q) There are many vested interests in the MMNR that prevent "World Class" conservation. The interests include land, businesses, irrigation agriculture, etc.
r) Poor coordination of national approaches to combating climate change adaptation, population density in the SMME and corruption that has made poaching difficult to stop.
s) While Kenya is for mass tourism, Tanzania favours quality tourism. Inadvertently, different approaches are used including unfriendly marketing gestures to gain the upper hand.
t) The EAC have agreed to market East Africa as one tourist destination, yet that has not been done. A benefit sharing mechanism that includes cash and services has not been developed.
u) In Kenya many have established conservancies around the MMNR. But, there is no legal mechanism to guide the establishment and business of conservancies although the wildlife bill recognizes their existence.
v) The policy in Tanzania is to establish wildlife management areas (WMA) in which communities participate proactively. Benefit sharing mechanisms are directed at communities focusing on providing social services. Individuals are therefore not motivated.
w) Land around the MMNR is either communal, private or group ranches. The reserve is hosted on communal land. Some four million titles to land in Kenya exists indicating near optimal land ownership and hence land scarcity for expansion of wildlife space. Such lands in Kenya are expensive to acquire in the public interest, a factor which limits, in part, wildlife space for the MMNR also.
x) Unlike Kenya, Tanzania's land is mostly village land where customary tenure is the mode of land holding. Less that 60 thousand certificates of customary rights of occupancy have been granted, out of less than 500 thousand in a country of close to 90 million hectares of land, indicating that most of the land is not secured under title making it easier to expand wildlife space. Tanzania is more flexible with regard to expansion of wildlife areas because the land is either public of communal.

It can be concluded that he divided management of the SMME by two sovereign nations, each with own philosophy, ideals and approaches has brought out issues that challenge the future outlook of biodiversity conservation in the area. Firstly, a fragile trust between the two countries with regard to biodiversity conservation, tourism and wildlife security has developed. Secondly, is the impact of divergent national position on bilateral relations with regard to conservation.

The future will probably be driven by needs of the economy and not those of conservation unless something drastically different is done. In particular and in spite of global, regional and other commitments, the two countries want to see to it that earnings from tourism increase and become a stimulant of other economic activities. Herewith is a general picture of the performance of the

tourism sector in both Kenya and Tanzania that pose to remain a priority in wildlife management.

2.9. Situation Analysis on the State of the Mara River Basin and Need for WAP

The Mara River runs through the Maasai Mara Game Reserve on the Kenyan side and the Serengeti National Park on the Tanzanian side, and eventually flows into Lake Victoria. People living along the Mara River and its basin area are increasingly facing water shortages, poor water quality and environmental degradation as a result of pollution, agricultural runoff, large-scale irrigation projects, and mining and other industrial activities. WWF is working with water users, local communities, water managers and decision-makers to better manage the Mara River so as to improve adequate water supplies, and to ensure sustainable economic development and conservation of the natural resources in the Mara-Serengeti ecosystem.

Increasing water shortages limits attempts to alleviate poverty and improve healthcare, food security, economic development and protection of the natural resources. The main competing interests for water resources in the Mara River include the large scale irrigation plantations on the Kenyan side, the Maasai Mara and Serengeti Wildlife protected areas, small scale farmers and pastoralists on both sides of the basin, the mining industry in Tanzania, small scale fishing activities and urban and rural domestic water supplies. Further problems are caused by the loss of forest cover in the upper catchments and along rivers, unsustainable agricultural practices (including irrigation), pollution threats from urban settlements, and mining.

Objectives - Facilitate integrated river basin management (IRBM) to ensure adequate water supply of sufficient quality for ecosystems and basic human needs. - Facilitate participatory and sustainable IRBM initiatives for the conservation, sustainable and equitable use and restoration of freshwater resources and ecological processes in the Mara River basin. In solving some of the challenges, a programme, which started its field operations in 2003, is making significant achievements. This is due to the support granted by the Ministry of Water and Irrigation through the Lake Victoria Basin Water Office in Tanzania and Lake Victoria South Catchment Authority in Kenya, government institutions and the local communities in both countries. Lessons learned from both Kenyan and Tanzanian components of the programme enhance its achievements. Both Tanzania National Water Policy (NAWAPO) and Kenya National Water Policy recognizes the importance of Integrated Water Resource Management (IWRM) and has directed the establishment of an institutional framework for the management of water resources that will ensure participation of stakeholders in water resource management down to the lowest level of a water user. The Nile Basin Initiative through the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP) and the Lake Victoria Basin Commission (LVBC) under the East African Community (EAC) also recognizes the importance of Integrated River Basin Management (IRBM) initiatives for the conservation, sustainable and equitable use of shared freshwater resources. IRBM is a process that promotes the coordinated development and management of water, land and related resources in a river basin in order to maximize the resultant economic and

social welfare in an equitable manner without compromising the sustainability of vital ecosystems (Global Partnership Technical Advisory Group Working Paper 4. 2002). This project is therefore a contribution to the implementation of national water policies (Kenya and Tanzania) and East African Community Treaty and Lake Victoria Basin Development Protocol and these other initiatives.

The following are programme outputs for practical interventions planned to address key threats to water and biodiversity resources: a) Carry out baseline surveys and as far as possible fill information gaps with documentation in the form of reports, maps etc; b) Gather and disseminate appropriate information on conditions and threats to the Mara River Basin for land-use planning and management of the Mara River Basin and raise awareness about the importance of catchment management; c) Facilitate the ongoing process of stakeholder dialogue on integrated water resources management, ranging from local people to high level policy makers, and support local peoples involvement in the inter-sectoral IRBM dialogue through capacity-building and advocacy; d) Start and facilitate a process to introduce or revive existing community organizations, where forums and working groups have been established, and management actions in the catchment are becoming more sustainable; e) Document best practices and failures in terms of sustainable management and conservation, and promote the sharing and exchange of these lessons through demonstrating measures in the field, community exchange visits and communication measures; f) Build capacity amongst key stakeholders including vulnerable groups (small scale farmers, poor urban dwellers and women) for effective and sustainable IRBM; g) Develop and promote recommendations for the development of an integrated water resource management strategy for the Mara River Basin, including appropriate policies and laws to secure sustainable management and conservation.

Mara River Transboundary Water Users Forum has been formed as a platform to dialogue and spearhead the transboundary water resources management initiative. The East African Community / Lake Victoria Basin Commission have been involved in the conservation of the Mara River and Mau Forest ecosystem. A collaborative effort with the Nile Basin Initiative (NBI) and the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP) in the management of the Mara River Basin has been greatly achieved to ensure synergy building between WWF and NBI initiative in Mara River Basin. Mara River Basin Biodiversity Action Plan and Environmental Flows of Mara River documents have been approved by Lake Victoria Basin Council of Ministers in meeting held in May 2009.

Ministers directed key stakeholders in Mara River Basin to use these documents as guidelines for biodiversity and water allocation in Mara River basin. In Kenya, a very active Water Resource Users Association board (WRUA) with 3 major sub-catchments and 33 sub-catchments group committees has been established along the Kenyan Mara River. Water Users Associations and Sub-catchment Committees were facilitated and managed to protect 14 water sources and catchments. They have successfully sensitized the government authorities and lobbied political

leaders for the re-establishment of the original forest boundaries and the eventual removal of people who invaded the Mau Forest Catchment, the source of the Mara River. Stakeholders have been educated on the new Water Act (2002) and Environmental Management and Coordination Act (EMCA, 1999). On-farm tree planting campaigns has been institutionalized within the established Mara River Water Users Association in the upper catchment of the basin. Over 1,000 families have installed energy conservation stoves. The concept of water thirsty crops is now clear to stakeholders in the Mara River Basin, with measures instituted to control water flows.

In Kenya, operational Community Forest Associations (CFAs) were formed. Key stakeholders were mobilized and facilitated to form three CFAs to manage Transmara Forest block. One CFA has been registered. 15.5 hectares of the forest area were rehabilitated through enrichment planting and reforestation under CFAs. Five nurseries are operational with total of 50,000 indigenous seedlings to be planted in the forest. 995 hectares are under soil and water conservation - 820 farmers were supported to establish terraces on 995 hectares of farms to control soil erosion and improve water conservation. Suitable tree and fodder species were planted to stabilize terraces and provide fodder for livestock. 18kms of riverine vegetation were also protected.

In Tanzania, Catchment Committee has been formed in the Tanzanian part of the Mara River Basin (MRB). This committee is equivalent to WRUA board in Kenya. This committee has 14 Water Users Associations formed by Programme Awareness raised amongst the local communities and other key stakeholders about the Tanzania. There is already National Water Policy with information and data documented on environmental, hydrological and social conditions, which are now being disseminated. Community Action Plans for water management and other natural resources have been prepared and are under implementation. Catchment Management Strategy has been developed and led to the development of catchment Joint Water Resources Management Plan, and has facilitated the formation of 14 Water Users Associations as legal entities in accordance to the National Water Policy requirements. This is supported by Tanzanian Ministry of Water and Irrigation which rehabilitated 13 completely stalled river gauging stations. Capacity built amongst vulnerable Community-Based Groups are involved in Income Generating Activities, and using technologies that support sustainable natural resources and conservation. Source: WWF Project data; Started: 1, Jan 2003, Planned end date: 30, Jun 2009; Executant: William Kasanga; Managing Office: WWF Eastern and Southern Africa Regional Programme Office (ESARPO); Address: WWF Eastern and Southern Africa Regional Programme Office / 5th Floor of ACS Plaza Lenana Road P.O. Box 62440-00200 Nairobi Kenya / Kenya / +254 20 3877 355. Website:
(http://wwf.panda.org/who_we_are/wwf_offices/tanzania/index.cfm?uProjectID=9F0749)

Mara River Basin (MRB) has several water sources, the most dominant being the Mara River and its tributaries. Other water sources include springs, rainwater, wells, dams and boreholes. According to household surveys conducted within the MRB, sixty-two percent of households use

water from the Mara River for both their domestic and livestock use (Aboud, 2002). A recent unpublished study in the Mara River basin also showed that rivers/streams were the main source of water for domestic use for majority (76%) of the households, while the same were a source of water for livestock, according to 92.7% of the respondents. Further, the same study showed that problems encountered in accessing water in the Mara River basin included long distances to the water source (26%), contamination of water sources (70.1%), water scarcity (2.6%) among others. Local communities recognize water quality as a major problem in the region, with growing concerns from the regional and districts authorities concerning pollution of waters from various sources, key among them urban runoff, poor agricultural practices, sewage discharge, industrial waste, gold mining among other activities. Wetland degradation due to poor farming practices has also been reported to be a cause of river water degradation.

The long term sustainability of the Mara River and the multitude of socio-economic activities that it supports are at serious risk, which calls for concerted efforts by all stakeholders to implement effective water management activities. The Mara River basin-wide water allocation plan (MRB-WAP) is therefore intended to compliment other plans and efforts by stakeholders to strengthen the management of the Mara River water resources and reduce the pressure on its water resources. These can be achieved through critical assessment of the environmental flows vis a vis the demand.

The waters of Mara River are currently being over abstracted for irrigation, commercial use, domestic use among other uses, significantly reducing the water levels. It was therefore necessary to develop a suitable water allocation plan in the Mara River basin to ensure water use and environmental sustainability within the basin. Sustainability depends on a delicate balance between use and conservation of environmental resources. These efforts aided in the development of a Mara River basin – wide water allocation plan (MRB-WAP) that would enable Kenya and Tanzania to manage the transboundary biodiversity resources of the MRB in an environmentally sound manner.

To arrive at practical management solutions for the Mara River, dialogue between upstream and downstream stakeholders and between the two basin countries need to be sustained to define joint management objectives and implementation strategies (O'Keeffe, 2007). This is because any form of abstraction, transfer, storage or other influences on natural stream has effects on the entire downstream river system (CAP-NET, 2008). As such, an efficient water allocation plan must include a system analysis to understand the entire river basin including the associated groundwater and how it affects the livelihoods and economic activities in the basin and vice versa. It is therefore important to allocate water based on its availability and the demands inferred from the ongoing and future / planned socio-economic developments (such as population growth, and increases in households with improved sanitation).

CHAPTER THREE

3.0 STUDY DESIGN AND METHODS

3.1. Study Design

This consultancy project was conducted along the entire Mara River on both the Kenyan side as well as Tanzanian side. This was done so as to develop Mara River Basin-wide Water Allocation Plan (MRB-WAP) which also included Integrated Water Resource Management (IWRM) issues that can help to better understand water resource management issues, environmental and socio-economic impacts of various water uses and resource management practices within the Basin. It will require conceptualization of the water situation in the whole Basin and analysis of both current and expected future conditions in order to identify where gaps/problems exist. It required focus on the stakeholders' expectations, available water resources (quantity), water users, their current and expected future consumptions, water quality and the various water uses, policies affecting water resources management and water service provision, water rights and permits, roles and capacity of the existing institutions concerned and existing water laws and their enforcement. Gaps, both institutional and legal, leading to lack of harmonization of both situations in Kenya and Tanzania were also explored.

The WAP development was accomplished through the following processes;

i. Desk review of existing documents and databases both in Kenya and Tanzania, e.g., conventions, protocals, legals and institutional frameworks, existing policies and water laws.
ii. Focus group discussions (FGDs) and /or key informant interviews (KIIs) involving stakeholders in the water sector and water users in Kenya and in Tanzania were carried out during field visits.
iii. Field visits to validate data on water uses from predetermined water users within the Basin was done.
iv. Use of a Water Evaluation and Planning (WEAP) model software to analyze the current water management scenarios to develop the MRB-WAP was done.
v. Joint workshop involving stakeholders from both Kenya and Tanzania to discuss and harmonize legal frameworks, policies and other emerging issues on Mara river basin wide water allocation plan (MRB-WAP) and integrated water resources management scenario within the basin will finally be done by LVBC.

While recognizing the importance and reliability of the Mara River, to various water users, and the complexity of the environmental flows; which describe the quantity, timing, and quality of water flows required to sustain freshwater ecosystems and human livelihoods and well being, it was critical to analyze the current water management scenarios and their consequences and evaluate the best options to ensure sustainable management of the water resources based on current and expected future trends. This required an integrated approach to water resources planning by providing a system for maintaining water demand and supply information **(water balance database)**, simulation of water demand, supply, natural (e.g., evapotranspirative

demands, runoff, baseflow, stream flows, storage, pollution generation, treatment and discharge and instream water quality and quantity **(scenario generation)** and evaluation of a full range of water development and management options, took into account multiple and competing uses of water systems **(policy analysis)**. It also took advantage of engineered components (e.g., reservoirs, groundwater pumping) of water systems, allowing the planner access to a more comprehensive view of the broad range of factors that must be considered in managing water resources for present and future use. This made it an effective tool for examining alternative water development and management options for the catchment.

Stream flow data, water quantity and quality data, water use, and water demand data were obtained from both primary and secondary sources and used to develop the WEAP model. The steps in WEAP included; definition of the study (set the timeframe, spatial boundary of the study area in question, system components and configuration); input scenario parameters (actual water demand, resources and supplies for the system) and water quantity and quality; definition of future assumptions (e.g. policies, costs, technological development, and other factors affecting demand, pollution, supply, and hydrology); construction of scenarios with different combinations of assumptions and policies to answer "what if" questions; evaluation of the scenarios with respect to their effects on water resources and economic well being of the local people; and review and revision of the scenarios based on stakeholders expectations within the respective catchment. WEAP model illustrated various water development scenarios and their consequences and evaluated options to identify sustainable ways of management of the water system.

The WEAP model aimed at linking stream flow data, state of water resources, water use/abstraction, water demand, and water quality status, in the river system, as well as evaluate the whole system, assessing effect of existing policies and impacts – and future trends. These efforts were geared towards promotion and development of a Mara River basin – wide water allocation plan that will enable Kenya and Tanzania to manage the transboundary biodiversity resources of the MRB in an environmentally sound manner. It will inform possible review of existing legal framework to support effective operations to ensure sustainable water allocation while ensuring healthy environment.

WEAP is an easy-to-use tool is needed to match water supplies and competing demands, and to assess the upstream-downstream links for different management options in terms of their resulting water sufficiency or un-met demands, costs, and benefits. The Water Evaluation and Planning tool (WEAP) has been developed to meet this need. It uses the basic principle of water balance accounting: total inflows equals total outflows net of any change in storage (in reservoirs, aquifers and soil). WEAP represents a particular water system, with its main supply and demand nodes and the links between them, both numerically and graphically. Delphi Studio programming language and MapObjects software are employed to spatially reference catchment attributes such as river and groundwater systems, demand sites, wastewater treatment plants, catchment and administrative political boundaries (Yates *et al*., 2005). Users specify allocation rules by assigning priorities and supply preferences for each node; these preferences are mutable, both in space and time. WEAP then employs a priority-based optimization algorithm and the concept of *equity groups* to allocate water in times of shortage. The simplicity of representation means that different scenarios can be quickly set up and compared, and it can be operated after

only a short training period. In Kenya, WEAP is being developed as a standard tool in strategic planning and scenario assessment for water management in partnership between the Green Water Credits team, the Water Resources Management Authority, KenGen and the Nairobi Water Company. Licences are free for NGOS, governmental and academic organizations in developing countries.

WEAP *operational steps include:*

a). The study definition sets up the time frame, spatial boundary, system components and configuration. The model can be run with any time step where routing is not a consideration; for the proof-of-concept in the Tana Basin for instance, a monthly time step is used.

b). System management is represented in terms of supply sources (surface water, groundwater, inter-basin transfer, and water re-use elements); withdrawal, transmission and wastewater treatment facilities; water demands; and pollution generated by these activities. The baseline dataset summarises actual water demand, pollution loads, resources and supplies for the system during the current year or some other baseline year.

c). Scenarios are developed - based on assumptions about climate change, demography, development policies, costs and other factors that affect demand, supply and hydrology. The drivers may change at varying rates over the planning horizon. The time horizon for these scenarios can be set by the user.

d). Scenarios are then evaluated with respect to desired outcomes such as water sufficiency, costs and benefits, compatibility with environmental targets, and sensitivity to uncertainty in key variables.

Water supply: Using the hydrological function in WEAP, the water supply from rainfall is depleted according to the water demands of the vegetation, or transmitted as runoff and infiltration to soil water reserves, the river network and aquifers, following a semi-distributed, parsimonious hydrologic model. These elements are linked by the user-defined water allocation components put into the model through the WEAP interface.

Water allocation: The problem is to distribute the supply remaining after satisfaction of catchment demand (the *Reserve* mentioned in the Water Act); the objective to maximize water delivered to various demand elements and in-stream flow requirements according to their ranked priority. This is accomplished using an iterative, linear programming algorithm. The demands of the same priority are referred to as *equity groups.* These equity groups are indicated in the interface with a number in parentheses (from 1, having the highest priority, and 99, the lowest). The program is formulated to allocate equal percentages of water to the members of the same equity group when the system is supply-limited.

WEAP integrates this information on water supply and water quality with the demands from irrigation, household supply, industry, hydropower generation and environmental flows. By integrating supply and demand with costs of different interventions, WEAP enables the analysis of the costs and benefits of different water allocation and development options. Vulnerabilities in

the system, mitigation options and coping capacity may be assessed by using data from extreme years. This, in turn, can be used for cost-benefit analysis of mitigation options.

3.2 Development of the Mara River Basin-wide -Water Allocation Plan (MRB-WAP)

The goal of developing the Mara River Basin-wide water allocation plan (MRB-WAP) was to establish a reasonable and practical framework for water allocation and water abstraction within the Mara River basin, which is anchored in the current policy and legislations, agreeable and adoptable by both countries, Kenya and Tanzania, all stakeholders, and which aims to safeguard the natural ecosystems from over abstraction while supporting multiple demands on the water resources. The process of developing the Mara River Basin-wide Water Allocation Plan was started in July 2012 by the Lake Victoria Basin Commission (LVBC) who engaged the services of consultants from Megascientific Limited Kisumu. The process of developing the water allocation plan for the Mara River was a rigorous one which was split into four specific objectives as shown above. Based on the first 3 specific objectives, the last (4^{th}) specific objective of developing a Mara River Basin – wide water allocation plan for the next twenty years was achieved after a review of various documented material and a visit to several stakeholders within the basin.

Deliberate efforts were made to ensure the participation of key stakeholders from the Mara River basin; both on the Tanzania and Kenyan side (see Appendix I for a complete list of stakeholders interviewed). Several meetings and focus group discussions were held with the key stakeholders in which all the issues concerning water allocation and abstraction within the Mara River Basin were discussed. The Key institutions/ stakeholders/groups contacted during the field work included:

a) WRMA- Lake Victoria South Catchment Area Regional Office Kisumu
b) WRMA - Lake Victoria South Catchment Area Sub- regional offices, Kericho
c) WWF Offices - Narok, Kenya
d) Kenya Wildlife Service - Ewaso Ngiro
e) Narok County Council - Narok
f) Large scale farmer (Tibu Farm, Olerai Ltd)
g) Water Users Associations (MRWUA and WUAs), Kenya and Tanzanian side
h) Government Ministries (Ministry of agriculture and livestock officials, Longisa Division)
i) Water Services Providers (Bomet District Water Office), Kenya
j) Tourist Operators (Fairmount Mara Safari club), Kenya.
k) Community Representatives (Business men and farmers), from Bomet area
l) WWF, Tanzania Office, Musoma
m) Lake Victoria Basin Water Office, Tanzania
n) Tanzania National Parks (Serengeti National Park), Tanzania
o) Water Services Providers (Serengeti Water Offices), Tanzania
p) NELSAP, Tanzania
q) Lake Victoria Basin Commission (LVBC)

Program logic approach was used to come up with a tabular representation of MRB-WAP. Roughley (2009) describes program logic as an approach to planning that captures the rationale behind the plan or program, probing and outlining the anticipated cause-and-effect relationships between activities, outputs, intermediate outcomes and longer-term desired outcomes. A program

logic is usually represented as a diagram or matrix that shows a series of expected consequences, not just a sequence of events. Program logic expresses how change is expected to occur. A program logic provides:

a) A tool to guide planning at the conceptual stage of the program,
b) A way to share understanding and ownership among members of a team and with stakeholders,
c) A tool for clarifying and evaluating the strengths and weaknesses of a program, often when it is in the development or re-development phase,
d) A framework from which to develop monitoring and evaluation criteria for program performance,
e) A tool to inform learning and adaptation of strategies to improve program performance,
f) A communication tool, particularly for complex programs, to inform partners, the government, community and investors.

Program logic approach can help ensure the levels of objectives; the strategies to achieve them; and the monitoring mechanisms if plans are logically linked. A critical aspect of the hierarchy is that there must be cause and effect relationships between the different levels of outcomes, with the achievement of lower level outcomes demonstrably contributing to higher level ones. The fundamental concepts are that there is a hierarchy; with causal links shown and the knowledge and assumptions underlying them being documented; and strategies and monitoring aligned with achieving them.

3.3 Challenges to MRB-WAP Development

The water balance analysis was however limited due to information gaps, particularly in relation to inaccurate information on the exact amount of water abstracted directly from the river as well as the amount of groundwater abstracted for domestic use, livestock, commercial or irrigation. Poor and inaccurate hydrological records, lack of actual number of water users and the quantities abstracted also posed a challenge to the development of the WAP. For this WAP, emphasis was placed on the available data and other estimates from research documents.

Existence of weak permit data whereby in some cases the permits did not exist or had expired posed a constraint in the development of a WAP in that it underestimated the amount of water abstracted. This implies that the permit data could not be used to provide an estimate of actual abstraction. While WRMA is addressing this situation, the lack of reasonable permit records has proved to be a significant constraint in the WAP development. On the Tanzania's side information on water abstraction through permits was limited and review of permits to monitor abstraction levels was very weak.

Poor compliance by the water users complicated the development of the MRB-WAP. Water users have historically and consistently failed to comply with the conditions of their water permits. WRUAs are now expected to monitor and support the compliance process. Weak enforcement of the water laws by both the Kenyan and Tanzanian governments encourages non-compliance among water users. Lack of resources and political will to enable proper enforcement of water laws was a major constraint. In summary, this WAP has been developed in the context of major information constraints. As a result it will need to be revised in future as more accurate information becomes available.

CHAPTER FOUR

4.0. REVIEW AND SUMMARY OF WATER ALLOCATION POLICIES, LEGAL AND INSTITUTIONAL FRAMEWORKS IN KENYA AND TANZANIA

This chapter reviews the policy settings and institutional frameworks for management including key stakeholder analysis, patent issues and concerns. It also addresses the second objective or terms of reference of the consultancy study: review and summary of water allocation policies and legislations in Kenya and Tanzania.

4.1. Review of Water Allocation Policies, Legal and Institutional Frameworks in Kenya and Tanzania

Water is an important natural resource to all forms of life and their existence. For mankind, it is the backbone of growth and prosperity. However, the growing water demand against the limited temporal and spatial natural endowment and its increasing scarcity could result in conflicts and catastrophes. Scarcity and misuse of fresh water pose a serious and growing threat to sustainable development and protection of the environment. Human health and welfare, food security, industrial development and the ecosystem on which they depend are all at risk, unless water and land resources are managed more effectively now and beyond than in the past.

The allocation of water resources is an important and increasing challenge for society development. It is a component of water management that involves matching or balancing the demand for water with its availability, through suitable arrangements. The particular challenge is to decide on quantity and quality that should safeguard ecological processes taking into account the class of water resource so as to achieve equitable access and efficient use of water resources. At the Mara River basin level there are a number of conflicting water uses which are considered in six broad categories. They include; Irrigated agriculture, Domestic use, Livestock, Industrial use (Mining), Wildlife and Tourism.

4.1.1. Policy framework

The management of water allocation is influenced by various policies and legislations for both Tanzania and Kenya. Key elements of the Water Sector Reforms were captured in the Policy Paper (Sessional Paper No. 1-1999). Key shifts in policy included:

a) Separation of functions;
b) Decentralization;
c) Commercialization of services;
d) Community and private sector participation.

4.1.2. Legislative framework for both Kenya and Tanzania

The Water Act 2002 captures the policy shifts and supersedes the former Water Act (Cap 372). The Water Act 2002, and the subsequent subsidiary legislation in the form of the Water

Resources Management Rules (2007) introduced a number of significant features that are noted below.

a) *Institutional Framework*. The Water Resource Management Authority (WRMA) and LVBWO are mandated as the lead agency in water resources management. The institutions have decentralised organisational structure, with regional offices.

b) *Government as custodian of water resources*. The water resources are managed by the governments in trust for the people of Kenya and Tanzania. Water resources are allocated for use through a system of permits for which a user must apply;

c) *Stakeholder participation*. Stakeholder representation and inclusion in water resource management is reflected in the "*Catchment Area Advisory Committee (CAAC)* "on catchment wide issues and the Water Resource User Associations (WRUAs) at the sub-catchment level.

d) *Strategies for Water Resource Management*. MWI has developed the National Water Resources Management Strategy (NWRMS) which sets out a broad approach towards water allocation. WRMA, with stakeholder participation, has developed a Catchment Management Strategy (CMS) for the management of the water resources and catchments areas within the Rift Valley Catchment Area. The CMS sets out priorities and arrangements for water allocation plans and for the involvement of WRUAs in water resource management;

e) *Water Use Charges*. A system of water use charges has been introduced which requires water users in certain permit classes to pay for raw water on the basis of water abstracted. The water use charges serve three primary functions: (i) to improve efficiency in water use, (ii) to provide WRMA with data on water use and (iii) generate revenue to support water resource management activities;

f) *Reserve*. Guideline criteria for determining the quantity component of the Reserve have been developed by WWF and LVBC. Violations of the Reserve are accorded higher priority to other complaints and are addressed as a matter of urgency. Once the requirements of the Reserve have been met, the water resources can be allocated through the permitting system as per the established and acceptable allocation guidelines for the Basin.

4.1.2.1. Water allocation policies, legal and institutional frameworks in Kenya

Kenya's Constitution has put in place a legal and institutional framework which can support water allocation and management. In addition, the country has got in place the National Water Services Strategy; the Water Act, 2002; and the Model Water Services Regulations developed by the Water Services Regulatory Board.

The whole of chapter 5 of the Constitution of Kenya is dedicated to Land and the Environment. In addition, Article 42, under the Bill of Rights states that "every person has the right to a clean

and health environment". Article 43 (1) (d) species that, "every person has the right to clean and safe water in adequate quantities". Article 69 (1) (a) explicitly states 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". At the same time, Article 69 (1) (h) clearly states that: "the Sate shall utilize the environment and natural resources for the benefit of the people of Kenya". The policy and the Acts of Parliament created the following institutions in Kenya as shown in Table 4.1.

Table 4.1. Water allocation and management institutions and their responsibilities and status in Kenya

Institution	Responsibility	Status
The Ministry of Water and Irrigation	Responsible for policy formulation, monitoring and evaluation	In place
Water Resources Management Authority (WRMA)	Responsible for the management of water resources;	In place
The Water Services Trust Fund (WSTF)	Has the mandate to mobilize financial resources for development and rehabilitation of water and sewerage services resources infrastructure	In place
Water Service Boards (WSBs)	Responsible for efficient and economical provision of water services as authorized by license, contracting, monitoring and enforcing agreements between WSBs and water service providers (WSPs), in accordance with the regulations set by the Water Service Regulatory Board (WSRB) in the licenses.	In place
Catchment Area Advisory Committees (CAAC)	Responsible for management of water resources, conservation, use and apportionment of water resources in a defined catchment area	In place
Kenya Water Institute (KWI)	Responsible for conducting training for middle level personnel in the water sector; and carrying out relevant research in the water sector	In place
Water Services Regulatory Board (WSRB)	To license the supply of water and sewerage services and to determine standards for the provision of water to consumers;	In place
Water Appeals Board (WAB)	Has the mandate to carry out conflict resolution within the sector management	In place
National Water Conservation & Pipeline Corporation	Has the function to construct dams, drill boreholes and supply water in bulk;	In place
Water Resource Users Associations	Participate in managing the water resources in their area of jurisdiction	In place

Autonomous Water and Sewerage Companies	Provide water and sanitation services in urban areas,	In place, but serving only urban areas

The main objective of the National Water Strategy and Water Act 2002 was to provide a framework for water sector reforms around four main areas: a) Separation of policy making from day to day administration and regulation; b) Separation of the management of water resources from the provision of water services; c) Decentralization of functions to lower level state organs; and; d) Involvement of non-government entities in the management of water resources and in the provision of water services.

The key principles underlying the water sector reform were: a) The participation of all key stakeholders in the management of water resources and the provision of water services; b) Decentralized decision making; separation of policy, regulation and service provision; c) Private sector participation in the provision of water services at socially responsible commercial rates; d) Putting into account economic, social and environmental concerns in water resource management and the provision of water services; and, e) Delegation of responsibilities for water actors and separation of Water Resource Management from Water Services Provision.

The Kenya segment of the Mara River Basin falls partly under the Lake Victoria South Water Services Board and the Rift Valley Water Services Board. There is one autonomous water and sewerage company in this part of the basin. However, at the time of writing the report, the company was not operational because of its inability to pay WRMA for water. The most active water users association (WRUA) is the Mara River Water Users' Association which purports to have members all the way from the border with Tanzania to the upper catchment at Enapuyipuyi swamp in the Mau forest. However, several other WRUAs are in the formation stage. These include the Nyangores River WRUA Amala River WRUA, Isei River WRUA, Lower Mara River WRUA, Talek River WRUA and Sand River WRUA.

In the absence of an autonomous water company, payment for water resources is made directly to WRMA. However, since WRMA has only got a thin presence on the ground, the Mara WRUA as an agent has got the responsibility of ensuring that water users pay WRMA. The authority is in turn supposed to manage the water resources in the basin, including the rehabilitation of the catchment. Having said that, residents in the upper catchment declared to the consultant that they have never heard of WRMA or the Mara WRUA. To be sure, the catchment is not being looked after or rehabilitated in a concerted manner. The Kenya Forest Service has taken the responsibility of looking after the Enapuyipuyi swamp, which lies in Nakuru County. However, nobody is looking after the water catchment in Narok County, as this is on private land.

Looking at the institutional arrangements, it is possible to have a legally binding Water Management Framework which can support MRB-WAP in place without changing the policy or the law. This would involve a simple change of attitude at WRMA. This can also include payment of ecosystem services (PES) which is being spearheaded by WWF to protect water catchments. WRMA collects payments from water users. A part of this money can be used to

assist farmers in the upper catchment to put in place soil erosion control measures on their farms. These measures can include erecting terraces, planting trees and planting live fences. Planting of bamboo can quickly reduce siltation from farms. This action would be supported by the Constitution as well as the Water Act, 2002. Indeed, Clause 8 (1) (f) of the Water Act, 2002 states that one of WRMA's responsibilities is "to manage and protect water catchments"; while (g) in the same clause states that WRMA will "in accordance with guidelines in the national water resources management strategy, determine charges to be imposed for the use of water from any water resource"; and (i) states that WRMA will "liaise with other bodies for the better regulation and management of water resources".

The fact is that WRMA is obtaining payments for water services, but not using part of the payment to improve the water catchment. WRMA can do this easily by contracting water users associations and community forest association as well as farmers associations to improve the water catchment. There is nothing in the law or policy to prevent the authority from doing so. Put another way, the water users are paying for environmental services, but their money is not going into improving the services. The water quality and quantity are not improving!

4.1.2.2. Water allocation policies, legal and institutional frameworks in Tanzania

Tanzania has in place the National Water Policy, 2002; the Water Resources Management Act, 2009; the Water Supply and Sanitation Act, 2009; and the Water Resources Management (Water Abstraction and Use) Regulations, 2009. The policy and legal framework is in place. The policy and the two Acts of Parliament created the following institutions shown in Table 4.2.

Table 4.2. Water allocation and management institutions and their responsibilities and status in Tanzania

Institution	Responsibility	Status
The Ministry of Water	Responsible for policy formulation and developing appropriate legislation	In place
The National Water Board	To advise the Minister responsible for water on among other things, resolution of national and international conflicts over water	Members of the Board identified but not yet appointed.
Nine Basin Water Boards	Data collection, processing and analysis; water allocation, pollution control, preparation of water utilization plans, collection of various fees and charges, resolution of water related conflicts.	Members of the Board identified but not yet appointed. The Water Offices are currently carrying out the duties of the Boards.
Catchment Water Committees	Preparation of water catchment plans and resolution of conflicts over water within the catchments	Members of the committees have been identified but not yet appointed.

Sub-Catchment Water Committees	Operating in sections of the main catchment	Members of the committees have been identified but not appointed.
Water Users Associations	Local level management of allocated water resources, mediation of disputes among users and between groups in their areas of jurisdiction, conservation and protection of water sources and catchments and control of pollution	Water users associations have been established but not yet officially registered.
Autonomous Urban Water Supply and Sanitation Authorities	Management water supply and sewerage services in urban areas.	In place

4.2. Existing and Potential Water Allocation Technologies in Relation to Water Uses and Legislations in Mara River Basin

Table 4.3 shows water uses/users, water source, extraction technology used and wether metered or not within the Mara Basin of Kenya

Table 4.3. Water uses/users, water source, extraction technology used and wether metered or not within the Mara Basin of Kenya

Key Uses/Users	Water sources	Extraction technology	Metered or not
Domestic	Borehole, shallow well, Mara River and its tributaries & springs	Hydram, Pumping and Gravity	19 metered, 71 not metered
Domestic and irrigation	Mara River and its tributaries	Pumping	4 metered, 2 not metered
Irrigation only	Mara River including tributaries and springs	Pumping and Gravity	1 metered, 4 not metered, 2 not indicated
Public use	Mara River and its tributaries	Pumping and Gravity	All not metered
Power Generation	Mara River tributaries	Gravity and canal	All not metered
Other (dispensary, industrial use)	Mara River tributaries	Pumping, Hydram, Gravity and Pond	2 metered, 8 not metered
All Users	**All sources**		**26 metered 85 not metered 11 not indicated**

4.2.1. Best water allocation technologies, legal and management recommendations

The Mara River currently has no major dams acting to significantly modify its flow regime. Thus, flow prescriptions must be achieved by improving management of the catchment and controlling permits for abstractions. The unequal distribution of flows throughout the year also poses the challenge of developing and implementing sustainable technologies for harvesting and storing wet season runoff for consumptive use during dry months.

Specific recommendations for the implementation of Reserve flows are as follows (LVBC, 2010):

a) Implement a comprehensive monitoring system on the Mara River to enable daily monitoring of the flow levels at multiple points in the basin,
b) Improve monitoring of permitted and non-permitted abstractions to reduce illegal abstractions and to develop an estimate of current abstraction levels,
c) Develop a system to easily communicate to water permit holders the current state of the river and the implications for their permitted abstraction amounts,
d) Build capacity among water resource managers to consider Reserve flow requirements in all water resource permitting in the basin,
e) Build capacity among water users in the basin with regards to the importance of maintaining Reserve flows, implementing soil and water conservation practices and reporting illegal abstractions,
f) Develop sustainable methods of harvesting and storing wet season flows for consumptive use during dry seasons,
g) Improve soil and water conservation practices in the upper catchment in order to improve dry season low flows,
h) Continue to monitor the river's flow levels and ecological health in order to refine Reserve flow recommendations.

In recent years, water resources management worldwide has started to shift from top-down type of regulatory management towards a governance regime that embraces the role of stakeholders in managing their own resources. A logical suggestion that has surfaced recently is that the downstream users pay for the costs of adoption of best management practices upstream so that there is adequate and constant flow of water in the basin for their benefits as well as incentives to the upstream communities to manage and provide more water and of good quality. Upstream communities in this context become sellers of environmental services while the downstream users become buyers. This financial scheme is popularly known as the Payment for Environmental Services (PES) and has potential to change the way that environmental flows could be implemented.

Bhat *et al* (2010) conducted a project *Payment for Watershed Services in the Mara River Basin.* This project comprised a series of studies by FIU professors and students in cooperation with WWF, led and summarized by Dr. Bhat. The studies and resulting implementation plan are being

implemented by WWF-ESARPO through the GLOWS program with funding from USAID/Kenya and USAID/East Africa. A report by Aboud *et al.* (2002) also provides information, but only from the basin in Kenya, that will contribute to resolution of the management issues needed to protect EF in the Mara River. They provide a proposal for an integrated management plan to manage the resources of the Mara. In this they document the causes of degradation of the water resources of the basin and the consequences of these threats if left unattended.

These consequences provide information and fuel to adopt a proper strategic management approach in order to prevent them from happening. They state that the development of an integrated water resource strategy in the Mara drainage basin would be based on the following premises:

a) That conservation of natural resources in the basin should not be in conflict with the socioeconomic needs and interests of the people, since the major economic activities are dependent on the maintenance of high levels of ecosystem health;
b) That watershed management in the basin and a sustainable water development strategy can only be achieved through stakeholder analysis, involvement, genuine partnerships and networking, and empowerment of resource users to plan and manage their resources;
c) That the strategy should aim at instituting a process of strengthening all stakeholders, and instituting reform processes that will encourage sustainable resource utilization in the basin;
d) That the strategy will aim at strengthening and building capacity of communities as one of the stakeholders, based on appropriate and sustained natural resource management.

4.2.2. How rainwater harvesting addresses environmental issues of MDGs targets.

According to the Global Water Partnership, 'IWRM is an approach that ensures the coordinated development of water, land and related resources to optimise economic and social welfare without compromising on the sustainability of environmental systems'. It can be seen that rainwater harvesting fits well in this scheme. A good example can be cited of a planting pit (or Trench) used to trap rainwater in organic matter to grow Napier grass for livestock. In this case, rainwater-harvesting structure is being applied to achieve soil conservation, forestation, provision of water and nutrients to the crops and provision of additional feed for livestock. This in turn implies increased food and/or income for the farmer, and effectively addresses livelihood and poverty issues.

Kenya's water policy takes into account all the relevant issues including water conservation and preservation of its quality. In this regard, mainstreaming of rainwater harvesting is very prominent. In agricultural production, rainwater harvesting is mainstreamed into the soil and water conservation. This approach promotes rainwater harvesting on the field thus minimising run off. Through a presidential initiative, district competitions are held to encourage farmers in water and soil conservation. Initially the emphasis was more on soil conservation but there has been a shift in thinking towards rainwater harvesting and soil conservation as equally important components.

Though it is not mandatory for institutional buildings to have rainwater-harvesting facilities, many institutional government buildings especially in the rural areas, as such as hospitals and schools have installed rainwater-harvesting facilities. To make rainwater harvesting sustainable, there is need to include the initiative in the national Integrated Water Resources Management strategy.

4.3. Existing Best Water Allocation Technologies in the MRB and Alternative Potential Technologies

In the Mara River Basin (MRB), the existing water extraction and allocation technologies include use of hydram, pumping, gravity, canals and ponds. These can be from the main river or its tributaries, and also pumping from boreholes and shallow wells. For small scale domestic use, water is abstracted and collected from various sources using human labour, animal labour (oxen or donkeys), hand carts, bicycles or motor cycles, and vehicles. For institutions and large scale uses, water is pumped and pited to various sources, including taps in buildings and houses, and storage pumps, some over ground and some underground.

Rainwater harvesting is not new, as communities in Kenya have practised it for a long time. Most rainwater harvesting technologies are simple, acceptable and replicable across many cultural and economic settings. There are many success stories that can be cited particularly in the arid and semi-arid areas of Kenya where rainwater harvesting has been replicated. Such rainwater harvesting include Kasaye project with its agriculture component, implemented by the Kenya Rainwater Association. UNEP/Earth Care Africa project on empowering women in rainwater harvesting has a strong women and gender component. In Machakos, the project consists of harvesting water and storing it in sand and sub-surface dams. All projects have strong training components in order to build capacity of operators/artisans. The projects have been replicated directly by neighbouring communities after they realize the positive impacts of the technology, and upon field visits from the same or different communities, training workshops where rainwater has been discussed. Operation manuals and water quality guidelines have been developed for use as tools for replication.

The most important lesson learnt in the implementation of rainwater harvesting is the need to take serious consideration of environmental impact assessment before conducting any major rainwater storage project. The implication of various interventions to the entire basin must be taken into account, project be developed with the beneficial community, and community allowed time to understand and internalized new technologies for their acceptance. In all projects undertaken, it has been vital to train the community in the initial stages of the project so that at the end of the project time skills are left behind to serve community members who may be keen in adopting the technologies.

The Smart River project has been planned to be located in Burguret River sub-catchment within the Ewaso Ngiro River Basin which flows west from Mount Kenya to the Laikipia plateau. In this region, observations and research has shown that total river abstractions doubled due to increasing community water project and agricultural demand over the last 10 years. There is increasing tensions between all water users and significant water shortages in dry periods that result in many communities without basic water supplies for extended periods. Such challenges are being experienced across Kenya compounded by increased frequency of climate extremes

that make resource management increasingly difficult leading to wider poverty impacts. For Phase I activities and outputs see: http://oxwater.co.uk. You can also refer to Hope *et al*., (2012) Harnessing Mobile Communications Innovations for Water Security; Global Policy (early view).

A Smart River System will be designed to automatically measure abstraction on daily time-steps to determine current water use patterns, to explore new allocation systems and to protect environmental flow allocations. The project aligns with Government of Kenya policy (2002 Water Act) on resource conservation, poverty reduction and community investment. Improved water resource management will lower water risk and enhance water security to benefit the poor who are more vulnerable to water supply failure.

The aim of the overall research is to design, implement and evaluate Smart Water Systems in rural Kenya to promote water security and to reduce poverty. Project outputs will include:

a) To pilot and empirically evaluate Smart River Systems and Smart Handpumps;
b) Increase awareness and new knowledge of poverty impacts of smart water systems for gravity-fed, piped systems and groundwater-fed, handpumps;
c) Develop new rural water management and regulatory models;
d) Link project activities to government policies and programmes;
e) Generate awareness amongst project stakeholders;
f) Agree on a shared pathway forward with stakeholders and project partners;
g) Undertake feasibility assessment of study sites.

4.4. Assessment of the Capacity of Institutions Mandated for Water Allocation and Monitoring Within the Mara River Basin

Some of the institutions mandated with water allocation within the Mara River basin include:

a) WRMA
b) WRUA (Kenya)
c) Lake Victoria Basin Water Office – Tanzania
d) Ministry of water (Kenya and Tanzania)
e) WUAS (Tanzania)

Based in the study findings in this consultancy project, most respondents felt that most institutions are not competent or lack the ability to carry out their roles effectively mainly due to lack of financial and infrastructural capacity.

4.5. Critical Examination of How Existing Allocation Frameworks Effectively Address Competing Demands for Water Resources (Current and Future)

The current water resources allocation frameworks within the Mara River basin do not effectively address the competing demands for the same against the available water resources. It was clear that demand outstrips the available supply especially during dry seasons; a situation worsened by increased fluctuation in rainfall patterns majorly driven by climate change. The consequences of low water levels are death of the large animals such as hippos and increased human wildlife conflicts as have been witnessed in the Mara River Basin in the recent past. Currently there is no existing allocation framework for the entire basin. The reference for water

allocation is different for both countries and the need to have a water allocation framework accepted by both countries is necessary.

4.5.1. Roles and responsibilities of catchment managers and stakeholders concerns and recommendations

In the recent past, there have been significant reforms in the way in which water is managed. One aspect of these water reforms is increased stakeholder participation in water management through catchment management organizations. Increasingly, water has become the limiting factor to development either on a catchment level or a national level in many countries. Future development and certainly further growth will, in many cases, rely on the location of a new source (such as through inter-basin transfers) or water saving either through increases in water use efficiency or a change in the catchment development strategy toward less water-intensive economic activities.

In planning the development of a catchment the potential changes in water use and demand, as well as the changes in the water resource, must be considered. Any change in the land use or activities in the catchment affects the water situation and requires decisions to be made about whether and how those changes can be incorporated into the water management strategy for the catchment. In order to make binding and all inclusive decisions, there is need to engage the various stakeholders in the decision making process.

The roles and responsibilities of catchment managers and stakeholders within the Mara River basin are given in the Table 4.4. Stakeholder concerns and recommendations are shown in Table 4.5.

Table 4.4. Roles and Responsibilities of WAP Stakeholders

Stakeholder	Major Role	Responsibility
Ministry of Water and Irrigation (Kenya) and Ministry of Water (Tanzania).	In charge of the overall management of water resources and general government policy on the water sector in the country.	Conserving, managing and protecting water resources for socio-economic development; developing legislations, policies and national strategies on water and sanitation; ensuring that all the water sector institutions work in coordination with each other and monitoring performance of water sector; ensuring funds are mobilized and properly allocated countrywide.
Water Resources Management Authority (WRMA)	Planning, management, protection and conservation of water resources such as ponds, lakes, streams, marshes, rivers, watercourses or anybody of flowing or standing water	Receives and determines applications for water permits in Kenya; monitors the compliance levels of permitted water users; management of water catchments; implements policies and strategies relating to the management of water resources and develops management for water catchment areas; encourages public participation in water resource management through formation and facilitation of Catchment Areas Advisory Committees and WRUAs.
Nile Basin Initiative	Dedicated to equitable and sustainable management and development of the shared water resources of the Nile Basin.	Building trust, confidence and capacity in member countries as well as creating an enabling environment for trans-boundary investments; preparation of investment projects that are trans- boundary in nature with the overriding goal of the investment agenda is to contribute to poverty alleviation, reverse environmental degradation and promote socio-economic growth in the riparian countries.
East African Community	To raise the living standards of the people through promotion of entrepreneurial skills and collaboration within the East African Region.	Promote adherence to the universal values and principles of democracy and respect for human rights; promote economic governance based on best practices and standards tailored to the domestic environment of the EAC; promote private sector development through appropriate regulatory and governance frameworks; establish mechanisms for promotion of peace and stability through prevention, management and resolution of conflicts in the region; promotion of equity with emphasis on gender equality, affirmative action, involvement of the youth, persons with disability and other marginalized groups in governance and development processes; encourage partner states to develop policies and strategies that promote human security through sustainable development.
Lake Victoria Basin	Promotion, facilitation and coordination of activities of different actors towards sustainable	Strengthening institutional capacity of LVBC; promotion of environment and natural resources management strategies; harmonization of policies, laws and standards; strengthening institutional development and governance; establishing

Commission	development and poverty eradication in the Lake Victoria Basin	relationships and working mechanisms with other stakeholders in the LVB; promote public awareness, information sharing and communication for sustainable development in the lake basin; promotion of integrated water resource management as well as sustainable development, utilization and management of fisheries resources in the basin; promoting improved health services with emphasis on HIV/AIDS, education and training, water supply, sanitation and nutrition status.
WWF	Coordination of Mara River water resource management activities in Kenya and Tanzania	WWF works towards protecting the river basin by supporting water users associations. However, they are not involved in water allocation to users as this is left to WRMA, though the WWF tries to ensure there is availability of water for drinking by wild animals.
LVBWO (Tanzania)	Mandated with the management and allocation of water resources in Tanzania.	Establishes guidelines for allocation of water resources based on priorities exist and priority; gives permits to water users and monitors compliance by the water users.
Mara Basin Transboundary Water Users Forum	To tackle any issues that may arise with regard to water resources between the two countries.	Work towards achieving transboundary agreements; implementing management practices and policies; promoting biodiversity conservation and monitoring and increasing access to safe water and improved sanitation and better hygiene.
District County Councils (e.g. Narok County Council)	To provide and manage basic services to residents in Narok	Responsible for the construction and maintenance of drainage channels and all other waste water; ensures proper storage, collection, transportation, safe treatment and disposal of waste; runs the Maasai Mara Game Reserve, with the help of KWS.
Water User Associations (MRUAS & WUAS)	Act as a medium for cooperative management of water resources and conflict resolution at the sub-catchment level.	Sensitize local communities on effective water resource management strategies, Participation in catchment restoration and conservation activities; advice WRMA on conservation of water resources; advice on the use and apportionment of water resources; advice on the grant adjustment, cancellation or variation of any permit to use water resources.
TANAPA	Oversee the growing roster of national parks in Tanzania: Arusha, Gombe, Katavi, Kilimanjaro, Lake Manyara, Mahale, Mikumi, Ruaha, Rubondo, Serengeti, Tarangire and Udzungwa.	Oversees the numerous reserves and game controlled areas, like the Selous, where limited hunting and foot safaris are permitted; ensures no hunting goes on in National Parks, while all flora and fauna are offered total protection.

