The State of the Fisheries Resources of Lake Victoria and Their Management

EAC Secretariat
Arusha, Tanzania



LVFO Secretariat
Jinja, Uganda

Proceedings of the Regional Stakeholders' Conference

Imperial Resort Beach Hotel, Entebbe
24th - 25th February 2005

The State of the Fisheries Resources of Lake Victoria and their Management

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Table of Contents

List of Abbreviations and Acronyms ..... *ii*
List of organising and Editorial Committee ..... *iv*
Acknowledgements ..... *v*
Foreword ..... *vii*
Preface ..... *viii*
Statements at the Opening Session of the Conference ..... *ix*
Conference Declaration ..... *xvi*
Papers presented at the conference 1
1. Historical Perspective of the Challenges and Opportunities in Management of the Fisheries: Lessons for the Future 1
2. Current and Future Challenges and Opportunities to Sustainability of the Fisheries Resources 11
3. The Institutional Structures, Functions, Processes and Linkages for Fisheries Resources Development and Management of the 16
4. The Status, Development and Role of Beach Management Units (BMUs) in the Management of the Fishery Resources 21
5. The Status of Policy and Legal Framework for Management of Fisheries Resources 31
6. Status of Fisheries Surveillance, Law Enforcement and Monitoring Compliance to Agreed Measures for Fisheries Management 43
7. Trends in Exploitation of the Fisheries Resources 55
8. Trends in the Composition, Abundance and Distribution of the Fishes 73
9. Reproduction and Growth of Commercially Important Fish Species 85
10. Critical Habitats for Fish Survival and Conservation of Biodiversity 97
11. Status of Water Quality and its Implication on Fishery Production 106
12. Lake Victoria Water Budget and Circulation 113
13. Distribution of Economic Benefits from the Fisheries 124
14. Socio-economic Impacts of Fish Trade 132
15. Regional Strategy for Fish Quality and Safety Assurance 143
16. Challenges of HIV/AIDS and Other Communicable Diseases among Fishing Communities 150
17. Meeting the Increasing Demand for Fish through Development of Aquaculture in the Lake Victoria Basin 159
18. Combating Insecurity and Enhancing Safety of Navigation 166
19. Strategies for Management of Transboundary Conflicts on Fishing and Fish Trade 172
20. Micro-Finance Opportunities and Access to Credit Facilities 178
21. The Potential for Civil Society Institutions (CSIs) to Contribute to Development and Management of the Fisheries Resource 187
22. An Option for Sustainable Funding of Fisheries Research Development and Management 194
23. Bibliography 204

Acronyms

BMU	Beach Management Unit
BOD	Biological Oxygen Demand
CA	Competent Authority
CAS	Catch Assessment Survey
CBD	Convention for Biological Diversity
CBO	Community Based Organization
CCRF	Code of Conduct for Responsible Fisheries
CFC	Comon Fund for Commodities
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora.
CM	Council of Ministers
COMESA	Common Market for Eastern and Southern Africa
CPUE	Catch Per Unit Effort
CSI	Civil Society Institutions
DFO	District Fisheries Officer
DSTs	Decision Support Tools
EA CDS	East African Community Development Strategy
EAFFRO	East African Freshwater Fisheries Research Organization
EAC	East African Community
EADB	East African Development Bank
ECOVIC	East African Communities Organization for Management of Lake Victoria Resources.
EU	European Union
FAO	Food and Agriculture Organization
FD	Fisheries Department
FIQA	Fish Quality Assurance
FMC	Fisheries Management Committee
FMP	Fisheries Management Plan
FS	Frame Survey
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GEO	Genetically Modified Organization
HACCP	Hazard Analysis Critical Control Point
HIV/AIDS	Human Immunodeficiency Virus
HRD	Human Resource Development
IDRC	International Development Research Centre
IFMP	Implementation of a Fisheries Management Plan
IPOA-IUU	International Plan of Action on to deter and eliminate Illegal, Unreported and Unregulated fishing.
ISPS	International Ship and Port Facility Security Code
IUCN	International Union for Conservation of Nature
KMFRI	Kenya Marine and Fisheries Research Institute
LAP	Local Administration Police
LTF	Fish Levy Trust Fund
LVB	Lake Victoria Basin
LVBC	Lake Victoria Basin Commission
LVEMP	Lake Victoria Environmental Management Project
LVFO	Lake Victoria Fisheries Organization
LVFRP	Lake Victoria Fisheries Research Project

