

## CASE REPORT

# Management issues in the Lake Victoria watershed

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### Abstract

Lake Victoria is the largest lake in Africa (68 800 km<sup>2</sup>) and is the eighth largest lake in the world by volume. The three East African countries of Tanzania, Uganda and Kenya share Lake Victoria and its resources. The total annual catch of fish from the lake ranges between  $400 \times 10^6$  kg and  $500 \times 10^6$  kg, bringing these riparian countries a combined annual income of approximately US\$250 000–500 000 from exports alone. Approximately 30 million people live in the riparian region and the catchment, with about 2 million of these depending directly or indirectly on fishing activities. Tragically, Lake Victoria's extremely diverse fauna was decimated in only 30 years following the introduction of non-native Nile perch in the early 1960s. An estimated 200 endemic cichlid species became extinct. Dramatic increases in overfishing, pollution from various sources, effects of noxious water weeds and other associated problems threaten the sustainability of the lake's resources and the economies of the riparian governments and peoples. Regulations governing Lake Victoria's resources are different in each country. The laws concerning treatment of effluents from point sources in the three countries are not harmonized, neither are implementation or enforcement provisions. The governments of Kenya, Uganda and Tanzania have begun to put in place regional mechanisms to address the lake's many problems including the creation of a permanent regional international institution through the establishment of the Lake Victoria Fisheries Organization (LVFO). A strategic vision document and action plans have been developed. Efforts are being made at local, national and regional levels to control the water hyacinth, including manual pulling, mechanical harvesting and introduction of weevils that weaken hyacinth root systems. To address the problem of overfishing, fishermen committees at landing beaches have been put in place. Each country has committed to take all necessary measures including legislation to implement the decisions of the LVFO governing bodies. All three countries have agreed to adopt and enforce legislation and regulations prohibiting the introduction of non-indigenous species to the lake and to enforce existing regulations regarding fisheries. A Global Environment Facility project which provides funding to the Lake Victoria Fisheries Organization addresses land use management, catchment forestation, fisheries research and management, water hyacinth control, industrial effluent treatment and municipal waste treatment.

### Key words

**Africa, catchment forestation, fisheries, municipal waste, overfishing, water hyacinths, watershed.**

### OVERVIEW OF LAKE VICTORIA

Lake Victoria is the world's second largest freshwater lake measured by surface area. It is the largest freshwater lake in the developing world, with a surface area of 68 800 km<sup>2</sup> and a catchment area of 284 000 km<sup>2</sup>. Lake Victoria, through the Victoria Nile (its single outlet to the north), is a lifeline to Sudan and Egypt.

The lake touches the equator in its northern reaches and lies between latitude 0.7°N–3°S and longitude 31.8°E–34.8°E. It is a relatively shallow lake with an average depth of 40 m and a maximum depth of 80 m.

Lake Victoria has a shoreline of approximately 3500 km. The countries of Tanzania, Uganda and Kenya border the lake and control 49%, 45% and 6% of the lake surface, respectively (Fig. 1). Economic activities in the basin include agriculture, livestock, forestry, tourism, floriculture, hydropower generation and transport. Crops grown in the watershed include maize, cotton, sisal, tobacco, beans, sugarcane and coffee.