Kenya Wildlife Service (KWS)	Acts as the chief custodian of wildlife in Kenya and also collaborates with other agencies on water resource conservation and protection.	KWS is responsible for protecting wildlife within the parks and even outside the parks, guard against poachers and also ensures availability of water for the wildlife.
Water Services Regulatory Board (WASREB)	To develop guidelines that fix tariffs for the provision of water and sanitation services i.e. the cost consumers will be charged for accessing water supply and sanitation.	Sets out requirements and procedures that Water Services Boards and Water Service Providers must follow for tariff adjustment; also reviews, approves and adjusts the tariffs over time.
Water Service Trust Fund (WSTF)	Assist in financing capital costs of providing services to communities without adequate water and sanitation services	Works closely with Water Service Boards to ensure that funds available reach poor, vulnerable and marginalized groups in the implementation of projects; is also works with WSB to identify priority areas that are to be funded; reviews the CBOs project proposals to ensure they meet set standards before release of funds; ensures that the projects are audited and any audit questions answered.
Water Appeals Board (WAB)	Adjudicates disputes within the water sector	Hears and determines appeals arising from decisions of the Minister of water and irrigation, WASREB and WRMA with respect to the issuance of permits or licences under the Water Act.
Water Services Boards (WSBs)	Provision of water and sewerage services within their areas of coverage	Are responsible for contracting Water Services Providers (WSP) for the provision of water services; review of the water services tariffs proposals from WSP before submission to WASREB for consideration.
Water Service Providers (WSPs)	Direct provision of water and sanitation services.	Development and, rehabilitation and maintenance of water and sewerage facilities of the WSB; act as agents of WSB

Table 4.5. Concerns aired by different stakeholders within the Mara Basin as relates to Mara River water resources

Stakeholders	Stakeholders Interest	Stake holders Concerns	What the law allows
LVBC	Interested in promotion, facilitation and coordination of environmental friendly activities in the Mara River basin.	Increased pollution and over abstraction of Mara River waters.	
WRMA	Interested in maintaining high quality and quantity in rivers for all users	Water pollution and over abstraction that at times lead to complete drying of the Mara River; default in paying water rates; inability to stop anyone from utilizing water since the constitution gives express access to water for everyone; water charges for licences are not linked to the volumes abstracted so they do not reflect the availability of water or the competing demands	
Water Resource Users Associations (WRUAs)	Are interested in rehabilitation of the Mara River, though they would also like to be paid for this	Polluted waters and reducing water levels; lack of funding to execute their activities; some of the policies on water resource conservation and protection are conflicting, lack of information on the required reserve flows	Rehabilitation and protection of the rivers
Livestock keepers	Interested in having sufficient water and pasture within the basin for their animals	Reducing water levels leading to livestock-wildlife conflicts	
Small scale farmers	Sufficient water for bucket irrigation for their farms during dry seasons	Human wildlife conflicts especially during dry seasons for communities bordering the game parks	
Large scale farmers	Sufficient water for irrigating their farms throughout the growing season	Dangerously low levels hindering their activities, wanton destruction of Mau Forest creating potential disaster in terms of water levels in the Mara River especially during the dry seasons, delays in obtaining water permits from WRMA once they apply for them;	
Tourist hotel industry	Sufficient and good quality water to run their operations effectively.	Poor water quality and also extremely low water levels in the Mara River especially during dry seasons forcing them to make adjustments such as moving their pumps further into the river or seek alternative water sources such as boreholes which is costly.	
Wildlife park managers (KWS)	Management would like the wildlife to have access to a sustainable source of clean water	Extremely low water levels in the Mara River especially during dry seasons leading to massive death of large animals such as hippos.	

NEMA	Interested in enforcing water quality standards as set out in the Environmental Management and Co-ordination (Water Quality) Regulations, 2006	There is minimal compliance with some of the laws governing water resources particularly as appertains to river bank protection and conservation.	The EMCA (Water Quality) Regulations, (2006), places the onus of upholding water quality standards onto the Ministry of Water and Irrigation
Commercial enterprises	Commercial enterprises like small industries and shops in centres like Mulot would like to see a river with adequate and clean water for their use	Increased pollution of the Mara River waters and also drying up of rivers, which increases the cost of accessing clean water	
Community/households	Sufficient and quality water throughout the year to sustain domestic use without paying for it	Poor water quality and low levels during dry seasons	
Mining enterprise	Adequate water from the river to process their minerals	Extreme low levels during dry seasons making their operations difficult	
WWF	Coordination of conservation activities on both sides of Mara River (i.e. Tanzania and Kenyan sides).	Lack of compliance with water allocation guidelines owing to poor enforcement by WRMA; extreme low waters experienced in Mara during dry seasons; ineffective water abstraction regulations and laws; licensing does not link the payment to water abstracted; lack of communication and understanding between players in the water sector and those other closely related sectors e.g. there are no discussions between WRMA, KWS, WWF and other players	
LVBWO Musoma	Keen to see proper management and allocation of water resources in Tanzania	Low levels of the Mara River occasioned by various human activities up stream especially in Kenya. This endangers wildlife and downstream populations.	
Water Users Associations WUAs),	Interested in a sustainable source of water for their members	Lack of clear laws that acknowledge the existence of WRUAs as well as lack of clear directions of weather the WRUAs should be paid for their services and if so, by who and how much.	There is lack of laws that acknowledge existence of WRUAs or even clarifies what they are supposed to do.

The study findings established that there were currently no agreed limits to the total amount of water that can be abstracted from the Mara River and its feeder tributaries. In addition, most of the abstractors lacked permits meaning that they continued to abstract water from the Mara River illegally. The net result is that the total water allocation and total water abstraction in the Mara River basin has been increasing with significant impacts – such as diminishing or ceasing completely of some of the Mara River stream tributaries at certain times of the year.

Without any limits in place, allocation of the water resource will continue to increase in response to the increasing demand, while illegal abstractors (those without permits) will continue abstraction if there is no strict enforcement and implementation of water resource conservation laws. This may result in any of the following consequences.

a) The Reserve may be violated in terms of either quantity or quality or both. This primarily affects those that rely directly on the water resource for their water supply. Violation of the Reserve can be considered as a violation of someone else's basic human right;
b) Non-optimal allocation of water resources to inefficient uses of water;
c) Water use conflicts increase due to insufficient water resource availability, non-equitable allocation, etc;
d) Severe negative impacts on the social and economic well being of all those dependent on the water resources;
e) Local pastoralists would be negatively affected through the loss of a traditional drought reserve.

CHAPTER FIVE

5.0. ASSESSMENT OF THE EXISTING PERMITTING THRESHOLD / FRAMEWORK AND DATABASE IN KENYA AND TANZANIA AND HOW THE EXISTING ALLOCATION FRAMEWORKS RESPOND TO WATER RESOURCE MANAGEMENT IN MARA RIVER

This chapter addresses objective two or the terms of reference of the consultancy study.

5.1. Examination and Review of the Existing Threshold Levels of Water Permits for the Mara River in Kenya and Tanzania

Water resource availability in the Mara River varies with seasons and is mainly driven by precipitation events and variation over the years. It is therefore important that both water abstractions and allocation be scaled based on its availability. In future LVSWRMA proposes to use traffic light colours as colour coding to describe the state of water resources with regard to water availability within the region and therefore set out the level of abstraction permitted for each state of the resource for each water body (WRMA Catchment Management Strategy, 2009). The traditional traffic colours are to be introduced and used where the water resources are detected to be stressed especially during the dry seasons. The proposed traditional traffic colours and their corresponding restrictions are given in Table 5.1. Modifications can be done on this based on hydrological information with specific reference to MRB to develop an effective mechanism for water abstraction restriction within MRB.

Table 5.1. Traditional traffic light colours proposed for monitoring water demand levels

Colour	Zone	Action – Example of Restriction
Green i.e. Satisfactory	No restrictions – abstractions allowed	Abstractions allowed up to permit limits
Yellow/Orange i.e. Stress	Restriction Zone 1 – slight restrictions imposed	Abstraction for irrigation reduced or ceases
Red i.e. Scarcity	Restriction Zone 2 – severe abstraction restrictions imposed	Abstraction for irrigation ceases Abstraction for domestic supplies limited/ rationed

5.2. Evaluation of How the Existing Allocation Frameworks Adequately Provide for Instream Needs and Ecosystem Services in Kenya and Tanzania

Reserve flow which is defined as the quantity and quality of water required to satisfy basic human needs for all people who are or may be supplied from the water resource; and to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the water resource. The Reserve commands the highest priority in terms of water allocation (LVSWRMA,

2009). Even though there have been efforts by various bodies to determine the environmental flows at given sections along Mara River, the set levels have not been fully operationalized in both countries for use in water allocation. The existing allocation framework therefore does not adequately provide for instream needs and ecosystem services on both sides of the border. Currently incidences of extraction beyond reserve flow/environmental flow are therefore very likely to occur revealing weak mechanism for water abstraction restriction within the MRB. This was realized during the focus group discussion at Olerai Farm, one of the major irrigation farms within the basin.

There are a number of initiatives that portray possible futures for the Mara River and include information on obstacles and possible paths to improving the situation in the basin. There is however, no initiative which directly seeks to describe possible future scenarios for the basin in a way which would allow government to make a choice on the direction that management should take. However, WWF, under the GLOWS program and with funding from USAID/East Africa, is in the process of developing a Strategic Environmental Assessment (SEA) which aims to do exactly this. The SEA will build upon the recommendations of the BSAP and EFA to identify different development scenarios in the basin for the purpose of assisting with planning and sustainable development in the basin. This report was supposedly completed in early 2011.

The EF for the Mara have only recently been described, so implementation of those findings is in the early phases. However, the findings and recommendations of the EFA have been adopted by the EAC Sectoral Council of Ministers and recommended for implementation in Partner States. In following with this recommendation, there is one major regional initiative under the umbrella of the EAC that has been designed and is ongoing with the express focus of implementing the recommendations of the EFA report.

There are also several other programs which have been ongoing, which were originally conceived to contribute to the protection of environmental flows. Those programs have now been strengthened by the specific recommendations of the report. Some of these initiatives are described below. A project supported by the Nile Basin Initiative “The Mara Investment Strategy (NBI, 2008d)” had as its objective to promote environmentally sustainable socio-economic development of the Mara River Basin through identification and implementation of appropriate investment programs aimed at addressing the critical water resources issues and challenges in the basin. This information would be of value to the implementation of environmental flows.

Three of its investment programmes, that would be relevant to EF, include (1) The Mara River Basin Integrated Water Resources Management Program and (2) The Mara River Basin Water Security Programme and (3) The Mara Basin Environmental Management Program. The first describes that it is important for the two countries to adopt an IWRM approach to ensure sustainable management and development of the shared Mara basin water resources. This will ensure rational and objective allocation of the scarce basin water resources among competing (and often conflicting) water uses without compromising environmental quality. The program will also support the development of appropriate management instruments and technical tools required to support decision makers in the planning, management and allocation of water resources to competing water uses in the basin.

The Water Security Programme aims to undertake a comprehensive survey of the water resources situation in the basin including the users of the water. This programme should thus consider environmental flow requirements as an integral part of this, especially as this is required by both Kenyan and Tanzanian law. The third programme on environmental management does not address environmental flow issues but concentrates on pollution, forest management and wetlands. The project identified a long list of potential projects to address the above, but unfortunately none of these was specifically related to environmental flows.

Improved management of water and biodiversity resources in the MRB requires trans-boundary coordination, consultation and agreement among the stakeholders. Although tremendous work has been done by the TWB-MRB WWF project, such as Environmental Flows Assessment (EFA), Biodiversity Action Plan (BAP), Strategic Environmental Assessment (SEA) and capacity building of key stakeholders, as well as the work of other implementing partners such as NELSAP, significant challenges still remain in the implementation of the study recommendations from a trans-boundary perspective.

To address these challenges, a high-level, regional program was designed by USAID/East Africa and the East African Commission, to implement the recommendations of the EFA through the LVBC. The LVBC is an apex institution of the EAC legally mandated to represent the five partner states of the EAC and responsible for the sustainable development of the Lake Victoria Basin. The commission is the most appropriate institution to take up the next steps towards implementation of the EFA, BAP and SEA recommendations.

Both the BAP and EFA reports were adopted by the LVBC Sectoral Council of Ministers in May, 2009, as critical documents for the management of the basin. The EAC and the LVBC, substantially supported by USAID, produced a work plan to guide the implementation of the **Sustainable Development of the Mara River Basin Project Work plan, (EAC – LVBC. 2009**). The project is funded by USAID EA, coordinated by LVBC and implemented by key stakeholders in Mara River Basin. The work plan provides the framework for stakeholder collaboration in implementation of the project objectives. This work plan has been developed through a consultative process which involved LVBC, WWF, Serengeti National Park, Maasai Mara National Reserve and FIU.

The overall object of the project is to promote harmonized Mara River Basin management practices for sustainability. The project seeks to achieve the following specific objectives:
1. Promote trans-boundary management framework for Mara River Basin
2. Improve protection and management of Mau forest resources and Mara riverine forests
3. Promote improved management of protected areas of Maasai Mara and Serengeti ecosystems
4. Improve water resources management in the basin
5. Institutional capacity building of the Lake Victoria Basin Commission to undertake its regional mandate.

Objective 4 (above) concluded “Water in Mara River is the driving factor to socio-economic development and biodiversity conservation. Whereas the demand for water is increasing its quality and quantity is decreasing. To manage water allocations for socio-economic development

and biodiversity conservation, Environmental Flows were established to ensure availability of water for sustaining ecological processes. This objective aims at establishing mechanism to implement the Environmental flows recommendations across the two countries.
It is expected that environmental flows concepts will be understood and agreements put in place amongst stakeholders to maintain "Reserve Flows". The proposed strategy is that the LVBC will convene a special training to inform the water resources management authorities at the national and basin/catchment levels across the two countries on environmental flows concept and its application. The LVBC will spearhead consultations aimed at establishing water monitoring guidelines and signing of agreements to ensure data is properly and systematically collected, analyzed and shared for effective allocations of water resources and its management in the MRB. LVBC will build on and scale up the WWF initiative at sub-catchment levels by engaging a consultant to develop the Mara river basin water catchment management strategy.

Relevant major activities that have been indentified are:
1) *Facilitate development and implementation of Mara River basin water catchment management strategy;* **Sub-activities include:**
a) Engage consultant to develop Mara River basin water catchment management strategy
b) Convene consultative workshop/s to validate the strategy
c) Facilitate the consideration of the Trans-boundary Water Users Forum (TWUF) by LVB Sectoral Council of Ministers
d) Strengthen/empower the Trans-boundary Water Users Forum to implement Mara River basin water catchment management strategy

2) Monitoring of water flows; **Sub-activities include:**
a) Harmonize water flow parameters across the basin and standardized schedule of water monitoring (agreements/MoUs).
b) Facilitate the signing of agreement for water quality and quantity monitoring

3) Facilitate dialogue with national decision makers about the Reserve Flow; **Sub-activities include:** Convene regional meetings to discuss recommendations of EFA.

*4) Capacity building on the Reserve Flows***; Sub-activities include:**
- **a)** Carry out training and awareness to key stakeholders to understand the EF concept and its application. The **Deliverables were:**

a) Mara River basin catchment management strategy developed by September 2010
b) Trans-boundary water monitoring parameters and schedules standardized, agreement developed and signed by September 2010,
c) Knowledge based on the Reserve Flows enhanced, adopted and monitored by September 2010.

The **Transboundary Water Users Forum Work-Plan (WWF, 2009-10)** of the WWF, supported by USAID, includes a description of the possible role of a thirty member forum (made up of government and stakeholder representatives from both countries) which has a mandate to take the lead on transboundary water issues of the internationally renowned Mara River Basin. The forum will ensure joint management of the basin, through promoting, coordinating and facilitating sustainable water resource management, and will push for integrated water resource

management. Their responsibilities are to undertake all issues that will harmonise the management of the Mara River including those aspects that surround EF. It was specifically stated that they would be *"Taking role in implementing recommendations of biodiversity action plan, environmental flows assessment and strategic environmental assessment"*.

The LVBC and TWUF have some degree of overlap in their work plans, because the two bodies play different roles in the basin. The LVBC is a coordinating institution, with the mandate to coordinate sustainable development in the Lake Victoria Basin. The TWUF is an implementing body comprised of relevant stakeholders and actors in the Mara. Ultimately, the TWUF is envisioned to be a body through which the LVBC can work in the Mara Basin. However, it is critical that specific roles be defined moving forward. Some of the objectivities and strategies of the TWUF relevant for EF are documented below (WWF, 2009-10):

Objective 1: Awareness creation for application of Environmental Flows as a tool for water allocation and monitoring: Within the recent past several studies have been undertaken within the Mara basin with various organizations such as WWF, USAID, FIU and the information obtained in these studies are crucial, in undertaking integrated water resources management of which is of major interest to the Forum. One such study is the Environmental Flows Assessment that shows the reserve levels within the Mara River that should support its ecological functions.

To achieve the above objective, the Forum will approach the relevant authorities involved in water resources management in both the riparian countries to adopt the EF concept when allocating water permits and when doing apportionment. In this case it will lobby the Ministries of Water and Irrigation in both Kenya and Tanzania and other relevant stakeholders dealing in water resources management within the basin.

To achieve the above, the Forum will carry out the following: *Carry out basin wide awareness campaigns on EF concept within the basin. The* **Sub-activities will be:**
a) Organize awareness creation workshops to various stakeholders and players within the water resources management sector within the basin
b) Disseminate EF concept information
c) Establish Transboundary EF monitoring unit to keep track on implementation levels
d) Organize exchange visit to learn and share experiences on EF within the transboundary users themselves and also other basins with similar initiatives.

Objective 2: Identify gaps in the existing water policies and propose necessary changes; **Sub-activity is:** Advocate for formulation and adoption of sound water policies. The **Deliverables will be:** Awareness creation for application of Environmental Flows as tool for water allocation and monitoring within the Mara River Basin; Ensure relevant water policies are reviewed, gaps identified and necessary amendments made where necessary and possible.

Another initiative, although in the upper Kenyan part of the basin, that could ultimately have a significant impact on the management of EF in the Mara River, and include various aspects of water resources management and represent an attempt to bring management of these resources into line with sustainable use, include the Sub-catchment Management Plan (SCMP) for the Amala and Nyangores Drainage Basins (Initiative Consultants, 2010).

5.2.1. Water Resource Quality Objectives (RQOs)

The Kenyan Lake Victoria South Catchment Management Strategy identifies Resource Quality Objectives (RQOs) for each of the catchment's major river basins. These RQOs are determined according to natural hydrological boundaries, social and economic development patterns and communal interests of the people. The water resources are classified as being of high (1), medium (2) or low (3) importance to ecology (E), livelihood (L) and commercial development (C). According to this strategy, the Upper Mara was categorized E1L2C3, indicating the area is of high importance for ecological concerns related to water resources management, medium importance for livelihoods acknowledging the importance of small-scale subsistence farming, and relatively low importance for commercial development.

The Lower Mara was ranked E1L2C2, indicating a high importance for ecological purposes, and medium importance for livelihood activities, with a majority of the population still dependent on water resources for subsistence farming; however, commercial activity is also of medium importance, acknowledging the importance of tourism and larger scale farming enterprises.

While the above is a first step towards the development of RQOs that could be used as targets for water resources management in the basin, they still require dissection in order to be more specific. RQOs that are most useful are either narrative or quantifiable measures that can be used to set targets for various aspects of the water resource. For example, in the above scenario, the lower Mara site was ranked E1L2C2 – taking the L2 (Livelihood medium importance). However the question is: just how much water and of what quality is required to satisfy livelihood needs which are of medium importance?

5.2.2. Summary of implementation initiatives described at a workshop to discuss EF inTanzania (IUCN, 2010).

Mr. Patrick Oloo representing the Ministry of Water and Irrigation noted that being a trans-boundary resource, Lake Victoria Basin Commission (LVBC) has initiated a project on the Mara River to build on work done by WWF – which included an eflow assessment. He mentioned that Mara is part of the Nile Basin and that there has been a programme running under the Nile Basin Initiative. This is the only basin in Kenya where an eflow assessment has been undertaken. He noted that in Kenya, policy formulation and implementation have been separated – while the Ministry of Water and Irrigation is in-charge of the former, Water Resources Management Authority (WRMA) is in charge of the latter.

From the policy perspective, he noted that there are issues that need to be addressed to enhance the understanding on eflow and its importance to the river ecosystem, such as: carrying out continuous monitoring; cap on allocations; capacity building; developing **a water allocation plan; and developing water catchment strategies**.

He noted that WRMA lacks capacity to implement the eflow assessment because it is a new science that requires specific skills and knowledge sets. The concern in Kenya was that the activities in the upper Mara were affecting the national parks (Masai Mara in Kenya and

Serengeti in Tanzania) and that the country did not want to compromise its relationship with its neighbour (Tanzania). He noted that the Kenya government is undertaking the rehabilitation and management of Mau forest which is part of the Mara River basin.

5.3. Need for Monitoring the eFlows and Ecosystems in MRB

The kind of monitoring that would be directly useful for the implementation of environmental flows is illustrated below (LVBC, 2010). (Note this list is not exhaustive and would need to be tailored for the particular site and situation):

1. Functioning of natural sediment generation processes, which include:
a) Presence of stable river banks
b) Intact riparian zones
c) Absence of large-scale erosion denuding landscapes
d) Absence of excessive fine-scale sediment deposition in river channel

2. Occurrence of a variety of instream and riparian habitats to provide habitat for diverse species, which include:
a). Adequate distribution of pools, runs and riffles
b). Presence of lateral and channel bars
c). Vegetated riparian zones that receive periodic inundation

3. Presence of sensitive species that reflect suitable water quality levels, which include:
a). Rare or threatened fish species that depend on appropriate timing of variable flows for feeding and reproduction
b). Sensitive invertebrate species that indicate subtle fluctuations in water quality and pollution levels
c). Important riparian plant species that depend on seasonal inundation for germination

4. Adequate provision of human needs by water resources, which include:
a). Year-round accessibility of water for domestic purposes
b). High water quality to reduce the occurrence of disease
c). Maintenance of tourism-dependent processes, such as water for wildlife habitats

Alternately the monitoring programme could be divided, having two main objectives:
1. Monitoring in order to update data and information in order to better understand the requirement for environmental flows at each site and in the basin as a whole.
2. Monitoring in order to test achievement of the desired river state or Ecological Management Category. Each of the above would need to be dissected into the variables of concern that require monitoring.

Some key documents which contain useful and possibly strategic guidelines for undertaking monitoring include: The LVBC (2009) Biodiversity Strategy and Action Plan for Sustainable Management of the Mara River Basin, noted that implementation of the BSAP for the MRB will require regular monitoring and evaluation of the progress of the different planned activities, which will be based on pre-determined performance indicators. This BSAP has been written to

elucidate a general strategy and approach to conserve critical biodiversity habitats throughout the MRB.
Detailed work plans will need to be developed by the responsible actors for each priority activity, and these work plans will include a list of measurable performance indicators in terms of quantity, quality and timeframe. The implementing actors will be responsible for conducting on-the-ground monitoring, evaluation and reporting of activities and indicators to LVBC, as the overall coordinating body.

The LVBC (2010) Assessing Reserve Flows for the Mara River, noted that it is necessary to implement a comprehensive monitoring system on the Mara River to enable daily monitoring of the flow levels at multiple points in the basin, and to improve monitoring of permitted and non-permitted abstractions to reduce illegal abstractions and to develop an estimate of current abstraction levels.

The Environmental Flow Assessment Proceedings of the Final EFA Workshop (WWF-EARPO, 2007) noted that more research into the relationship between water quality and flow levels would be helpful. Higher resolution temporal monitoring data is needed. A minimum frequency for water quality monitoring should be monthly for basic parameters, i.e. temperature, pH, dissolved oxygen, electrical conductivity, nutrients, biochemical oxygen demand, and more specialized analyses (e.g. pesticides and metals).

There is a high priority to investigate water quality at very low flows. A new report is due to be published in the near future looking at the relationship between flow level and water quality and refining EF recommendations at critical low flows. The data collection was complete in June, 2010, and the findings will be published in a Follow-up EFA Report in early 2011.

In the report NBI, (2008a) Consulting Services for the Assessment and Design of Hydrometric Network and Guidance of Water Quality Survey for the Mara River, there is detail on how a hydrometric and water quality monitoring programme should be structured, but this in relation to general IWRM and not specifically for environmental flows.

The Water Quality Baseline Assessment Report: Mara River Basin, Kenya-Tanzania (GLOWS, 2007) noted that currently, there is little systematic monitoring of water quality in Mara River Basin. On the Kenyan side of the basin, the Ministry of Water and Irrigation has established water quality laboratories in the Narok and Bomet District Offices and a limited number of monitoring campaigns have been conducted. On the Tanzanian side of the basin, the Ministry of Water has established a water quality laboratory in Musoma with support from the Lake Victoria Environmental Management Programme, and this office conducts occasional water quality campaigns into the lower Mara Basin.

TANAPA conducts monthly water quality monitoring in Serengeti National Park (including at a UNESCO Ecohydrology study site), and Barrick Gold Mines has conducted regular monitoring of rivers in the area of its activities. Barrick's monitoring, however, is for the company's own compliance purposes and results are not routinely distributed to local authorities.

5.4. Successes, Limitations and Gaps

5.4.1. Management issues

1. Due to the transboundary nature of the Mara River, the chief obstacle will be to overcome the National interests of the riparian countries and to harmonise these to suite the environment and thus the flow of benefits to society.
2. There is considerable data and information in the academic literature that would be of use to the management of EF in the Mara. This literature needs to be brought into the management realm. In the future, where possible, coordination of such academic exercises would be of benefit to the Mara.
3. Many development agencies, academic institutions and national and regional government initiatives have been involved in work on the Mara catchment. Every bit of the work that has been done adds value, but there are obvious challenges to make these efforts most effective. This requires considerable coordination which may not always have been effective but there are indications that there are efforts to improve this. A new initiative is to have a quarterly meeting of the coordinators of the different programmes which will go a long way to syncronising the situation.

5.4.2. Environmental flow (ecological) issues

1. The ecological consequences of NOT providing EF flows have only been superficially documented.
2. In the EF projects done on the Mara, there is only one site in Tanzania at the upper end of the river. This leaves unattended a significant reach of the river in Tanzania and also the downstream Mara swamps before it joins Lake Victoria. It would be necessary to increase survey sites to both of these river reaches and to the swamps, in order to properly understand the Mara River environmental flow requirements. There were plans to undertake this in 2010-11 by FIU under the TWB-MRB program.
3. The PES for all sites on the Mara were determined to be a B category – thus only slightly modified. This conflicts somewhat with the overall hype about the state of the river and needs further explanation as it is often stated that the river is in poor condition. Apparently flows in the river do not cease except during exceptional droughts, which implies that there is sufficient water remaining in the system to sustain the B category. The cause of this uncertainty may be that the present findings were based on a single site visit to determine the EF. A second survey has been carried out but these results are not yet integrated. These new results may throw some light on this but possibilities for more uncertainties could be real in the event that new findings contradict the first study in any significant way.
4. There is no detailed information presented on the quality of the hydrological data used for the EF, although there are statements that the hydrological information is poor on both Kenyan and Tanzanian sides.
5. The importance and sensitivity of the Mara River is generally related directly to the maintenance of goods and services for society. Unfortunately there are many other services provided by the river which are possibly even more important than those discussed above, but

because they are not as obvious, may not gain the same level of support. For this reason, it is wise if the importance of the ecosystem in its own right is established, even if the provision of environmental services is not so obvious. Thus, in the management of a river, the importance of the ecosystem, as an ecosystem, needs to be established. There has been insufficient consideration of the importance of the Mara River ecosystem in this way, considering the species that it contains, the rare and endangered species, the ecological process that underlie the workings of the ecosystem, the role in maintaining channel form, in cleaning up polluted water and processing organic contaminants, the importance of the in-channel and riparian habitats, etc. It will also be important to understand whether these ecosystems are important on a local, regional and international scale to help in their conservation and management.

6. Future planning by water managers requires both greater understanding of the flow regime necessary to protect aquatic ecosystems as well as clear justification of how people benefit from the goods and services provided by these ecosystems.

7. There is also a need to understand the spatial and temporal variability in the Mara River flow regime as a function of climate and land characteristics. Also the spatial and temporal dynamics of flooding in the Mara Wetland as a function of Mara River discharge, water levels in Lake Victoria, and wetland geomorphology – something that will be addressed by Mara Flows. Then, there is a need to understand the spatial and temporal variability of water quality as a function of measured flow and flow indices along the river channel network and wetland, work that was also published in 2011.

8. There is a real need to further study the fish, invertebrates and riparian vegetation of the Mara, which are so essential to establishment of the EF. Given the importance of mega-fuana in the basin, there would also be value in understanding the water requirements of these fauna (hippos, wildebeest, crocodiles, etc).

9. There is a prevailing sentiment that the ecosystem need only be conserved if it provides for people. While this view is true at a level and does at least acknowledge the relationship between the ecosystem and the value to society, leaving the judgment of this to stakeholders is fraught with dangers, as stakeholders do not always appreciate the provision of services from the ecosystem, mainly because they do not understand what is being provided to them. For example, can rural stakeholders understand the value to them of a carbon sink offered by a peat swamp? Do they understand the value of benthic invertebrates in purification of water of organic pollutants? Stakeholder often have a biased and short term view on the provision of these services, and thus cannot be relied on to be arbiters of what needs protection. It is thus strongly recommended, that a proper evaluation of the importance and sensitivity of the Mara River ecosystem is carried out.

10. There is reference to a “default standard for determining the Reserve in Kenya” (this does not appear to have been stated for Tanzania) which is the flow level that is exceeded 95% of the time, or Q95 (LVBC, 2010). It is recommended that the reserve should rather be estimated as outlined in the BBM approach even if at a low confidence level, which would be better than making use of such a “default standard”.

11. The reserve process has defined Ecological Management Categories (EMC) – which become objectives for management. The determination of these categories was done on a purely ecological basis, and represents a category which the ecologists on the team felt would sustain the river ecosystem and would not be an unreasonable objective to implement. Unfortunately what this EMC does not do, is take into consideration all of the other demands on the system,

which may make this EMC unreasonable. A process to determine the needs of all stakeholders and the wider basin requirements, needs to be included in this process.
12. There are a number of initiatives that portray possible futures for the Mara and include information on obstacles and possible paths to improving the situation in the basin. There is however, no documented strategy which seeks to describe possible future scenarios for the basin in a way which would allow government to make a choice on the direction that management should take. Apparently this is being addressed by the WWF who are undertaking an SEA process in the basin.
13. A proper process to describe resource quality objectives (RQOs) needs to be developed. These may not be the same objectives for monitoring that emerged from the Reserve process, as they need to consider more than just the ecosystem e.g. they need to include users of the resource.

5.4.3. Best method for EFs

Following the review of several methods and their application, the question is asked what constitutes the ideal "method" or "approach" for the management of environmental flows? Overall this can be broken into two main aspects:

1. The determination of the flow requirements required to maintain an ecosystem in a particular class or condition.
2. The integration of the above into wider catchment management processes including the management of the water resource to satisfy the needs of society.

In order to cover the entire range of issues that could be regarded as the determination and management of environmental flows, each case study can be broken into different sections that it could be argued, constitute the complete EF procedure, i.e.:

Section A – Initiation and scope of study.
Section B - Process to define areas of study and assessment.
Section C - Evaluation of the original and present state of the systems.
Section D - Evaluating the importance and sensitivity of the systems.
Section E - Quantifying the environmental flow requirements.
Section F - Setting a vision for the river and development of scenarios.
Section G - Implementation of environmental flows.
Section H – Monitoring (and review).

It is recommended that in the future, all studies should be designed to ensure that all of these components are addressed. Each of the different methods used (DRIFT, BBM, etc) can be used although in some cases there will be gaps in the information generated by any one of them that will need to be filled. The sections are discussed in details below:

Section A – Initiation and scope of studies.

The policy situation for the management of environmental flows in both Kenya and Tanzania are existent though there are gaps to be filled. The government agencies have followed a long path of working with the support of international support agencies, and in this way have described the environmental flows, to a greater or lesser degree in some catchments.

There have been concerns expressed that compliance with existing laws is poor which mitigates against successful implementation of environmental flows. This is a political issue that can only be solved at that level.

Section B - Process to define areas of study and assessment.

In few of the studies there has been a detailed presentation of how the areas to be studied, and the sites chosen to represent the area, were decided on. Normally this should be based on a combination of ecological factors and other practical and catchment features. In the classical EF approach, there should be detailed documentation of the suitability of each site chosen for assessment.

In some of the studies, the number and location of sites was less than ideal for a full understanding of the environmental flow requirements of the river. This includes the integration of the estuary into the river environmental flow assessment, as unless these two are aligned then one of these systems may be disadvantaged.

Section C - Evaluation of the original and present state of the systems.

In all of the studies there has been some evaluation of the original and present state of the system, but in some this is limited to stream flow and knowledge of the rest of the ecosystem is poor. Ideally the documentation of the original state should be for a wide range of ecosystem components (quantity, quality, habitat and biota), each of which will tell something different about the state of the ecosystem.

For a full EF assessment, it is imperative that there is some knowledge of the natural reference condition of the ecosystem, which is necessary in order to be able to measure the extent of degradation that has taken place. It is then necessary to quantify the present state in a way that enables measurable objectives (for the quantity, quality, habitat and biota) to be set for future management activities. In some of the case studies this has been well done, but in others there remains a great deal to document.

Unfortunately, where changes to a system are already substantial, then the opportunity to gain an understanding of the natural reference condition may be lost but this can be partially rectified through a process of considering unimpacted but neighbouring systems within the same ecoregion. In such situations it is prudent to develop a Reference Condition for a river system, even where this is hypothetical (but based on the best available data and information). This highlights the need to gather baseline data and information on the river systems before it is too late.

Hydrological records in most catchments were inhibiting to the process. Increased monitoring in the future is strongly recommended. In the same way, the level of knowledge of the components of the ecosystem (biological and physical), is in many of the studies rather poor. Over time, this should be supplemented by implementation of an ongoing and carefully designed monitoring programme, which will allow the EF assessments to be improved upon when they come up for review.

Section D - Evaluating the importance and sensitivity of the systems.

Most of the studies reviewed express strong sentiments about the importance of the river to the country, to its people, etc. While this forms a part of the assessment that is necessary, what is generally missing is an evaluation of the importance of the rivers in terms that are less obvious. This may include aspects of the ecosystem that are completely beyond the understanding of stakeholders and political leaders but somehow they need to be included in management objectives in a way that makes them acceptable. For example, the contribution of benthic macroinvertebrate diversity to the purification of pollutants in the river water; the necessity of maintaining a stream morphology and preventing the sedimentation of deep pools; the contribution of wetlands as sinks of carbon, etc. All of these issues need to be protected for the long term benefit of society, although society may not be able to understand how this works. The need here is for scientists to present these more subtle issues in ways that are acceptable to managers and stakeholders so that they may be included in management strategies.

An issue that requires a thorough understanding of the ecosystem but has been given little attention, is the sensitivity of the ecosystems to stressors. Ultimately this forms the basis of the environmental flow assessment, but a real understanding of these relationships is generally limited and can only be built up by sustained investigation over a long time.

Section E - Quantifying the environmental flow requirements.

At the centre of any environmental flows assessment, is a system or model that assists with the translation of large amounts of biophysical data in order to assist with the process of deciding on the flow requirement of each component (quality, habitat and biota) of the ecosystem. The literature contains several reviews of these approaches which have multiplied following the creative nature of scientists and the need to produce a model which is most appropriate. It could be said that this proliferation of methods is an indication that no single method has yet been developed which has been accepted by both scientists and resource managers.

A range of methods have been applied in Tanzania i.e. DRIFT, BBM, Desktop Model and a combination based on the Savannah approach. Each of these approaches is significantly different from the other, each having advantages and disadvantages. Methods such as DRIFT are relatively complex, while other approaches e.g. the Desktop Model, are probably deficient for the task. For Tanzania, the use of such a diverse array of methods may be counter-productive and there is possibly a need for a decision on the most appropriate way forward. For basins where no approach has yet been used, consideration needs to be given as to what would be the most appropriate model to use.

Unfortunately the comparison of models is not straight forward as they do different things and have different outputs. The BBM method has been criticised as it does not integrate easily with possible scenarios for water flow that may be used by water resource planners, something which was introduced by the DRIFT model (and others which are available). Unfortunately, this introduces a high level of complexity into the presentation of environmental flows and moves the approach into the preserve of only a few.

The BBM on the other hand, is immediately understandable by scientists and managers alike, and if accepted into a framework for planning which is based on the principles of adaptive

management, may be the more appropriate system for MRB. It must be noted though, that this is the view of this review, and will no doubt be contested by some.

The science of understanding the relationship between environmental flows and the health of the ecosystem, in particular and the different components of the ecosystem such as fish, invertebrates and riparian vegetation, is in its infancy. Further understanding elicited by research would greatly enable the process of environmental flow assessment and help to secure sustainable use of the water resource. While international research efforts will be providing some of this understanding, the unique aspects of the MRB ecosystems will require research in the basin.

Section F - Setting a vision for the river and development of scenarios.

The first step for any resource management strategy should be the setting of a Vision for the resource. The vision describes society's aspirations for a particular resource. The description is often a narrative one but it encapsulates a high level objective that provides a framework for management to work in. To some extent this is done by statements in the legislation, but this needs to be downscaled to the basin level.

In consideration of the benefits of the river systems to society under various resource use scenarios, there is an overriding consideration of the provisioning services provided by these river basins e.g. resources for direct consumption. There is a danger that other types of services, which may be more important e.g. supporting, cultural and regulating services, are not being given fair consideration. Unless these are given equal priority, poor decisions about the management of the resource may result.

Consultation with stakeholders in the development of scenarios should not be overlooked. Unless there is buy-in from stakeholders, implementation becomes difficult. Governments should also take the stance that "a problem shared is a problem halved". Inclusion of stakeholders reduces the risk of failure by governments.

Section G - Implementation of environmental flows.

To date some excellent work has been carried out on the assessment of environmental flows and it is clear that this situation is now moving into the realm of implementation. Some of the cases are actively making decisions on resource management based on these environmental flows which is a most positive step. The consequences of *not* providing environmental flows, both to the ecosystem and to society, needs to be made clear. This aspect will in the future require active work, to continually reinforce the need to maintain environmental flows particularly in situations where there is a contest for resources. It is the experience in some other countries, that when the enthusiasm of installing environmental flows has passed, pressing issues of water provision, etc, often smother out the reasoned process of protecting the resource that was followed before. This needs to be guarded against.

Tom Le Quesne (March 2010 workshop) noted several issues about implementation that are of relevance:

1. Implementation is the big challenge and there needs to be a guard against overcomplicating things.

2. Implementation needs to be phased.

a. Progressive implementation. There are no countries which have the capacity to implement fully – so need to do what is possible.
b. Catchments for implementation – limit the number of catchments for implementation and introduce in general terms first and then advance over time.
i)**. Introduce a cap on the total amount of water that can be abstracted as soon as possible, as once a river has been over-allocated, it is difficult to reverse the situation**. Thus introduce a cap even if not strongly defensible as this can always be improved. If there are objections, then move to a more detailed study, etc. A warning is found in Australia where the government is going to spend 5 billion dollars to buy back water rights.
ii). Be opportunistic in instituting environmental flows, e.g., droughts can open debate and assist with initiating EF. Often this does not happen in a carefully planned way.
iii). There is a need to allow some flexibility in the approaches and methodologies that are used. It is a mistake to set too much in stone with one method – rather adapt as necessary. But – do set fixed time tables – and not allow these to be flexible.
iv). Clarity of intuitional frameworks is important as is independent oversight. Responsibility must be clear. The advantages in Kenya and Tanzania are that new acts do set out responsibilities quite clearly. Independent scrutiny is also important – the dilemma is whether the body responsible for EF is the same as that for implementation. There are benefits to both situations.
v). Build support and capacity through on-the-ground proof-of-concept projects.
vi). Do not exceed the ability to implement – most countries who try to implement, come up with an approach which is more complex than they can implement.

The science of Adaptive Management needs to be firmly embraced as MRB stakeholders moves towards implementation. This acknowledges that any environmental flow assessment is just a first hypothesis, and will prove to be inaccurate in some respects and will need to be refined over time. **It should never be considered that an EF is final and absolute. This has significant ramifications for the allocation of water resources and issuing of licenses** for abstractors, etc, as there needs to be acknowledgement that over time things will change. Failure to be adaptive will inevitably lead to a "locked in" situation where managers come under increasing pressure to force a situation to work even where it is obvious that it cannot. A good review of this aspect can be found in Allen (2007).

There has been little movement to establish Resource Quality Objectives for the rivers. What are RQOs? *The Resource Quality Objectives for a water resource are a numerical or descriptive statement of the conditions which should be met in the receiving water resource, in terms of resource quality, in order to ensure that the water resource is protected (DWAF, 1999).*

The purpose and application of objectives is documented as follows:

a. They represent a goal for desired protection towards which management can be directed.
b. They provide a clearly understood line between which activities and impacts are acceptable and not. This includes the impacts of point sources, non-point sources, land use and development, water abstraction, etc.
c. They are a baseline for measuring the success of management and for reviewing the effectiveness of source directed control and regulatory activities.

d. They provide a stable framework for a time period, for both resource managers and the regulatory community to undertake decision making and planning.

The National Water Resources Strategy of South Africa (DWAF, 2004) sates that Resource Quality Objectives provide numerical and/or descriptive statements about the biological, chemical and physical attributes that characterise a resource for the level of protection defined by its class. Thus resource quality objectives might describe, among other things, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat, and the characteristics and condition of the aquatic biota.

It also states that "resource quality objectives must take account of user requirements and the class of the resource. Accordingly, the determination of the management class of a resource and the related Reserve and resource quality objectives will usually be undertaken as an integrated exercise."

In some Tanzanian cases, RQOs have been considered at a high level (e.g. the EMC should be a C category), but this has not been dissected into meaningful and objective standard which can be used for monitoring. Also to be considered should be resource objectives in terms of user requirement, for example what water quality is required by the people drinking directly from the rivers. This water quality may be different from that required to protect the resource.

Section H - Monitoring issues.

The final phase of all of the development and application of environmental flow assessments should be to install a monitoring programme. This is important for a number of reasons. First, to monitor compliance of implementation against resource quality objectives. Second, to increase the base of knowledge so that the environmental flow assessments can be refined over time.

Third, there is an axiom that says that "you cannot manage what you do not measure". Unless there is an ongoing understanding of where the resource is at any time, management becomes *ad hoc* and inefficient and decisions on resource use become driven by the wrong factors.

5.5. Outcomes from a Tanzanian Workshop

This is extract of a report by Katharine Cross of the IUCN (2010) entitled "Report on a Workshop on Environmental Flows Review - The Future of Environmental Flows: Providing Water for Nature and People held in Morogoro between August 2nd and 4th 2010).

For effective management of environmental flows inTanzania, the IUCN organized a workshop to validate the information gathered and develop the way forward for operationalizing and implementing EF in Tanzania and Kenya. The workshop was held between August 2nd and 4th, 2010 in Morogoro, Tanzania and convened by Pangani River Basin Management Project 1 and IUCN. The workshop was attended by over 40 (forty) participants drawn from the a number of Basin Water Boards in Tanzania, Ministry of Water and Irrigation (Tanzania and Kenya), Vice President's Office (Division of Environment), Integrated Water, Sanitation and Hygiene (iWASH), University of Dar Es Salaam, Sokoine University, members of the Tanzanian EFlow Assessment Team, experts on eflow from South Africa (Southern Waters and Institute of Natural Resources) UNDP Tanzania Office, SNV Netherlands Development Organization, WWF, UNEP

and IUCN. The workshop was facilitated by Prof. Francis Mutua from the University of Nairobi, Department of Meteorology/School of Physical Science, Chiromo Campus.

The workshop objectives were: 1. To share experience and knowledge on EF assessments in Tanzania and Kenya; 2. To determine possible criteria for harmonized EF assessment in Tanzania; and 3. To discuss and determine how to operationalize EF assessments to achieve wise and sustainable management of river flows.
In a group work setting, the participants discussed the key characteristics of a good eflows assessment from a technical and socio-economic viewpoints. The main outputs of this discussion can be summarized as follows:

a). **Policies**: There is a need for viable institutions which are economically sustainable, and there must be an enabling environment for these institutions to function which includes national policies and legislation supporting all levels of water management that provides for the environment as well as human well-being.

b). **Teamwork**: A multi-disciplinary team (i.e. hydrology, economics, vegetation) is necessary for an eflow assessment, and there should be sufficient capacity building so that local teams can sustain the current and future eflows initiatives.

c). **Consultations**: There should be sufficient funds in eflows assessments for comprehensive stakeholder involvement that incorporates gender considerations and demographic dynamics (i.e. women and youth need to be included and consulted).

d). **General considerations about methods**: A number of different issues need to be incorporated such as development activities and infrastructure that influence flows; water use; climate change; upstream-downstream relationships; available data; and inclusion of indigenous knowledge.

e). **Specific consideration of methods**: Different types of studies should be undertaken including hydraulics, hydrology, vegetation, invertebrates, basin delineation, water quality, sediments, socio-economics and macro-economics, etc.

f). **Inputs**: This reflected on the type of information gathered to be input into an eflow decision support tool. For example, this includes information on ecosystem services, land use changes, socio-economic dynamics, water quality, and biological indicators of river health.
g). **Outputs**: The outputs from an eflows assessment must be of good scientific quality; there should be an implementation plan along with a strategy to communicate and disseminate results.

Participants in a group setting discussed the requirements and enabling conditions needed to operationalize eflows. In summary, the discussions touched on the following: policy and legislation; assessment and modeling; allocation and licensing procedures; reallocation mechanisms; monitoring and enforcement; and organizational requirements. Through this visioning exercise, the groups came up with a number of targets that would enable eflows to be operationalized.

The main targets for implementation included: Regulations and guidelines for eflows should be in place to implement the act; Eflows have been determined, and; Skills, equipment and finances to carry out eflow assessments are developed and operational.

The main targets for operationalization are: The desired configuration of River Health state is determined; Water licenses have been re-evaluated to support the desired configuration; and Monitoring of the state of environmental resources including Eflows is enforced.

CHAPTER SIX

6.0. ASSESSMENT OF THE EXISTING WATER ALLOCATIONS AND THEIR RELATIONS TO WATER RESOURCES MANAGEMENT IN MARA RIVER

This chapter addresses objective three or the third terms of reference of the consultancy study.