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Foreword

The Sixth Special Session of the LVFO Council of Ministers held at Nile Resort Hotel,Jinja on 30th October 2003, deliberated on major problems facing the Lake Victoria fisheries. The Council was concerned that key stakeholders especially those involved in policy formulation and implementation ranging from Members of Parliament and District leaders to local authorities and the private sector were not adequately informed about the state of the fisheries resources of Lake Victoria to enable them make informed decisions and take appropriate actions. The Council of Ministers, therefore requested the Secretary General of the East African Community (EAC) to mobilize resources and convene a stakeholders' conference where the different stakeholders would be informed of the state of the fisheries resources of Lake Victoria and their management.

The Secretary General of the EAC in collaboration with the LVFO formed a Committee to organize the stakeholders' conference. The conference was intended to provide improved understanding of the current situation and the actions that should be undertaken towards sustainable development and management of the fisheries resources. The conference was held from 24th to 25th February 2005 in Entebbe and was opened by the Prime Minister on behalf of H.E. President Yoweri Museveni of the Republic of Uganda. It was attended by 260 participants that included Council Members; LVFO Policy Steering Committee, Members of Parliament from the three Partner States, East African Legislative Assembly MPs, Fisheries Managers, Civil Society Organizations, Local Government Authorities, Researchers, Development Partners, the Private Sector and other Key Stakeholders.

Through various structured presentations and discussions, clarity emerged on such issues as changes in the composition of the fish stocks from historical times and factors behind the observed changes including the increased human population, fishing effort, globalization of the fisheries, deteriorating water environment, water levels and critical fish habitats. With improved understanding of trends in fish stocks and exploitation patterns, fish exports and domestic needs, water quality and quantity regimes, the threats posed by overfishing, biodiversity values, environmental degradation, disease and poverty, participants were able to more effectively analyse institutional structures and linkages, policy frameworks and status of compliance with the existing legal framework, and the role of the emerging Beach Management Units (BMUs). The exceptional socio-economic importance of the Lake Victoria resources and uniqueness of the geographical setting of the lake and its peoples were highlighted as a strong basis for effective intervention and continued cooperation among the Partner States of the East African Community. These concerns are reflected in what emerged as the '**Entebbe Declaration**.'

I would like to thank Sida, the EC and Government of Finland, for funding the conference, the Organizing Committee for the efforts put in organizing the conference, the authors of the thematic papers, and the participants to the conference for their interest and commitment to addressing the challenges facing the lake. I would like to specifically thank the EC for providing a grant for Implementation of a Fisheries Management Plan Project for Lake Victoria.

I call upon the Partner States and particularly those organizations that are directly benefiting from the resources of Lake Victoria such as the water undertakers, the power generators, the fish processors and others to come out and actively contribute and participate in the enormous task required to protect and sustainably manage, use and develop the resources of the lake and its ecosystem.

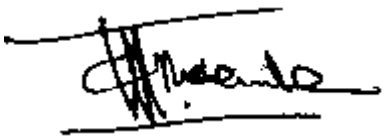
Preface

Lake Victoria is economically very important to the East African Community (EAC) Partner States of Kenya, Uganda and Tanzania. It is the largest inland lake in Africa and has the most productive freshwater fishery in the world. By 2003 the fishery was producing about half a million tonnes of fish annually valued at US$ 600 million at the landings and US$ 250 million in export. In order to sustainably manage the fisheries resources,the EAC Partner States formed the Lake Victoria Fisheries Organisation (LVFO) through a Convention signed in 1994 to coordinate efforts towards sustainable utilization of the fisheries resources of the lake. As a specialised institution of the EAC, the objective of the LVFO is to foster cooperation among the Partner States by: Harmonizing national measures, developing and adopting conservation and management measures for the sustainable utilization of the living resources of Lake Victoria through: promoting proper management and optimum utilization of the fisheries and other resources of the lake; enhancing the capacity of existing fisheries institutions; providing a forum for discussion of the impacts of initiatives on the lake; providing for the conduct of research on the living resources and the environment; coordinating training and extension in all aspects of fisheries; serving as a clearing house and a data bank for information on the fisheries resources of the lake; and promoting the dissemination of information.

