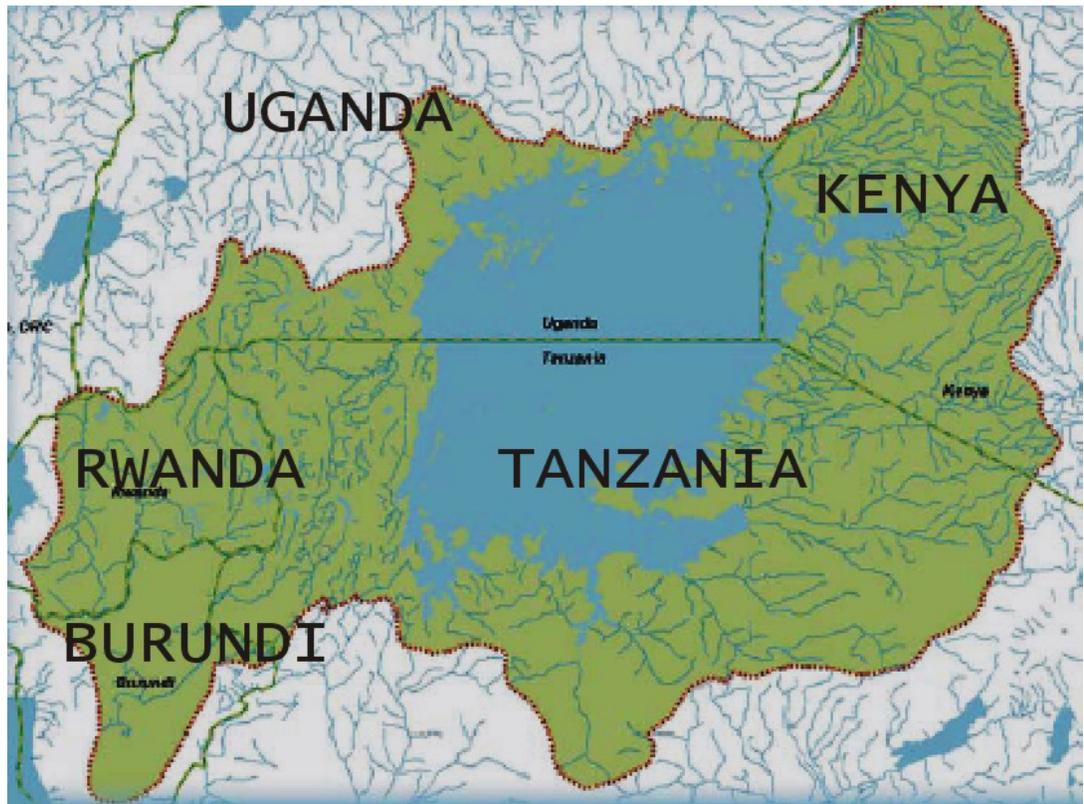


EAST AFRICAN COMMUNITY



LAKE VICTORIA BASIN COMMISSION



REGIONAL TRANSBOUNDARY DIAGNOSTIC ANALYSIS OF THE LAKE VICTORIA BASIN

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
MAJOR CONTRIBUTORS TO THE RTDA PROCESS	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	vii
LIST OF FIGURES	vii
ACRONYMS AND ABBREVIATIONS.....	viii
ACRONYMS AND ABBREVIATIONS.....	viii
EXECUTIVE SUMMARY	x
SECTION ONE: BACKGROUND	1
1.1 Introduction.....	1
1.2 Objectives.....	2
1.3 Methodological Tools Applied.....	2
1.3.1 <i>The Global International Waters Assessment methodology</i>	3
1.3.2 <i>Pair Wise Ranking methodology</i>	3
1.4 Preparation of the Regional Transboundary Diagnostic Analysis	3
1.4.1 <i>Identification of Major Perceived Problems and Issues</i>	4
1.4.2 <i>Prioritization of Major Perceived Problems and Mitigations</i>	4
1.4.3 <i>Causal-effect-chain analysis</i>	5
SECTION TWO: STATUS OF THE BASIN.....	6
2.1. Geographical Characteristics	6
2.1.1 <i>Basin Area</i>	6
2.1.2 <i>Climate</i>	7
2.1.3 <i>Geology, Land forms and Soils</i>	9
2.1.4 <i>Drainage patterns</i>	10
2.2 Social Profile	12
2.2.1 <i>Demography</i>	12
2.2.2 <i>Social Development and Living Conditions</i>	13
2.2.3 <i>Basin Water Supply and Sanitation</i>	16
2.2.4 <i>Health Status</i>	16
2.2.5 <i>Disaster Preparedness and Management</i>	17
2.3. The Basin Economy	18
2.3.1 <i>Overview</i>	18
2.3.2 <i>Productive Sectors</i>	18
2.3.2.1 <i>Water Resources</i>	18
2.3.2.2 <i>Fisheries</i>	18
2.3.2.3 <i>Agriculture and livestock</i>	19
2.3.2.4 <i>Wetlands</i>	20
2.3.2.5 <i>Forestry resources</i>	20
2.3.2.6 <i>Wildlife and Tourism</i>	21
2.3.2.7 <i>Mineral resources</i>	22
2.3.3 <i>Trade and Industry</i>	23
2.3.4 <i>Infrastructure</i>	23
2.3.4.1 <i>Energy</i>	23

2.3.4.2	<i>Communication</i>	24
2.4	Governance of Environmental Resources	25
2.4.1	<i>Policy Framework</i>	25
2.4.2	<i>Legal Framework</i>	25
2.4.3	<i>Institutional Framework</i>	26
SECTION THREE: TRANSBOUNDARY PROBLEMS AND ISSUES		27
3.1	Land Use and Land Degradation	28
3.1.1	<i>Population Pressure and Changing Land Use Patterns</i>	28
3.2	Water Quality and Pollution	29
3.2.1	<i>Water quality and pollution trends</i>	29
3.2.2	<i>Eutrophication in Lake Victoria</i>	30
3.2.3	<i>Trends in Nutrients</i>	32
3.2.4	<i>Persistent organic/inorganic pollutants</i>	32
3.3	Water Quantity and Water Balance	33
3.3.1	<i>Outflows</i>	33
3.3.2	<i>Water levels and Water Balance of Lake Victoria</i>	33
3.4	Water Hyacinth and other Invasive Aquatic Weeds	36
3.5	Biodiversity and Fisheries Decline	36
3.5.1	<i>Aquatic Biodiversity</i>	36
3.5.2	<i>Fisheries diversity</i>	37
3.5.3	<i>Phytoplankton</i>	37
3.5.4	<i>Zooplankton</i>	39
3.5.5	<i>Zoobenthos</i>	40
3.5.6	<i>Fish stocks of Lake Victoria</i>	41
3.5.7	<i>Fisheries of the upper riparian catchment</i>	41
3.6	Forest ecosystem changes	42
3.7	Wetlands	42
3.8	Socio-economic and cross-cutting issues	44
3.8.1	<i>Poverty</i>	44
3.8.2	<i>Health</i>	44
3.8.3	<i>Pests and diseases</i>	45
3.8.4	<i>Water supply and Sanitation</i>	46
3.8.5	<i>Urbanization and the associated infrastructure</i>	46
3.8.6	<i>Refugees</i>	47
3.8.7	<i>Conflict over resource access and use</i>	47
3.8.8	<i>Vulnerability</i>	47
3.9	Policy, Legal and Institutional Frameworks	47
3.9.1	<i>Policy, Formulation and Implementation</i>	48
3.9.2	<i>Compliance and enforcement</i>	48
3.9.3	<i>Institutional Frameworks</i>	49
3.10	Environmental and socioeconomic costs	49
3.10.1	<i>Land degradation</i>	49
3.10.2	<i>Water Pollution</i>	50
3.10.3	<i>Water imbalance</i>	50
3.10.4	<i>Fisheries decline</i>	50
3.10.5	<i>Water hyacinth</i>	51

3.10.6	<i>Wetlands degradation</i>	52
3.10.1	<i>Forestry</i>	53
SECTION FOUR: CAUSES OF MAJOR PERCEIVED PROBLEMS AND ISSUES		54
4.1	Interrelationships between MPPIs	54
4.2	Causal-Effect-Chain Analysis	57
SECTION FIVE: PROPOSED INTERVENTIONS AND TARGETS		68
5.1	Ecological Quality Objectives for the Basin (Conceptual Framework)	68
5.2	Interventions.....	68
SECTION SIX: RISKS AND SUSTAINABILITY		77
6.1	Risks	77
6.2	Sustainability	78
SECTION SEVEN: CONCLUSION AND RECOMMENDATIONS		79
7.1	Conclusions	79
7.2	Recommendations	79
REFERENCES		81
ANNEXES		85

LIST OF TABLES

Table 2.1: Lake Victoria surface area, catchment and shoreline statistics	6
Table 2.2: Drainage of Lake Victoria Basin	10
Table 2.3: Population of the Lake Victoria Basin (Source: Adopted from NTDA Reports 2005)	12
Table 2.4: Socioeconomic and Human Development Characteristics in the LVB countries	15
Table 3.1: Major Perceived Problems and Issues in the Lake Victoria Basin by country	27
Table 3.2: Relative Magnitude of Loading Sources to Lake Victoria	30
Table 3.3: Estimates of total N, P and Suspended Sediment loads	31
Table 3.4: River Nile outflow statistics (also expressed as % of total Basin outputs	33
Table 3.5: Summary of water balance of Lake Victoria	34
Table 3.6: Levels of cyanotoxins in selected Bays of Lake Victoria in March 2005	39
Table 3.7: Levels of microcystin from Gaba water works (Uganda)	39
Table 3.8: Value of Wetlands in Uganda	52
Table 4.1: Causal-Effect-Chain Analysis	57
Table 5.1: Ecological Quality Objectives for the Basin	70

LIST OF FIGURES

Figure 2.1: Map of Lake Victoria Basin	7
Figure 2.2: Seasonal wind patterns of the Lake Victoria Basin	8
Figure 2.4: Demographic Pattern in the Lake Victoria Basin	13
Figure 3.1: Ranking of Urban Point Sources of Pollution for Lake Victoria	31
Figure 3.2: (a) Distribution of point sources and TN (kg/day) Figure 3.2: (b) Distribution of TP (kg/day)	32
Figure 3.3: Long term series generated by the water balance model.	35
Figure 3.4: Comparison of water level and outflow of Lake Victoria (from 1950-2005)	35
Figure 3.5: Biomass of 4 main phytoplankton groups in littoral and pelagic waters of Lake Victoria	38
Figure 3.6: Relative biomass of major phytoplankton groups in Lake Victoria	38
Figure 3.7: Taxonomic composition of major benthic macroinvertebrates in Lake Victoria	40
Figure 4.1: Land use and land degradation linkages	54
Figure 4.2: Water quality and pollution linkages	55
Figure 4.3: Water quantity and balance linkages	55
Figure 4.4: Fisheries decline and biodiversity loss linkages	56
Figure 4.5: Socioeconomic and cross cutting issues linkages	56

ACRONYMS AND ABBREVIATIONS

ACTS	African Centre for Technology Studies
AIDS/HIV	Acquired Immune Deficiency Syndrome/ Human Immunodeficiency Virus
As	Arsenic
BIF	Burundi Franc
BRB	Bank of the Republic of Burundi
BMU	Beach Management Unit
BOD	Biological Oxygen Demand
CAS	Catch Assessment Survey
CBPP	Contagious Bovine Pleuro-pneumonia
CBO	Community-Based Organization
CITES	The Convention on International Trade in Endangered Species
CPUE	Catch per Unit Effort
DFID	Department for International Development
DGHER	General Directorate for Hydraulics and Rural Energies
EAC	East African Community
EDA	Environmental and Development Associates
EEC	European Economic Commission
EIA	Environment Impact Assessment
EQO	Environmental Quality Objective
EU	European Union
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographical Information System
GOB	Government of Burundi
GOK	Government of Kenya
GOR	Government of Rwanda
GOT	Government of Tanzania
GOU	Government of Uganda
GIWA	Global International Waters Assessment
HACCP	The Hazard Analysis Critical Control Point
IBA	Important Bird Area
ICR	Implementation Completion Report
IFMP	Integrated Fisheries Management Project
ILBM	Integrated Lake Basin Management
INECN	National Institute for the Environment and Conservation of Nature
ISTEEBU	Burundi Institute of Statistics and Economic Surveys
IW	International Waters
IWRM	Integrated Water Resources Management
KRB	Kagera River Basin
LBDA	Lake Basin Development Authority
LVB	Lake Victoria Basin
LVBC	Lake Victoria Basin Commission
LVEMP	Lake Victoria Environmental Management Project

LVFO	Lake Victoria Fisheries Organisation
MERECF	Mount Elgon Regional Ecosystem Conservation Programme
MINECOFIN	Ministry of Finance and Economic Planning (Rwanda)
MINITERE	Ministry of Lands, Environment, Forestry, Water and Mines (Rwanda).
MIS	Management Information System
MOU	Memorandum of Understanding
MPPIs	Major Perceived Problems and Issues
MW	Mega Watts
NEAP	National Environmental Action Plan
NBI	Nile Basin Initiative
NEPAD	The New Economic Partnership for African Development
NGO	Non-Governmental Organization
NR	Natural Resources
NTDA	National Trans-boundary Diagnostic Analysis
OSY	Optimum Sustainable Yields
PA	Protected Area
POPS	Persistent Organic Pollutants
PPM	Parts Per Million
PRA	Participatory Rural Appraisal
REGIDESO	Water and Electricity Production and Distribution Company
RSAP	Regional Strategic Action Programme
RTDA	Regional Trans-boundary Diagnostic Analysis
SADC	Southern Africa Development Community
SAP	Strategic Action Plan
SLM	Sustainable Land Management
SNPA	DB - Biological Diversity National Strategy and Action Plan
SPS	Sanitary and Phytosanitary Standards
TDA	Trans-boundary Diagnostic Analysis
ToR	Terms of Reference
TP	Total Phosphorous
TN	Total Nitrogen
UBOS	Uganda Bureau of Statistics
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
WB	World Bank
WHO	World Health Organization

EXECUTIVE SUMMARY

Introduction

The Regional Transboundary Diagnostic Analysis (RTDA) covers the Lake Victoria Basin in the Republics of Burundi, Kenya, Rwanda, Uganda and the United Republic of Tanzania. The analysis was conducted between June 2006 and March 2007 and was based on critical reviews of National Transboundary Diagnostic Analyses (NTDAs) carried out by the five East African Partner States between February and June 2006. In addition, the analysis was informed through various relevant works and documents, including literature and knowledge accumulated through the implementation of the 1st phase of the Lake Victoria Environmental Management Project (LVEMP I) and East African Community (EAC) policy and development documents, among others. To enhance ownership, consensus building and enrichment of the process, a series of consultative workshops were held across the region.

The review process built upon, and mostly relied, on the respective National TDAs which focused was on a clear understanding of the causal-effect-chain analysis of the transboundary Major Perceived Problems and Issues (MPPIs). At the national level, a domesticated Global International Waters Assessment (GIWA) and also Pair Wise Ranking methodological tools were applied to map out the MPPIs.

In conformity with RTDA process, this report presents a comprehensive scientific analysis of transboundary water-related issues and proposes mitigation measures in respect to the Lake Victoria Basin (LVB). The transboundary major problems and issues identification and subsequent formulation of mitigation measures were aimed at enhancing the Basin's ecosystem stability/health and environmental integrity. The RTDA, therefore, forms a foundation for the formulation of the second Phase of the Lake Victoria Environmental Management Project (LVEMP II) as well as the development of the Strategic Action Plan (SAP) for the Basin.

The RTDA presents a case for targeted investments in the Basin given that the area supports approximately 35 million people and has considerable social, economic, environmental and ecological values. Its potential is based on rich social capital, rich agricultural soils, abundant water resources, minerals, fisheries, wetlands, diverse forest resources, wildlife and tourism opportunities. The Basin's natural resources endowment forms the foundation of its socio-economy as well as the basis for the various threats and challenges being experienced. Increasing population without corresponding technological innovations and adoption and increasing reliance on natural resources has a series of manifestations. The key manifestations of the trends include widespread watershed degradation, increasing water pollution and declining lake levels, rising prevalence of water borne diseases, increasing conflicts over access and use of natural resources, declining fisheries, loss of aquatic and terrestrial biodiversity and, more frequent and severer droughts and floods.

Major Transboundary Problems and Issues

The transboundary water-related problems and issues that affect sustainable development in the lake Victoria Basin, as identified based on the three pillars – Economic, Social and Ecological, are presented and discussed under six thematic areas in this report. The thematic areas are: land use and land degradation; water quality and pollution; water quantity and water balance; fisheries decline and biodiversity; governance of environmental resources; and socioeconomic and cross cutting issues. The discussions focus on the major threats to the natural resource base, major causes, socioeconomic impacts and the proposed mitigation measures.

First, in the context of land use, this analysis identified land degradation as a widespread problem in the Basin. Land degradation is perceived to be a consequence of many complex and interrelated factors which include; increasing pressure on land resources particularly from rapidly increasing population, low technological innovations and adoption to match the demand on natural resources, inappropriate governance structures and mechanisms as well as constraint livelihood sources and levels. The high demand for land has led to unsustainable land use practices such as land fragmentation and cultivation on marginal and fragile areas including steep areas, river banks; watersheds and wetlands, among others. Stocking of livestock beyond the carrying capacities has also contributed to land degradation. The ultimate consequences of poor and inappropriate farming practices and patterns are; flash floods, severe soil erosion, siltation of water bodies and excessive nutrient enrichment of the Lake. Land degradation is a common problem throughout the Basin, but particularly acute in the Republics of Burundi, Rwanda, South Western Uganda, Nyando and Rachuonyo Districts in Kenya and Mwanza, Shinyanga and Mara regions in Tanzania.

Second, water quality and pollution is a major challenge in the Basin. Water is becoming increasingly eutrophic through nutrient inputs from atmospheric deposition, nutrient runoff from agricultural areas, urban and industrial effluents. Available data show that high Biological Oxygen Demand (BOD) levels, resulting from untreated waste waters and runoff is on the rise and thus causing oxygen depletion across much of the Lake which has become a common phenomenon. Application of fertilizer especially for tea, coffee, and sugar cane growing is significantly contributing to the increasing nutrient load in the lake. In addition, phosphorus concentrations have increased 4 - 8 times, whereas silica concentration in the open Lake has decreased by a factor of 3 - 8. The impact of all this has been deterioration in water quality, regular occurrence of algal blooms, increased costs of water treatment, frequent fish kills, poor fish catches, declining community livelihoods and increased poverty and malnutrition. The major causes of these problems hinges on poor land management which causes excessive nutrient runoff, poor sanitation due to inadequate solid and liquid waste handling capacity by urban centres and the slash and burn practice which release much of the airborne phosphorus. The problem is more pronounced in all cities and urban centers in the Basin.

Third, the issues of water quantity and water balance are of great importance in the region where the main concern is the receding water levels of Lake Victoria. The level of Lake Victoria has fallen below the long-term mean of 1,134 metres above mean sea level. Prolonged droughts, the destruction of the catchment, together with excessive releases of water at Jinja have contributed to this problem. The key consequences of the receding lake levels include; reduced water intake, increased number of sunk investment (in respect to jetties, piers, water intake points and fish landing infrastructure), interference and destruction of fish breeding and nursery habitats, and reduced hydro-power generation. Shipping companies have suffered huge financial losses due to increased maintenance costs, reduction in cargo to ensure safe anchoring and relocation of jetties and piers.

Fourth, it is evident that the fisheries sub-sector which, is one of the mainstays of the rural and urban populations in the Basin, is under threat. There is a decline in fish catches from Lake Victoria as well as in the other lakes within the catchment. The immediate causes of declining fish diversity and catch per effort include; over fishing through excessive fishing effort and use of destructive fishing gears, destruction of fish breeding and nursery habitats, introduction of alien fish species (notably the Nile perch), water pollution and rapid increase in demand for fish. The consequences of this have been poor fish yields, loss of unemployment opportunities and livelihoods, malnutrition, increase in national as well as regional and community conflicts. In respect to fisheries resources decline (an indication of biodiversity loss in the Basin), the most important concern is the evident loss in fish species diversity over the last 50 years. Within this period, an estimated

over 200 fish species have disappeared from the original 400-500 species known in Lake Victoria. In Lake Rweru in the upper catchment of Rwanda and Burundi, for example, the entire fishery industry collapsed due to predation by *Clarias gariepinus*. However, some species thought to be extinct are now re-appearing, giving hope that the rich biodiversity may be recovering. A major shift has also been observed in the phytoplankton community where there is now a dominance of the blue green algae (*Cyanophyta*) replacing the diatoms (*Bacillariophyta*). This may be due to absence of a prolific blue green feeder.

Fifth, it is noted that water hyacinth and other invasive weeds, which occupied about 90% of the littoral zone of Lake Victoria in 1990s, has been brought under control through the application of various approaches including mechanical, manual and biological control methods. However, the weed continues to flow into the Lake from river systems, especially River Kagera. There is, however, evidence of water hyacinth resurgence particularly around Mwanza, Winam Gulf, Nyakach Delta and Jinja. Other invasive weeds of potential nuisance in the Basin include *Azolla*, *Striga*, duckweed, *Lantana camara*, *Solanum nigrum*, African marigold and Mexican marigold. If unchecked, the proliferation of these weeds will impact negatively on the communities' livelihood systems.

Also, large areas of wetlands fringe the shoreline of Lake Victoria and along river courses in all the riparian countries. They are important habitats for biodiversity and play a major role in the socio-economy of the riparian communities through the provision of food, fish, raw materials for construction and crafts, source of medicinal plants and, more importantly, their capacity to capture and filter pollutants that could impact adversely on fisheries and water quality in the lake. Across the Basin, wetlands are threatened through excessive harvesting, draining and conversion to agricultural use, construction of buildings and roads as well as dumping sites for both solid and chemical wastes. The destruction of wetlands has worsened following the receding Lake water levels, accelerating the temptation and impetus for their conversion for agriculture as seen at, for example, the Nakivubo channel, Yala and Mara river wetlands.

The Basin is endowed with a variety of wildlife and sceneries of tourist value. Such sites and sceneries include national parks, wildlife reserves, lakeshore beaches, wetlands, forests and unique physical features, with huge potential for tourism. The Basin has some of the best wildlife sanctuaries in the world, notably, the famous Maasai Mara and Serengeti National Parks, which are globally recognized as world heritage sites. The Basin is also designated as an Important Bird Area (IBA) with about 70 IBAs.

Due to population pressure and hence increasing demand for agricultural land, the Basin has experienced accelerated watersheds conversions. Major water towers in the Basin, and particularly, the Mau forest have for several years now been degazetted to pave way for agricultural and other development needs. As a direct consequence of forest degradation, the Basin continues to experience flash floods and reduced baseflows which are common benefits associated with forest cover. Similarly, reduced lake inflows are linked directly to catchment destruction.

The Basin is endowed with varying levels of infrastructure spanning from roads, air transport, railway system, inland water transport to non-motorized transport. In respect to roads communication system, many of the feeder roads are impassable during the rainy seasons, causing serious disruption and delays in the movement of people and goods and thus imposing huge costs on providers of transport services. Water transport in the Lake is inadequate and is, largely, underdeveloped. Similarly, air transport and railways network are not developed or not used optimally. There are, however, some on-going reforms on revamping the railway system as well as the improvement of safety of navigation. The Basin for a long time has been

poorly served with fixed telecommunication facilities, but the situation is being alleviated by the introduction of mobile telephones. The mobile industry has made inroads into most of the urban and rural parts of the Basin.

Energy, mining, trade and industry are important sectors in the Basin. Wood biomass supplies over 90% of the energy requirement in the Basin. Despite the huge potential of expanding hydro-power generation and solar energy, investments in these areas are still low. The situation could be improved through greater access to electricity and by investing in the undeveloped (potential) energy sources such as solar, geothermal, water currents, wave and wind energy. The Basin is endowed with mineral resources such as gold, diamond, nickel, copper and oil which are exploited at commercial scale. These significantly contribute to the economy of the Basin, although, to some extent, mining has negative impacts on the environment. Industrial activities in the Basin are dominated by agro-processing and food industries for fish, coffee, cotton, rice, maize, millet, tobacco, sugar cane, dairies, oil mills and breweries. The other industrial activities relate to the production of consumer goods, chemicals, textile, wood, pulp and paper, building materials and hydropower generation.

Socioeconomic and cross cutting issues, covering poverty, human and animal health, sanitation, population pressure, migrations, refugee situation, disaster preparedness, conflicts in resource use and civil strife are recognized as major problems impacting on most of the other sectors of the Basin. Several factors in the Basin favour high occurrence of water and vector-borne diseases, communicable and others diseases. The most prevalent human diseases include malaria and HIV/AIDS. The warm and humid climate also encourages high prevalence of animal and crop diseases and pests.

Finally, the Basin is increasingly facing conflicts largely as a result of institutional failure, population pressure and market failure. The root causes of conflicts are poverty, limited resources, environmental degradation, poor governance, poor and inappropriate policies, conflicting institutional interests, increase in livestock numbers, low literacy levels, political instability, and complex land tenure systems whose validity is gradually eroding particularly in the face of growing monetized economies. The conflicts are characterised by competition for fresh waters, productive land, fishing grounds, minerals, wetland resources, wild life resources, forest resources and pastures.

Causes of Major Transboundary Problems

The RTDA has identified Major Perceived Problems and Issues (MPPIs) in the Basin, analyzed their root and immediate causes, their causal-effect-chain relationships and proposed a series of mitigation measures. The problems and issues identified under different thematic areas include; improper land use and land degradation; water quality deterioration; declining fisheries and loss of biodiversity; wetlands degradation; water hyacinth infestation; watershed destruction; insufficient energy for industrial and domestic use; inadequacies in policy, laws and institutions; and increasing conflicts over resource access and use; increasing prevalence of diseases and pests; and population pressure. These are key issues spanning across the East African Partner States.

The report identifies common root causes of MPPIs as including the following: inadequate integrated national and regional development planning; weak community participation in the Basin's development process and inadequate awareness on the need to engage in sustainable development; weak law enforcement, compliance and governance; high population levels with constrained livelihood opportunities; inadequate technology to harness available existing natural resources opportunities; weak financial resources management mechanisms; and inadequate market information and access. Other immediate causes include; inadequate implementation of funded projects and investment options; unpredictable political will; inadequate

social capital in certain strategic areas; inadequate financial resources; lack of private-public sector partnership policy and legal framework; erosion of traditional norms and systems for natural resources management; and insufficient applied research. The root sources of the aforementioned problems thus include; institutional and policy failures in regard to ecosystems and natural resources management, market failure, and population pressure with the overall impact being lowering of quality of life of human and deteriorating ecosystem health and stability

Mitigation Measures

To address the major transboundary problems and issues, a cluster of five intervention areas are proposed. These are: natural resources, ecosystems and environmental management, improvement of living conditions and quality of life; population and demography; realization and improvement of the production and income generation potential of the Basin; and improvement of governance, institutions and policies on environmental resources management. For each of the five clusters, specific interventions were identified ranging from investment in re-forestation and afforestation programmes; strengthening of policies, legal frameworks and institutions; improvement of infrastructure; to strengthening of public health sector among others.

The Basin is of immense value in providing ecological and socioeconomic goods and services to the riparian communities. However, the Basin faces many challenges that need to be addressed to pave way for the exploitation of its potentials. This forms the focus of this report which gives a comprehensive analysis of the existing situation. The report points out key transboundary issues, causes and mitigations. It informed the SAP and LVEMP II project preparation processes. The document provides requisite knowledge that contributes towards achieving a regionally shared vision for Lake Victoria Basin of “*a prosperous population, living in a healthy and sustainably managed environment providing equitable opportunities and benefits*”.

SECTION ONE: BACKGROUND

This section gives a background to the RTDA study by introducing the objectives and the institutional setting. It discusses the methods used for carrying out the RTDA, including a review of the methodological framework and its application in this particular study.

1.1 Introduction

The Lake Victoria Basin faces complex environmental, socioeconomic, geo-political, and technological innovations challenges that need to be addressed in order to achieve sustainable development. In response to these challenges, various interventions have been initiated by the riparian countries, with the support of development partners through bilateral and multilateral arrangements. The first phase of the Lake Victoria Environmental Management Project (LVEMP-I) was one of such interventions whose objectives were to; maximize sustainable benefits to riparian communities by using resources within the Basin; conserve biodiversity and genetic resources for the benefit of the riparian communities; and to harmonise national management programmes in order to reverse environmental degradation trends in the region. The project was implemented by then three East African Partner States. Some of the key achievements realized through LVEMP I included accumulation of data, information and knowledge on various aspects of the Basin management as well as capacity enhancement.

In order to consolidate the gains achieved through the implementation of LVEMP I, up scale the best practices and apply some of the useful lessons learnt, it became necessary to formulate the second phase of LVEMP. The implementation of LVEMP II will significantly contribute towards the realization of the Basin's Vision. It is expected that LVEMP II will promote sustainable management of transboundary natural resources and enhance conservation of biodiversity in the Lake Victoria Basin (LVB) through the following:

- Improvement of management regimes of trans-boundary LVB resources,
- Protection of targeted sensitive ecosystem in LVB,
- Reduction of water pollution of the LV, and,
- Enhancement of public participation, education and communication.

While LVEMP I was implemented by the Republics of Kenya, Uganda and Tanzania, LVEMP II will be implemented not only by these three countries but also the Republics of Burundi and Rwanda.

The Lake Victoria Basin Commission (LVBC) commissioned a Regional TDA (RTDA) study with a view to draw from the findings of the NTDA of the riparian countries. This was on the premise that all the participating countries had carried out NTDA to identify from national perspective major problems and issues that would have transboundary impacts either within or between different countries. In the context of the RTDA, regional transboundary issues were those with transboundary causes, sources and or impacts originating from one or more countries and directly or indirectly affecting two or more riparian countries.