6.1. Existing Water Allocation Plans in Kenya

With 650m^3 fresh water per person per year, Kenya is classified a water scarce country. The World Water Development Report (UNESCO, 2006) sums up the current situation in Kenya as:

> *'Demand management strategies are lacking, and water resources allocation decisions related to surface and groundwater abstractions are made without adequate data. It is estimated that more than 50 per cent of water abstractions are illegal. Water metering systems are used in few projects; as a result, revenue collection is very low and corresponds to just 55 per cent of the total operation and maintenance costs.'*
>
> *'The need for domestic, industrial and agricultural water supply is growing, but the absence of demand-management strategies means that the increase in demand will likely outstrip the available supply.'*

In addressing water management, the Government of Kenya (2007) describes one of its biggest challenges as 'the unaccounted-for water in our water-supply infrastructure', citing poor infrastructure and illegal connections as the two major factors. It estimates the cost of infrastructure needed up to 2010 as $US 2.6 billion, excluding the needs of hydropower generation.

Management options include the reduction of illegal water abstraction, provision of new reservoir storage and also improved land and water management in the catchment. To develop and evaluate these options, it is necessary to consider both demand and supply, and to value the benefits and negative effects of different options to mitigate water scarcity.

The present wide-ranging reform of the water sector in Kenya stems from the Water Act 2002. Draft rules for implementation of the Act are set out in the Draft Water Resource Management Rules and Forms (WRMA, 2006). The essence of the reforms is the transition from dealing with water as a social good to dealing with it as an economic good. This is summed up by the National Water Resource Management Strategy 2006-2008 (GoK, 2006a):

> *'Current pricing policies have not significantly contributed towards the financing of the sector both for recurrent and investment purposes, Social and political considerations outweighed the economic considerations in the setting of tariffs such that water is largely considered a social good. The low tariffs for both urban and rural domestic water supplies do not promote efficient utilization of water, environmental conservation and preservation. With the increasing pressures on the water resources, the need to have a different view on*

the pricing of water becomes urgent. Increasingly, water is now viewed as an economic good.'

The Draft Rules and Forms seek to provide equitable access, sustainable use, and efficient water use to optimize social and economic benefits.

Water allocation is the apportionment of the total available resource within a water management area. The responsibility for water allocation and issue of water permits has been delegated to the water regulating bodies, WRMA in Kenya and LVBWO in Tanzania, which in turn have decentralized the function to its regional offices. Availability of water resources is determined and allocation for various uses done with a priority to reserve water.

The reserve is the quantity of water set aside for environment and basic human (domestic) requirements. The reserve commands the highest priority in terms of water allocation. However, a detailed, comprehensive and agreed upon reserve water levels are not in place within the Mara River basin and is therefore not being used currently. The two countries should harmonize their existing allocation plans. Water users' records in the regional WRMA office at Kericho (Kenya) indicate that there are 123 permitted water abstractors within the basin with most of the users not having permits. For those with the permits, the permits indicate the sources of water mainly; boreholes/wells, River Mara or its tributaries. It also indicates the various water users and the volume of water permitted on a daily basis.

Permitting: This process is decentralized and all permits for water abstractions within the region are issued by the WRMA sub-regional office in Kericho on the Kenya side. In Kenya all permits are issued for a maximum of five (5) years subject to renewal. A number of expired permits were identified. The permit applications is subjected to commenting by WRUAS, the CAAC and/or the Head Office, advertisement in the local daily Newspapers for stakeholders' information and comments before authorizations to construct works are issued. All applications for water permits must register, be classified and adherence to compliance plan. From the data available, there are few abstractors on the Tanzanian side and authority to extract water is given by the LVBWO in Mwanza. However, it was noted that there could be much more abstractors who are unaccounted for. The North Mara Gold Mines was the major water abstractor from the Mara River on the Tanzanian side with a daily extraction of 4200m^3/day.

6.2.1. Permit applications

Water permit applications can be categorized into different classes (e.g. A, B, C & D) for the better management of water resource as defined in the National Water Resources Management Strategy (WRMA, 2006). This needs to be harmornised for use within the MRB. Table 6.1 gives a description of the classification.

Table 6.1. Different water permit classes/categories

Category	Description
A	*Water use activity deemed by virtue of its scale to have a low risk of impacting the water resource.*
B	*Water use activity deemed by virtue of its scale to have the potential to make a significant impact on the water resource.*
C	*Water use activity deemed by virtue of its scale to have a significant impact on the water resource.*
D	*Water use activity which ' involves either two different catchments areas, or is of large scale or complexity and which is deemed by virtue of its scale to have a measurable impact on the water resource.*

6.2. Key Users and Quantity of Their Existing Water Demands in Relation to Water Allocation Permits

In order to obtain a clear approximation of the water demand within the Mara River basin, some of the key water users were identified and the status of their water permits, source of water, extraction technology and class of abstraction noted. Below is a breakdown of the registered water users on the Kenyan side of the Mara River. The total number of registered water users on the Kenyan side is 122. They include; domestic (90), domestic and irrigation (6), Irrigation only (7), public (6), power generation (3) and others e.g. dispensary, industrial etc (10). The water sources for the users include 35 boreholes/wells and 85 from River Mara and its tributaries (Table 6.2). Only 26 of the 122 water users have water meters. Classification of water users; based on Table 6.2; Class A (19), Class B (52), Class C (43) and Class D (6). On the expiry of permits 30 have valid permits, 53 permits expired and 37 not indicated. On extraction technology, of the 122 users, 102 use pumping equipments and 18 use gravity system. However, this list is only for those water users that are registered by WRMA. It was established that most of the users are actually not registered both on the Kenyan and Tanzanian sides and are therefore abstracting water illegally.

Table 6.2. Registered key water users, quantity abstracted, permit category, water source, extraction technology used and weather metered or not within the Mara Basin of Kenya

Permit Category	Key Uses/Users	Number of users	Water sources	Quantity abstracted	Extraction technology	Metered or not
A, B, C, D	Domestic	90	Borehole, shallow well, Mara River and its tributaries & springs	5554.22	Hydram, Pumping and Gravity	19 metered, 71 not metered
B, C	Domestic and irrigation	6	Mara River and its tributaries	101.95	Pumping	4 metered, 2 not metered

A, C, D	Irrigation only	7	Mara River including tributaries and springs	2804.8 (others missing)	Pumping and Gravity	1 metered, 4 not metered, 2 not indicated
A, C	Public use	6	Mara River and its tributaries	1493.18	Pumping and Gravity	All not metered
D	Power Generation	3	Mara River tributaries	Not indicated	Gravity and canal	All not metered
A, B, C	Other (dispensary, industrial use)	10	Mara River tributaries	456.81	Pumping, Hydram, Gravity and Pond	2 metered, 8 not metered
Total	**All Users**	**122**	**All sources**	**10,410.9**		**26 metered** **85 not metered** **11 not indicated**

6.3. Water Balance Analysis

6.3.1 Water balance

Water resources management, with its inherent multilateral relations and under poorly predictable hydrological and other natural processes, imposes serious challenges for the national economic development and the existence of human society in general (Dukhovny and Sokolov, 2000). The rate at which water resource use has occurred in the past few decades has taken its toll on the aquatic environment in terms of increased pollution, destruction of wetlands, depletion of fish species and other aquatic organisms among other ecosystem imbalances in both the developed and developing economies (Assaf, 2009). With dramatic rise in water demand, water development has adversely impacted on environmental conditions and consequently, human health and security.

6.3.2 Water balance concept

The water balance concept is based on assessing the available water resources in the ecosystem against their corresponding demand, (environmental demands inclusive) taking into consideration the storage capacity. It is a planning tool which allows for the projection of future scenarios of water demand against availability, and determines whether there is sufficient water resource to support all water demands within the basin. The water balance is therefore important as it conceptually provides boundaries for water allocation thus safeguards the reserve.

6.3.3. Water available for allocation in the MRB

The hydrological analysis to configure the component of water supply involves the use historical hydrological (discharge) data and involves defining standard types of water years as wet, normal and drought years. The different types of years are used to test the system under hypothetical dry, wet or normal conditions. For this study the basin was divided based on the EFA sites, and continuity equation used to balance all the inflow, outflow and storage. Of interest are the reserve flows, water permitted for withdrawal, and discharge from gauging stations. The basin-

wide water availability results from the lumped model seem to indicate that there is enough water however from the distributed and spatial point of view the water demand outstrips the water availability during the drought years.

The drought years are expected after every 7 years and there is need to come up with measures to mitigate the impacts of its effects as recovery might be extremely difficult. There is need to promote and adopt both supply and demand management strategies by all the water users and stakeholders.

Under the water balance analysis, available/deficit water at EFA 1, during the drought year was negative during all the months except the month of September, which recorded available water of 0.05m^3/s. However, during normal year, no water deficit was noted throughout the year with Auguts recording the highest water availability at 17.4m^3/s and December recording the least at 1.141m^3/s, Table 6.3.

Table 6.3. The water balance analysis at EFA 1

Index	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of Days	D	31	29	31	30	31	30	31	31	30	31	30	31
Ecological reserve													
Drought year	m^3/s	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.6	1	0.4	0.5	0.5
Normal year	m^3/s	1.3	1.3	1.3	1.7	1.7	1.5	1.5	2	1.9	1.5	1.3	1.3
Naturalised													
Drought year	m^3/s	0.09	0.15	0.11	0.09	0.23	0.1	0.09	0.58	1.14	0.2	0.38	0.311
Normal year	m^3/s	3.92	3.34	3.73	12.8	11.9	8.7	7.45	19.5	16.7	8.6	2.86	2.803
Maximum flows	m^3/s	95.4	27.41	34.6	71.8	133	53	73.7	68.9	58.5	61	53.8	84.54
Water allocated (permits)	m^3/s	0.09	0.09	0.09	0.09	0.09	0.1	0.09	0.09	0.09	0.1	0.09	0.09
Available/Deficit													
Drought year	m^3/s	-0.3	-0.24	-0.3	-0.3	-0.25	-0.3	-0.3	-0.1	0.05	-0.3	-0.2	-0.28
Normal year	m^3/s	2.53	1.95	2.34	11	10.1	7.1	5.87	17.4	14.7	7	1.47	1.414

Under the water balance analysis, available/deficit water at EFA 2, during the drought year was negative during nine of the 12 months of the year. The months July, August and September, water availability of 0.02, 0.05 and 0.33m^3/s, respectively. However, during normal year, no water deficit was noted throughout the year with August recording the highest water availability at 25.1m^3/s and March recording the least at 3.17m^3/s, Table 6.4.

Table 6.4. The water balance equation at EFA 2

Index	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of Days	D	31	29	31	30	31	30	31	31	30	31	30	31
Ecological reserve													
Drought year	m^3/s	1.2	1.1	1	1	1.3	1.3	3.3	3.1	4	2.2	1.7	1.5
Normal year	m^3/s	4.1	4	4	6.5	7	6	6	8	7.8	5.8	4.4	4.3

Naturalised													
Drought year	m^3/s	0.79	0.557	0.47	0.53	0.81	0.8	3.5	3.33	4.51	2.1	1.34	1.184
Normal year	m^3/s	7.73	7.378	7.34	23.2	26.6	21	20	33.2	31.7	19	9.78	9.335
Maximum flows	m^3/s	385	111.5	213	642	813	361	936	405	359	199	510	207.3
Water allocated (permits)	m^3/s	0.18	0.176	0.18	0.18	0.18	0.2	0.18	0.18	0.18	0.2	0.18	0.176
Available/Deficit													
Drought year	m^3/s	-0.6	-0.72	-0.7	-0.6	-0.67	-0.6	0.02	0.05	0.33	-0.3	-0.5	-0.49
Normal year	m^3/s	3.45	3.202	3.17	16.5	19.4	15	13.8	25.1	23.7	13	5.2	4.859

The water balance equation at EFA 3, showed availability of water throughout the year during both the drought year as well as the normal year, Table 6.5.

Table 6.5. The water balance equation at EFA 3

Index	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of Days	D	31	29	31	30	31	30	31	31	30	31	30	31
Ecological reserve													
Drought year	m^3/s	2.4	2	2.4	4.2	6	4.3	3.9	4.2	4.5	3.4	2.5	2.7
Normal year	m^3/s	6.1	6	7.9	15	15	9.4	6.6	6.8	8.2	6	6.9	6.1
Naturalised													
Drought year	m^3/s	5.94	4.241	6.01	14	21.8	14	12.6	13.7	15.2	10	6.22	7.12
Normal year	m^3/s	10.1	9.556	16.4	42.6	36.3	19	13.4	13.9	16.8	10	14.1	12.5
Maximun Flow	m^3/s	294	97.32	247	477	587	253	497	222	204	121	306	273
Water allocated (permits)	m^3/s	0	0	0	0	0	0	0	0	0	0	0	0
Available/Deficit													
Drought year	m^3/s	3.54	2.241	3.61	9.81	15.8	9.9	8.66	9.51	10.7	6.8	3.72	4.42
Normal year	m^3/s	3.98	3.556	8.5	27.6	21.3	9.7	6.8	7.08	8.6	4	7.24	6.4

The water balance equation at EFA 4, showed water deficit during the month of March, July and August and availability of water during the remaining nine months during the drought year. No water deficits were however reported throughout the year during the Normal year, Table 6.6.

Table 6.6. The water balance equation at EFA 4

Index	**Unit**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
No. of Days	D	31	29	31	30	31	30	31	31	30	31	30	31
Ecological reserve													
Drought year	m^3/s	2.87	3.015	3.42	3.35	5	5.2	4.34	3.58	4.91	3.7	3.31	2
Normal year	m^3/s	9.31	9.184	14.1	26.2	23.5	12	10.4	10.8	11.9	9.4	6.5	9.132
Naturalised													
Drought year	m^3/s	3.53	2.403	5.87	8.48	9.46	3	4.29	7.21	6.98	4.7	4.05	2.235
Normal year	m^3/s	14.9	14.53	32.1	80.3	82.7	27	22.2	23.6	27.7	15	13.8	14.38

Maximum flows	m^3/s	203	83.15	281	312	362	144	58.2	39.3	49	42	103	338.6
Water allocated (permits)	m^3/s	0	0	0	0	0	0	0	0	0	0	0	0
Available/Deficit													
Drought year	m^3/s	0.67	-0.61	2.45	5.13	4.46	-2.2	-0.1	3.63	2.07	1	0.74	0.235
Normal year	m^3/s	5.61	5.35	18	54.1	59.2	16	11.8	12.9	15.8	5.8	7.26	5.247

The water balance equation at EFA 5, showed water deficit during the month of February and June and availability of water during the remaining ten months during the drought year. No water deficits were however reported throughout the year during the Normal year, Table 6.7.

Table 6.7. The water balance equation at EFA 5

Index	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of Days	D	31	29	31	30	31	30	31	31	30	31	30	31
Ecological reserve													
Drought year	m^3/s	2.87	3.015	3.42	3.35	5	5.2	4.34	3.58	4.91	3.7	3.31	2
Normal year	m^3/s	8.81	8.713	13.3	25.7	23.5	12	10.7	11.1	12.1	8.9	6.5	8.673
Naturalised													
Drought year	m^3/s	3.89	2.661	6.43	9.27	10.3	3.3	4.71	7.89	7.63	5.1	4.45	2.477
Normal year	m^3/s	16.3	15.85	34.9	87.3	89.9	30	24.2	25.7	30.2	17	15	15.68
Maximum flows	m^3/s	221	90.38	337	416	483	192	77.6	52.4	65.3	46	112	368.1
Water allocated (permits)	m^3/s	0.05	0.049	0.05	0.05	0.05	0	0.05	0.05	0.05	0	0.05	0.049
Available/Deficit													
Drought year	m^3/s	0.98	-0.4	2.96	5.87	5.29	-2	0.32	4.26	2.67	1.4	1.09	0.429
Normal year	m^3/s	7.41	7.084	21.6	61.5	66.4	18	13.4	14.6	18	7.6	8.46	6.957

Water balance analysis for the whole MRB is done on a monthly basis as per the water demand scenarios. Water supply is based on the basin-wide water availability results from the lumped model and categorized as drought and normal flows. Table 6.8, Table 6.9 and 6.10 show the situations of water balance analysis for Reference Scenario, Scenarion A and Scenario B respectively. From the tables, it is observed that in all the situations there is adequate water throughout the years from 2010 to 2030 during the normal flows. However extreme water deficiency is experienced during drought years in the months of February, March, June and July. Water availability in the months of October, November, December and January is highly threatened. The month of December as from 2020 in Reference Scenario (Table 6.8) and 2015 for both Scenario A and B (Tables 6.9 and Table 6.10) shows water deficits. This means that with slight increase in water demand above the predicted levels water deficits will be experienced in eight months of the year during drought periods. It is also observed that the level of water scarcity is increasing over the years for all the situations.

Table 6.8. Water balance with respect to normal and drought flows (Scenario: Reference)

Resource available for allocation (m3/s)	January	February	March	April	May	June	July	August	September	October	November	December
Reserve												
Drought Year	9.6306401	9.4302532	10.539086	12.200342	17.7	16.389432	16.185887	15.055785	19.32569	13.365582	11.314925	8.7
Normal Year	29.628371	29.196211	40.504842	75.096211	70.7	40.749023	35.174336	38.621609	41.89125	31.579614	25.6	29.50488
Normal flow												
Drought Year	12.202314	6.2795324	11.131915	19.046377	29.982028	12.577305	13.137703	21.198238	23.383038	15.332417	13.231137	9.676965
Normal Year	37.352168	36.594202	62.433259	136.92578	137.36456	58.831363	48.928795	53.541646	60.195433	39.513348	34.375189	36.77526
Flood flow	220.62923	90.379	336.83408	415.65064	483.14409	192.31333	77.57787	52.442694	65.345335	46.125613	111.50595	368.0557
Water allocated in permits (m3/s)												
	0.315	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**
Water Demand (m3/s)												
2010	0.9327377	0.9334882	0.9324642	0.932179	0.9311135	0.9327738	1.0604189	1.0614448	1.0595496	1.0593931	0.932073	0.932282
2015	0.9578916	0.9586421	0.9576181	0.9573329	0.9562674	0.9579277	1.0855729	1.0865987	1.0847035	1.084547	0.9572269	0.957436
2020	0.9862597	0.9870101	0.9859861	0.985701	0.9846355	0.9862957	1.1139409	1.1149667	1.1130715	1.1129151	0.985595	0.985804
2030	1.0543343	1.0550848	1.0540608	1.0537756	1.0527101	1.0543704	1.1820156	1.1830414	1.1811462	1.1809897	1.0536696	1.053878
Water Balance with respect to Normal flow (m3/s)												
2010	6.7910592	6.4645031	20.995952	60.897395	65.733445	17.149567	12.694041	13.858592	17.244633	6.874341	7.8431157	6.338094
2015	6.7659053	6.4393492	20.970798	60.872241	65.708291	17.124413	12.668887	13.833438	17.21948	6.8491871	7.8179618	6.31294
2020	6.7375373	6.4109811	20.94243	60.843873	65.679923	17.096045	12.640519	13.80507	17.191111	6.820819	7.7895938	6.284572
2030	6.6694626	6.3429065	20.874355	60.775798	65.611848	17.02797	12.572444	13.736995	17.123037	6.7527444	7.7215191	6.216497
Water Balance with respect to Drought f low (m3/s)`												
2010	1.638936	-4.0842089	-0.3396355	5.9138566	11.350914	-4.7449007	-4.1086032	5.0810074	2.9977983	0.9074417	0.9841391	0.044683
2015	1.6137821	-4.1093628	-0.3647894	5.8887027	11.32576	-4.7700546	-4.1337571	5.0558535	2.9726444	0.8822878	0.9589852	0.019529
2020	1.585414	-4.1377309	-0.3931575	5.8603347	11.297392	-4.7984227	-4.1621252	5.0274855	2.9442764	0.8539198	0.9306171	-0.00884
2030	1.5173394	-4.2058055	-0.4612321	5.79226	11.229318	-4.8664973	-4.2301998	4.9594108	2.8762017	0.7858451	0.8625425	-0.07691

Table 6.9 Water Balance with respect to normal and drought flows (Scenario: Scenario A)

Resource available for allocation (m3/s)	January	February	March	April	May	June	July	August	September	October	November	December
Reserve												
Drought Year	9.6306401	9.4302532	10.539086	12.200342	17.7	16.389432	16.185887	15.055785	19.32569	13.365582	11.314925	8.7
Normal Year	29.628371	29.196211	40.504842	75.096211	70.7	40.749023	35.174336	38.621609	41.89125	31.579614	25.6	29.504883
Normal flow												
Drought Year	12.202314	6.2795324	11.131915	19.046377	29.982028	12.577305	13.137703	21.198238	23.383038	15.332417	13.231137	9.6769645
Normal Year	37.352168	36.594202	62.433259	136.92578	137.36456	58.831363	48.928795	53.541646	60.195433	39.513348	34.375189	36.775259
Flood flow	220.62923	90.379	336.83408	415.65064	483.14409	192.31333	77.57787	52.442694	65.345335	46.125613	111.50595	368.05574
Water allocated in permits (m3/s)												
	0.315	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**	**0.3136**
Water Demand (m3/s)												
2010	0.9336353	0.9343857	0.9333617	0.9330766	0.9320111	0.9336713	1.0613165	1.0623423	1.0604471	1.0602907	0.9329706	0.9331794
2015	1.0970463	1.0977967	1.0967727	1.0964875	1.0954221	1.0970823	1.2247275	1.2257533	1.2238581	1.2237017	1.0963815	1.0965903
2020	1.2826629	1.2834133	1.2823893	1.2821042	1.2810387	1.2826989	1.4103441	1.4113699	1.4094747	1.4093183	1.2819982	1.282207
2030	1.7404882	1.7412386	1.7402146	1.7399295	1.738864	1.7405242	1.8681694	1.8691952	1.8673	1.8671436	1.7398235	1.7400323
Water Balance with respect to Normal flow (m3/s)												
2010	6.7901617	6.4636056	20.995055	60.896497	65.732547	17.148669	12.693143	13.857694	17.243736	6.8734434	7.8422182	6.3371962
2015	6.6267507	6.3001946	20.831644	60.733086	65.569136	16.985258	12.529732	13.694283	17.080325	6.7100324	7.6788072	6.1737852
2020	6.4411341	6.114578	20.646027	60.547469	65.38352	16.799641	12.344116	13.508667	16.894708	6.5244158	7.4931906	5.9881686
2030	5.9833088	5.6567527	20.188202	60.089644	64.925694	16.341816	11.88629	13.050841	16.436883	6.0665905	7.0353653	5.5303433
Water Balance with respect to Drought f low (m3/s)												
2010	1.6380384	-4.0851065	-0.340533	5.9129591	11.350017	-4.7457983	-4.1095008	5.0801099	2.9969008	0.9065442	0.9832415	0.0437852
2015	1.4746274	-4.2485175	-0.503944	5.7495481	11.186606	-4.9092093	-4.2729118	4.9166989	2.8334898	0.7431332	0.8198305	-0.1196258
2020	1.2890108	-4.4341341	-0.6895606	5.5639315	11.000989	-5.0948259	-4.4585284	4.7310823	2.6478732	0.5575166	0.6342139	-0.3052424
2030	0.8311855	-4.8919594	-1.147386	5.1061062	10.543164	-5.5526512	-4.9163537	4.273257	2.1900479	0.0996913	0.1763886	-0.7630677

Table 6.10. Water balance with respect to normal and drought flows (Scenario: Scenario B)

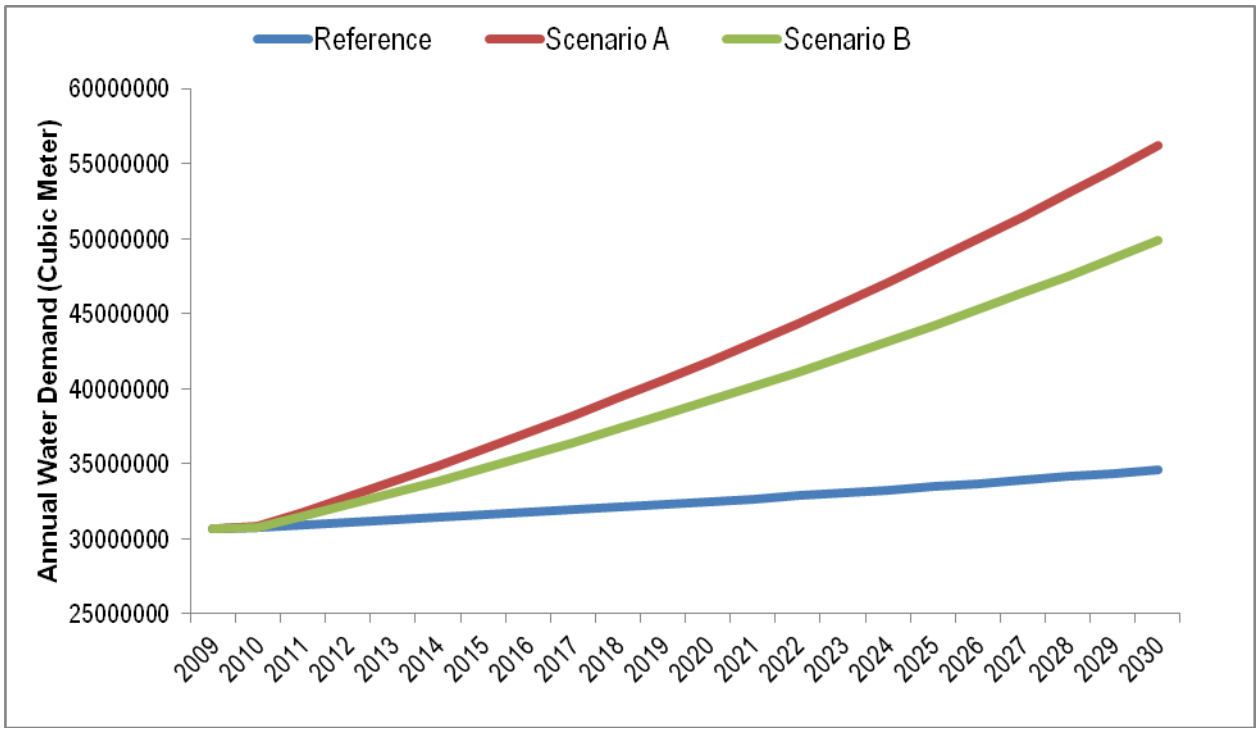
Resource available for allocation (m3/s)	January	February	March	April	May	June	July	August	September	October	November	December
Reserve												
Drought Year	9.6306401	9.4302532	10.539086	12.200342	17.7	16.389	16.186	15.05579	19.32569	13.365582	11.314925	8.7
Normal Year	29.628371	29.196211	40.504842	75.096211	70.7	40.749	35.174	38.62161	41.89125	31.579614	25.6	29.504883
Normal flow												
Drought Year	12.202314	6.2795324	11.131915	19.046377	29.982	12.577	13.138	21.19824	23.383038	15.332417	13.231137	9.6769645
Normal Year	37.352168	36.594202	62.433259	136.92578	137.365	58.831	48.929	53.54165	60.195433	39.513348	34.375189	36.775259
Flood flow	220.62923	90.379	336.83408	415.65064	483.144	192.31	77.578	52.44269	65.345335	46.125613	111.50595	368.05574
Water allocated in permits (m3/s)												
	0.315	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136	0.3136
Water Demand (m3/s)												
2010	0.9330585	0.933809	0.932785	0.9324998	0.93143	0.9331	1.0607	1.061766	1.0598703	1.0597139	0.9323938	0.9326026
2015	1.0571528	1.0579032	1.0568792	1.0565941	1.05553	1.0572	1.1848	1.18586	1.1839646	1.1838082	1.0564881	1.0566969
2020	1.1991831	1.1999335	1.1989095	1.1986243	1.19756	1.1992	1.3269	1.32789	1.3259949	1.3258385	1.1985183	1.1987271
2030	1.5381547	1.5389052	1.5378812	1.537596	1.53653	1.5382	1.6658	1.666862	1.6649666	1.6648102	1.53749	1.5376988
Water Balance with respect to Normal flow (m3/s)												
2010	6.7907384	6.4641823	20.995631	60.897074	65.7331	17.149	12.694	13.85827	17.244313	6.8740202	7.8427949	6.3377729
2015	6.6666442	6.340088	20.871537	60.77298	65.609	17.025	12.57	13.73418	17.120218	6.7499259	7.7187007	6.2136786
2020	6.5246139	6.1980578	20.729507	60.630949	65.467	16.883	12.428	13.59215	16.978188	6.6078956	7.5766704	6.0716484
2030	6.1856422	5.8590861	20.390535	60.291978	65.128	16.544	12.089	13.25317	16.639216	6.2689239	7.2376987	5.7326767
Water Balance with respect to Drought f low (m3/s)												
2010	1.6386152	-4.084529	-0.339956	5.913536	11.3506	-4.7452	-4.1089	5.080687	2.9974775	0.907121	0.9838183	0.044362
2015	1.5145209	-4.208624	-0.464051	5.7894416	11.2265	-4.8693	-4.233	4.956592	2.8733833	0.7830267	0.859724	-0.079732
2020	1.3724906	-4.350654	-0.606081	5.6474113	11.0845	-5.0113	-4.375	4.814562	2.731353	0.6409964	0.7176937	-0.221763
2030	1.0335189	-4.689626	-0.945053	5.3084396	10.7455	-5.3503	-4.714	4.47559	2.3923813	0.3020247	0.378722	-0.560734

6.4. Forecast of Future Demand of Water Uses from Mara River

This study isolated the various water use factors as outlined by Hoffman, 2007. This study estimates each one of them to represent the current circumstances and projects them based expected trend of events and situations as discussed under different scenarios in section 6.5 and summarized in Table 6.11. These water use factors included;

1. Domestic water use
2. Livestock consumption
3. Irrigated agriculture
4. Wildlife consumption
5. Tourism (Hoteliers including tourist lodges and tented camps).
6. Industrial water use (Mainly mining in Tanzania and electricity generation at Tenwek, Kenya)

Figure 6.1 shows the annual water demand for the various water demand scenarios. All the water use factors are analysed and estimated for the current situation (2010) and projected to 2030. The details of the development of the scenarios are outlined in Table 6.11. The highest annual water demand is observed in Scenario B and the least in Reference Scenario.



2Figure 6.1. Current and projected annual water demand curves under the reference, scenario A and Scenario B.

6.5. Scenario Development

Scenario development for demand analysis was based on Water Evaluation and Planning (WEAP) Model. Scenarios are self-consistent story-lines of how a future system might evolve over time in a particular socio-economic setting and under a particular set of policy and technological conditions (Sieber and Purkey, 2011). For the application of the WEAP model and configuration of the problem with MRB being the spatial boundary, the time frame for analysis was set as between 2009 to 2030 and the system components comprising of the six water use factors. The current account is the first year of the analysis and provides a snap shot of actual water demand and resources as it currently exists. It was taken as 2009 coinciding with the detailed Census information carried out in Kenya in the same year. The alternative sets of future assumptions, based on factors that affect demand, were used in constructing the different scenarios. The scenarios were finally evaluated with regard to water sufficiency and compatibility with environmental targets among other parameters. See Section 6.3 on water balance analysis.

In this report, three different scenarios; Reference scenario, Scenario A and Scenario B, were identified for demand analysis. The reference scenario mainly assumes that the current trend of events shall continue with minimum changes (maintains business as usual situation). Scenario A introduced a higher population growth rate to take care of both natural growth rate and continued migration into the basin. It assumes improved water supply situation resulting into increased human per capita water use from 20litres in 2010 to 40litres in 2030. It also assumes that tourism activities and stocking levels for both wildlife and livestock are at maximum levels resulting into a constant corresponding water demands for the water use factors over the years. In addition, mineral development is expected to increase by 50% by 2030 leading to increased water demand. The area under irrigated agriculture is expected to increase by 50% in 2020 and double by 2030.

Scenario B assumes a reduced population growth rate of 2.6% which further reduces to 2.3% by 2030. In this scenario measures shall be introduced to restrict irrigation area increase to 50% over the existing levels as provided for in the reference scenario. The other water use factors including; tourism, livestock, wildlife and mining are based on scenario A and therefore will take up the corresponding values. See Table 6.11 for the scenario development.

Table 6.11. Scenario Development Starting 2010 to the year 2030

Scenario	Domestic water use	Livestock Water Demand	Wildlife	Irrigated agriculture	Tourism	Mining
Reference	Population Growth rate (Kenya-2.4% and Tanzania-2.5%) Per capita water use 20l/day	Based on the livestock population and the daily drinking water requirements (See section 4.2.2). Current stocking levels are maximum and will continue up to 2030.	Based on wildlife population and migration trend (See section 4.2.3). Current stocking level as at 2010 is maximum and will continue up to 2030	Based on irrigation area of 690 hectares and half year (six months) irrigation at 7mm daily. No expansion in irrigated area. (See section 4.2.5)	Based on the number of tourists visiting annually as determined by monthly bed occupancy rates and the daily water use (See section 4.2.4) Current levels maximum.	Based on daily allowable extraction of $4200m^3$/day throughout the entire period (2010-2030).
Scenario A	Population Growth rate (2.9% for Kenya and Tanzania). Per capita water use (Rising from 20l/d in 2010 to 30l/d in 2020 to 40l/d in 2030)	Current stocking level as at 2010 is maximum and will continue up to 2030	Current stocking level as at 2010 is maximum and will continue up to 2030	Increases by 50% by 2020 and reaching 100% increase by 2030	Current level as at 2010 is maximum and will continue up to 2030	Mineral development assumed to increase by 50% by 2030.
Scenario B	Population Growth rate (2.6% from 2010 to 2020 then to 2.3% by 2030). Per capita water use (Rising from 20l/d in 2010 to 30l/d in 2020 to 40l/d in 2030)	Current stocking level as at 2010 is maximum and will continue up to 2030	Current stocking level as at 2010 is maximum and will continue up to 2030	Increases by 50% from 2010 to 2030	Current level as at 2010 is maximum and will continue up to 2030	Mineral development assumed to increase by 50% by 2030.

6.5.1. Domestic water use

Domestic water use depends on the human population within the region and their per capita water use. In Kenya, the total human population within the MRB was determined based on the National Census carried out in 2009. The individual sub locations falling within MRB were identified and their corresponding population data noted. Those falling partly within MRB were also noted and required population determined based on assumption of uniform population distribution and proportion of the area within the basin. Table 6.12 shows the population on the Kenyan side of MRB based on 2009 National Census (Kenya NBS, 2009).

Table 6.12. Human Population within MRB (Kenya)

Districts within MRB of Kenya	Population as at 2009
Molo	85,984
Bomet	253,715
Trans Mara	50,358
Narok South	165,177
Narok North	9,032
Total	**564,266**

The projected combined annual population growth rate for Nakuru (Molo), Bomet, Narok and Trans Mara is 2.4 percent (Kenya NBS, 2006). This population growth rate was used in developing the reference scenario to project the population on the Kenyan side. Population within the Mara Region of Tanzania, which includes the districts of Tarime, Serengeti and Musoma based on the 2002 Tanzania National Population Census with a population growth rate of 2.5 percent (Tanzania NBS, 2003; 2005). Table 6.13 shows the projected population growth up to the year 2009 on the Tanzanian side of the MRB.

Table 6.13. Human population within MRB (Tanzania)

Districts within MRB of Tanzania	Population as at2002	Projected Population for 2009
Tarime	81,627	97,029
Musoma	51,114	60,758
Serengeti	98,873	117,529
Total	**231,614**	**275,316**

The population growth rates for Scenarios A and B were derived from the strategic environmental assessment report for the MRB (Nelson *et al*., 2012). See Table 6.11 for scenario development.

6.5.1.1. Per capita water use

Human per capita water use is affected by several factors including; weather conditions, cost of water, family income levels, the number of people in a household, the proportion of children in a household, water supply method (e.g. piped or communal) among others. Furthermore, human water use also varies depending on whether or not the household is piped or unpiped. For piped households water use depends on the number of service hours that make water available, and in the case of un-piped households, water use depends on the location of the water source (Wong *et al*, 2005). Research shows that the urban populace tend to use approximately twice as much water as rural residents, while households with piped connections (mostly in urban areas) use, on average, three times more water than unpiped households (Katui-Katua, 2004). Therefore, in looking at the dynamics of a population, one major consideration mandating water use and availability would be whether the population is in a rural or urban area. According to the 2002 Tanzanian Population and Housing Statistics and the 1999 Kenyan Population and Housing Census, the vast majority of towns and villages that exist within the MRB are classified as rural areas. While there are a few community water schemes throughout the river basin that provide piped water to higher class housing areas, the majority of the population within the MRB relies on manual methods of retrieving water from the source.

Using the population numbers for 2009, water-use within the MRB can be calculated by using established water-use data for both Kenya and Tanzania. The majority of the populations residing within the MRB live in rural areas (Hoffman, 2007). For the purposes of this analysis water-use for the entire MRB population is estimated using water-use standards for a rural population. A year-round availability for per capita domestic water consumption in the rural areas of both Kenya and Tanzania is considered to be twenty litres per day (Mati, *et al*, 2005 and Zaba and Madulu, 1998). Per capita water use of 20l/day per person is used in developing the Reference Scenario. Scenarios A and B assumed that not everybody lives in the rural set up and that water use varies with time depending on water supply improvements. The values for these scenarios are similar to the ones suggested in the SEA Report (Nelson *et al*., 2012).

Figures 6.2 – 6.7 presents the estimated annual domestic water demand for the various districts both in Kenya and Tanzania for the current situation in 2010 and the projected conditions upto 2030 based on the conditions outlined in Table 6.11 for scenario development.

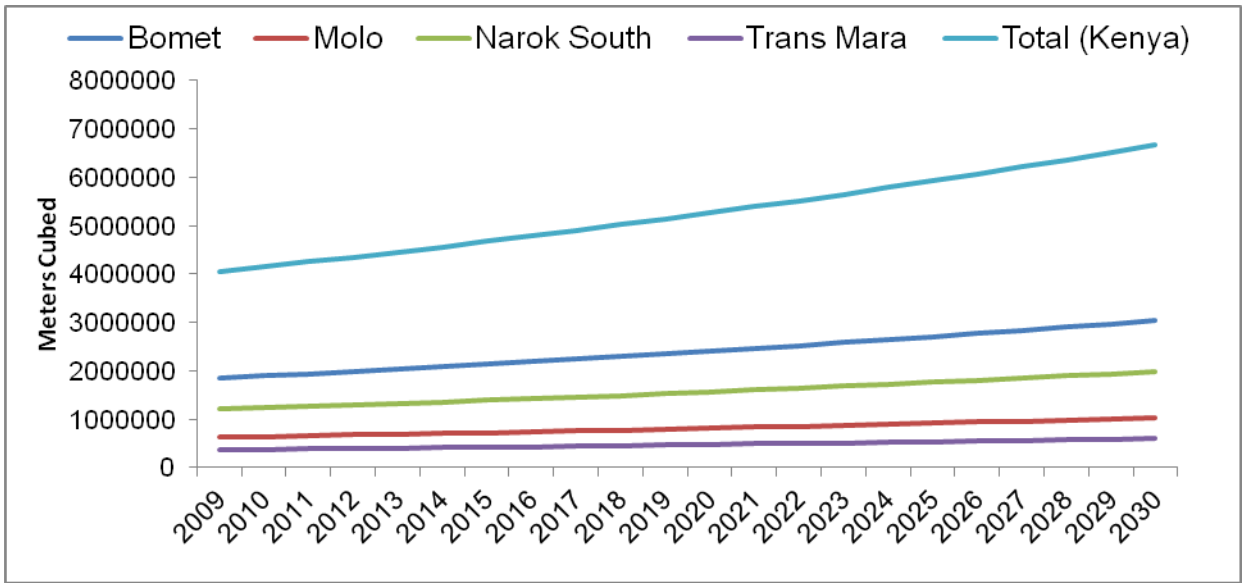


Figure 6.2: Domestic water demand in Kenya (Reference Scenario)

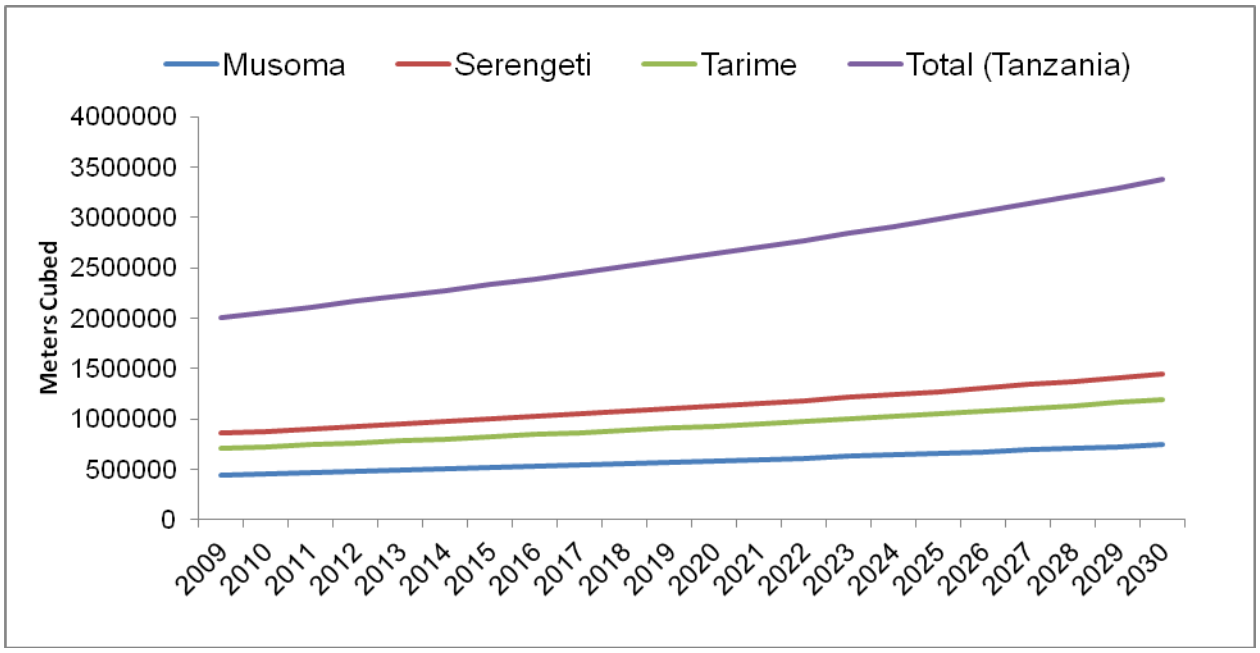


Figure 6.3: Domestic water demand in Tanzania (Reference Scenario)

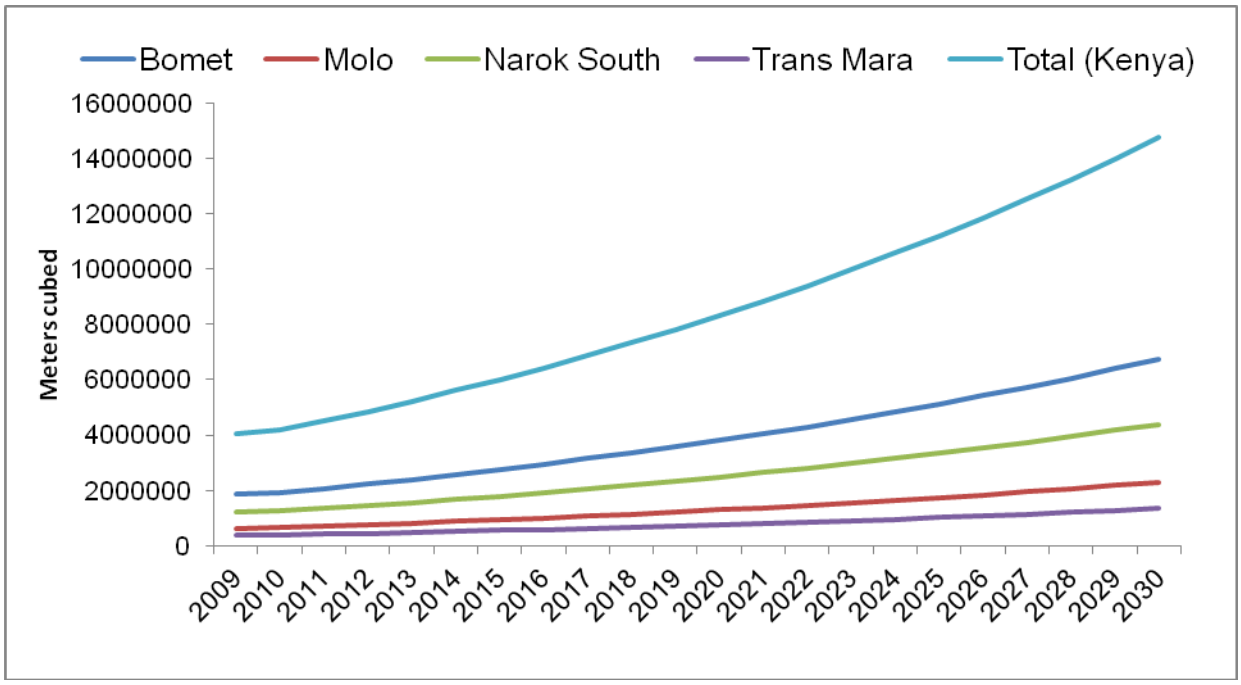


Figure 6.4: Domestic water demand in Kenya (Scenario A)

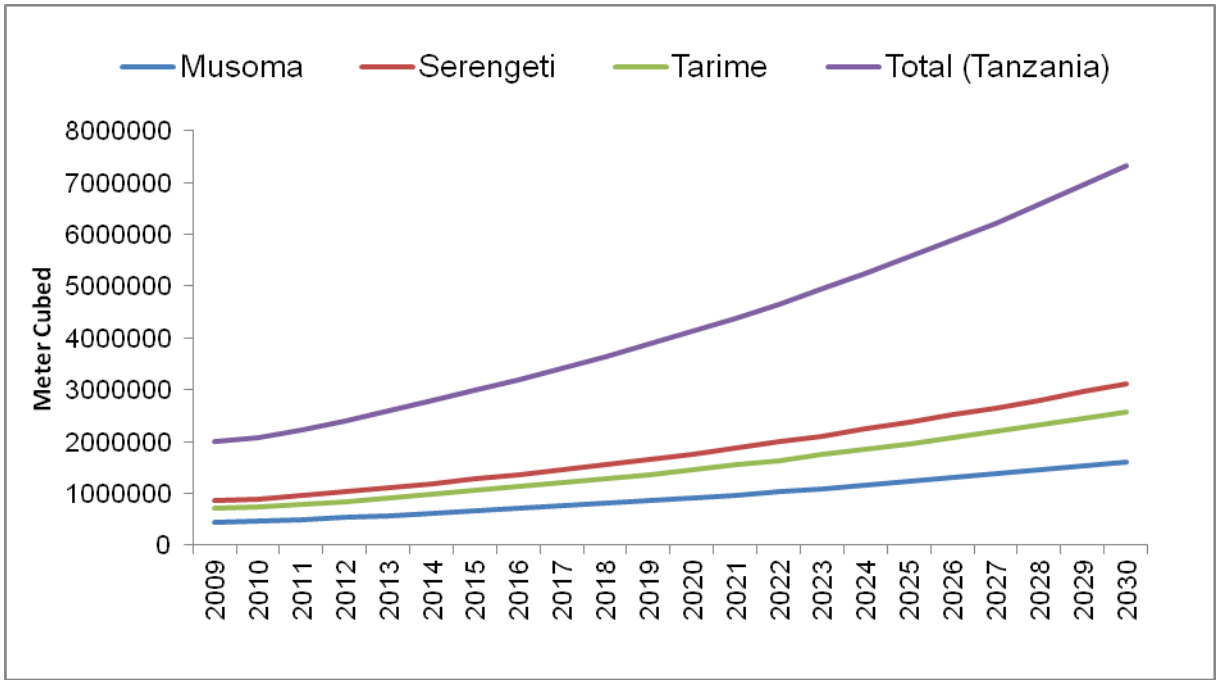


Figure 6.5: Domestic water demand in Tanzania (Scenario A)

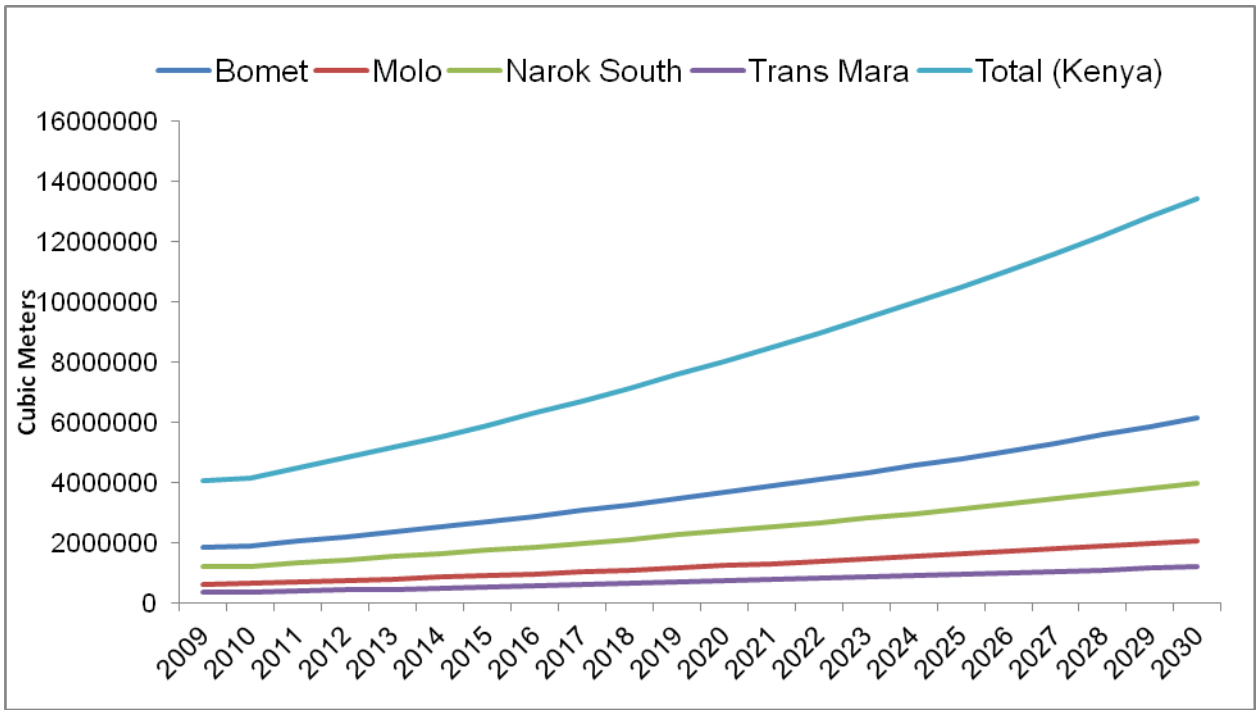


Figure 6.6: Domestic water demand in Kenya (Scenario B)

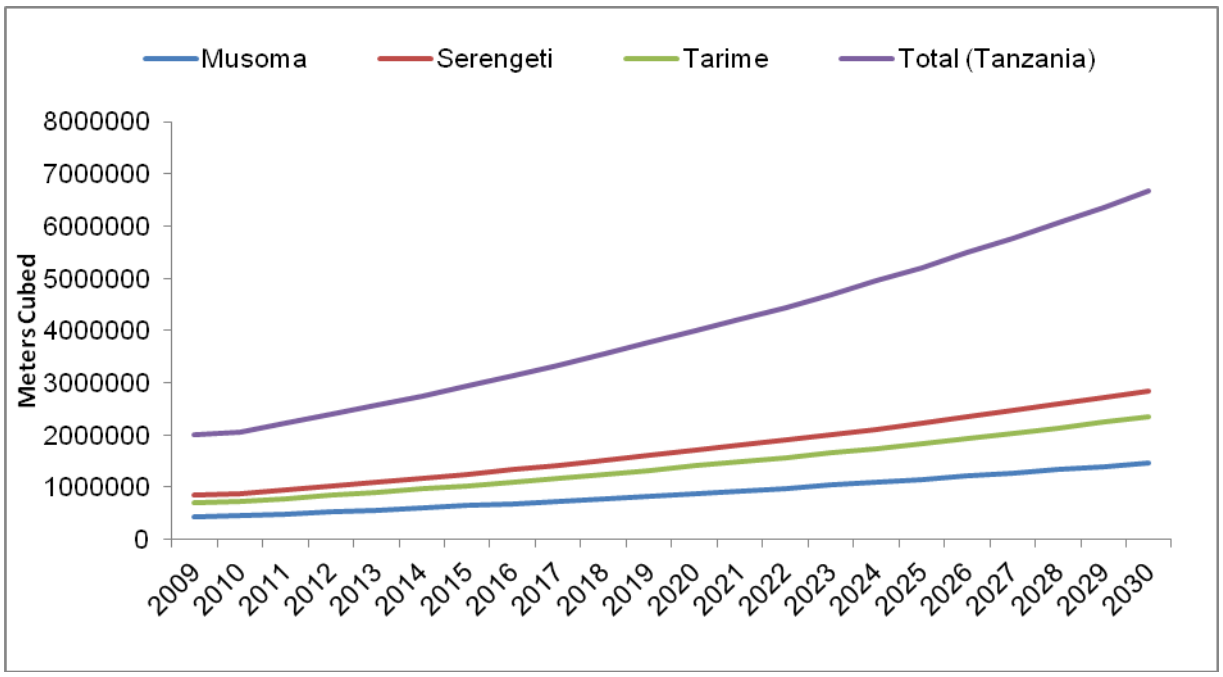


Figure 6.7: Domestic water demand in Tanzania (Scenario B)

6.5.2. Livestock

Livestock population trends show that in the Mara Basin region of Tanzania, both cattle and goat populations have increased according to 1984, 1998 and 2000 census data, while the sheep population for the same periods has slightly declined (Majule and Yanda, 2004). The 2009 National Population Census in Kenya was very detailed and considered even livestock population at sub-locational/ward levels. For purposes of this analysis, livestock population in Kenya was based on the Kenya National Population and Housing Census 2009, Table 6.14.