This report on **The State of the Fisheries Resources of Lake Victoria and their Management** provides the first edition of the State of the Fisheries Report by the LVFO. The report was specifically requested by the LVFO Council of Ministers during its Sixth Special Session held in Jinja on 30th October 2004 after they recognised that key stakeholders, especially senior policy makers and implementers were not adequately informed about the fisheries resources of the lake to enable them take appropriate actions. The report presents: policy and institutional frameworks for management of the fisheries resources, the state of the fisheries resources and the environment of the lake, key socio-economic factors in the fishery, resource utilization, management and law enforcement, conflict resolution and a proposal for funding the fisheries sector on a sustainable basis. The report is preceded by a separate Book of Abstracts with the same title.

This book of conference proceedings provides details of the presentations given under the four thematic areas identified by the organizing committee namely; State of Policy, Institutions and Processes; State of the Resources and Environment; Social and Economic Factors of the Fishery; State of Resource Utilization, Management and Law Enforcement. The presentations are preceded by statements made at the opening session and a keynote address by a senior fisheries scientist with long experience on Lake Victoria. Each paper outlines the relevance of the subject to the stakeholders, the challenges to sustainability of the Lake Victoria fisheries resources, the current status based on available data, the concerns and opportunities to address the challenges and proposals for action. In addition, a smaller version in form of a Book of Abstracts, and a Conference Declaration have been published.The Organization will periodically update the report on The state of the fisheries of the lake to provide information that wll guide its management.

Development partners especially the EC, World Bank, NORAD, Sida, and IDRC have supported implementation of fisheries and related programs on the lake. I greatly appreciate their efforts and I appeal to them to continue supporting more programmes on Lake Victoria. I also call upon all stakeholders to carry on with the committiment they have displayed towards the wise management of the fisheries resources of Lake Victoria for the benefit of present and future generations.



Thomas Wanyika Maembe
Executive Secretary, Lake Victoria Fisheries Organisation

mentation of a Fisheries Management Plan Project and were committed to the Lake Victoria Environmental Management Project Phase II. These interventions have supported a multi-million dollar fish industry and thousands of livelihoods, which depend upon it.

The statement warned that uncontrolled increase in fishing effort with no commensurate increase in catch, especially in the case of the Nile perch would affect the stocks. They noted that, changes in fishing gears and their modes of operation that put further pressure on the stocks were causing concern. Nevertheless, the fishery remains a major source of income for populations around the lake and the lake itself continues to hold a position of significant socio-economic importance to the region.

On the basis of the research work on the state of Lake Victoria's fish resources conducted by Lake Victoria Fisheries Research Project, which was supported by the EC, the Development Partners echoed concern raised on the state of these stocks and reaffirmed that they both share a common goal to manage these resources sustainably.

The EC and World Bank expressed concern over the long-term impact of the intense fishing pressure. In line with their policy towards poverty reduction, they noted that millions of people would be affected by a collapse in the fisheries resources. There was therefore need to avoid the potential collapse of the fisheries through stakeholder, country and regional collaboration. In this regard, the European Commission and World Bank reiterated their commitment to working with regional bodies, national governments and other development partners in ensuring that the lake and its resources continue to hold socio-economic and regional importance.

Among the challenges highlighted by the development Partners was the need for better data to ensure better management especially, strategies for monitoring and assessment of the status of the fisheries as the basis for improved management. Enhanced controls were needed to ensure the sustainability of stocks and better enforcement to ensure compliance. There was therefore need to strengthen regulations and enforcement to regulate fishery practices as well as identifying and implementing mechanisms for reducing fishing pressure.

In order to help face these challenges, the European Commission had provided € 30 million to help LVFO implement a Lake Victoria Fisheries Management Plan and the World Bank is committed to supporting LVEMP II. Money alone would, however not solve the concerns raised over the Lake's resources and there was need for better partnerships. Improving partnerships and cooperation will help improve the lake, its fish resources and thus the lives of those living around it. The World Bank and European Commission made some recommendations to this end:-

a) Improve data sharing amongst institutions and stakeholders to improve assessment of the status of the fisheries and management interventions.
b) Enhance community involvement in the management of the fisheries.
c) Encourage donor collaboration under the Lake Victoria Basin development initiatives.