The preparation of RTDA for the Basin involved the assessment of the impacts (both environmental and socioeconomic) of transboundary issues, and the identification of non-environmental factors such as institutional, legal and policy issues. The RTDA was intended to assist the riparian countries to identify the priority trans-boundary concerns from a geographic and spatial perspective along with their root causes. The

The RTDA would then provide a basis for ranking and prioritizing trans-boundary environmental concerns to be addressed in LVEMP-II. Further, the RTDA was intended to enhance exchange of information between and/or among riparian countries and to provide a foundation for developing joint approaches to addressing common environmental problems. In addition, RTDA would create a benchmark for monitoring the health of the Basin ecosystem. On this basis, the RTDA is intended to provide the technical basis for the preparation of the Strategic Action Plan (SAP) for the Basin.

1.2 Objectives

The overall objective of the RTDA was to enhance the responsiveness of the proposed interventions to real transboundary problems and issues affecting the Basin. The specific objectives of the analysis were to:

- (a) Enhance the understanding on the causal-effect-chain of the various transboundary problems and issues,
- (b) Inform the preparation of the Strategic Action Plan for the Basin and LVEMP II and,
- (c) Facilitate priority setting on the problems, issues and interventions

To achieve the aforementioned objectives, the key activities undertaken as part of this study included; analysis, categorization and synthesis of various environmental issues; provision of information relating to the degradation and changing state of the whole Basin environment in terms of the natural resource base and socioeconomic parameters; identification of the root causes of the environmental and socioeconomic concerns; scaling of the relative importance of the causes and sources of the trans-boundary problems; and identification of the cause-effect-chain underlying the identified problems; and list of mitigation measures to address the identified issues.

1.3 Methodological Tools Applied

On the basis of Global Environment Facility's (GEF) established principles of formulating TDAs, relevant scientific and technical assessments were needed with a view to:

- (i) Identify, quantify, and set priorities for environmental concerns that are transboundary in nature; and,
- (ii) Identify their immediate, intermediate and fundamental causes. This entails specifying causes, practices, sources, locations and anthropogenic activities triggering environmental degradation and threats.

The RTDA methods relied on the primary application of the key methods applied during the formulation of the NTDA. In this context, it is worthwhile indicating the various methods applied at the national level. It is however, recommended that a sound TDA ought to be based on detailed information collected on the consequences of each of the transboundary issues; comprehensive description of key issues using available data on changes over time; examination of the impacts of the identified problems and issues from an environmental perspective; and examination of the social and economic impacts. The preparation of the NTDA, therefore, took into cognisance the aforementioned principles. Consequently, at the national level, two key tools namely, *the Global International Waters Assessment* and *Pair Wise Ranking* were applied in the analysis of the major transboundary problems, issues and interventions.

1.3.1 *The Global International Waters Assessment methodology*

The Global International Waters Assessment (GIWA) is one of a number of methodologies applied in conducting TDA/SAP and it aims at generating comprehensive and integrated strategic assessment of various environmental problems. The method was modified to suit the Basins characteristics by taking into consideration the ecological status and causes of environmental issues in transboundary fresh water-related in the Basin and their associated aquatic systems. This approach was used to identify priorities for remedial and mitigatory actions. It was undertaken from the perspective of water quality and quantity; associated biodiversity and habitats; human activities affecting the Basin; the societal causes of the regionally identified issues; and scenarios of future conditions based on projections of demographic, economic and social changes associated with the process of human development.

The GIWA methodology was used due to its inherent strengths and appropriateness for the Lake Victoria Basin. Such strengths include;

- (i). It is holistic in nature and hence allows regional aspects in its in execution;
- (ii). Facilitates assessment of transboundary issues within natural boundaries defined by catchments and their associated aquatic systems;
- (iii). Enhances the examination of problems and issues from the perspectives of the integrity of biological diversity and habitats as well as their use by society;
- (iv). Allows examination of the causes of the perceived problems within society; and,
- (v). Enhances evaluation of likely future perspectives for international water issues based upon various human development scenarios.

1.3.2 *Pair Wise Ranking methodology*

Pair Wise Ranking was applied to prioritize various transboundary problems, issues and mitigation measures. The approach is easily applied, particularly, at the local level since it enables respondents to easily conceptualize issues and problems being compared. This methodology has been widely used as a ranking tool in various studies (Oakley, 1991; FAO, 1995; FAO, 1996; Roca *et al.*, 1999; Lal, 1999) as well as in several GEF/UNEP TDA studies on several international waters including lakes, rivers and oceans. In the East African region, the method has been used in the prioritization of the Lake George issues (DFID, 2001) and is extensively used in Participatory Rural Appraisals (PRAs). This method, therefore, is participatory and quantitative in nature and is commonly employed as a first step to prioritizing of environmental issues to reduce their number to a manageable level.

1.4 **Preparation of the Regional Transboundary Diagnostic Analysis**

To address the Terms of Reference in respect to the RTDA, four principal tasks were implemented. The first step involved a review and collation of information from national TDAs and other information sources including; LVEMP I, East African Community (EAC), national governments (such as policy and legislation documents, sectoral policy documents, environmental and resource status reports). Second, an analysis of data and information was carried out to identify MPPIs and develop causal-effect-chains for the priority transboundary issues using a modification of GIWA methodology. Third, stakeholder consultations were undertaken mainly at the national levels during the national TDA processes as well as at the regional level. Finally, a series of workshops were conducted where an attempt was made to rank MPPIs and prioritise the

actions. Furthermore, the workshops also provided an opportunity for stakeholders to provide input on various draft reports and also to enhance participation and promote ownership.

1.4.1 Identification of Major Perceived Problems and Issues

The NTDA had already highlighted the main national MPPs, but it was important to revisit them, agree on whether or not the list was comprehensive, examine their transboundary relevance, determine preliminary priorities and examine the geographical and temporal scope of the identified issues, with focus on the regional scope. During the preparatory phase of the RTDA six major concerns or thematic areas were identified relating to the degradation of Lake Victoria waters and their associated ecosystems. The thematic issues were;

- (i) Land use and degradation;
- (ii) Water quality and pollution;
- (iii) Water quantity, hydrology and water balance;
- (iv) Biodiversity and fisheries decline,
- (v) Socioeconomic and cross cutting issues; and,
- (vi) Policy, legislation and institutional issues.

The NTDA had identified a total of 21 key issues within the aforementioned six thematic areas. In order to determine the geographical scale of the system to be examined and to assess the importance of each of the issues within the system in terms of their environmental and socioeconomic impacts, a scaling and scoping approach was developed. This involved the use of a simplified prioritisation exercise based on Pair Wise Ranking methodology, in order to determine the severity of the environmental and socioeconomic impacts of the 21 issues and also to determine the relevance and transboundary nature of each issue.

1.4.2 Prioritization of Major Perceived Problems and Mitigations

The MPPs were evaluated and prioritized based on the following six aspects;

- (i) The level of threat to the resource base;
- (ii) The level of “livelihood” threat;
- (iii) Geographical distribution of the threat (i.e. regional spread of the problem);
- (iv) Consequences of maintaining the status quo;
- (v) Source - Point or non-point (point sources being easier, cheaper and quicker to mitigate compared to non-point source problems); and,
- (vi) Cost-effectiveness and feasibility.

Mitigation measures were proposed to address each MPPs and were evaluated and prioritized based on the following six aspects;

- (i) Affordability and relative costs of the mitigation;
- (ii) Sustainability of the mitigation if implemented;
- (iii) Availability of appropriate technology to address the problem;

- (iv) Experience in the region or in other parts of the world of the practicability and degree of ease in the implementation of the mitigation;
- (v) Availability of human resources to implement the mitigation; and,
- (vi) Geographical spread of the problem and hence the spread of the mitigation.

The above criteria made it possible to segregate the mitigations in order of either high, medium or low priority mitigations. To guide future investment decisions for LVEMP II, the mitigation measures proposed have been linked to one or more of the three pillars of Applied Research, Management Systems and Socioeconomic Development. Further analysis and segregation of the mitigations enabled their categorization into one or more of the GEF priority themes, such as; Biodiversity, International Waters and Sustainable Land Management.

1.4.3 Causal-effect-chain analysis

For this RTDA the causal chain methodology examined the causes of individual MPPIs within the regional context under the six identified thematic areas. Having selected the priority issue to be addressed by the chain, examination of the immediate causes of the issue was carried out. The methodology then explored the social and economic reasons for the key resource uses and practices. This tertiary stage in the chain also included a simple analysis of existing measures taken to limit the cause. It explored factors related to governance, legislation and stakeholder involvement and provided important information for examining future options for intervention.

The final step in the methodology was an analysis of underlying or root causes. Existing and/or emerging transboundary environmental issues could be attributed to a range of socioeconomic and legal root causes. The Socioeconomic root causes themselves represented social and economic issues whereas the Legal root causes were associated with policy, legal and governance issues. Economic, political, legal and governance issues constituted a suite that in itself was a cause of social issues and underlying sectoral causes.

SECTION TWO: STATUS OF THE BASIN

This section describes the status of Lake Victoria Basin at the time of the study, focusing on the geographical characteristics, social status, the Basin economy and governance of environmental resources.

2.1. Geographical Characteristics

The geographical characteristics of Lake Victoria Basin in this context cover the location and area of the Basin, climate, geology, land forms, soils and the drainage pattern. These characteristics of the Basin form the basis of the potentials and the extent of vulnerability of the area.

2.1.1 Basin Area

The Lake Victoria Basin is one of Africa's largest transboundary water resources covering an area of about 194,200 km², and surrounding the second largest freshwater Lake in the world (68,800 km²), with the largest freshwater fishery resources. Other Africa's large transboundary water resources are among others the Lake Tanganyika with surface area of 32,000 km² and Lake Malawi/Nyasa with a surface area of 29,500 km². The Lake Victoria catchment is shared among five states in the following proportions; Tanzania 44% (85,448 km²), Kenya 22% (42,724 km²), Uganda 16% (31,072 km²), Rwanda 11% (21,362 km²) and Burundi 7% (13,594 km²). The Lake is shared among three of the five Partner States of East Africa, i.e., **Kenya, Uganda** and **Tanzania**, with a shoreline of approximately 3,450 km long, demarcated among the riparian countries as depicted in Table 2.1. A map of the Basin indicating some towns and drainage pattern is shown in Figure 2.1.

Table 2.1: Lake Victoria surface area, catchment and shoreline statistics

Country	Lake surface area		Catchment area		Lake shoreline length	
	Km ²	%	Km ²	%	Km	%
Kenya	4,128	6	42,724	22	550	16
Uganda	29,584	43	31,072	16	1,750	51
Tanzania	35,088	51	85,448	44	1,150	33
Burundi	0	0	13,594	07	0	0
Rwanda	0	0	21,362	11	0	0
Total	68,800	100	194,200	100	3,450	100

Source: NTDA's Reports (2005), LVEMP I (1996 - 2005)

Figure 2.1: Map of Lake Victoria Basin



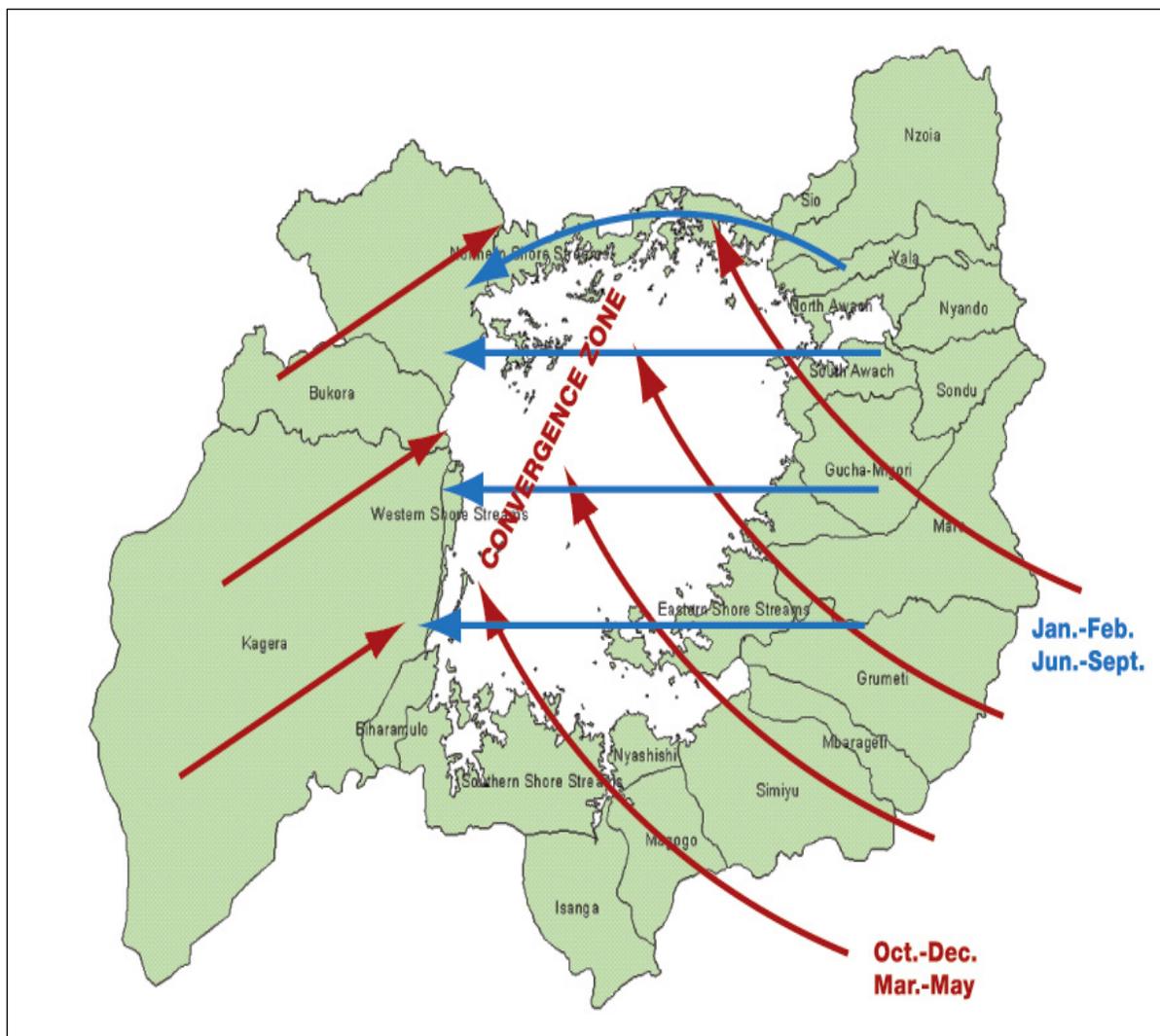
2.1.2 Climate

Lake Victoria Basin falls under the equatorial hot and humid climate with a bi-annual rainfall pattern, where the long rains are experienced from March to May and short rains from October to December. July is the coolest month of the year and the warmest month is variable and fluctuates in the period from October to February. Rainfall varies considerably from one part of the Basin to another. The highest rainfall in Uganda is received in the Ssese Islands and is about 2,400 mm annually, while Tanzania and Kenya receive between 1,350 mm - 2,447 mm annually. On the other hand, Burundi and Rwanda get an average rainfall of 1800 mm annually.

On the Northern and Western shores, the effects of rainfall do not extend more than 40 km inland. Rainfall amount increases from east to west, ranging between 600 to 2,800 mm annually. The temperature in the Basin countries reaches maximum in February, just before the March equinox and reaches its lowest records in July after the June equinox maximum and range from 28.6° C – 28.7° C. The minimum temperature varies from 14.7° C to 18.2° C. Comparison of temperatures records for the period 1950-2000 to 2001-2005 show that maximum temperatures have increased by an average of 1° C.

The hydraulic process of the Basin is influenced by seasonal winds as depicted in Figure 2.2. In the months of January-February and June-September, the wind pattern is predominantly East-West, parallel to the equator, with origins from the western parts of Kenya and Tanzania. These, fairly dry winds pick moisture while crossing the lake subsequently depositing it to the Western catchments especially Bukora catchment, Uganda. During March-May and October-December, the wind pattern changes towards the northern parts of the Lake.

Figure 2.2: Seasonal wind patterns of the Lake Victoria Basin



Source: LVEMP, 20002. (adapted from the Integrated Water Quality and Limnology Study of Lake Victoria 2002)

2.1.3 Geology, Land forms and Soils

Lake Victoria straddles the equator, perched high on the African craton in tectonic sag between the two Rift Valleys of East Africa. The lake is relatively young, formed through tectonic forces over 400,000 years ago (Yisong *et al.* 2004; Johnson *et al.* 2000). Most of the lake is surrounded by Precambrian bedrock, with the exception of the Kavirondo Gulf in the northeastern corner. Tertiary and recent alkali volcanic and sedimentary units dominate the terrain. Three major desiccation events are recorded in the seismic records that may reflect the 100,000-year Milankovitch cycle. The lake has suffered periods of complete desiccation and sometimes pluvial flooding escapades. The most recent arid period resulted in complete desiccation of the pre-existing lake.

In Burundi and Rwanda, rocks that dominate in the Akagera Basin (Schists, phyllites, quartzites, granites and gneiss) are, in particular, impermeable to water. Moreover, owing to the fact that relief is generally broken, the run-off of rain water is very important. However the meta sediments that form the substratum of the mountains and the plates allows infiltration, between the successive layers of polytic and arenaceous rocks and in the many cracks which the tectonic movements left in the earth crust. It is probably that this it possible for sources to continue running in the bottom of valleys, even after three to four months of the dry season.

The mountain forests and the prairies which cover the Congo-Nile Crest and its slopes contribute much to this infiltration, by slowing down the run-off. If vegetation covers disappears completely it will not only strip the land surfaces through erosion but also the constitution of ground water reserves and regulation of the rivers downstream.

In Bugesera the deep tablecloths cannot be constituted, infiltration is more difficult in the granitic substratum also attributed by the low rainfall in the area. The nature of lands drained upstream mark the physico-chemistry of water as majority of the rocks referred to earlier, are rich in silicates, aluminium and iron, elements far from being soluble in water and low in alkaline ions and alkaline earth water drainage is little and have rather acid reaction.

The river drainage patterns and exposed lacustrine sediments to the west of Lake Victoria reveal the lake's origin: a result of uplift along the western branch of the East African Rift Valley in late Pleistocene time, and back ponding of rivers that previously had drained westward.

The Basin is characterized by different types of soils suitable for a variety of crops. Ferrosols are dominant within the lower parts of the Basin which are characterized by strong acidity and low in base saturation. Vertisols, which are also common, are dark-coloured-clays that expand and contract markedly with changes in moisture content and develop deep drying cracks. There is intensive cultivation in these soils. Acrisols, characterized by an argilic B horizon, containing illuvial clay and clay skin. Nitosols and cambisols are also common in the lower parts of the Basin.

2.1.4 Drainage patterns

The drainage pattern of Lake Victoria Basin consists of rivers, streams and wetlands. The Kagera River is the largest inflow, contributing up to 33% of the surface inflow into the lake. It originates from Rwanda and Burundi (as River Akagera) and from parts of south western Uganda passing through Tanzania.. The other major rivers are Bukora and Katonga which originate in Uganda; the Nzoia, Sio, Mara, Yala, Awach, Gucha, Migori and Sondu which originate from Kenya while the, Mori, Simiyu, Grumeti, Mbalageti, Magogo-Moame, and other small streams originating from Tanzania (Table 2.2).

The Rwanda Basin Sub-catchment covering about 21,362 Km² accounts for 11% of the Basin, and Kagera River drainage system accounts for 90% of the drainage system in Rwanda thereby making her a very critical component of the Basin. Similarly, the Burundi Basin Sub-catchment measuring about 13,594 Km² accounts for 48.6% of its national surface area and corresponds to the southern most portion of the Akagera Basin. The sub-catchment is mainly sub-divided into two sub-Basins (Sinarinzi, 1999) which are:

- (i) Ruvubu River Sub-Basin (10,450 sq. Km i.e. 77.3%) corresponds to what is called the “Central Plateau”
- (ii) The Akanyaru and higher Akagera Sub-Basin (3,065 sq km i.e. 22.7%) corresponds to the “Depression of Bugesera” or “Northern Depression”

The annual average contributions of the two affluent of Akagera flows are 108 m³/s on Nyabarongo-Kazenze and 121 m³/s on Ruvubu-Mumwendo. The annual average flow of Akagera-Rusumo after receiving water from Ruvubu is 222 m³/s.

Table 2.2: Drainage of Lake Victoria Basin

Country	River Basin	Flow in Cumecs*	%	Flow in Cumecs**	%	Flow in Cumecs***	%
Kenya	Sio	11.4	1.4	9.8	1.4	11.3	1.4
	Nzoia	116.7	14.5	107.4	15.7	116.1	14.6
	Yala	37.7	4.7	47.9	7.0	38.4	4.8
	Nyando	18.5	2.3	41.9	6.1	20.3	2.6
	North Awach	3.8	0.5	3.3	0.5	3.7	0.5
	South Awach	5.9	0.7	5.5	0.8	5.9	0.7
	Sondu	42.2	5.2	43.9	6.4	42.4	5.3
	Gucha-Migori	58.0	7.2	39.9	5.8	56.6	7.1
Tanzania	Grumeti	11.5	1.4	4.6	0.7	11.0	1.4
	Mbalageti	4.3	0.5	3.5	0.5	4.2	0.5
	Eastern Shore Streams	18.6	2.3	11.3	1.6	18.1	2.3
	Simiyu	39.0	4.8	12.2	1.8	37.0	4.6
	Magogo-Maome	8.4	1.0	1.6	0.2	7.8	1.0
	Nyashishi	1.6	0.2	0.3	0.0	1.5	0.2
	Issanga	31.0	3.9	4.3	0.6	29.0	3.6
	Southern Shore Streams	25.7	3.2	3.5	0.5	24.1	3.0
	Biharamulo	17.8	2.2	18.3	2.7	17.9	2.2

Country	River Basin	Flow in Cumecs*	%	Flow in Cumecs**	%	Flow in Cumecs***	%
	Western Shore Streams	20.7	2.6	18.9	2.7	20.6	2.6
Uganda	Bukora	3.1	0.4	2.0	0.3	3.0	0.4
	Katonga	5.1	0.6	2.1	0.3	4.9	0.6
	Nothern Shore Streams	25.6	3.2	28.2	4.1	25.8	3.2
Shared rivers	Kagera	261.1	32.4	252.5	36.8	260.5	32.7
	Mara	37.5	4.7	23.1	3.4	36.5	4.6
	Total	805.3	100	686.2	100	796.6	100

*Data for 1950-2000; ** Data for 2001-2004; *** Data for 1950-2004

Source: Integrated Water Quality and Limnology Study of Lake Victoria LVEMP, 2005.

2.1.5. Wetlands

All the five countries have significant wetland coverage. In Kenya, key wetlands include the Yala Swamp (17,500 ha) and it includes Lake Kanyaboli (1,050 ha), Lake Sare (500 ha), Lake Namboyo (1 ha), the Nyando Swamp (15 by 6 km); the Sondu- Miriu wetland (10,000 ha); the Saiwa Swamp (20 km long) and the Kimandi River wetland (4,800 ha).

The Republic of Tanzania accounts for the largest area of wetlands in the Basin with a total of 422,000 hectares of wetlands occurring in 28 distinct sub-Basins. The major wetlands include Mara, Rubana, Simiyu, Magogo, and Kagera among others. It is estimated that 57,000 hectares of the total wetland area is classified as permanent swamp or (14%) while 73% and 8% of the wetland area is classified as seasonal swamp and tree swamps respectively.

Wetlands in Uganda cover 13% of total surface area and have been categorised as swamp (8,392 sq. km), swamp forest (365 sq. km) and zones with impeded drainage (20,392 sq. km). They include Nabugabo Wetland, Mabamba, Sango Bay and Lutembe. They form areas of seasonally flooded grasslands and swamp forest (such as Sango Bay), permanently flooded papyrus, grass swamp and upland bog. Most wetlands in the country fall into two broad categories, namely those associated with lakes (lacustrine) and those that lie along rivers. These include wetlands that border the bays of Berkeley at the Kenya/Uganda border, Macdonald, Hannington and Napoleon Gulf; as well as the bays of Murchison, Waiya and Bunjako. The islands of Kalangala also have extensive fringes of wetlands. Lacustrine wetlands are often permanently flooded.

In Rwanda, wetlands fringe most of the river systems and lakes found in the Basin. The entire aquatic system within the Basin in the country is a wetland because the system is comprised by riverine swamps and shallow lakes mostly less than four meters deep. Wetlands in Rwanda are categorized into upland and floodplain types.

Upland wetlands occur mostly in the mountainous western and northern zones of the country perched in the valleys along tributaries of Rivers Nyabarongo, Akanyaru and the Maziba. The floodplain wetlands stretch several kilometers straddling the border between Rwanda and Burundi where it is marked by River Akanyaru and River Akagera. Extensive floodplains of rivers Nyabarongo and Akanyaru in southern Rwanda and River Akagera are found along the country's eastern border with Tanzania.

2.2 Social Profile

2.2.1 Demography

The Lake Victoria Basin has a population of about 35 million people and a very high population density, which is more pronounced in the upper riparian countries. The lake Victoria Basin population is about 30% of the total inhabitants of the five riparian countries and is expected to rise to about 42 million by the year 2010. The population distribution within the five riparian countries is shown in **Table 2.3** and the demographic Pattern in the Lake Victoria Region is shown in **Figure 2.4**. The area around the Basin is the most densely populated rural area in the region.

Table 2.3: Population distribution in the Lake Victoria Basin

Population	Burundi	Kenya	Rwanda	Tanzania	Uganda	LV Basin
Total population (Million)	3.9	12.5	6.9	5.6	5.6	34.5
Rural population	95%	92%	90%	87%	6%	60%
Urban population	5%	7.8%	10%	13%	94%	40%
Population density	285	257	323	66	180	

Source: Adopted from NTDA Reports 2005

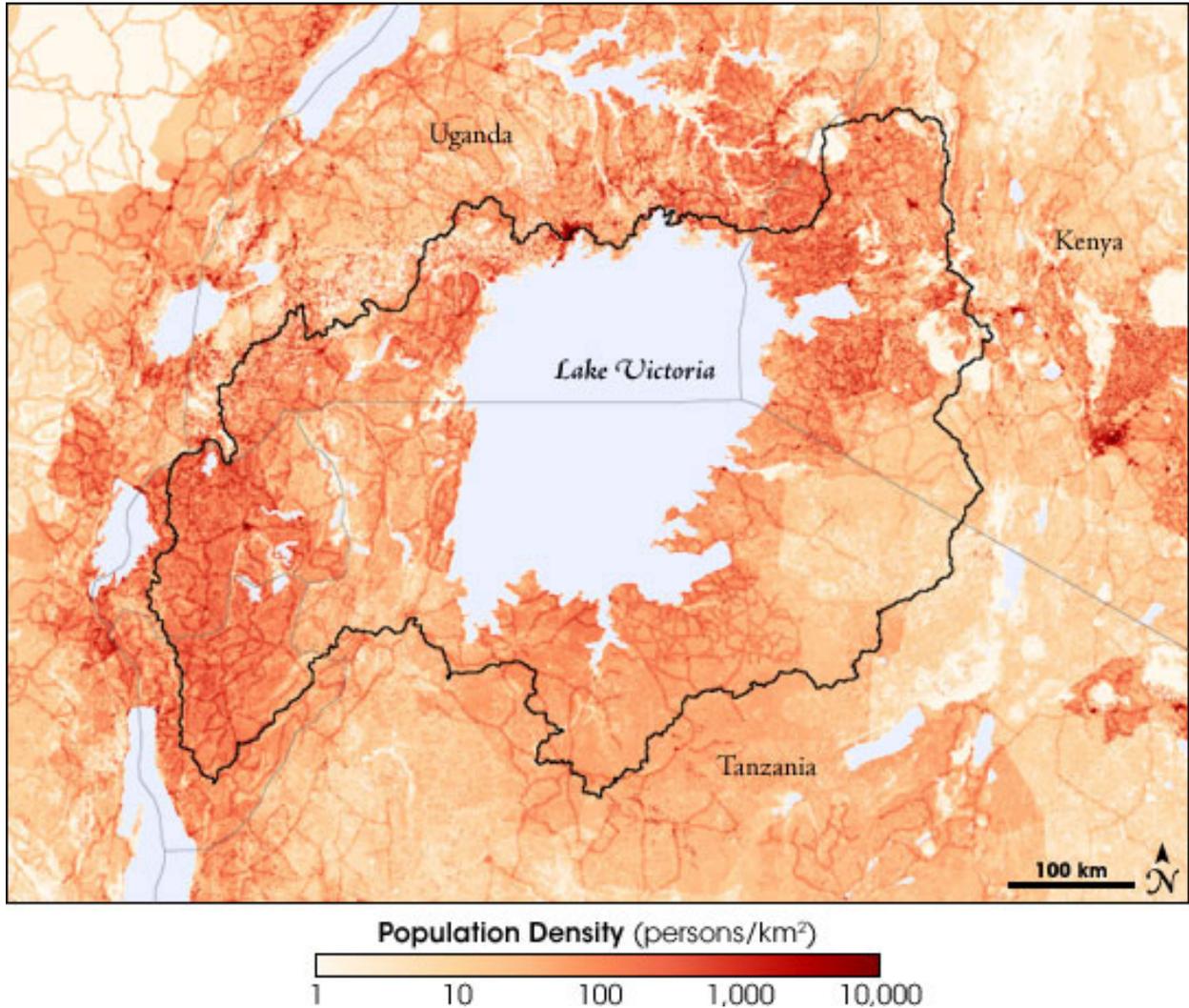
The Basin population density for each of the five riparian countries is higher than the respective national population densities. Broken down by country, the population of the Basin varies from 3.9 million people living in Burundian part of the Basin to 12.5 million people living in Kenyan part.

Rwanda, with a population density of 308 persons per sq. km and an annual growth rate of 2.9 %, has one of the highest population densities in Sub-Saharan Africa. The population has nearly quadrupled in the last four decades from approximately 2.6 million people in 1960 (MINITERE, 2003) to the current 9.1 million people. The Basin population density for Rwanda is 323 persons per km² which is higher than the national average. Similarly, Burundi, with an estimated population of 7.6 million, has a national average density of about 274 people per Km² growing at 2.1% per annum. The Burundian part of the Basin has a population density of 285 persons per km². It is organized in 16 provinces and 11 are in the Basin.

