

Thematic Paper:

Lake Basin Management Problems in Africa: Historical and Future Perspectives.

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1. Introduction

The African Great Lakes comprise a chain of fresh and alkaline water reservoirs located mainly in the Greater and Lesser Eastern and Central Rift Valley (Fig.1). Apart from Lake Chad and the man made Lake Kariba, the remaining Lakes Baringo, Malawi/Nyasa, Tanganyika, Victoria, Naivasha and Nakuru are situated in the Rift Valley and are tropical lakes. Each has its splendid and curative beauty that for aesthetic reasons alone earn them posterity (Figs. 2-7). The age of the oldest lakes range from 7 to 12 million years. Youngest, except for Lake Kariba, is about 400,000 years. Each lake has its own unique catchments basin with its own variety of endemic species. Table 1 presents unique characteristics of these lakes that focus attention to their conservation. All the lakes are used for the support of fast expanding human population. The riparian communities have increased with time. For example, the riparian population around L. Victoria in 1820 was around three million. This increased to 4.6 million in 1932 and stands at 27.7 million in 1995 (Verschuren et al. 2002, United Nations 1995). The trend in population increase is projected to be about three percent for all riparian communities around all the lakes. The increase for Lake Victoria communities will be 53 million by 2030 (United Nations 1995). The riparian population around the other lakes are L. Tanganyika, 10 million, and L. Malawi, 11 million. L. Kariba riparian community population growth is reflected in Kariba town population increase which grew from under 5,000 in the early sixties to 30,000 by the end of the century. L. Chad is home to about 20 million people, according to Lake Chad Basin Commission (LCBC). These include 11.7 million in Nigeria, 5.0 million in Chad, 2.5 million in Cameroon, 634,000 in Central African Republic (CAR) and 193,000 in Niger. L. Naivasha has a riparian population of over 250,000 people in its vicinity that gets its domestic water from the lake and its aquifer (Gichuki and Gichuki, 1992). L. Nakuru has seen its major town population grow at seven percent to 360,000 in 1995.

The lakes have experienced rapid expansion of riparian population growth as a result of flourishing urban centres, Agricultural activities, volume of trade and commercial activities in their vicinities, easy transport and communication through them. Some of the riparian communities have experienced dramatic political conflicts. The Uganda, Rwanda, Burundi, Democratic Republic of Congo and Chad Republic civil wars have resulted in Ecological modifications of the affected Lakes Victoria, Tanganyika, Kivu, Edward and Albert. The above factors together with weak governance structures have contributed in increasing the pollution levels of the Lakes. The Rift Valley Lakes are unique and special in several ways L. Victoria is the second largest fresh water Lake in the world. Lake Tanganyika is approximately 12 million years old (Scholz and Rosendall 1988). It is the oldest of the African Lakes and only second to Lake Baikal in age and depth. Lake Malawi/Nyasa, Victoria and Tanganyika are famous for their endemic species flocks of cichlid fishes; L. Malawi hosts a large flock of 700+ species, L. Tanganyika 250+ and L. Victoria 500+ cichlid species (Snoeks 2000, Seehausen 1996, Snoeks,

1 teal. 1994). In addition to fish species they have a rich biodiversity ecology (Coulter 1994,
2 Hughes and Hughes 1992, Gichuki and Gichuki 1992). They are home to special animal and fish
3 species as shown in Table 1. They provide water or electricity, for example, L. Victoria is one of
4 the sources of River Nile whose waters Sudan and Egypt are so dependent for agriculture and
5 household use. Both Lakes Kariba and Victoria provide water for electricity generation in
6 Zambia, Zimbabwe, and Uganda and is the reservoir of many rivers water in the other East
7 African countries. The Lakes have special economic value and resource base for the riparian
8 communities.