The European Commission and World Bank applauded the efforts of the EAC and LVFO in promoting a regional solution to the management of a common resource. They also praised the efforts of national authorities in promoting better fisheries management. They however called for the application of the Precautionary Principle for the management of the Lake's resources. The European Commission and World Bank pledged to continue supporting partnerships to restore and maintain the health of Lake Victoria and its ecosystem.

(d) The lake level has decreased. Some have politicised this issue and yet there is good science to inform stakeholders on sources of lake water and how it is lost. The lake creates its own regional climate and wind system where it derives most of its water. It is important that all work together to ensure that other sources of additional lake waters flow into the lake unhindered for our common good;
(e) There have been misunderstandings on where the fish breeds. This issue has also been politicised and yet there is good science to inform us on where fish breeds in relation to where it grows to be harvested. This has sometimes generated conflicts on the lake between partners for no reason;
(f) There were still inadequate fish handling facilities to enable fishers to reduce post harvest losses and obtain optimum price from their catch to fight poverty in households;
(g) There are still some conflicts in fishing and fish trade especially along common borders in addition to piracy, theft and smuggling. Adherence to the rule of law is a common value enshrined in the Treaty establishing the East African Community. It is in common interest to ensure that the resources in the lake basin are used sustainably, cooperatively and peacefully. The region must also ensure that the large expanse of lake waterways do not become conduits for insecurity;
(h) Policies, laws, regulations and institutions still need to be improved and harmonised to protect the resource from abusive harvest and enable our citizens conduct *bona fide* business without fear through established channels. Communities will not object to fish regulations as long as they are sensitised about them and, enforced fairly to advance shared objectives;
(i) Despite the wealth accruing from fish, poverty is still high among the fishing communities, literacy still low and there are high incidences of diseases especially HIV/AIDs. There is urgent need to work together to change the life style of fishers to reduce their vulnerability. A sick fishing labour force is unproductive and destructive to the fisheries resources. While those who are already sick should be supported to get health care, the message must be put across to prevent new infections for a future healthy fisheries labour force that has a stake in lake fisheries and care to conserve; and
(j) Development and management of fisheries resources is still heavily donor dependent.Thewealth generated by the resources could support its management to reduce continued dependence on development partners.

The Minister requested the conference to come out with a roadmap to:
(a) Manage fishing effort and fishing capacity to optimum levels;
(b) Provide an understanding on where the water in the lakes comes from and how it leaves the lake to guide control of lake levels;
(c) Clear the misunderstanding on how and where the fishes breed, the fishing grounds and renewable nature of our fisheries heritage;
(d) Improve fish handling facilities to reduce post harvest losses and add value to fish and fisheries products;
(e) Fight poverty among fisheries and riparian communities;
(f) Reduce vulnerability as well as incidences of HIV/AIDS among fishers; and
(g) Devise options for sustainable funding of the fisheries resources management and information requirements.

The Minister concluded by calling upon the participants to consolidate the achievements already made and find solutions to the challenges affecting sustainability of the fisheries resources and optimization of socio-economic benefits from the resources of Lake Victoria.

To address the challenges that arise out of these major management concerns, President Museveni reiterated the need to consolidate goodwill among the Partner States in order to harmonize policies and build credible sustainable institutions to implement these policies. He commended the work being done by the Lake Victoria Fisheries Organization, and charged the Organization to strengthen the institution further by finding solutions that will stand the test of time, and devise measures that will enable the Partner States to harness our resources sustainably.

His Excellency the President informed participants that Uganda was following a private sector-led, export-oriented economic strategy, with emphasis on value addition, in order to compete favorably in the challenging global economy. Fish exports, especially to Europe, had become a lucrative business in East Africa. European consumers who feared mad-cow disease infection turned to fish consumption. Fish from Lake Victoria was now found in super markets in the United States of America. Uganda was having about 10 fish processing factories, which was a development and achievement of the National Resistance Movement. This was through deliberate government policy to promote the fish industry through privatization. There was a very big potential for Uganda fish, especially if there were concerted efforts through the East African Community, because this would give the region more credibility as an investment destination, and enhance bargaining power with the rest of the world.