Kenya, with an estimated population of 34 million, has a national average density of 58 people per km² with an average growth rate of 2.4% per annum. The Kenyan part of the Basin has a much higher population density of 257 persons per km². Uganda has an estimated population of 27.4 million growing at 3.4% and an average density of 180 persons per km² in the Basin compared to national population density of 113 people per km². Tanzania, with an estimated population of 37.4 million growing at 2% per annum, has an average population density of 40 persons per km² compared to 66 persons per km² for her part of the Basin.

On average, about 65% of the population is under 25 years which implies high dependency level. The vast majority of this population is dependent on natural resources and small land holdings with approximately 75% of the population subsisting on one hectare or less. About 40% of the population in the Basin falls within the working age group of 15-64 years.

Figure 2.4: Demographic Pattern in the Lake Victoria Basin



Source: Image extracted from USDA

2.2.2 Social Development and Living Conditions

The living conditions and life expectancy of the Basin population are greatly affected by the prevailing economic, political, policy and institutional situation at the national level as well as the socioeconomic services within the Basin. There is variation among the Basin countries on these national socioeconomic indices, some of which are presented in Table 2.4.

The national GDP ranges from US\$ 1.6 billion in Burundi to US\$ 18.9 billion in Kenya. The GDP per capita is lowest in Burundi (US\$ 210) and highest in Kenya (US\$ 507). The Human Development Index in the Basin places the countries in positions 145, 152, 158, 169 and 162 for the Republics of Uganda, Kenya, Rwanda, Burundi and the United Republic of Tanzania respectively (Human Development Report, 2004). These ratings are an indication of a population deprived of many social facilities and amenities. It is also a reflection of a

population whose income is low and/or poorly distributed. It is a further demonstration that a vast majority of the population depend on the natural resources for their subsistence.

Over the last two decades, the Basin has been ravaged with HIV/AIDS. HIV/AIDS prevalence varies from one country to another and from one part of the Basin to another even within the same country. The prevalence varies from around 4% in Uganda to about 9% in Tanzania. With concerted government efforts, HIV/AIDS prevalence has stabilised. Similarly, child (under five years) mortality differs among the countries, with Burundi having the highest mortality rate of 190 children per thousand, while Kenya has the lowest figures at 90 per thousand. The percentage of undernourished population is highest in Burundi and is estimated at 68% while Uganda has the lowest level of 19%. Average life expectancy is relatively low in all countries of the Basin, with an average of 44.6 years for males and 47.8 years for females. Poverty levels are rampant and it is estimated that over 50% of the total population in the Basin lives under the poverty line. Countries with the highest levels of poverty include Burundi and Rwanda, which stand at 62% and 60%, respectively.

Development of various energy sources in the Basin remains a major challenge. Low investment rates in the sector characterise the Basin in all the five countries. In addition, monolithic reliance on hydro-power as the main source of energy for urban utilisation and industrial use has exposed the Basin to the consequences of vagaries of nature. Declining water levels of Lake Victoria has for the last 5 years adversely affected hydro-power generation at Jinja while the droughts experienced in 2000 and 2005, respectively, affected hydro-power generation for both Kenya and Tanzania. The consequences of such constraint hydro-power generation include reduced industrial production, increased unemployment and inefficient utilisation of available resources.

Due to hampered expansion of hydro-power generation and associated poor infrastructure, electricity supply is still very low within the Basin. Kenya has the highest connectivity, with 12% of the population accessing electricity, while Burundi, Rwanda and Uganda have only 5% of the population with access.

Table 2.4: Socioeconomic and Human Development Characteristics in the LVB countries

Country	Pop. Millions	Pop. Density	Pop G/R %	GDP Billions /US\$	GDP per capita (US\$)	% of population below US\$ 1 a day	Life/Exp at birth Male/ Female	HIV/AIDS Prevalence adult %	< 5 mortality per 1,000	% Pop. Under nourished	% Pop. Using Improved water sources	%Adult Lit. /Rate	Road density (Km/1,000 Km ²)	% Pop. with access to electricity	HDI Rank
Burundi	7.6	274	2.1	1.6	210	62.0	40/45	6.0	190.0	68	90	56/40	-	5%	169
Kenya	34.0	58	2.4	18.9	507	50.0	49/52	6.0	90.4	50	22	60	387.4	12%	152
Rwanda	9.1	308	2.9	2.9	328	60.0	43/46	5.1	203.0	37	92	74/60	486.0	5%	158
Uganda	27.4	113	3.4	9.6	350	31.5	47/50	4.1	140.0	19	87	87/57	137.0	5%	145
Tanzania	37.4	40	2.0	11.7	317	35.7	44/46	8.8	165.0	44	92	84/67	99.8	9%	162

Sources: Statistical Profiles of the Least Developed Countries: Prepared by UNCTAD, the UN 2005, New York; UNDP Development Reports for Burundi, Kenya, Uganda, Rwanda and Tanzania 1995-2005 and UNEP, Africa Environment Outlook, 2002, Rwanda, Tanzania National Census 2002. Projections from National Population Census Reports, National Statistical Bureaus and National Economic Survey Reports

2.2.3 Basin Water Supply and Sanitation

Despite the major towns and cities in the Basin being in the neighbourhood of one of the largest fresh water lakes in the world, access to clean water remains a major challenge. In all the major towns (Mwanza, Bukoba, Musoma, Kampala, Jinja, Masaka, Kisumu, Homa Bay, Kendu) on the shores of Lake Victoria water supply is remains far below the demand levels. Similarly, the hinter land towns such as Mbarara, Ntungamo and Kisii also experience water access problems. For the majority of these cities and towns the water and sanitation analyses is such that:

- (i) Water supply for domestic and industrial use is far below the demand levels;
- (ii) On the average, only about 40% the urban Basin population is served with clean water supply as at 2006;
- (iii) Most of the water supply and sewerage infrastructure is old consisting of very old and outdated equipment;
- (iv) The conventional waste-water treatment systems have, generally, collapsed. For example, Kisumu City discharges raw sewage into the Lake through Kisat River and into Kisumu Bay due to this situation.

On the Burundian part of the Basin, the northern and eastern provinces have the lowest water supply services coverage in the country with Kirundo at 33.2 %, Cankuzo at 36.5 % and Ruyigi at 31.9 %. In Rwanda, only about 5 % of the population is connected to piped water, and the rest depend on unimproved sources for domestic and other uses. Kenya, Tanzania and Uganda also have water supply coverage of between 60% and 75 % in the main towns of Kampala, Entebbe, Jinja, Masaka, Mbarara, Kabale, Kisumu, Mwanza, Musoma and Bukoba and between 1 % and 30 % in the rural areas (National TDA Reports, 2006). These data indicates that the state of improved and safe drinking water supply remains poor at all levels.

2.2.4 Health Status

Major human diseases commonly afflicting people in the Basin include, malaria, HIV/AIDS and related illnesses, tuberculosis, upper respiratory infections, meningitis, pneumonia, anemia, vector-borne diseases (Schistosomiasis, Trypanosomiasis), and water-borne diseases (Typhoid, Cholera, Amoebiasis). According to the official definition of the World Health Organisation, water-borne diseases refers to any significant and widely spread negative effect on human health (death, disability, disease or disorder) that is directly or indirectly caused by the state or changes in quantity or quality of any water. There is a continuous threat of outbreaks of waterborne diseases in the Basin. Available data shows numerous limited outbreaks of diseases caused by exposure to or consumption of poor quality water containing pathogenic bacteria that are responsible for transmitting various contagious diseases mentioned above

In the recent past much media publicity has been given to the avian influenza (H5N1). However, there have not been any confirmed cases in the Basin..

In Burundi, just as in the other Basin countries, diarrhoeal diseases are one of the most important causes of mortality in infants. Bilharzia is known around the marshes and the lakes of Bugesera. Among the other widespread waterborne diseases in the Basin are typhoid fever, the bacterial dysentery and variety of intestinal parasites.

The maternal mortality rates in the Basin countries are high. For example, in Uganda it is as high as 527 per 100,000 deliveries, and infant mortality is at 81 per 1,000 live births, and life expectancy at 48 years. In Kenya the incidences of malaria is amongst the highest in the world, closely followed by HIV/AIDS. A study done between 1992 and 1994 in the Asembo Bay, Kenya indicated a malaria parasite prevalence of 83 % in 1-4 year old and 60 % in 10-14 year olds (Boland *et al.*, 1999).

Malaria in Rwanda is the leading cause of morbidity accounting for 41% of reported cases of sicknesses and 8% of deaths for under five-year olds (MINISANTE, 2004). In Uganda, incidences of malaria epidemics were experienced in the highland areas of Ntungamo, Kabale and Kisoro during 1992, 1994, 1997/8 and 2000/01. This is partly due to changing environmental conditions and lifestyles. Malaria has, in recent times, surfaced amongst populations living in mountainous regions which were previously not susceptible to malaria and, therefore, have little or no immunity to the disease (MINISANTE, 2004; MINECOFIN, 2001a; Uganda MoH, 2001).

The prevalence of HIV/AIDS in the Basin for all countries ranges between 4% and 13% (Muyodi, *et al.*, 2005). HIV/AIDS prevalence in Rwanda is high especially in Kigali City where prevalence rate for 2003 was reported to be about 13.2%. The incidence of HIV /AIDS in Rwanda was exacerbated by the 1994 genocide during which many women and girls were raped. As a result, there has also been increasing numbers of widows and orphans that has increased vulnerability to HIV/AIDS.

In Tanzania, HIV/AIDS pandemic is, particularly, serious in the Kagera Region where it has decimated the economically active population, aged between 15 and 45, leaving behind an estimated 200,000 orphans throughout the region. Although the national HIV/AIDS indicator Survey 2003-04 (URT, 2005) showed very low prevalence rates for Kagera (3.7%) and Mara (3.5%) and slightly higher prevalence rate for Mwanza (7.2%). The data from the National AIDS Control Program Report for the year 2003 showed that the prevalence rates were 8.7%, 7.8%, and 20.7% for Mwanza, Mara and Kagera, respectively (URT, 2004; Kessy, 2005). Fishing communities in particular have been identified to be potentially at risk of high transmission for HIV and other sexually transmitted diseases because of higher migration (Yanda *et al.*, 2001).

2.2.5 *Disaster Preparedness and Management*

The Basin is prone to limited disasters with the most common being floods and maritime accidents. The floods have, over the years, become more frequent and severer, imposing huge economic and social costs on the affected communities. The lower parts of Kano Plains and Budalangi in Kenya continue to experience floods almost on annual basis resulting in heavy economic losses. The El Nino floods of the early 1960s and later in 1997-1998 caused havoc, destroying Lake Victoria shoreline infrastructure such as roads, railway lines, settlements, buildings and crops.

In the recent past, passenger and cargo ships have had catastrophic accidents on Lake Victoria involving loss of life and property. Fishing boats capsize almost weekly due to over loading and poor maintenance of craft. Similarly, tankers on lorries and train wagons often over turn spilling huge quantities of fuel as they ply the long distances from the coast to the hinterland in Uganda, Rwanda, Burundi, Tanzania and parts of Kenya.

In most of these cases there were insufficient arrangements amongst the governments departments, private sector and the communities to handle the disasters. There are no precautionary arrangements and what is happens, as always, is routine uncoordinated reactions to events as they unfolded.

2.3. The Basin Economy

2.3.1 Overview

The Basin economy is mainly defined through agriculture and livestock production, fisheries production, wildlife and tourism and cash crop production. Other key sectors of the economy in the Basin include the energy sector, service industry, trade and industry, forestry and the telecommunication. Most of these sectors have recorded expansion over the years and this may explain the deteriorating state of the environment as epitomised by declining water quality, declining fisheries resources, catchment destruction and soil erosion.

Regional trade in goods and services have improved over time leading to emergence of urban centres along the shores of the Lake. These urban developments have been growth points attracting employment. In addition, they pose a continuous threat of point source pollution to the Lake waters.

2.3.2 Productive Sectors

2.3.2.1 Water Resources

The water resources of the Basin comprises of surface water resources (Lake Victoria, satellite lakes, rivers, dams and ponds), ground water resources, and rainwater. Lake Victoria is the main surface water body in the Basin and hence defines the operational framework for the Basin activities. There are a number of other smaller lakes of varying depths, major inflowing rivers, dams and ponds, extensive riverine and lacustrine swamps. Direct rainfall over the Lake contributes by far the greatest (82 %) source of water to Lake Victoria and the rest comes via major inflowing rivers, as discussed in section 2.1.4 of this report.

Ground water resources are regarded as potential sources of water for domestic and commercial purposes. However, no comprehensive studies have been undertaken to establish the potential of this resource. Exploitation of ground water resources is still limited. This resource supports most of the productive sectors in the Basin including agriculture (both irrigated and rain fed), wildlife and tourism and fisheries among others.

2.3.2.2 Fisheries

The lake is an important warehouse of fisheries resources both in diversity and numbers. In the early 1960s, there were about 400 to 500 species of fish comprising of 12 families and 27 genera, including over 100 identified species of the *Haplochromis* taxon, alone, in Lake Victoria (Greenwood 1965). However, 40 years after the introduction of the Nile perch into the lake, it is estimated that the number of fish species has been reduced to about to over 200, the rest having been decimated through predation by the Nile perch and competition from the introduced tilapiines (*Tilapia zillii*, *T. rendallii*, *Oreochromis niloticus*, *O. melanopleura* and *O. leucostictus*). Over fishing has also contributed to depletion of the fish species.

Other Basin lakes and rivers also support fisheries but mainly for domestic use. In the upper catchment areas of Burundi and Rwanda, some lakes have proven good potential for commercial fisheries including; lakes Rwihinda, Cohoha, Rweru, Kazingiri, Gaharwa, Kirumbi and Bugesera located in the southern floodplain, Ihema, Kivumba and Rwanyakizinga located in Akagera National Park, and Bulera and Ruhondo found in Ruhengeri close to the border with Uganda. Riverine fish is being exploited for subsistence purposes. The fisheries of Lakes Rweru, Ihema and Muhazi can be commercially redeveloped as these lakes had commercial fisheries that collapsed during the civil strife in 1994.

2.3.2.3 Agriculture and livestock

Agricultural production is the mainstay of the Basin economy in terms of food security, income generation and employment. The main food crops include; maize, beans, rice, cassava, sweet potato, Irish potato, sorghum, wheat, millet, banana, pineapples, groundnuts, simsim, cowpeas, green grams, soybeans, yams, tomato and a wide variety of indigenous and exotic fruits, vegetables and other horticultural crops. The main cash crops are; Sugar cane, tea, coffee, cotton, tobacco, sunflower, pyrethrum and vanilla.

The proportion of land used for agriculture varies in the riparian countries, depending on the topography, soils, rainfall, population pressure and climate. The area of arable land in the Basin is 33%, 20% and 28% for Kenya, Tanzania and Uganda, respectively (Bullock *et al.*, 1995). Changes have taken place in the agricultural sector of the five riparian countries of the Basin over a period of time, leading to a continuous reduction in the proportion of arable agriculture compared with total agricultural output.

Poor farming practices and continued use of chemicals and fertilizers have led to deterioration of soil quality with agricultural land getting acidified. Soil erosion has also become a major problem. It is inherent on agricultural fields located on slopes with gradients greater than 1.5° – 2° especially in the Kenyan, Rwanda and Burundian parts of the Basin. It is estimated that only a third of erosion-susceptible land has been protected against erosion through the use of simple anti-erosion practices such as lateral slope tillage. Intensive farming contributes significantly to the anthropogenic pressure on the upper parts of the Basin where there has been continuous expansion and fragmentation of crop farming areas. Small to medium scale irrigation schemes are common within the Basin, and the existing area of irrigated farmland in the lower part of the Basin is 233,470 million hectares mainly utilizing river water for irrigation.

The livestock industry in the Basin is based mainly on cattle, shoats (goats and sheep), pigs, donkeys and poultry. The local breeds dominate the stocks. Meat, milk and milk products, hides and skins are important animal products. Livestock plays an important role in the social fabric of the some of the communities in the Basin.

The industry is under threat from animal diseases with the common ones including Trypanosomiasis, East Coast Fever (ECF), Anaplasmosis, Babesiosis, Heartwater, Newcastle disease, Foot and mouth disease (FMD), Rift Valley Fever and Rabies. Other livestock diseases common in the Basin include Black quarter, which is known to be endemic in the Basin and it occurs periodically particularly during the dry season, and Contagious Bovine Pleuro-pneumonia (CBPP). Livestock diseases have been the major challenges to pastoralists with wild animals being a major factor in the spread of these diseases. The occurrences and impacts of these diseases have been high. In Lamadi village in the Tanzanian part of the Basin, for example, ECF had a frequency of 82.5% and very high mortality rate, while FMD had a frequency of 78% with low mortality rate. Trypanosomiasis prevalence was observed to be between (55%) and (73.5%). The occurrence

of these diseases normally has adverse effects on the local communities as they often lead to not only loss of animals but also human life. They also lead to closure of markets leading to major losses to livestock farmers and the Basin economy.

2.3.2.4 Wetlands

The Basin contains major wetland areas that provide a habitat for various birds and animals. Wetlands in the Basin are grouped mainly into two categories - Upland and Floodplain types of wetlands. Upland Wetlands are mostly in the western mountainous areas perched in valleys along the tributaries of rivers, which originate from Rwanda and Burundi. Most of them, however, have been converted to agricultural use for production of Irish potatoes and sweet potatoes, maize, beans, peas, tomatoes, cabbages, tea and sugar cane on a large scale. On the other hand, flood plain wetlands are extensive in the south at the border between Rwanda and Burundi and along the lakeshore in Kenya, Uganda and Tanzania. Pressure on flood plain wetlands by resident communities and large-scale developers is evident and is set to increase.

This encroachment and use of wetlands for agricultural purposes is, however, compromising the functions of wetlands particularly as buffering zones and biodiversity warehouse. Plants commonly found in wetlands are Sedges, *Cyperus* spp, Bulrush (*Typha* spp), Date palm (*Phoenix* spp) Grasses (*Pennisetum* spp., and *Hyperhenia* spp), Reeds (*Phragmites* spp), while wetland animals include Hippopotamus, Sitatunga (*Tragelaphus spekel*) Nile crocodile (*Crocodyles niloticus*) Wild pigs (*Potamochoerus porcus*), snakes, fish species, amphibians and birds.

2.3.2.5 Forestry resources

Natural forests are distributed unevenly in the Basin, with higher concentration in the upper parts of the Basin while in the lower areas, forest cover is limited to relatively small plantations and wind break strips surrounding agricultural fields. Forestry resources in the Basin are pivotal in supporting community livelihoods as well as the proper functioning of the ecosystem. Communities rely on forestry to meet a wide range of household needs. These resources are sources of foods, fruits, construction materials, source of pasture (particularly during the dry season) and even as source of spiritual inspiration. Agroforestry or on-farm forestry has grown over the years with the main species being the nitrogen-fixing species and other fast growing species, which are being tended for cash.

Despite the key structural and functional roles played by forestry resources, the Basin has experienced extensive forest ecosystem destruction through encroachment, unsustainable exploitation and fires. The search for agricultural land has triggered forest destruction mainly in Rwanda, Burundi and Kenya.

The Rwandan part of the Basin mainly consists of unevenly distributed savannas and mixed forests occupying an area of 90,000 hectares. It is further observed that the hilly northern and western catchments where the drainage network originates are facing degradation due to cultivation on very steep slopes.

The Burundian part of the Basin is dominated by savannas and pockets of forests, of which the important protected areas are the Ruvubu National Park (50,000ha) and the Kibira National Park (40,000ha). The vegetation types in the forests are determined by altitude. The Bugesera Depression has a lower population density and hence has not been extensively degraded.

On the Tanzanian part of the Basin, forest covers a total of 1,092,883.2 ha. The Kagera region is fairly well endowed with natural forests covering 302,593.6 ha (51.5 %) of the land area and the Shinyanga region has a total area of 788,556.4 ha covered with forest. However, the Mwanza region has lost most of its tree cover and has only 130 sq. km under forests while Mara region has very low forest potential, consisting mainly of woodlands, wooded grasslands and bush lands covering 1,733.2 ha.

On the Kenyan side of the Basin, forest resources occur in highland and lowland areas. The highland catchment areas have a total forest cover of 220,750 hectares where 191,356 ha (86.7 %) are indigenous forests while the rest are plantations. The highlands also have woodlots on individual and private lands. The forest cover in the lowland areas is 17,763 ha, representing 7 % of the total forest cover in the Basin and its catchments. Extensive forest destruction is mainly within the Mau forest, which is apparently an important source of Sondu and Mara Rivers. Such continued destruction is likely to have an adverse impact on the potential of hydro-power generation at the Sondu-Miriu plant as well as the health of the Mara and Serengeti ecosystems.

In Uganda, forest reserves cover an estimated 1.5 million hectares, representing about 7 % of the country. They comprise 732,000 hectares of high tropical forests, 775,000 hectares of savannah forests and 25,000 hectares of plantation forests. Forestry contributes to about 3 % of the GDP and provides for more than 95 % of the country's timber requirements. About 400,000 hectares of forest are available for industrial use.

2.3.2.6 *Wildlife and Tourism*

The Basin is endowed with some of the best wildlife areas in the world, a variety of sceneries with huge potential for nature and ecotourism. Sites for tourism include national parks, game reserves, lakeshore beaches, wetlands, forests and unique physical features. The Kagera River Basin, the Mara River Basin and the Mt Elgon ecosystem are typical examples of sub-ecosystems housing nature reserves of high biological resources. Other important areas include the Akagera National Park, Maasai Mara and the Serengeti National Park, the latter being partly in the Basin.

Some sections of the Basin enjoy international recognition and special protection under the United Nations Educational, Scientific and Cultural Organisation (UNESCO). The Basin has high fish biodiversity, bird species, a number of wild animal species and plant species. Some parts of the Basin with fragile ecosystems have been gazetted as Ramsar sites. The world famous Serengeti National Park in Tanzania, found partly in the Basin and the Maasai Mara in Kenya has been designated amongst the new Seven Wonders of the World. Some parts of the Basin have also been designated as an Important Bird Area (IBA) with 70 IBAs. The endangered bird species in the Basin include the vulnerable papyrus yellow warbler (*Chrolopetta gracillostris*) and papyrus gonolek (*Laniarius mufumbiri*).

In Rwanda there are three protected areas namely: Nyungwe Forest National Park in the West; Akagera National Park in the East; and the Volcano National Park in the north, all which are situated in the Basin and constitute critical watersheds. These ecosystems provide unique physico-geographical characteristics that support a variety of different life forms spread over different altitudinal ranges. In addition to the economic returns from tourism, these parks provide habitat to some of the rarest species, making them internationally important biodiversity sites. The parks in Rwanda are a major tourist attraction, contributing substantially to the economy through tourism revenue.

Despite its potential, the Basin has yet to be fully developed as a tourist destination. In particular, the huge potential for Lake wide transport is minimally developed to support tourism. The Sesse Islands in Uganda and

the Ukerewe Islands in Tanzania have beautiful sandy beaches highly suitable for tourism but little development has taken place in these areas and the numbers of tourists are still very low. Tourist attractions could include water sports, bird watching, angling, and other natural attractions. Apart from Government contribution, the private sector has taken steps to put in place utilities and facilities in the tourism industry such as increased hotel accommodation, providing travel and tour operations, professional tour guiding, tourism promotion, and capacity building and linking with supportive institutions. Eco-tourism is proving important as an income earner in the hospitality industry in the Lake Basin.

2.3.2.7 Mineral resources

The mining industry in the Basin is a major land use activity currently contributing about 2.3% of the GDP. Artisanal exploitation of the ores exists in the Burundian Basin of Lake Victoria and targeting alluvial gold, cassiterite, columbo-tantalite and wolframite. The activities have, however, a negative impact on the environment because they cause pollution of the rivers by solid loads and an excessive silting of bottoms of valleys, making them unsuitable for agriculture.

The Kenyan part of the Basin has minerals including the Kisii soapstone, phosphate, sulfur, wollastonite and nephelinite, manganese, tin, kaolin, clay, flourspar, iron ore, graphite and diatomaceous soil. Industrial mining of limestone continues at Koru in Nyando District, while there is extraction of building material, such as granite, brick clay, sand, tuffs, murrum and material for ballast.

A range of minerals (cassiterite, coltan, wolfram and colombo tantalum) and other valuable materials such as sand, gravel, stones, etc, are obtained in various parts of the Basin in Rwanda. Mining sand and stones is not well regulated and there are concerns for the destruction of other natural resources particularly wetlands and fragile hillsides. Mining activities support significant proportions of livelihoods and local economies although there are concerns that, current mining activities in Rwanda are not sustainable. The Government of Rwanda has intervened by outlawing mining in some areas, but appropriate mechanisms are needed to ensure a delicate balance between environment and livelihoods.

The mining industry in Tanzania is a major land use activity currently contributing to about 2.3% of the GDP. In the Tanzanian part of the Basin there are old and new gold mines, the Williamsons Diamond Mine at Mwadui being the oldest mine is still in operation. The main gold areas in the Tanzanian Basin include the Lake Zone gold fields, south and east of Lake Victoria up to the Kenyan border. The most active sites are Geita, Bulyanhulu near Kahama, Iramba, Sekenke, Kilima Fedha, Serengeti, Nyambegena, Musoma and Tarime. The current new large-scale gold mines operating in the Tanzanian part of the Basin are typical examples of the current trend in the large-scale mining sector, and this is being boosted through a conducive investment climate provided under the mineral policy as a result of the on-going policy reforms in the Countries.

The storage of mine waste dumps, mercury contamination resulting from artisanal mining activities and the continued pumping of saline wastewater from mines and quarries, however, poses a threat over increasing levels of pollution in the lower part of the Basin.

2.3.3 Trade and Industry

Trade and industry is one of the fastest growing sectors in the Basin with high potential for contributing to improved incomes and employment. This sector has been greatly promoted by the current regional integration process exemplified by the Customs Union of the EAC. These have facilitated intra and inter-regional trade in the Basin. As a focal economic growth zone, the Basin has an advantage over other regions in terms of attracting investments. Currently, there is no data on the volume and value of transboundary trade within or across the Basin. However, judging from the movement of goods within and out of the Basin, it is obvious that trade plays a very important role in the local economy both as a source of income, employment and food. Most of the trade within and across the Basin is based on agricultural and livestock products, fisheries products, other food products, non-agricultural household goods, farm inputs, wood and timber products, clothes and textiles and construction materials.

Trade between Kenya, Uganda and Tanzania has greatly increased since the initiation of the integration of the EAC Partner States. Exports to Tanzania from Kenya grew at the rate of 62 percent annually from US\$ 0.16 billion in 2000 to 0.28 billion in 2005 while exports to Uganda from Kenya grew at the rate of 65% annually from US\$ 0.35 billion in 2000 to 0.61 billion in 2005. Imports to Kenya from Tanzania also grew at the rate of 20.4 percent annually from US\$ 7.84 million in 2000 to 41.4 million in 2005. The Uganda imports to Kenya grew by 49.2 percent annually.

In Burundi, industrial activities are dominated by agro-processing and food industries for coffee, cotton, rice, tobacco, sugar cane, dairies, oil mills and breweries. The other industrial activities relate to the production of consumer goods, chemicals, textile, wood, paper, as well as building materials. Most of the goods (about 70%) use the major roads, which connect Burundi to Rwanda, Uganda and Kenya and the principal axis, which joins Burundi to Tanzania.

In Tanzania, industrial activities in the Lake regions are characterized by small or medium sized production units based mainly on agriculture and fishing. These include fish processors, fishmeal mills, abattoirs, vegetable oil mills; animal feed mills, coffee and tea processors. In Uganda, investment is taking place in various sectors of the economy including mining and agriculture (coffee, tea, fish, milk, edible oil and fruits processing).

2.3.4 Infrastructure

2.3.4.1 Energy

Generally, wood fuel supplies over 90% of the energy requirement in the Basin countries. Other potential energy sources such as solar, geothermal, and wind energy are not significantly developed. Wind power is used mainly to pump water in few parts of the Basin and to propel sailboats in the lake. Hot springs are present in parts of the Basin, but these have not been exploited for energy. Similarly, conversion of solar power to electric energy is limited.

In Burundi, there are many small hydroelectric generating dams, but they have low capacity of less than 1,000 KW. Some of them function minimally during the dry season due to insufficient water. In Kenya, wood fuel accounts for 70%, while oil and electricity constitute 20 % and 9 %, respectively, of the energy requirements.

The Kenyan part of the Basin has a large potential for hydroelectric power. According to the Lake Basin Development Authority Master Plan (1987) the Basin has the potential to generate 563 Mega Watts (MW) of hydroelectric power from the Nzoia river (159 MW); River Yala (114 MW); the Nyando river (14 MW); the Sondu-Miriu river system (249 MW) and the Kuja–Migori river system (27 MW). Currently hydroelectric power generation is limited in the Kenyan part of the Basin but is bound to expand with the ongoing implementation of the Sondu-Miriu Hydro-power project.

In Tanzania, around 90 % of its national energy needs are met by wood fuel, while petroleum and electricity, combined, account for 8 % of energy consumption. Coal and other sources account for less than 1 %. Correspondingly, the majority of the Basin population relies on bio-fuel (wood, animal waste, etc.) as their primary fuel source. A large proportion of the rural population depends on forest resources to meet the firewood needs. In Mwanza, a study in 2000 showed that the City consumed about 438,102 m³ of firewood and charcoal with a deforestation rate of 17,777 ha (Chamshama, 2005). In Musoma there is evidence that even forest reserves which are supposed to be protected, have been seriously deforested as evidenced by Kyanyari Forest Reserve, which, currently, is devoid of trees.

There is high potential for hydroelectric power generation in Uganda with more than 95 % of this potential being within the Basin. The Owen Falls dam at Jinja has installed capacity of 380 megawatts (MW) although it currently generates about 50 % of this potential. In addition the Government has approved US\$ 500 million for 250 MW hydropower plant at Bujagali Falls and further plans for the establishment of 200 MW at Karuma. To address the current energy demand, the Government of Uganda has commissioned a 50MW geothermal plant at Kampala and 50MW in Jinja, while additional 100MW of thermal plants are planned for in the short-term.