9 **Figure 1. The Great Rift Valley Lakes**

10
11 **Figure 2. Lake Victoria (Photo: M. Nakashima)**

12
13 **Figure 3. Lake Tanganyika (Photo: S.Yamagishi)**

14
15 **Figure 4. Lake Malawi/Nyasa (Photo: Bootsma)**

16
17 **Figure 5. Lake Nakuru (Photo by Adams)**

18
19 **Figure 6. Lake Kariba (Photo: N. Hata)**

20
21 **Figure 7. Lake Chad. Source: Hutchinson and Kolawole (1987)**

22
23 **Table 1. Unique characteristics of the lakes.**

24
25 On the other hand, each lake differs from the other with respect to limnology, catchments
26 dynamics and human impacts (Hamilton, 1982). However, one thing in common to all the lakes
27 is that they face unprecedented differentiating pressures from a variety of human related
28 activities. The critical issues facing the lakes include rapid riparian population growth,
29 unsustainable exploitation of fisheries and other living resources (over exploitation), pollution-
30 microbiological and chemical, eutrophication, suspended soils arising from deforested
31 catchments areas, fresh water shortage, global change, habitat and community modification. The
32 rapidly evolving ecological changes occurring in these lakes threaten their survival as sites of
33 great human heritage and may alter permanently their ecosystem function and overall
34 biodiversity (Hecky and Bugenyi, 1992).

35
36 Efforts to increase food productivity have resulted in the introduction of alien species to all of the
37 lakes. The introduced alien species have accelerated the extinction of indigenous species in some
38 lakes and may have altered the ecology of these lakes. Such human experimentations have had
39 disastrous results in shallow lakes like L. Victoria, L. Chad and L. Naivasha. Industrial and
40 commercial activities have blossomed around these lakes with the establishment of small and
41 large industries in urban centres which today spew high loads of untreated industrial waste,
42 sewage and solid waste into the lakes. Poor farming practices, firewood and charcoal burning
43 activities have resulted in deforestation of the catchments. High nutrient and soil loads have
44 entered the lakes through basins' drainage rivers. Global climate change, high demand for
45 irrigation waters, unpredictable weather condition extremes have potential risks for fresh water
46 shortage, lake temperature change, silted lake shores and beds, altered ecology that have already

1 started affecting the lakes or are foreseen in the future scenarios. Several socio-economic issues
2 such as wide spread poverty, diseases like malaria, cholera, typhoid, tuberculosis and HIV/AIDS
3 have serious implications on the riparian communities and may affect the management of the
4 lakes. Conflicts such as between man and wild animals, between communities over the use of
5 water, between farming, urban and indigenous communities have arisen. The basins environment
6 does not have, if any, infrastructural development nor do the communities have resources to
7 develop one without external assistance.

8
9 Therefore, it is concluded that deterioration of the African Great Lakes has resulted from the
10 following major causes:

- 11 • Rapid population growth of the riparian communities with concomitant rapid
12 expansion of urban centres
- 13 • Large demand of export markets for fisheries with no improvement of fish
14 handling capacities and technologies
- 15 • Lack of compliance to and enforcement of legislations governing fisheries
16 industry and environmental pollution
- 17 • Weak regional integration of legal, institutional and implementing mechanisms
18 for sustainable ecosystems management
- 19 • Low level of community participation in ecosystems management due to lack of
20 education and public awareness of issues
- 21 • Pervasive prevalence of endemic disease like malaria, HIV/AIDS, typhoid,
22 cholera and tuberculosis that reduce productivity of people.

23
24 Several communities, national, regional, and international efforts to save these lakes have been
25 initiated. Experiences and lessons learned from living with the people made and natural changes
26 on the lakes, efforts to ameliorate the pressures are reviewed in this paper.

27 28 **2. Background**

29 30 **2.1 Description: Geographical, socio-economic, physico-chemical and environmental** 31 **characteristics of the lakes' basins**

32
33 The African Great Lakes are situated in an area stretching from the Gulf of Eden covering
34 Ethiopia, Kenya, Uganda, Republic of Congo, Rwanda, Burundi, Tanzania to the northern parts
35 of Mozambique and Zambia (Fig.1). Some of the main lakes in the region include Victoria,
36 Tanganyika, Malawi/Nyasa, Turkana, Albert, Edward, George, and Kivu. All are typical tropical
37 lakes and are generally referred to as African Great Lakes eco-region (WWF SARPO, 2001).
38 The large lakes of East African Rift Valley (Fig.1) are unique natural resources that are heavily
39 utilised by their bordering countries for transportation, water supply, fisheries, waste disposal,
40 recreation and tourism. Over fishing, siltation from the erosion of deforested basins, species
41 introductions, industrial pollution, eutrophication and climate change are all contributing to a
42 host of rapidly evolving ecological changes in the lakes' basins that seriously threaten their
43 ecosystem function and overall diversity (Odada, et. al. 2003a; Hecky and Bugenyi, 1992). Lakes
44 Chad and Kariba are included in this review because the former is fast disappearing and the latter
45 is one of the largest man made lakes. The physiographic statistics of each lake are given in
46 Tables 2 to 10. Each lake exhibits a distinct physiographic feature that is rarely repeated except