Table 6.14. Livestock Population by Type and District (Kenya)

	Molo	Narok North	Narok South	Trans Mara	Bomet
Cattle	182,243	255,881	701,899	459,106	210,855
Sheep	149,906	529,492	935,757	184,780	53,060
Goats	37,724	219,394	510,328	150,496	82,395
Camels	2	116	449	43	5
Donkeys	20,208	38,796	38,934	20,466	18,363
Pigs	1,789	3,959	2,275	1,097	604
Chicken	439,209	113,328	172,644	275,347	364,644
Bee Hive	64,052	19,402	22,730	22,335	14,807

(Source: KNBS, 2010)

Livestock population numbers in Tanzania was obtained for each district existing within the MRB (Hoffman, 2007). Goats and sheep are categorized together as “shoats” and were observed as a single group for this analysis. Estimates were calculated using proportional ratios comparing district livestock population for the entire district area to the area of the district that exists within the MRB. The resulting number is the livestock count for the portion of the districts lying within the MRB, essentially based on livestock population densities, Table 6.15.

Table 6.15. Livestock Population by Type and District (Tanzania)

District	Cattle	Shoats	Donkey
Musoma	115,573	56,162	963
Serengeti	109,307	117,459	308
Tarime	84,959	35,082	253
Total Livestock	**309,839**	**208,703**	**1,524**

With the estimated livestock population, livestock water demand for the MRB was determined based on daily drinking water requirements per livestock type as determined by King (1983), Table 6.16.

Among the livestock kept by residents of the Mara River basin, cattle (weighing an average of 350 Kg) had the daily drinking water requirements, followed by donkeys, goats and sheep, Table 6.16.

Table 6.16. Daily drinking water requirements

Species	Weight (Kg)	Daily drinking water requirements (Litres)	
		Mean	Practical guideline for development
Zebu bovine	**350**	**16.4**	**25**
Goat	**30**	**2.0**	**5.0**
Sheep	**35**	**1.9**	**5.0**
Donkey	**120**	**12.4**	**15***

Source: King, 1983

The region with the highest livestock demand within the Mara River on the Kenyan side was Narok South with a livestock water demand of 5,276,540m^3/year, probably owing to its vastness and a high population, while the district with the least was Molo with 444,362 m^3/year, Table 6.17.

Table 6.17: Livestock water demand in m^3/year (Kenya)

District	2010
Bomet	1658409
Molo	444362
Narok South	5276540
Trans Mara	1473985
Total (Kenya)	8853296

On the Tanzanian side of the Mara River, the largest livestock water demand per year was recorded at Tarime (840,660.7m^3/year) and the least at Musoma (116,372 m^3/year), Table 6.18.

Table 6.18: Livestock water demand in m^3/year (Tanzania)

District	2010
Musoma	1162372
Serengeti	1213475
Tarime	840660.7
Total (Tanzania)	3216508

Considering the entire Mara River basin, livestock water demands were highest at Narok and lowest at Molo both on the Kenyan side of the Mara River. In total, livestock water demands were also higher on the Kenyan side compared to the Tanzanian side of the Mara River, Figure 6.8.

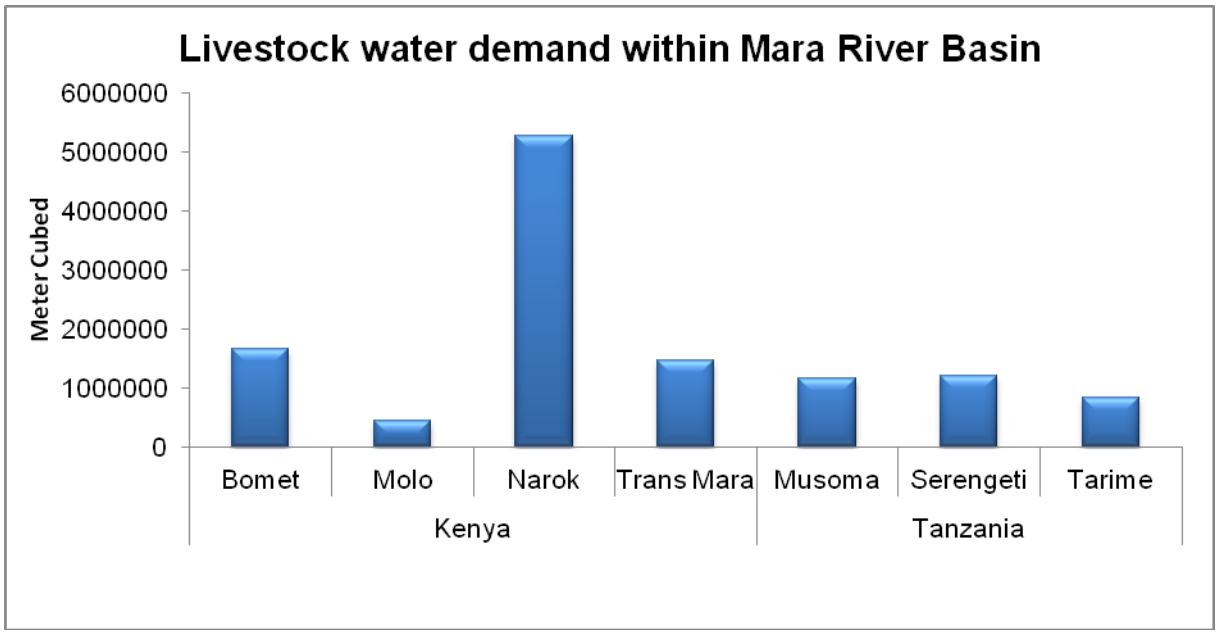


Figure 6.8: Livestock water demand in Kenya and Tanzanian side of Mara River

6.5.3. Wildlife

Wildlife is the backbone on which tourism within the Mara River Basin is hinged and the annual migration is one of the magnificent spectacles that fuels this industry. As the world's largest migration of mammals, people travel from all areas of the globe to witness the annual trek of over 1 million wildebeest, Thompson Gazelles, and zebras, as well as the 3,000 lions that prey upon these species, to their dry season refuge in the northern part of the SNP and the MMNR (Wolanski *et al*, 1999). Much of the wildlife within the Mara River Basin depends on the Mara River as their only surface water source during the dry seasons. Moreover, herbivore populations are largely limited by the availability of water and forage as noted by Mduma *et al* (1999). This is especially true in drought years, when water shortages severely affect water and forage availability, causing declines in wildlife populations through reduced reproduction, starvation, or insufficient water consumption. Gereta *et al* (2002) predict that if water in the Mara River were to dry out, wildlife would start dying at an estimated rate of thirty percent per week starting from the first week.

A large portion of wildlife water demand not only comes from the wildlife populations that live within the MRB year-round, but also from the seasonal migration of wildlife that enters the basin in search of water during the dry season (Hoffman, 2007). Each year, an estimated one million wildebeest and approximately 300,000 of each Thomson gazelle and zebra migrate from the Serengeti plains northwards to the MMNR to drink from the Mara River when water sources further south have dried up (Wolanski *et al*, 1999). This massive migration is estimated to move into the MMNR from July to October (Gereta *et al*, 2002) or from August to November

(Musiega and Kazadi, 2004). Regardless of the variations, both estimates place the migration within the MMNR for an approximate four month span.

Due to the complexity of wildlife movements over the landscape, only wildlife populations within the Narok and Trans Mara districts of Kenya (which includes the MMNR in entirety) are included in the water-demand estimation, in addition to the migrating species that enter the basin during the dry season. Wildlife population counts for the Narok and Trans Mara districts of Kenya are taken from a study conducted by the United Nations Environment Program (UNEP) (2002) using data provided from aerial censuses provided by the Department of Resource Surveys and Remote Sensing (DRSRS) in Kenya. The portion of the SNP wildlife population existing and remaining solely within the MRB is not considered in this water-demand analysis due to its complexity. This results from the fact that the SNP is split by basin boundaries, leaving the majority of the park outside the MRB.

In conjunction with wildlife population numbers referenced above, Table 6.19 shows coinciding estimated daily water requirements for the selected wildlife (du Toit, 2002). Daily water requirements adapted from du Toit (2002) were calculated at four percent of the body weight of an adult male. While water consumption rates vary by species, consumption is directly proportional to each animal's body weight (Peden *et al*., 2003).

Table 6.19. Estimated daily water requirements for wildlife populations within the MMNR

Animal	2000 Population	Individual Daily Water Requirements (liters)
Buffalo	4,733	31
Eland	1,025	23
Elephant	989	150*
Gran't Gazelle	13,353	2.6
Thomson's Gazelle	32,880	1
Maasai Giraffe	2,213	40
Impala	36,929	2.5
Hartebeest	1,295	5.5
Topi	6,244	5
Warthog	1,889	3.5
Waterbuck	143	9
Wildebeest	88,256	7
Burchell's Zebra	43,624	12
Total	**233,573**	**292.1**

Source: UNEP, 2002 and du Toit, 2002

*It is estimated that the daily water requirement is150-300 liters

The Figure 6.9 shows the monthly wildlife water demand. The rise in demand between June and November is as a result of the annual wild beast migration into the Basin. However the annual wildlife water demand is estimated to be constant at 1.9812m^3 for all the scenarios.

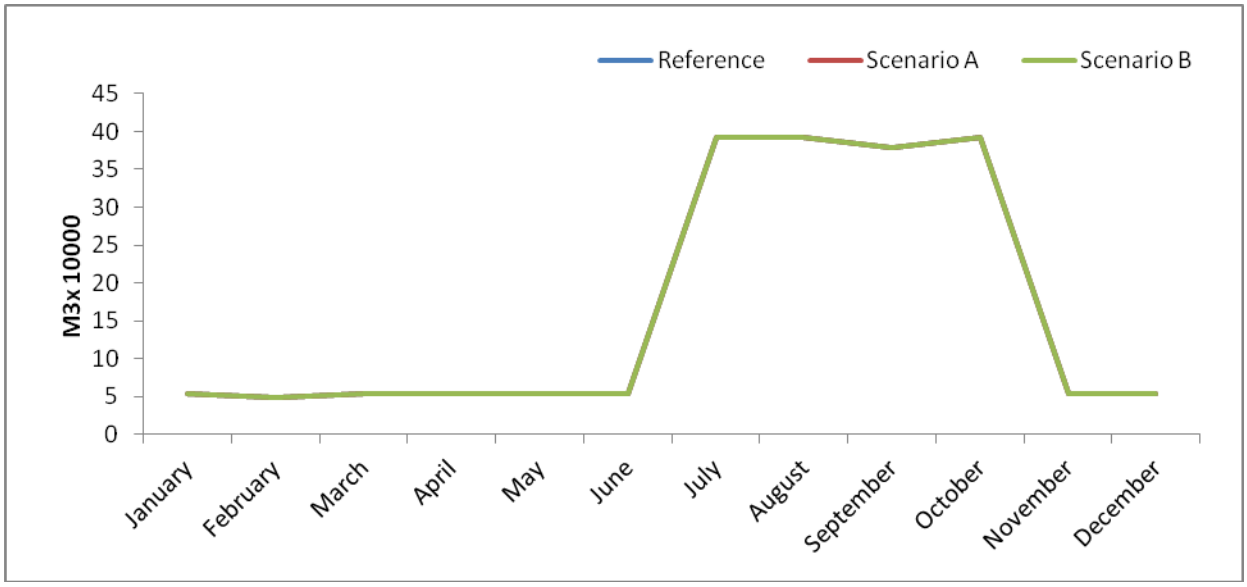


Figure 6.9: Monthly wildlife water demand

6.5.4. Tourism

In addition to augmenting resident populations within the MRB, the number of tourists visiting the Maasai Mara National Reserve and the Serengeti National Park are also inclining. Tourist numbers increased from 133,000 visitors in 1995 to 240,000 in 2004 in the Maasai Mara National Reserve and from 59,564 visitors in 1990 to 378,218 in 2002 in the Serengeti National Park (Kenya CBS, 2005 and Tanzania NBS, 2002). This rise in tourism leads to escalating revenues, providing a vital source of income for the region. While escalating tourism brings in much needed revenue to the region, it also leads to additional demands for tourist lodging facilities and additional water supplies to support these facilities. The annual migration begins at the start of the dry season and reaches the MRB between the months of July and October (Gereta *et al*, 2002). The migration moves through the SNP into the MMNR in a quest for water and pasture provided by the Mara River. Therefore, tourism not only places strain on the Mara River when water flows within the Mara River channel are already low, but tourism in SNP is experiencing the greatest growth during the dry season as well.

An inventory of lodges and tent camps within the MRB was done by Hoffman, 2007 and the parameters determined included; their number, total bed capacity, monthly bed occupancy rates and water use per day. Once the number of beds occupied per day throughout the year was determined, the next step in determining water-use and demand was achieved by working out the amount of water used per person per day in the tourist facility. A general guideline for water

demand for non-residential use estimates the average daily water use per person staying at a luxury camp to be 380 to 570 litres per day (Water Systems Design Manual, 2001). For the purpose of this analysis, it was assumed that the average water use per day per guest was 380 litres. Table 6.20 below was used to show the reference scenario for water demand analysis for the tourist facilities. Also, Table 6.21 shows hotels and lodges, occupancy and water abstraction levels in the MRB.

Table 6.20: Number of beds occupied per day in the MMNR based on mean monthly bed occupancy rates

Month	Bed Occupancy Rate	Number of Beds Occupied (of the 2116 available)
Jan.	50	1058
Feb.	58	1228
March	47	995
April	43.5	921
May	32.5	688
June	50	1058
July	66	1397
Aug.	77	1630
Sept.	57.5	1217
Oct.	55	1164
Nov.	42.5	899
Dec.	45	953

Table 6.21. Hotels and lodges, occupancy and water abstraction levels in the MRB

S/ No	Name	Contact	Bed Capacity	No. Rooms	No. Staff	No. Visitors	Abstraction Level/Remarks	Country
1	Mara Safari	PO Box 58581 NBI	105	51			Meter Readings 51207m^3	Kenya
2	David Livingstone	PO Box 11136 NBI	80	40	40	200	Meter not yet installed	Kenya
3	Karen Blixen	PO Box 9912 NBI	44	20	50	94	Meter not yet installed.	Kenya
4	Mararianda Pri.	PO Box 486 Narok	200	-	822	-	No pumping Meter not installed	Kenya
5	Olonana Camp	PO Box 41789 NBI	30	14	46	30	Meter readings 02579m3 Alt. 5118Ft, long. 36M0726559 09863468	Kenya
6	Mpata safari Club.	PO Box 58402 NBI	46	23	50	46	Meter not installed	Kenya
7	Mara Siria Camp	Box 11141-	28	14	23	28	5175Ft 36M0720788,	Kenya

		0062NBI					09864814	
8	Kilima camp		8	15	18	30	5882Ft 36M072394 0.9863430	Kenya
9	Kichwa Tembo	Box 74957 NBI	116	52	163	116	Meter readings 028016m3	Kenya
10	Governor Camp	Box 48217 NBI	74	32	220	74	Meter readings 1787(333) 54151 (329)	Kenya
11	Little Governor	Box 48217 NBI	34	17	100	34	Served with one source	Kenya
12	ILMoran		20	10	50	20	Served with one source	Kenya
13	Mara Serena Safari	Box 48690 NBI	156	78	150	156	Meter not yet installed. 4979Ft 36M0726253, 09845740	Kenya
14	Mara Simba	Box 66601 NBI	180	90	200	180	135 Casuals 5233Ft. 36M0755698, 09837436.	Kenya
15	Fig Tree Camp	Box 683-00100 NBI	144	72	200	144	Casuals are 135.	Kenya
16	Mara Leisure Camp	Box 17545 NBI	50	24	48	50	Meter readings 02210.9m3. 5165 Ft 36M0750368, 09838552.	Kenya
17	Mara Intrepid Camp	Box 74888 NBI	80	40	100	80	Meter reading - 04460m3. Swimming Pool capacity 116.25m3.	Tanzania
18	Serengeti Bush-Top		50	25				Tanzania
19	Nomad Tented Camp	Box 681 USA River, TZ	50	25	57	50	57	Tanzania
20	Sayari Tented Camp		50	25		50		Tanzania
21	Mara Mines							Tanzania

6.5.5. Irrigation agriculture

Only a small number of large-scale farms operating within the Kenyan portion of the Mara River basin, as well as a handful of small-holder farms throughout the basin utilize irrigation. A complete inventory of the irrigation schemes operating within the basin is difficult to obtain. Permitting and monitoring systems are weak and numerous illegal water abstraction operations exist. However, it is evident that irrigation agriculture has expanded within the basin over recent

years and there is considerable development potential for irrigation schemes throughout the basin in the future (Nile Basin Initiative, 2004; Onjala, 2004). Specifically, the Nile Basin Initiative had dedicated funds to implement small-holder irrigation development projects within Tarime District, Tanzania beginning early in 2007 (Nile Basin Initiative, 2004). This project is not yet started but if it becomes operational it will put more strain in the basin's water resources.

Currently, within the Kenyan portion of the MRB, there are 690 hectares under irrigation. There are no significant irrigation activities within the Tanzanian portion of MRB. For purposes of irrigation water demand analysis, area estimates therefore assume year-round irrigation of the 690 hectares of cropland under irrigation within the MRB. Realistically, however, this might not be the case because crops are often rotated to some extent and might not require irrigation year-round. While irrigation timeframe and quantities vary with rainfall, it is estimated that land under irrigation uses approximately five to seven mm of water per day as estimated by Tarquin Wood of Olerai Limited Mara Farm (Personal communication, 2012), to satisfy the crops consumptive use (evapotranspiration) requirements.

Because of the complexities in determining the irrigation water requirements, this report assumes that irrigation will be done for six months of the year at 7mm application rate. 690 hectares is used to formulate the reference scenario and while scenarios A and B assume that there will be increase in area under irrigation based on proposals suggested in the SEA Report and indicated herein (Figure 6.10) for the diffent scenarios.

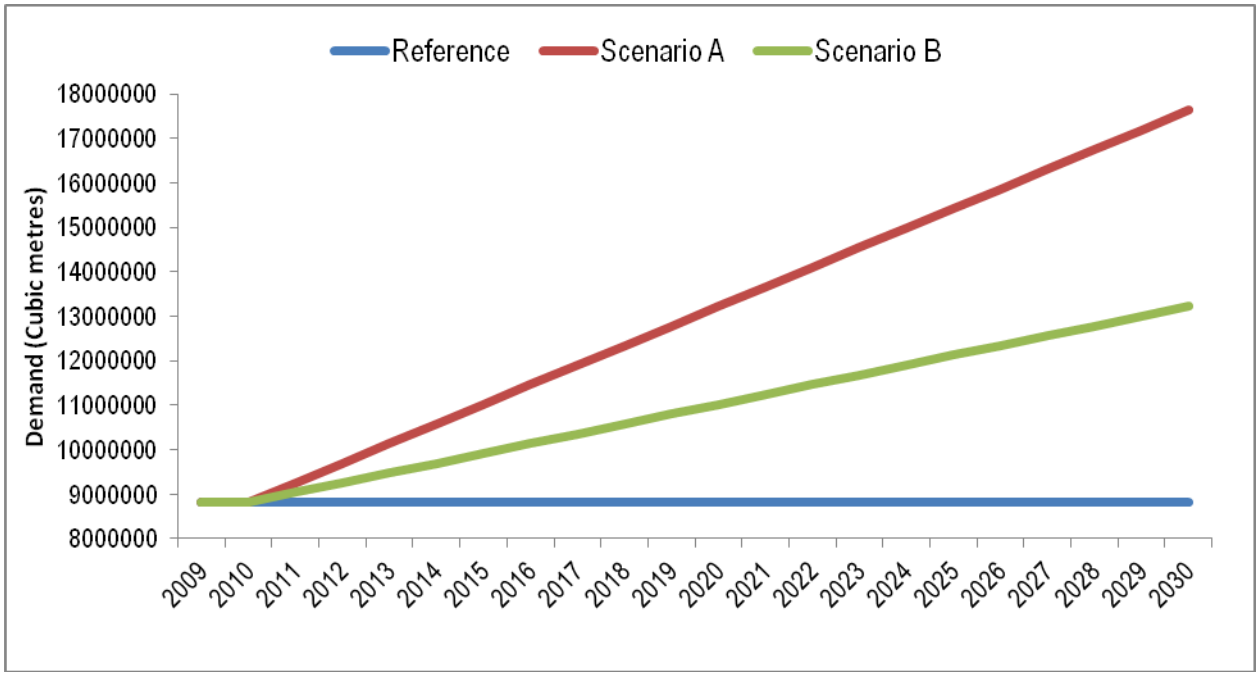


Figure 6.10: Agricultural water demand for the three different scenarios

6.5.6. Mining

Industrial water use is very limited within the MRB and is mainly restricted to the large-scale mining activity within the Tanzanian portion of the basin. Industrial use of public water in the Kenyan portion of the MRB is little. Mining is a major water consuming industry that is expected to expand in the Tanzanian portion of the MRB due to its richness in minerals, namely gold, kaolin, limestone, and gemstones (Majule and Yanda, 2004).

The quantity of water abstracted from the Mara River is compared to the daily allowable abstraction rate of 4200 cubic meters. According to data provided in the NMM 2005 Environmental Monitoring Report, the monthly amount of water withdrawn from the Mara River was 15,058 m^3 in February, 5,204 m^3 in March, 52,828 m^3 in June, 180,015 m^3 in July, 136,120 m^3 in August, 110,789 m^3 in October, and 124,685 m^3 in November (NMM, 2006). There was minimal abstraction from the river for the months of January, April, and May due to sufficient amounts of rainfall being collected in the raw water dam as well as recycling of water from the tailings pond. However, for the months of September and December, water abstraction from the Mara River was not physically possible because the level of the river fell below the pipe intake point (NMM, 2006).

However, if the mining efforts within the basin expand, additional water resources will be required, making it more likely that the allotted abstraction quantities would be fully utilized, or further exceeded. Since gold mining is a growing industry in Tanzania, expansion seems inevitable and therefore increases in water demand from this sector are most likely also inevitable (Figure 6.11). Permitting and enforcement will play a role in the growth of the mining sector, for growth will depend in part on the amount of water that is available and the amount of water that is permitted for mining use.

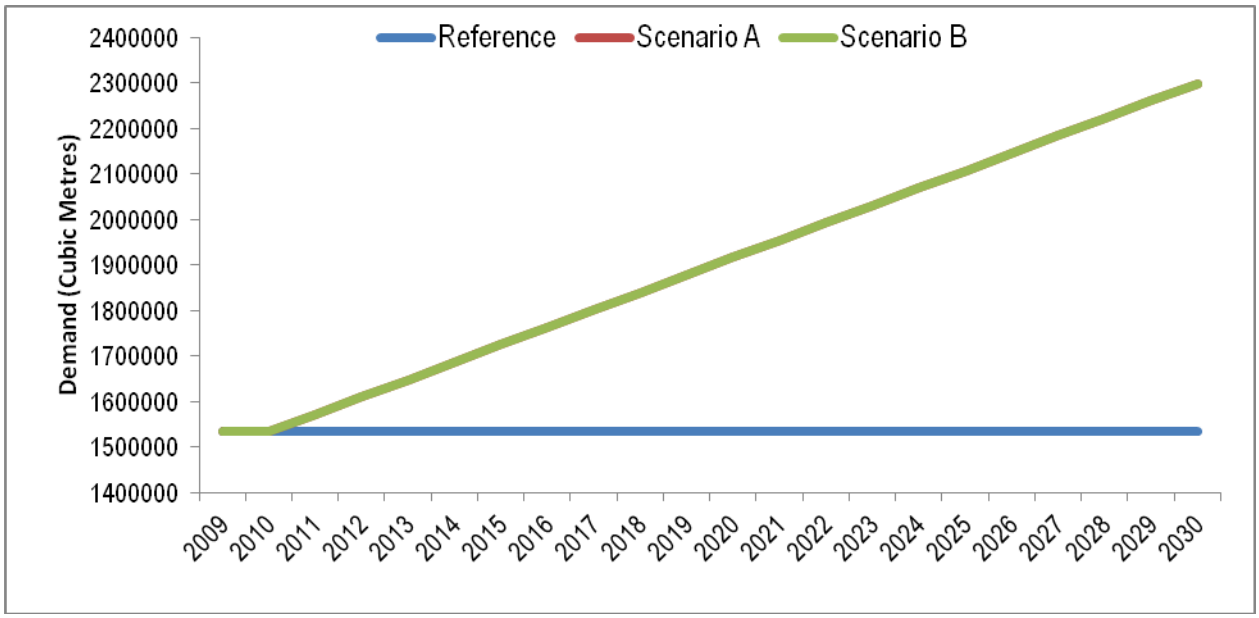


Figure 6.11: Current and projected water demand for mining under the three different scenarios

6.6. Analysis and Proposition of How Water Allocation Can be Intergrated Into Existing Catchment Management Planning to Ensure that Monitoring of Water Abstractions and Ecosystem Monitoring is a Part of Ongoing Watershed Monitoring Programmes

This section provides the rules governing water allocation within the Mara River Basin and how water allocation can be integrated into catchment management planning. These rules are consistent with the policies and guidelines for water allocation in both Kenya and Tanzania. It is to put in place measures that will enhance the availability of water resources of suitable quantity and quality where and when it is needed. Although water can be renewable, it is often in short supply and not sufficient to meet the demand. Demand for water resources within Mara Basin continue to grow due to increased human population, increased agricultural activities demanding more land at the expense of the basin's forests and grasslands and more water for irrigation. Other water use factors within the basin include; livestock, wildlife, mining and visiting tourists. The ever increasing water abstractions from Mara River are certain to, at some point in the future, to severely degrade the riverine ecosystem and even impinge upon the most basic water needs of people living along the river. Given the interconnected nature of river systems, choices that are made in one portion of the river basin implicitly impact those living downstream. There is need to make decisions regarding water use and work together across district and national boundaries to manage the entire system, from top to bottom.

The allocation plan also addresses the element of catchment conservation and protection measures, awareness campaign, developing a system to promote conservation issues and volumetric monitoring of abstraction of the water resource. The WAP also aims to capture the priorities, procedures and management controls that relate to equitable sharing of water as a resource.

During 2010 The Institute of Natural Resources based in Pietermaritzburg, South Africa, was contracted by the IUCN – ESARO to undertake a review of the work done on environmental flows in Tanzania. The main objectives of this study were:

1. A critical anaylsis of environmental water requirement studies and assessment that have been carried out in Tanzania including the Pangani, Wami, Mara and Ruaha basins and catchments.
2. Dissemination of lessons learned and discussion on current environmental flows assessments
3. A series of recommendations on implementing environmental flows and operationalizing the concept.

A report by Dickens (2011) entitled *Critical analysis of environmental flow assessments of selected rivers in Tanzania and Kenya* was a first step to achieving the above objectives. This was followed by a process of interaction with stakeholders in order to disseminate lessons learned but also to refine the way forward. The International Union for Conservation of Nature (IUCN) in collaboration with the Pangani Basin Water Board, and the Ministry of Water and Irrigation of Tanzania held a 2 and a half days workshop on "The Future of Environmental Flows: Providing water for Nature and People" from August 2nd to 4th, 2010 in Morogoro, Tanzania. Outputs from this workshop were used to strengthen the review report.

In order to introduce the subject of environmental flows, a good place to start is the definition as contained in the Tanzania Water Resource and Management Act (2009), which defines the "Reserve" for rivers as: "Reserve" means the quantity and quality of water required for: (a) satisfying basic human needs be securing a basic water supply for people who are now or who shall in the reasonably for (sic) near future, bea. relying upon i. taking water from, or ii. being supplied from the relevant water resources: and (b) protecting to protect (sic) aquatic ecosystem in order to secure ecologically sustainable development and the use of the relevant water resource, i.e. those water volumes and flows (and quality) that are required to maintain the very ecosystem that the provision of benefits is dependent on.

The Brisbane Declaration (2007) provides a useful description of environmental flows: "Environmental flows describe the quantity, quality and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems". This definition acknowledges the linked variables of quantity, quality, and timing that together constitute an environmental flow regime of sufficient quality to meet management goals.

At first appearances it may seem like a simple task to secure a portion of a river flow for basic human needs and to protect the aquatic ecosystem. However, all ecosystems are the result of thousands of years of interaction between physical, chemical and biological components of the ecosystem in a way that may be unique to a small section of an individual river. Thus, to determine the Reserve or environmental flow requirement, this has to be done uniquely for each approximately homogeneous reach of river. To make matters more complicated, these flow requirements change during the course of the year, different in each season and also different in wet and drought cycles. Thus has evolved the science of environmental flow assessment, a process whereby the quantity and quality of a water resource required to maintain the ecosystem on which society depends, may be determined.

Countries all over the world have taken up the challenge of determining and implementing environmental flows, and it is written into the law books of many. As is the tendency with any new creative science, the approaches to doing this are many and varied, some successful and others less successful, some operating at a minimalist and others at a complex level.

In Tanzania, the determination and implementation of environmental flows is just beginning. A number of parallel initiatives have been started and the environmental flows of four rivers given priority i.e. the Pangani, Wami, Great Ruaha and Mara rivers. In most of these, the foundation science has been undertaken, making use of a variety of different methods and approaches. The next priority will be implementation, where the science has to align with political and socioeconomic priorities in order to be implemented on the ground.

A report on **Assessing Reserve flows for the Mara River (LVBC, 2010)** was authorized and published by the Lake Victoria Basin Commission of the East African Community. It was conducted by the Kenya and Tanzania Ministries of Water and Irrigation, with technical expertise from water resource managers from Lake Victoria South Catchment Management Authority and Lake Victoria Basin Water Office in cooperation with scientists from local and international universities. The undertaking was facilitated by the Global Water for Sustainability (GLOWS) Program and the Worldwide Fund for Nature-Eastern and Southern Africa Regional Programme Office (WWF-ESARPO) with financial support from the United States Agency for International Development- East Africa (USAID-EA).

Scientists from Florida International University and UNESCO-IHE Institute for Water Education have also been conducting research in partnership with scientists from Egerton University, Jomo Kenyatta University and the National Museums of Kenya. These scientists work closely with WWF-MRBMI, NELSAP-MRBP and other implementing bodies in the region, which in turn work closely with local, national and regional water resource management authorities from both Kenya and Tanzania. Other developments include the formation of National Technical Advisory Committees, a Trans-boundary Water Users Forum, National and Trans-boundary Stakeholder Forums, and a Secretariat for the MRB.

In both Kenya and Tanzania, the responsibility for water resource management occurs at multiple levels: national, basin, catchment and local. Both countries have national policies that recognize the importance of the Reserve and call for its protection and consideration in all water resource decisions. They also both have independent regulatory bodies—National Environmental Management Authority in Kenya and National Environmental Management Council in Tanzania—that are not part of any particular Ministry. These agencies can prove invaluable in enforcing the national environmental policies protecting Reserve flows.

In Tanzania, the Mara River and the responsibility for establishing and maintaining the Reserve in the Mara River, falls under the management of the Lake Victoria Basin Water Office (LVBWO) located in Mwanza, in the Ministry of Water and Irrigation (MOWI). They are currently drafting a water resource use and management plan for the catchment to implement Tanzania's Water Resources Management Act (2008), and protection of the Reserve is included in this plan. At the basin level, the Sub-catchment Water Office, located in Musoma, is

responsible directly for the Mara River. They are legally mandated to enforce LVBWO's management plan through monitoring and regulation.

At an even more local level, water resource use is regulated by a District Water Engineer in the Ministry of Local Government. Each district has developed a Water Master Plan that is approved by the MOWI, and abstraction permits are first applied for through the District Water Engineer.

Transboundary issues related to management of the Mara River and the equitable sharing of its economic benefits between Kenya and Tanzania could be addressed through the Lake Victoria Basin Commission of the East African Community. This effort would also benefit from the participation of the newly formed Mara Transboundary Water Users Forum. Eventually, a transboundary Reserve flow and surplus flow could be agreed upon by Kenya and Tanzania under the auspices of the East African Community.

There is a long list of projects that have been carried out over the past decade, which operate at a transboundary level, but deal with particular issues related to the Mara basin. Such project objectives have included studies on the hydrology, use of resources, water quality issues and indeed the assessment of the EF requirements. All of these play some role in supporting the assessment of environmental flows, and where this is the case, they are introduced below.

The **Mara River Basin Management Initiative (MRBMI)** is a transboundary project (Kenya/Tanzania) implemented by WWF Eastern African Regional Programme Office (WWF EARPO) in partnership with national/local governments and other stakeholders in the basin. The project is funded by NORAD , WWF-Norway and USAID through the Global Waters for Sustainability (GLOWS) programme. Activities implemented by the project include the documentation of best practices and failures in terms of sustainable management and conservation related to the river. This initiative is the home of the main EF projects to be done that are documented below.

The two key reports in the context of this review are those dealing directly with the environmental flow requirements of the Mara River in both countries – the **Environmental Flow Assessment (EFA), Mara River Basin: Proceedings of the Final EFA Workshop (WWF-EARPO, 2007)** and **Assessing Reserve Flows for the Mara River, LVBC (2010)**. The project described by these two reports was undertaken by the Kenyan and Tanzanian Ministries of Water and Irrigation and carried out in cooperation with the GLOWS Programme (funded by the U.S. Agency for International Development) and the WWF-EARPO office. The Mara River is a transboundary river shared by Kenya and Tanzania, supporting both biodiversity and livelihoods of people living within the basin. This was the first EFA exercise to be carried out in Kenya and the first to be done on a transboundary river. Following a meeting held in November 2005, it was decided that the Building Block Methodology (BBM) (King *et al*. 2008) was the most suitable method for the needs of resource managers in the basin and would be adopted as the method of choice for the Mara River. Three sites referred to as BBM1, BBM2 and BBM3 were sampled. Although only the latter site physically represented Tanzania, all three sites were deemed critical to understanding basin-scale dynamics in this transboundary system.

CHAPTER SEVEN

7.0. PROPOSED MARA RIVER BASIN-WIDE WATER ALLOCATION PLAN (MRB-WAP) FOR THE NEXT FIVE YEARS

This chapter meets the specific objective 4 and gives the Mara River basin wide water allocation plan.

7.1. The Program Logic of MRB-WAP Showing Outcomes, Objectives, Strategies and Performance Indicators in the Next Five Years

Table 7.1. Table showing program logic of the Mara River basin-wide water allocation plan (MRB-WAP)

Outcomes	Objectives	Strategies	Performance Indicators
1.Ecosystems dependent on the Mara River and its tributaries' catchments, which are important for biodiversity, tourism, MMSE, mining, agricultural and other commercial or economic activities, and Indigenous cultural values, including springs and the Mara River and its tributaries, are managed and preserved in good condition.	To preserve the following proportions of annual discharge from the Mara River and its tributaries' catchments including feeder springs and streams to maintain base flow in the Mara River and its Tributaries: a) During drought years at least maintain the drought reserve flow as indicated in table 6.8. b) During normal or wet years at least maintain the normal reserve flow as indicated in table 6.8. c. Protection of ecosystem integrity and water quality within MRB watershed and water sources and the main Mara River and its Tributaries against degradation through extraction, damning, or bore constructions, Table 6.4..	Annual extraction limits to be applied in accordance with Table 7.5, where the estimated un-impacted Mara River and its tributaries flows are to be established at the beginning of each season (drought, normal or wet) based on recommended environmental flows as in Table 6.8-6.10. Annual extraction limits in Table 7.5 may be adjusted following the review. To manage increases in extraction through water trading towards the Mara River and its Tributaries through the water management zones. All water licences to be issued based on water sources and uses and as per conditions outlined in Table 7.2. Boreholes must not be drilled within 100m from potential sources of contamination. Boreholes construction permits will not be issued to properties that have access to reticulated water. Continue partnership with WRUAs, research organizations and other	River health assessment parameters and ranges consistent with national guidelines of Kenya and Tanzania will be developed in an implementation strategy to this Plan. Annual discharge from the catchments and water sources to the Mara River and its tributaries relative to other years. Water quality in the Mara River and its tributaries (Parameters and ranges consistent with Kenyan and Tanzanian national guidelines will be developed in an implementation strategy to this Plan.) Identification of methodology to quantify water requirements for indigenous domestic use, livestock watering, wildlife maintenance, and economic activities. Identification of specific environmental water requirements that maintain ecological processes in the Mara River and its Tributaries.

		institutions to improve knowledge of ecosystem water requirements Undertake consultation and research to improve understanding of Indigenous water issues and options to address them	
2. Communities, institutions, and business ventures including Tenwek hydropower dam, Olerai irrigation farm, hotels and resorts, MMSE and its wildlife, livestock, mining and other rural communities and rural properties, have access to water sufficient in quantity and quality for essential needs and for commercial and economic development.	In all years except very dry years: Rural stock and domestic use to have access to sufficient water, plus additional amount should there be growth in lawful exercise of water rights. a) Bomet and Mulot towns, Tenwek hydropower dam and dependent services (hospital, etc), farm, wildlife, hotels and resorts, and mining activities, and rural stock and domestic users to have access to sufficient water. Protection of water quality within MRB and integrity of	Water made available under this Plan to rural properties. License issued for public water supply will have first priority in allocation of water up to the annual extraction limit each year. Other uses e.g. Irrigation and mning to have restrictions based on water availability at any given time. Boreholes must not be drilled within 100m from potential water contamination. Bore construction permits will not be issued to properties that have access to reticulated water. No new license will be given where bores of <20L/s are within 100m of an existing	Number and level of water restrictions applied within Mara River basin, including irrigation and mining activities. Reports of contamination or interference of bores. Restriction to licenses, stock and domestic and other small volume groundwater uses. Water quality in the Mara River and its tributaries (Parameters and ranges consistent with Kenyan and Tanzanian national guidelines will be developed in an implementation strategy to this Plan.) Estimated volume of water being extracted for rural stock and domestic and other small volume ground water uses.

	the catchments including Mau Forest against degradation through extraction or bore construction and other unlicenced abstraction practices.	bore. Monitor number of boreholes and other sources e.g. springs for rural stock and domestic and other small volume groundwater uses as part of the Implementation strategy to this Plan	
3. Local communities have access to water from the Mara River and its Tributaries for commercial and economic development	At the 5 year review, or sooner if practicable, aim to have sufficient water available from the consumptive pool to satisfy identified requirements.	Reclaim water from licenses or users who have not complied with water allocation conditions e.g. as indicated in Tables 7.2 and 7.3 within agreed timeframe and reallocate to other purposes including indigenous economic development.	Development of water reliant enterprises by local communities and use of best water allocation technologies. Volume of water rights held for or issued to local communities.
4. All water major users have permits and meters and illegal abstractions are eliminated.	At the 5 year review, or sooner if practicable, aim to have all water users permitted, bring existing users to compliance, see Section 7.2.2 and Table 7.3, and permits renewed/amended, Table 7.4.	Regular surveys, monitoring and enforcement of water allocation conditions, Table 7.2, will be required.	All major water users permitted; Existing users brought to compliance, Permits renewed/amended. Water restriction procedures understood and availed to users.

5. Environmental flow settings in MRB reviewed and enforcement done, See section 8.1.4; New EFA sites set-up, see Section 8.2, and evaluation of original and present sites systems done, see section 8.2. Water use and abstraction surveys done, and sufficient hydrological data obtained. Monitor current and projected water demands in MRB as per various scenarios in this report: See figure 6.1, table 6.11, and figures 6.3-6.6, 6.10, and 6.11.	At the 5 year review, or sooner if practicable, aim to have environmental settings in MRB reviewed, evaluate the original and present sites and set up new sites. Aim to carry out water use and abstraction surveys and carry out studies or put systems in place to collect adequate hydrological data, including underground water. Aim to monitor current and projected water demands for 5 years and even beyond as per various scenarios in this report: See figure 6.1, table 6.11, and figures 6.3-6.6, 6.10, and 6.11.	The strategy is to involve all the stakeholders and donor communities and other regional institutions to fund the studies and surveys. Funds collected from water users can also be used. Also, funds from Payment of Ecosystem Services, if frameworks can be set-up can also be used.	Environmental flow settings in MRB reviewed, accepted by both Kenya and Tanzania and enforcement done. New EFA sites set-up, and evaluation of original and present sites systems done. Water use and abstraction surveys done, and sufficient comprehensive hydrological database developed. Current and projected water demands in MRB monitored as per various scenarios in this report: See figure 6.1, table 6.11, and figures 6.3-6.6, 6.10, and 6.11.

6. Harmonization and enforcement of policies and legal requirements for supporting full implementation of MRB-WAP done, including identification of existing gaps, See section 8.1 of this report, andreviews by both Kenya and Tanzania; and implementation of proposed activities for effective implementation of MRB-WAP, see Table 8.1. New laws, revised laws, subsidiary legislation and by laws established in 5 years time, including full enforcement, compliance, and roles of different parties established.	At the 5 year review, or sooner if practicable, the two countries should aim to harmonization and enforce policies and legal requirements for supporting full implementation of MRB-WAP, including identification of existing gaps. The two countries and institutional bodies and stakeholders should set up new laws, revised laws, subsidiary legislation and by laws, where required, and ensure full enforcement, compliance, and roles of different parties established.	The strategy is to have the two governments and their relevant institutions involved in the management of the MRB water resources in a manner agreed uponand acceptable by both countries. Stakeholders and donor communities and other regional institutions can fund the meetings, trainings, studies and surveys, etc.	Harmonization and enforcement of policies and legal requirements for supporting full implementation of MRB-WAP done, including identification of existing gaps, and reviews by both Kenya and Tanzania; and implementation of proposed activities for effective implementation of MRB-WAP. New laws, revised laws, subsidiary legislation and by laws established in 5 years time, including full enforcement, compliance, and roles of different parties established.

7.1.1. Environmental flow settings in the MRB

The Mara River water allocation plan shall maintain the Mara River environmental flow settings as a priority to sustain river ecosystems, for people and nature. The Kenya Water Act (2002) and Tanzania Water Resources Management Act (2008) both support the principle of maintaining environmental flows in river systems and call for this reserve to be set for all rivers and to be considered in all water allocation plans. International Development (USAID), the Lake Victoria South Catchment of the Kenya Water Resource Management Authority and Lake Victoria Basin Water Office of Tanzania, in partnership with the Global Water for Sustainability Program and the WWF-Eastern Africa Regional Programme Office (WWF-EARPO), have jointly carried out environmental flow assessment and established the reserve flows along the Mara River. A total of five Environmental flow assessment sites, three in Kenya and two in Tanzania, were identified and Environmental flow requirements set based on Building Block Method (BBM) through two joint workshops. The environmental flows for the sites in Kenya were established in a three day workshop held in Narok on 15th -19th October, 2007 (Batula, 2007) and the ones in Tanzania on 10th-11th July, 2011 (Mc Clain, 2011). The exact values agreed on in the workshops are indicated in Tables 6.3-6.7which indicate the minimum monthly environmental flow requirements in m^3/s both normal and drought (dry) years. The reserve flows need to be embraced by the stakeholders, including both Kenya and Tanzania, and operationalized within the basin. Establishing more EFA sites with recommended environmental flow settings needs to be considered to satisfactorily cover the basin and to allow for effective water resources management for water allocation. It was noted that, no EFA site was located along River Nyangores which is the major tributary of River Mara.