Hydroelectric power is the most important form of energy in Rwanda. Within the Basin, about 30 MW is generated annually from the power stations of Rusizi in the West and Ntaruka and Ruhondo in the north. In addition, Rwanda has 30 megawatts generated from thermal and some electricity is obtained from Uganda. Electricity connection is, however, still low considering that the numbers of subscribers are about 67,000. Recent, peat, mainly mined from wetlands, is being used as an alternative to fuel wood in industrial activities. Others are biogas, solar, thermal and methane gas, which are being explored.

2.3.4.2 Communication

Communication infrastructure within the Basin includes road network, air transport, railway transport, inland water transport, and telecommunications in each of the five countries. Some of the transport systems interface among the riparian countries. There is well-structured road network in the Basin but the condition of most rural roads makes it difficult to travel or move goods within the Basin, particularly during the wet season.

In terms of telecommunication, the Basin is served with both fixed and mobile communication facilities. In the last five years there has been a remarkable growth in mobile telephone subscription, with tendency towards region-wide networks. The fixed telephone network has, however, lagged behind in expansion, thereby affecting access to internet. Each of the riparian countries has several radio and TV stations and newspapers.

Transboundary public road transport vehicles include buses and larger vehicles transporting goods, including oil tankers. Cross-border rail transport in the Basin is being revived with heavy private Sector involvement to eventually link Rwanda and Burundi. There are several small passenger and goods transport boats operating in the Lake, and a few large regional cargo transport vessels. In Tanzania and Uganda, sizable vessels serve the islands in the lake.

Air transport is limited to the main international airports in Nairobi, Entebbe, Dar-es-Salaam, Kilimanjaro, Kigali and Bujumbura with connections to inland airports within the Basin like Kisumu and Mwanza.

2.4 Governance of Environmental Resources

The governance of the environmental resources in all the Basin countries takes its roots from the laws and policies put in place by the colonial governments. These policies and laws focused on utilization rather than conservation and as such, they were not comprehensive enough to respond to the environmental problems. However, from the early 1990's all the five countries have undertaken marked reforms and developments of the environmental policies and laws including creation and strengthening of institutions for the management of the resources. These undertakings have demonstrated the commitment of the countries to the declarations of the Rio World Earth Summit of 1992. A summary status of the policy, legal and institutional frameworks are outlined below.

2.4.1 Policy Framework

The key and relevant environmental resources policies that are in place were all developed and adopted in the countries at different times between 1996 and 2006. They include the following: Burundi (land, forest and waste management policies and a national environment management plan), Rwanda (land, forest, tourism, water and sanitation and; environment policies), Uganda (wildlife, forestry, wetlands, mining, fisheries, water and environment policies), Tanzania (land, forest, agriculture, mineral, wild life, water, fisheries and environment management policies), and Kenya (forest, land, wildlife, water resources management and environmental management policies).

Most of these policies have a common foundation mainly that they emphasize on participatory management of environmental resources. The cognizance that communities have a key role to play in sustainable environmental management is an important positive element in the recently formulated policy frameworks in the Basin. The frameworks further recognize the need for communities to access benefits arising out of environmental conservation. However, most of the policies in the region do not pay any attention to regional elements of environmental resources management.

2.4.2 Legal Framework

The implementation of most of the above policies in the countries has been effected through the enactment of specific legislations. However, in some countries, certain laws were enacted without a specific policy. The main and relevant legislations that are in place in the countries are as follows: Rwanda (land management, water and sanitation, Rwanda Environment Management Authority, Protection, Conservation and Promotion of Environment and; Mining and Quarry Exploitation Acts), Uganda (Land, Wildlife, Forestry and Tree Planting, Mining, Fish, water and Environment Management Acts), Tanzania (National Land, Village Land,

Forest, Mineral Wildlife, Fish, Water and National Environment Acts), and Kenya (Government land, Registered land, Trust Land, Land Acquisition, Forest, Wildlife, Fisheries, Water and, Environmental and Coordination Acts).

In addition to the above national legislations Kenya, Uganda and Tanzania are signatories to the Treaty for the Establishment of the East African at the regional level Community and the Protocol for Sustainable Development of Lake Victoria Basin. A Protocol for Environment and Natural Resources has been signed and is under ratification process in the Partner States. Rwanda and Burundi will assent to these instruments by July 2007. Internationally, all the five countries are signatories to various Conventions of relevance to Lake Victoria Basin.

2.4.3 Institutional Framework

The implementation of these policies and laws is vested on various respective sectoral government ministries and agencies. The extent of decentralization of implementation to the lower governance levels up to districts and further below, varies amongst the five countries. The Environmental Acts in countries are cross cutting rather than sectoral and hence the implementation has been vested (or shared) with specialized Agencies. The National Environment Management Authority of Uganda and Kenya; the Rwanda Environment Management Authority; the Department of Environment in the Vice President's Office and National Environmental Management Council of Tanzania and, the Department of Land and Environmental Management in Burundi are responsible for the implementation and enforcement of the environmental legislations.

At regional level, the Lake Victoria Basin Commission established in 2005 as an apex institution of the East African Community is charged with the responsibility of coordinating programmes and other interventions undertaken by various stakeholders operating in the Basin. The Commission functions in the Countries through the designated National Focal Point Ministries and the Ministries responsible for East African Community Affairs.

SECTION THREE: TRANSBOUNDARY PROBLEMS AND ISSUES

This presents major transboundary problems and issues in the Basin. It explores the magnitude of the problems, causes, potential mitigations and the environmental and economic costs that may arise out of continued environmental degradation. These issues are discussed under thematic areas of land use and land degradation; water quality and pollution; water quantity and water balance; biodiversity and fisheries decline; socioeconomic and cross cutting issues..

A total of 21 transboundary Major Perceived Problems and Issues (MPPIs) were identified in the National TDAs of the five riparian countries. The MPPIs were ranked as of high, medium or low priority, based on each country's own perception (Table 3.1).

The MPPIs are categorized and analyzed in this section under six thematic areas, namely;

- (i) Land use and land degradation
- (ii) Water quality and pollution
- (iii) Water quantity and water balance
- (iv) Biodiversity and fisheries decline
- (v) Socioeconomic and cross cutting issues.
- (vi) Policies, laws and institutions

Table 3.1: Major Perceived Problems and Issues in the Lake Victoria Basin by country

MPPIs	Country				
	Burundi	Kenya	Rwanda	Tanzania	Uganda
1. Pollution (water quality deterioration)	H	H	H	H	M
2. Water balance and water level fluctuations	H	H	M	H	H
3. Declining fisheries (over fishing)	L	H	M	H	H
4. Biodiversity loss	H	H	H	H	H
5. Land degradation	H	H	H	H	H
6. Deforestation	H	H	H	M	H
7. Shortage of energy	H	H	H	H	H
8. Wetland destruction	H	H	H	M	H
9. Water hyacinth	H	H	H	H	H
10. Inadequacies in policy, laws & institutions	H	H	H	M	M
11. Prevalence of diseases and pests	H	H	H	H	H
12. Poverty	H	H	H	H	H
13. Population pressure	H	H	H	L	L
14. Conflicts in resource use	H	H	H	M	H
15. Unsustainable urbanization and industrialization	M	M	L	M	M
16. Poor public and stakeholder participation	M	M	L	M	M
17. Poor information generation and management	M	M	L	M	M
18. Climatic changes	H	M	M	M	M
19. Population displacement	H	M	H	M	L
20. Poor mining and quarrying practices	H	M	H	M	M
21. Degradation of river banks and the lake shore	M	H	H	M	H

Source: National NTDA's

Categorization of MPPIs: H = High priority; M = Medium priority; L = Low priority.

3.1 Land Use and Land Degradation

Land degradation and poor land management in the Basin are major challenges that are impacting negatively on community livelihoods and cut across issues of poverty, health, the environment and economic growth. Although land degradation is recognized as a major development issue, sustainable land management (SLM) has not received the desired attention in the development agenda of the Basin due to the existence of several critical barriers. The Basin farming systems are dominated by crop agriculture. The expansions and new settlements are targeting very fragile ecosystems (forests, wetlands, steep hills, river banks, shorelines etc).

Transboundary issues and concerns in the land use context mean national issues with transboundary or cross-border effects (downstream effects or off-site effects) or national issues that require a common strategy and collective action with other riparian states in the Basin. Based on the above understanding, the land use transboundary issues have been broadly grouped into two categories: Upper Sub-catchment areas (that covers Rwanda, Burundi, N.W. Tanzania and S.W. Uganda) and Lower Sub-catchments areas (that includes Kenya and the remaining parts of Tanzania and Uganda catchment areas). Some of the causes of land degradation include population pressure, poor infrastructure, lack of diversification strategy, inadequate markets and marketing channels, indiscriminate application of fertilizers, catchment destruction, and inadequacy in value addition.

3.1.1 Population Pressure and Changing Land Use Patterns

The highlights below cover key land use change trends in each country that are due to the high population pressure in the Basin as discussed in Section 2.2.2. Very high level of poverty and low literacy at the grassroots aggravates the situation further.

Rwanda has one of the highest population densities in Sub-Sahara Africa, with about 75 % of households subsisting on 1 ha or less, of whom 54 % own 0 - 0.5 ha. There is considerable pressure on the land considering that only 52 % is arable (National Land Policy, 2004). Most of the land opened for agriculture is located near rivers and lakes particularly in the western and northern parts of the country. Further, the hilly northern and western catchments, where the drainage network originates, are facing degradation due to cultivation on very steep slopes.

Deforestation is spreading at a very alarming rate. For instance, 15 % of the Nyungwe forest was converted to agricultural use and settlements between 1958 and 1978. The Akagera National Park area was reduced from 331,000 ha (1956) to 225,000ha (1992) and more land was degazatted to settle refugees after 1994. To date only about a quarter (90,000ha) of the original protected area remains. The Akagera National Park previously provided a natural buffer against increased siltation of River Kagera. The maintenance and conservation of many non-commercial forest plantations in this region needs to be urgently addressed.

In Burundi, the river Basins of Ruvubu, Akanyaru and higher Akagera that are dominated by extensive wetlands are under intense population pressure for conversion into agricultural lands. During the dry season the wetlands are intensively grazed leading to soil compaction. The forest areas are equally under intense population pressure for conversion into agricultural lands, and have shrunk from an estimated 100,000 ha (1950) to the current estimate of 50,000 ha.

Rapidly increasing population in Kenya has put pressure on the Basin's limited resources, resulting in competition and conflict over access rights and threats to sustainable use of resources. It has further resulted in diminished land parcels as the land gets sub-divided due to inheritance and customary requirements. Currently the Yala, Nyando and Sondu swamps are being drained for agriculture. The forestry resources are equally subjected to enormous pressure in Kenya. About 7,084 ha of Mau forest, which is considered as the water tower of Lake Victoria, were destroyed between 2000 and 2003. In Mt. Elgon area around Trans Nzoia District there has been a loss of 1,029 ha of indigenous forest. Floods are a persistent problem in the flood plains, in particular Kano Plains, Budalangi and Aneko areas which are usually flooded annually during long rains, and sometimes also during the short rains.

In Tanzania, dense settlements characterize good agricultural land. For example, in Muleba, Bukoba, Biharamulo, Geita, Tarime and Sengerema Districts the highlands and the Lake shore are densely populated, putting pressure on land and thereby accelerating land degradation. There are many areas in the Basin, particularly in Sukumaland, that are dominated by human-induced vegetation and are generally referred to as "cultivation steppe" due to lack of trees. An assessment of 36 Forest Reserves, 7 in Mara and 29 in Mwanza, established that all of the forest reserves had highly distorted boundaries, were highly encroached and also that the big *Miombo* species were disappearing and being replaced by *Acacia* sp (Chamshama, 2005).

Unsustainable land use practices in Uganda continue to cause negative transboundary impacts. These practices include irrational agriculture, deforestation, overstocking of livestock, bush burning, land fragmentation, unplanned land use, excessive harvesting of fauna and flora and wetland degradation. High density of livestock, particularly, in Rakai, Mbarara and Masaka has caused serious soil erosion and degradation.

3.2 Water Quality and Pollution

Lake Victoria is relatively shallow with a mean depth of 40 m and eutrophic with the littoral zones being hypertrophic. It is now recognized that human activity including urbanization, deforestation, intense cultivation, animal husbandry, introduction of exotic fish species and over fishing, accelerated the rate of nutrient inputs and recycling, resulting in changes in the physical, chemical and biological properties (Ogutu-Ohwayo, 1990; Hecky, 1993; Hecky *et al.*, 1994, 1996; Lipiatou *et al.*, 1996; Mugidde, 1993; Mwanuzi, 2005).

3.2.1 Water quality and pollution trends

The increasing human population and the associated activities have accelerated the rate of delivery of nutrients causing eutrophication in Lake Victoria. Land use has intensified and human and livestock populations have increased, especially along the lakeshores and on the islands in the lake. The effects of increased pollution from urban and industrial discharges and soil erosion are visible in some of the rivers and streams (e.g. Nakivubo Channel, Kisat, Nzoia, Yala, Nyando, Kagera, Ruvubu, Simiyu).

Poor land use causes soil erosion, leads to siltation of water bodies, and is widespread in all the countries of the Basin. Rivers that flow into Lake Victoria are, therefore, heavily loaded with silt derived from eroded catchments. The largest contribution of inflow (33 %) is from River Kagera. This has resulted in very poor water quality because of the resultant algal blooms that have caused fish kills and contributed to the raising costs of water treatment. The released algal toxins make the water unsuitable for human and livestock use.

3.2.2 Eutrophication in Lake Victoria

Most of the phosphorus (39,978 tons TP p.a.) and nitrogen (167,650 tons TN p.a.) enter the Lake by atmospheric deposition, representing 60 – 80 % of total deposition. The second most important load sources into the Lake are the rivers that contribute an estimated 9,250 of TP and 38,800 tons/y of TN (Table 3.2).

Table 3.2: Relative Magnitude of Loading Sources to Lake Victoria

Pollution Source	TN (tons/year)	%TN	TP (tons/year)	%TP
Atmospheric Deposition	167,650	17	39,978	79
Rivers	38,800	4	9,250	18
Biological Nitrogen fixation	757,000	78	-	-
Point source	4,300	1	1,690	3
Total	967,750	100	50,915	100

Source: LVEMP, 2005

The total phosphorus loading is dominated by direct atmospheric deposition on the lake surface with atmospheric loading of P accounting for 60 to 80 % of total annual P loading depending on whether the low or high estimates of atmospheric P loading are used. Nitrogen loading is dominated by biological N fixation with atmospheric loading of N being the second most important source. Municipal and industrial loadings only account for a small portion of the total annual loading of N or P. Point sources are estimated to contribute about 4,300 tons/year of TN and 1,690 tons/year of TP (LVEMP, 2005). However, these localized point sources, in the immediate vicinity of coastal urban areas and settlements and the associated biological pollution represented by faecal coliforms and potential pathogens, create unacceptable health risks and intense algal blooms when they are released into confined in the Lake Victoria bays such as Kisumu Bay, Mwanza and Inner Murchison Bay.

Therefore, these point sources have first priority for reduction. Similarly, the loads from the catchment, entering at river mouths, can also have severe local impact in local gulfs, bays and some near-shore areas. For the expansive open lake, however, the atmosphere sources dominate the nutrient loading for both N and P. The high N loading rates are dependent on biological N fixation that is driven by the excess availability of P. To reduce the P loading in Lake Victoria back to natural rates, it will be necessary to reduce atmospheric P deposition and catchment P loading. Because point source loadings are a small fraction of loading at the lake-wide scale, efforts to improve land management will be necessary to reduce the non-point sources and thereby lake-wide loadings.

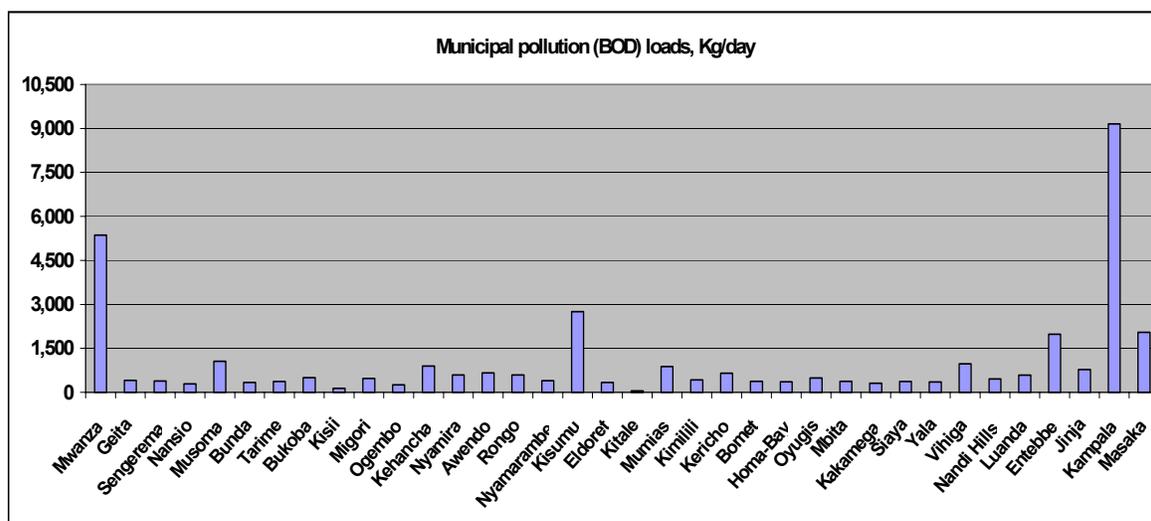
Table 3.3: Estimates of total N, P and suspended sediment loads

Parameter	Catchment (tons/Year)	Atmospheric (tons/Year)	Total Load (tons/Year)	Percentages	
				ATM.	CATCH.
TP	9,247	39,978	49,225	81.2	18.8
TN	38,828	167,650	206,478	81.2	18.8
TSS	6,511,950	-	6,511,950	-	-

Source: Tamahtamah (2005)

The major urban centres of Kampala, Entebbe, Masaka and Jinja in Uganda, Mwanza and Musoma in Tanzania, and Kisumu in Kenya are the key point sources of pollution. In Rwanda, the manufacturing industries are concentrated in Kigali, which are origins of point sources of pollution too. The industries in the Gikondo Valley in Kigali City are a source of chemical pollution into river Nyabarongo that feeds the River Akagera. Most of the industrial facilities in the Lake Victoria catchment have inadequate waste treatment facilities. Therefore, wastewaters are discharged into the general storm water drains which then finds its way, in some cases via wetlands, into the lake (Figure 3.1). The facilities that have wastewater treatment plants exhibit, generally, low treatment efficiencies.

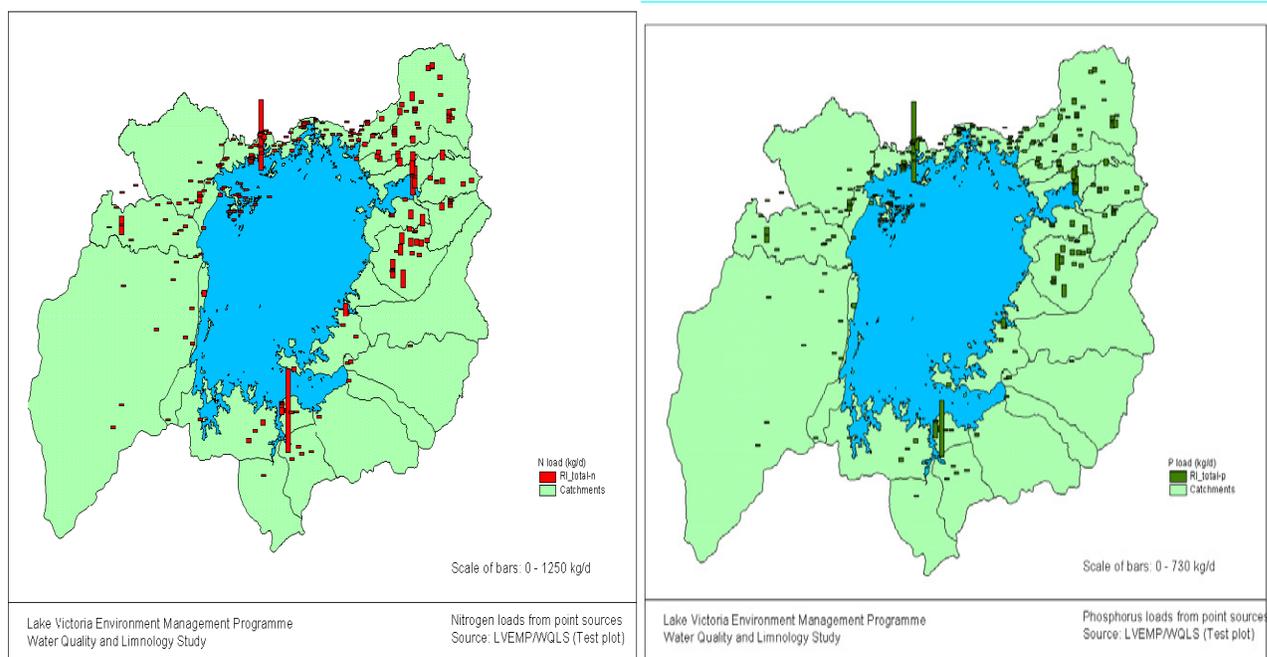
Figure 3.1: Ranking of Urban Point Sources of Pollution for Lake Victoria



Source: LVEMP, 2005

Similarly, the loads from the catchment, entering at river mouths, are also known to have severe local impacts in gulfs, bays and some near-shore areas. Mining is increasing in parts of the catchment, leading to contamination of the waterways arising from residuals of mercury and soils from the spoils. The distribution of point sources of pollution resulting from urban development is shown in Figure 3.2a and 3.2b.

Figure 3.2: (a) Distribution of point sources and TN (kg/day) Figure 3.2: (b) Distribution of point sources TP (kg/day)



Source: COWI, 2002

3.2.3 Trends in Nutrients

In comparison to historical data (Talling, 1961), the level of silica concentrations Lake-wide, excluding the semi-closed inshore areas, has decreased by a factor of 3, although at Bugaia Island silica concentration has decreased by a factor of as much as 8. Phosphorus concentration in the open Lake waters, however, has increased by 4 to 8 fold when compared to historical values (Talling, 1961; LVEMP, 2005). The draw down of silica, an essential element for diatoms, is due to eutrophication effects of high phosphorus loads into Lake Victoria (LVEMP, 2005). Total Phosphorus (TP) concentration has increased 4 folds, from 20 to 47 $\mu\text{g/l}$ (Talling, 1961), to 78 to 140 $\mu\text{g/l}$ (LVEMP, 2005). The nitrogen to phosphorus ratio (TN:TP) in the main Lake indicates that phytoplankton growth in the Lake is nitrogen deficient (Guildford & Hecky, 2000). This has promoted the dominance of nitrogen fixing cyanobacteria in line with high nitrogen fixation in the lake (Mugidde *et al.*, 2003). Low TN:TP ratio is associated with the increased phosphorus loading into the Lake and selective loss of nitrogen through denitrification and enhanced recycling of phosphorus which is associated with increased anoxic conditions in the deep pelagic waters (Hecky, 1993; Hecky *et al.*, 1996; LVEMP, 2002).

3.2.4 Persistent organic/inorganic pollutants

Persistent organic pollutants (POPs) is a major class of problem pollutants that impact on water quality in the Basin. The major POPs in the Basin are Dichloro-dipheyl-trichroethane (DDT), Aldrin, Chlordane, Dieldrin, Dioxins, Endrin, Furans, Heptachlor, Hexachlorobenzene, Mirex, Polychlorinated Biphenyls and Toxaphene (LVEMP 2005). The main POPs used in malaria control in the Basin have been DDT, Dieldrin and Benzene

hexachloride since the 1950s. These insecticides are persistent in the environment with adverse impacts to human health as well as the environment. A recent investigation of the pesticide concentration in water, sediment and fish from Lake Victoria show no detectable levels of DDT, HCH, PCBs, Organophosphates, Pyrethroids and Malathion or their derivatives in all samples analyzed (Fisheries Department, Uganda, 2000). However, there are detectable levels in soils and air in the Basin indicating continued use in the region.

3.3 Water Quantity and Water Balance

The main hydrologic processes in Lake Victoria include river inflows from catchments and outflow through the River Nile at Jinja, while the lake acts as a reservoir. The quantity of water stored in the lake is determined by the difference between the inflows and outflow.

3.3.1 Outflows

The Owen Falls dam was constructed during the period between 1950 and 1954. The outflow from the lake was naturally occurring before the commissioning of the Owen Falls Dam in 1954. This was built to operate on the “Agreed Curve” Policy that determines the amount of water to be released by using the prevailing water levels in order to maintain natural flow in the Nile.

The operationalisation of this water release policy maintained a natural flow pattern up to the year 2000. During the period 2001-2004, disparities began to occur between Lake levels and Nile outflow. Table 3.4 shows that on average, the Nile outflows have increased while Lake levels, as shown in the hydrograph in Fig 3.3, have fallen. This is attributed to increasing outflow at Jinja and other climatic factors, such as periods of lower rainfall and the declining river discharge into the Lake that has occurred over the historic period.

Table 3.4: River Nile outflow statistics (also expressed as % of total Basin outputs)

Drainage Basin	LVEMP Study (1950-2000)		LVEMP (2001-2004)		Long term (1950-2004)	
	Flow in Cumecs	% losses	Flow in Cumecs	% losses	Flow in Cumecs	% losses
Nile Outflow	1,046	24	1,201.9	26.5	1,057.6	24.1

Source: Integrated Water Quality and Limnology Study of Lake Victoria (LVEMP, 2005)

3.3.2 Water levels and Water Balance of Lake Victoria

Water balance is the comparison of input and output quantities of hydrologic processes that operate in a reservoir. For the case of Lake Victoria, water balance is influenced by the outflows at Jinja, evaporation, and inflows from the catchments through the rivers.

The Kagera drainage system accounts for 33 % of the total surface inflows, which is 90 % of the drainage system in Rwanda thereby making Rwanda a very critical component of the Basin. About 76 % of the water leaving the Lake is through evaporation with the remaining 24% leaving through the dam as releases.

The catchment time series of the flow shows a striking revelation about some periodic events. Not only does the time series exhibit nearly all the peak annual events associated with the *El Niño* event years, but also does correspond to periods of low flows associated with below normal rainfall performance. The *El Niño* rains of the 1961-62, 1978-79 and the 1997-98 are well replicated. All the time series have shown declines in catchment discharges in the last five years from 2000.

The lake's water balance, however, is also governed by precipitation and evaporation (Welcomme, 1970; 1971). Monthly average water level at Jinja Gauge Level between 1956 and 1978 ranged from 11.8 m to 12.2 m (Sutcliffe & Gibb, 1993).

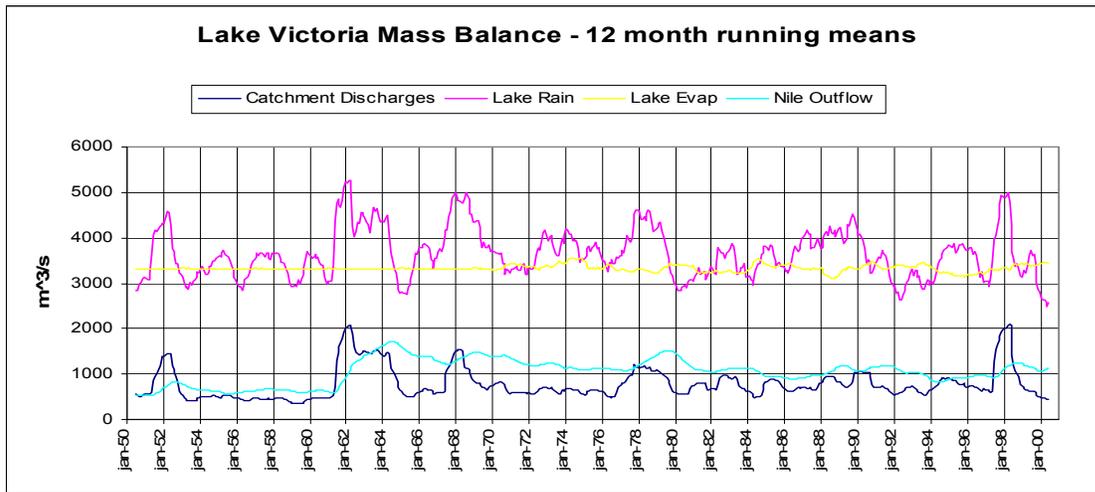
The water levels of Lake Victoria, over the last 104 years, have exhibited striking regime changes. From 1900 to 1961, the Lake was at a different hydrologic regime from the 1961-2002 regimes. The post 2002 regime has tendencies towards the pre-1961 regime. High and low levels recur in an approximately cyclic manner both in the post-1961 level and earlier in the century. However, the most recent drop in level is a record for the post-1961 period. Rainfall and Nile outflows varied significantly to warrant their use in explaining the drop in the Lake level (See Table 3.5, Figures 3.3 and 3.4). The Government of Uganda has, however, in the recent past, taken steps to manage releases from the two dams at Jinja by reducing outflow whilst at the same time sustaining hydropower generation with the aim of returning to the Agreed Curve water release operation policy.