1 for transparency and dissolved oxygen. There is a steady decline in some of the features like
2 transparency, dissolved oxygen, siltation and depth over time as a result of anthropogenic
3 activities.

4
5 **Table 2. Physiographic statistics for Lake Victoria**

6
7 **Table 3. Physiographic statistics for Lake Tanganyika**

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9 **Table 4. Physiographic statistics for Lake Malawi/Nyasa**

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11 **Table 5. Physiographic statistics for Lake Naivasha**

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13 **Table 6. Physiographic statistics for Lake Nakuru**

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15 **Table 7. Physiographic statistics for Lake Baringo**

16
17 **Table 8. Physiographic statistics for Lake Chad**

18
19 **Table 9. Physiographic statistics for Lake Kariba**

20
21 **Table 10. Physiographic Statistics for Lake Malawi/Nyasa**

22 23 **2.2 Biophysical Features**

24
25 Fig 8 gives the Lake Victoria catchments basin. The ecology of the basin has seen rapid changes
26 resulting from agricultural practices, thus has resulted in massive deforestation of forests
27 originally found in the area before independence in the 1960s. Poor agricultural practices have
28 resulted in increased soil erosion and particulate deposits in the lake. Massive soil erosion has
29 been experienced in Rwanda, Burundi and Kenya. The three countries contribute most of the
30 nutrients load deposited into the lake (Odada, et. al. 2003b).

31 32 **(Fig 8) Lake Victoria Catchments Basin**

33
34 All the African great lakes have had similar experience of rapid ecological alterations in their
35 basins. The changes that occurred are represented by what happened in L. Nakuru. For example
36 Nakuru Town near Lake Nakuru in 1930 was just a railway station. The forests were untouched
37 and rangeland was unaltered (Fig. 9). However, between 1986 and 1998 as depicted in Figs. 10
38 and 11 considerable changes took place with the development of the town and the introduction of
39 farming activities. In slightly over one decade, the catchments forest cover reduced to small
40 patches (Fig. 11). Farming, illegal logging and urbanisation replaced the once thick forests.
41 Demand for fresh water withdrawals increased and further reduced the river water volumes
42 flowing to the lake. Similarly, Lake Chad has possibly received the worst combined human and
43 natural degradation effects. Today, this lake that was once possibly the largest in Africa has been
44 reduced to a pond during some seasons (Hutchinson and Kalowale, 1987).