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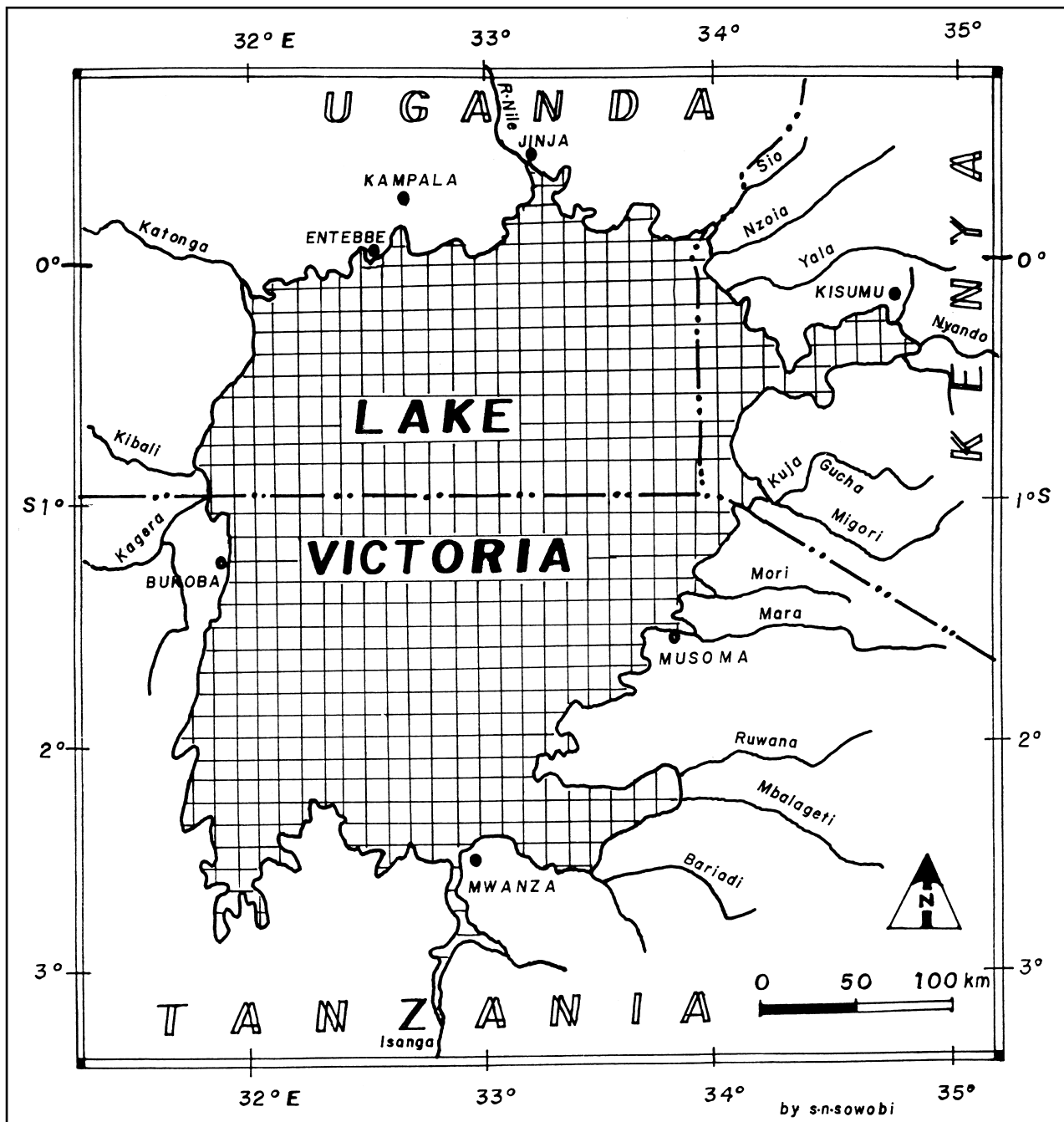


Fig. 1. Map of Lake Victoria.

Most of the native fish fauna of the lake lived between 2 million and 10 000 years ago in the west-flowing rivers that later flooded to form the lake. Fish in the lake experienced explosive speciation, particularly among the haplochromine cichlids, and by the 1950s there were an estimated 300 cichlid species in the lake. The haplochromines segregated themselves into different substrates, different depths of the water column, different areas and different food sources.

Tragically, the Lake Victoria fauna has been decimated in only 30 years. The lake lost an estimated 200 endemic cichlid species following the introduction of non-native Nile perch in the early 1960s (Barel *et al.* 1991).

#### LAKE MANAGEMENT CHALLENGES

Until the 1960s, Lake Victoria could boast a rich, well-balanced plant and animal species complex (Greenwood 1956). Overfishing, pollution from industrial and agricultural

sources, noxious water weeds and predatory introduced fish species have all threatened the sustainability of Lake Victoria's resources and, consequently, the economies and well-being of the surrounding governments and people. Many of the threats to Lake Victoria have been the result of increases in the surrounding human populations (Food and Agriculture Organisation (FAO) 1990; FAO 1996; LVFO 1996).

In the early 1960s, the Nile perch (*Lates niloticus*) was introduced into Lake Victoria in an effort to improve the declining fishery of the popular native species, partially for sport fishing purposes and partially to boost the fishing economy. At the time, there were heated disputes about the possible costs and benefits to such an introduction (Fryer 1960; Anderson 1961). Nile perch introduction resulted in the disappearance of many native species that were abundant in the lake. At present, the huge haplochromines cichlid flock has been driven to near extinction and only pockets of some species may be seen in protected bays, rocky shores and inlets acting as refugia (Ogari and Dadzie 1988). Scientists estimate that 200 cichlid taxa have been lost (Barel *et al.* 1991). The native tilapia (*Oreochromis esculentus*), previously a fish of great commercial importance, has fallen to insignificant numbers in Lake Victoria (Goldsmidt and Witte 1992; Witte *et al.* 1992). It is likely that many other biota such as aquatic insect, crustacean and plant species have been affected by the radically altered trophic structures in the lake. At present, two exotic species (Nile perch and Nile tilapia) and a native sardine dominate the commercial fishery. The lake fishery that was once multi-species is now dominated by three species.