Table 3.5: Summary of water balance of Lake Victoria

Process	1950-2000		2001-2004		1950-2004	
	Flow m ³ /s	%	Flow m ³ /s	%	Flow m ³ /s	%
Inflow						
Rainfall	3611.5	81.8	3644.0	84.2	3613.8	81.9
Basin discharge	805.3	18.2	686.2	15.8	796.6	18.1
Outflow						
Evaporation from lake	3329.8	76.1	3337.5	73.5	3330.3	75.9
Victoria Nile	1046.2	23.9	1,201.9	26.5	1057.6	24.1
Sum	40.8		-209.2		22.5	

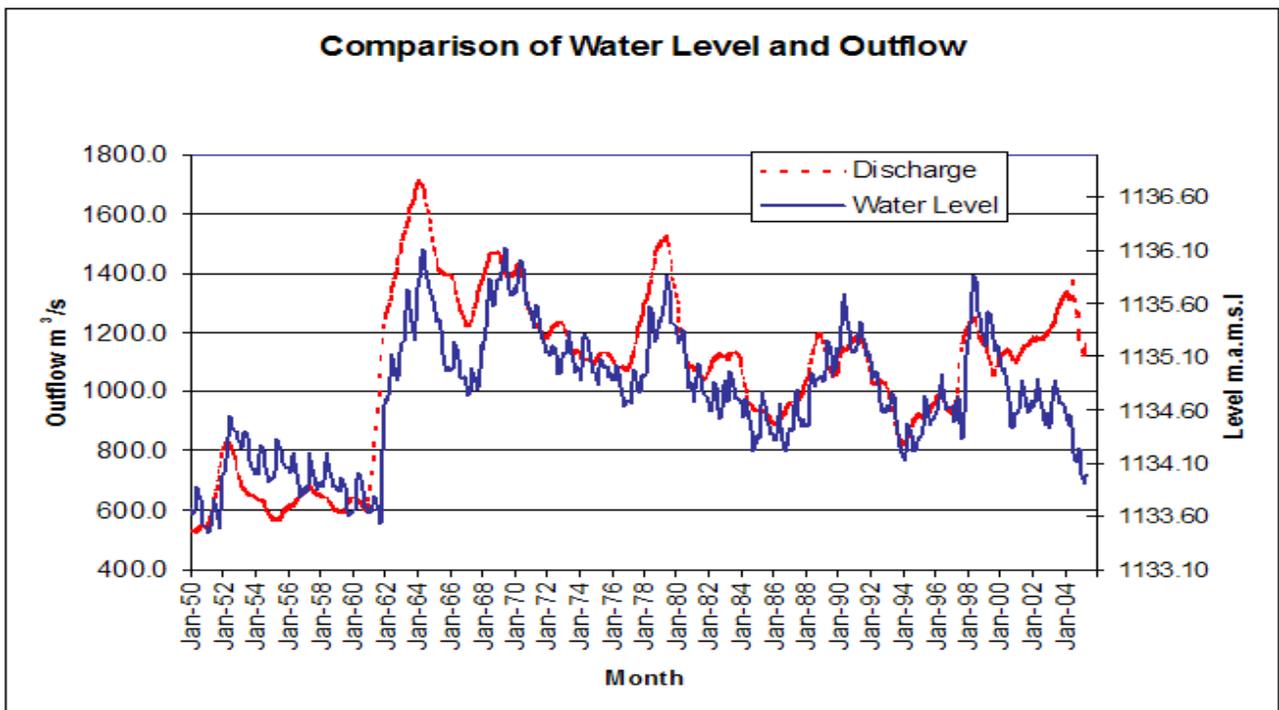
Source: Integrated Water Quality and Limnology Study of Lake Victoria LVEMP, 2005

Figure 3.3: Long term series generated by the water balance model.



Source: LVEMP Water Quality Synthesis Report, 2005

Figure 3.4: Comparison of water level and outflow of Lake Victoria (from 1950-2005)



Source: LVEMP Water Quality Synthesis Report, 2005

3.4 Water Hyacinth and other Invasive Aquatic Weeds

The water hyacinth is a free floating and migratory plant introduced into Lake Victoria from the Kagera River (Twongo *et al.*, 1995). The weed proliferates in quite and suitable environment and doubles its mass in 11-18 days. It is sustained in Lake Victoria through high nutrient input from the catchment and point sources of pollution. The weed rapidly increased in Lake Victoria, achieving its peak in 1998. In the Ugandan waters of Lake Victoria, stationary fringes were estimated to cover 2,200 hectares along 80 % of the shoreline by 1995 (NARO, 2001). By 1998 the weed occupied nearly 90 % of shoreline but combined physical, manual and biological control using weevils (*Neochetina eichorniae* and *Neochetina bruchi*) methods reduced the infestation significantly by 2000 (Njoka, 2004) (See Annex 25 for water hyacinth harvester).

Lakes Bulera and Ruhondo in Ruhengeri in Rwanda were reported as the highest location of water hyacinth in the Kagera River system (Twongo & Rolf, 1999). The seasonal flushing of water hyacinth from the River Kagera floodplains influences the discharge patterns and magnitude of the waterweed into Lake Victoria.

A major transboundary environmental problem is the continuous deposition of vast quantities of water hyacinth biomass and debris into the lake. The downstream riparian communities in Kenya, Tanzania and Uganda suffer serious environmental and socioeconomic impacts generated by the proliferation of water hyacinth upstream in the Kagera River system. The major impacts of the water hyacinth include blockage of water intake points, disruption of hydropower generation, disruption of water transport, blocking of fish landings, damaging of lakeside infrastructure and ruining of beaches and recreation sites. The weed also influences de-oxygenation with the resultant impact being fish kills.

3.5 Biodiversity and Fisheries Decline

3.5.1 Aquatic Biodiversity

It has been recognized that environmental degradation, particularly in aquatic ecosystems, is causing changes and loss of biodiversity in selected freshwater and wetland ecosystems.

The impacts of human activities and accelerated eutrophication of rivers, lakes and wetlands in the Lake Victoria Basin has:

- (i) Resulted in loss of habitat, changes in biodiversity and loss of recreational potential;
- (ii) Contributed to the decline in species of fish, invertebrates and algae in Lake Victoria;
- (iii) Increased carbon production in Lake Victoria due to phosphorus and nitrogen deposition;
- (iv) Led to elevated risks to human health through increased frequency and spatial extent of toxic algal blooms in lakes;
- (v) Contributed to quality of life concerns in the Basin through water use impairments, for example, excessive algal and aquatic weed growth; blockages of screens and filters, and aesthetic (taste and odour) concerns related to water supplies;
- (vi) Increased the economic burden to communities as a result of the need for treatment, monitoring and remediation of contaminated water.

3.5.2 Fisheries diversity

Fish biodiversity in Lake Victoria has declined over the last three decades. The Lake used to support over 400 cichlid species of which were dominated by the endemic haplochromines (Witte *et al.*, 1992a). At least 51 non-cichlid species such as endemic species of catfishes, mormyrids, carps, (Greewood, 1965; Ogari, 1985; Ogari & Dadzie, 1988) flourished in the 1950s.

Several factors including introduction of the piscivorous Nile perch in the late 1950s and ensuing food-web changes and as well as eutrophication impacts have contributed to loss of fish diversity in Basin. In Lake Victoria, after the introduction of *Lates niloticus*, several herbivorous haplochromines and tilapiine fish species disappeared, while populations of some fish species (*Rastrineobola argentea* and *Oreochromis niloticus*), that prey on zooplankton, increased in Lake Victoria (Ndawula, 1994).

3.5.3 Phytoplankton

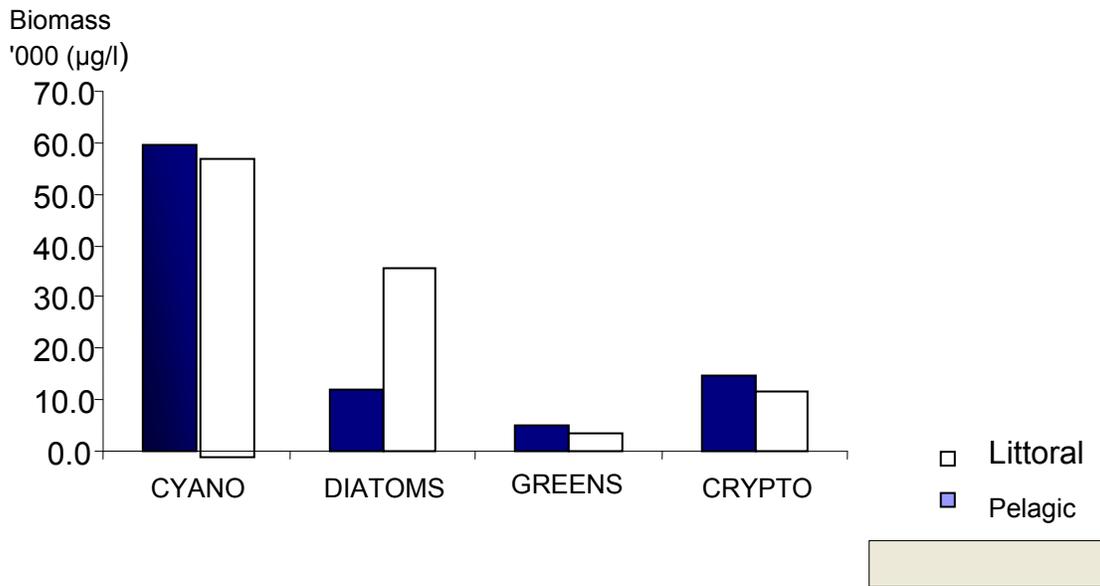
Since the mid-1980s, algal blooms have become more frequent and are responsible for de-oxygenation of bottom water upon decomposition, a situation that commonly leads to, first, increased sickness for humans and animals drawing water from the lake: second, clogging of water intake filters, and, third, increased chemical treatment costs for urban water supplies. Apart from the near-total loss of deepwater fish species, the de-oxygenation of the lake bottom posed threat even to fish in shallower portions of the lake, as periodic up welling of hypoxic water cause massive fish kills.

In Lake Victoria, increased inflow of nutrients, particularly nitrogen and phosphorus, has stimulated algal growth and lead to a shift in algal community composition. By the early 1990's, the lake's algal growth was nutrient saturated as high phosphorus concentrations enable nitrogen fixing cyanobacteria to dominate and algal growth became light limited due to self-shading effects of the increased algal abundances (Mugidde, 1993; Mugidde *et al.*, 2003). Phytoplankton primary productivity was on average twice higher than the values recorded in the 1960s (Mugidde, 1993) and supports high fish production in the Lake Victoria.

The very fertile Lake conditions also support elevated algal wet biomass in the range 5 mg L⁻¹ to 250 mg L⁻¹, which has risen by a factor of 4 to 5 since the 1960s (Kling *et al.*, 2001). The high P concentrations and nitrogen demand favours the dominance of cyanobacteria (>50 %) (Figures 3.5 and 3.6), where the dominate species are *Cylindrospermopsis*, *Anabaena* and *Microcystis* (Tables 3.6 and 3.7)., which is unlike in the 1960s where diatoms were of primary importance (Lung'ayia *et al.*, 2000; Kling *et al.*, 2001; Mugidde, 2001).

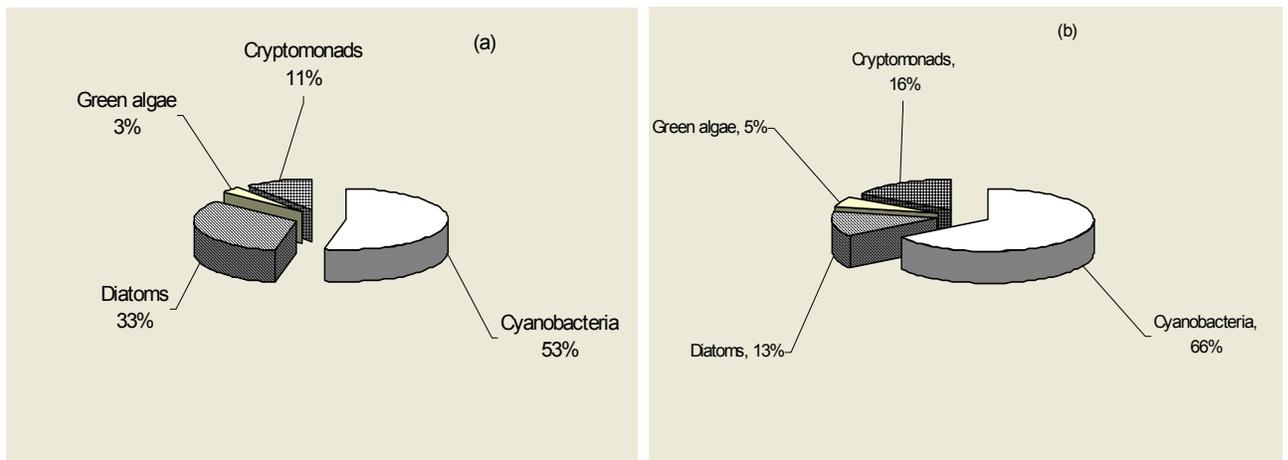
There has been a shift in diatom dominance from *Aulacoseira (Melosira)* in the 1960s to *Nitzschia* in the 1990-2000s. Green algae occur in very low abundance and several taxa, in particular desmids that were present in 1950s-1960s have declined or disappeared. The large chlorophytes such as *Pediastrum* species are now rare.

Figure 3.5: Biomass of 4 main phytoplankton groups in littoral and pelagic waters of Lake Victoria



Source: LVEMP, 2005

Figure 3.6: Relative biomass of major phytoplankton groups in (a) Open pelagic waters and (b) in littoral areas in Lake Victoria



Source: LVEMP, 2005

The presence of the potentially toxic algal species such *Microcystis* and *Cylindrospermopsis* threaten the ecosystem health of Lake Victoria. Data and information available confirm phycotoxin production in the shallow inshore Bays in the Ugandan and Tanzanian portions of Lake Victoria (Tables 3.6 and 3.7). Phytotoxic production varies with location and time and concentrations can exceed the WHO standards for

acceptable level in drinking water is 1 µg L⁻¹). There is need to continue assessing phycotoxin production in order to determine whether the Lake Victoria Basin Ecosystems are healthy”.

Table 3.6: Levels of cyanotoxins in selected Bays of Lake Victoria in March 2005

Locality	Concentrations of phycotins in (µg/mg) dry weight
Murchison Bay, Kampala, Uganda	0.03
Napoleon Gulf, Jinja, Uganda	0.20
Mwanza Gulf, Tanzania	0.99

Source: Data from the IFMP project reports, 2005

Table 3.7: Levels of microcystin from Gaba water works (Uganda)

Date	G1 intake	G2 intake	G3	G4	G5	G6	Shoreline
Units (µg/l)							
July 31	<0.5	< 0.5	Nd	<0.5	< 0.5	Nd	
Aug – 07	0.5	0.5	Nd	< 0.5		< 0.5	
Aug – 14	< 0.5	< 0.5	Nd	< 0.5	< 0.5	Nd	0.5 – 3.0
Aug. – 21	Nd	Nd	Nd	Nd	Nd	Nd	
Octo- 02	Nd	0.5	0.5	0.5-3.0	0.5-3.0	Nd	
Octo- 16	< 0.5	0.5	0.5-3.0	0.5-3.0	0.5- 3.0	Nd	
Nov-05	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Nov -20	0.5-3.0	0.5-3.0	0.5- 3.0	0.5-3.0	0.5-3.0	0.5	> 3.0

Source: Data from the LVEMP reports 2005 (* WHO standards for acceptable level in drinking water is 1 µg L⁻¹)

3.5.4 Zooplankton

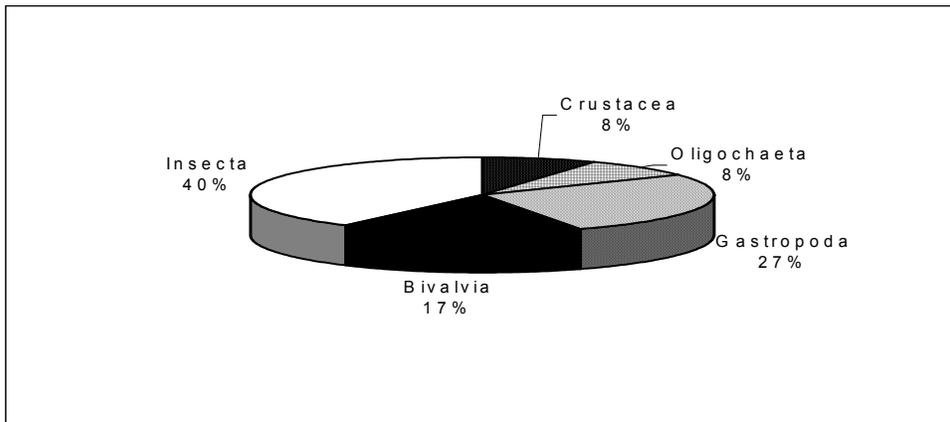
The zooplankton community in the Basin is dominated by crustaceans and consists of mainly copepods and cladocerans. Non-crustacean zooplanktons include rotifers and insect larvae largely chaoborids which are semi-planktonic. Water mites (*Hydracarina*) are rare in the pelagic zones. Zooplanktons form the sole food source for the pelagic cyprinid, *Rastrineobola argentea*, and pelagic haplochromines (Mwebaza-Ndawula, 1994,1998). A change in zooplankton community from dominance of larger types (calanoid copepods; cladocerans) to smaller types (cyclopoid copepods) is a concern. There have been shifts in zooplankton dominance from Calanoids to cyclopoid in the deep offshore waters of Lake Victoria. Further, there has been proliferation of freshwater shrimp, *Caridina niloticam*, as a result of increased algal biomass creating a conducive environment for their growth. These changes in zooplankton communities have resulted in a simplified food web which may have negative consequences for sustainable fish production in Lake Victoria.

In Lake Victoria, zooplankton is an important food source for fish larvae. It is, therefore, believed that the survival of fish larvae and eventual recruitment of various fish species into the fishery largely depends on zooplankton availability. The juveniles of Nile perch feed largely on the semi-planktonic freshwater prawn, *Caridina nilotica* (Ogutu-Ohwayo, 1990; Ogari & Dadzie, 1988; Acere, 1984; 1988; 1993). The piscivorous adult Nile Perch is directly dependent on zooplankton through feeding on zooplanktivorous *Rastrineobola argentea* Pellegrin (*Mukene, Omena or Daga*).

3.5.5 Zoobenthos

The benthic macro-invertebrate fauna of Lake Victoria is composed mainly of mollusks (ca. 44%), insect larvae and nymphs (ca. 41%) as well as oligochaetes, leeches, crustaceans, nematodes and ostracods (Figures 3.7 and 3.8), in various proportions. One way to determine the status of the health of the Lakes ecosystem is to use zoobenthos indicators which address a spectrum of conditions, ranging from the health and habitat diversity component of the system including ecosystem quality or trends in quality.

Figure 3.7: Taxonomic composition of major benthic macroinvertebrates in Lake Victoria



Source: Adapted from P. Kasoma (Ed.), 2005)

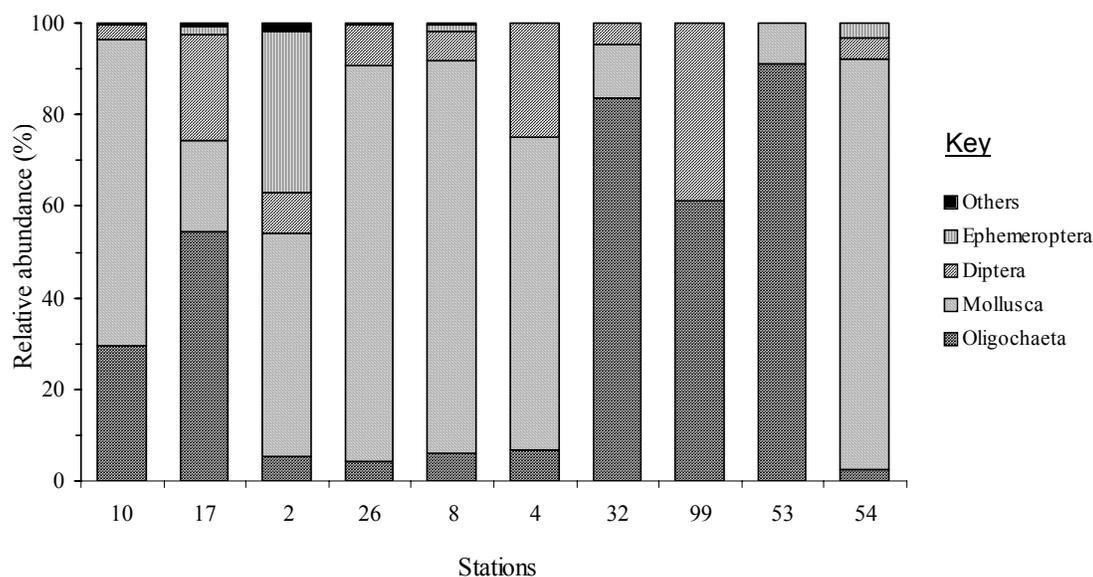


Figure 3.8: Relative abundance (% mean density individuals m⁻²) of the major macroinvertebrate groups in the various stations in Kenya waters of Lake Victoria (March-1993-March 1994. Source: Adapted from P. Kasoma (Ed), 2005]; Kenya TDA, 2006

3.5.6 Fish stocks of Lake Victoria

The Lake Victoria Basin is a source of fish and fish-products to the local and international markets. The Basin has undergone rapid and profound changes in its fish stocks and fish diversity linked to human activities, reduction in fish habitat and changes in the food webs, which lower the potential fish production.

So far, the dynamics in fish stocks in Lake Victoria appear to be environmentally driven. However, catch per unit effort of the accessible stocks has declined and in particular that of the endemic herbivorous tilapiine cichlids, *Oreochromis esculentus* and *Oreochromis variabilis*. The catch per standard net in 1905 was 100 fish, which dropped to 30 fish in 1921, to 7.8 fish in 1928 and to less than one fish in the 2000s. The catch per unit of effort (tonnes per boat) was good in 1967 going up to 70 metric tonnes, but dropped to 10-15 metric tonnes per boat in the 1980s. In 2000s, the catch per boat dwindled to around 3 metric tonnes as the Lake Victoria fishery attracted over 35 fish processing plants to the region (12 in Kenya, 11 in Uganda and 12 in Tanzania). Reduction in catch per unit effort has translated to classical transboundary problems for Lake Victoria.

3.5.7 Fisheries of the upper riparian catchment

Similarly, environmental degradation and overexploitation of fisheries in the Basin has adversely affected the sub-sector in Rwanda and Burundi. In Lake Rweru, the fishery industry collapsed largely due to over fishing and use of destructive fishing gears such as beach seines and gillnets of inappropriate mesh-size. Heavy predation by the alien catfish, *Clarias gariepinus*, also has contributed to decline in fish stocks. In 2003, the Rwandan Government authorized fishers to hold cross-border discussions on the problems of the collapsing fishery but no progress has been made to control destructive fishing practices.

Given the role of the sub-sector, not only as a source of income but also as a source of food security and biodiversity integrity, there is the need for the Governments in the region to take specific measures to restore the fisheries status within the upper catchment parts of the Basin. Continued decline of the fisheries resource at the upper parts of the Basin has direct linkage with the status of fisheries within the Lake Victoria. Some of the interventions for consideration include; (i) undertaking basic, strategic and applied fisheries research aimed at providing data and information for improving the management of the sub-sector (ii) Basin-wide mapping of fisheries resources in respect to ecological and utilization parameters and trends that affect the resource, and (iii) intensify fish farming within the Basin for local consumption and export market.

3.6 Forest ecosystem changes

Forest ecosystem in the Basin is highly influenced by spatial and temporal variation and forest patterns and their distribution are highly dependent on lithology, geology, topography, corresponding soil moisture, season of the year, management approaches, and human activities.

The degradation of forest ecosystem in the Basin continues to be a major challenge and one that has regional consequences. Within the lower and upper parts of the Basin, forest ecosystems have declined both in extent and biodiversity richness. Some of the root causes of these trends include population pressure, policy and institutional failures as well as market failure. The Basin's population largely relies on environmental resources as a source of livelihood. Declining investments in technological innovations on resources harnessing and poor adoption rates do compound the effect and impact on the increasing population on the environment. Institutional issues including policy, legal and organizations aspects of forest ecosystem management continue to exacerbate the situation. The current institutional framework across the Basin is not adequate enough to respond to the emerging challenges. Policy and legal framework formulation is not responsive enough to local community needs. To a large extent, enforcement is weak. In addition, forest ecosystems are lowly valued, with most of the values not fully captured by the National Systems of Accounting.

The degradation of forest ecosystem is evidently location specific, but with immense regional consequences. The declining river baseflows and biodiversity as well as increased flash floods and soil erosion are clearly due to forest ecosystem destruction. These trends are contributing to silting in the lake, raising eutrophication levels, as well as declining water levels in the lake.. The destruction of forest ecosystems also has effects on the functional and structural values of wetlands in the Basin.

3.7 Wetlands

Pollution hotspots consist of major urban centers and industries, most of which discharge their effluents into sheltered bays and wetlands. This affects wetland quality and hence their beneficial use by the riparian communities. Some wetlands have lost their stripping capacity and this contributes to the nutrient loading of the entire lake.

A number of socioeconomic activities, including crop, flower and horticultural farming; livestock keeping, fishing, craft making; grass, fuelwood, timber and medicinal plants collection, sand mining, clay and stone extraction, hunting and tourism are undertaken in wetlands of the Basin. However, wetland degradation threatens their continued beneficial use. As a result, a number of wetlands have been protected through global efforts declaring them protected Ramsar sites such as Lake Nabugabo Wetland, Mabamba, Sango Bay, Lake Mburo and Lutembe Bay in Uganda.

Undoubtedly, wetland destruction (extent and functionalities) is location specific but with regional consequences. The major primary sources of degradation are similar to those affecting forest ecosystems, including agricultural expansion (search for food security and sufficiency), least cost waste disposal practice, over-extraction of wetland products to meet household needs (subsistence and/or cash), and infrastructure development. The continued wetland encroachment and discharge of waste beyond the assimilative capacity of these buffer zones will impair their functionalities resulting into leakage of the waste or excessive nutrients into the lake.

There is need for development of clear standards and consistent enforcement policy for municipal and industrial point sources around the Basin in order to protect wetlands from over saturation with nutrients/pollutants. This can be done through upgrade of existing treatment facilities and add tertiary removal of phosphorus while expanding the sewerage system to cover most of the urban populations. Further, public education and sensitization should be emphasized in order to reduce wetland degradation and public awareness of accompanying risks. Promotion of Cleaner Production in the industrial sector should be intensified to reduce wastes into the wetlands and water bodies.

3.8 Socio-economic and cross-cutting issues

3.8.1 Poverty

Poverty, which is linked to cash-income generating sources, is widespread in the Basin particularly among the rural communities. The causes of poverty in the Basin are numerous and they range from lack of education and skills, diseases, conflicts and lack of infrastructure amongst others. National statistics indicate that poverty (i.e. living on below US \$1 a day) stands at 62 % of population in Burundi and at 50 %, 60 %, 31.5 % and 35.7 % in Kenya, Rwanda, Uganda and Tanzania, respectively (Table 2.4).

There is inadequate infrastructure in the Basin to cope with the increasing population. Roads have continued to deteriorate making it difficult for communities to access social services such as health facilities and markets. The high population density in the Basin is one of the indicators of scarcity of land as a resource and thus directly influencing food security. Trends also indicates that rapid urbanization and high population growth is accompanied by low performance of economic growth and environmental degradation

Increasing poverty levels and incidences across the region has implications on the utilization patterns of environmental resources, land management practices and social status and stability. Unchecked poverty incidences, therefore, has the potential of impacting negatively on various ecosystems including the Lake Victoria.

3.8.2 Health

The major human diseases commonly afflicting people in the Basin are; malaria, HIV/AIDS and related illnesses, tuberculosis, upper respiratory infections, meningitis, pneumonia, anaemia, vector-borne diseases (malaria, schistosomiasis, trypanosomiasis) and water-borne diseases (typhoid, cholera, amoebiasis). . The important disease vectors in the Basin include the mosquito, water snails and the tsetse fly.

The Basin population is particularly vulnerable to diseases due to a number of factors, including:

- i) Warm and humid climate: vector and water-borne diseases are very sensitive to warming and are readily affected by climate change. The warm humid climate of much of the Lake Basin is particularly favourable to the spread of diseases.
- ii) High population density and growth: There is a close link between unmanaged population growth, poverty and health. The Basin has very high population density with very fast growth rate, which puts increasing pressure on health facilities and services as well as on food resources and livelihood amenities.
- iii) Water pollution and poor water quality: Scarcity of clean and potable water compromises health and basic survival. The lake, most rivers and water bodies in the Basin receive organic and inorganic pollutants, for example, fertilizers from farms in upper catchments, raw faecal material, oil spillages, runoff and storm water inflows with suspended and dissolved solids, including heavy metals.
- iv) Water hyacinth and algal blooms: Water hyacinth degrades water quality, limits access to water for domestic use and prevents fishing activities, thereby affects livelihoods. The weed is known to harbour snakes and is suitable habitat for disease vectors, for example, for malaria and schistosomiasis.

- v) Inadequate health facilities and services. Many parts of the Basin, particularly in rural areas, lack vital health facilities and services.
- vi) Ineffective disease control strategies, leading to resistance of disease parasites against some of the antibiotics.
- vii) HIV/AIDS prevalence is high in the region due to a number of factors including lifestyle, poverty, lack of access to ARV treatment, migration and political strife etc.

Issues related to human health include: high public and private expenditure on disease prevention and control, poverty, high income inequality, high dependency ratio, increased pressure on food and environmental resources, short-term resource exploitation strategies, etc.

Ecosystems management, including land use and land management, is directly related to the health status of the population. Inflicted population tends to invest less on proper land management (including the growing of the most appropriate crops) and efficient use of resources. Such trends consequently impact adversely on the Basin's state.

3.8.3 *Pests and diseases*

The Lake Victoria Basin has high prevalence of crop and livestock pests and diseases. These are favoured by a number of factors, including; warm and humid tropical weather, heavy rainfall, non-synchronized cropping seasons that ensure availability of alternative crop hosts most of the year and ineffective control strategy. The concentration of livestock within relatively smaller area, free movement of livestock and their interaction with wildlife in game parks and reserves, for instance in Masaai Mara and Ruma in Kenya, Serengeti in Tanzania, Lake Mbulo in Uganda, and in the districts of Gabiro and Rukara in the upper catchment favour the spread of livestock diseases and pests.