45 46 **Figure 9. Lake Nakuru Catchments Basin (1930)**

1
2 **Figure 10. Lake Nakuru Catchments Basin (1986)**

3
4 **Figure 11. Lake Nakuru Catchments Basin Changes (1998)**

5
6 All the lakes are situated in valleys that are fed by rivers draining the catchments. The states of
7 these rivers have changed with increased human population that has resulted in high farming
8 activities and deforestation. Today these rivers have high loads of nutrients and pollutants that
9 are drained into the lakes. For example, increased nutrient flows into Lake Victoria, coming
10 mostly from rural areas (Verschuren, et. al., 2002) have been estimated to range between 69×10^7
11 kg/yr to $1.98 \times 10^{10} \text{ kg/yr}$. L. Tanganyika receives 1.500 mm sediment load per year in the
12 southern basin, 0.500 mm sediment load per year in the central basin and 47.00 mm per sediment
13 load year in the northern basin, while Lake Victoria receives 2.3 mm per year of nutrient load
14 (silt, P, N and others) (Odada, et al., 2003a; Verschuren, et. al., 2002). Most of this results from
15 poor agricultural practices. Fertilizer use is less in the catchments basin farms compared to other
16 basins but it may be estimated that the P and N nutrients are released mainly from soil particles
17 washed off the upstream farms and land by erosion; from burning wood-fuels and industrial
18 particulates that are transported by air and deposited into the lakes; household detergents
19 released into the untreated sewer dumped into the lake; human and animal waste from
20 municipalities and areas surrounding the lake all find their way to the lakes. The increased inflow
21 of nutrients into Lake Victoria is resulting in eutrophication. Phosphorus and nitrogen
22 concentrations have risen and algal growth has increased five-fold since the 1960s. A shift of
23 algal flora composition towards blue-green algae is causing deoxygenation of water, health
24 problems for humans and animals drawing water from the lake, clogging of water intake filters
25 and increased treatment costs for urban centres. Deep water species have sharply declined and
26 periodic upwelling of hypoxic water has caused massive fish kills (Talling, 1966, Verschuren, et
27 al., 2002).

28
29 Urbanization has led to destruction of littoral zone habitat, poorer water quality, and increased
30 nutrient load, which in turn, has led to anoxic conditions in some areas of the lake, triggering
31 massive indigenous fish die-offs in lakes Victoria, Naivasha, Nakuru, Baringo and Chad
32 (Hutchinson and Kalowale, 1987; Verschuren, et. al., 2002; Oguttu-Ohwayo, 1990 and Witte, et.
33 al, 1992). Some exotic species introduced into these lakes like the Nile perch may be better
34 adapted to live in the lake as it now exists; perch have better vision at low light and do not
35 require use of the littoral zone for cover and breeding. Haplochromines, on the other hand, have
36 better daylight vision, and with some of the lakes now continually dusk-like, they are less able to
37 avoid predators. In addition, Haplochromines traditionally relied on the littoral zone for breeding
38 and for protection, since the immobile waters of the littoral zone contain less oxygen and
39 dissuade perch from swimming there. The Haplochromines have been forced to come to the
40 surface where they found voracious predator, the Nile perch (Verschuren, et al., 2002).

41
42 The use of pesticides has intrinsic public health and environmental risks. Some pesticides are
43 toxic and others are suspected to be carcinogenic, mutagenic and endocrine disruptors. Despite
44 the reported rapid degradation of pesticides in tropical terrestrial, marine and freshwater
45 (Wandiga, 2001; Aryamanya-Mugisha, 1993) aquatic environments the potential for bio-
46 accumulation and bio-concentration of these pesticides even in the tropics (Taylor, et al, 2003)

1 poses serious ecological and health concerns for the lakes. Among the sources of pollution are a
2 number of basic industries such as breweries, tanning, fish processing, agro-processing, abattoirs
3 and mining whose waste discharge is increasing in parts of their catchments leading to
4 contamination of waterways by mercury (Kishimba, personal communication). Most of this
5 results from poor sewage treatment plants.
6

7 Human activities are affecting the lakes directly or indirectly. Global climate change resulting
8 from greenhouse gases effects may have started affecting the lakes. For example the recent
9 observation of rise in Lake Tanganyika's water temperature has been attributed to climate
10 change (Verburg, et. al., 2003). Similar observation has already been recorded for Lake Victoria
11 (Bugenyi and Magumba, 1996). Lake Chad is a worst example of impact of climate change
12 (Hutchinson and Kolawole, 1987). All the Great Lakes may be affected by climate change.
13

14 Table 11 gives the types of flora and fauna found in each lake. Except for the invasive species
15 like water hyacinth and water lilies that are found in four lakes, each lake has a distinct
16 characteristic of species. Indeed the table confirms the non-connectedness of these lakes. Their
17 biodiversity is distinctively unique and further argues for their special treatment.
18

19 **Table 11. Flora (Macrophytes, Phytoplankton's) and Fauna (Fish) found in the lakes**