7.1.2. Insufficient data on water use abstraction and hydrological information

There is no comprehensive database with regard to water use abstraction and hydrological information within the basin. There is need to compile or update the existing database by carrying out water use and extraction survey. The database needs to be accepted and used by both countries.

7.2. Applications of Water Permits

7.2.1. New applicant for a water permit

Water allocation permits (WAP) is to regulate and control management and use of water resources within the basin in line with integrated water resources management principles. The basis of allocation is to include equitable allocation of water among different uses, e.g. domestic and public, industrial, agricultural and energy among others. Water use inventory, water costs, and assessment of water use efficiency are to be undertaken at the same time. Table 7.2 shows water allocation conditions

Table 7.2. Water allocation conditions

Water body/Section	Intended water use	Conditions for water allocation
All water bodies	Any	Installation of master water meter and controlling device.
	Domestic and public Supplies	No limitations as long as intended beneficiaries are within MRB. Abstraction for use outside the Basin can only be permitted for state schemes and only where alternative resources have been proved to be unavailable and after approval of the Environmental Impact Assessment.
	Irrigation & other commercial uses	Abstraction for use outside the MRB can only be permitted for state schemes and only where alternative resources have been proved to be unavailable and after approval of the Environmental Impact Assessment.
Ground water reserve (borehole development, shallow well)	Any	Every borehole must be inspected and the installed pump capacity tested by the regulation body. Maximum daily allocation (m^3/day) not to exceed 25% of tested yield (60% of tested yield pumped for 10 hours a day) as measured from test pumping (continuous and constant rate pumping test of not less than twenty four hours duration and recovery duration of not less than twenty hours), or otherwise stated by the regulating body.
	Irrigation	Applications for water permits to be subject to the normal water permit application process based on aquifer recharge rate. In addition, new applicants will be expected to utilise efficient water use technologies.
Springs	Any	Allocated from normal flow (spring yields tend to be less responsive to rainfall)
River	Domestic	Allocated from normal flow
	Minor irrigation	Allocated from normal flow but limited to a maximum of levels set for individual abstraction by regulating bodies.
	General Irrigation	Allocation from Flood Flow only. Off-take works to be compliant with self-regulating principles and storage is mandatory
	Livestock	Allocated from normal flow as per set limit. Requirements above set limits to be allocated from flood flow, implying storage requirement.
	Commercial use for livestock, tourism, power, other (except commercial irrigation	Subject to normal water permit application process
	Other uses	To be decided on a case by case basis.

7.2.2. Bringing existing water users into compliance

Bringing an existing water user into compliance will not necessarily involve a decision regarding allocation, but rather deals with bringing the abstraction into compliance with the permitted allocation. It involves identification of illegal abstractors and those whose permits have expired, over abstraction of both surface water and groundwater, poor/inefficient irrigation technologies and non compliance with the water rules are some of the most pertinent issues that are to be addressed to ensure compliance. Table 7.3 shows how existing water user should be brought into compliance.

Table 7.3. Bringing an existing water user into compliance

Action By	Action required	Comment
Water User	Notify the regulating body of intention to obtain permit and be advised of requirements prior to inspection.	Requirements will include fulfilment of conditions of authorisation: 1. Installation of master meter and controlling devise 2. Finalization of works 3. Abstractions on rivers - making works compliant with self regulating principles (including storage if required)
Regulating body	Inspects the site; Determines the capacity of the system; and checks consistency with authorisation Determine category of Permit	If regulating body finds significant inconsistencies when comparing the works, abstraction capacity, and/or water use with the authorisation, then the water user will be required to apply for amendment or be required to amend the works to be consistent with the authorisation.
Water User	Pays permit issuance fee	Amount to depend on Category of Permit
Regulating body	Issues Permit	

7.2.3. Case of existing abstractor seeking permit renewal or amendment

The section applies in the case of an existing abstractor and permit holder whose permit has expired or is inconsistent with current abstraction because the allocated amount is significantly above or below the normal abstraction volume. Table 7.4 shows permit renewal/amendment procedures.

Table 7.4. Permit renewal/amendment

Action By	Action required	Comment
Water User	Apply to regulating body for renewal of permit or variation or transfer and pay requisite fees	Requirements will include fulfilment of conditions of authorisation or permit: 1. Installation of master meter and controlling devise 2. Abstractions on rivers - making works compliant with self regulating principles
Regulating body	Inspects the site; Determines the capacity of the system; Checks consistency with permit; Determine category of Permit.	If regulating body finds significant inconsistencies when comparing the works, abstraction capacity, and/or water use with the authorisation, then the water user will be required to apply for amendment or be required to amend the works to be consistent with the authorisation.
Water User	Pays permit issuance fee	Amount to depend on Category of Permit
Regulating body	Issues Permit	

7.2.4. Water abstraction restrictions

This section sets out restrictions on abstraction that come into effect when water resource availability reduces. These restrictions are required because, despite the allocation rules, the variability of the water resources means that abstraction must be restricted to safeguard the Reserve which is the water set aside for basic human needs and environmental requirements. The general concept is based on three zones representing different conditions of resource availability.

The thresholds between the different zones are specific to each water resource and the restrictions may be different depending on the type of water use. The thresholds are developed based on an estimate of the naturalised flow record.

The rules/guidelines to be such that states related to resource availability for rivers are identified, e.g.:

a) Reserve – this would occur 5% of the time;
b) Normal flow – this occurs 15% of the time;
c) Flood flow – this occurs 80% of the time.

Table 7.5. shows water abstraction restrictions.

Table 7.5. Water abstraction restrictions

State of water resource	Conditions	Flow level

Satisfactory (Green)	No Restrictions (Abstraction permitted up to permit limits)	Above flood flow level
Stress (Amber)	Abstraction for irrigation reduced	Between normal and flood flow
Scarcity (Red)	Abstraction for domestic use reduced Abstraction for irrigation heavily curtailed	Between reserve and normal flow
Reserve (Black)	Abstraction for basic human needs only	Below reserve flow level

CHAPTER EIGHT

8.0. IMPLEMENTATION OF THE PROPOSED MRB-WAP OVER TIME

This chapter gives the possible mechanisms which can be applied during the implementation of the water allocation plan.

8.1. Policy and Legal Opportunities Which Can Support of MRB-WAP Implementation and of Identification of Existing Gaps

The policy and legal frameworks in both Kenya and Tanzania support commercialization of water services which can support the implementation and operationization of Mara River Basin - wide Water Allocation Plan (MRB-WAP). This has been effected efficiently and water users are paying for the resource. However, there is a missing link between the water resource management authorities and the water catchment entities. The money that the water resource management authorities collect from the water users does not seem to be ploughed back to rehabilitate or improve the water catchment areas. The policy and legal frameworks are not against independent associations of water users entering into payment of ecosystem services (PES) arrangements to help protect the catchment and adequate levels of environmental flows which can also support MRB-WAP implementation.

8.1.1. Kenyan policy and legal opportunities which can support MRB-WAP Implementation and Identification of gaps

Water Act, 2002 Clause 7 (1) establishes the Water Resources Management Authority (WRMA) which as stated in Clause 8 (1) has the following duties among others: to receive and determine applications for permits for water use; to regulate and protect water resources quality from adverse impacts; to protect and manage water catchments; to determine charges to be imposed for the use of water from any water resource; and to liase with other bodies for the better regulation and management of water resources. The implementers of the Water Act, 2002 have not interpreted the Act widely enough to include MRB-WAP. Their interpretation is that water users should pay for the resource and that the government should provide WRMA with resources to manage the water catchments. At the same time, there is nothing to prevent WRMA from contracting WRUAs to rehabilitate catchments.

Water Act, 2002 Clause 46 (1) establishes the Water Services Regulatory Board, whose responsibilities among others, is: to develop guidelines for the fixing of tariffs for the provision of water services; to promote water conservation and to demand management measures; to determine fees, levies, premiums and other charges to be imposed for water services. If a wide interpretation of the Water Act, 2002 is employed, it would be possible to write rules and regulations that would allow downstream water resources users associations to engage upstream associations in a MRB-WAP and PES business relationship. A wide interpretation of the Water Act, 2002 has not been employed. The result is that stakeholders often express a wish for the Act to be revised to include PES which can also help the implementation of MRB-WAP.

Water Act, 2002 Clause 83. (1) establishes the Water Services Trust Fund (WSTF); with its objective being to assist in financing the provision of water services to areas of Kenya which are without adequate water services. The Trust Fund has kept to its objective. However, WRMA expects it to support WRUAs to rehabilitate degraded water catchment areas. This is taking away attention from establishing real WAPs and PES schemes. This fund is not meant to assist WRUAs to protect the water catchments. However, WRMA has worked with the Mara WRUA to apply for funds from WSTF for rehabilitating the catchment. This is an exceptional case. Most WRUAs find it difficult to obtain funds from the WSTF. This means that catchments remain un-managed and continue to be degraded.

The Water Act, 2002 Clause 15 (1) of the Water Act, 2002 empowers WRMA to formulate a catchment management strategy for the management, use, development, conservation, protection and control of water resources within each catchment area. This strategy will among other things, provide mechanisms and facilities for enabling the public and communities to participate in managing the water resources within each catchment area. Clause 15 (5) states that the catchment management strategy shall encourage and facilitate the establishment and operation of Water Resources Users Associations as fora for conflict management and co-operative management of water resources in the catchment areas.

Clause 71 (1) allows a Water Services Board to enter into an agreement with any person to protect a catchment through soil conservation measures. These clauses if interpreted widely would allow WRMA to support MRB-WAP implementation including PES schemes. All that would be needed is to prepare regulations to facilitate the implementation of the schemes.

Forests Act, 2005: Section 3 of the Forests Act, 2005 defines water as a "forest produce". Section 5 (1) requires the Kenya Forest Service (KFS) to carry out the following duties, among others: to enforce the conditions and regulations for forest utilization activities; to collect all revenues and charges due to the Government in regard to forest resources, produce and services; to manage forests on water catchment areas primarily for purposes of water and soil conservation, carbon sequestration and other environmental services. Section 41 (1) states that all indigenous forests shall be managed on a sustainable basis for among other things, the conservation of water. Section 46 (1) empowers community forest associations to make proposals for the use of forest resources. While water is regarded as a major forest product, the revenue from water does not go to the Kenya Forest Service, but to WRMA. For this reason, the KFS pays more attention to the management of trees than to the management of water catchment areas. Trees bring in more revenue to the KFS than water. This Act should be amended to harmonize with mandates of WRMA and help in smooth implementation of MRB-WAP.

Water Act, 2002 and Forests Act, 2005: The Water Act states that the responsibility of managing and protecting water catchments belongs to WRMA. The Forests Act, 2005 states that indigenous forests should be management for water catchment. A wide reading of these laws can support the implementation of MRB-WAP and PES if WRMA and KFS facilitate WRUAs and community forest associations to rehabilitate degraded indigenous forests. WAP including PES are best operated where there are clear property rights over the environment service. In Kenya, the ownership of water has not been sorted out openly. Are water catchment areas in indigenous

forests the responsibility of WRMA or the KFS? Because this question has not been answered adequately, water catchment areas have not been managed as well as they should be.

Water Act, 2002 Clause 8 (1) (g) requires WRMA "to determine charges to be imposed for the use of water from any Water Resource. Some stakeholders are of the view that WRMA does not produce clear reports stating how the authority uses the funds it collects from water users. Further, the authority does not provide information on the basis for its charges and fees. This negates efforts to smoothly implement MRB-WAP and also introduce PES schemes.

Water Act, 2002 Clause 8 (1) (h) requires WRMA **"**to gather and maintain information on water resources and from time to time publish forecasts, projections and information on water resources". Some stakeholders are of the opinion that WRMA is not providing them with adequate information.

The Environmental Management and Coordination Act, 1999 (EMCA): Clause (47) (1) (c) and (f) mandates the National Environment Management Authority (NEMA) to issue guidelines to the responsible ministries and agencies to curb soil erosion and to protect water catchment areas. The tone of this clause is punitive and may not encourage smooth implementation of WAPs and PES directly.

The Environmental Management and Co-ordination (Water Quality) Regulations, 2006: These regulations provide parameters that determine the water quality for various uses. These could be used to monitor the success of PES schemes.The regulations place the onus of upholding water quality standards onto the Ministry of Water and Irrigation. The Ministry is a policy organ and so this responsibility is not carried out and can jeopardize WAP implementation and PES schemes.

The Agriculture Act, CAP 318: The Agriculture (Basic Land Usage) Rules, legal notice number 26/1965 in clause 6, stipulate the distance which a farmer should keep from a water course when cultivating his or her land. This buffer zone could be planted with trees or grass in support of WAP and PES implementation. The Agriculture Act, CAP 318 presumes that there will be extension staff in every location. This is not the case, and therefore many farmers are either not aware of this rule, or they simply neglect to comply.

The Land Policy, 2009: In section 3.4.2.3 the policy states that the government will: introduce incentives to encourage the use of technology and scientific methods for soil conservation; and put in place measures to control degradation of land through abuse of inputs and inappropriate land use practices. This policy opens a window for supporting WAPs and PES implementation. The Ministry of Water and Irrigation and other bodies under it, including WRMA have not taken advantage of this section of the Land Policy, 2009.

The Constitution of Kenya has articles which support a clean environment and the availability of clean water. Thus Article 42 states that "every person has the right to a clean and healthy environment". Article 43 (1) (d) states that "every person has the right to clean and safe water in adequate quantities".

The Environment Management and Coordination Act, (EMCA), 1999 in clause 70 (1) establishes the Standards and Enforcement Review Committee. Some of the responsibilities of this committee include providing and recommending the minimum water quality for drinking water, water for industrial purposes, water for agricultural purposes, water for recreational purposes, water for fisheries and wildlife and water for any other prescribed use. These recommendations led to the preparation of the "Environmental Management and Coordination (Water Quality) Regulations, 2006 which were published through legal notice No. 120. These regulations set out clearly what quality of water for different purposes should be. The Drinking Water Quality and Effluent Monitoring Guidelines developed by the Water Services Regulatory Board set out the standards that should be adhered to.

Land in Kenya is classified as public, private or community. In the upper catchment of the Mara River, these three types of land ownership exist. Thus the forests managed by the Kenya Forest Service fall under public ownership. The land in the Narok County of the catchment is under private ownership; while the forests owned by the Ogiek forest dwellers are under community ownership. These issues can frustrate the smooth implementation of MRB-WAP and should be looked into and harmonized.

Contract Enforcement: Contracts can be entered into by legal persons. In the case of MRB-WAP and PES services in the Mara River Basin, these include individuals, associations, private companies and government corporations.

Cash incentives immediately come to mind when considering implementation of WAPs and PES scheme. However, these are not necessarily the best. Land owners in the catchment should be given an incentive to protect their land from soil erosion. This can be through terracing the land and planting life fences along their land boundaries. In addition, bamboo can be planted at strategic locations to clarify run-off from the farms. Further, farmers could be encouraged to grow tree crops like apples to lessen the tilling of the land that growing potatoes requires.

8.1.2. Tanzanian policy and legal opportunities which can support MRB-WAP Implementation and Identification of gaps

National Water Policy, 2002 Section 5 of the introduction of the policy states that economic incentives would be used to conserve water, and reduce pollution of water sources. This is a clear indication that implementation of WAPs and PES can be supported by the policy. Most of the institutions envisaged by the policy are not in place and therefore no incentives have been provided to conserve water or to reduce the pollution of water sources.

Water Resources Management Act, 2009: Clause 37 (1) gives the Minister power to protect a water source from erosion or pollution by declaring the water source to be a protected area. However, the institutions that would enforce the decision of the Minister have not been in place in the past, and probably the situation has now changed which needs verification.

Water Resources Management Act, 2009: Clause 37 (2) empowers the basin water boards to put up structures to protect water sources. In the past, the members of the basin water boards had not been appointed, but situation as per now needs verification.

Water Resources Management Act, 2009: Clause 37 (3) (b) requires an occupier of land in a protected zone to take measures to prevent the water source from being degraded. Clause 37 (4) requires the basin water board to compensate occupiers whose land has been declared a protected water catchment area. This clause can support implementation of WAPs and PES schemes. In the past, the basin water boards were not in place, although board members had already been identified and therefore compensation as envisaged in the Act could not be paid. Information need to be updated on current situation.

Water Resources Management Act, 2009: Clause 97 (b) (iv) envisages the funding of water associations and other entities to conserve and improve the catchment. The funds should come from fees paid for water by users. While the water associations are all in place, they could not operate officially as they had not been registered, by the basin water board, which in turn was not officially in existence. However current situation needs verification, as some respondents during our field research also mentioned lack of official existence of the basin water boards.

The Water Supply and Sanitation Act, No. 12 of 2009: Part IV, Clause 9 (1) (a) establishes water supply and sanitation authorities, which may operate on a commercial basis. In the Tanzanian segment of the Mara River Basin, the autonomous Musoma Urban Water & Sewerage Authority (MUWASA) is the only water company and it charges the residents of Musoma for water. This is a in a way is a WAP and a form of PES. The authority remits some 4 million shillings to the Lake Basin Water Office every month. At first sight, this may look like a lot of money. However, it represents only one day's collection for the authority. There is a clear gap as MUWASA has not negotiated with the Water Office the possibility of using these funds for improving the water catchment. MUWASA abstracts water directly from the lake and this may make the authority feel that it is not responsible for the rehabilitation of the Mara River catchment.

The Water Resources Management (Water Abstraction and Use) Regulations, 2009: These regulations deal with abstraction and use of water. They offer an opportunity for WAP and PES implementaton. The rules deal with administrative details on how to apply for a water permit, and do not mention any fees. This is a gap that will negate the implementation of WAPs and PES schemes.

The Forest Act, 2002 Clause 3 (c) states that one of the objectives of the Act is "to ensure ecosystem stability through conservation of forest biodiversity, water catchments and soil fertility" which can support WAPs implementation.

From the above policies and legal regulations, it is clear that the current policies and laws can support the implementation of WAPs and PES schemes. However, this is not happening because of two main reasons: the policies and laws concentrate on the commercialization of water services; and the people in charge of water institutions have not interpreted the policies and laws widely enough to be able to adequately and comprehensively allow implementation of WAPs and PES schemes.

According to the FAO Payment for Environmental Services in Agriculture and Landscapes (PESIL), for PES to work (and also related WAPs), there should be "regulations are already in

place to facilitate the implementation of PES programmes. This includes regulations that support the demand for environmental services (e,g. environmental, health, food safety regulations) as well as regulations and institutions that support the supply of environmental services such as security of land tenure and contract enforcement". This means that in the case of water, there must be regulations that demand that water should be of a certain quality. In addition, those who participate in PES should have property rights over their land and be in a position to enter into contracts. Further, there must be a legal framework in place for enforcing such contracts.

The Water Resources Management Act, 2009 and the Water Resources Management (Water Abstraction and Use) Regulations, 2009 do not define "water quality". However, they define pollution of water resources as "any direct or indirect alteration of the physical, thermal, chemical or biological properties" so as to make it less fit for the purposes for which it is meant. The Tanzania Water Quality Standards **(**Tanzania Standard TZS 789:2008) sets the microbiological requirements for piped water and the chemical and physical limits for drinking water sources. If these standards are adhered to, they will encourage WAPs and PES schemes which lead to the rehabilitation of water catchment areas.

The Tanzania National Environmental Policy identified six major problems as follows: land degradation, lack of accessible good quality water for both urban and rural inhabitants, environmental pollution, loss of wildlife habitats and biodiversity, deterioration of aquatic systems and deforestation. The Environmental Impact Assessment and Audit Regulations, 2005 require that an environment impact assessment should be carried out for schemes which involve abstraction or utilisation of ground and surface water for bulk supply.

Property Rights: According to the Law Reform Commission of Tanzania, "land tenure in Tanzania is in the form of a right of occupancy and leasehold". There is no freehold system. The primary legislation governing land ownership is the Land Act, No. 4 of 1999 as well as Village Act, No. 5 of 1999. Under the Land Act, there are several categories of land but the most relevant is general land. This is the land that a right of occupancy or leasehold may be granted by the Commissioner for Lands upon application and fulfilment of certain conditions. On the other hand, Village Land is administered at grass root level for which a "Certificate of Title can be granted to the holder". This means that private land ownership is not actively encouraged.

Contract Enforcement and Incentives: Contracts can be entered into by all legal persons, including associations, companies and government corporations. Because of loose land ownership rights, it is difficult to provide incentives that include the prevention of soil erosion. Cash incentives may be the best way to go.

8.1.3. Framework for legalizing MRB-WAP (new laws, revised laws, subsidiary legislation, and by-laws)

The laws in place at the moment are adequate for legalizing MRB-WAP. However, both counties would need to write subsidiary legislation to anchor MRB-WAP in the law. The subsidiary legislation should be in harmony with the water quality standards already in existence in both countries. Further, they should include the incentives that should be provided and by whom. In Kenya, the subsidiary legislation should be based on Clause 71 (1) of the Water Act, 2002, which allows a water services board to enter into an agreement with other entities (for example, water resources users associations) to protect the water catchment and carry out soil conservation measures.

In Tanzania, the subsidiary legislation should be based on Clause 37 (4) of the Water Resources Management Act, 2009 which requires the basin water boards to compensate occupiers whose land has been declared a protected water catchment area. In particular, Clause 97 (b) (iv) of the same Act envisages the funding of water associations and other entities to conserve and improve the catchment. The funds should come from fees paid for water by users. This clause is also a good basis for a piece of subsidiary legislation for smooth implementation of WAPs and PES in Tanzania.

Along with legal and institutional reforms, two other processes affecting water management have unfolded. The first is an increase in private participation in the provision of water-related public services, and the second is the complex process of transferring ownership of irrigation systems to their users. In several countries these processes are well advanced, while in others they are still the subject of fierce controversy. There is also a general intention to establish water markets, in the belief that they will improve the allocation of water resources among competing uses. In most countries these processes take place within a weak regulatory and institutional framework.

In the past, the management of multiple water uses was centralised in State hands. Hence private participation implies changes in the latter's role in this area. The State will have to give up some activities and take on others, and it will need to exercise greater regulatory power and promote the establishment of more participatory systems for multiple water-use management at the river-basin level, e.g. in MRB. For these reasons, the activities of international, regional and bilateral organisations should be increasingly concerned with institutional management, defining the roles of the State (in particular as regards privatisation and regulatory frameworks), and contributing to the design and application of public policies for integrated water resource management.

Advisory services are needed in aspects of the privatisation of water-related public services, especially as regards regulation of public utilities, and in setting up organisations for water management at the river basin level and in drafting water laws. At the same time there is a clear tendency to assign to the municipalities a series of new roles that were previously carried out at the central level. Many of these are directly related to water management, including water quality

control, environmental management and land use planning. This has given rise to several initiatives to promote municipal participation in river-basin management projects. One of the first tasks is to further advance the dissemination and analysis of experiences with regional initiatives to redefine the role of the municipalities.

All of this is occurring in a context of changing macroeconomic policies and a globalization process in which international capital and transnational corporations are investing in the water industry and, in some cases, entering into competition with indigenous communities and informal users whose water rights are ancestral. At the same time, a number of rural areas are affected by large-scale natural disasters and indigenous and peasant social movements. This situation is made more complicated by increasing concern for the environment, and in particular the need to restore and conserve the quality of surface and ground water, an issue that is not yet a priority on national agendas.

In water resouces and environmental management, it is always important to involve the local community. Key reasons for community engagement are to respect and incorporate local knowledge (which is very helpful if you don't have a comprehensive monitoring program) and to enhance a culture of stewardship through helping the community understand that 'their' resource will be affected if everyone misuses water.

The WAP awareness campaign is an opportunity to enhance the local culture of stewardship. According to Dr Baldwin (personal communication, 2012), in some countries such as in Australia, the government in some cases installs the meters to ensure adequate standard of make and installation, sealed from cheating. The user is levied a fee as a contribution to the cost. In other States of Australia, the user is allowed to install a meter, according to a certain standard, so often the WUAs bulk order meters to get a good price for their members. In some cases the WUA employs someone to install the meters. Similarly in some States in Australia, government reads the meters on private abstractions, and in other cases the user reads and reports on the meters, with spot checks by government. According to Dr Baldwin, the idea of users being involved in some way in meter reading is good in that they get quick feedback on how any changes they make in water management affects the amount of water they use. It would also probably be better in Kenya and Tanzania for WUAs to have the opportunity to make their own rules, and to establish their role.

Ostrom's work on principles for successful self-governing NRM bodies indicates that there should be graduated sanctions, commensurate with the severity of the impact of rule-breaking. The lightest is a warning, peer pressure within the WUA, and if possible assistance in doing things correctly. Mark Hamstead and Dr BaIdwin (who reviewed water planning across Australia) recommend using a logic frame that establishes objectives and indicators right at the beginning and follows them through, so that each objective has a strategy for implementation, as well as corresponding indicators for measuring and evaluating to help establish and implement WAPs. This is a program logic which is also used in this report.

According to Dr Baldwin, while water allocation efficiency is much talked about, it is hard to implement and possibly unfair. It implies that poor people would have less priority for water since they might use it for subsistence and don't employ anyone. That may not help achieve MDGs. In one over-allocated groundwater area in Australia, Dr Balwin and colleagues asked the users how they thought the cut in allocation should be shared: evenly among all users; or a bigger cut to those in the groundwater depression; or less cut to those who use water efficiently. They voted for equal proportionate cut to everyone, as they felt that would be fairest. They said that they need to live with their neighbours. Much conflict is due to perception of unfairness (in either distribution of assets/resources or in process = procedural and distributional justice).

Effects of pricing water is important, as is already happening in Kenya and Tanzania. However, it is best first applied to industries and big operations. It may be appropriate to charge only those users who consume volumes over a certain amount.

8.1.4. Policies and legal guidelines pertaining to environmental flows assessments and gaps to be filled for gradual operationalization of MRB-WAP

The LVBC (2010) report was the only one of the several documents reviewed, that deals directly with environmental flows and is of prime importance. This report makes an important point clear – that "*Reserve flows are not for the purpose of protecting the fish and insects chosen as indicators. Rather, the Reserve is intended to protect the ecological processes and services indicated by the presence of these species, such as degradation of contaminants, breakdown of organic matter and erosion control. These processes are critical not only to the health of the river, but primarily to the health of the human communities that depend on it, many of whom rely on it as their primary source for drinking water."*

Other projects which have the potential to contribute useful information to understanding environmental flows include: **Tanzania National Parks – UNESCO-IHP Demo site on Mara River and Serengeti Plain, Kenya and Tanzania (WWF-EARPO 2007).** The project links the concept of Ecohydrology principles in the use of water to various initiatives taking place within the Mara River Basin. Activities to be completed are a full evaluation of the hydrological balance of the Mara River System and assessing the effectiveness of cooperation/integrated management of water resources in improving water quantity and quality and biodiversity in Mara River Basin. This project works closely with various stakeholders such as World Wildlife Fund (WWF), Kenya and Tanzania in the Mara River Basin, East African Community, Frankfurt Zoological Society, Ministry of Water and Irrigation and various non-government organizations. (Note that the thrust of this project was the large mammal migrations – not the environmental flow requirements of the river).

Kisoyan (2006) reported on a project which has as one of its objectives the "production of scientifically tested strategies to guide policy, regulations, and support systems required for integrated management of livestock, wildlife, and water resources.". However, this project was wide ranging and only touched on EF. What is usefully contained in it though, is the socio-

economic and institutional background, and the management of the catchment that will ultimately need to be managed in order to achieve EF in the Mara. *NOTE that there are several other relevant projects, many of which are mentioned in the report below.*

8.2. Site Selection for EFA Studies in MRB: Past, Present and Future

The process to define areas of study and assessment (rivers, estuary, lakes and wetlands) is important for environmental flow assessment site selection. While there are many studies that have examined water issues in this basin, only the **LVBC (2010) Assessing Reserve Flows for the Mara River** study has exclusively dealt with this issue. For this LVBC (2010) study, site selection began with geomorphological surveys that classified the river into three uniform macro-reaches based on gradient, channel pattern and bed structure. During initial field visits, the multidisciplinary group of specialists chose a representative site for each macro-reach. The selected sites exhibit fluvial processes characteristic of the macro-reach, as well as represent the interests of multiple stakeholders in the basin. Additionally, these sites incorporate small-scale habitat diversity; as such, all sites were placed on 100 meter long, straight stretches of the river that included runs, pools and riffles.

In the report Consulting Services for the Assessment and Design of Hydrometric Network and Guidance of Water Quality Survey for Mara River (NBI, 2008a), it notes that at present there are only 2 hydrometric stations operational on the Kenyan side of the Mara River Basin out of 7 stations that have been operated before. On the Tanzania side there are only 2 stations that are operational. This gives a network density of 3500 km2 per station, which is below the range of norms for a minimum network. In view of the anticipated development in the Mara River Basin, ten river gauging Stations are proposed to constitute the hydrometric network on the Kenyan side, while seven river gauging stations are proposed to constitute a network on the Tanzanian side of the Mara River Basin.

It is also important to consider assessment of the water quality in the basin, looking at this from a general IWRM point of view and not specifically from an EF point of view. The thesis by Christina Hoffman (2007) Geospatial Mapping and Analysis of Water Availability –Demand-Use within the Mara River Basin published by the Florida International University concluded that the total current water demand within the basin does not appear to eclipse water supply during periods of mean flow. However, the current water demand does pose a threat to water resources within the basin during periods of minimum flow. Most of this report was however, based on the demands for water resources in the basin linked to its availability. This work was done before any estimate of the EF for the Mara was developed, and thus EF principles were only considered in rough terms.

Gereta *et al* (2009) noted that as a result of various land based activities in Kenya, with business-as-usual in Kenya, the Mara River may dry out for at least one month when a severe drought such as that of 1972-1973 next occurs, and that as a result the Serengeti ecosystem may collapse - more precisely, the wildebeest population would drop 80% from about 1 000 000 to about 200,000 animals. They recommend that remediation measures are urgently needed in Kenya to restore the flow in the Mara River during low flow conditions and, if this does not occur, disaster prevention measures are needed to preserve this ecosystem by providing water in weirs, dams, and artificial wetlands along the Mara River, as well as extending by 5 km the western edge of

the park so as to reach Lake Victoria and to provide access to permanent water. They note that daily flow rates of the Mara River at Mara Mines during exceptional droughts may have been smaller than 1 m^3s^{-1}. Nevertheless, all eyewitnesses (e.g. park rangers) state that the Mara River has never stopped flowing though the flow apparently reduced to a trickle during the Oct-Nov. droughts in 1972, 1973, 1992, 1993, and 1997. The overall conclusions of the hydrological condition of the river in relation to environmental flows, is that during years of normal rainfall, the EF is met and ample water is available for extractive uses. During drought, the situation may be quite different, with a trend toward unacceptable alterations of the Mara River's flow regime. There is thus cause for much concern if the system is not to degrade to a point where the services from the river begin to fail.

There are currently three EFA stations along the Mara River i.e. (1) along Amala tributary at Kapkimolwa, (2) just after the confluence at the Mara Safari Club and (3) at the Kenya Tanzania border – New Mara Bridge. These stations mainly track the river flows at the upper and mid Mara and not the lower Mara. This study proposes two additional new stations: i.e station (4) to be located just after the Serengeti national park so as to track the activities within the Maasai Mara National Reserve and Serengeti National Park in the upper sections of Tanzania, while the last station (5) should probably be located at Kirumi just before the swamp so as to capture the influence of the North Mara Mines as well as other perturbations from upstream regions. Figure 8.1 shows the existing EFA stations 1,2 and 3, and the proposed EFA ataions 4 and 5.

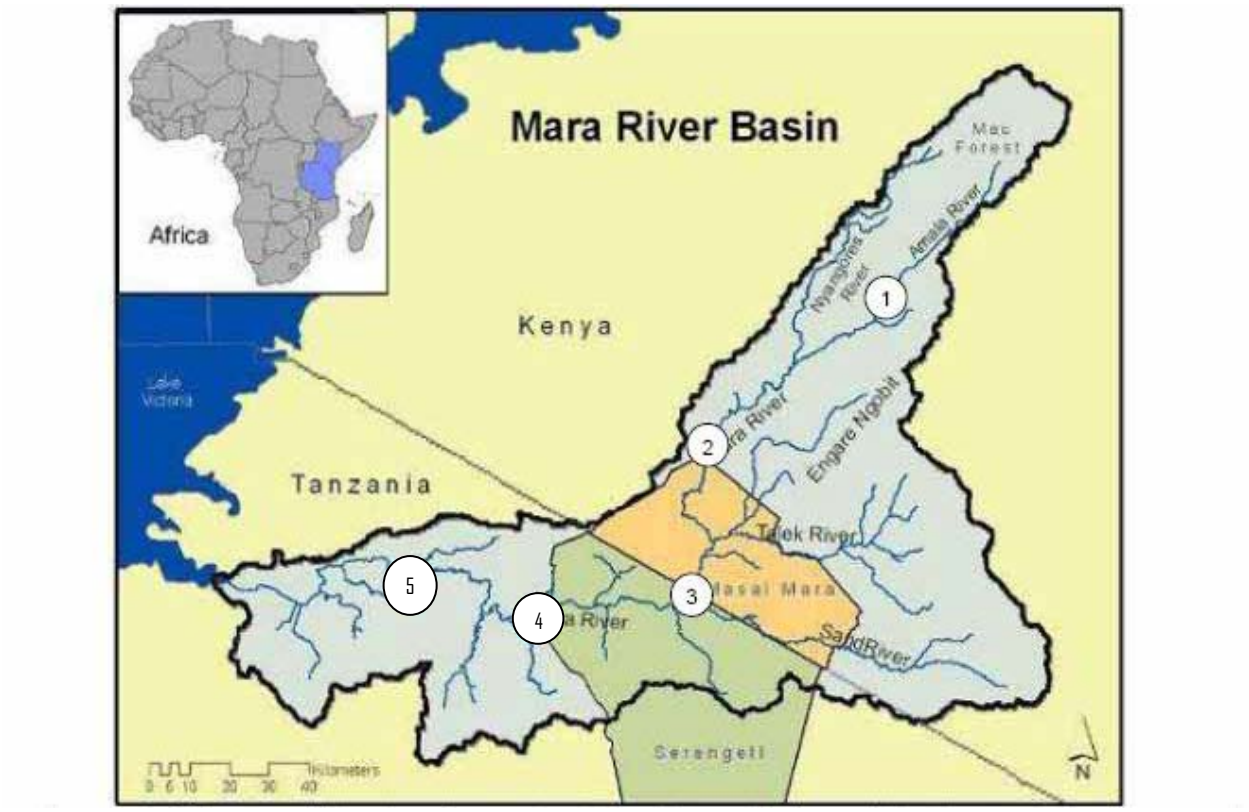


Figure 8.1. Map showing the zoning of MRB, current gauging stations and proposed gauging stations

In the LVBC (2010) Mara study, all sites were found to be declining under the current management regime. This is cause for concern, as all sites also had a Very High EIS (ecological importance and sensitivity). Pristine conditions are not likely to be achievable in this system given its importance to the Livelihood sector. Thus, an Ecological Management Category of a B was chosen, suggesting that management actions act to maintain current levels of system structure and functioning and to prevent further modification and degradation.

A follow-up assessment was conducted in February 2009 where a subset of the specialists who conducted the original work were brought back to investigate the situation during critical low flows in the river. The aim of this additional work was to identify and fill the data gaps from the initial assessment, and to emphasize the importance of ongoing monitoring to ensure recommended environmental flows are adequate.

8.2.1. Evaluation of the original & present state of the systems to be considered in gradual implementation and improvement of MRB-WAP

There are several reports which document the change in the river ecosystem over time, thus establishing the original condition against which the present is measured. It is not the place for this report to review all of these results other than in general terms related to the process of assessment rather than the results. Many of these reports refer to the change in hydrology of the river and attribute the decline to the degradation of the vegetative cover in the upper catchment as well as an increase in abstractions. These studies also refer to the deterioration of water quality in the river.

The LVBC (2010) project describes the Present Ecological State (PES) of the river at the three selected sites, recognizing the natural, or reference condition at each site and including an assessment of how far each site has changed from the reference condition. Sites have been ranked on a scale from A (natural) to F (critical/extremely modified) and were assigned a Trajectory of Change, indicating whether each component was getting better or worse under the current river management regime.

Sites were also classified according to their Ecological Importance and Sensitivity (EIS), indicating their importance for maintenance of ecological diversity and system functioning on local and wider scales, their ability to resist disturbance and their capability to recover from disturbance. Finally, sites were assigned an Ecological Management Category (EMC), summarizing the overall objective or desired state for each site. Sites could be ranked from A (natural) to D (largely modified); categories E and F were excluded from consideration because they were not considered sustainable.

The details of the PES, EIS, trajectory of change, and Ecological Management Category are all documented in the reports. Also provided are objectives for achieving a particular ecological category for each major component of the river ecosystem, e.g. the discharge required to provide for critical indicator species in the category selected, during February, is provided. The ecological consequences of NOT providing these flows are also documented, although in a way that is rather difficult to follow.

8.2.1.1. Hydrology

The LVBC (2010) report documented the hydrological situation in the basin. In order to determine historic patterns of flow in the Mara and its tributaries, data were collected from three different river gauging stations on the Amala River at the town of Mulot, the Nyangores River at the town of Bomet, and the Mara River at Mara Mines. Hydrology data from these sites were extrapolated to fit the three chosen study sites (Sites 1-3). Data were compiled to present historical flow records at different time scales and in wet and dry years. Data were also used to calculate flow duration curves and flood frequency and low flow recurrence intervals. This data indicated the magnitude and timing of flows, and noted that the river has not dried up completely at the study sites in the past fifty years of monitoring. Many of the tributaries, however, do stop flowing during the dry season. Note that no information on the quality of the hydrological data used for this project is provided in this report.

A report by Krhoda (2006) also documented the hydrology of the Mara basin. This report set out to link the hydrological characteristics with options for sustainable use of the water resource. The investigation did not undertake any field work and was limited in its ability to collect and produce information. All information used was in the public domain. One of the objectives of the report was to discuss the impact of upstream water users on downstream users, including requirements for wildlife in the Masai Mara National Reserve and spillover into Serengeti National Park and the biodiversity of the wetlands along the Mara river. This it does but provides only limited information, concentrating mostly on Kenya, with little that is of value to the environmental flow assessment. The basic hydrology is however useful.

A report by Melesse, *et al* (2008a) Hydrometeorological Analysis of the Mara River Basin, Kenya/Tanzania, part of the GLOWS project, documents the rainfall and corresponding discharge at three sites in Tanzania. They document the basic hydrology of the river, the maximum and low flows, and the monthly flow duration curves. A second paper by Melesse, et al (2008b) Modeling the Impact of Land-Cover and Rainfall Regime Change Scenarios on the Flow of Mara River, Kenya, noted that hydrometeorological analysis of the basin has shown a decline in the dry season flow and increase peak flood frequency in recent years. Changes in the precipitation pattern (distribution and volume), deforestation in the upper basin and increased water use activity in the large scale agricultural areas upstream is noted as an issue.

The LVBC (2010) report provides several hydraulic cross sections which were surveyed at each site, and enables a quantitative assessment of the habitat availability in relation to river discharge to be made. This information is essential if actual quantities of water are going to be attached to the flow requirements of the river ecosystem.The hydraulic information was used to calculate ecologically relevant parameters, such as wetted perimeter and depth. This information is presented in flow graphs such as that below.

8.2.1.2. Geomorphology

According to LVBC (2010) at Site 3 both the riverbanks and bed were assessed to be in good condition, although vegetation was sparse and wildlife trails had formed gullies traversing the riparian zone. It was concluded that frequent floods are necessary in both wet and dry years to maintain sandbars, benches and terraces of the active channel. Infrequent but extreme flood

events are necessary at this site to maintain the high terraces and floodplain of the macro channel, to transport sediment of larger size, and to reconstruct macro channel features that may have been degraded by external disturbances.

8.2.1.3. Water quality

In order to evaluate overall water quality in the basin and identify potential threats, a water quality survey was done throughout the length of the Mara River Basin in May-June, 2005 and 2006, and the findings were incorporated into the EFA. Water samples were analyzed for temperature, pH, electrical conductivity, total dissolved solids, salinity, turbidity, total suspended sediments, dissolved oxygen and nutrients. A subset of samples was further analyzed for the presence of heavy metals and pesticides.

Flows were recommended in order to maintain high water quality by flushing through of pollutants. The comprehensive results from this basin-wide water quality assessment can be found in GLOWS (2007). Again, a great deal of the work took place in Kenya and is not always relevant to this project, although naturally the upstream water quality impacts on the downstream river. Also, not all aspects of the work are of relevance to environmental flows, but the report provides a useful source of information for water quality that has been used in the environmental flow assessment.

While it is accepted that the environment should not be treated in the same way as a user of water (and impacted by water quality), a water quality standard for protection of the natural ecosystem would be of value and should be included in the list. List of water quality data collected and reported on the GLOWS report: Temperature, Alkalinity, pH, Electrical conductivity, TDS and salinity, Turbidity and Total Suspended Sediments, Hardness, Dissolved Oxygen, Nutrients, Dissolved Organic Carbon, Mercury and Aluminium (on some samples only), Pesticides (on some samples only).

This report concludes that “Increasing water demands in the upper basin in combination with contamination sources also seriously threaten the environmental flows needed to sustain wildlife in Masai-Mara National Reserve, Serengeti National Park, and Mara Wetlands”. In this they omit the perspective that environmental flows are needed to sustain the ecosystem in the entire Mara River, not just in the Game Reserves.

A report by Krhoda (2006) documented the hydrology as well as the water quality of the Mara basin. The data presented though is minimal and also old (1990-1992). In the report by the NBI (2008a) there is detail on a proposed monitoring programme for water quality. This report includes a baseline survey of the water quality on the Kenyan side of the basin, the outputs of which will be of value to the Tanzanian study.

8.2.2. Biotic requirements

The two reports (WWF – EARPO, 2007 and LVBC, 2010) that document the EF for the Mara River, present the results of a number of biological requirements for river flows. These are usefully presented, separately for each taxon, noting the discharge, duration and timing that is

needed to sustain that particular taxon. This follows detailed assessments of the present state of the ecosystem and of each biotic indicator, as presented above.

8.2.2.1. Riparian vegetation

The vegetation component of the LVBC (2010) study aimed to address three primary questions: 1) what important vegetation components are present at the selected study sites; 2) how does that vegetation relate to instream flows; and 3) which species at each site can serve as an indicator of appropriate flow regime?

During vegetation surveys, sample plots were systematically placed along transects running perpendicular from the river bed to the edge of the riparian forest. A list of plant species was recorded for each transect, along with species cover, abundance, height and structure. Vegetation zones along the transects were classified according to dominant plant species. The list of species and their horizontal distribution across the channel were analyzed by a classification approach, yielding information on the natural flow regime of the river.

At Site 3, it was determined that maintenance flows and flood events are important to foster recruitment potential and sustain appropriate density and age structure of important species. At all sites, maintenance flows are necessary to recharge the groundwater table in order to sustain woody species. Maintenance flushing floods are critical to maintain marginal vegetation species for bank integrity and to enhance seed germination and dispersal.

8.2.2.2. Invertebrates

The survey of invertebrates at Site 3 showed some deterioration (LVBC, 2010), with a substantial change in sensitivity score and a reduction of the number of taxa to 7. Because this site was located within the protected areas, human impacts were minimal; however, upstream degradation continued to impact these downstream locations. Target flow-dependent species were identified and their flow requirements determined, both at low flow and higher flow conditions.

8.2.2.3. Fish

Fish were sampled in surveys at each study site (LVBC, 2010) using gillnets placed in all available river habitats (i.e., riffles, runs and pools) and number and abundance of species, length and weight of individuals, and reproductive condition determined. Fish species were characterized according to their environmental guild, a classification system that groups species that respond similarly to changing hydrology and geomorphology. The flow requirements of the fish species were thus determined.

Additional work describing the fish in the Mara, in this case the lower section of the river, included that by Chitamwebwa (2007) Baseline Survey of Fisheries Resources in the Mara Swamp and Musoma Bay, Mara River Basin, Tanzania. Reports such as this provide added information for determination of the EF for the entire river, including the Mara Swamp and Musoma Bay.

8.2.3. Socio-economic situation

Data on population growth and increasing water demand were collected (LVBC, 2010). Surveys and interviews were conducted in communities dependent on the Mara River to determine the primary resources and services the Mara River provides. Participants were asked to rate the importance of those resources and also to identify current anthropogenic threats to the river ecosystem.

Based on projections of population increase in the Mara Basin, meeting the minimum needs of people in the basin will require only a small fraction of river discharge and are accommodated by the larger flows required to protect the ecosystem and Reserve flow. This may not always be the case in smaller rivers and tributaries. Documented in a report by Munishi (2007), the existing biodiversity of the Mara River swamp presents a variety of benefits to the communities adjacent to the swamp. These benefits accrue from utilization of this biodiversity for various purposes including domestic consumption as well as trade that can either be interhousehold trade or distant trade to various parts of the districts.

The total biodiversity benefits accruing from agricultural crops and other wetland products per person were estimated. A great deal of information is provided in this report, documenting the economic value of the Mara Swamp system. This is useful in establishing the need to provide EF in the Mara. A report "Mara River Basin Monograph (NBI, 2008b)" documents in great detail the *status quo* of the use of water resources in the basin. This ranges from water supply and sanitation, to agricultural use, fisheries, hydropower and environmental issues. Much of this information will be of value to understanding the situation of environmental flows, and will assist with the implementation of measures to manage the flows.

8.2.4. Evaluating the importance and sensitivity of the systems

A number of reports have been published which document the importance of the Mara River and Basin for the peoples of Tanzania and Kenya. These provide useful context for the imperative of proper management of the river system. Some examples are: According to Kisoyan (2006) and quoting widely from the work of Mutie *et al* (2005), the Mara watershed, straddling the Kenya–Tanzania border, is critical to the survival of pastoralists, farmers, fisher families and wildlife in the Mara-Serengeti ecosystem. It faces growing threats. The forested part of the Mara Basin has decreased from 752 km2 in 1973 to 493 Km² in 2000. This forest cover reduction in the headwaters has reduced the base flow and water quality in the river. They discuss the involvement of stakeholders and government in management of resources and note that a lack of regulatory government mechanisms and low capacity of key stakeholders in natural resource management has contributed to the current state of ecosystem degradation and the inequitable distribution of resources among the communities in Mara River basin.

It is widely noted that the Mara supports some of the highest levels of both species diversity and biomass of large herbivores in the world and is important internationally, regionally and nationally. The migration of large herbivores reaches the Mara River in July or August and continues northward, eventually crossing the border into Kenya's Masai-Mara National Reserve in September or October. This migration has been linked to water availability and water quality.

During severe droughts, which occur every six or seven years, even pools dry up, leaving the Mara River as the only perennial water in the region, essential for the survival of the migrants.

According to Gereta *et al*. (2009) the flow rate of the Mara during a drought has decreased by 68% since 1972 and modeling suggests that the Mara River would now dry out during drought years, leading to catastrophic collapse of herbivore populations. It is thus necessary to restore the natural hydrology of the Mara River in Kenya, and this requires remediation measures in Kenya.

The Mara Swamp is an integral part of a large and important fisheries industry which is dependent on the inflows from the Mara. Continued outflow of services from this system requires an input of flows from the Mara River, which highlights the importance of maintaining EF. At a superficial level, the Mara provides critical in-channel and riparian habitats to a host of animals.

There are two primary aquatic habitats, the Mara River itself, and the Mara Swamp. These habitats are linked in a continuous network extending from the headwaters of the basin in the Mau Forest through the Mara Swamp to Lake Victoria. They include channels and adjacent riparian habitats which are heavily dependent on the water and the flow regimes provided by the river.

The importance and sensitivity described above is generally related directly to the maintenance of goods and services for society. Unfortunately there are many other services provided by the river which are possibly even more important than those discussed above, but because they are not as obvious, may not gain the same level of support. For this reason, it has become an accepted norm that the importance of the ecosystem in its own right needs to be established, even if the provision of environmental services is not so obvious. Thus, in the management of a river, the importance of the ecosystem, as an ecosystem, needs to be established.

There has unfortunately been little consideration of the importance of the Mara River ecosystem in this way, considering the species that it contains, the rare and endangered species, the ecological process that underlie the workings of the ecosystem, the role in maintaining channel form, in cleaning up polluted water and processing organic contaminants, the importance of the in-channel and riparian habitats etc etc. Are these ecosystems important on a local, regional and international scale – understanding of which would lend context to efforts to maintain them?