The most common animal diseases within the Basin are trypanosomiasis, East Coast Fever (ECF), anaplasmosis, babesiosis, heartwater, Newcastle disease, foot and mouth disease (FMD), Rift Valley fever and rabies. For example, at Lamadi village in the Tanzanian part of the Basin, ECF had a frequency of 82.5 % and very high mortality rate while FMD had a prevalence of 78 % although with low mortality rate. Trypanosomiasis prevalence was observed to be between (55 %) and (73.5 %). In Kenya, an outbreak of Rift Valley Fever caused death of an estimated 200 people and several livestock and crippled the beef industry in the first quarter of 2007. Other livestock diseases common in the Basin include Black quarter, which is known to be endemic in the Basin and occurs periodically, particularly during the dry season, and the Contagious Bovine Pleuro-pneumonia (CBPP).

There are a number of crop diseases in the Lake Victoria catchment. The high temperatures, humidity and rainfall provide ideal conditions for crop diseases and pests. Furthermore, the uncontrolled movements of farm products, seeds and other planting materials across the region mean that diseases can be easily transferred. There is a legal framework detailing the procedures for importing and exporting plants and plant materials so as to limit cross-border spread of pests and diseases. However, informal, illegal and uncontrolled trade takes place at several points along the border, making it difficult to restrict imports of plant materials between the riparian states. The diseases are mostly fungal, although there are also viral and bacterial diseases. Some of the most important crop diseases in the Basin are; cassava mosaic virus, wheat rust, coffee berry disease, maize leaf rust, streak rust, bean mosaic virus, bean rust, sugarcane mosaic virus etc.

Crop pests are mainly insects, birds and rodents. Outbreaks of insect pests such as the army worm and desert locust have caused serious crop losses over the years across the region. Insects such as the maize stem borer, cotton bollworm, millet stink bug, weevils, cassava mite, potato aphid, tobacco whitefly are some of the common pests in the region, causing significant crop losses on a continuous basis. Rodents such as squirrels, rats, mice and moles, cause a lot of damage to root crops.

The issues in relation to crops and pests in the Basin are: heavy crop losses leading to reduced crop quality and shelf life, reduced incomes, increased cost of farming. Heavy application of pesticides, particularly organochlorides have long-term residual effects on the environment and human health.

3.8.4 Water supply and Sanitation

The main freshwater reservoirs in the Basin are surface water systems and groundwater aquifers. Lake Victoria, the affluent rivers, streams, floodplains and wetland habitats form the main surface water ecosystems. Groundwater aquifer systems are little understood but they constitute a very important water reservoir.

Rainfall is the primary source of freshwater reserves in the Basin lakes, rivers, streams, wetlands and groundwater aquifers. Most parts of the Basin receive high precipitation, particularly in the mountain ranges and in some islands in the lake. Rainfall patterns determine land use and population distribution in the Basin. Due to dependence on rain fed agriculture, areas with heavy and reliable rainfall face extremely high population pressure on land. Unsustainable land use related to high population density and poor land use practices often lead to environmental degradation involving extensive degradation of catchments. Destruction of catchment forests in turn contributes to climate change, disruption of rainfall patterns, extreme droughts and floods.

3.8.5 Urbanization and the associated infrastructure

Over the last two decades, the Basin has experienced increased urbanization. Major towns and cities acting as hubs of urbanization include Jinja, Entebbe, Kisumu, Homa Bay, Musoma, Bukoba and Mwanza. Rural-urban migration is primarily triggered by the perception that there are better job opportunities within urban areas and declining livelihood opportunities within the rural areas. Further, the working class, comprising mainly of the youth believe that urban-based income generating opportunities have better returns as compared to rural-based.

Despite the expansion of urban centres, towns and cities, there is no corresponding investment in the necessary infrastructure to support the increasing population. Waste management and sewerage disposal facilities remain inadequate. This has resulted in accumulation of solid and liquid waste to which the lake has become the sink. Sewerage treatment and disposal facilities are inadequate for most of these centres and incidences of direct domestic sewage disposal into the lake are becoming common. This situation is exacerbated by the usually unplanned expansion of urban centres. The overall impact of these trends includes increasing levels of eutrophication in the lake.

3.8.6 *Refugees*

The Basin, particularly in 1990s, experienced an influx of refugees displaced as a result of political, civil strife and environmental reasons. The political and social unrest in some parts of the Basin have triggered movement of populations to settle and depend on fragile ecosystems. Immediate impacts of such population include overexploitation of environmental resources, outbreaks of waterborne diseases and increased incidences of HIV/AIDS and breakdown of traditional conservation methods. To a lesser extent, environmental challenges have triggered migrations of sections of society. Such scenarios have been occasioned by flooding particularly on the lower parts of the Basin and, forced evictions from settlements within gazetted areas.

The consequences of such population displacements include land degradation, water pollution, wetlands encroachment and deforestation among others. Although these impacts are location specific, the associated downstream effects gradually take a regional dimension.

3.8.7 *Conflict over resource access and use*

Fisheries and access to pasture remain the most important sources of conflicts in the Basin. Fishing areas, particularly across the administrative boundaries of Kenya, Uganda and Tanzania, have stirred conflicts among the fisherfolks. Such conflicts resulted in confiscation of fishing gear, harvests, detention and to some extent loss of life. Access to pasture has occasionally triggered cross-border tensions, increased livestock diseases and loss of life.

3.8.8 *Vulnerability*

The geo-political location of the Basin, the environmental resources endowment and global markets development continue to expose the region to a wide range of challenges. As part of the Great Lakes Region in the Sub-Saharan Africa, the Lake Victoria Basin remains exposed to consequences of political developments within and outside its political boundaries. If unmanaged well, such political and social developments make the Basin quite vulnerable.

The Basin is characterized with fragile ecosystems including wetlands, forests, and savanna grasslands among others. The Basin is also vulnerable to climate variability and change.

Globalization and global markets development appears to be a major challenge for the countries in the Basin. The Basin is not, currently, adequately prepared to meet the emerging demands of globalization and the global markets environment. To effectively participate in this fast evolving environment, there is the need to have in place adequate infrastructure (roads, telecommunication), efficient production technologies, conformity with international environmental standards, and clear identification of Basin's competitive advantages in respect to agriculture and fisheries development.

3.9 **Policy, Legal and Institutional Frameworks**

The extent and success of implementation of the various policies and laws outlined in part 2.4 is different in all the five countries. However, the common factor as deduced from the National Transboundary Diagnostic reports is that, there are still problems that are negatively affecting the implementation of these policies and laws.

3.9.1 *Policy, Formulation and Implementation*

The process of formulation of policies in all the five countries is similar namely that: Policies are drafted by the technical teams of the respective sectors. The draft policy is presented to Cabinet by the respective Minister for discussion and approval. The Cabinet, upon approval of the Policy, instructs the office of Attorney General to draft a law for implementation of the policy. The draft law is presented to Cabinet for approval, which is then taken to Parliament for debate. Once debated and passed by Parliament, it is taken to the President for assent by signing and then it becomes an Act of Parliament to be enforced.

To date, as demonstrated by the legal reforms undertaken from the 1990's, this cycle has not been a significant issue. Most countries are implementing the policies and laws but in many cases not to the extent and levels expected. The major cause of this low performance has been associated with inadequate human and financial resources, laxity on the part of government/ weak institutions and logistical constraints. Additional causes include: absence of enabling regulations, limited and disparity management data, sectoral conflicts and/or lack of harmonization as well as inadequate political response in cases when it is urgently needed.

3.9.2 *Compliance and enforcement*

The compliance and enforcement levels of the various laws of relevance to Lake Victoria Basin vary from country to country. In all cases where compliance and enforcement is poor, the causes are more or less the same in all the five countries namely: shortage of manpower, financial constraints, logistical constraints, lack of awareness by the general population and inadequacy in the dissemination of relevant information, inadequate capacity and laxity on the part of the enforcement agencies and high poverty levels. These weaknesses could be addressed through awareness campaigns, improvement in information exchange, greater involvement of the community in management and capacity building through training and logistical support.

Additional problems of implementing regulations relate to non-deterrent penalties that do not discourage the offender, and would be offenders, from committing a similar offence and varied levels of penalties applied in the different countries. Given the transboundary nature of the Basin, it is important to reflect the gravity of each offence in respective penalties in a uniform manner. The penalty for an offence should carry the same gravity no matter where it is committed. This would deter offenders from committing particular offences on the basis of the weakness in the penalty in one country as opposed to the others.

On the regional perspective, implementation of the Protocol for Sustainable Development of the Lake Victoria Basin is dependant of the national laws. In cases where there is disparity in the laws, compliance to the law to have a desired impact may not be achieved. Hence there is a need to review and harmonize the relevant country laws for ease of their implementation by the Basin countries. Further, most of the International Conventions have not been fully implemented in the countries due to delay or failure to domesticate the conventions into national laws.

3.9.3 Institutional Frameworks

The implementation of the policies and laws enumerated above is vested on various respective sectoral government ministries and agencies. The extent of decentralization of implementation to the regions and districts is, however, various among the five countries. The Environmental Acts in countries are cross cutting rather than sectoral and hence the implementation has been vested (or shared) with specialized Agencies. The National Environment Management Authority of Uganda and Kenya; the Rwanda Environment Management Authority; the Department of Environment in the Vice President Office and National Environmental Management Council of Tanzania and, the Department of Land and Environmental Management in Burundi are responsible for the implementation and enforcement of the environmental legislations.

At regional level, the Lake Victoria Basin Commission established in 2005 as an apex institution of the East African Community, is charged with the responsibility of coordinating programmes and other interventions undertaken by various stakeholders operating in the Basin. The Commission functions in the countries through the designated National Focal Point Ministries and the Ministries responsible for East African Community Affairs.

3.10 Environmental and socioeconomic costs

3.10.1 Land degradation

Environmental, economic, cultural and aesthetic costs of land degradation are immense and widespread. Their effect cuts across all sectors and impacts on every aspect of human livelihood. Living examples are the effects of deforestation on micro-climate, drought, floods, soil erosion and loss of soil fertility. Floods can cause huge destruction of infrastructure and famine, just like drought. These impacts and effects have not been quantified in many cases; hence, it is not easy to attach monetary values in these cases. However, by assessing certain cases and examples, it is possible to get some insight into some of the effects of land degradation in the Basin.

Deforestation, coupled with overgrazing, has had serious negative consequences on land productivity arising from serious soil erosion and farmland degradation. All cultivated areas in the Basin Districts, especially in Kwimba, Magu, Misungwi, Musoma and part of Sengerema Districts of Tanzania, which lack vegetation cover, have been exposed to different levels of soil erosion risks. As a result the suspended sediment load to the Lake is estimated to be about 4,905.2 k tons per year, with Simiyu River carrying the largest suspended sediment load estimated at about 42.3 % of the total load to the Lake (Mwanuzi, 2005).

In 1991, environmental degradation was estimated to cost the country up to 12 % of Uganda's Gross National Product (GNP) per year. At the time the cost was equivalent to US\$ 170-460 million, which is currently estimated to be in the tune of US\$ 230-600 million. Approximately 80 % of this is from soil erosion, nutrient loss and *inter alia* declining crop yield and increasing water rehabilitation costs (Olson *et al.*, 2001).

Land degradation has serious consequences on the ecosystem(s). Further, it has been demonstrated in Uganda that proper soil and water management e.g. mulching alone, increased banana bunch weight from an average of 10 to 32 Kgs which was associated with an increase in net income from US\$ 130 to US\$ 810 per

ha in Mayuge District (Isabirye, 2005). Furthermore, the Soil Erosion Hazard Map showed that the economic value of the total soil lost due to erosion alone in the Ugandan catchment of the Basin was estimated at US\$10 million per year. The figure would be much higher if the soil lost is translated into equivalent loss in output.

3.10.2 *Water Pollution*

The main benefits are derived from avoiding losses that can be anticipated if no effective remedial actions are taken to prevent or minimize pollution of Lake Victoria. The major consequences of not halting the present trend of pollution are; Water quality deterioration resulting in loss of biodiversity, fishery and source of livelihood; Unsuitable water quality for domestic, animal watering, industrial and agricultural use, and; Increase in water hyacinth infestation.

Pollution has many consequences that if avoided can be counted as potential benefits of the suggested mitigations (actions). The direct effects of pollution of the Lake include; increased water treatment costs due to eutrophication (algal bloom); unsuitable water for livestock and human consumption (algal toxins); loss of potential tourism revenue due to loss of aesthetics, and; health effects on the community and other water users because of prevalence of water borne diseases (e.g. cholera, dysentery, diarrhoea and typhoid fever).

The cost for wastewater treatment plants vary according to treatment options and level of treatment desired with capital cost ranging from US\$20 to US\$500 per capita plus operation and maintenance ranging from US\$ 5 to US\$150 per capita per year (World Bank, 2003a).

The cost of different macrophyte control measures are manual cutting (mean US\$ 54 ha/year), mechanical removal (mean US\$189 ha/year), herbicide application (mean US\$ 110 ha/year) and combinations (US\$ 45 ha/year) World Bank, (2003b). It has been difficult to estimate the value of biological control of water hyacinth in Lake Victoria.

3.10.3 *Water imbalance*

Issues related to Lake Victoria water level fluctuations are important as the rise and fall of the Lake level has far reaching social, economic and cultural impacts. Although hard figures are difficult to obtain on the fiscal costs of impacts of such events, some cases in the 1962/63 and in 1997/98 indicate what would happen to shoreline infrastructure if there is serious water imbalance. In these cases, there were huge collateral damage to transportation, buildings, agriculture and a host of many facilities and amenities due to flooding. Many accidents were triggered off and water born diseases became rampant. On the other hand similar events would have positive impacts on fisheries and hydropower generation. Hence, these issues of lake level manipulation artificially or through natural causes needs careful handling as it has regional and global ramifications and impacts.

3.10.4 *Fisheries decline*

Fisheries constitute one of the most important resources of Lake Victoria, with a production value estimated at 500,000 metric tones annually valued approximately at US\$ 500 million and an export value of US\$ 250

million for the three riparian countries of Kenya, Uganda and Tanzania. The fisheries contribute significantly to the GDP of the riparian countries (3 % in Uganda, 2.8 % in Tanzania and 2 % in Kenya).

The Lake Victoria fishery is also an important source of employment with about 180,000 fishers and about 600,000 fish traders directly employed in the three countries. With an average dependency ratio of 8:1, this means that about 7 million people depend directly or indirectly on the fisheries. Additionally, many more people, both within and out of the Basin, depend on fish for food.

Fisheries are a finite resource although it is renewable. It is a natural resource, which is highly fragile and sensitive to over exploitation, misuse, abuse and pollution. If no action is taken to manage exploitation and effort, the entire resource could be decimated. A living example of harmful destruction of this resource is the disappearance of over 100 species of fish from Lake Victoria in the last 50 years alone.

Immediate consequences could be loss of US\$ 500 million worth of this industry; loss of US\$ 250 million export earnings to the three lower riparian countries. Fish is a good source of protein to the 30 million riparian communities. If lost, these communities would be immediately exposed to food shortage, malnutrition, sicknesses, hospitalization and heavy medical expenditure. At an average medical bill of US\$ 10 per annum per inhabitant, the medical bill for the riparian countries would go up by US\$ 300 million per annum if the fish became unavailable to these communities.

Basing on the employment figures of 180,000 fishers and about 600,000 fish traders, and considering an average earning of about US\$ 5 per person per day, if this job opportunity is lost, these people will lose income of US\$ 900,000 annually. The fisheries industry employs a whole range of other skilled workers like carpenters, builders, drivers, mechanics, fishing gear manufacturers and fabricators. Decimation of the fish stocks would mean loss of jobs and incomes to all these people.

3.10.5 *Water hyacinth*

According to the World Bank Appraisal Report (1996) the EAC Governments have an emergency action program to tackle the water hyacinth problem. This report also indicated that the spread of water hyacinth imposes a wide range of direct costs including the following: delays in commercial waterborne transport of people and goods; increase operating costs (and possible loss of revenue) for hydropower production at Owens Falls Dam, due to clogging of water intakes; loss of fishing time and revenue as a result of blocking of the beaches; increased difficulty and time spent on gathering water in villages where access to traditional water collection areas is blocked or dangerous (because of snakes or crocodiles in the weed), and blockage of intakes and loss of production at urban and industrial water supply systems.

Some initial estimates have been made for these costs of water hyacinth for a five year period as follows (World Bank Appraisal Report, 1996):

- i) Maintain a clear passage for ships to dock at Port Bell in Uganda: US\$ 3-5 million p.a;
- ii) Cleaning intake screens at the Owen Falls hydroelectric plant at Jinja in Uganda: US\$ 1 million p.a.; Losses in local fisheries from accumulation of water hyacinth at fishing beaches and landing sites around the Lake making it difficult or impossible for fishing boats to be launched or recovered: US\$ 0.2 million p.a. but with a very serious local impact;
- iii) Loss of water supply for domestic, livestock and agricultural purposes: US\$ 0.35 million p.a;

- iv) Loss of supply or increases in the maintenance costs in urban water supply schemes because of blockages of the water intakes by water hyacinth: US\$ 1.5 million p.a; and,
- v) Small-scale horticultural irrigation schemes rendered useless because of blockages of channel and pipes with hyacinth: no costs have yet been attributed to these losses but they are important from a distributional viewpoint.

The total direct costs attributable to the water hyacinth (at peak infestation period) were estimated to be US\$ 6-7 million p.a. with a present value of US\$ 25-40 million. This figure can be compared with the estimated US\$ 4.5 million cost for the Uganda

3.10.6 Wetlands degradation

The main values of wetlands consist of opportunities for wastewater treatment. Haskoning–CMS-Delft hydraulics evaluated the Ugandan wetlands to provide annual benefits in the order of US\$ 55.6 million (Haskoning – CMS- Delft hydraulics, 2001; Table 3.8). This value comprises of the benefits of typical wetland goods and services as well as those of the non-typical ones (like agriculture cropping, livestock grazing, fishing etc.). The value of typical wetland goods and services (e.g. craft and construction materials from papyrus and the Phoenix palm, tertiary wastewater treatment), option values and all non-use or ecological functions, is estimated at US\$ 35.9 million, representing 65% of all wetland benefits.

Table 3.8: Value of Wetlands in Uganda

Value type	All wetland functions (Mil. Ushs)	Value type	Typical wetland functions (Mil Ushs)
Direct (extractive) use value	45,724	Direct (extractive) use value	10,323
Indirect (non-extractive) use value	20,899	Indirect (non-extractive) use value	20,899
Option value	10,503	Option value	10,503
Existence value	22,882	Existence value	22,882

Source: Haskoning–CMS–Delft Hydraulics (2001)

The typical wetland goods and services in Uganda consist of:

- (i) Direct extractive (human) use goods and services, valued per year at US\$ 5.7 million;
- (ii) Indirect human use values, giving an annual benefit of US\$ 11.6 million;
- (iii) Option values (indicating the known and yet unknown future values of wetland), valued at US\$ 5.8 million annually; and,
- (iv) Existence or non-use benefits, returning annually US\$ 12.7 million.

The total value of wetland goods and services in the five pilot areas was equal to 0.76 % of the Gross Domestic Product in 1999 for the entire country. The value of wetland goods and services, for a large part not sold on the market, was equal to 3.3 % of the non-monetary part of GDP.

3.10.1 Forestry

Despite their economic value in providing variety of tangible and intangible goods services. Benefits derived from forests and woodland resources are among others wood fuel, timber and building poles, and grass for thatching and grazing livestock. They also provide sanctuary to a variety of wild animals and other living organisms. Fruits, vegetables and medicinal herbs are also available for livelihood support of the Basin communities. However, natural vegetation cover is rapidly being degraded in the Basin threatening protected areas. Forest ecosystems and woodland resources in the Basin have declined considerably because of indiscriminately harvesting as evidenced by ongoing deforestation.

SECTION FOUR: CAUSES OF MAJOR PERCEIVED PROBLEMS AND ISSUES

Section four presents analyses of MPPIs, their root and immediate causes, causal-chain relationships and proposes suitable mitigation measures. The MPPIs include land degradation, water quality deterioration, declining fisheries, loss of biodiversity, wetlands degradation, water hyacinth infestation, deforestation, shortage of energy, inadequacies in policy, laws and institutions; conflicts over resource use; prevalence of diseases and pests and population pressure as issues, among others.

4.1 Interrelationships between MPPIs

Land Degradation and Land use Issues are attributed to inappropriate land husbandry practices within the Basin, fast growing population coupled with high demand for land, cultivation on marginal areas, steep slopes and along river banks; insecure land tenure systems; excessive land fragmentation and diminished farm sizes; frequent bush burning; over cultivation/ lack of fallow or shortened fallow periods; encroachment on wetlands/forest ecosystem; overstocking; lack of crop rotation; low levels of adoption of improved technologies; and weak governance in natural resources management and land use planning; overdependence on rain fed agriculture and lack of alternative sources of livelihoods.

These can result in the following impacts: deforestation, soil erosion/ runoff, agro-biodiversity loss, eutrophication and changes in water quality, decreased and degradation of wetlands, increased sediment transport capacity, changes in biological diversity and food chains, changes in sediment budgets, degradation of river banks and Lakeshore, severe degradation of rangelands and climate change. Figure 4.1 illustrates how land use and land degradation is inter-linked with the other identified thematic issues.

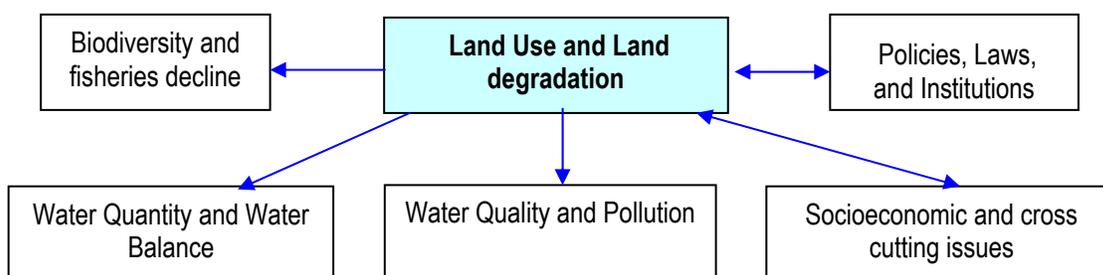


Figure 4.1: Land use and land degradation linkages

Water Quality and pollution is associated with poor waste management and sanitation practices; point and non-point pollution sources; excessive nutrient loads and algal blooms; inadequate data management; atmospheric deposition; gaps in water quality management legislation; inadequate water quality and pollution management structure at all levels and limited coordination among stakeholders .

This can result in the following impacts: deterioration in drinking water quality, eutrophication, decreased recreational value of water bodies, infestations/diseases in aquatic and terrestrial species, changes in the structure and functions of aquatic ecosystems, changes in species composition and the productivity of native fish species, and decreased species diversity. Figure 4.2 illustrates how water quality and pollution is inter-linked with the other identified thematic issues.

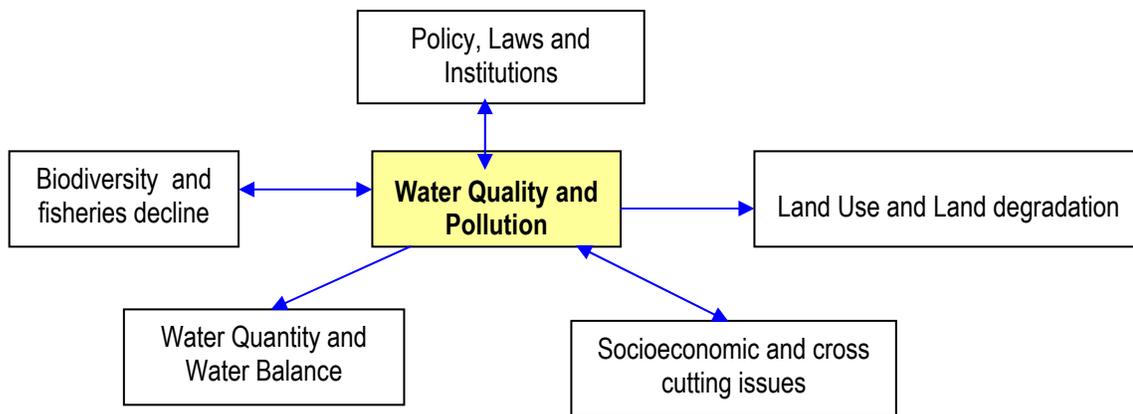


Figure 4.2: Water quality and pollution linkages

Water Quantity and balance is associated with increased water releases, declining rainfall, increased water abstraction for development, increased evaporation rates, poor watershed management, climate change and inefficient water use.

This can result in the following impacts: reduction in agricultural output, declining fish stocks, destruction of fish breeding areas, inadequate water supply for development, ground water level variation and poor water service level coverage. Figure 4.3 illustrates how water quantity and balance is inter-linked with other thematic issues.

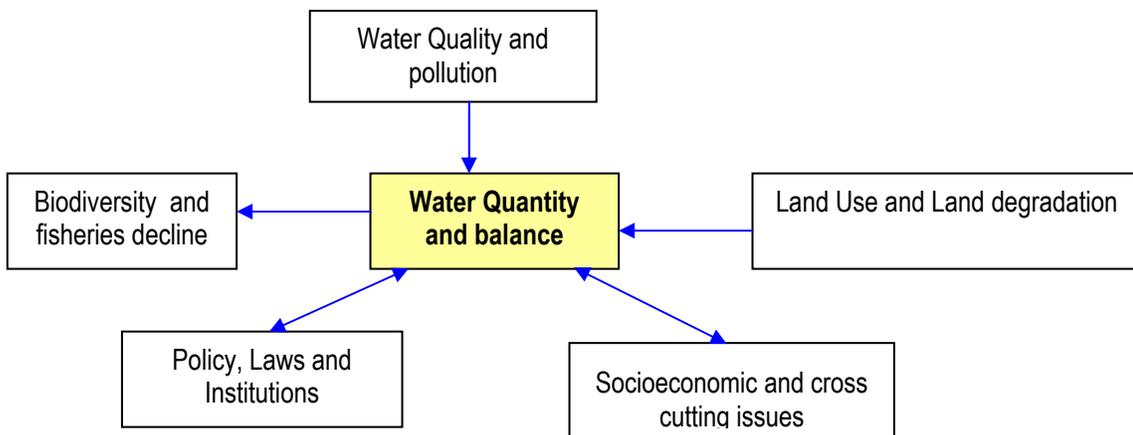


Figure 4.3: Water quantity and balance linkages

Declining fisheries and aquatic biodiversity is attributed to: decline in fish stocks and fish catches, invasive aquatic weeds particularly water hyacinth, pollution of fish habitat, low fish quality and high post harvest losses, low level of aquaculture production, use of destructive fishing gears and methods, dumping of liquid, solid and chemical wastes, among others.

This can result into the following impacts: loss of biodiversity, loss of species, genetic and habitat levels, reduction of catches, reduced incomes and other multiplier effects, reduced fisheries based employment, reduced nutrition and food security, reduced fish exports and increased fishing pressure. Figure 4.4 illustrates how decline in fisheries and biodiversity loss is inter-linked with the other identified thematic issues.

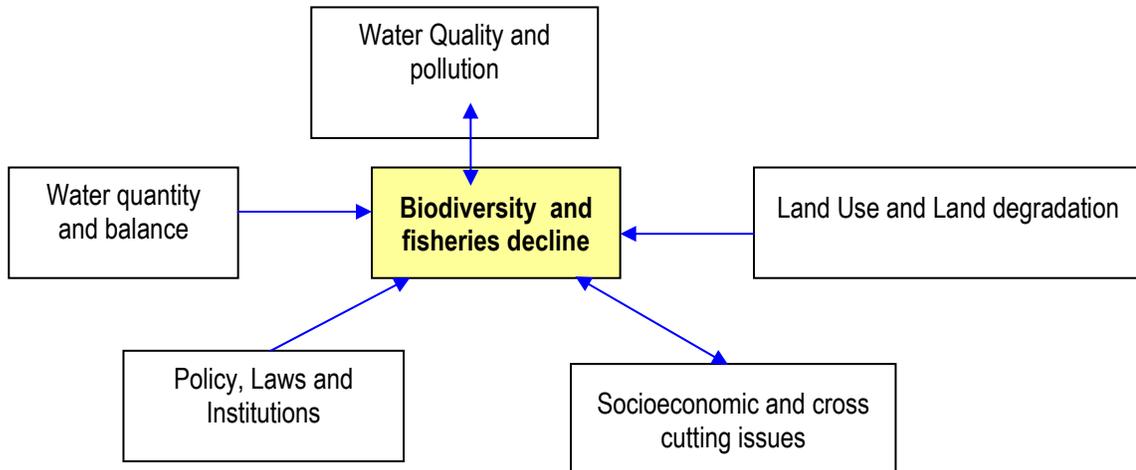


Figure 4.4: Fisheries decline and biodiversity loss linkages

Problems of Socioeconomics and other cross-cutting issues is attributed to poverty (quality of life and technological ability of the population i.e. healthy, wealthy, enterprising and stable population), Conflict in resource use, migrations, population pressure, civil strife and regional wars; weak Legal, Policy and Institutions are attributed to inadequate human and financial capacities, low level of technology adoption, limited flow of information, weak institutional coordination and lack of disaster preparedness.

These can result in the following: poor health, poor education, poor standards of living, malnutrition, high mortality and morbidity, no development, high incidence of wars and civil strife, potential for international conflicts and political instability. Figure 4.5 illustrates how problems of socioeconomics and other cross-cutting issues are inter-linked with the other identified thematic issues.