20
21 **2.3 Socio-economic issues**
22

23 The beginning of the decline of the Great Lakes can probably be traced to the early 1920s and
24 1930s, with the opening of the interior to settlement by the colonizing powers. Until then, the
25 pressure on the Lakes was limited to that exerted by indigenous riparian communities whose
26 population within each lake basin in the 19th and early 20th centuries varied but was small. With the
27 establishment of urban centres around the lakes came more people to help with their construction,
28 which was the beginning of a continuous increase in urbanization. Population increased for example
29 around Lake Victoria at a rate of about 3.5% per year resulting in a population exceeding the
30 carrying capacity of the land as it is today. As the population around the lakes grew, so did the
31 fishing pressure on the native species and the farming pressure on the surrounding land. More
32 efficient fishing techniques were introduced, and the fish caught got smaller and fewer. Demand for
33 increased food production and the introduction of modern agricultural activities introduced fertilizer
34 and pesticide runoff into the lake's drainage rivers and directly into the lake itself (Wandiga, et. al,
35 2003) with serious implications for daily food intake and ecology.
36

37 The lakes are economically important as sources for fish whose export has seen increased
38 demand. The fisheries contribute directly or indirectly to the income of riparian communities
39 with varied annual landed values in US\$ millions. The catchments have seen cash crops, like
40 horticultural produce, farming activities and together with small and medium scale industries
41 became second income earners. Tourism and recreation facilities are well developed in most
42 lakes environments and there is vibrant small artisanal activities to service the tourism industry.
43 Utilization of the lake resources has made them to be designated by various governmental
44 authorities as Development Zones. The same designating body has developed strategies to foster
45 economic growth in the basins. For example, Lakes Victoria, Naivasha, Nakuru, Malawi,
46 Tanganyika, Chad and Kariba have strategies for their development. Despite these efforts, the

1 multiple activities in the lake basins have increasingly come into conflict with riparian
2 communities due to several negative trends mentioned above and driving forces, often working
3 in combination. Some major threats to the basin are:

- 4 • Ecological degradation e.g. pollution, land/forest degradation, biodiversity degradation,
5 introduction of exotic species.
- 6 • High population pressure.
- 7 • Wide spread poverty.
- 8 • High incidence of diseases such as HIV/AIDS, malaria, bilharzia, tuberculosis, typhoid
9 and pneumonia
- 10 • Policies, laws and regulations-scattered legislations, insufficient enforcement and un-
11 harmonised policies and laws governing natural resources management.

13 **3. Management of Environment**

14
15 A first management issue is the stabilization of rapid riparian community growth. The basins'
16 urban centres have seen very rapid expansion of their dwellers who are seeking illusive jobs. The
17 built infrastructures in these centres cannot cope with the fast population increase. As a result,
18 almost all urban centres have no functionary public health facilities like sewer treatment plants.
19 There are also non-existent enforcement of laws governing pollution of water, environment,
20 farming practices and waste discharge in all countries.

21
22 A second major management issue relates to land use/land cover change. The Great Lakes
23 catchments have been adversely affected by farming, urbanization and infrastructures
24 construction. Most original forests have been cut. Rivers have been diverted for irrigation and
25 drilling of wells, withdrawal of waters from the lakes for farming, recreation and household use
26 are prevalent. Today water conflicts are found in communities living around all the lakes
27 reviewed in this paper. Lake Naivasha has a unique conflict between the large-scale farmers,
28 urban dwellers and indigenous people who feel displaced and marginalized.

29
30 Other management issues that require urgent considerations include preservation of lakes
31 shorelines, use of safe pesticides, fishery management, fertilizer use, introduction and control of
32 alien species, urban planning and development and environmental monitoring. All countries have
33 legacies of fragmented laws that were passed to correct problems in any sector. Recent attempts
34 in Uganda and Kenya have seen coordination of such laws into one authority. Proper functioning
35 of such efforts has not been achieved. Fragmented laws need to be harmonized by countries that
36 still have them. Regional cooperation is essential if the lakes are to benefit from future forward
37 looking environmental management legislation.