The accidental introduction of water hyacinth (*Eichhornia crassipes*) in 1988 has brought much suffering to communities around Lake Victoria. The weed now regularly enters the lake from Rwanda as part of the inflow from the Kagera River. The water hyacinth has now spread to all the corners of the lake. The weed has choked many bays and inlets, making fishing and navigation difficult if not impossible and has also interfered with the generation of electricity. Much of the water covered with hyacinth has also been rendered unfit for domestic use because of its high organic content and hydrogen sulfide. Water hyacinths, which can reportedly double their area within as short a period as 5 days, also calm the water. It is speculated that increases in still water may have led to increased rates of schistosomiasis and malaria that are transmitted by insects that breed on still water.

The introduction of Nile perch appears to have boosted the fishing industries in Uganda, Kenya and Tanzania, at the cost of 200 fish species extinctions. Fish production from the lake rose from 250 000 metric tonnes prior to the

introduction of Nile perch to the present annual catch of approximately 500 000 mt, according to 1997 statistics. There are indications, however, that catches of this size may not be sustainable. There appears to be localized overfishing and the average size of fish being caught is diminishing in some areas. In 1990, Uganda harvested 132 400 mt of fish, but in 1995, Uganda's catch was down to 106 000 mt (FAO 1990, 1996, 1998). Fish processing plants have been established which target the international fish markets of Europe and Asia. Fish processing industries in the basin now number 12 in Kenya, 10 in Uganda and 12 in Tanzania. The demand for fish by fish processors has resulted in many additional people joining the fishing industry.

Fisheries in Lake Victoria are free and unrestricted, anyone can make or buy a vessel and start fishing. This is dangerous without an understanding of which constitutes a sustainable level of fishing and some ability to control it. The Lake Victoria Fisheries Research project is currently working on quantifying the fisheries stocks of Lake Victoria. Traditional fishing methods are now often considered inadequate for landing a sufficient catch. Fishermen increasingly resort to deploying illegal fishing gear such as cast nets, fish poison and weirs to improve their catches. The practice of fish poison has been going on for some years but it was not until human deaths due to fish poison were reported in 1999 that the authorities took action.

Fishing and the sale of fish were banned in March 1999 until measures to curtail the use of fish poison were established. Although the ban on fishing has been lifted, the European Union ban on importation of Lake Victoria fish is still in place and has greatly harmed the economies of the communities surrounding the lake.

Growth in the human population in the Lake Victoria Basin is estimated at 6% per annum in the urban centres and over 3% in rural areas. The rapid rise in human population in the Lake Victoria watershed has put significant pressure on the environment. Forests in the watershed are being rapidly developed for agriculture, firewood, charcoal and human settlements. Deforestation coupled with bad agricultural practices have exacerbated the problem of siltation in the rivers and lake, resulting in a degraded habitat for fish. The rise in the human population has also increased the demand for fish leading to higher prices, which in turn have catalysed fishermen to increase their catches.

There is also a significant rise in industrial development in the major urban centres near the lake such as Kampala and Entebbe in Uganda, Mwanza and Bukoba in Tanzania and Kisumu in Kenya. Rapid industrial development has greatly contributed to the polluting of the lake. Pollution from point and non-point sources has contributed to the degradation of lake water for habitat and drinking use. Most

industries still do not treat their wastes and the rapidly expanding areas are not served by a public sewerage system. There are multiple obstacles to solving this problem including a low level of awareness of environmental conservation among industrialists, poor sewer systems, inadequate sewer treatment plants and too few technical personnel. The leading suspected polluters include breweries, sugar refineries, soft drink and food processing factories, dairies, oil and soap mills and leather tanning factories. Most of these factories discharge their raw effluents either directly or indirectly into the lake.

Sediment loading and siltation of the lake is partially due to urban run-off from construction sites and solid wastes from urban centres. The extent of this problem has not been quantified.

Use of fertilizers and animal manure has increased tremendously, causing accelerated eutrophication of Lake Victoria waters. It appears the Lake Victoria has undergone a dramatic change associated with excessive eutrophication causing its bottom waters, which were previously oxygenated by wind-inducing mixing, to remain stratified and anoxic year-round (Lowe-McConnell 1997). The use of agrochemicals is gaining momentum in the lake basin even among the small-scale producers, particularly in Kenya and Tanzania where there are large-scale farms of coffee, tea, cotton, rice and maize. In Uganda, the use of fertilizers and pesticides is largely restricted to large plantation crops such as sugar, tea and tobacco.