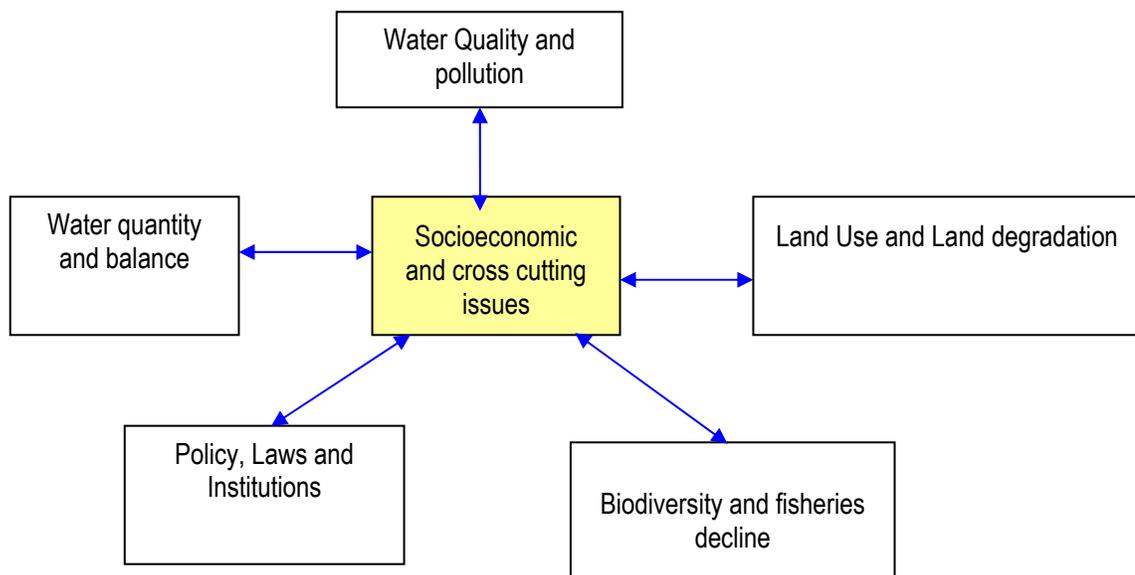


Figure 4.5: Socioeconomic and cross cutting issues linkages

4.2 Causal-Effect-Chain Analysis

The Table below presents the Causal Chain Analysis for each of the MPPIs identified in the RTDA according to the six thematic areas identified in section three. It presents an outline of the common root causes for all MPPIs that are common in the Basin countries. The symptoms or immediate impacts of each MMPI, their immediate or primary and specific/root causes are also analysis. The Table also outlines spatial and geographical coverage of these MPPIs in the Basin while their level of priority are presented based on individual Basin countries prioritisation presented in Table 3.1

Table 4.1: Causal-Effect-Chain Analysis

Common Root causes of Major Perceived Problems and Issues (MPPIs) in the Lake Victoria Basin					
i) Inadequate development planning ii) Inadequate regional plans iii) Poverty iv) Weak community participation and inadequate awareness v) Weak law enforcement, compliance and governance vi) Population dynamics vii) Corruption viii) Inadequate technology ix) Weak financing mechanism x) Inadequate market access					
MPPIs	Immediate Impacts on LVB/Symptoms	Immediate/Primary Causes	Specific Root Causes	Spatial/Geographical Extent within the Basin	Priority
Land Use and Land degradation					
Soil erosion/ land degradation	1. Degradation of land resources and loss of habitas and biodiversity due to reduction of vegetation cover; 2. Reduced agricultural productivity due to loss of top soil leading food insecurity; 3. Unsustainable utilization of wetlands, draining them for agricultural purposes; 4. Soil Erosion/Runoff from <ul style="list-style-type: none"> Agriculture and rangelands 	1. Unsuitable land use practices within the Basin leading to decreased soil quality and erosion such as cultivation on marginal areas, steep slopes and along river banks, overgrazing and overstocking; 2. Fast growing population coupled with high demand for land leading to encroachment of wetlands, forest ecosystems and protected areas; 3. Rapid Urbanisation without spatial planning to guide urban	1. Poverty 2. Population pressure 3. Weak governance in NR management; 4. Inadequate land use planning; 5. Inadequate capacity for generation and dissemination/ sharing of climatic/ meteorological information; 6. Inadequate watershed planning and management;	This is a Basin-wide problem more critical in <ol style="list-style-type: none"> Burundi: Ruvubu river region, on steep slopes and hill sides; Kenya: Trans-zoia, Uasin Gishu, Kakamega/Vihiga, Kisii and Migori districts and lakeshores; Rwanda: Runyima, Murama,, Bulinga, Nyamutera, Kibali Tanzania: Steep hills in Mwanza, Mara, Kagera and 	High priority

	<ul style="list-style-type: none"> • Roads construction • Storm water <p>5. Degradation of river banks & Lake shores; desertification, wind erosion in arid areas and sheet, rill and gully erosion after heavy rains;</p> <p>6. Water quality degradation due to increased nutrient and sediment loads in aquatic environment, siltation of water bodies, wetlands, reservoirs and low lying lands;</p> <p>7. Loss biodiversity (aquatic and terrestrial)</p> <p>8. Climate Change and variability leading to frequent floods causing destruction of infrastructure, houses and social services and droughts</p>	<p>development;</p> <p>4. Insecure land tenure systems; Weakly defined ownership of agricultural land undermines production and discourages investment for environmental protection.</p> <p>5. Excessive land fragmentation and diminishing farm size leading to over cultivation; lack of fallow or shortened fallow periods.</p> <p>6. Frequent bush burning leading to continued massive loss of vegetation cover, deforestation and deterioration of catchment buffer zones;</p> <p>7. Overstocking and overgrazing;</p> <p>8. Limited crop rotation;</p> <p>9. Low levels of adoption of improved technologies;</p> <p>10. Overdependence on rain fed agriculture and</p> <p>11. Lack of alternative sources of livelihoods.</p>	<p>7. Low adoption of soil and water conservation technologies;</p> <p>8. Low awareness on land-water interaction</p> <p>9. Uneven topography; relief streams flow velocities, uneven rainfall patterns exemplified by floods, droughts and climate variability;</p> <p>10. Low implementation of EIAs for infrastructure projects due to lack of financial and human resources</p> <p>11. High livestock densities</p>	<p>Shinyanga regions and lakeshores</p> <p>5. Uganda: hill slopes of Kabale, Rakai, and Iganga, Mayuge, Kamuli and Busia districts</p>	
Deforestation and Shortage of energy	<p>1. Deterioration of watershed; high run-off associated with increased erosion leading to loss of top fertile soil, sedimentation and siltation of water bodies;</p> <p>2. Decreasing vegetation/forest cover leading to loss of biodiversity;</p> <p>3. Energy crisis due to decreased availability of fuel wood and charcoal resulting in high prices of the same;</p>	<p>1. Land use conversion due to increasing demand for agricultural land and grazing areas as a result of population increase; slash and burn practices for land clearing and shifting cultivation;</p> <p>2. Uncontrolled logging for timber and construction materials for local and commercial needs and demand for fuel wood and charcoal;</p>	<p>1. Poverty and population pressure leading to pressure on resources; lack of alternative livelihoods and low technological absorption capacity to increase unit agricultural production;</p> <p>2. Insufficient/lack of alternative sources of energy to fuel wood;</p> <p>3. Insufficient awareness and</p>	<p>This is Basin-wide problem more acute:</p> <p>1. Burundi: Along the Ruvubu river and other rivers, along steep slopes, hill sides and high mountains;</p> <p>2. Kenya: Mau forests in Trans-Mara, Kericho, Bomet and Nakuru districts and Kakamega/Vihiga, Kisii and</p>	High priority

	<p>4. Variability in local climate and rainfall patterns;</p> <p>6. Habitat destruction resulting in loss of wildlife in terms of numbers and biodiversity and shrinking of protected areas such as national parks due to encroachment.</p> <p>7. Limited, availability and accessibility of alternative sources of energy e.g access to electricity</p>	<p>3. Low local tree planting initiatives and programs due insecure land tenure systems exemplified by weak ownership which discourages investment;</p> <p>4. Human migration (refugees and internally displaced populations) and resettlement encroaching into forested areas;</p> <p>5. Unsustainable and inefficient resource use e.g. overgrazing, extensive cultivation and uncontrolled logging</p>	<p>knowledge of sustainable land use practices and effects of deforestation;</p> <p>4. Weak land tenure systems leading to allocation and use of marginal lands and lack of incentives for sustainable land use practices;</p> <p>5. Large number of refugees and resettlements without guided spatial planning</p> <p>6. Drought and overall climate variability and uneven topography.</p>	<p>Migori districts;</p> <p>3.Rwanda: Nyungwe National Forest, the Akagera National Park and Gishwati Forest</p> <p>4.Tanzania: Several divisions in Mwanza, and Mara, Kagera and Shinyanga regions and lakeshores</p> <p>Uganda: hill slopes of Kabale, Rakai, districts. And districts of Iganga, Mayuge, Kamuli and Busia</p>	
River Bank and Lakeshore degradation	<p>1. Destruction of vegetation cover in river banks and lakeshore buffer zones;</p> <p>2. Erosion, landslides and down stream sedimentation leading to change in river and stream course;</p> <p>3. Adverse effects on riverine aquatic life and lake ecosystems</p>	<p>1. Poor land use and agricultural practices such as cultivation on river banks and destruction of vegetation cover to increase agricultural land due to population increase and high animal densities</p> <p>2. Declining in water levels and drying up of rivers and streams</p> <p>3. Rapid urbanization and construction without spatial planning</p>	<p>1. Insufficient national land use plans, laws and regulation and enforcement of existing laws</p> <p>2. Population pressure and rapid urbanization</p> <p>3. Expansion of agricultural lands coupled with improper agricultural practices near river banks and lake shores including overstocking and overgrazing</p> <p>4. Uneven topography and relief and soil morphological structures</p> <p>5. Climatic variability conditions including seasonal floods and other natural catastrophes</p>	<p>This is a Basin-wide problem and more pronounced in:</p> <p>Burundi: Areas along rivers Akanyaru and lakes Cohoha and Rwinda</p> <p>Kenya: Rivers Nyando and Guchamigori and the lake shores of Victoria</p> <p>Rwanda: Along rivers Akanyaru, Nyabarongo and Akagera and on shores of lakes Rweru</p> <p>Tanzania: Estuaries of rivers entering lake Victoria</p> <p>Uganda: Severe in seasonal wetlands and Nakivubo Channel</p>	

MPPIs	Immediate Impacts on LVB/Symptoms	Immediate/Primary Causes	Specific Root Causes	Spatial/Geographical Extent within the Basin	Priority
Water Quality and Pollution					
Pollution (Point and non point source) and Water Quality deterioration	<ol style="list-style-type: none"> 1. Water quality degradation resulting in water being unsuitable for domestic, agricultural, industrial and other uses; 2. Decrease in aquatic environmental quality resulting in disappearance of natural habitats and proliferation of water hyacinth and other invasive weeds; 3. Negative impacts on water-dependent flora and fauna including loss of habitats, fish and other aquatic biodiversity resulting from nutrient discharges and leading to eutrophication; and 4. Pollution of water bodies and rivers resulting in contamination of domestic and other uses of water leading to water-borne diseases, among others 	<ol style="list-style-type: none"> 1. Discharge and run-off of untreated water from urban and industrial sources containing excessive dissolved nutrient loads, industrial pollutants, agricultural chemicals/fertilizers leading to algal blooms and toxins, oxygen depletion and alteration of aquatic biota structure 2. Poor Waste Management and sanitation practices such as lack of recycling of wastes and uncontrolled dumping; leading to diseases (human and livestock) 3. Pollution from Non-point sources such as agriculture through improper use of and high application of agro-chemicals leading to eutrophication; 4. Atmospheric deposition of substances such as Phosphorus and Nitrogen 5. Degradation of vegetation cover especially buffer zones and wetlands which could act as filters; 6. Loss of aesthetic values (beauty) 	<ol style="list-style-type: none"> 1. weak governance in NR management exemplified by weak policies, laws and regulations for environmental management such as low implementation of EIAs due to lack of financial and human resources, Insufficient monitoring and enforcement; 2. Inadequate data management, gaps in water quality management legislation, limited coordination among stakeholders; 3. Inadequate water quality and pollution management structure at all levels and inadequate watershed planning and management 4. On non-point sources: unsustainable land use practices and insecure land tenure systems and low adoption of soil and water conservation technologies 5. On point sources: inadequate funding/low budget provisions for investments, high capital operation and maintenance costs, inadequate containment and waste treatments and lack of sanitary facilities; 6. Inadequate zoning regulations and or enforcement, inadequate environmental and spatial planning (Unplanned urbanization); and 7. Low environmental awareness 	<p>This is a Basin-wide problem and more pronounced:</p> <ol style="list-style-type: none"> 1. Burundi: Along the Ruvubu river and other rivers, along steep slopes, hill sides and high mountains; 2. Kenya: Urban centres of Kisumu and districts of Trans-zoia, Uasin Gishu, Kakamega/Vihiga, Kisii and Migori areas around the lakeshores such as the Winam Gulf; 3. Rwanda: Nyungwe National Forest, the Akagera National Park and Gishwati Forest 4. Tanzania: Several divisions in Mwanza, and Mara, Kagera and 5. Uganda: Point source localized mainly in urban centres such as Kampala 	High priority

			across all levels and sense of value for environmental protection;		
Eutrophication	<ol style="list-style-type: none"> 1. Algal blooms, toxins and increasing invasion of water weeds; 2. Decreased water quality; and 3. Reduction and changes in fish stock 	<ol style="list-style-type: none"> 1. Discharge of nutrients from domestic and industrial waste and agricultural run-off; 2. Catchment degradation especially on wetlands 	<ol style="list-style-type: none"> 1. Inadequate environmental provisions in industrial and urban centres; 2. lack of spatial planning and catchment management 3. Poor land use and farming practices; land degradation and deforestation 	<p>This is a Basin-wide mostly pronounced in:</p> <ol style="list-style-type: none"> 1. Burundi: Water bodies including shallow lakes and Kagera Basin 2. Kenya: The lower Yala, Nzoia, Guja-Migori , Sondu-Miriu and Nyando; 3. Rwanda: Akanyaru, Nyabarongo, and the Kagera Basin 4. Tanzania: Mara and Simiyu Rivers, Shinyanga and Mwanza regions <p>1. Uganda: Entire Ugandan part of the Basin</p>	High priority
Siltation	<ol style="list-style-type: none"> 1. Heavy sedimentation and silt loads in water bodies leading to changes in water courses and river bank erosion due to non-functionality and degraded wetlands among others 2. Decreased dams and reservoirs life span, siltation of flooded fields, plains, irrigation canals and threats associated with toxic pollutants adsorbed in silt particles 	<ol style="list-style-type: none"> 1. Heavy rainfall and drought associated with unsuitable land use practices resulting in catchment degradation and soil erosion 	<ol style="list-style-type: none"> 1. Inappropriate land management practices and lack of soil conservation practices often perpetuated by insecure land tenure systems, catchment degradation such as deforestation; 2. Lack of awareness of the relationship and implication between land and water resources exploitation; and 3. Low enforcement of environmental policies and regulations. 4. Climatic variability conditions 	<p>This is a Basin-wide mostly pronounced in:</p> <ol style="list-style-type: none"> 5. Burundi: Water bodies including shallow lakes and Kagera Basin 6. Kenya: The lower Yala, Nzoia, Guja-Migori , Sondu-Miriu and Nyando; 7. Rwanda: Akanyaru, Nyabarongo, and Kagera Basin 8. Tanzania: Mara and Simiyu Rivers, Shinyanga and Mwanza regions 9. Uganda: Entire Ugandan part of the Basin 	High and Medium Priority

Water Hyacinth and other invasive Weeds	<ol style="list-style-type: none"> 1. Spread of water weeds infestation and resurgence of water hyacinth of water bodies and eutrophication; 2. Interference with ecology and economy, interference with safety of navigation and fishing activities leading to decreases in fish yields as well as eutrophication; 3. Decrease in diversity of certain fish species; 	<ol style="list-style-type: none"> 1. High nutrient levels from pollutants from industrial and domestic discharges and agricultural run-off due to poor land use practices in the catchment and lack of waste water treatments; 2. Inadequate response mechanisms 	<ol style="list-style-type: none"> 1. Uncontrolled introduction of hyacinth and other invasive weeds and insufficient preventive measures against introduction of foreign species; 2. Low capacity in water resources and environmental management resulting in insufficient enforcement of regulations; 3. Low budgets in programs to combat infestation at national and regional levels 	<p>This is a Basin-wide mostly pronounced in:</p> <ol style="list-style-type: none"> 1. Burundi: In the Ruvubu River, Lake Coyoha and Rwinda and Kagera Basin 2. Kenya: The Winam Gulf in Lake Victoria; 3. Rwanda: Akanyaru, Nyabarongo, Kagera Basin, Lakes Coyoha, Rwero, 4. Tanzania: Southern shores of Lake Victoria in the bays of Mara and Mwanza regions 5. Uganda: Hot spots include, Murchison bay, and all Bays, the Nile system in Jinja 	High priority
MPPIs	Immediate Impacts on LVB/Symptoms	Immediate/Primary Causes	Specific Root Causes	Spatial/Geographical Extent within the Basin	Priority
Water Quantity and Water Balance					
Fluctuation of water levels	<ol style="list-style-type: none"> 1. Uneven rainfall distribution; 2. Increased releases at Nalubaale and Kiira Dams; 3. Reduced catchment inflows 4. Increased evaporation rates 5. Poor water shed management (Deforestation) 6. Interference with micro and macro climatic factors 7. Climate Change 8. Increased water abstraction for development 9. Poor infrastructural designs 10. (High) water wastage 11. Poor water service level coverage 12. Inadequate Water Supply for development 13. Reduction in agricultural output 	<ol style="list-style-type: none"> 1. Climate change and variability (Natural and global factors) 2. Ground water level recharges and variation 	<ol style="list-style-type: none"> 1. Inadequate coordination and interpretation of laws and regulations 2. Inadequate capacity in local governments to handle and manage natural resources; 3. Unsustainable tax collection from natural resources; 4. Poor watershed planning & monitoring 5. Variable water release policies (Excessive water releases) 6. Poor technology 7. Disparity in Water utilization policies 8. Inadequate Instrumentation on the land and lake 9. Inadequate capacity on hydro-meteorological 	<p>This is a Basin-wide mostly pronounced in:</p> <ol style="list-style-type: none"> 1. Burundi: In the Ruvubu River, Lake Coyoha and Rwinda and Kagera Basin 2. Kenya: The Lake Victoria system and major rivers flowing into it. 3. Rwanda: Akanyaru, Nyabarongo, Kagera Basin, Lakes Coyoha, Rwero, 4. Tanzania: Southern shores of Lake Victoria in the bays of Mara and Mwanza regions <p>Uganda: The Lake Victoria</p>	High

	14. Declining fish stocks 15. Erosion of fish breeding areas		10. Inadequate Regional Coordination 11. Inadequate Water resources Assessment of Ground and Surface water 12. Inadequate and Fragmented Databases for early warning 13. Lack of Operation and Maintenance procedures and policies 14. Low levels of sensitization and mobilization of the community on water shed management 15. Lack of reliable systems for climatic data collection and dissemination 16. Inadequate skills for information utilization; 17. Increasing economic development	system and major rivers flowing into it.	
MPPIs	Immediate Impacts on LVB/Symptoms	Immediate/Primary Causes	Specific Root Causes	Spatial/Geographical Extent within the Basin	Priority
Fisheries and Biodiversity					
Declining in Fisheries	<ol style="list-style-type: none"> 1. Decline in fish stocks and fish catches 2. degradation of fish habitats and aquatic ecosystems 3. Low Fish quality and high post harvest losses 4. Use of destructive fishing gears and methods 5. Loss of Biodiversity 6. Loss of species, genetic and habitat levels 7. Reduced incomes and other multiplier effects 8. Reduced fisheries based employment 9. Reduced nutrition and food security 10. Reduced fish exports 11. Increased fishing pressure 	<ol style="list-style-type: none"> 1. Loss of Biodiversity 2. Loss of species, genetic and habitat levels 3. Dumping of liquid, solid and chemical wastes 4. Invasive aquatic weeds particularly water hyacinth 5. Non point sources (Discharge of agrochemicals and atmospheric deposition) 6. Point sources (domestic, industrial and urban waste) 7. Persistent organic pollutants (POPs) 8. Poison fishing and contamination of fisheries products 9. Destruction of fish breeding and nursery grounds 10. Inadequate of fish fry and feeds 11. Low level of aquaculture production 	<ol style="list-style-type: none"> 1. Poor Infrastructure 2. Weak capacity (Human and Financial resources) 3. Weak Management 4. Low adoption of technology; 5. Open access policy to fisheries resources; 6. Weak Fish Marketing; 7. Poor coordination within the security organs and weak/inadequate Monitoring Control Surveillance (MCS) 8. Limited budgets allocated for conservation 9. Conflicting policies and unclear and conflicting mandates 10. Limited access to information on market 11. Limited access to information on market 12. Poor infrastructure (such as road network from fish landings to markets) 	<p>This is a Basin-wide mostly pronounced in Tanzania Kenya and Uganda:</p> <p>The shallow lakes and rivers in the upper catchment countries of Burundi and Rwanda</p>	High priority

Loss of biodiversity (valuable species, ecosystem and habitats)	<ol style="list-style-type: none"> 1. Species loss and deterioration of ecosystems and unique habitats: 2. Loss of unique flora and fauna species especially the endemic ones, and general decline in aquatic and terrestrial biodiversity; 3. Decrease in numbers of large mammals impacting negatively on tourism and revenue accrued there from; 4. Decrease in forest cover resulting in decrease in food, fuel, timber and shelter. 5. Loss of agrobiodiversity: 6. Loss of genetic base (cattle breeds, crops, vegetables, fruits etc.) loss of benefits from local variety qualities (tolerance, productivity, resilience); dependency on exotic seeds and breeds and imported varieties 	<ol style="list-style-type: none"> 1. Species loss and deterioration of ecosystems and unique habitats: 2. Poaching and illegal trade in valuable species as well as intensive and unsustainable resource use and land management such as deforestation, wetlands conversion, expansion of agriculture (crops and livestock farming, over-fishing, uncontrolled burning and bush fires) 3. Lack of alternative sources of livelihoods and income sources. 4. Loss of agro biodiversity: 5. Expansion of high yielding crops and livestock varieties (hybrids), leading to decreased genetic diversity of domestic species 6. Introduction of exotic species 	<ol style="list-style-type: none"> 1. Population pressure and poverty coupled with high dependence on natural resources and incomes from agriculture. 2. Low financial and human resources capacity in management of natural resources associated with lack of control and monitoring, poor law enforcement such as in protecting gazetted forests and protect areas; 3. Lack of financial resources for development and implementation of relevant plans (IWRM) and programmes such as awareness and education. 4. Weak agricultural and other extension services 5. Lack of awareness of biodiversity and concerns on benefits from conservation. 6. Weak regulations (not harmonized, coordinated) to prevent introduction of exotic species. 7. Weak and unregulated land use practices and insufficient integrated programs. 	<p>This is a Basin-wide problem</p> <p>In water bodies, wetlands, forest areas and protected areas for species, ecosystems and habitats</p> <p>Intensification of agricultural areas for agro biodiversity</p>	High
Wetlands Destruction	<ol style="list-style-type: none"> 1. Decrease and degradation of wetland areas through reclamation and draining, siltation, flood damage and water weed infestation 2. Decreased benefits from functioning wetlands, e.g. less groundwater re-charge, decreased buffering of flood, 3. loss of filter functions to absorb and degrade pollutants and improve water quality, 	<ol style="list-style-type: none"> 1. Reclamation of wetlands to expand agricultural production 2. Deforestation, erosion and sedimentation 3. Overuse of natural resources (wetlands, over fishing, poaching/hunting, overgrazing, unsustainable farming practices). 4. Pollution from industrial, agricultural and domestic sources 	<ol style="list-style-type: none"> 1. Limited policies, regulations and institutional frameworks for the management of wetland at all levels. 2. limited capacity (human and financial) 3. Poverty and population pressure resulting in land shortage and inadequate spatial planning and land use policies 4. Lack awareness on wetlands functions, values and services and cultural habits. 	<p>This is a Basin-wide problem more pronounced in:</p> <p>Burundi: Along the Ruvubu and Akanyaru valleys and around lake Rwindu</p> <p>Kenya: The Winam gulf, Kisumu estuary of Nzoia River and the Yala swamp</p> <p>Rwanda: Upstream of Rusumu falls, lakes Rweru and Mugesera, Coyoha and Bugesera.</p>	

	4. decreased ability to act as sediment trap and destruction of habitats and loss of biodiversity			Tanzania: Along the Simiyu River, Lake Victoria shores and banks of river Kagera and swamps Uganda: Nakivubo channel, and other wetlands	
MPPIs	Immediate Impacts on LVB/Symptoms	Immediate/Primary Causes	Specific Root Causes	Spatial/Geographical Extent within the Basin	Priority
Socio-Economic and Cross Cutting Problems					
Problems related to socioeconomics	<ol style="list-style-type: none"> 1. Poor health; 2. Poor education; 3. Poor standards of living; 4. Malnutrition; 5. High mortality; 6. High morbidity; 7. No development; 8. High incidence of wars and civil strife 9. Potential for international conflicts. 10. Political instability. 11. Food insecurity. 12. Spiralling of poverty. 13. Loss of income. 14. Loss of employment. 15. Loss of cultural heritage. 16. Increased migration 17. Ignorance 18. Reduced level of productivity 19. Reduced level of technology transfer Ignorance 20. Cultural beliefs 21. Cattle rustling & thefts 22. Poor governance 23. Inadequate investment culture 24. Few entrepreneurs 25. Weak re-investment culture 26. Inappropriate technology 27. Poor saving cultures and other cultural rigidities 	<ol style="list-style-type: none"> 1. Poverty; Poor standards of living (quality of life and technological ability of the population i.e. healthy, wealthy, enterprising and stable population), Conflict in resource use, Migrations, Population pressure, Civil strife and regional wars 2. Poor health; Diseases (Malaria, HIV/AIDS, Bilharzia, etc.) 3. Malnutrition; 4. High mortality; 5. No development; 6. High incidence of wars and civil strife 7. Potential for international conflicts. 8. Spiralling of poverty. 9. Poor education; 10. Political instability. 11. Food insecurity. 12. Loss of income. 13. Loss of employment. 14. High morbidity 15. Reduced level of technology transfer Ignorance 16. Loss of cultural heritage. 17. Increased migration 18. Ignorance 19. Reduced level of productivity 20. Cultural beliefs 21. Cattle rustling & thefts 22. Poor governance 23. Inadequate financial capacities, failure to implement development plans 24. public education, inadequate water 	<ol style="list-style-type: none"> 1. Weak governance 2. Low level of education 3. Poor development planning 4. Weak laws and rules 5. Poor economic performance 6. Limited budgets for developmental programmes 	This is a Basin-wide problem more pronounced among the rural and poor urban communities	High

		<p>supply and sanitary services, weak spatial planning</p> <p>25. declining performance of productive sectors (Agriculture, Livestock, Fisheries, Forestry, Mining Biodiversity, Water, Wildlife)</p> <p>26. Inadequate energy</p> <p>27. Weak commerce and trade</p> <p>28. Weak Industries</p> <p>29. Inadequate Infrastructures & Amenities in the Basin</p>			
Disaster preparedness including Floods and Droughts	<p>Floods</p> <p>1. Direct impacts include loss of life and property (crops/livestock and arable land, housing, infrastructure); food insecurity (availability and increased prices) declining in economic performance coupled with environmental degradation;</p> <p>Drought</p> <p>2. Direct impacts are food insecurity, famine and human migration including refugees; change in water availability such as permanently dried springs and perennial rivers becoming seasonal</p> <p>Floods/droughts</p> <p>3. Displacement of populations and high numbers of disaster victims such as food insecurity and high incidences of water borne diseases.</p>	<p>Floods</p> <p>1. Heavy rainfall related to certain terrain features (uneven topography) contributed by improper land use practices, lack of spatial planning in flood prone areas aggravated by pressure on land and insecure land tenure.</p> <p>Drought</p> <p>2. Long and prolonged dry seasons resulting in water shortages for both humans and livestock and other uses aggravated by improper land and water resources management such as deforestation, overgrazing and cultivation on marginal areas leading to decrease in vegetation cover, water retention capacity and ground water recharge and increased desertification;</p> <p>Floods and droughts</p> <p>3. Poorly equipped meteorological stations and lack of efficient and reliable early warning systems, information sharing on climatic conditions contributing to lack of disaster preparedness</p>	<p>Floods</p> <p>1. Irregular seasonal and year to year variability in rainfall patterns increased climatic changes, mismanagement of land and water resources leading to soil erosion and increased run-off</p> <p>Drought</p> <p>2. Climate change manifested by conditions such El Niño and La Nina</p>	<p>This is a Basin-wide problem but more pronounced</p> <p>1. Burundi: In the Ruvubu River, Lake Coyoha and Rwinda</p> <p>2. Kenya: The Winam Gulf in Lake Victoria;</p> <p>3. Rwanda: Akanyaru, Nyabarongo, Kagera Basin, Lakes Coyoha, Rwero,</p> <p>4. Tanzania: Southern shores of Lake Victoria in the bays of Mara and Mwanza regions</p> <p>5. Uganda: The Nile system and Lake Victoria</p>	High
Refugees and displaced people	<p>1. Pressure and destruction of surrounding ecosystems for fuel and agriculture, threats to wildlife habitats and pressure on drinking water resources;</p>	<p>1. Large scale refugee influxes overwhelming local capacity to provide, protect, shelter and food.</p> <p>2. Inadequate basic subsistence</p>	<p>1. Political instability, potential for armed conflicts, weak governance problems and potential for social unrest</p>	<p>Localised</p> <p>Burundi: Ruvubu River region</p> <p>Kenya:</p>	

	<ol style="list-style-type: none"> 2. Spread of disease in camps, especially waterborne contributing to poor health, malnutrition and death 3. Migration of large number of people to refugee camps, lack of spatial planning and leading to conflict with existing populations 	resources such as fuel wood and waste inadequate containment and treatment facilities	2. Natural calamities such as famine	<p>Rwanda: South of the country to the border with Burundi</p> <p>Tanzania: SW lake-shores, Muleba, Ngara and Karagwe districts of Kagera Region.</p> <p>Uganda:....</p>	
Impacts of Climate Change	<ol style="list-style-type: none"> 1. Changes in species composition and distribution; changes in migration patterns; and wildlife and aquatic habitat deterioration 2. Food insecurity, unsuitable agriculture and land use: 3. Landslides and change in forest and rangeland cover and desertification. 4. Changes in local water availability and deteriorating water quality. 5. Increase in water-borne and other communicable diseases and rapid urbanization 6. Increased vulnerable populations especially agricultural dependent economies to climate change 	<ol style="list-style-type: none"> 1. Changes in temperature, rainfall and wet and dry cycles; 2. Population pressure and limited resources 	Global phenomenon related to human induced (anthropogenic) activities leading to increased emissions of green house gases among others	This is a Basin wide problem	High
MPPIs	Immediate Impacts on LVB/Symptoms	Immediate/Primary Causes	Specific Root Causes	Spatial/Geographical Extent within the Basin	Priority
Socio-Economic and Cross Cutting Problems					
Weak Legal, Policy and Institutions at all levels: (uncoordinated, un-harmonized, un-enforced and overlapping etc)	<ol style="list-style-type: none"> 1. mismanagement and unsustainable exploitation of environment and natural resources 2. unresponsive mechanisms to environmental challenges 3. Low level of technology adoption, 4. Limited flow of information Weak institutional coordination, 5. Lack of disaster preparedness 6. conflictin g of mandates and duplications 	<ol style="list-style-type: none"> 1. Weak governance 2. Low budgetary allocations 3. Inability to handle disasters 4. Weak demographic structure 5. weak institutional, human resources 6. Inadequate human and financial capacities, 	<ol style="list-style-type: none"> 1. weak governance 2. uncoordinated, un harmonized and un-enforced policies and regulations at all levels 3. Little public awareness 4. Inadequate funds 	This is a Basin wide problem critical in the environment and natural resources sector.	High

SECTION FIVE: PROPOSED INTERVENTIONS AND TARGETS

Section five presents proposals on mitigation measures so as to address problems and issues analyzed in section four. It proposes interventions and set targets aimed at conserving and utilizing the Basin's environmental resources, for sustainable environmental and socio-economic benefits of the riparian communities. The section describes the ecological quality objectives which provide important inputs and framework for the SAP development.