38
39 The community management bodies that have been established have not been sustainable in the
40 long term because of framework of their articles of formation. Some of these bodies did not
41 anticipate the rapid changes that have taken place. As such, their articles of association did not
42 for example define what is a permanent building, and what is a cultivation, definition and
43 provision of buffer zones beyond which no human activity is allowed was not included, no
44 provision was made for free access or otherwise of animals to the littoral zone and to water direct
45 from the lake. The rapid increase of human and animal population, the introduction of large scale
46 farming and industry, the attendance pesticides, fertilizers, sewer and industrial pollution of lakes

1 have become serious and raised conflicts between the stakeholders. Multiplicity of government
2 ministries responsible for management of issues within the lake is a serious bottleneck for
3 decision making. Furthermore, resolution of trans-boundary environmental challenges has not
4 been easy even where there is a regional cooperation treaty. A new framework article for
5 community management should consider these issues and find a win-win solution to all pertinent
6 issues.

7 8 **3.1 Capacity Building**

9
10 A number of researchers have conducted studies on these lakes that have great bearing on their
11 management plans. There have been several community based but externally funded
12 management and conservation projects conducted for the lakes. In all of these there has been
13 lack of capacity building for the local scientists, community and young potential researchers. In
14 some cases a number of students from external institutions have conducted useful research and
15 earned M.Sc. degrees with only a few local students involved. Upon completion there is no one
16 locally to carry on research. The other issue is failure to engage local communities or when
17 engaged in projects they do so as a form of employment but do not integrate it as part of their
18 daily life. Hence, at the end of the project they drift away from the lakes' ecosystem
19 management. There is also the issue of use of indigenous expertise trained locally and have
20 excellent ideas and knowledge on these lakes. They are, however, not encouraged/assisted or
21 supported through projects and research funding to ensure maximum implementation of lessons
22 learnt from their indigenous knowledge.

23 24 **3.2 Sharing, Transfer and Dissemination of Information**

25
26 Even though each lake is unique and share some common problems in many cases, the lessons
27 learnt from one basin are not transferred amongst the stakeholders involved in other basins
28 riparian communities. There is therefore, need for information sharing, improving on lessons
29 learnt and achievements from amongst all researchers, stakeholders involved and catchments
30 basins in order to improve their management. The incorporation of scientific information and
31 research in the lake management programs is also needed.

32 33 **4. Policy Options**

34
35 The feasibility of policy options in the Great Lakes are looked upon in conjunction with the
36 establishment of the community/regional integration of their development authorities. The
37 authorities offer good prospect for the success of the proposed policies, in that they provide
38 enabling environment for respective riparian communities/countries to work together towards
39 common goals. Some means are required in order to incorporate all countries in the catchments
40 basins in the management structure of the respective lake. Since, even though some may not
41 share the lake shore, they form a significant part of the lakes catchments area and may be
42 principal polluters, being the source of the highest sediment load and the original entry point for
43 invasive species; for example Rwanda, Burundi and Democratic Republic of Congo in the case
44 of Lake Victoria.

1 Despite these enumerated drawbacks there have been good demonstrations of projects that have
2 been initiated to save the lakes. The Lake Victoria Environmental Management Project
3 (LVEMP), the Lake Naivasha Riparian Association (LNRA), the Lake Nakuru Community
4 Development Organization (LNCDO), the Lake Baringo Community Based Land and Water
5 Management Project (LBCBLWMP), Lake Chad Basin Commission (LCBC) have all
6 demonstrated that riparian communities, national governments and international communities
7 can work together for the restoration of the lakes environment. The experiences learned from
8 each of the projects differ but in general there are positive results in tackling the issues and
9 promotion of public awareness.

10
11 The Great Lakes Authorities need to be expanded to cover management agreements in the
12 following areas:

- 13 • The development of a common environmental management policy;
- 14 • The development of special environmental management strategies;
- 15 • Taking measures to control trans-boundary air, land and water pollution arising
16 from developmental activities;
- 17 • Integrating environmental management and conservation measures in all
18 development activities;
- 19 • Strategies for poverty reduction
- 20 • Improvement of health care facilities and control of endemic diseases
- 21 • Construction and /or improvement of infrastructures and
- 22 • Provision of educational facilities.