The control of ticks using cattle dips is also an area of concern, although the practice is still limited to localized areas. Sedimentation due to soil erosion from poor agricultural practices, overstocking of animals in dry pastoral areas, poor vegetation cover in dry seasons, bush fires, highly degraded soils and deforestation continues to be a problem.

The degradation of Lake Victoria has been exacerbated by the unsustainable reclamation of nearby wetlands. Wetlands are needed to anchor soils, catch silt, filter out pollutants and absorb nitrogen and phosphorus from the water flowing through the wetlands into the lake. Wetlands loss means the loss of crucial nursery and breeding ground habitat for fish. Development of appropriate, sustainable wetland management is an integral element in the protection of Lake Victoria water resources.

## **FRAMEWORK FOR LAKE VICTORIA CONSERVATION**

Three East African countries share Lake Victoria and its resources. Obviously, protection and restoration efforts in one country's portion of the lake will be blunted if other portions of the lake continue to be managed in an unsustainable way. A participatory watershed-wide management plan for Lake Victoria is vital. As many individual projects

and grants are only for limited time periods, a group of Lake Victoria stakeholders from Uganda, Tanzania and Kenya formed the Lake Victoria Fisheries Organization (LVFO) in 1994 as a permanent institution to protect and restore the lake. The main objectives of the LVFO are to foster cooperation among the three East African countries on lake issues to coordinate and harmonize national measures for the sustainable utilization of the living resources of the lake and to develop and adopt conservation and management measures.

The negotiations between Uganda, Tanzania and Kenya leading to the establishment of LVFO, and the agreement itself, were crucial opportunities to maximize commitment and meaningful participation by all three governments and other stakeholders in the protection of Lake Victoria. This agreement was an important vehicle whereby each country committed to take all necessary measures including legislation to implement the decisions of LVFO's governing bodies. Each country restated its commitment to enforcing its national laws and regulations regarding fisheries. All three countries agreed to adopt and enforce legislation and regulations prohibiting the introduction of non-indigenous species to the lake.

The secretariat of the LVFO is located in Jinja, Uganda. It is headed by an Executive Secretary with a team of professional staff that includes a Senior Scientist, a Senior Socio-economist, an administrative assistant responsible for finance and another responsible for information and databases. The main organs of the LVFO include the Executive Committee, whose members are Directors of research and fisheries management, the Policy Steering committee, whose members are Permanent Secretaries of ministries responsible for fisheries; and the Council of Ministers responsible for fisheries. The Council of Ministers, the LVFO supreme body, meets every 2 years. There are also national consultative committees comprising ministries responsible for water, environment, agriculture, forestry, natural resources, home affairs, science and technology and lands. The private sector, community-based organizations (CBO) and non-governmental organizations are also part of these committees.

On another front, structural adjustment programmes instituted by the International Monetary Fund and the World Bank have impaired the efficiency of government personnel who monitor the fishing industry in Uganda, Tanzania and Kenya. Many experienced fisheries personnel have seen their jobs disappear. Decentralization has compounded the problem, leaving one, or at most two, qualified fisheries personnel in each district. One person per district can not handle both extension work and law enforcement adequately. Funds that are collected from the fishing industry go to the national treasury. None of these funds come

back to fund jobs or programmes which could motivate a shift toward sustainable fishing.

To date, the regulations governing Lake Victoria resources are different in each country. Use of the mono-filament net is banned in Tanzania and Kenya, but allowed in Uganda. Light-fishing, which is probably the best method to catch 'dagaa' (*Rastrineobola argentea*), is restricted in Uganda but is allowed in the other two countries. There is still no agreement regarding minimum mesh sizes for certain fish species such as *Bagrus docmak* and *Clarias gariepinus*.

The laws concerning treatment of effluents from point sources in the three countries are also not harmonized, neither are implementation nor enforcement provisions. When the regulations of all three countries are similar, the penalties tend to be different.

Due to the seriousness and the magnitude of Lake Victoria's problems, Kenya, Uganda and Tanzania also sought funding from the GEF to address Lake Victoria's health. The proposal was approved in 1992 as a biodiversity grant. The GEF is providing funding through the World Bank to the LVFO initially for a 5-year period.