There is then also little consideration of how sensitive and resilient these ecosystems are all to stresses imposed by utilization of the resource. A sentiment expressed in the report by Chitamwebwa, (2007) states that *"in co-management of resources,which takes into account the interests of every stakeholder, a fish species becomes of conservation significance if it is important to the stakeholders. And for local communities, they would pay attention to the conservation of a given species if it is profitable to them either as food or as an income earner. Thus all currently exploited species from the bay and swamp are of conservation significance since they are of value to the communities"*.

While this view is true at a level and does at least acknowledge the relationship between the ecosystem and the value to society, leaving the judgment of this to stakeholders is fraught with

dangers, as stakeholders do not always appreciate the provision of services from the ecosystem, mainly because they do not understand what is being provided to them. For example, can rural stakeholders understand the value to them of a carbon sink offered by a peat swamp? Do they understand the value of benthic invertebrates in purification of water of organic pollutants? Stakeholders often have a biased and short term view on the provision of these services, and thus cannot be relied on to be arbiters of what needs protection.

It is thus strongly recommended, that a proper evaluation of the importance and sensitivity of the Mara River ecosystem is carried out. New initiatives are presently under way under the MaraFlows programme that will provide additional information that will address some of these issues (UNESCO-IHE: Institute for Water Education, 2009). The project addresses the overall objective of *understanding better the relationships between the flow regime of the Mara River Basin and aquatic ecosystem processes that maintain water quality in the river channel and the productivity of papyrus and select fish species in the Mara Wetland*.

8.2.4. Quantifying the environmental flow requirements

A standard approach as outlined by the BBM method for determination of environmental flows was followed for the three sites on the Mara River. This has been summarized in the two reports – the Environmental Flow Assessment (EFA), Mara River Basin: Proceedings of the Final EFA Workshop, (WWF – EARPO, 2007) and Assessing Reserve Flows for the Mara River (LVBC, 2010), which can be summarized as follows:

The EFA Team met in October, 2007, to determine the flow regime needed to meet the Resource Quality Objectives (RQOs) of the river. Each specialist presented the necessary flow requirements for his or her component of the river system for each of the environmental flow building blocks. Specialists explained their motivations for all flow requirements and described the potential consequences of not meeting the requirement. During the process, a consensus was sought among the specialists of the minimum flows and floods that would suffice to achieve the RQOs.

Based on the specialists' recommendations for average flows during key months of the year, the hydrologist extrapolated these recommendations across the entire year in a manner that simulated the natural shape of the river's historical hydrograph. The modified hydrograph, with associated floods, serves as the recommended Reserve flow. These Reserve flow recommendations were compared with the historical hydrograph for each site in order to determine the amount of water available for extractive use.

At Site 3 on the border between Kenya – Tanzania and Masai Mara National Reserve – Serengeti National Park, the Reserve accounts for, on average, 35% of the average monthly flow recorded over the 26 years of available flow data from the nearest gauging station.

It is important to note, however, that the percent of flow held in the Reserve varies over the course of a year, mirroring the natural highs and lows of the system. The majority of water available for abstraction is therefore concentrated in a few months when flows are high. Far less water is available for abstraction during dry season months.

The observation that drought year reserve flows are not being met in the upper and middle reaches of the Mara may be the first clear evidence of a trend toward unacceptable alterations of the Mara River's flow regime. Upstream impacts are necessarily linked to downstream resources, and poorly managed water abstraction above the wildlife reserves will ultimately affect the downstream reaches as well. Furthermore, the Reserve estimates in this assessment have not taken into account the environmental flow requirements of the Mara Wetland, which may be different.

The Reserve also does not include flow volumes necessary to meet the extractive water needs of Tanzanian communities and industries between Serengeti National Park and the Mara Wetland. Thus, flow levels reaching Tanzania must be high enough not only to sustain the Reserve but also to meet Tanzanian extractive needs.

8.3. Process for Revising MRB-WAP

Revisions to the WAP are expected given changes in the human and natural environment and emerging information on the availability and use of the water resources. This section sets out the procedures to be adopted when revisions to the WAP are deemed necessary or at the end of each period.

8.3.1. Incremental changes to MRB-WAP

All proposed changes to the WAP must be channelled through to the MRB joint office which is also the custodian of WAP then to regional offices for endorsement. Proposals for changes to the WAP can be initiated by an individual water user and/or WRUA and must be submitted in writing to regulating body, stating the following:

i. Part of the WAP that requires amendment;
ii. The alternative options with supporting details as well as recommendations

Proposal for amendment will be reviewed by the MRB Office and send it to regional offices then to WRUAs for comments. The regional offices can support and recommend further action on the proposal. If the proposal has merit and regional offices recognise the need to take action, a meeting is convened and WRUAs are invited for discussion. More information can be sought before the discussion if necessary.

If there is agreement that certain provisions within the WAP require amendment, then the WAP can be amended and endorsed by all the stakeholders. There might be need to place an advertisement in the newspaper to ensure widespread notification of the changes to the WAP.

8.3.2. Evaluation and review of MRB-WAP

At the end of the period of the WAP, the regional offices and joint MRB office carry out a detailed evaluation of the WAP. The evaluation would provide a basis for detailed, and if required, substantial revisions to the WAP. The areas to be covered include;

i. Objectives and indicators;

ii. Conditions;
iii. Compliance;
iv. Enforcement;
v. WAP monitoring and review process.

Preparations for Revising MRB-WAP will require amendment as additional information becomes available. However, the regional offices, the MRB joint office, the WRUAs, the water users and other stakeholders have a responsibility to see that additional information is collected and made available to the WAP review process. There are key areas where additional information is required and can make significant contribution towards the WAP review process. These include;

8.3.2.1. Water use efficiency survey

At present there is a gap of information regarding detailed information on abstraction and water use within the MRB. It is proposed that the WRUAs will initiate comprehensive field based abstraction and water use survey. The terms of reference for the survey revolve around:

i. Details on abstractor;
ii. Details on water use activity (production information and systems);
iii. Details on abstraction works, meters, controlling device, number of intakes, etc;
iv. Details on quantity of abstraction;
v. Details on water demand management (storage, re-use, soil moisture monitoring);
vi. Details on all authorisations and permits.

Water use efficiency survey can be used to analyse various options for promoting water demand management. It involves the application of selective economic incentives, to promote efficient and equitable use of water as well as a number of water conservation measures aimed at raising awareness on the scarcity and finite nature of the resource. It may vary from season to season depending on water availability but more critical in situations with insufficient water supply like the MRB. LVSCA is keen in developing and adopting water resources allocation thresholds for each sub-catchment and this should be expanded to include the whole basin. It allows for efficient water use to free up water to meet reserve requirements. It can be encouraged through;

i. **Water pricing**: If a water user has to pay for the actual quantity of water that is abstracted from the resource, and the cost is significant in terms of the returns made from the water, then the user is more likely to reduce unnecessary abstraction. This will reduce wastage and provide an incentive for more water efficient technology;
ii. **Water efficient technology**: With respect to irrigation, more efficient production can be made using efficient irrigation application systems (hydroponics, dripping water to root zone), applying irrigation water when a plant needs it, (i.e. using soil-water tensiometers) and generally being much more scientific about the quantity and timing of irrigation applications.

iii. **Crop selection**: A water user may select a crop with a lower water demand, hence reducing the water use.

Technology Based Strategies to include; Self regulating and metering devices to measure water flows, recycling of water to reduce water abstracted, encouragement of Conjunctive use of water, application of efficient water use technology in agriculture and making everyone aware of the state of water resources and the expected actions to be taken by the individual users or organizations.

8.3.2.2. Hydrological data

The regional offices, the MRB joint office and the WRUAs to make a concerted effort to update the hydrological monitoring network. This includes making investments in the gauging stations and local gauge readers and establishment of a joint data base for data management and analysis for clear and accurate definition of thresholds between different resource availability zones for use in WAP.

8.3.2.3. Permit and water use data

The MRB joint office in consultation with the regional offices to development a comprehensive Permit Database to support the management of permit and water use data. In effect this means that allocated amounts and actual abstraction can be quickly compared through the functionality of the Permit Database.

8.3.2.4. Water allocation efficiency

Water allocation efficiency requires that for limited water resources, the water should be allocated to those types of uses that maximise the benefits. Water allocation efficiency looks at whether the water is being allocated and used by the most efficient user with reference to economic returns per cubic metre of water or number of people employed per cubic metre of water or impacts on the environment.

8.3.2.5. Water demand management

Water demand management is concerned with efficient use of water or reduction of water demand. In the context of limited availability of resources, it is important to find ways of using the water more efficiently to free up water for the Reserve. Various options are available some of which were mentioned by stakeholders during the field visits. These included:

8.4. Making MRB-WAP Operational

This section outlines how to make the MRB WAP operational after it has been adopted by the regional offices, the MRB joint office, the WRUAs and other stakeholders.

The MRB-WAP will be put into effect once it has been approved by the regional offices. This implies that the WAP will be used in respect of decisions and actions by the WRUAs, the regional offices and the MRB joint office when considering water permit applications and dealing with water allocation decision. In order to make the MRB WAP operational, the MRB joint office will review its responsibilities within the WAP and plan and budget. The items to be included are;

i. Staff requirements
ii. Logistics for monitoring
iii. Communication costs
iv. Costs for establishing a joint database.

Table 8.1 shows the proposed activities for effective implementation of MRB-WAP.

Table 8.1. Proposed activities for effective implementation of MRB-WAP

	Activity	Timeframe	Actors
1.	Establishment of a joint regulating body with effective administrative office and supported by all the WRUAs to be in charge and manage the water resources and related issues of the trans boundary MRB.	Jan-June, 2013	Water and related ministries of both countries, LVBC, NGOs, WRUAs
2.	Establishment of gauging and weather stations within the MRB to provide reliable hydrological data.	Jan-April, 2013	WRMA, LVBWO, WWF, LVBC, WRUAs, Locals
3.	Establishment of reserve flow levels/ Environmental flow settings at all critical identified river reaches and their operationalization in water allocation within MRB.	Jan-June, 2013	WRMA, LVBWO, WWF, LVBC, WRUAs, Locals
4.	Carrying out of a joint (both Kenya and Tanzanian) comprehensive water extraction survey within the entire MRB to update existing water use database.	Jan-June, 2013	WRMA, LVBWO, WWF, LVBC, WRUAs, Locals
5.	Development of effective water allocation frameworks/guidelines for MRB to address competing demands for water resources (current and future scenarios).	Jan-April, 2013	WRMA, LVBWO, WWF, LVBC, WRUAs, Locals
6.	Examination and review of the existing threshold levels of water permits for the Mara River in both in Kenya and Tanzania	Jan-March, 2013	WRMA, LVBWO, WWF WRUAs

7.	Development of an effective mechanism for water abstraction restriction for both countries.	Jan-June, 2013	WRMA, LVBWO, WWF WRUAs
8.	Establishment of joint eenforcement plan of the water laws and regulations guiding water allocation	Jan-June, 2013	WRMA, LVBWO, WRUAs
9.	Harmonization and development of joint procedures with conditions/requirements applicable in the whole basin for both Kenya and Tanzania for; i. Water permit application ii. Establishment of different water permit classes/categories iii. Permit renewal/amendment iv. Bringing an existing /new water user into compliance v. Water abstraction restrictions when water resource availability reduces	Jan-June 2013	WRMA, LVBWO, WWF WRUAs, Locals
10.	Development of procedure for revising WAP-Key areas of revision may include; i. Water Use Efficiency Survey ii. Hydrological Data iii. Permit and Water Use Data iv. Water Allocation Efficiency v. Water Demand Management	Jan 2013-Dec 2015	WRMA, LVBWO, WRUAs

8.4.1. Supporting joint MRB office

Many of the responsibilities for the implementation of the WAP fall on the MRB joint office. It will combine operations in both Kenya and Tanzania and it's to be established within the Basin and as such requires support to develop the capacity to be able to fulfil its roles effectively. Support to strengthen the MRB joint office is required from:

i. Regional offices and the related ministries in the two countries
ii. Development and environmental NGOs e.g. WWF, TANAPA, ;
iii. WRUAs

8.4.2. Financing MRB-WAP

The WAP is a framework for decision making and is therefore not a 'one-off' project requiring financing. It will require all the institutions involved to have sufficient financial resources to cover their own activities and responsibilities. The institutions need to consult and examine their

responsibilities and budget accordingly to complement their activities and avoid duplication of roles.

CHAPTER NINE

9.0. ENFORCEMENT, COMPLIANCE, AND ROLES OF DIFFERENT PARTIES

This chapter discusses the enforcement plan of the Mara River Basin – wide water allocation plan.

9.1. Enforcement Plan

The legal requirements are laid down in the water laws in both countries (Water Act 2002, Kenya and Water Resources Act 2008 – Tanzania) outlines the necessary regulations and for proper apportioning and use, to meet the economic and social development through sustainable management of water resource. The institutional arrangements allows for the formation of WRUAs with specific roles to perform.This section sets out the arrangements for enforcement of the WAP. It is recognised that there are various actions that the individuals (whether water users or not), WRUAs and environmental groups can undertake prior to engaging regulating body to bring the force of the law to bear. The WRUAs are actually water users and are an important entry point because they will easily identify non compliant users, sensitize their members, conducting inspection and patrols and embedding codes of practice for the users in their constitution. Thus they become vital enforcement tools at the primary level. The enforcement plan touches on:

a) Mechanisms for reporting infringements to the WAP;
b) Action against violators;
c) Penalties and restrictions on violators;

The Approach to enforcement of the WAP is a primary responsibility of the regulating body as it has the overall responsibility to see compliance to all the water regulations.

a) A “name and shame” approach has been adopted as it is hoped that most water users would be embarrassed to be singled out and see their names appearing in the newspaper in respect of violations to the agreed WAP.
b) The WRUA would therefore invite the regulating body in cases where it cannot obtain compliance by a WAP violator.
c) It is assumed that the majority of violations will occur in regard to the application of abstraction restrictions as there is more open sharing of information regarding allocation decisions through the WRUA commenting on permit applications.

9.1.1. Reporting violations

Violations of WAP conditions must be reported in writing by any individual, organisation, WRUA or Even by the regulating body. The report can be anonymous. Each report will in the

first instance be directed to the relevant regulating body and must contain the following information:

a) Name;
b) Place/location;
c) Water body;
d) Nature and time of violation.

Typical violations include:

a) Lack of or tampering with master meter and controlling device;
b) Lack of proper water use data;
c) Restricting access to WRUA inspector;
d) Abstraction in excess of permitted amount;
e) Failure to comply with Water Allocation Plan during restrictions periods;
f) Unauthorised modification to abstraction works and/or equipment;
g) Modification of the water course or channel;
h) Abstraction without valid permit.

9.1.2. Investigating violations

Each WRUA will appoint a person or persons to be the Investigating Officer ("Referee") – someone mandated and facilitated to investigate WAP violations on behalf of the WRUA. The procedure to be followed is:

a) WRUA to notify investigating officer of reported violation within 1 week of receiving report;
b) Investigating officer to undertake investigation within 2 weeks of receiving report and submits report to WRUA committee with recommendations.

9.1.3. Taking appropriate action

The action taken will depend on the severity of the violation. If the violation is considered severe enough to warrant an action, the following actions will be taken:

a) 1st warning: Written instruction from WRUA to water user to cease the violation within 2 weeks. WRUA follows up with inspection;
b) 2nd warning: Written instruction from WRUA to water user to cease the violation within 2 weeks. Notice is copied to all WRUA members. WRUA follows up with inspection;
c) Last warning: Written instruction from WRUA to water user to cease the violation within 2 weeks. Notice is copied to all WRUA members, regulating body and a notice is placed in national newspaper. WRUA follows up with joint inspection with regulating body;

The regulating body will then take official action against the violator if no remedial action has been taken. Action by WRMA may include:

a) Issuing an Order as per laid down WRM rules;

b) Confiscating equipment and/or blocking the illegal activity (e.g. locking pump house or controlling device);
c) Suspending or revoking permit;
d) Prosecuting the offender who, if found guilty, would be liable for a fine, imprisonment or both.

9.1.4. Review and reporting

At the end of each year the WRUA will prepare a report stating the number of reported violations and the action taken. This report will be included in the Chairman's Report during the AGM.

9.1.5. Penalties for violation

The regulating body will follow the WRM Rules in respect of penalties for violations of the WRM Rules.

Each respective WRUA may consider introducing penalties on their members for violations as part of their bylaws. Options for penalties may include:

a) Financial penalties (varied according to whether it is a yellow or red card warning);
b) Restrictions on water use;
c) Imposed community service obligations.

9.2. Compliance Plan

This section sets out a plan to bring water users into compliance with the WAP.

The Approach will involve the regulating body will work collaboratively with the WRUAs and water users to protect the interests of legal water users as well as ensure environmental sustainability and support economic growth. Compliance will be sought by education and encouragement wherever possible, but, where appropriate, enforcement measures will be used.The regulating body shall promote compliance by:

a) Removing barriers to compliance (e.g. lack of knowledge regarding WAP and how to comply with them);
b) Overcoming factors that encourage non-compliance (e.g. lack of public support for, or misunderstanding of water resources management objectives);
c) Raising awareness of the benefits of complying with the rules and the potential consequences of not complying.

9.2.1. Communication

The system of water abstraction restrictions can only function if two conditions are met:

a) Water users are given adequate information regarding the state of the resource and the likely onset of the restriction condition;
b) Water users respond to the information and comply with the restriction conditions. This second aspect requires monitoring and enforcement.

In order to provide water users with adequate information, the following action is required:

a) Sufficient staff gauges measuring water levels placed on each water resource at relevant locations. This should be undertaken by regulating body and the WRUAs. This is captured in the compliance plan;
b) WRUAs to monitor the staff gauges and provide WRUA members and other water users with information regarding
    (i) The current state of the resource (i.e. which restriction zone applies)
    (ii) The likely onset of any change in the restriction zone (i.e. a forecast of future resource conditions). This information to be provided:
        1) On email;
        2) On public billboards;
        3) Through periodic notices in the national newspapers;
        4) Through SMS technology.

Information regarding the current state of the resource is obtained from the staff gauges. At present there is no basis for forecasting future resource conditions. This is a research topic that needs to be pursued by research stakeholders e.g. the local university institutions.

9.2.2. Actions required to build compliance

Proposed actions to cover water availability status, communication systems and awareness promotion, compliance building, conditions of authorization, and monitoring water use, allocation, compliance to abstraction restrictions and funding plans.

i. Establishment of a joint sub-office to be responsible for water allocation and monitoring within the whole MRB by the LVSCA WRMA in Kenya and LVBWO in Tanzania.
ii. Establishment of staff gauges and setting/clear definition of thresholds for flood, normal and drought flows for monitoring state of water resources.
iii. Awareness campaign on Water Allocation Plan, its purpose and importance
iv. Establishments of locations for public notifications on resource availability
v. Establishment of systems or models for forecasting future resource state
vi. Accurate updating of Water users register at the regional offices through extraction survey and apply for, renewal, or amendment of allocation where applicable
vii. Installation of metering and controlling devices by the water users where applicable and confirm application of self-regulating principles.
viii. Regular submission of water use data by the water users.
ix. Sharing of all permit applications, renewals, transfers and amendments with the WRUAs for their comments and information.
x. WRUAs to undertake monitoring inspections during restriction periods e.g. during red and black restriction periods
xi. Develop budget and solicit funds for WAP implementation by WRUAs and the regional offices.

CHAPTER TEN

10. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

In view of the competing demands for Mara River water resources by different users against the ever diminishing water resources, there is need for a shift in the casual way in which water resources are viewed as unlimited and free for all to a clear recognition of the basic principles that are critical for efficient water resource management within the basin. Some of the most important principles include:

The Reserve flow which commands the highest priority in terms of water allocation and it implies that in the context of a very severe drought, even domestic water supplies may need to be rationed; Equity is another important principle which essentially implies that there should be a fair balance between environmental, livelihood and commercial benefits. Additionally it implies that new water users should be eligible for water allocation, depending on the priority attributed to their needs.

Minimization of the social and economic disruption is another important principle in WAP. The principle implies that any changes that need to be implemented to ensure compliance with the WAP or any future changes in the WAP should provide for a transition period to enable social and economic adjustments to be made. This therefore means that any existing lawful and beneficial use of the waters of the Mara River should not be quickly, arbitrarily or unnecessarily curtailed;

The development of the WAP is made in the context of the current demands, populations and priorities available at the present time. However, as population increases, better information and understanding is gained, or priorities change, this also changes the quantities of water in the stream and also the quantity of water abstracted. This therefore brings to the fore the need for revising the WAP to reflect such developments. There is need for negotiations and trust during revisions to the WAP between different stakeholders. In addition, the process of negotiations requires informed and mandated representatives of stakeholder groups as well as sufficient time and the right for the negotiations to take place effectively.

During this study, it was noted that hydrological information including ground water yields, soil erosion, sediment transport, and water management practices was limited. Further studies will be needed to provide more precise data for river flows as well as environmental flows, water demand, water extraction, permiting andpermiting for review of the MRB-WAP in the future. The WEAP scenarios and water balance analysis in this MRB-WAP will provide a starting point for dialogue with interested parties about the various options for water resources allocation. Beyond this, determination of the unit costs of providing additional water may provide a basis for water charges and permits. The relevant ministries in both Kenya and Tanzania have expressed the need for this kind of information under their water reforms that value water as an economic good by the introduction of user water charges and permits, and decentralization of water resources management to the catchment level. The Catchment Management Strategies should also recognize the eco-hydrological, hydro-economic and socio-cultural information

generated for different water management scenarios and embrace appropriate measures for informed and improved basin-wide water allocation.

The MRB-WAP aims to preserve the proportions of annual discharge from the Mara River and its tributaries' catchments including feeder springs and streams to maintain base flow in the Mara River and its tributaries, and to maintain the drought reserve flow, and during normal or wet years to maintain the normal reserve flow; to protect ecosystem integrity and water quality within MRB watershed, and also, to protect water sources and the main Mara River and its tributaries against degradation through extraction, damning, or bore constructions, and unlicenced abstraction practices to be monitored and corrective measures taken.

In all years except very dry years, MRB rural folk and domestic use to have access to sufficient water, plus additional amount should there be growth in lawful exercise of water rights. At the 5 year review of MRB-WAP, or sooner if practicable, the aim should be to monitor current and projected water demands; to have sufficient water available from the consumptive pool to satisfy identified requirements. According to this MRB-WAP, all water users permitted, existing users brought to compliance, and permits renewed/amended, metering of major uses done; environmental settings in MRB reviewed, original sites and present sites evaluated and new sites set up; water use and abstraction surveys carried out, and systems put in place to collect adequate hydrological data, including underground water distribution, levels, and other information.

The stance of each of the two countries (Kenya and Tanzania) on current national ecosystem management approaches is very strong, as attempts to joint management have revealed. To help support full implement of the MRB-WAP, there is therefore need to use third parties, including diplomatic approaches and channels, to assist each country to soften its position on issues of ecosystem management, including wildlife management and tourism, before attempting to draw up a viable management plan that has ecosystem and neighbourly considerations. The two countries should be assisted to come together at a high level (Ministerial) and discuss this report with a view of agreeing on fundamental issues raised with regard to ecosystem management and possibly agreeing on the action plan provided in this document or any other emanating from revelations herein. The action plan developed to enable a step by step progress to a goal desired and expected by all conservators. Local and international non-state actors with deep and genuine interest in wildlife conservation in the two countries have not been fully involved in setting policy towards ecosystem management. These should not only be involved but, ought to play a moderation role between the two parties who do not seem to relax their historically attained positions. Ecosystem management in the two countries will not be easy achieve by only amending clauses in the existing national legislations, since these have been built on policies that are not trans-boundary friendly and which do not consider broader ecological concerns. Change of policies is the key to future direction. Policies for management of trans-boundary resources should be designed in a participatory manner with the involvement and consultations of the country across the frontier.

The two countries of Kenya and Tanzania should aim to harmonize and enforce policies and legal requirements for supporting full implementation of MRB-WAP, including identification of existing gaps. The two countries and institutional bodies and stakeholders should set up new laws, revised laws, subsidiary legislation and by laws, where required, and ensure full enforcement, compliance, and roles of different parties established; continue partnership with WUAs and WRUAs, research organizations and other institutions to improve knowledge of

ecosystem water requirements; undertake consultation and research to improve understanding of indigenous water issues and options to address them. The strategy is to involve all the stakeholders and donor communities and other regional institutions to fund the studies and surveys. Funds collected from water users can also be used. Also, funds from Payment of Ecosystem Services, if frameworks can be set-up, can also be used; to have the two governments and their relevant institutions involved in the management of the MRB water resources in a manner agreed upon and acceptable by both countries.

REFERENCES

Aboud, A. A., Obweyere, G. O., Mutinda, M. M. & Raini, J. A. (2002). A Rapid participatory assessment of the River Mara Basin. Mara River Catchment Basin Initiative, WWF Eastern Africa Regional Programme Office (EAPRO), WWF, Nairobi, Kenya.

Agarwal, A. K., Rajiv, M., Yadav, S.K. and Haldar, A. L. (2005). "Augmentation of Irrigation Water Requirement Using Remate Sensing and GIS Technique in Jalalabad block, Kannauj district, U.P.",Procc. Of National semi on GIS Application in Rural Development, Hyderabad, PP 21-23.

Allen C. (2007). Can adaptive management help us embrace the Murray-Darling Basin's wicked problems? In: PAHL-WOSTL C, KABAT P and MOLTGEN, J (2008) *Adaptive and Integrated Water Management, Coping with Complexity and Uncertainty.* Springer, pg. 61-74.

Assaf, H. (2009). A hydro-economic model for managing groundwater resources in semi-arid regions. *In Water Resources Management V* (ed. C.A. Brebbia). WIT Transactions on Ecology and the Environment, Volume 125, WIT Press, Southampton.

Ayieko J (2007). Mara River EFA Study, Annex 6.1 Starter Document 5. Riparian Vegetation Component.

Batula Awale 92007). Mara River Basin. Environmental Flow Assessment Proceedings of the Final EFA workshops – MRB-WWF-EARP

Bhat, M., Ombara, D., McClain, M., Atisa, G. and Kasanga, W. (2010). *Payment for watershed services in the Mara River Basin*. Global Water for Sustainability Program, Florida International University.

Biswas, A. K. (2004). Integrated Water Resources Management: A Re-assessment. Water International 29(2): 248-256.

Borst, L., Haas de, S.A., (2006). Hydrology of sand storage dams. A case study in the Kiindu catchment, Kitui District, Kenya, Master Thesis Hydrogeology, Vrije Universiteit Amsterdam. <http://www.hydrology.vu/hydrology/ student_1.html> (accessed 03.09.12).

Braadraart Okke (1995). "Regulatory Strategies and Rational Polluters: Industrial waste-water control in Indonesia, 1982-1992." *Third World Planning Review*, 17(4) 1995.

Cap-Net, United Nations Development Programme (UNDP). 2008

Central Bureau of Statistics 1994 Report- volume II and volume IV

Chitamwebwa, D. B. R. (2007). *Baseline survey of fisheries resources in the Mara Swamp and Musoma Bay, Mara River basin, Tanzania*. Global Water for Sustainability Program, Florida International University, Miami, Florida.

Daily Nation (2010). Daily Nation, Wednesday March 3, 2010.

Davies, T. C. (1996). Chemistry and Pollution of Natural Waters in Western Kenya. *Journal of African Earth Sciences 23(4): 547-563.*

De Pauw (1984). Soils, physiography and agro ecological zones of Tanzania. A Consultant Report submitted to United Republic of Tanzania.

Dickens, C. 2011. *Critical analysis of environmental flow assessments of selected rivers in Tanzania and Kenya*. Nairobi, Kenya: IUCN ESARO office and Scottsville, South Africa: INR. viii+104pp.

Dinar, A., Rosegrant, M. W. and Meinzen-Dick, R. (1997). *Water allocation mechanisms: Principles and examples*, World Bank Working Paper, World Bank, Washington, DC, USA.

Du Toit, J. T. (2002). Wildlife harvesting guidelines for community based wildlife management: a southern African perspective. Biodiversity and Conservation 11:1403-1416.

Dukhovny V.A., Sokolov V.I. (2000). Integrated Water Resources Management in the Aral Sea Basin. ICWC Training Center and McGill University. Tashkent.

DWAF (2004). National Water Resources Strategy. Department of Water Affairs and Forestry Pretoria, South

DWAF, (1999). Resource Directed Measures for Protection of Water Resources. Volume R29. Using Ecological Management Classes to Derive Integrated Resource Quality Objectives and the Ecological Reserve for Water Resources. Department of Water Affairs and Forestry, Pretoria, South Africa.

Dwasi, J. (2002) 'HIV/AIDS and Natural Resource Management in Africa: Findings from Kenya, Namibia, South Africa, and Uganda', unpublished report http://www.frameweb.org/adl/en-US/2323/file/327/Final_Draft_of_Jane_Dwasi_Report.doc (12 February 2013)

Fu, B. J., Zhao, W. W., Chen, L. D., Zhang, Q. J., LU, Y. H., Gulink, H., Poesen, J. (2005). Assessment of soil erosion at large watershed scale using RUSLE and GIS: A case study in the Loess Plateau of China. Land Degradation and Development 16: 73-85

Gediz basin - Turkey. WatManSup report No. 5, 44pp. http://www.futurewater.nl/watmansup/

Gereta E, Wolanski E, Makus B & Serneels S (2001) .Use of hydrological model to predict the impacts on Serengeti ecosystems of deforestation, irrigation and the proposed Amala weir in Kenya *URL http//www.2gf.de/mitarbeiterbereich/pdf/AmalaStudy.pdf*

Gereta, E., Mwangomo, E. and Wolanski, E. (2009) Ecohydrology as a tool for the survival of the threatened Serengeti ecosystem, Ecohydrology and Hydrobiology 9(1) 115-124.

Gereta, E., Wolanski, E., Borner, M. and Serneels, S.. (2002). "Use of an Ecohydrology Model to predict the impact on the Serengeti Ecosystem of deforestation, irrigation and the proposed Amala Weir water diversion project in Kenya: Tranboundary Issue". *Ecohydrology & Hydrobiology*, 2 (1-4), 127- 134.

Global Water for Sustainability (GLOWS) 2007. *Water quality baseline assessment report: Mara River Basin.*

GLOWS (2005) Water quality data – May 2005 sampling campaign. The Global Water Sustainability (GLOWS) Program. Accessed at http://glows.fiu.edu.

Government of Kenya (1975). Sessional Paper no. 3 of 1975: Statement of future wildlife management Policy in Kenya.

Government of Kenya (1994). Sessional Paper No: 1 of 1994: recovery and Sustainable Development to the Year 2010 (GoK 1994).

Government of Kenya (1999). Sessional paper No. 6 of 1999: Policy Paper on environment and Development

Government of Kenya (2000). National Biodiversity Strategy and Action Plan (NBSAP) (GoK 2000). Government Printers, Nairobi

Government of Kenya (2002). The Water Act, Chapter 372, Laws of Kenya. Government Printer, Nairobi, Kenya.

Government of Kenya (2006). National Tourism Policy. Government Printers, Nairobi.

Government of Kenya (2006a). *National water resources management strategy*. Ministry of Water and Irrigation, Nairobi.

Government of Kenya (2007). Water Resource Management Rules. Government Printers, Nairobi

Government of Kenya (2008). Environmental and Social Management framework for The Lake Victoria Environmental Management Project Phase II. Ministry of Environment and Mineral Resources. Nairobi

Government of Tanzania (1998). Forest Policy. Government Printers, Dar es Salaam.

Govt Kenya (2006b). *Facts and figures* 2006. National Bureau of Statistics http://www.cbs.go.ke/downloads/pdf/Kenyafacts.pdf accessed June 2007.

Guiraud, R. (1989). *Les Barrages d'Inféroflux Leur Intérêt pour l'Afrique Saharienne et Sahélienne*

Hoffman, C. M. (2007). Geospatial Mapping and Analysis of Water Availability-Demand-Use within the Mara River Basin, Master of Science in Environmental Studies Thesis. Florida International University, Miami, Florida

Homewood et al. 2001. Long-term changes in Serengeti-Mara wildebeest and land cover: Pastoralism, population, or policies?

Hope, R. A., Foster, T., Money, A. and Rouse, M. (2012). Harnessing Mobile Communications Innovations for Water Security. Global Policy (early view).
http://www.eflownet.org/index.cfm?linkcategoryid=1&siteid=1&FuseAction=main

Huisman, L. & Wood, W. E. (1974). *Slow Sand Filtration*, World Health Organization, pp. 122.

Initiative Consultants. (2010). *Upper Mara River sub-catchment management plan*. Mara Water Resources Management Authority, Nairobi, Kenya.

IUCN (2010). Report on a Workshop on Environmental Flows Review - The Future of Environmental Flows: Providing Water for Nature and People held in Morogoro, Tanzania, between August 2nd and 4th 2010.

JICA (2000) *Ghana Kangai Shokibo Nogyo Shinko Keikaku Junkai Shido Chosadan Hokokusho* [Report by the Research Team for the Traveling Guidance of the Small-Scale Irrigated Agriculture Promotion Project in the Republic of Ghana].

Katui-Katua M. (2004). *Drawers of Water II: Kenya Country Report.* International Institute for Environment and Development, UK: http://www.eldis.org/static/DOC16232.htm.

Kenya National Bureau of Statistics (KNBS), (2010). Population & Housing Census Results 2009. Minister of State for Planning, National Development and Vision 2030, Kenya.

King, J. (1983). Livestock water needs in pastoral Africa in relation to climate and forage. Nairobi: International Livestock Research Institute.

King, J. M., Tharme, R. E. and de Villiers, M. S. (2008). *Environmental Flow Assessments for Rivers: Manual for the Building Block Methodology*, Report No TT 354/08, Water Research Commission, Pretoria.

Kiragu, G. M. (2009). Assessment of suspended sediment loadings and their impact on the environmental flows of Upper transboundary Mara River, Kenya. MSc Thesis, JKUAT.

Kisoyan, P. K. 2006. *Baseline report on the integrated management and restoration of Forest, Rangelands and Wildlife for Sustainable Land Management in the transboundary Mara Basin*. WWF Eastern Africa Regional Programme Office (EARPO), Nairobi, Kenya.

KRA – 1998 Kasaye Monitoring & Evaluation Reports

KRA (1999) – Kasaye Evaluation Report.

Krhoda, G. O. (2006). *Preliminary Phase: Project Development and Stakeholders Analysis. The Hydrology of Mara River*. WWF and Eastern Africa Regional Programme Office (EARPO) Mara River Catchment Basin Initiative.

Ladu, M.B. (1993). Possibilities of rainwater harvesting in urban centres" Proceedings of the 6th IRCSA 1993 Nairobi, Kenya.

Lake Victoria Basin Commission (LVBC) (2009). *Biodiversity strategy and action plan for Sustainable Management of the Mara River Basin*. WWF Eastern Africa Regional Programme Office (EARPO), Kisumu, Kenya.

Lake Victoria Basin Commission (LVBC). 2010. *Assessing reserve flows for the Mara River*. Lake Victoria Basin

Lamprey, R. H. and Reid, R. S. (2004) Expansion of Human Settlement in Kenya's Maasai Mara: What Future for Pastoralism and Wildlife. *Journal of Biogeography 31: 997-1032*.

Lasage, R., Aerts, J. C. J. H., Mutiso, G. C. M. and Vries, A. de (2007). Potential for community based adaptations to droughts: Sand dams in Kitui, Kenya. *Physics and Chemistry of the Earth*. (accepted).

Loon, A. van, Mathijssen, H. van & Droogers, P. (2007). *Water Evaluation and Planning System*

Lu D, Li, G., Valladares, GS., Batistella, M. 2004. Mapping soil erosion risk in Rondonia, Brazillian Amazonia: Using RUSLE, remote sensing and GIS. Land Degradation and Development 15:499-512.

LVBC & WWF-ESARPO, (2010). Assessing Reserve Flows for the Mara River. Nairobi and Kisumu, Kenya.

Majule, A. E. (2010). Towards sustainable management of natural resources in the Mara river basin in Northeast Tanzania. *Journal of Ecology and the Natural Environment* Vol. 2(10), pp. 213-224.

Majule, A. E. and Yanda, P. Z. (2004). *Baseline studies on socio-economic and cultural aspects on the Mara River Basin*. WWF Tanzania Programme Office (TPO).

Mango LM, Melesse AM, McClain ME Cann D & Setegn SG (2011) Land Use and Climate change Impacts on the hydrology of upper Mara River Basin, Kenya: Results of a modeling study to support better resource management. *Hydrology and Earth Systems Science (15): 2245-2258.*

Mango, L. M. (2010). Modeling the Effect of Land Use and Climate Change Scenarios on the Water Flux of the Upper Mara River Flow, Kenya. MSc thesis, FIU.

Mati, B. M, R., Morgan, P. C., Gichuki, F. N., Quinton, J. N., Brewer, T. R. and Liniger, H. P. (2000). Assessment of erosion hazard with the USLE and GIS: A case study of the Upper Ewaso Ng'iro North basin of Kenya. International Journal of Applied Earth Observation and Geoinformation, Volume 2, Issue 2, 2000, Pages 78-86.

Mati, B. M., Mutie, S., Home, P., Gadain, H., Home, P, & Mtalo, F. (2008). Impacts of land-use/cover changes on the hydrology of the transboundary Mara River, Kenya/Tanzania. *Lakes & Reservoirs: Research and Management 13:169-177.*

Mati, B. M., Mutie, S., Home, P., Mtalo, F. and Gadain, H. (2005) Land Use Changes in the Transboundary Mara Basin: A Threat to Pristine Wildlife Sanctuaries in East Africa. Paper presented at the 8th International River Symposium, Brisbane, Australia, September 6-9, 20.

Mduma, S. A. R., Sinclair, A. R. E.&Hilborn, R. (1999). Food regulates the Serengeti wildebeest: a 40-year record. *J. Anim. Ecol*. **68**: 1101–1122.

Melesse A, McClain M, Abira M, Mutayoba W. (2008a). Hydrometeorology of the Mara River Basin, Kenya/Tanzania: Trend analysis and Wavelet application, ASCE- EWRI. World Environmental and Water Resources Congress, (doi 10.1061/40976(316)589).

Melesse, A., McClain, M., Abira, M., Mutayoba, W., Wang, X. M. (2008b). Modeling the Impact of Land-Cover and Rainfall Regime Change Scenarios on the Flow of Mara River, Kenya ASCE-EWRI. World Environmental and Water Resources Congress, (doi 10.1061/40976(316)558).

Munishi, P. K. T. (2007). *The biodiversity values of the Mara River (Masurura) Swamp, Mara region northern Tanzania*. WWF Tanzania Program Office, Dar es Salaam, Tanzania

Musiega, D.E. & Kazadi, S.N. (2004). Simulating the East African wildebeest migration patterns using GIS and Remote Sensing. Afr. J. Ecol. 42, 355–362.

Mutie S.M., Mati B., Gadain H. (2005). Land cover changes and effects on flow regime of Mara River.

Mutie, S. M., (2006). Modelling the influence of landuse change on the hydrology of Mara River using USGS GeoSpatial Stream Flow model. A Master of Science in Agricultural

Engineering thesis submitted to Biomechanical and Environmental Engineering Department in the Jomo Kenyatta University of Agriculture and Technology.

Mwiturubani, D. A. (2010). Climate change and access to water resources in the Lake Victoria Basin. *Institute for Security Studies, Monograph 170*.

Naiman, R. J., Bunn, S. E., Nilsson, C., Petts, G. E., Pinay, G., and Thompson, L. C. (2002). Legitimizing fluvial ecosystems as uers of water: an overview. Environmental Management 30(4):455-467.

NBS (2002). *Tanzanian Household Budget Survey (HBS), 2000/01*. National Bureau of Statistics. United Republic of Tanzania. (available at http://www.tanzania.go.tz/hbs/HomePage_HBS.html).

Nelson, P. J., Nyarangi, J. Kimutai, Z. M., (2012). The Trans-Boundary Mara River Basin Strategic Environmental Assessment (MRB SEA). Prepared for Lvbc, WWF, USAID and the Governments of Tanzania and Kenya. March, 2012.

Nile Basin Initiative, 2004. Mara River Basin Transboundary Integrated Water Resources Management and Development Project – Project Document-September, 2004.

Nile Basin Initiative. (2008c). *Mara River Basin Policy, Legal, and Institutional Cooperative Framework*. Nile Equitorial Lakes Subsidiary Action Program (NELSAP), Mara River Basin Transboundary Integrated Water Resources Management and Development Project, Water Resources and Energy Management (WREM) International Inc.

Nilsson, C., Reidy, C. A., Dynesius, M., and Revenga, C. (2005). Fragmentation and flow regulation of the world's large river systems. Science 308:405-408.

O'Keeffe, T. (2007). Landscape and memory: historiography, theory, methodology' In: N. Moore & Y. Whelan (eds). *Heritage, Memory and the Politics of Space: New Perspectives on the Cultural Landscape* . Aldershot: Ashgate.

Onjala, J. (2004). *Gross margin analysis of various crops cultivated in the Mara River Basin 2004*. WWF East African Regional Programme Office (EARPO), Nairobi, Kenya.

Onyando, J. O., Kisoyan, P. and Chemelil, M. C. (2005). Estimation of Potential Soil Erosion for River Perkerra Catchment in Kenya. Water Resources Management (2005) 19: 133–143

Onyango, L. (2007). Mara River EFA Study, Annex 6.1 Starter Document 6: Socio Economic Component.

Ottichilo, W. K., Leeuw, J., Skidmore, A.K., Prins H.T. and Said, M. (2000). "Population Trends of Large Non-Migratory Wild Herbivores and Livestock in the Masai Mara Ecosystem, Kenya, between 1977 and 1997" *African Journal of Ecology*, 38, 202-216.

Peden, D., M. Alemayehu, T. Amede, et al. (2009). Nile basin livestock water productivity. CPWF Project Report Series , PN37. Colombo: CPWF.

Peden, D., Tadesse, G. & Mammo, M. (2003) Improving the water productivity of livestock: An opportunity for poverty reduction. In: Integrated water and land management research and capacity building priorities for Ethiopia. Held at ILRI, Addis Ababa, Ethiopia, 294 December 2002. Addis Ababa, Ethiopia, International Livestock Research Institute (ILRI).

Postel, S., and Richter, B. (2003). Rivers for Life: Managing Water for People and Nature. Island Press, Washington, D.C.

Ramsar Convention (2002). Wetlands: water, life, and culture. 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971) Valencia, Spain, 18-26 November 2002; guidelines for the allocation and management of water for maintaining the ecological functions of wetlands. Adopted by Resolution VIII.1 (2002) of the Ramsar Convention

Renard, K.G., Foster, G.R., Weesies, G. A. and Porter, J. P. (1991). RUSLE: Revised universal soil loss equation. J. Soil Water Conserv. 46(1): 30-33.

resolution, A/RES/55/2.

Semeels, S. and Lambin, E. F. (2001). Proximate causes of land use change in Narok district Kenya: A spatial statistical model. Agric. Ecosyst. Environ., 85(1-3): 65-81.

Sieber, J. and Purkey, D. (2011). Water Evaluation And Planning System (Weap), User Guide . Stockholm Environment Institute, U.S. Center 11 Curtis Avenue.

Singler, H. and McClain M. (2006). A water quality baseline assessment of Mara river basin Kenya-Tanzania.

Stokke, K. B. (2006). The Morsa River Basin, Norway: collective action for improving water quality. In: Rydin Y, Falleth EI (eds) Networks and institutions in natural resource management. Edward Elgar, Cheltenham, pp 123–138.

Timmerman, J. G., and Langaas, S. (2005). Water information: what is it good for? The use of information in transboundary water management. Reg Environ Change 5:177–187.

Tuinhof, A. and Heederik, J. P. (2003). *Management of Aquifer Recharge and Subsurface Storage –Making Better Use of Our Largest Reservoir*, NNC-IAH publication No. 4, Netherlands National Committee – International of Our Largest Reservoir, NNC-IAH publication No. 4, Netherlands National Committee – International.

UN Habitat (2005). UN Human settlement Programme. ”A Guidebook for Local Management in Cities”.

UNDP, UNEP, World Bank and WRI (2000). *World Resources 2000-2001*. Washington DC, World Resources Institute.

UNESCO (2006). *Water: a shared responsibility*. The UN World Water Development Rept 2. UNESCO, Paris.

UNESCO-IHE: Institute for Water Education. 2009. *Environmental flows for people and ecosystems in the Mara River Basin (MaraFlows)*. UNESCO-IHE Partnership Research Fund (UPaRF).

United Nations (2000). United Nations Millennium Declaration, General Assembly

United Nations Environmental Programme, UNEP, 2008. Mau Complex and Marmanet forests: Environmental and economic contributions Current state and trends. UNEP, Nairobi, Kenya.

URT (2003). Mara Region Socio-Economic Profile. National Bureau of Statistics. Tanzania

USAID & WWF (2011). Development of an Equitable Payment for Environmental Services Scheme in the Mara River Basin; Policy and Legal Report; by Dominic Walubengo.

van der Knijff, J. M., Jones, R. J. A. & Montanarella, L. (2000). Soil Erosion Risk Assessment in Europe, Eur 19044 en, European Soil Bureau, Space Applications Institute, Joint Research Centre, Ispra Italy, Office for Official Publications of the European Communities, Luxembourg.

Wamalwa, I. W. 2009. Prospects and limitation of Integrated Watershed Management in Kenya: A case study of Mara Watershed. MSc Thesis, Lund University.

Wanyonyi J.M. (1998a). KRA Household Rainwater Harvesting Workshops Reports

Wanyonyi, J.M. (1998b) Possibilities and challenges in rainwater harvesting KBC Radio English Service Water and Society program

Wischmeier, W.H., Smith D. D. 1978. Predicting Rainfall Erosion Losses— A Guide to Conservation. Agricultural Handbook 537. US Department of Agriculture: Washington, DC.

Wolanski, E., Gereta, E., Borner, M., Mduma, S. (1999). Water, migration and the Serengeti ecosystem. American Scientist 87, 526-533.

WRMA (2009). Tana Water Catchment Area Management Strategy.

WRMA 2006. *Water resources management rules and forms, revised draft.* Water Resources Management Authority, Nairobi

WWF Tanzania Programme Office (TPO WWF and Eastern African Regional Program Office (EARPO). (2007). *Environmental Flow Assessment (EFA), Mara River Basin: Proceedings of the final EFA workshop.*

Yates, D., Sieber, H. H., Purkey, D. and Huber-Lee, A. (2005). WEAP21 a demand-, priority-, and preference-driven water planning model: Part 1, Model characteristics. *Water International* 30 487-500.

Zaba, B., Madulu, N.F., (1998). A drop to drink? Population and water resources: illustrations from Northern Tanzania. In: Sherbinin, A., Dompka, V. (Eds.), Water and Population Dynamics: Case Studies and Policy Implications. American Association for the Advancement of Science (AAAS), Washington, DC.

Zhang, H., Wang, Q., Dai, L., Guofan, S., Tang, L. Wang, S and Gu, H, (2006). Quantifying soil erosion with GIS-based RUSLE under different forest management options in Jianchang Forest Farm. Science in China Series E Technological Sciences, Vol 49 Supp I, 160-166.

APPENDICES

Appendix 1: General Allocation Rules applicable to New Water Permit Applications

The general allocation rules set out any conditions that apply in allocating water and typically apply for new applications for water permits. The rules depend on the type of water body that water is being allocated from.

Water Use Permit Processing Procedures by the Water Resources Management Authority

WATER RESOURCES MANAGEMENT AUTHORITY	
TITLE: Water Use Permit Processing	REF.NO:
	ISSUE NO:
SECTION: Water Rights	REV. NO: 01
ISSUED BY: WRO	DATE OF ISSUE:
AUTHORIZATION BY:TCM	

1. PURPOSE: To provide guidelines for effective water use permit processing
2. SCOPE: Applies to all water use permit applications
3. RESPONSIBILITY: The OIC Water Rights shall be responsible for the implementation of this procedure.

4. METHOD:

4.1. Upon receipt of a duly completed Water Use Permit Application form F/15/1/1 together with relevant attachments as per checklist CL/15/1/1, the WRO at the Sub Region shall:

4.1.1. Within 1 day verify the application and if the requirements are not met, advice the customer to make the necessary corrections.