23
24 There are long term benefits that will accrue from a regional vision that results from harmonised
25 policies and strategies. These benefits include but are not restricted to the following areas
26 identified by the Regional Task Force, 2003:

- 27 • The population will prosper from livelihood derived from the properly managed
28 resources, ecosystems and a clean healthy environment.
- 29 • Sustainable and equitable utilisation of resources will improve production and
30 increase income generated from the same.
- 31 • Improved income and quality of life will create a healthy, well educated society
32 with high quality of life, well developed infrastructure and free from poverty.
- 33 • Stabilisation of population growth and demographic changes will naturally
34 develop from a healthy competent and productive population that is able to utilize
35 and manage natural resources sustainably to achieve economic growth and
36 development.
- 37 • Better governance, institutions and policies will arise from an empowered and
38 gender sensitive community that recognizes its rights and upholds its laws in
39 order to safeguard its institutions and policies.

40 41 **5. Financing**

42
43 Financing of lake management projects have come from national and urban (local) governments,
44 community levies, and international development facilities like the World Bank, the Global

1 Environmental Facility (GEF), National Science Foundation (NSF), World Wildlife Fund
2 (WWF), the regional bodies and bilateral technical assistance organizations. With the erosion of
3 most African government's economic base, the financial resources from central and local
4 governments have declined considerably. Community organizations financial contributions have
5 depended on the economic viability of their trade in commodities they produce. The resources
6 from development facilities organizations have been tied to projects with limited time-frame and
7 objectives. At the end of the projects, the progress in ecosystem management has declined or
8 stopped.

9
10 Therefore, there is a need for a new financing framework that will involve the governments,
11 communities and official donor assistance groups in a more sustainable manner. Special
12 dispensations should be made for those benefiting from the lakes' resources to contribute to their
13 sustainable ecosystem management through taxes, levies and duties.
14

15 **6. Recommendations for Future Actions**

16 In order to achieve the above management objective and using the recently concluded causal
17 chain analysis (Odada, et. al. 2003b), it might be prudent to initiate at the national levels the
18 following policy changes:

19 20 1) Over fishing

21
22 Establish:

- 23 • Quota for fishing
- 24 • Quota for processing
- 25 • Review of the rules and regulations and existing policies
- 26 • Civic education and awareness

27 28 2) Destructive Fishing Practices

- 29 • Strengthen the monitoring and enforcement of restrictions
- 30 • Enforce the rule of law
- 31 • Provision of civic education and awareness, empower and involve more communities in
32 management
- 33 • Imposition of size restrictions on fish processing factories
- 34 • Provision of credit to artisan fishers

35 36 37 3) Pollution

- 38 • Accreditation of Analytical Laboratories for standards enforcement.
- 39 • Liberalisation of waste disposal activities to involve the private sector and communities.
- 40 • Revision of regulations in urban planning that has not taken into account environmental
41 issues and improvement of monitoring and enforcement.
- 42 • Improvement of natural resource management and farming practice through training, better
43 governance and technologies in agriculture.
44

- 1 • Stronger vetting of technologies that are being promoted by the national and international
- 2 agencies.
- 3 • Strengthen enforcement of regulations requiring effluent treatment in municipalities and
- 4 industries.
- 5 • Incorporate all stakeholders in drafting of regulations and in monitoring and enforcing agreed
- 6 upon regulations.
- 7 • Integration of institutional framework at two levels: national and regional
- 8 • Integration of regulations and laws at two levels: national and regional.
- 9 • Legal and economic empowerment of institutions e.g. Lake Victoria Fisheries Organization
- 10 (LVFO).
- 11 • Enforce compliance to international conventions e.g. RAMSAR, CITES, and the Biological
- 12 Diversity Convention of Agenda 21.
- 13 • Strengthening the capacity of National Environmental Protection Authorities in order to be
- 14 able to be more effective.

15 16 4) Recommendations for future research

- 17
- 18 • Water quality assessment, monitoring and improvement of use.
- 19 • Study of socio-cultural issues (holistic rather than focusing within the fisheries sector,
- 20 encompassing also health, agriculture, education, etc. within the entire lake basin).
- 21 • Resource inventory, mapping and use (including mapping of critical resources).
- 22 • Assessment and harmonisation of legal and institutional status of National Acts, regional and
- 23 international Treaties and Conventions.
- 24 • Study of the biology of the exotic species such as Nile perch, which is suspected to have up
- 25 to three different sub-populations.

26 27 **Acknowledgement:**

28
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30 together.

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