### **PARTICIPATORY WATERSHED MANAGEMENT APPROACHES**

The first task of the LVFO was to identify all the scientists, stakeholders and institutions that are dealing with the lake and to bring them together regionally in order to develop a vision and action plan for the organization. A strategic vision document and action plans have been developed. LVFO is in the process of organizing workshops with the various stakeholders to harmonize their activities. The organization is working to build regional consensus on lake issues. LVFO will also identify gaps in the regional plans so that sustainable funding can be sought to address them.

Efforts are being made at local, national and regional levels to control the water hyacinth. A regional task force for the control of water hyacinth has been set up under the East African Community Secretariat in Arusha, Tanzania. All three countries advocate an integrated approach to the control of the weed involving a three-step process. First, water hyacinths are removed manually in order to involve communities in the physical removal of the weed. Second, additional water hyacinths are mechanically removed using heavy machinery. Third, weevils (*Neochetina bruchi* and *Neochetina eichhorniae*) are introduced that have been proven to blunt the weeds' reproductive capacity. The 5-year budget for the control is US\$350 000 and so far the weed is already under control. This combination has proved successful in Uganda at specified locations and is to be extended to larger sections of Lake Victoria and to other water bodies in the region.

Introduction of an exotic species was considered only after extensive research and testing was done to determine its impact on all elements of the lake's diverse biology. The member countries remain cautious about using chemical control methods, and laboratory studies are still being carried out to establish their safety in East African conditions. Whatever solution is attempted, partners realize that its effectiveness will depend on the reduction of nutrient inflows in the lake that have enhanced the growth of water hyacinth and other invasive weeds.

To address the problem of overfishing, fishermen committees at landing beaches have been put in place. Their duty is to inspect all boats before setting sail and inspect the catch after it has been landed. All fishermen, fishmongers and transporters of fish are being licensed to ensure a safe product for consumers. Countries are collecting the same information for the same time periods. The Directors of Fisheries meet at least once per year and the technical people meet once every 3 months. There are currently no catch limits.

The GEF project is being executed nationally and has 10 components: (i) establishment of the Lake Victoria Fisheries Organization (LVFO); (ii) land use management; (iii) catchment forestation; (iv) fisheries management; (v) fisheries research; (vi) water hyacinth control; (vii) industrial effluent treatment; (viii) municipal waste treatment; (ix) water quality and eutrophication; and (x) training.

LVFO commits to work toward optimum, sustainable utilization of the Lake Victoria fishery. The organization will promote and coordinate training and extension activities in all aspects of fisheries. LVFO will also oversee capacity building of existing institutions and develop additional institutions as needed. The group will provide a forum for discussion on the impacts of initiatives dealing with the environment and water quality in the Lake basin and will maintain a strong liaison with existing programmes by acting as a clearing house and data bank for information on Lake Victoria fisheries. LVFO will oversee the conduct of research on lake water quality and the nature, extent and pathways of its pollution, and will also tackle the problem of invasive exotic plant and animal species.

Other regional projects on Lake Victoria include the European Union-funded Lake Victoria Fisheries Research project (LVFRP), which is addressing the status of fish stocks in the lake. An FAO-funded Lake Victoria Water Resources Project (LVWRP) is tasked with addressing issues about the lake water balances.

### **CONSERVATION AND RESTORATION SUCCESSES**

The greatest accomplishment of LVFO so far is the organization of fisheries managers to harmonize their fisheries regulations and code of practice for fish handling and

quality assurance. Some native species like *Labeo victorinus*, *Bagrus docmak*, *Protopterus aethiopicus*, *Schilbe mystus* and *Synodontis* spp. are rebounding. The organization has also managed to bring together scientists working on Lake Victoria from the three countries to exchange views and identify gaps in research and recommend how to deal with those gaps.

The lack of accurate data on fertilizer and pesticide usage continues to hinder decision-making about appropriate measures to control their use. New environmental impact assessment measures being put in place by the national environment authorities of the three countries bordering the lake may help clarify many of the issues related to data and monitoring.

The greatest ongoing challenge is to develop an integrated management plan for Lake Victoria and its basin. Meanwhile, there are gaps in the original project proposal to GEF, which need to be addressed and require international assistance in carrying them out. LVFO needs to: (i) develop a Lake Victoria basin resources map; (ii) produce a bathymetric chart of the lake (the one currently in use was made in 1901); (iii) describe in detail the hydrologic cycle of Lake Victoria; (iv) study the water balance of Lake Victoria waters; (v) use remote sensing to track and assess the spread of water hyacinth; and (vi) establish laboratories to deal with fish quality assurance.

Lake Victoria is a huge natural resource for the East African people and also serves as an important world resource in terms of its waters and immense biodiversity base. Management efforts by the three countries surrounding the lake need to be complemented with support from the international community.

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