4.1.2. If the requirements are met, proceed as follows:

4.1.2.1. Record the application in Register No. RG/15/1/1 within 1 day.

4.1.2.2. Determine the class of application as per the set Abstract Permit Thresholds WI/15/1/1 within 20 minutes

4.1.2.3. Cause the customer to make payment, as per WRM Rules 2007 WI/18/9 (Fees for Assessment and Issuance of Water Use Permits) and submit a copy of WRMA official receipt No. F/4/2/1

4.1.2.4. Enter the application in permit database system within 7 days and update RG/15/1/1.

4.1.2.5. Cause for display of the application as per WRM Rules No. WI/18/9 (Rule 29) within 7 days.

4.1.2.6. If within 30 days of public notification

4.1.2.6.1. An object is received; the WRO shall proceed as per WI/18/9(Rule 30-32).

4.1.2.6.2. No objection is received; the WRO shall post both soft and hard copies of the permit application to the WRO, at the regional office within 10 days.

4.2. Upon receipt of the application the WRO at the Regional office shall:

4.2.1. Cause TEC to evaluate the application and make recommendation as follows, within two months;

4.2.1.1. If deferred or rejected, the WRO at the regional office shall communicate to the WRO at the Sub Region with appropriate recommendations.

4.2.1.2. If accepted, and it is class A the WRO at the Regional office shall issue authority to OIC of the Sub Region to issue an approval to abstract water

4.2.1.3. If accepted and it is class B the WRO at the Regional Office shall issue an approval to OIC of the Sub Region to issue an authorization to construct works

4.2.1.4. If accepted, and it is class C or D the WRO at the Regional office shall cause for public notification in the national newspapers with widest circulation within 60 days and if:

4.2.1.4.1. There is an objection refer to OIC of the Sub Region with recommendations

4.2.1.4.2. No objection proceed as follows

4.2.1.4.2.1. In consultation with OIC of the Region shall convene a CAAC meeting to advice on the application.

4.2.1.4.2.2. If the CAAC advice is against the approval of the application and is technically acceptable, the WRO in consultation with OIC of the Region shall communicate the decision to WRO at the Sub Region within 7 days.

4.2.1.4.2.3. If the CAAC advice is against the approval of the application and is technically unacceptable, the WRO in consultation with OIC of the region shall issue authority to WRO at the Sub Region to issue authorization to construct works within 7 days of class C.

4.2.1.4.2.4. If the CAAC advice is acceptable, the WRO in consultation with OIC of the Region shall issue authority to WRO to issue authorization to construct works form F/15/4 within 7 days if class C

4.2.1.4.2.5. If class D the WRO in consultation with OIC of the Region forward the technical recommendations and CAAC advice to the OIC Water Rights-HQ who shall;

4.2.1.4.2.5.1. Cause the TEC at HQ to consider the application

4.2.1.4.2.5.2. Communicate the decision of the TEC at HQ to OIC of the Region

4.2.1.4.2.6. Upon receipt of the decision of the TEC-HQ, the WRO at the Regional office in consultation with OIC of the Region shall issue authorization to construct works within 7 days

4.2.1.4.2.7. If rejected, the WRO at the Regional office shall communicate to OIC at the Sub Region with comments.

4.3. Upon receipt of the deferment from the WRO at the Regional office, the WRO at the Sub Region shall communicate the decision to the applicant within 2 days.

4.4. Upon Receipt of the rejection from the WRO at the Regional office, the WRO at the Sub Region shall communicate the decision to the applicant within 2 days.

4.5. Upon receipt of the approval from the WRO at the Regional office, the WRO a the Sub Region shall print the authorization to construct works, complete with inspection schedule and cause for dispatch within 2 days.

4.6. During construction of works, the WRO at the Sub Region shall cause for inspection of works as per conditions in Form F/15/1/4 and fill in form F/15/1/7 until completion.

4.7. Upon receipt notice of completion of works from the applicant the WRO at the Sub Region shall:

4.7.1. cause for final site inspection,

4.7.2. fill the completion certificate F/15/1/8

4.7.3. inform the applicant to pay the permit fees as per Abstraction Permit Thresholds WI/15/1/1 and WRM Rules EXT.WI/18/9

4.8. Upon receipt of proof of payment as per F/4/2/1, the WRO at the Sub Region shall enter the information in the database and post application to the WRO at the Region.

4.9. Upon Receipt of application, the WRO at the Regional office shall;

4.9.1. Update permit water use RG/15/3/1

4.9.2. In consultation with the OIC at the Sub Region.

4.10. Upon receipt of approval from the WRO a the Regional office, the OIC at the Sub Region shall print the permit Form No. F/15/1/10 and cause dispatch within 2 days.

APPENDICES

5.11. Borehole Register	-RG/15/1/4
5.12. Register of applications	-RG/15/1/1
5.13. Register of Authorizations	-RG/15/1/2
5.14. Register of Water Permits	-RG/15/1/3
5.15. Abstraction Permit Thresholds	-WI/15/1/2
5.16. Fees for Assessment and Issuance of Water Use Permits	-WI/15/1/2
7.1. Attachment checklist	CL/1/1/1
7.2. Water Use Permit Application	F/15/1/1
7.3. Application for Easement	F/15/1/2
7.4. Comments by WRUA on Application for Water Permit	F/15/1/3
7.5. Authorization to construction Works	F/15/1/4
7.6. Application for Extension of Time of Authorization	F/15/1/5
7.7. Extension of Authorization to Construct Works	F/15/1/6
7.8. Inspection Report	F/15/1/7
7.9. Completion Certificate	F/15/1/8
7.10. Water Permit	F/15/1/10

Appendix II. Requirements for Water Permit Application

Case of Existing Abstractor seeking Permit on basis of existing or expired Authorization

This case does not necessarily involve a decision regarding allocation, but rather deals with bringing the abstraction into compliance with the permitted allocation. The following procedure will apply.

1. SURFACE WATER:

i. Fill forms WRMA OOIA, WRMA 008
ii. Person/individual-ID copy
iii. Group -registration certificate copy

- -Bye laws
- -List of members
- -PIN copy

iv. Company - registration certificate copy
-PIN copy
v. Land documents -Title deed or lease agreement copy, way leaves on land owned by a third party (form WRMA 002 or 017)
vi. Map -DOS map photocopy marked clearly
vii. Site assessment report
viii. Technical report - hydrological assessment report
ix. Technical design report - depends on scale of works
x. Dam design report- in case involving dam (form 001)
xi. Soil and water conservation plan- a condition on authorization where necessary
xii. EIA license-depends on scale of works and required for permit issuance
xiii. WRUA comments, form WRMA 003-where WRUA exists
xx. Payment receipt copy

2. GROUND WATER:

i. Fill forms WRMA 001A, WRMA 008
ii. Person/individual-ID copy
iii. Group -registration certificate copy

- -Bye laws
- -List of members
- -PIN copy

iv. Company - registration certificate copy
-PIN copy
v. Land documents -Title deed or lease agreement copy, way leaves on land owned by a third party (form WRMA 002 or 017)
vi.. Map -DOS map photocopy marked clearly
vii. Site assessment report
viii. Technical report - hydro geological assessment report

ix. Technical design report - depends on scale of works
x. Dam design report- in case involving dam (form 001)
xi. Soil and water conservation PLAN- plan- a condition on authorization where necessary
xii. EIA license-depends on scale of works and required for permit issuance
xiii. WRUA comments, form WRMA 003-where WRUA exists
xx. Payment receipt copy

FEES FOR ASSESSMENT AND ISSUANCE OF WATER PERMITS:

Applications	**Assessment of application**	**Issue and renewal of permit (Ksh) (for 5yrs)**
Water use category A	1,000	Nil
Water use category B	5,000	7,500
Water use category C	20,000	25,000
Water use category D	40,000	50,000

NOTE:

- For permits for less than 5 years, the cost of the permit will be charged on a **pro rata** basis
- Application for extension of time of authorization---------- Kshs.2000
- Variation of permit ---------- Kshs.2000
- Transfer of permit---------- Kshs.2000
- Search of water permit---------- Kshs.1000
- Authority to enter land---------- Kshs.2000
- Supplement of water permit/authorization---------- Kshs.3000
- Easement---------- Kshs.2000
- Copy of authorization or permit---------- ---- Kshs. 250

Case of Existing Abstractor seeking Permit Renewal or Amendment

For water user, For the authority

Appendix III. Water Abstraction Survey

WATER RESOURCES MANAGEMENT AUTHORITY	
TITLE: Water Abstraction Survey	REF. NO: PM/15/4
	ISSUE NO: 01
DEPARTMENT: Water Rights	REV. NO: 0
ISSUED BY: WRO	DATE OF ISSUE:30th January 2012
AUTHORIZED BY: TCM	

1. PURPOSE: To provide guidelines for an effective Water Abstraction Survey
2. SCOPE: Applies to all abstraction surveys
3. RESPONSIBILITY: The OIC at the Region shall be responsible for implementation of this procedure
4. MEHTOD:

4.1. Upon a need arising to conduct a Water Abstraction Survey the OIC of the Region shall cause the OIC at the sub region to proceed as follows:

4.1.1. Delineate the area where the Abstraction survey is required on a map according to drainage within 1 day

4.1.2. Constitute survey team within 4 days and cause for desk study for compilation of all known water use authorizations using the register RG/15/3/3 Permits and RG/15/3/2 Authorizations, prepare an abstraction survey plan within 7 days and submit to the OIC at the Region for approval.

4.2. Upon receipt from the OIC at the Sub Region the OIC of the Region shall:

4.2.1. If disapproved return to the OIC at the Sub Regions with comments.

4.2.2. If approved return to the OIC at the Sub Region with facilitation for implementation.

4.2.3. In consultation with the CEO cause for public notification in the print media with widest circulation 7 days before commencing of the survey

4.3. Upon receipt of approval the OIC at the Sub Region shall:

4.3.1. Cause the team to commence the survey within 14 days.

4.3.2. Cause an induction with the survey team within 7 days of receipt of facilitation.

4.3.3. Upon completion of the induction, cause for official launch of survey within 2 days.

4.3.4. Cause survey team to collect data on official form F/15/4/1 and make returns to the OIC at the Sub Region after every 7 days.

4.4. Upon receipt of duly filled forms, the OIC at the Sub Region shall cause for verification for completeness and entry into the database within 7 days and prepare weekly progress reports.

4.5. Upon completion of the survey, the OIC at the Sub Region shall cause the compilation and submission of the final report in accordance to Water Abstraction Report format WI/15/4/1 within 21 days to the OIC of the Region

4.6. The OIC of the Region shall study the report and forward to CEO within 7 days

5. APPENDICES:

5.1. Abstraction survey forms - F/15/4/1

5.2. Water Abstraction Report format - WI/15/4/1

Appendix IV. Water Use Permit Processing

WATER RESOURCES MANAGEMENT AUTHORITY	
TITLE: Water Use Permit Processing	REF.NO:PM/15/1
	ISSUE NO: 02
SECTION: Water Rights	REV. NO: 01
ISSUED BY: WRO	DATE OF ISSUE: 30th January 2012
AUTHORIZATION BY:TCM	

1. PURPOSE: To provide guidelines for effective water use permit processing
2. SCOPE: Applies to all water use permit applications
3. RESPONSIBILITY: The OIC Water Rights shall be responsible for the implementation of this procedure.

4. METHOD:
4.1. Upon receipt of a duly completed Water Use Permit Application form F/15/1/1 together with relevant attachments as per checklist CL/15/1/1, the WRO at the Sub Region shall:

4.1.1. Within 1 day verify the application and if the requirements are not met, advice the customer to make the necessary corrections.

4.1.2. If the requirements are met, proceed as follows:
4.1.2.1. Record the application in Register No. RG/15/1/1 within 1 day.
4.1.2.2. Determine the class of application as per the set Abstract Permit Thresholds WI/15/1/1 within 20 minutes
4.1.2.3. Cause the customer to make payment, as per WRM Rules 2007 WI/18/9 (Fees for Assessment and Issuance of Water Use Permits) and submit a copy of WRMA official receipt No. F/4/2/1
4.1.2.4. Enter the application in permit database system within 7 days and update RG/15/1/1.
4.1.2.5. Cause for display of the application as per WRM Rules No. WI/18/9 (Rule 29) within 7 days.
4.1.2.6. If within 30 days of public notification
4.1.2.6.1. An object is received; the WRO shall proceed as per WI/18/9(Rule 30-32).
4.1.2.6.2. No objection is received; the WRO shall post both soft and hard copies of the permit application to the WRO, at the regional office within 10 days.

4.2. Upon receipt of the application the WRO at the Regional office shall:
4.2.1. Cause TEC to evaluate the application and make recommendation as follows, within two months;
4.2.1.1. If deferred or rejected, the WRO at the regional office shall communicate to the WRO at the Sub Region with appropriate recommendations.

4.2.1.2. If accepted, and it is class A the WRO at the Regional office shall issue authority to OIC of the Sub Region to issue an approval to abstract water

4.2.1.3. If accepted and it is class B the WRO at the Regional Office shall issue an approval to OIC of the Sub Region to issue an authorization to construct works

4.2.1.4. If accepted, and it is class C or D the WRO at the Regional office shall cause for public notification in the national newspapers with widest circulation within 60 days and if:

4.2.1.4.1. There is an objection refer to OIC of the Sub Region with recommendations

4.2.1.4.2. No objection proceed as follows

4.2.1.4.2.1. In consultation with OIC of the Region shall convene a CAAC meeting to advice on the application.

4.2.1.4.2.2. If the CAAC advice is against the approval of the application and is technically acceptable, the WRO in consultation with OIC of the Region shall communicate the decision to WRO at the Sub Region within 7 days.

4.2.1.4.2.3. If the CAAC advice is against the approval of the application and is technically unacceptable, the WRO in consultation with OIC of the Region shall issue authority to WRO at the Sub Region to issue authorization to construct works within 7 days of class C.

4.2.1.4.2.4. If the CAAC advice is acceptable, the WRO in consultation with OIC of the region shall issue authority to WRO to issue authorization to construct works form F/15/4 within 7 days if class C

4.2.1.4.2.5. If class D the WRO in consultation with OIC of the Region forward the technical recommendations and CAAC advice to the OIC Water Rights-HQ who shall;

4.2.1.4.2.5.1. Cause the TEC at HQ to consider the application

4.2.1.4.2.5.2. Communicate the decision of the TEC at HQ to OIC of the Region

4.2.1.4.2.6. Upon receipt of the decision of the TEC-HQ, the WRO at the Regional office in consultation with OIC of the Region shall issue authorization to construct works within 7 days

4.2.1.4.2.7. If rejected, the WRO at the Regional office shall communicate to OIC at the Sub Region with comments.

4.3. Upon receipt of the deferment from the WRO at the Regional office, the WRO at the Sub Region shall communicate the decision to the applicant within 2 days.

4.4. Upon Receipt of the rejection from the WRO at the Regional office, the WRO at the Sub Region shall communicate the decision to the applicant within 2 days.

4.5. Upon receipt of the approval from the WRO at the Regional office, the WRO a the Sub Region shall print the authorization to construct works, complete with inspection schedule and cause for dispatch within 2 days.

4.6. During construction of works, the WRO at the Sub Region shall cause for inspection of works as per conditions in Form F/15/1/4 and fill in form F/15/1/7 until completion.

4.7. Upon receipt notice of completion of works from the applicant the WRO at the Sub Region shall:

4.7.1. cause for final site inspection,

4.7.2. fill the completion certificate F/15/1/8

4.7.3. inform the applicant to pay the permit fees as per Abstraction Permit Thresholds WI/15/1/1 and WRM Rules EXT.WI/18/9

4.8. Upon receipt of proof of payment as per F/4/2/1, the WRO at the Sub Region shall enter the information in the database and post application to the WRO at the Region.

4.9. Upon Receipt of application, the WRO at the Regional office shall;

4.9.1. Update permit water use RG/15/3/1

4.9.2. In consultation with the OIC at the Sub Region.

4.10. Upon receipt of approval from the WRO a the Regional office, the OIC at the Sub Region shall print the permit Form No. F/15/1/10 and cause dispatch within 2 days.

APPENDICES:

7.1. Attachment checklist	CL/1/1/1
7.2. Water Use Permit Application	F/15/1/1
7.3. Application for Easement	F/15/1/2
7.4. Comments by WRUA on Application for Water Permit	F/15/1/3
7.5. Authorization to construction Works	F/15/1/4
7.6. Application for Extension of Time of Authorization	F/15/1/5
7.7. Extension of Authorization to Construct Works	F/15/1/6
7.8. Inspection Report	F/15/1/7
7.9. Completion Certificate	F/15/1/8
7.10. Water Permit	F/15/1/10
7.11. Borehole Register	RG/15/1/4
7.12. Register of applications	RG/15/1/1
7.13. Register of Authorizations	RG/15/1/2
7.14. Register of Water Permits	RG/15/1/3
7.15. Abstraction Permit Thresholds	WI/15/1/2
7.16. Fees for Assessment and Issuance of Water Use Permits	WI/15/1/2

Appendix V. Development of a Water Allocation Plan

WATER RECOURCES MANAGEMENT AUTHORITY	
TITLE: Development of Water Allocation Plan	REF. NO: PM/15/2
	ISSUE NO: 01
DEPARTMENT: Water Rights	REV.NO:0
ISSUED BY:WRO	DATE OF ISSUE: 30th January, 2012
AUTHORIZED BY:TCM	

1. PURPOSE: To provide guidelines for developing a Water Allocation Plan.

2. SCOPE: Applies to allocation of water for all uses in a basin.

3. RESPONSIBILITY: The OIC Water Rights shall be responsible for the implementation of this procedure.

4. METHOD:

4.1. Upon a need arising for development of a WAP the OIC of the Region shall cause the OIC at the Sub Region to Proceed as follows:

4.1.1. Cause for demarcation of the area on the map which an allocation plan is to be prepared within 14 days.

4.1.2. Facilitate constitution of a multi-sectoral working group and or request for out sourcing the preparation of an allocation plan within 30 days and if:

4.1.2.1. Outsourced cause for procurement of services as per PM/16/2.

4.1.2.2. Internally constituted the OIC at the Sub Region shall cause to gather data as per water sources, use and demand Form No. F/15/2/1 and produce a report within 30 days showing an analysis of current allocation in space and by sector

4.2. Upon receipt of the report the OIC at the Sub Region shall within 30 days cause for water resources assessment and produce a report that will show water availability by type, quantity and how it is distributed in space and in accordance with Water Allocation Guidelines WI/15/2/1 and proceed as follows:

4.2.1. Cause analysis of gathered data on water availability, water demand and present allocation and within 90 days produce a report showing water balance and submit to the RM.

4.3. Upon receipt of the report, the OIC of the Region shall;

4.3.1. Distribute copies to stakeholders for information and comments

4.3.2. Convene a stakeholder forum to discuss the comments and adopt the report within 30 days

4.4. Upon receiving comments from the stakeholders forum the OIC of the Region shall prepare a draft of WAP within 30 days and reconvene a stakeholders forum for adoption

4.5. Upon adoption of the WAP draft the OIC of the region shall within 7 days forward CEO for approval

4.6. Upon approval the OIC of the Region shall cause for the implementation of the WAP

Appendix VI. Focus Group Discussion/KII

Project Name	**MARA RIVER BASIN – WIDE WATER ALLOCATION PLAN**
Consultants	**Megascientific Services Ltd**
Date	
Country/Town	
Province	
District/County	
Location	
Sub-Location	
Meeting Place	
GPS Position	

No.	Name s	Designation	Contact
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Appendix VII. Information from WRMA-LVBO and Other Stakeholders Both in Kenya and Tanzania

DEVELOPMENT OF MARA RIVER BASIN - WIDE WATER ALLOCATION PLAN

The overall objective of this consultancy is "to develop the Mara River basin wide water allocation Plan which will be used by key stakeholders in Mara River Basin to sustainably allocate water to different uses while ensuring good health of the river and maintaining the reserve flow".

FOCUS GROUP DISCUSSION/KII

Project Name			
Date			
Meeting Place			
Sub-Location			
Location			
District/County			
No.	Name s	Designation	Contact
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Review and summarize water allocation policies and legislations in Tanzania and Kenya looking at the overall approach to allocation and the guiding principles.

vi. What are the water allocation policies legal and institutional framework in Tanzania and Kenya? Dou have relevant documents you can assist us with on this?
vii. What are the transboundary issues related to policies on water allocation and use?
viii. What are the possible human/wildlife conflict issues related to water use in the Mara river basin?
ix. Are there plans and needs to review the current Water Acts and harmonize the various legal and political frameworks relating to water policy, land, environmental conservation (riverine cultivation and planting of blue gums, etc)?
x. Could you name and describe the current existing and potential water allocation technologies in relation to water uses and legislations in Mara River?

xi. Could you identify and explain existing best water allocation technologies?
xii. Which are the current institutions mandated to allocate, monitor and control water allocation technologies?
xiii. In your view, what is your assessment of the capacity of institutions mandated for water allocation and monitoring; an
xiv. Examine how existing allocation frameworks effectively address competing demands for water resources (current and future).

Existing permitting threshold / framework and database in both countries and how existing allocation frameworks respond to water resource management in Mara River;

iii. What are the existing threshold levels of water permits for the Mara River?
iv. Do the existing thresholds adequately provide for instream needs and ecosystem services?

The existing water allocations and their relations with water resources management in Mara River

vii. Identify the water sources within the Mara River basin (e.g. Mara River and its major tributaries, springs and boreholes and shallow wells, ponds/water pans, roof catchment, and rank them in the level of importance.
viii. What are the existing water allocation plans/criteria in Mara River Basin, if any?
ix. Identify the water uses (domestic, livestock, irrigation, wildlife, industrial, etc) within the Mara River basin. Could you rank these uses based on level of water use and possible related socio-economic factors.
x. Could you identify key users (e.g. farms, institution, hospitals, etc), their location within the basin and quantify their existing water demands in relation to water allocation permits? Do you have any data on the water users and amounts permitted to extract?
xi. Do you have data to quantify river flows in relation or comparison with the existing water demands in Mara River Basin? Do you have supporting data?
    a. Analysis of Mara River discharge data/ information at agreed sites with regard to reserve flow, Normal Flow and Flood flow, dry years, Minimum flows, wet years, and average discharge over the years.
    b. Flow thresholds (e.g. Q95, Q80, Q50 etc) for the EFA sites
    c. Estimate amount of water available for consumptive use using environmental flow analysis at the sites both in Kenya and Tanzania.
xii. Where do you have the river gauging stations along the Mara basin?
xiii. How much data, and for how long back, do you have for the named stations?
xiv. What is your opinion on the reserve flows (Environmental flows) as calculated by Environmental Flows study conducted in Mara River Basin in 2009? Which other flow

assessments have been done, and are there documents and reports on these so that we can look at them?

xv. Do you have any hydrogeological information on the Mara river basin?

xvi. Do you have rainfall data for this locations, or comprehensive climatic data including temperature, moisture, etc?

xvii. Do you have any information on sub-surface or underground water with regard to availability and quantity extracted?

xviii. Do you have water quality data, and which ones i.e. microbiological, turbidity, and other pollutants?

xix. Which sections of the river in your opinion are polluted and what could be the cause of the pollution?

xx. Could you forecast or give us information on the future demand of water uses from Mara River lets say in the next five years: domestic……., livestock……, wildlife……irrigation/agriculture……..
Any others…….

xxi. What is your projection of future demand in Mara River basin in the next five years? Where can we get additional information to help us forecast the future water demand for the Mara River basin? Could you name them and give us some contacts?

xxii. What are the various options and technologies for water management (e.g. storage dam construction, increased use of underground water or roof catchment, water demand management techniques, etc) in the Mara River basin to ensure sustainability and effective water use?

xxiii. Can you give us information to help us analyze and propose how water allocation can be integrated into existing catchment management planning to ensure that monitoring of water abstractions and monitoring is a part of ongoing watershed monitoring programmes in the Mara River basin.

Could you give us any other important information:

…….

…….

List the Observations and Photos Taken:

1. ……
2. ……
3. ……
4. ……
5. ……

APPENDIX VIII: INFORMATION FROM WATER USERS AND INDIVIDUALS
MRB DEVELOPMENT OF WAP

FGD/KII/INDIVIDUALS SCHEDULE

The overall objective of this consultancy is "to develop the Mara River basin wide water allocation Plan which will be used by key stakeholders in Mara River Basin to sustainably allocate water to different uses while ensuring good health of the river and maintaining the reserve flow".

1. Name of the water user:……
2. Location of the water user:……..
3. Country…….District/County……..Division……
4. Location……
5. Sub location……..
6. GPS Location; Easting……Northing……..
7. Water use information
   a. Source of water:……..(River/stream, Borehole/wells/springs, Water pans, Others (Name)……
   b. Purpose for withdrawal;……

Water use	Estimated daily use (m^3/day)	Remarks
Domestic		
Irrigation		
Livestock		
Industrial/commercial		
Institutional		
Wildlife		

   c. Availability of water permit (Yes/No)……..
   d. If Yes; Date issued;…… Quantity permitted (m3/day)……
   e. Validity of the permit ;…….(Confirm compliance)
8. Water allocation guidelines and challenges;

……
……
……

9. General complaints from the water user;…….

……
……
……

10. Water laws, policies, regulation and institutions
    a. What is your view on the existing water laws and policies? [Interpretation of Water Resources Act and its effect on sustainable water allocation].
    b. What is your assessment of viability of different water allocation technology options and implications on existing policies and legislations?

Review and summarize water allocation policies and legislations in Tanzania and Kenya looking at the overall approach to allocation and the guiding principles.

xv. What are the water allocation policies legal and institutional framework in Tanzania and Kenya? Do you have relevant documents you can assist us with on this?
xvi. What are the transboundary issues related to policies on water allocation and use?
xvii. What are the possible human/wildlife conflict issues related to water use in the Mara river basin?
xviii. Are there plans and needs to review the current Water Acts and harmonize the various legal and political frameworks relating to water policy, land, environmental conservation (riverine cultivation and planting of blue gums, etc)?
xix. Could you name and describe the current existing and potential water allocation technologies in relation to water uses and legislations in Mara River?
xx. Could you identify and explain existing best water allocation technologies?
xxi. Which are the current institutions mandated to allocate, monitor and control water allocation technologies???
xxii. In your view, what is your assessment of the capacity of institutions mandated for water allocation and monitoring; an
xxiii. Examine how existing allocation frameworks effectively address competing demands for water resources (current and future).

Existing permitting threshold / framework and database in both countries and how existing allocation frameworks respond to water resource management in Mara River;

v. What are the existing threshold levels of water permits for the Mara River?
vi. Do the existing thresholds adequately provide for instream needs and ecosystem services?

The existing water allocations and their relations with water resources management in Mara River

xxiv. Identify the water sources within the Mara River basin (e.g. Mara River and its major tributaries, springs and boreholes and shallow wells, ponds/water pans, roof catchment, and rank them in the level of importance.
xxv. What are the existing water allocation plans/criteria in Mara River Basin, if any?

xxvi. Identify the water uses (domestic, livestock, irrigation, wildlife, industrial, etc) within the Mara River basin. Could you rank these uses based on level of water use and possible related socio-economic factors.

xxvii. Could you identify key users (e.g. farms, institution, hospitals, etc), their location within the basin and quantify their existing water demands in relation to water allocation permits? Do you have any data on the water users and amounts permitted to extract?

xxviii. Do you have data to quantify river flows in relation or comparison with the existing water demands in Mara River Basin? Do you have supporting data?

d. Analysis of Mara River discharge data/ information at agreed sites with regard to reserve flow, Normal Flow and Flood flow, dry years, Minimum flows, wet years, and average discharge over the years.

e. Flow thresholds (e.g. Q95, Q80, Q50 etc) for the EFA sites

f. Estimate amount of water available for consumptive use using environmental flow analysis at the sites both in Kenya and Tanzania.

xxix. Where do you have the river gauging stations along the Mara basin?

xxx. How much data, and for how long back, do you have for the named stations?

xxxi. What is your opinion on the reserve flows (Environmental flows) as calculated by Environmental Flows study conducted in Mara River Basin in 2009? Which other flow assessments have been done, and are there documents and reports on these so that we can look at them?

xxxii. Do you have any hydrogeological information on the Mara river basin?

xxxiii. Do you have rainfall data for this locations, or comprehensive climatic data including temperature, moisture, etc?

xxxiv. Do you have any information on sub-surface or underground water with regard to availability and quantity extracted?

xxxv. Do you have water quality data, and which ones i.e. microbiological, turbidity, and other pollutants?

xxxvi. Which sections of the river in your opinion are polluted and what could be the cause of the pollution?

xxxvii. Could you forecast or give us information on the future demand of water uses from Mara River lets say in the next five years: domestic……., livestock……., wildlife……irrigation/agriculture……..
Any others…….

xxxviii. What is your projection of future demand in Mara River basin in the next five years? Where can we get additional information to help us forecast the future water demand for the Mara River basin? Could you name them and give us some contacts?

xxxix. What are the various options and technologies for water management (e.g. storage dam construction, increased use of underground water or roof catchment, water demand management techniques, etc) in the Mara River basin to ensure sustainability and effective water use?

xl. Can you give us information to help us analyze and propose how water allocation can be integrated into existing catchment management planning to ensure that monitoring of water abstractions and monitoring is a part of ongoing watershed monitoring programmes in the Mara River basin.

Level of Community Awareness and Participation in the Planning, Allocation, and Management of Water Resources within the Mara River Basin

i. Are you as a member of the community actively and adequately involved in the planning, allocation, and management of the water resources within the basin?
ii. In your view, do you think the community actively and adequately involved in the planning, allocation, and management of the water resources within the basin?
iii. In which ways do you think the community should participate or involved to ensure sustainability in water resources management?
iv. Do you think the WRUAs and WUAs are effective in water resources planning and management?

Could you give us any other important information:

…….
…….
…….
…….
…….
…….

List the Observations and Photos Taken:

6. ……
7. ……
8. ……
9. ……
10. ……

General remarks:……

…….
……

Appendix IX. Resource Persons Contacted at the Mara Basin

A	**MARA RIVER BASIN – KENYAN SIDE**			
	Names	**Organization**	**Designation**	**Contact**
1	Peterlis Opango	WRMA offices Kisumu	Water quality and pollution control officer	0721 493509 opango69@yahoo.com
2	Reuben Ngessa	WRMA offices Kisumu	Senior surface water officer	0733 549184 ngessa@yahoo.com
3	Naomi Olero	WRMA Sub-regional offices, Kericho	Sub-regional manager	0721 474672 njkolero@yahoo.com
4	Patrick Meya	WRMA Sub-regional offices, Kericho	Service water officer	
5	Peter Okeyo	WRMA Sub-regional offices, Kericho	Service water officer	
6	Dr. Seif Hamisi	WWF Offices Narok		0725 011864
7	Benard Koruta	Kenya Wildlife Service – Ewaso Ng'iro	Senior Warden	0725 825935
8	Ntolei Lamurt	Narok County Council	Principal Administration Officer	0721 715984 lntolei@gmail.com
9	David Francombe	Tibu Farm- Olerai Ltd	Director	0722 618794
10	Audiliah Zaule	Tibu Farm- Olerai Ltd	Administrator	0725 327514
11	David Msafiri	Tibu Farm- Olerai Ltd	Manager	0705 614595
12	Wesley Koech	Tibu Farm- Olerai Ltd	Harvesting superintendent	0703 372446
13	Kennedy Onyango	Mara River Water Users Association	Manager (MRWUA)	0728 336090
14	Joseph Chepusit	Mara River Water Users Association	Chairman	0723 074580
15	Kiplangat Robert Kirui	Mara River Water Users Association	Student on attachment	0728 277057
16	Richard Chepkwony	Mara River Water Users Association	Grounds man	0700 431695
17	John Marindany	Ministry of Livestock-Longisa Division	Division livestock extension officer	0723 934627
18	Bornes Rotich	Ministry of Agriculture Longisa Division	Division agriculture extension officer	0720 179494
19	Winnie Mutai	Bomet District water office	Laboratory Technologist	0720 221392
20	Koech Josephat	Bomet District water office	Clerk	0725 372365
17	Richard Maritim	Fair Mount Mara Safari Club	Repair and Maintenance Supervisor	0728 104358 Richard.Maritim@fairmount.com
18	Simon Rohoh	Bomet area community representative	Farmer	0750 941809

19	Gilbert Kirui	Bomet area community representative	Business man	0706 852489
B.	**MARA RIVER BASIN – TANZANIAN SIDE**			
20	William Kasanga	WWF Offices- Tanzania	Project Manager	+255 784627462
21	Elibariki Jambau	WWF Offices -Tanzania	Community Ext. Officer	0784 624299
22	Cornel L. Missana	Lake Victoria Basin water office- Musoma	Principal technologist	0784 626265
23	Everist Mulohi	Lake Victoria Basin water office- Musoma	Principal technologist	0788 536673
24	Nyakwarolando Suleiman	Lake Victoria Basin water office- Musoma	Principal technologist	0759 282056
25	Alex N. Goerge	Lake Victoria Basin water office- Musoma	Chemist I	0787 690336
26	Manyanza Neso	Lake Victoria Basin water office- Musoma	Principal technologist	0755 638645
27	Robert Bille	Serengeti National Park		0766 910907 Robert.bille@tanzaniaparks.com
28	Josephat Ngodangula	Mugumu – Serengeti water office	District water engineer	0786805253
29	Mathayo Athumani	Regional water offices- Musoma	Regional water engineer	0713314807

APPENDIX X. Minutes to the Various Meeting Held with Stakeholders at WRMA Offices and other offices within the Mara River Basin

1. **WRMA Offices on 11th August 2012**

Present

1. Prof. Ayub O. Ofulla
2. Dr. Michael O.Oloko
3. Dr. Basil T. Iro Ong'or
4. Mr. Peterlis Opango
5. Mr. Reuben Ngessa
6. Mr. Douglas Anyona

The meeting commenced at 5.20pm and the following was discussed and agreed on:

1.) WRMA officials were given an overview of the consultancy by Dr. Oloko, who outlined the tasks to be performed to achieve the goals as outlined in the TOR. The order of events/timetable was also given.

2.) It was observed that there was need for WRMA to be involved in this exercise so as to provide guidance since the office's jurisdiction fell within the study area and that their participation was to be at three levels namely:

- As Key informants
- As part of the team (consultants)
- As providers of the much needed information/data

3.) It was observed that some of the tasks of the consultancy require very specific data which the team needed to obtain from WRMA, though some had already been given out aready, while the remaining was to be given later.

4.) It was agreed that Dr. Oloko, Dr. Iro and Mr, Ngessa meet on Monday 13th Aug 2012 to go through the existing data at WRMA so as to determine which one would be needed for the task at hand.

5.) It was however observed that some of the information (Precipitation and water levels) needed to be purchased as it is not given out for free. The cost is charged per parameter, per station, per year.

6.) It was also noted that data on water abstractors in the Mara Basin was available and this was given out without any payment, by the WRMA officials as their contribution to the team.

7.) On water abstractors, it was agreed that there was need to know exactly how many are licensed or have permits and the compliance levels of those who have the permits e.g. do they pay for the amount of water abstracted? Do they abstract the amount required? e.t.c.

8.) It was resolved that these were some of the questions that were to be asked to Key Informants and in the workshop.

9.) It was agreed that the consultants narrows down on major abstractors especially those whose activities have major effects on the river flow, since it was not possible to include every water abstractor in the basin. To this effect, it was agreed that Hugo, a major farmer in the basin be visited.

10.) It was also agreed that effluents from various establishments along the river be considered.

11.) The meeting also resolved to focus more on Key informants since the workshops may not be well attended based on past experiences.

12.) Due to the complexity and intensive nature of conducting water abstraction surveys, it was agreed that the existing data on water abstractors be used for this task.

The water abstractor's data included:

- Name of water abstractor
- Source of the water abstracted
- Amount of water abstracted

13.) However, it was noted that there were some constraints to data availability (especially precipitation and water levels), key among them unavailability / missing data attributed to break up of systems in the 80s and 90s.

14.) During the meeting, the WRMA officials gave out hard and soft copies the following documents:

- Water abstraction survey tools
- Water use permit processing
- Development of a water allocation plan
- Map of the Mara Basin showing position of RGS sites
- Data on water abstractors in the Mara Basin (Mr. Ngessa promised to give an updated one later)
- Water Act
- WRMA Rules for water abstraction

15.) It was resolved that ground water data be used to make the report complete, though there were concerns on the general lack of comprehensive ground water data for the region.

16.) Mr. Anyona was given the task of receiving all the information/data both in soft and hard copies for consolidation. In addition, he was to make a list of all the data already available.

17.) It was also observed that WRMA has three RGS stations of which only one falls within the EFA sites.

The codes and location of RGS stations were as follows:

a) RGS 1LA 03 – Nyangores tributary at Bomet town (Downstream of EFA station 2)
b) RGS 1LB 02 – Amala tributary at Kapkimolwa bridge (At EFA station one)
c) RGS 1LA 04 – Mara River at Kichwa Tembo (Downstream of EFA station 3)
d) RGS 1LA 05 – At the border (New station) Next to EFA site 4.- However there is no data for this station

The meeting agreed to focus on 3 stations namely: 1 EFA station and 2 RGS stations

18.) Mr. Ngessa promised to help run the data from Tanzania using the MIKE Basin software

19.) As a way forward, Mr. Opango of WRMA promised to link the team with the WRMA sub-regional officer, Kericho as soon as possible so that she can prepare to meet the team on Tuesday 14th August 2012.

20.) WRMA officials also promised to attend the workshops and also to introduce the team to some key stakeholders in the Mara River Basin.

21.) On facilitation of WRMA officials, it was agreed that there was provision for one person, who will be compensated as other consultants, though two officials (Mr. Opango and Mr. Ngessa) will be working with the team.

22.) In conclusion, it was observed that capacity was lacking particularly in Environmental flow assessment in Kenya since no other river had been assessed apart from Mara River. The meeting resolved to explore the possibility of conducting flow assessments in future.

The meeting was adjourned at 8.25pm.

2. Minutes to a Meeting Held at WRMA Sub Regional Offices, Kericho on 14th 08 – 2012 at 12.45 Pm

IN ATTENDANCE:
1. Naomi Olero – WRMA Sub-Regional Manager
2. Patrick Meya – Service water Officer- WRMA, Kericho Office
3. Peter Okeyo – Service water Officer - WRMA, Kericho Office

WRMA sub regional offices, Kericho's area of jurisdiction is the Mara River and Sondu River basins.

The office relies on three river gauging station (RGS) with 1 station each located at Amala, Nyangores and Lower Mara at Kichwa Tembo and designated as follows:

1LA 02 – located along Amala tributary, 1LA 03 – located along Nyangores tributary and 1LA 04 – located at Mara Bridge around Kichwa Tembo.

1LA 04 is an automatic station, whose data is downloaded monthly, and is also regarded as a national station due to its location.

Mara River water quality data was available at the regional office, while sampling was done quarterly. In addition, some WRUAs have been given turbidity kits (such as MRWUA) to determine the river turbidity twice a day. However, turbidity data available at present was minimal covering only the last three months, since the kits had just been bought.

Precipitation data existed but could only be obtained from the Kenya Forestry services, who are the custodians and not WRMA.

Challenges in obtaining data from some of the stations

Data available for station 1LA 04 was only from November 2011 to present since the station had broken down before. Likewise the other two stations (1LA 02 and 1LA 03), did not have any data between the year 2008 and 2012, as the data was lost after the computer system crushed. Another station located at the border was swept away by floods hence no data available.

Some of the improvements made by WRMA and other stakeholders towards water resource management

Recently, WRMA installed automatic weather stations to replace the manual ones that have been used in the past.

Community participation in water resource management was currently high and there was increased awareness of importance of water resources management among the locals;

A new water ACT is in the pipeline and it is likely to give more powers to communities in resource management issues

Water abstraction requirements

- Water users were allowed to apply for more than they abstracted.
- There water users have been categorized into four different classes (class A, B, C and D) and are charged differently;
- Class A users (domestic use) are however not charged;
- The water rates are charged at 50 cents per cubic meter and are paid quarterly;
- Water permits are always reviewed based on consumption;

- Hotels were also classified under class A – a situation that WRMA feels should be revised;

Compliance levels:
According to WRMA most users were actually compliant with the permit limits as they abstract much less than they had applied for.

WRUAs and their roles in water resource management
WRUAs are established by WRMA and each WRUA has a constitution which governs them;
They act as the representatives of WRMA at the sub-catchment levels;
Initially, MRWUA used to cover the entire Mara River basin of Kenya, but was split to several other WRUAs.
WRMA has established a minimum of 24 WRUAs within the Mara River basin of Kenya, each covering an area of between 150 to 200m^2.
These WRUAs are managed by community members and are tasked with several duties including:

- Monitoring compliance with water resource management laws at sub-catchment levels
- Sensitizing locals on good and effective water resource management;
- Carrying out water resource protection activities e.g. tree planting along the banks, among other activities;

Challenges faced by WRMA and the WRUAs in water resource management

- Most conservation issues are long term in nature hence the results are not seen immediately;
- There are currently no incentives in terms of payments for the WRUAs to encourage them keep on with their conservation efforts.
- Some of the water ACTS particularly those dealing with riverine conservation/protection are conflicting, hence the need for their harmonization.
- The most popular trees (blue gum) among area residents that are planted along the river are a setback to water resource conservation as these trees use up a lot of water.
- Most of the blue gums were found at the upper Mara section, which was also characterized by human settlements, while the mid and lower Mara sections did not have blue gums, implying that they are actually planted by the locals.
- Blue gums were preferred by the community largely because of their high economic returns, with some of the community members being ignorant of the effects of these trees on the environment or they did not have a suitable option.

Other challenges facing WRMA with regard to water resources allocation and management include:

Default in payment of water rates by some water users e.g. some water service providers (who are among the major users) defaulted in paying their water fees.

Operating costs and poor management of some of the water companies could be reducing their profits considerably, and contributing to their high default rates.

WRMA finds it difficult to stop water users from using water resources since the constitution recognizes the right to use water as a basic human right.

Future plans, projections and strategies in the water resource sector within the Mara River Basin

There are plans to construct a Dam at the upper Mara which may push the water demand higher.

Due to the destructive nature of blue gums, WRMA has identified the need for aggressive public awareness campaigns to educate the people on best trees to plant along river banks and wetlands.

WRMA projects future water demand to increase though admits that the available data may not be sufficient to help make accurate projections of future water demands.

There have been community based transboundary fora between Tanzanians and Kenyans, whose aim has been to discuss and harmonize activities within the Mara River. The fora has even set a Mara Day to be celebrated each year.

WRMA acknowledges the part played by WRUAs and to this end, WRMA has plans to introduce incentives to be given to such associations.

3. **Minutes to a Meeting Held at the MRWUA Offices at Mulot on 15th August 2012 at 11.57 am**

In attendance:

Mr. Joseph Chepsait – Chairman Amala water users association

Water resources issues within Mara River Basin

The districts that form the Mara River Basin include: Nakuru, Narok South, Narok North, Bomet, Chepalungu and Transmara. However, none of these districts falls wholly within the Mara River Basin.

Major sources of water for the community as identified by MWRUAs included:

Rivers, springs (especially in the upper Mara), wells/boreholes, seasonal streams, water pans, water ponds and rainwater harvesting, with most people in the upper Mara River section relying more on springs than those at the middle and lower Mara, who rely on the river.

The main uses of the Mara River water were: domestic use, livestock use, irrigation, commercial use, power generation, and wildlife consumption.

The nature of water use was different at different sections of the river with water use in the upper Mara section comprising mainly of domestic and livestock use, while the mid Mara was mainly for irrigation and wildlife use, though livestock and small scale farming were also present.

Some of the large institutions that were cited as being the major water users in the Mara included: Olerai Farm, Olemiran secondary school, Bomet municipal water supply, Hoteliers along the river (Mainly in the mid and lower Mara River), Tenwek power generating point among others.

According to MRWUA, in the event of low water levels in the river, domestic use is given first priority, followed by hoteliers, irrigation, then other uses follow.

No cases of extreme low water levels have been recorded in the Mara River on the Kenyan side according to the MRWUA.

All water abstractors are required to obtain a permit from WRMA weather abstracting from the river of boreholes/wells, while the MRWUA are aware that everyone has a right to water.

WRUAs, their makeup, roles and mandate

The WRUAs work on behalf of WRMA, so as to ensure its presence is felt by the people at the grassroot level. The MRWUA has a sub-catchment management plan.

The original MRWUA has been split by WRMA into six small WRUAs namely: Amala water resource users association, Nyangores water resource users association, Issei water users association, Talek water resource users association, Sand river water resource users association, Lower Mara water resource users association

In addition, to these WRUAs, there are many more upcoming smaller WRUAs within the Mara Basin, for instance, Sand River water users association has further been divided into 5 more WRUAs. Normally WRMA dictates where and when to sub-divide (this could be regarded as a top-down approach).

The sub-divisions are done due to the vast nature of the Mara River Basin so as to make them manageable (i.e. for effective management).

Initially, there were no clear policy guidelines as to the expanse/area that each WRUA was to cover, with MRWUA covering the entire Mara Basin. However, currently each WRUA is being reduced to between 150 and 200m^2.

Some of the tasks carried out by WRUAs include recommending small water users to WRMA for permits.

The WRUAs work towards preserving the water resources by protecting the riverine vegetation, reducing soil erosion, planting suitable riverine trees, among other environmental protection activities.

Challenges facing WRUAs in water resource management

MWRUAs lack the powers to act on those going against the laid down regulations instead, all they can do is to report them to WRMA for action to be taken. The MWRUAs are also not recognized by law.

Lack of funds is one of the major challenges facing MWRUAs due to the totally voluntary nature in which they operate. As such, planning and logistics becomes a problem due to lack of funds hence the WRUAs are not able to execute their plans effectively.

According to MWRUA, the current policies on water resource conservation and protection are conflicting, thus need for policy mainstreaming particularly between ministry of lands and that of water.

A case in point is where the water act which restricts and form of cultivation upto 30meters from the river banks, yet the ministry of agriculture issues title deeds right upto the river banks.

It was established that currently, there are no limits on threshold that can be abstracted from the river, and that it is only WRMA that gives water permits to the users based on the quantity required.

MRWUA felt that community participation in water resource management is low, and they attributed this to the voluntary nature of the association and lack of incentives for their members making other community members reluctant to join.

MRWUAs felt that there is need to create more public awareness among community members to encourage them to join the group. According to MRWUA, many people actually joined the group when there were cases of waterborne diseases in the region.

On the overall, officials of MRWUA felt that the group has done a lot despite encountering huge logistic and financial challenges.

Sources of funding for WRUAs

MRWUAs get occasional financial help from WWF which is however not constant (for instance, the new MRWUAs building was sponsored fully by WWF).

WRUAs also get some funds from water development Sacco (WDS) an arm of the government, though the process of obtaining this money is lengthy making this source of finances less reliable and appealing to the WRUAs.

Only active and registered members of MWRUA benefit from any income generating activities carried out by the association.

Key issues identified with regard to Mara River water resources

Water pollution particularly high turbidity and coliform levels emanating from deforestation, poor farming methods, encroachment of river catchment, overgrazing, washing of vehicles, mushrooming urban centers among other destructive practices was identified as a major transboundary issues facing the Mara River water resources.

Destruction of the Mau forest was also cited as a key transboundary issue within the Mara River Basin.

According to MRWUA, Amala tributary is more polluted than Nyangores possibly because it flows through a large expanse of land characterized by farming activities, human settlements, urban centers and other human activities.

On the contrary, Nyangores tributary flows mostly through forested upper catchment and land covered with tea plantations thereby considerably reducing surface runoff and other pollutants into the water.

It was established that there were plans to construct a dam at Kapkimolwa along Amala tributary and the feasibility study has already been done and the locals have no issues or objections with its constructions. This is likely to increase water demand.

Most town if not all along the Mara River in Kenya do not have sewage treatment facilities implying that sewage and untreated waste may find its way into the Mara River thus polluting the waters.

It was established that the MRWUAs lack information on the reserve flows that should be maintained in the river, though they were aware of the river gauging station installed by WRMA.

Plans were at an advanced stage of setting up a water services provider at Longisa area, a move likely to increase the water demand.

Current plans and corrective measures aimed at protecting the water resources

MRWUA has been involved in restoration and protection of Mara River water resources with their counterparts from Tanzania.

Washing of clothes in the river and vehicles along the river banks has been prohibited.

MRWUA advices the locals on best management options while giving them other options that are more environmental friendly, for their farms but with equally high returns.

There are plans for instance to plant fodder trees along the Mara River to protect its banks and prevent soil erosion.

Currently, there is a Mara River Transboundary forum comprising of member from Kenya and also from Tanzania, though the Kenyans form the majority of members.