5.1 Ecological Quality Objectives for the Basin (Conceptual Framework)

Ecological Quality Objectives (EQOs) are broad policy-oriented statements with specific targets, interventions/actions and a timeline. The targets often illustrate the logical chain of actions for achievement of the EQO while the interventions enable realization of each of the targets. The interventions are prepared with reference to the Causal Effect Chain Analysis. The EQOs provide important inputs in the framework of the Strategic Action Plan (SAP).

The use of Environmental Quality Objectives (EQOs) helps to refine the TDA process by achieving consensus on the desired status of the Basin. Within each EQO (which is a broad policy-oriented statement), several specific targets are identified. Each target has a timeline associated with it, as well as a specific level of improvement. The targets, therefore, illustrate the logical chain of events required for eventual achievement of the EQO. Specific interventions or actions are also identified. The interventions will be used to enable the realization of each of the targets. The interventions are prepared with close reference to the Causal Effect Chain Analysis, noting the importance of addressing the root causes.

The EQOs lead to the identification of specific targets to be met within the desired time frame, and from there identification of specific interventions and actions that can be considered in the framework of the Strategic Action Plan (SAP).

5.2 Interventions

To conserve and utilize the Basin's environmental resources, for sustainable environmental and socio-economic benefits of the riparian communities, the RTDA has identified the trans-boundary issues/threats, and their causes and impacts and has proposed suitable mitigation measures against them after undertaking the causal-effect- chain analyses.

A range of mitigation measures that lead to interventions have been proposed including gradual restoration of the damaged surface including wetlands, river banks and lakeshores; vegetation and reforestation; proper and adequate treatment of industrial and municipal wastes and effluent; improvement in the surface and subsurface water management; restoration of biodiversity; provision of appropriate educational and skills development facilities and skills; creating and managing appropriate investment environment; provision of adequate health services; strengthening national and regional management and coordination framework; establishment of mechanisms for monitoring development performance against set targets; harmonization of policies and legislation; control entry and access to fisheries; and development of adequate capacity for monitoring, control and surveillance among others are specific interventions and proposed.

The interventions are proposed in close reference to the five thematic areas defined in the Lake Victoria Shared Vision and Strategy Framework (LVVSF). The LVVSF thematic areas are Ecosystems, Natural Resources and Environment, Production and Income Generation, Living Conditions and Quality of Life, Population and Demography and Governance, Institutions and Policies and three themes of GEF of Biodiversity International Waters and Sustainable Land Management.

Table 5.1 below provides specific mitigation measures to address environmental degradation, the ecological quality objectives (EQOs) to facilitate consensus on the desired state of the Lake Victoria during the coming decade.

Key for Table 5.1

Indicators

PI: Process indicator
SRI: Stress reduction indicator
ESI: Environmental status indicator

LVEMP II – Pillars

SED: Socioeconomic Development
M: Management Framework
AR: Applied Research

GEF Themes

SLM: Sustainable Land Management
IW: International Waters
BD: Biodiversity

Type of Interventions

Investment
Scientific Investigation
Institutional Strengthening and/or Capacity building
Legal and/or regulatory reform

Table 5.1: Ecological Quality Objectives for the Basin

Cluster: Ecosystem and Natural Resources and Environment						
EQO I – Sustainable Land Use of the Basin environment						
MPPIs	Targets	Interventions	Type of Intervention	LVEMP-II PILLARS	GEF THEMES	Indicators
Soil Erosion and Land Degradation	Develop and Implement Land Use plans (including spatial plans) in the five riparian countries by 2012.	1. Carry out Land use planning and management, including adoption of Integrated Watershed Management Plans,	Investment	M	SLM	PI: Land Use Plans developed and implemented PI: Land use planning guidelines developed and harmonized.
		2. All riparian countries develop full environmental, socioeconomic, water and land-use and other related information databases such as GIS on the Basin by 2012.	Scientific Investigation	M	SLM	PI: Databases developed and operational
		3. Capacity building in land use planning	Investment	M	SLM	PI: Level of capacity built for land use planning
		4. Survey the sensitive areas and habitats (hotspots) in the Basin exposed to anthropogenic and natural impacts; (Soil erosion risk mapping)	Scientific Investigation	M & AR	SLM	PI: Soil erosion risk hazard maps PI: Action Plans on sensitive territories PI: Legislative instruments on protection.
		5. Develop Action Plan for sensitive eco-system/habitat; and				
		6. Develop necessary recommendations for legislative protection.				
		7. Strengthen planning authorities in the riparian local governments and implement land use plans by 2016.	Institution strengthening & investment	M	SLM	PI – Convention ratified and its provisions implemented SRI – Impact of economic activities on biodiversity reduced
		8. Harmonise policies Legal and Institutional frameworks related to land use and water resources	Legal/regulatory	M	SLM	PI: Harmonized laws and regulations
	50% of all arable and grazing land put under sustainable land husbandry (soil & water conservation,	1. Strengthen awareness on sustainable land husbandry	Institutional strengthening and Capacity building Investment	M & SED	SLM	PI, SRI & ESI – Level of awareness on sustainable land husbandry
		2. Carry out integrated watershed management planning and implement IWRM plans in the whole Basin	Investment	M & SED	SLM	SRI, PI – Number of plans developed and implemented

	agro-forestry, pasture improvement etc) within 10 yrs	3. Promote Sustainable Land Management (SLM) including rangelands	Investment, Capacity building	M & SED	SLM	PI &SRI – Level of awareness on land management and rangelands
		4. Promote Watershed Management	Investment, Capacity building	M & SED	SLM	PI &SRI – Level of awareness on watershed management
		5. Intensify sustainable use of agricultural inputs (fertilizers etc) to increase output per unit area.	Investment	M &SED	SLM	PI & SRI: agricultural output, increased incomes (only linked to fertilizer use)
Deforestation & Shortage of energy	Area under forest cover increased (20% of the Basin area to be under forest cover in 20 yrs from 2008)	1. Carry out massive tree planting using appropriate multipurpose tree species	Investment	M & SED	SLM	ESI & SRI: Number of trees planed ESI & SRI: Area planted ESI & SRI: Survival rates of trees
		2. Reclaim all forest degraded areas	Investment	M & SED	SLM	ESI: Area reclaimed
		3. Value addition to forestry and forestry products	Capacity building and Investment	M & SED	SLM	PI: Value added in forestry products
		4. Improve Market Access 5. Encourage wise use and sustainable exploitation of forest and land resources and all natural resources.	Investment	M & SED	SLM	PI: amount of forestry products marketed
		6. Harmonise policies Legal and Institutional frameworks related to forestry	Legal and/or regulatory reform	M	SLM	PI: harmonized policies, laws and regulations
		7. Develop and implement alternative sources of energy	Scientific investigation and investment	M & SED	SLM	PI & SRI: Level of effective alternative sources of energy in use
		8. Minimize the drive to degazette national forests and if done must be based on scientific information	Institutional strengthening and capacity building Investment	M & SED	SLM	ESI, SRI & PI: Number of forest reserves gazetted
River bank and Lakeshore Degradation	River banks and Lake shore rehabilitated by 50% in 20 years from 2008	1. Reclaim all marginal areas, river banks, and lakeshore degraded areas 2. Carry out massive tree planting using appropriate multipurpose tree species 3. Harmonize policies Legal and Institutional frameworks related to fragile ecosystems such as river banks, lake shores and other marginal lands 4. Promote Watershed Management	Investment	M & SED	SLM	ESI & SRI: Number of trees planted ESI & SRI: Area planted ESI & SRI: Survival rates of trees ESI & SRI: Area reclaimed

Cluster: Ecosystems, Natural Resources and Environment, Production and Income Generation, Living Conditions and Quality of Life, Governance, Institutions and Policies						
EQO II - High Quality of the Basin, surface and ground waters that sustain both human and other uses Sustainable Land Use of the Basin environment						
Pollution (point and non point source) Water Quality Deterioration	Reduce pollutant/contaminants loads from point and non point sources, entering the Lake by 50% by 2015	1. Governments buy-off of the already and degraded wetlands	Investment	M	SLM	PI: Number of degraded wetlands bought-off and rehabilitated
		2. Implement integrated watershed management Programmes	Investment	M & SED	IW, SLM & BD	SRI: Number of Integrated Water shed Management Plans implemented
		3. Review of National policy, legal, and regulatory frameworks, and institutional structure for addressing adverse land-based activities	Legal and/or regulatory reform Institutional strengthening	M	SLM, IW & BD	PI: Reviewed Policy, regulatory and functional institutions
		4. Identify sources of atmospheric deposition and implement control measure	Investment & Scientific Investigation	M & AR	IW, BD & SLM	ESI, & PI: Identified sources of Atmospheric deposition and control measures in place
Eutrophication and Siltation	Develop and Implement Integrated Water Resources Management (IWRM)(including spatial plans) in the five riparian countries by 2010	1. Carry out integrated water resources planning and management,	Investment	M & SED	SLM, IW & BD	PI: Integrated Water shed Management Plans implemented No conflicts on water resources by different users
		2. All riparian countries develop full environmental, socioeconomic, water, land-use and other related database on the Basin by 2010.	Scientific Investigation	M	SLM, BD & IW	PI: Integrated database systems in place and functional
		3. Capacity building in integrated water resources planning	Institutional Strengthening and/or Capacity building Investment	M & SED	SLM IW & BD	PI: level of capacity built in integrated water resources management
		4. Strengthen water resources development authorities in the riparian local governments and implement IWRM 2016.	Institutional strengthening and investment	M & SED	SLM, IW & BD	PI: level of capacity in riparian local authorities for IWRM
		5. Harmonise policies Legal and Institutional frameworks related to Water resources	Legal and/or regulatory reform	M	SLM, IW & BD	PI: Harmonised policy, regulatory and functional institutions
Water Hyacinth and other invasive weeds	Control hyacinth and other weeds infestation to below non nuisance level by 10%	1. Control environmental factors e.g. nutrients which promotes proliferation of the weed	Investment	M & SED	SLM, IW & BD	ESI: Levels of nutrients
		2. Develop and implement a comprehensive water hyacinth and other weeds programmes in the Basin with the emphasis to build capacities in especially Burundi and Rwanda	Investment Capacity building and institutional strengthening	M & SED	SLM, IW & BD	ESI & PI: Comprehensive water hyacinth and other weeds management programmes in place

		3. Control water hyacinth and other weeds at the source (Kagera, Nyabarongo and Akanyaru)	Investment	M & SED	SLM, IW & BD	ESI: Level of infestation ESI: Area covered
Cluster: Ecosystems, Natural Resources and Environment, Production and Income Generation, Living Conditions and Quality of Life, Governance, Institutions and Policies						
EQO III: Optimal Quantity and balanced water resources in the Basin						
Fluctuations of Water Levels	Per capita storage tripled, regulated and water levels sustained through IWRM by 2015	1. Implement IWRM in the Basin	Investment	M & SED	IW & BD	PI: Integrated Water shed Management Plans implemented PI: No conflicts on water resources by different users
		2. Review the policy guiding release of water at Jinja to that which promotes storage	Legal and/or regulatory reform Institutional strengthening	M	SLM, IW & BD	PI: Reviewed Policy, regulatory and functional institutions
		3. All water users to follow allocation guidelines with in the next 5yrs	Legal and regulatory reform and institutional strengthening	M & SED	IW & BD	PI: Amount of water allocated and used
Cluster: Ecosystems, Natural Resources and Environment, Production and Income Generation, Living Conditions and Quality of Life, Governance, Institutions and Policies						
EQO IV: Conservation of the Basin Aquatic Biodiversity						
Declining in Fisheries	Increased annual yield of fish and biodiversity by 10%	1. Reduce and control rising fishing pressure and manage fishing capacity to optimum levels.	Investment Institutional strengthening and capacity building	M & SED	BD	PI: Level of fishing effort and fishing capacity ESI: annual fish yields
		2. Determine fish stocks and their sustainability and evaluate if can meet current demand	Scientific investigation	AR	BD	ESI: Level of fish stocks
		3. Restock to enhance fish production where appropriate	Investment	M & SED	BD	ESI & PI: Number of introductions and levels of yields
		4. Intensify fish farming production (Aquaculture) in the Basin	Investment	M & SED	BD	PI: Number of productive aquaculture farms in the Basin PI & ESI: Yields from aquaculture
		5. Diversity fish farming and explore possibilities of cage farming	Scientific investigation Investment	AR & M	BD	PI & ESI: Number of productive cage farms in the Basin ESI & PI: Yields from cage culture
	Increase fish	1. Determine fish stocks and their sustainability and evaluate if can meet current demand	Scientific investigation	AR	BD	ESI: Level of fish stocks

	stocks to sustainable levels within 10yrs	2. Control fishing pressure and apply other management measures.	Investment Institutional strengthening and capacity building	M & SED	BD	PI: Level of fishing effort and fishing capacity ESI: annual fish yields
		3. Restock to enhance fish production where appropriate	Investment	M & SED	BD	ESI & PI: Number of introductions and levels of yields
	Reduced post harvest fish losses to 1% in 5 yrs	1. Improve fish handling infrastructure in the Basin	Investment	M & SED		PI: Number of modernized fish infrastructure in place
		2. Invest in facilities for post harvest storage	Investment	M & SED		PI: Number of modernized fish post harvest in place
		3. Add value to fisheries products	Investment	M & SED		PI: Valued added on fisheries products
	Wetlands destruction	All degraded wetlands within the Basin restored with in 20 yrs	1. Promote wise use of wetlands	Investment, Capacity building	M & SED	SLM
2. Carry out assessment of all wetlands and mapping			Scientific investigation & institutional strengthening and capacity building	AR & M	SLM	PI: number of wetlands assessed PI: Declared protected area ESI: Wetland maps
3. Harmonise policies and Legal frameworks relevant to wetlands at National Regional level			Legal and/or regulatory reform	M	SLM	PI: harmonized policies, laws and regulations
4. Governments buy-off of the already and degraded wetlands			Investment	M	SLM	PI: Number of degraded wetlands bought-off and rehabilitated
Loss of biodiversity	All existing and potential wildlife areas and nature reserves identified and protected by 2015	1. Promote wise use of wildlife and nature reserves e.g. ecotourism	Investment, Capacity building	M & SED	SLM	PI & SRI – Level of awareness on wise use of wildlife and nature reserves
		2. Carry out assessment of all existing and potential wildlife and nature reserves and map them	Scientific investigation & institutional strengthening and capacity building	AR & M	SLM	PI: number of wildlife and nature reserves assessed PI: Declared protected areas ESI: wildlife and nature reserve maps
		3. Carry community awareness and sensitization programmes on natural resources				
		4. Harmonise policies and Legal frameworks relevant to wetlands at National Regional levels				

Cluster: Ecosystems, Natural Resources and Environment, Living Conditions and Quality of Life, Governance, Institutions and Policies						
EQO V: Regionally harmonized, and coordinated Policies, Legal and Institutional frameworks						
Weak Legal, Policy and Institutions at all levels	All policies, legal and institutional frameworks reviewed, harmonized and implemented in 5 years	1. Develop, review, harmonize and implement all policies, laws and institutions related to natural resources and environment	Investment, Scientific Investigation Institutional Strengthening and/or Capacity building Legal and/or regulatory reform	M, AR & SED	IW, BD & SLM	ESI & PI: Number of laws and policies reviewed and implemented
Cluster: Ecosystems, Natural Resources and Environment, Production and Income Generation, Living Conditions and Quality of Life, Governance, Institutions and Policies						
EQO VI: Improved socioeconomic and living standards in the Basin						
Problems related to socioeconomics	Half of the Basin population access to clean water, health and education by 2015	1. Invest in water and sanitation, education and health facilities	Investment	SED & M	IW, BD & SLM	PI: Number of people served PI: Number of healthy population and number of operational health facilities PI: Primary, Secondary and University enrolment
	Poverty levels within the riparian communities reduced by 50% by 2020	1. Modernise farming practices in the Basin	Investing	M & SED	SLM	PI: Income and poverty levels
		2. Improved fair market access	Investment and scientific investigation	M, AR & SED		PI: Amount of Basin resources marketed
		3. Improve access to micro credits	Investment	M & SED		PI: Number of operational micro finance institutions PI: level of borrowing and lending PI: Level of use of credits for socioeconomic development PI: Credit recovery rates
		4. Introduce gender sensitive programmes	Investment	M & SED		PI: number of vulnerable groups engaged in socioeconomic activities. and accessing basic social facilities
	30% costs of managing environment and	1. implement polluter and user pay principles	Investment	M & SED		PI: amount of money collected from users and polluters and used for conservation ESI: level of pollution

	natural resources paid from environment and natural resource services	2. Introduce and implement economically viable levies and/or charges for all environmental services	Investment	M & SED		PI: amount of money collected from levies and charges and used for conservation ESI: ecosystem conserved
Impacts of climate change and disaster preparedness	50% of the Basin serviced with monitoring and early warning systems within 10 years	1. Develop and implement monitoring systems for all environment and natural resource parameters	Investments	M & SED	SLM, IW, BD	PI: Number monitoring systems PI: information generated
		2. Develop and implement early warning systems for disaster preparedness on all environment and natural resource parameters	Investment	M & SED	SLM, IW, BD	PI: Number early warning systems PI: Information generated

SECTION SIX: RISKS AND SUSTAINABILITY

6.1 Risks

There are some important risks that may arise due to implementing interventions and also for not observing proposed mitigation measures in the RTDA. These encompass events such as:

a) Lack of Commitment by the Basin countries: Success of the proposed interventions critically depends on the commitment of the five countries of the Basin to the proposed collaborative/cooperative institutional frameworks; and to achieving the objectives of the second phase of the Lake Victoria Environmental Management Project (LVEMP). Factors such as political instability, poverty and diseases might pose a great risk to realization of proposed mitigation measures identified in the RTDA. The commitment is intimately related to political stability and other factors, and, therefore, it becomes a crucial and important element of the proposed interventions to have success and tangible benefits. The emphasis on regional cooperation and the collaborative efforts that have been made resulting into the preparation and ownership of this RTDA are powerful instruments for not only achieving the desired objectives but also for accomplishing the long-term trust and understanding among all players. In addition, the Key Note Addresses given by the five Heads of State during the 8th Summit Meeting of the EAC emphasized on the Regional Integration, Governance and Environmental protection; and they should, therefore, be adhered to.

b) Weak or Inadequate Governance: This is an area of crucial importance in the successful implementation of programs and projects in the region because successes of programs are highly dependent on good governance, transparency and accountability. The absence of these elements poses a risk to implementation of programs. It is, therefore, imperative that the riparian countries of the Basin remain committed to good governance, transparency and accountability for the successes of the proposed mitigation measures in the RTDA.

c) Weak/limited Regional Coordination Capacity: A strong regional coordination mechanism by the LVBC is crucial to the successful implementation of the proposed mitigation measures in the RTDA. Therefore, there is need to strengthen the LVBC and other relevant institutions so as to realize the Basin's objectives and mitigation measures proposed in the RTDA. The presence of able regional institutions is important. For instance, LVBC is responsible for the enhancement and coordination of the harmonization of policies and regulations to enable effective management of transboundary issues within the Basin.

d) Weak/limited National Institutional Capacity: The RTDA identified that all the five countries, in one way or another, face institutional capacity constraints and this poses a risk to the implementation of mitigation measures in the RTDA. This calls for a need to also strengthen the national coordination units.

e) Governments Policies and Regulations: Constraints to remedial action include Government policies that inadequately address environmental challenges and trans-boundary issues/threats. Regional frameworks and standards are also inadequate. The enforcement mechanisms for Government regulations are also weak posing a risk to the implementation of proposed mitigation measures. Therefore, the planned transformation of the Protocol to an act by the Partner States will greatly enhance this process.

f) Climate Change: Occasionally manifested by droughts, floods and global warming phenomenon poses a high risk to the implementation of the mitigation measures. This calls for a joint concerted effort in the establishment of an early warning and monitoring system, data collection and information sharing and the

implementation of integrated watershed management plans such as Integrated Water Resources Management (IWRMs).

g) Fiscal Sustainability: The EAC Partner States currently finance the recurrent costs of the EAC Secretariat, including the Lake Victoria Basin Commission. The success of this initiative is pegged on the assumptions that Partner States will continue to adequately finance the proposed interventions. If Partner States will fail to contribute financial resources and support regional initiatives, then proposed interventions in the RTDA are risked.

g) General instability: In recent years, the Great Lakes Region had been daunted by incidences of insecurity giving rise to civil strife and wars. The region is, however, gradually becoming stable and peaceful. The accession of the States of Burundi and Rwanda into the East African Community will consolidate the emerging peaceful and stability situation. There are currently political efforts within the Great Lakes Region to put in place mechanisms for addressing conflicts. However, should instability become prevalent, then there is a risk of all the partners becoming unable to implement the interventions proposed in the RTDA.

6.2 Sustainability

a) High Level of Government Commitment: The success of these interventions requires that high-level commitment both at national and regional level be maintained. The programme is fully integrated into the existing development programmes and national and regional institutional framework.

The Participating Governments should see the proposed interventions as offering the possibility of moving beyond isolated planning and unilateral actions, in a non-cooperative and possibly confrontational setting, towards cooperative development planning in the utilization of trans-boundary resources seeking “win-win” opportunities in the spirit of equitable utilization and benefit sharing.

b) Project Ownership: Through the participatory process of project design, so far, every effort has been made to ensure that the people of the five countries genuinely own the proposed interventions. Local communities, NGOs and the Private Sector have been engaged in the national and local consultations underlying the RTDA and this, therefore, indicate their commitment and ownership of the project. The spirit should continue during implementation.

c) Tangible Benefits: Another important concern is whether the project outcomes will, indeed, result in tangible benefits for local communities. The project, primarily, targets the local communities, who are the major beneficiaries, as a potential incentive for participation, continuity and sustainability.

d) Financial Continuity: Some projects will entail costs beyond their life-span and where this is the case, mechanisms for long-term sustainable financing should be explored and piloted during implementation of the project. It is expected that, where the project has led to tangible benefits on the ground, costs are likely to be covered by the beneficiaries of the project. Other potential innovative strategies to be tested by the Basin countries could include user fee for ecosystem services and the operationalisation of the Fish Levy Trust in Uganda, Kenya and Tanzania.

e) Regional Cooperation: Project sustainability will also depend on maintaining and strengthening the growing regional cooperation among the Basin countries. The accession of the States of Burundi and Rwanda into the East African Community, with effect from July 2007, should be seen as strength towards jointly and sustainably managing the Basin and its resources.

SECTION SEVEN: CONCLUSION AND RECOMMENDATIONS

7.1 Conclusions

There are missing data and information gaps; mismanagement of environmental threats emanating from human activities and also weaknesses in the existing institutions in the overall management of the Basin natural resources; and, therefore, it can be concluded as follows:

1. For a permanent solution and bringing to halt the problem of data scarcity in the region, there is need to effectively plan and improve data collection regarding water quantity, water pollution, watershed and general environment, policy, laws and institutional capacities, as well on the financing mechanisms for the projects;
2. There is need to strengthen, monitor and control of anthropogenic activities in the Basin that are the root cause of loss of important ecosystems; public awareness programs geared to sensitize public on the ongoing environmental destruction; encourage regional interventions and incorporation of harmonized principles, policies, strategies, laws and other agreements into national legislation to enhance enforcement; and increasing environmental education and awareness among communities;
3. There is need to strengthen regional institutions, and in particularly LVBC, to enhance the coordination and harmonization of policies and regulations for effective management of transboundary issues in the Basin, and, lastly but not least,
4. Partner States should continue availing financial resources and support regional initiatives and proposed interventions in the RTDA.

7.2 Recommendations

The following mitigation measures are recommended from this RTDA, based on the six thematic areas:

- i) A successful intervention should aim to improve **land use management** by designing and implementing integrated watershed management, developing capacity in land use planning, massive tree planting and protection, controlling livestock overstocking and encouraging private-public sector partnership.
- ii) Active community participation programme to enhance **environmental management** should be put in place, which shall include among others strengthening, monitoring and control of human activities causing the loss of important ecosystems within the Basin; carrying out public awareness on trans-boundary environmental issues; incorporation of regionally harmonized principles, policies, strategies, laws and other agreements into national legislation to enhance enforcement; and increasing environmental education and awareness among communities.
- iii) Local Authorities and inhabitants should be encouraged to practice **proper management of wetlands** by promotion of wise use strategies, conducting a detailed assessment of wetlands in the Basin, protection of critical wetlands and creating awareness on values of wetlands for water treatment.

- iv) Fisher folks and other interested beneficiaries should be encouraged to sustain **fisheries activities** by promoting all user friendly practices, harmonizing fishing regulations among the riparian countries; reviewing and controlling open access fishing, strengthening enforcement of agreed and harmonized regulations, strengthening co-management through Beach Management Units (BMU), protection of breeding and promoting appropriate aquaculture species and systems.
- v) Countries should conserve **biodiversity** through development and implementation of national and regional biodiversity strategies including species specific action plans; putting in place mechanisms for prevention of adverse human activities on sensitive areas and to reduce impacts of agriculture grazing and hunting practices including bush fires.
- vi) In order to bring to steady state and improve **Water Quality** there should be harmonization of water quality management legislation to address trans-boundary issues; investment in efficient solid, liquid and urban waste management schemes, cleaner production technologies; developing planning capacity of Local Government and subjecting all development plans, programs, projects and budgets to Environmental Impact Assessment (EIA) procedures before implementation.
- vii) Water security and proper decision on water distribution requires ample and correct **Water Quantity** information which should be gathered from regular and continuous data collection on climate, hydrology, inflows, outflows and water balance in the riparian countries; standardization of data collection equipment and instruments to ensure data uniformity; collection of more data on water circulation so as to understand fully the dynamics within the Lake; reviewing and strengthening of existing Regional River/Lake Basin Agreements; monitoring the water quantity, quality and utilization in major rivers; construction of water reservoirs, dams and flood protection devices along flood prone rivers.
- viii) Regarding **Policy, Laws and Institutions** there should be a formulation and implementation of an Integrated Lake Basin Resources Management Plan; harmonization of existing Policies, Laws and Institutional frameworks and mandates to facilitate sharing of information and data; strengthening of regional and national government policies and management procedures; expansion of areas of international and regional cooperation, including technology transfer, personnel and information exchange; development of regional policies that addresses various sectors; and encouraging sharing of research data and information within the Basin.

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ANNEXES

- Annex 1: Terms of Reference
- Annex 2: Burundi National TDA
- Annex 3: Kenya National TDA
- Annex 4: Rwanda National TDA
- Annex 5: Tanzania National TDA
- Annex 6: Uganda National TDA
- Annex 7: Appendices to RTDA
- Appendix 1: List of Stakeholders in the Lake Victoria Basin (LVB)
- Appendix 2: List of Stakeholders consulted during the regional Validation
- Appendix 3: List of participants in the Inception Workshop held in Mwanza
- Appendix 4: Physical, Geographical and Demographic Characteristics
- Appendix 5: Agricultural land use in the Kenyan Lake Victoria Catchment (2004)
- Appendix 6: Land under cultivation in Kagera Region, Tanzania in 2001
- Appendix 7: Major land use types in the Lake Victoria Basin- Uganda
- Appendix 8: Distribution of Wildlife Parks, Game Reserves and Protected Areas
- Appendix 9: Summary of yields of sediments (TSS), TN and TP for the rivers
- Appendix 10: Summary of annual loads from total discharge in the rivers
- Appendix 11: Heavy metal concentration in fish tissues (*O. niloticus*)
- Appendix 12: Heavy metal concentrations (ppm) (mean \pm SEM) in sediment sample
- Appendix 13: Fish Biodiversity in Lake Victoria in form of trophic groups
- Appendix 14: A Checklist of zooplankton species identified in Lake Victoria
- Appendix 15: TDA Decision Ranking Matrix for Policies, Laws and Institutions
- Appendix 16: Causal –Effect- Chain Analysis for Policy
- Appendix 17: Causal –Effect- Chain Analysis for Laws
- Appendix 18: Causal – Effect - Chain Analysis for Institutions
- Appendix 19: Policy, Legislative and Institutional Weaknesses/Gaps
- Appendix 20: Typical Algal Bloom in Lake Victoria at Mwanza
- Appendix 21: The current dominant algal sp in Lake Victoria
- Appendix 22: Copepoda, Cladocera and Rotifera of Lake Victoria
- Appendix 23: Examples of common aquatic macro-invertebrates in Lake Victoria
- Appendix 24: Harvesters dredging Water hyacinth in Murchison Bay