MRWUA has a sub-catchment management plan for Amala tributary, while the Nyangores sub-catchment plan is also available.

4. Minutes to a Meeting Held at Olerai Farm on the 16th August 2012 at 16.00 pm.

Olerai farm is a large scale farm within the Mara Basin of Kenya that abstracts water from Amala tributary of Mara River for irrigation purposes.

The farm is 1100 hectares in size of which 480 hectares are under crops and 190 hectares of this are under full irrigation of which about 200 acres of land are under beans crop which needs constant watering.

The farmer uses water pumps to abstract water from the Amala tributary, while there are plans to construct a dam whose capacity will enable the farm to run its activities for a minimum of three months during the dry seasons, so as to avoid drawing water from the river when the levels are insufficient.

Olerai farm neither has any greenhouses nor any other sources of water apart from the Mara River.

Irrigation consumes approximately $100m^3$ of water per day and domestic activities within the farm consume about $10m^3$ per day. The farm management does not however have any plans of further expansion in the near future.

Olerai farm applied for $3000m^3$ of water per month from WRMA and when they abstract anything above this, they pay for the extra water abstracted. The farm complies with the WRMA regulations and also pay their water dues regularly.

The amount of water extracted by Olerai farm was known since their water intake was metered.

Olerai Farm is highly involved in the MRWUA and they reported to have contributed in setting up of the association. The farmer appreciated the role played by MRWUA as far as water resources conservation is concerned.

Concerns and challenges identified by Olerai Farm management with regard to water resources

The farm managers decried the wanton destruction of the Mau forest as the major cause of dwindling water resources within the Mara River.

The large scale farmer also felt that it is only the perceived big users of water that were actually paying the water rates while other users including hotels classified under domestic use (class A) were not paying for the water abstracted, despite the high volumes they abstracted from the river.

Deteriorating water quality, particularly *Escherichia coli* levels were a cause for concern to the farmer as they dealt in export of French beans whose processing requires very high degrees of sanitation and hygiene.

The *E. coli* problem forced the large scale farmers to test their water every 6 months increasing their production cost.

Delays were reported in the renewal and issuance of permits by WRMA, forcing some water users to operate without permits for relatively long durations.

The large scale farmer also wanted to know if the other water users were paying the water rates, and how WRMA as an institution utilizes these funds in water resource conservation.

The farmers raised concerns that stakeholders at the Mara including the park management have a perception that Olerai farms are the largest water abstractors of Mara River water.

The large scale farmer did not know of any thresholds relating to water abstraction and use within the Mara River.

Suggestions and Recommendations given by the Olerai farm Management

There is need to review water permit requirements to bring other large water users on board.

There is also need for WRMA to monitor the exact amount of water abstracted by all registered users to ensure compliance with permit requirements.

There is need to determine the amount of water abstracted at the different sections of the river (Upstream, midstream and downstream).

There is need to protect the Mau Forest from destruction so as to save the Mara River from completely drying..

The Olerai farm management highlighted the need for transparency at all levels including issuance of permits and revenue collection and expenditure by WRMA.

5. **Minutes to a Meeting Held at the Ministry of Agriculture and Ministry of Livestock-Longisa Divisional Offices on the 15th of August 2012 at 11.00 am.**

Water resource issues within Longisa Division

Domestic and livestock use were the main water uses within Longisa division during the time of study, while the sources of water included: springs, seasonal streams (major sources of water),

water pans, boreholes, shallow wells and roof catchment, though the water pans were mainly in the mid areas.

Shallow wells were estimated to be over 300 in Longisa division alone, though these were operated without any permits from WRMA as the water was abstracted by use of a bucket.

Those who used hand pumps were required to have permits though this was not mainly the case due to lack of enforcement.

River water is used by a minimal number of people in Longisa division, particularly those living along the banks or in close proximity to the river, while there was no much irrigation within the division, with bucket irrigation being the only dominant type of irrigation in the area.

The Livestock officer predicted that the number of livestock was likely to increase in the future due to improved technology, thus increasing the water demand.

On daily water consumption by the livestock, it was estimated that exotic cows take between 60 and 80 litres of water per day, while zebu takes between 40 and 60 litres a day.

Lower Mara zone was mainly characterized by zebu, while the upper zone was characterized by the exotic breed. However, generally the exotic cattle (about 5000) are fewer compared to the zebu and the cross breeds (8,000) within Longisa Division.

Challenges facing agriculture and livestock keeping within Longisa division

Acute shortage of water during severe droughts often forces farmers to take livestock to Amala tributary when the pans dry up. The tributary is only useful to the locals only during dry spells/drought.

It was established that there were no limitation imposed by WRMA on the amount of water consumed by livestock.

It was also interesting to note that most farmers were not aware that livestock keeping can cause erosion at the water drinking points. Attempts have been made to rehabilitate the river banks through construction of gullies.

Maize crop used to be the major crop grown in the region though it has now succumbed to a viral disease.

Due to the viral disease that is attacking maize crops, other crops such as Irish potatoes, beans, finger millets, sorghum, sweet potatoes (in the lower zone), soya beans and tomatoes and cash crops like tea, coffee and pyrethrum are increasingly being promoted within the upper Mara.

It is projected that agriculture will most likely decrease due to land fragmentation, emerging pest and diseases and also population growth which encourages conversion of agricultural land to other uses such as settlements and urbanization.

It was established that the ministry of agriculture and that of livestock normally collaborates to protect the river bed.

Water was a problem for the inhabitants of Longisa division with most of them relying on vendors who get the water whose quality is often poor from the springs.

The two ministries were not concerned with water allocation within Longisa, though they worked closely with MRWUAs in environmental conservation, soil protection, river bank protection among others.

In addition, they are also advocating for a 10% increase in forest cover within the division.

6. Minutes to a Meeting Held at the WWF Offices in Narok on the 16:08:2012 at 8.15 am

The mandate of WWF is to coordinate water resource management activities on both sides of the Mara River i.e. Kenyan side and Tanzanian side.

However, they are not involved in water allocation within the Mara Basin as this task rests squarely with WRMA.

Challenges identified and suggestions by WWF for better water resource management

The water allocation guidelines were not being followed owing to poor enforcement by WRMA and any enforcement agency.

The water allocation process was not clear among stakeholders especially the users as there was lack of clarity on surface and ground water allocation i.e. who gets what and where and also how exactly the revenues collected used.

WWF felt that the revenue raised from water permits should be ploughed back in a clear and transparent manner to conserve and restore the environment.

WRMA was thought of as attaching too much emphasis on water resource pricing and profits with complete disregard of potential effect to the surrounding environment including aquatic organisms.

Extremely low water levels are experienced in the Mara Basin particularly during the dry spells (between January and February), when the water levels are always too low to the extent that it becomes possible to walk across the river at some points.

WWF supports water users associations in their bid to protect the basin, while proposing that all large water abstractors should be permitted by WRMA. Community members are always encouraged by WWF to identify and report to WRMA any illegal water abstractions and use along the Mara River.

Lack of laws that acknowledges the existence if WRUAs or even clarifies what WRUAs are supposed to do is another setback to the WRUAs. This leaves the WRUAs to operate under goodwill.

In addition, the laws are also silent on if and what WRUAs should be paid if at all they are to be paid for their role in protecting the environment and awareness creation.

Low water levels and poor water quality were identified as some of the most common transboundary issue that normally arises between the two countries.

There is no official transboundary legal channel through which any dispute arising between the two countries can be resolved. As such, there is need to have strong transboundary water policies, which can be used to safeguard the Mara River waters across the boundaries.

The WWF also felt the need to make WRMA acknowledge the transboundary nature of Mara River and recognize it as a shared water resource that needs to be protected by strict enforcement of the regulations by both countries.

In addition, the water bill needs to be amended since it does not take into consideration the fluctuating water levels especially during droughts when allocating water to various users.

There is need to incorporate the payment for ecosystem services in the water bill so as to take care of the environment conservation and protection issues since millions of wildlife and other aquatic organisms rely on the waters of Mara River.

It was observed that the Mara River water levels were currently low, with increase in human-wildlife conflicts projected to increase and become more severe due to reducing water levels.

WWF projected that water quality will most likely deteriorate increasing water borne diseases such as typhoid, cholera e.t.c in the process, thus the need to increase the water levels in the river so as to "reduce pollution through dilution".

It was noted that up to 90% of the people do not have access to tap water within the Mara Basin, forcing them to rely heavily on water from the river/streams and springs.

Due to presence of large scale farmers who consume significant amounts of water daily, along sections of the Mara River, WWF is trying to encourage the use of drip irrigation in order to reduce the amount of water abstracted from the river.

According to WWF, WRMA's capacity to protect the water resources in Kenya is inadequate, while some of their laws are also not adequate. For instance, there are no laws that allow WRMA to give or invest on WRUAs, yet the WRUAs are expected to continue helping WRMA at the grass root level.

There are no policy frameworks which support financing of WRUAs by any other interested parties such as Hugo.

According to WWF, there is need for increased financing of environmental conservation issues though this funds should not be channeled through WRMA, instead should be given directly to

the respective players e.g. MRWUAs so that they appear independent and be able to stand up against WRMA or any other body on environmental issues.

WRMA should only play a role of quality control and also oversee the work of WRUAs in water resource protection and conservation.

The water abstraction regulations and laws governing water resources are ineffective, poorly enforced, while the criteria for licensing does not link the payment to water abstracted.

There is also lack of communication and understanding between players in the water sector particularly those that are closely related. For instance, there are no discussions between WRMA, KWS, WWF and other players.

Wildlife consumption is also not looked at as a water use to be billed.

The WWF had no idea whatsoever on how WRMA comes up with or sets the water allocation criteria for various users as the process remains a mystery to other stakeholders. To this end, there is need to make such information public and transparent so that it is clear to all on how these things are done.

Contrary to the situation on the ground, large scale water users are supposed to have reservoirs before they are even licensed to abstract water. In addition, such abstractors are not supposed to extract water when the levels are low.

Most critical months in terms of diminishing water levels in the river are January, February and March and also October and November.

Majority of the people in the Mara Basin did not have access to tap water, hence most relied on springs which are in one way or another linked to the Mara River, with up to 100 % reliance during dry periods.

According to WWF, sections of the Mara River that are most polluted include those flowing through urban centres like Bomet and Mulot and also areas with elevated anthropogenic activities such as washing of cars, washing of clothes, bathing among others.

Talek and other tributaries in the mid Mara are also polluted by lodges and hotels along the Mara River.

On community participation, the WWF acknowledges that community awareness in Kenya is very high, however, investment by key players is still relatively low, and this reduces the community's morale towards environmental protection.

There is lack of linkage between communities' expectations and WRMA policies, while existing laws and regulations governing water resources in Kenya and those in Tanzania are not harmonized.

There is need for a legal expert to look at these laws very critically, with the aim of harmonizing them.
Currently, the transboundary water forum is not recognized legally in both Tanzania and Kenya, hence need to legalize it. There is however a transboundary policy in Kenya already in a draft form.

7. Minutes to a Meeting held at Narok County Council Offices on the 16th August 2012 at 11.02 am

The Maasai Mara National Reserve is managed by Narok County Council, while KWS provides security within the park. All the Mara park revenues are collected by Equity Bank on behalf of Narok County Council. Hoteliers operating within the park however pay their fees to KWS.

The council gives wildlife top priority since it is their main source of revenue, arguing that human beings can always take care of themselves.

According to the Council, local communities are very much involved in conservation of forestry resources, wildlife and water resources. However, the best way to manage the parks according to the council is to get one body which incorporates every stakeholder to oversee all matters of park management.

Most hotels within the Mara River basin have their own boreholes and also harvest rainfall therefore do not rely much on waters from the rivers. However, most of them damp their waste into the river channel as they lack sewage treatment facilities.

A list of wildlife and their numbers is kept by the council, with an estimated Rhinos population of only about 38 within the Mara, while Hippos and elephants are in their thousands.

Some of the institutions concerned with water allocation and management in the region according to the Narok County Council include: Narok County Council, Ewaso Ngiro South Development Authority (ENSDA), WRMA, WWF, KWS, Lake Basin Development Authority (LBDA).

Water allocation and Management issues
The main water uses within Narok County Council are domestic use, livestock use, wildlife consumption and irrigation by both large and small scale irrigators.

The council normally liases with WWF and other key stakeholders in the water sector to ensure the Mara River waters are adequately protected. In addition, the council monitors the level of the river using the gauging stations located at various points along the Mara Rive and run by WWF.

Provision of water for the people of Narok is one of the roles of the council and to achieve this, the council has been involved in creation of water pans, securing springs, drilling boreholes among other methods. A role the council feels should be shared with other stakeholders as well.

The council is aware that abstractors are supposed to be permitted by WRMA, but do not know if the users are actually permitted.

There was however no clear relation or cooperation between Narok County Council and WRMA as far as water resource management issues are concerned, as the council rarely gets in touch with WRMA and therefore are not aware of exactly what WRMA does, especially within Narok District.

According to the Narok county council officers, the current water allocation policies are not clear and not many people were conversant with them.

Concerns with regard to water resources and effect on wildlife

It was established that there were no clear linkages and coordination between different players in the water sector, which makes their disjointed efforts fruitless.

The council was concerned about the large volumes of water abstracted from the Mara River, citing its effect on wildlife. For instance in the year 2004 – 2005 and 2009, water levels receded to very low levels causing massive death of hippos in the process, hence causing a public outcry.

Olerai farm and Simba farm on the upper Mara were identified as some of the major water abstractor from Mara River.

Illegal logging at the Mau Forest was also an issue of concern to the council since such actions together with over abstraction are the main cause of reducing water levels in the Mara River.

Reduced water levels have always been a transboundary issue. For instance, in the 1990s, the then Tanzanian first lady (Maria) wrote a protest letter to the Kenyan government (a copy of which was given to Narok county council) concerning the reduced water levels at Musoma, that affected agricultural activities downstream. The Kenyan government took this up and removed the illegal immigrants from the water catchment by 1995 but by 1997 these people were again back and are still there to date.

According to the council, there are no human-wildlife conflicts within the Mara but there are human to human conflicts especially between communities as relates to water use, especially at Lameck (Border point).

Suggested corrective measures to improve water resources

The council encourages the planting of trees along the rivers to protect river banks

The relationship between Narok county council and KWS was not cordial because of differences arising from reports that some KWS officers who are supposed to be protecting wildlife are the same officers poaching these animals. This causes tension among the two institutions which is not healthy for conservation of the Mara River resources.

8. **Minutes to a Meeting Held at the Kenya Wildlife Services Office (Ewaso Ng'iro) on the 16th August 2012 at 13.49 pm.**

Host: Benard Okurta – Seniour Game Warden

Kenya wildlife Service is the chief custodian of wildlife in Kenya, and in the Mara Basin, they concentrate more on wildlife that is outside the Mara Reserve, since the management of the Mara National Reserve is left to the Narok County Council.

KWS argues that for the high tourist season to be what it is in the Mara, there must be adequate water in the river.

KWS has no permit from WRMA for water consumption by wildlife as they expect nature to balance by itself.

Some of the sources of water in the Mara as mentioned by KWS include manmade water pans in the reserves, outside the reserves and in the community. KWS also makes watering points for wildlife.

KWS works in collaboration with other agencies such as ministry of agriculture, water, environment, tourism among others on issues of conservation and management.

Issues of concern raised by KWS with regard to water resource management

Over abstraction of water from Mara River for irrigation and other uses was cited by KWS and identified as a risk to the survival of wildlife. For instance, the water levels were very low during the study and the KWS feared that if the situation continued that way, then the wild animals could be forced to relocate.

In case of water shortage, the KWS felt that domestic users should be given top priority, followed by livestock and wildlife. However at some sections along the Mara River, e.g. at the mid Mara, wildlife watering takes top priority over other uses such as irrigation etc.

Lack of water especially during dry periods poses a danger to wildlife as well as leads to human wildlife conflicts.

It emerged that issues of concern over the Mara River management are always the same both for Tanzania and Kenya and mainly revolve around destruction of forests in the Mau forest and dwindling water levels.

Political interference is partly to blame in the wanton destruction of forests upstream as some of the evictees are often not given alternative land, hence they are forced or incited to go back to the forest. In addition, part of the Mau belongs to some powerful individuals making it difficult to conserve and protect.

Conflicts were reported between livestock and wild animals over natural resources like water and pasture. However, in the event of these conflicts, farmers are never compensated as there are no clear laws supporting this. It was however established that the laws are there in draft form but they have not been passed by parliament.

Some of the human-wildlife conflicts especially within the Mara occur because it is practically not possible to fence the park as some of it is community land.

Poaching was one of the main challenges facing KWS which acknowledges that there have been isolated cases of its officers poaching wildlife.

In recent times, poachers have become a serious threat to the wildlife and that given a chance they can wipe out wildlife especially the elephants completely. The infiltration of Somalis into the Mara basin has worsened the poaching activity causing an even serious threat to the elephants. These poachers have even influenced the locals and are giving them large sums of money to poach elephants, making a bad situation worse.

It was also established that issues of water quality are not so much of a problem presently, though it is feared that they may have some impact in the near future.

Suggestions and corrective measures given by KWS
KWS advocates for reforestation of the Mau Forest, where they have been key players in protecting the upper Mara River.

9. **Minutes to a Meeting Held at Twigs Hotel on Behalf of Mara Water Users Association on the 16th August 2012 at 7.30pm.**

Sources of water within the Mara River Basin include: Rivers, streams, groundwater/boreholes, and rainfall. The most popular though is river /stream water, while the least popular is groundwater.

Water uses include: domestic, irrigation, livestock, commercial users- water suppliers etc. However, there are no clear laws governing water vending. Domestic water users are given priority over other water users followed by livestock then irrigation comes last, according to MWRUA. Wildlife comes in at around 3rd or 4th position depending on the section along the Mara River.

Some of the technologies used with regard to water use and allocation in the Mara include: weirs which are metered to check the amount of water abstracted per day, gravity and pumps

The institutions with stakes in the Mara River according to MRWUA include: Olerai farm, Hoteliers, KWS, Narok county council, Tenwek Hospital (which generates electricity), Water supply outlets (e.g. Chepalungu H^2O supply, Bomet W, S), Ministry of wildlife, other stakeholders.

Water resource management issues
MRWUA uses less than $10m^3$ per day mainly for irrigating their tree nursery of which they pay 1000 ksh per year. It is only Olerai who pays the highest water rates of about 1,000,000 per year within the Mara River basin.

About 30% of abstractors in the upper Mara River have permits and there are no fake permits, it either one has a permit or does not have. However, very few users have permits within the Mara River basin according to MRWUAs, though this depends on the level and type of use, for instance, irrigation, schools and hospitals have permits, while small scale users such as domestic users generally have no permits.

WRMA has guidelines of water fees to be paid by the different user categories, though these guidelines are not known to many people.

According to MRWUA, unpermitted water users are the largest abstractors due to their large number. However, WRMA normally halts excessive abstraction of water from the Mara River when the levels are extremely low by announcing to the public through various communication media.

Challenges facing water resource management
Lack of meters makes it difficult to know exactly how much water is abstracted by water users both with and without permits.

Some of the existing water resource management guidelines are not clear and therefore implementing them is not easy.

The returns on revenue collected by WRMA towards, water resource conservation is not clear or transparent to key stakeholders including water users.

The proposed dam to be constructed along Amala, is a source of concern and therefore a transboundary issue of which the Tanzanians are not particularly happy with. In addition, there is growing disquiet among the Tanzanians who feel that Kenya is being given too much focus than Tanzania yet the river is transboundary.

There are no harmonized policies, though there are plans to harmonize these policies by the LVBC which is trying to work with all key stakeholders, through such bodies as the recently formed transboundary water forum.

Wanton destruction of Mau Forest is also creating tension between the two countries since this particular forest is the major water tower that supports the Mara River.

The Mara swamp at Musoma is also expanding due to increased siltation resulting from increased soil erosion from upstream. This leads to displacement of people downstream as well as floods.

According to MRWUA, institutions tasked with water resource management lack capacity to effectively manage water allocation and abstraction from the Mara River.

WRMA has more or less commercialized the water resource sector and they seem to concentrate more on permits and revenue, while they do not seem to plough back the revenues into environmental conservation.

The water services trust fund (WSTF) provides funds towards the protection of water resources, though WRMA claims to plough back their revenues through WSTF. However, it was not clear how the revenues collected by WRMA are handled.

The thresholds used by WRMA are generally those in the EFA, though they are not clear to the stakeholders and which some argue do not take into consideration the fluctuating water levels.

Apart from EFA, there are no clear documents or reports showing the threshold for water allocation within the Mara River basin.

It is projected that water use is likely to increase for domestic, irrigation, livestock and industrial purposes, especially with the advent of counties.

Increased pollution of the river resulting from waste water and sewage along the Mara River is also a source of concern among stakeholders as it compromises the water quality, thus exposing users to waterborne diseases.

Despite increased participation of the locals in water resource conservation and protection especially with the advent of WRUAs, WRMA does not involve them during water allocation planning, as such WRUAs do not have a say in water resources allocation as they rely on the policies provided by WRMA.

Suggestions given by MRWUA for further improvement

Based on the limited information currently available, there is need for more studies to be carried out to determine the reserve flows. In addition, there is need to have more stations as well as improve investment in modern equipment as some of the ones currently in use are outdated and old.

However, plans to involve communities in the Nyangores and Amala sub-cathcment water allocation plan is at an advanced stage, though it will still be spearheaded by WRMA.

There is need to critically study the laws and policies regarding water resource conservation with the aim of harmonizing them (For Kenyan and Tanzania). Considering various sub-catchments and ignoring some is not likely to succeed.

Presently, there are plans to hold a Mara Day at Mulot MRWUA offices to help create awareness on the Mara River. However, the Tanzanians are not particularly happy since they feel that it should have been held in Tanzania.

10. Minutes to a Meeting Held at Fair Mount Mara Safari Club on the 17th August 2012 at 11.30 am

Fairmount Mara Safari Club has a bed capacity of 100 and 50 tents with a capacity of two people each. The approximate number of visitors to the hotel is about 10 to 15, though the number fluctuates depending on the season, with certain times having no visitors completely. During low seasons, huge losses are incurred due to high running costs. There are no plans by the management to expand in the near future since the occupancy is still low.

The main source of water for the hotel is the Mara River which is about 150m from the hotel and the water is abstracted by use of a pump which is metered. Boreholes were used in the past though they were abandoned because of being salty.

The hotel uses about $2500m^3$ of water every month but this highly depends on the number of visitors present. During the peak season for instance, average water use can be as high as $4000m^3$ per month, while during the low tourist season, it can be as low as $1500m^3$ per month. This water is treated by the establishment before use and the hotel is permitted to abstract the water from the river by WRMA.

WRMA normally charges a water fee of fifty cents per cubic meter of water, which the hotel management pays promptly.

In the past, the hotel lacked a meter hence WRMA used to estimate their water usage, however, currently they are metered.

The hotel has no challenges as far as water resources are concerned, though they are of the opinion that WRMA should collect their dues monthly instead of quarterly as it is done currently.

No problems were reported with regard to water quantity of the Mara River at least in the last 2 years, though previously, there were instances of extremely low levels that it became a security threat to the hotel as there were fears that intruders could access the hotel premises by crossing the river. In addition, the management was forced to move their water pump much deeper into the Mara River water.

There were no reported cases of human wildlife conflicts as the establishment was surrounded by an electric fence.

Other hotels and lodges /tented camps in the Mara River Basin Include: Ngerende, Livingstone, Kichwa Tembo, Governors, Mara Serena, Olkyombo, Sarova and Other small tented camps. Some of these hotels and lodges use boreholes e.g. Kichwa Tembo.

The Fairmount Mara Safari Club has septic tanks and sock pits which they use to manage their waste water and sewage biologically by use of bacteria.

Concerns and suggestions given by Fairmont management for further improvement
The establishment holds regular environmental meetings to try and come up with ways of protecting water resources and the environment. For instance, plans are at top gear to start harvesting rainwater to be used within the establishment.

The establishment is concerned about the increased irrigation upstream which reduces the level of water considerably.

The hotel management proposes that WRMA should set the amount of water to be abstracted from the Mara River by users per day during different seasons, while top priority in water resource allocation should be given to domestic users as well as community projects during scarcity

The establishment involves the community on water resource management and conservation issues particularly when the levels are really low. For instance, the community members are paid a sum of some money to preserve the riverine forests.

11. **Minutes To The Meeting Held At Bomet Water Offices on the 17th August 2012 at 3.45 pm**

Bomet water office falls under the Lake Victoria South Water Services Board and is mandated to supply clean water for domestic use to inhabitants of Bomet town.

About $700m^3$ is supplied in Bomet area every day out of a demand of about $2000m^3$ for Bomet town alone.

The water is abstracted from the Nyangores tributary using a pump, treated then supplied to users and there are plans for its expansion to cover more customers

Bomet water service providers have a permit from WRMA and they pay their water rates promptly. Currently, the water service provider has about 900 customers (including institutions), all of whom are expected to pay for the water, since the water is not given for free.

The WSP relies on a gauging station along the river which is also recognized and relied by WRMA. However, the records of this station are kept by WRMA.

Other water service providers in the region include Longisa water supply, which gets its water from springs, with a capacity is $10m^3$ per day and Chepalungu water supply which supplys the locals around that area.

Challenges facing Water Service Providers in water resources management
Low water levels in the river which forces some providers to raise their weirs to obtain more water.

Lack of sewage treatment plant in Bomet and solid waste dump sites located about 5 km from the river banks pose a challenge to water quality in the region. However, no serious cases of water borne diseases have been reported in the area in the recent past.

Revenue collection from clients was also a major challenge facing the WSP.

Plans and Suggestions for best water management options
The WSP conducts training to community members on hygiene and wise use of water. However, the WSP do not relate directly with WRUAs.

Bomet water supplies is not a company, however, there are plans to privatize it so as to enable it expand and better its services.

12. Minutes to a Meeting with Community Members at Bomet Water Offices on the 17th of August 2012 at 4.30 pm

The meeting observed that the current water levels of Nyangores tributary had fallen unlike in the past. This was attributed to the cutting down of trees at the Mau Forest.

Water sources in the community include: Rivers, (used by about 80%), Roof catchment (about 10%) and Boreholes (Used by about 5%), while the water uses include: domestic, irrigation (Kabosom irrigation scheme), industrial (Tenwek electricity generation) and livestock consumption.

The community members were knowledgeable on the existence of water permits with some of them paying for the water abstracted for washing motor vehicles.

It was realized that the fear of WRMA confiscating their generators makes them pay their water fee regularly.

Some of the community members did not see the need for water allocation of the Nyangores river waters since they believe that the Nyangores River cannot get finished, while some did not seem to care about what happens downstream as long as they get water.

The quality of water along Nyangores tributary was good according to some community members as some took the water directly from the river without treatment.

Water resource management issues
The community knew of the existence of WRMA though they are not aware of what exactly is done by WRMA apart from giving out water permits. There is need for community awareness and empowerment so as to see the need to protect the water.

The community members were first educated on the negative effect of blue gums on water quantity before the trees were cut down, though they were not given options on which trees to plant instead.

Challenges identified
Some of the challenges in the water sector according to the community members included: ignorance of the rules governing the water resource management in Kenya, hence the need for aggressive public awareness campaigns.

Some members felt that WRMA officers are too far hence cannot monitor the polluters effectively

13. Minutes to a Meeting Held at the WWF Offices in Tanzania on the 22nd August 2012 at 12.30 pm.

Host: Dr. Kasanga

The WWF Tanzanian office at Musoma's jurisdiction falls within Tanzania but the two WWF offices in Tanzania and Kenya are coordinated.

Water allocation plan was left to the Lake Victoria Basin Water Office, since they are the ones responsible for water resources in Tanzania.

Some of the main water users identified within the Mara Basin included: communities - domestic use and livestock, wildlife, mining industry (Bulk North Mara Gold Mines) and fisheries in the swamp for subsistence use. The Gold mines use more water in the Mara River, on the Tanzanian side, compared to agriculture, domestic and other uses.

There are just a few tourist hotels on the upper part of Mara in Tanzania, though most of them are temporary tented camps which are often set up during peak tourist season with the dominant water sources for domestic use being rivers and streams.

There were virtually no large scale irrigators along Mara Tanzania, probably because communities lack entrepreneurial skills or lack the resources necessary to carry out such ventures.

It was reported that most water abstractors were on the Kenyan side as there were no major irrigators on the Tanzania side.

In addition, environmental degradation was not only prevalent at Mau Forest, but also along and within the entire Mara River catchment. This is because the contribution of springs and streams from across the basin has also reduced, just like those from Mau forest.

Low water levels affect wild animals forcing them to move into human settlement thus leading to human-wildlife conflicts. In addition wildebeests were particularly affected by the low water levels making them more vulnerable of falling prey to crocodiles.

Water resource management issues

WWF was aware of existing policies on water allocation issues in the Mara River basin and they also felt that it was important for water users and indeed all stakeholders to know exactly how this water should be shared among them.

There were many transboundary issues most of which relate to water quality and quantity especially during the dry season.

The Lake Victoria Basin Water Office is mandated with the management and allocation of water. However, institutions tasked with managing water resources lack the capacity to effectively manage these resources partly due to lack of sufficient financial resources and the vastness of the area.

WWF office was aware that water users (abstractors) are given permits, though information on the number of users (abstractors) with the permits and those without is not known to the WWF office. In addition, there are several river gauging stations from which data is collected by the Lake Victoria Basin water office.

The guidelines for allocation of water based on priorities existed though they were not available to most water users and that priority was normally given to domestic and livestock use especially during dry seasons.

It was established that the North Mara Mines have a water abstraction permit. Mara North Mines have a fresh water dam where they store the water obtained from the river before using to ensure that they do not experience shortages during the dry spells.

It was established that communities do participate in water resource issues through institutions such as water users associations, which also act as representatives of the community.

In addition, it was established that the WUAs in Tanzania were formed even before the 1974 Water Act was enacted. They had a total of 11 water user associations then, which LVBC is trying to legalize.

Communities are involved in the WUAs as they are always free to discuss issues and even elect their leaders.

Challenges with regard to water resource management

There were no formal fora for discussing transboundary issues according to WWF Tanzania thus triggering the drive to form a transboundary water users' forum which was in the process of being formalized and registered.

Formalization of the forum was left to the Lake Victoria Basin Commission (LVBC).

Human wildlife conflicts mainly over water issues were also common particularly among households living in villages bordering Serengeti National Park.

It was established that Buffaloes can displace and prevent people from accessing water collection points by camping at the water collection points (water sources) especially during dry seasons hence worsening the human-wildlife conflicts.

Wildlife-livestock conflicts were also experienced especially during the dry seasons when communities moved livestock into game parks and reserves for pasture, leading to disease transmission from wildlife to livestock.

The Water ACTs of both Tanzania and Kenya are critical to WWF offices though they are conflicting in some sections, necessitating their harmonization.

The low water levels of Mara River especially during the dry season, was a source of concern among stakeholders.

Floods were reported to have increased in frequency and this was attributed to, environmental degradation (mainly decimation of forests at the Mara River Catchment and over abstraction for irrigation purposes).

It was established that WWF Tanzania and their counterparts in Kenya have been carrying out studies on how best to reverse the excessive water abstraction in the Mara River.

The WWF was concerned that apart from taking care of availability of water for drinking by wild animals, the EFA settings did not take into consideration the wellbeing of larger animals such as hippos in relation to their lifestyle and the level of water required to support them.

In addition, the EFA settings were faulted since they cater only for wildebeests drinking needs but do not take into consideration the amount of water required for migration. As such, the EFA settings do not address the needs of larger animals wholly.

There were concerns over the quality of the Mara River waters, with some of the town such as Musoma, Dar es alam etc. which lack sewage treatment facilities being some of the polluters of the water.

Water pollution threats at the Mara North mines were real particularly because they use cyanide which is dangerous (though they claim that it disintegrates when exposed to air) and later damp the wastewater back into the river after the processing. It was however reported that monitoring of groundwater around the dumpsite was normally done.

Future projection of water demand

Water demand was likely to increase mainly due to: Increasing population, agricultural expansion particularly on the Tanzanian side, socio-economic plans to construct dams, irrigation systems and industries within the basin.

Some of the proposed options and technologies for future water management among communities within the Mara basin included: Storage technologies of harvested rain water to

ensure water availability during dry periods and Construction of large dams (1 on the Tanzanian side, and 2 on the Kenyan side), which will benefit a large number of people (NELSAP has already carried out feasibility studies of the proposed dams).

WWF Tanzania felt that there was need to carry out a major survey within the Mara Basin to identify all water users (small and large scale), their permit status, amount abstracted and any other critical information regarding water resources management.

There is need for the TZ and Kenyan governments to work together and share information freely concerning water resource management issues within the basin and any planned developments in the basin.

It was established that complains had been raised over lack of fish at Kirumi swamp probably due to increased levels of pollutants at the swamp and lack of oxygen resulting from high organic matter decomposition rates.

14. Minutes to a Meeting at the Lake Basin Water Office- Regional Administrative Office –Musoma on the 22nd August 2012

Host: Engineer Athuman Mathayo

The LVB water office in Musoma was responsible for water allocation in the basin.

Tanzania has both the water ACT and the water regulations/policies and that these legislations and many others such as NEMA ACT etc, are all in agreement as far as restriction of human encroachment of river bank is concerned, with all setting an allowance of 60meters from the river bank.

Water allocation policies were in place but their implementation was and still is a challenge due to lack of sufficient resources on the part of the offices concerned.

It was also established that large scale farmers were permitted to abstract water from the Mara River.

However it was established that the ministry of water is mandated to extend the protected area from 60 meters to cover even a larger area (say to $100m^3$), if it feels that the area is of absolute importance.

There are four districts within the Mara Basin, headed by the district executive directors. These are: Serengeti district, Tarime district, Rorya district and Musoma district. The Lake Victoria covers only Rorya and Musoma regions in Tanzania.

Major source of water in the Mara Basin of Tanzania is ground water followed by river water, while the main uses of water within the basin was domestic use, livestock use and industrial use in that order.

Only the Mara North Mines that use large quantities of water from the Mara River. All others are small scale abstractors. In addition, there are only a few hotels along the Mara Basin on the Tanzanian side but most of them use ground water and they have permits based on the amount of water abstracted per day.

Irrigation is only important during the dry seasons and therefore if water levels are low during such times, then it may not be viable.

At low flows, there were even fish kills thought to have been caused by toxic materials and possibly siltation which reduced the water levels. The dead fish were found about a metre from the river channel, and the cause of their death has not been ascertained.

It was established that accessibility of water by the population of Mara River stands at only 43%, while those who get access to clean and safe water are only 19%.

The EFA flow settings were satisfactory according to the respondent, though there is need to set the best level (about 1.5m) to ensure that the hippos are completely submersed in water, so as to keep them alive.

Some of the River gauging stations (RGS) and EFA stations on the Tanzanian side include: At Kirumi bridge, at Tarime bridge, at Serengeti National Park, at Mara Mines also has the EFA station and at Kogatende – EFA station

In Tanzania, land is owned by the state and individuals are just tenants. If the state takes away some one's land, then the person is only compensated for the developments therein and allowed to go build elsewhere.

Long term leasing of land (e.g. for 100 years) is also allowed, though the government can take it back any time it so wishes.

The water policy outlines the water allocation plans, procedures on what should be done and by whom.

Some of the technologies with regards to water resources management within the Mara Basin include: Use of pumps, channeling – i.e. deviation of water from the main river to a different area, Ponds and Roof catchment (though not common among the local communities)

It was established that there were plans to come up with laws that will require everyone to put in place infrastructure that will facilitate harvesting of rain water in buildings as is done in Kenya, to encourage more water storage for use during dry seasons.

Permits were required for users with pumping systems while those drawing water manually using buckets did not need any permits. However, not all water abstractors who use mechanical devices had permits, probably due to laxity on the part of the arm responsible.

Permits are issued upon inspection by experts who then decide on whether to give or not.

During water shortage, priority is given to domestic use, followed by agriculture, then wildlife. Wildlife was not given top priority especially by the LVB water office, because there are other arms e.g. TANAPA that were taking care of them.

On the Tanzanian side of the Mara River, wildlife forms the upstream users, while human beings are the downstream users of water.

Initially the water policy used to have a top-down approach to water resource management issues though this was changed and in 2003, they decided to involve the people at the grassroots. However the people's participation is still low due to lack of incentives.

Water resource issues and challenges identified by the LVBWO Tanzania

Challenges in reaching a consensus on the levels of flow of Mara River between different stakeholders and even countries were cited. As such, there were no joint water resource management plans for the two countries

Human wildlife conflicts especially between elephants and communities, particularly during dry seasons, were some of the challenges cited.

Human to human conflicts also exist with regard to water resources e.g. Tigithe River which passes through the Mara mining area was acidified in 2005 creating conflicts between water users and the gold mine management. The water pollution (chemical pollutants) lead to fish kills, though the situation has been corrected.

There are cases of competition by small scale water abstractors especially from Somache and Tobora River for small scale agriculture, while pastoralists also compete for the same resources, making it more scarce.

The Lake Victoria water office was not satisfied with the water allocated for ecosystem maintenance, citing the massive death of hippos in the year 2011 during the dry season. At this

time, even humans were not getting enough water. It was revealed that statistics were even there concerning human beings who died due to poor water quality and also lack of water.

Water quality issues within the basin mainly from chemical pollutants (especially from the mines) and microbial pollutants (especially from upstream sections of the river), which are thought to be contributed by hippos were the major issues of concern. This was more pronounced during the dry season.

Human activities also contribute to pollution of the Mara River resources. For instance, small scale miners were also a source of pollution due to their tendency to burn mercury (Amalgamation process) so as to get the gold, causing the mercury to evaporate into the atmosphere, thus endangering their lives and that of others.

There are no waste water treatment plants within the Mara as most establishments use septic tanks and exhausters. Other towns such as Musoma discharge their waste into the Mara Bay thus contributing to water pollution.

There are many water users' associations/entities but they are largely dormant (not active at all on the ground). Politics was cited as one of the barriers to effectively running of water users associations within the basin.

Suggestion and way forward

There is need to harmonize the existing laws, policies and regulations since some of them are so varied that its' not possible to deal effectively with polluters or over abstractors.

There is need to come up with a joint protocol that can be used for Mara River water management on both the Kenyan and the Tanzanian side.

There is need to introduce incentives so as to motivate the community members and encourage their participation.

Information on the number of boreholes within the Mara River basin of Tanzania was available but lack of funds and capacity to monitor and enforce regulations as required was the main challenge.

There is need for training to create capacity as well as need for more financial resources to take care of water resource management issues within the Mara River basin.

15. Minutes to a Meeting Held at Mugumu Water Office at Serengeti on the 23rd August 2012 at 11.20 am

HOST: AREA WATER ENGINEER

Mugumu water office is mandated to ensure that people around are adequately supplied with water and to advice on water use within the district.

There is a national water authority which deals in water allocation within the district, while some of the most common water uses in the Mara include domestic and livestock use.

The water demand has gone up considerably according to the Serengeti water office. Currently, the water office supplies up to 37,000m^3 of water per day which is only 52% of the demand. Out of this, 20 to 25% of the water is unaccounted for, meaning that the actual supply is only about 30%.

The impact of spring water to the Mara River within Serengeti is very minimal, as most springs flow for a short distance (20 to 50metres) then dries up. The water office does not have adequate human and financial resources to monitor all water sources within the Mara.

Priority in water resource allocation is normally given to wildlife within the park while domestic water use is given first priority outside the park.

There are not major abstractors in the Mara on the Tanzanian side as most of the section is forested and also host a game park.

Serengeti National Park (more than 50%) is within the Mara River Basin but part of it is not. The water supplied to the basin inhabitants (37,000m^3) does not come from the Mara River alone, as some of it is abstracted from Gurumeti and Simei basins, while about ½ comes from the Mara River.

The water service providers (water office) do not have a permit for water abstracted. However, it was established that abstraction of 5m^3 per hour and above needs a permit as well as any abstractor who use mechanical devices to access water needs a permit. This does not however apply to those who use temporary pumps as these are taken as small scale users.

Issues raised concerning water resource management within the basin

Water users associations existed but they were mostly dormant due to lack of resources to run them. Participation was also low probably due to the “free things mentality”.

Diversion of water upstream on the Kenyan side which leads to reduced water quantities for the users in the lower Mara was one of the main transboundary issues.

Cutting down of trees at the Mau forest was largely blamed on the dwindling of the water resources especially within the last 2 years. There are plans to construct a dam of which 8

villages out of 9 have accepted. The dam will be located along the Mara River at Morito and will be used for irrigation and flood control once complete. However the dam may increase the water demand further.

Water policies and water acts are just fine as they are now, but their implementation is poor probably due to financial constraints, though some quarters felt that the policies are not detailed.

Attempts have been made to try and harmonize these laws with those of Kenya by the WWF so as to facilitate effective management of the Mara River water resources.

Most water users abstract directly from the Mara River, while the sources of water included, man-made dams, rainwater and boreholes (e.g. at Nyansasura, Kisaka, Serenga and Nyansurumati). The water basin office issues the permits for exploration and drilling of boreholes for domestic or any other use.

The office advises people to use borehole water because it is safe. However, most inhabitants of Serengeti (mostly livestock keepers) dislike underground water but prefer man-made dams, natural springs and the river in that order.

No conflicts between livestock and wildlife have been reported in the Mara.

The decreasing water quantity of Mara River interferes with the ecosystem.

Water quality degradation was cited as an issue with the water office reportedly carrying out monitoring of water quality twice a year, with the current quality of water generally reported as fair.

The water office admitted not having sufficient equipment and resource persons for the water quality monitoring forcing them to use other laboratories.

The waters of the Mara are not sufficient for all users on the Tanzanian side of the Mara River.

The water demand was projected to rise in the near future mainly due to the planned construction of an airport at Serengeti and a dam at Morito.

Not much has been done on technologies that can be used to conserve water locals have been taught to clean water before consumption.

Way Forward and recommendations

There is need to involve the people right from the planning to implementation of water management issues. The water office at Mugumu educates the community on water resources conservation.

16. Minutes to a Meeting Held at Serengeti National Park – (Tanzania National Park-Tanapa) on the 23rd August 2012

The water sources for wildlife include: Mara River, Gurumeti River, Tana springs, Kerawira River, boreholes (numbering about 3) and water pans. However, Mara River is the main source of water for the wildlife in the Serengeti national park.

The park's management has constructed man-made dams which ensure water availability for the wild animals especially during the dry seasons.

Borehole water was mainly used for domestic use and not for wildlife as the river is very far. Most of the water users boiled the water before use.

The park management was aware of river gauging stations, but was not aware of the plans to construct a dam, while the community was not involved in water allocation or even in wildlife conservation.

The main use of water especially within the park is wildlife, while outside the park it is used mainly for domestic purposes.

There are no water permits for the wild animals drinking needs.

Challenges with regard to water resource management

There were conflicts between the locals and wildlife especially during dry seasons, or during wildlife migration.

There have also been complains of people blocking the wildlife from accessing water points or blocking their migration corridor, which fuels human-wildlife conflicts.

There are cases of human-wildlife conflicts over water resources as predators go out of the park in search of water and food during droughts.

In addition, there are also cases of disease transmission between livestock and wildlife especially when livestock come into contact with wild animals.

No compensation for losses resulting from wildlife attacks by wildlife are given because TANAPA believes that "wildlife have no boundaries".

The waters of the Mara have generally reduced leading to loss of many wildebeests this year (2012) during the migration as they are not able to cross. Water quality issues of concern to TANAPA was the high salinity of the waters.

Mitigative measures / suggestions for further research

The park management holds conflict resolution meetings, while there are laws in place that protect both the wildlife and water resources.

The TANAPA ACT also restricts development within 60 meters of the river bank. The park management also keeps reports on wildlife protection.

Cross border meetings are also held to address issues such as poaching, trophy dealers etc and how to combat such vices. In addition, occasional joint patrols are also organized between Kenya and Tanzania to combat the menace.

The park management has recruited village game scouts who are paid approximately TZ shs. 25,000to help protect wild animals when need arises.

17. Minutes to a Meeting Held at the Lake Victoria Basin Water Office – Musoma, (Nelsap Offices) on the 24th of August 2012

The meeting established that there were water users associations and water resource groups in various villages within the Mara River basin, though most of them were not active.

Some of the water sources mentioned include: rivers, boreholes, springs and rain water harvesting. However, Mara River was the main water source. Mara North mines were identified as the users who consume the most amount of water (they use pumps to get water directly from the river).

Small scale miners were also cited as users of significant amount of water, while TANAPA also uses a good proportion of water for wildlife (though they also have boreholes and dams). It was established that Tarime does not get their water from the river but from springs which feed the Mara River. The same applies to Mugumu.

Some of the water users include: Miners, livestock, agriculture, irrigation (small scale), fishing (ponding) and domestic use. However the main water uses include domestic, mining and livestock in that order. It was established that in the Tanzanian side, large scale irrigation is just starting as non has been there previously. Some of the institutions involved in water issues include: WWF, Mara River Basin Project (NELSAP), LVMP and Lake Victoria Basin Water Office.

There are three river gauging stations namely: Kirumi gauging station, Mara Mine gauging station and Nyansarura gauging station

During low flows, community members are urged to use water efficiently while domestic use is given first priority, while in the park, wild animals are given first priority.

The water office gives permits after inspecting the user's establishment to ascertain the purpose and the quantity required.

Due to few irrigation systems along the Mara River on the Tanzanian side, the office did not see the need to have limitations on the amount of water that can be abstracted by a user.

Flooding incidences are reducing due to low water levels caused by deforestation at the sources, poor agricultural practices and poor livestock farming.

Water resource management issues

The water policy document (Sera ya Maji) containing water resource management issues was also available and was used in water resource management.

Water users normally visit the LVB water offices for permits (these are government offices).

The LVBW Office issues water permits to people and a water certificate is given to successful applicants by the ministry whose offices are based at Mwanza.

The previous water ACT of 1974 was revised and now it is the water ACT 2009.

Communities were involved in water resource management but to a small extent especially in the planting of trees in the watersheds and other such activities.

The associations' aim is to protect the water resources, they also ensure the wise use of water resources, solving small issues that arise with regard to water resources.

Challenges identified with regard to water resource management

There had been transboundary issues especially with regard to water quality and quantity issues which are normally solved by holding consultative meetings with the aggrieved parties.

Human-wildlife conflicts especially when the water levels are low were mentioned as being common within the Mara River basin. A total of nine water user associations within the Mara were cited, namely: Bukabwa water users association, Tigite water users association, Tobora water users association, Busawa water users association, Nyamatoke water users association, Kwisaro water users association, Kwibuse water users association and Nyanchabakenye water users association.

The water act of 2009 has some shortcomings as the citizens have not understood it well with some still believing that water resources are a gift from God, hence the can use it as they please and therefore do not see the need to preserve or conserve water.

It was reported that the water level of the Mara River had reduced drastically in recent times. For instance, the discharges over a 20 year interval show that Mara River used to discharge up to $120m^3$ per second in 1989, but currently (2012), the discharge rate is about 50 to $60m^3$ per second. (Data obtained from the river gauging station at Mara Mines).

Mara River dries completely at times, implying that the water levels are insufficient for all users especially during dry seasons, therefore making EFA station insufficient in determining water allocation.

Several boreholes were present around the basin and the water office usually conducted borehole assessment.

The most polluted section of the Mara River is at the North Mara Mines where chemical pollutants from the mines intermix with river water.

Future projections, challenges and suggestions for better water resource management

It is projected that the water demand within the Mara River basin will continue increasing due to increased population growth, expansion of urban centers, increased agricultural activities and planned industrialization (e.g. construction of an international airport at Serengeti) and setting up of large scale irrigation systems along the Mara River

There are proposals that the monitoring and collection of revenues should be done from the Mara water offices at Musoma, because it is the office at the grassroots.

Most water abstractors were not metered, and that whatever is abstracted is just estimated and the cost determined based on the number of people in a household, livestock etc.

The water rates are also calculated through a one time estimate. For instance, Tarime hospital was given a permit about 30 years ago and was paying Tshs. 5,000 per year, up to very recent when the water office decided to revise the rates to Tshs. 35,000 per year.

It was established that urban water suppliers have meters for raw water abstraction but they all pay a flat rate set by the Lake Victoria Basin water office. There were proposals that the water tariffs need to be raised so as to make the water office autonomous and independent.

The laws are clear but effective implementation of these laws was lacking. This was blamed on the lack of sufficient funds to implement the laws effectively.

There was generally lack of information on how much water should be left in the river to ensure survival of biodiversity.