The President advised that the deliberations at the conference should not only address immediate challenges but should include long-term measures aimed at improving the export potential of the region. He emphasized that industrialization is key to this end. More fish factories will ensure that our people have ready market for their catch, and because standards and competition would be high, they would be forced to adhere to the right fishing methods in order to sell. Increase in the number of fish processing factories would ensure better employment for the fisher community and increase their household incomes. This would have a great impact on several of the challenges currently being faced by the fisheries resources. If that happened, the people would not have to resort to illegal activities in a bid to earn a living. The management of the lake's ecosystem also hinges greatly on our people's poverty levels. There may be many policies geared towards the protection and management, but if the people are still poor, they will unsustainably exploit and exhaust our resources, with no regard to the degradation they are causing.

The President called upon leaders to mobilize and sensitize fisherfolk in order to enhance community participation and a sense of responsibility in sustainable development and management of the fisheries. An important measure to this effect is the development of the human resources, capacity. There is no need talking of emancipating our people from poverty if they are unschooled. All people should at least have basic literacy so that they are in position to appreciate the value of development for instance the proper management of the environment, and the need to ensure sustainability even as we harness our fisheries resources.

The President stressed the need to ensure proper health of the fisher communities, especially through preventative measures and proper nutrition. He called for measures to provide medical facilities to those already ailing, backed by sensitization on the need for the people themselves to look out for their own health. The President noted that sickness has a direct bearing on the socio-economic well being of not only a community, but also the nation as a whole. He said bilharzia, malaria and HIV/AIDS are all diseases that can be curbed through proper sensitization.

The President called on leaders to ensure that there are mechanisms to enable the fishermen to access credit facilities, to empower them to make savings and sound financial decisions. The President added that the fast growing regional and international markets have increased pressure on the wild stocks on Lake Victoria, which makes aquaculture a very viable alternative, in addition to other livelihood options. He emphasized that aquaculture would boost fish production and relieve the pressure on our lakes. The challenges from growing markets, the human population explosion, decline in wild stocks, had made aquaculture not only very attractive but also imperative.

CONFERENCE DECLARATION

Entebbe Declaration

We, the participants of Regional Stakeholders Conference on the Status of the Fisheries Resources of Lake Victoria and their Management: Concerns, Challenges and Opportunities; held at Entebbe Imperial Resort Beach Hotel, Uganda, 24th-25th February, 2005:

Recognizing that the three Partner States of the East African Community have a shared heritage and a common interest in the health of Lake Victoria and their commitment to ensure proper management and sustainability of its living resources for the benefit of present and future generations;

Acknowledging that adverse actions in any part of the Lake within the territorial limits of one Partner State will have negative impacts on the other Partner States;

Aware that the World Summit on Sustainable Development (WSSD) Principles requires that the Lake Basin is developed in a manner that does not compromise the health of the ecosystem that supports living resources;

Aware that the Food and Agricultural Organization Code of Conduct for Responsible Fisheries and the associated technical guidelines places responsibility on governments, including industry, fishing communities and all stakeholders to ensure responsible and sustainable fisheries in respective areas of operations;

Cognizant that the Treaty for the establishment of the East African Community committed Partner States to establish common fisheries management and investment guidelines for inland and marine waters; and the Convention for the establishment of the Lake Victoria Fisheries Organization (LVFO) committed Contracting Parties to sustainably manage the fisheries resources of the Lake;

Noting that the Partners States have adopted and ratified the Protocol for Sustainable Development of the Lake Victoria Basin;

Aware of the decisions and management measures made and adopted by the Council of Ministers of the LVFO and thereafter, the implementation of the same by the Partner States to sustainably manage the exploitation of the fisheries resources;

Recognizing that the Council of Ministers of the LVFO has adopted a Regional Plan of Action (RPOA) to prevent, deter and eliminate Illegal, Unregulated and Unreported (IUU) fishing in Lake Victoria as an integral part of the international Code of Conduct for Responsible Fisheries;

Recognizing that the quantity, quality and value of fish from Lake Victoria has increased substantially and hence the need to ensure sustainability of the fish yields;

Informed that the lake fish stocks are in danger of irreparable damage as a result of human activities leading to siltation, pollution loading, unsustainable fishing practices and rapid increase in fishing pressure;

Conscious of the dangers of over fishing, the use of illegal fishing methods and practices and of other environmental degradation;

Noting that the rapid growth of the human population in the lake basin, the first growing regional and international fish markets have increased pressure on the wild stocks of the lake;

j) Strengthening national and regional institutions for fisheries research and management including infrastructure and human resources capacity;

k) Making deliberate efforts to develop aquaculture through promotion of semi-intensive commercial private sector ventures and providing State support for the improvement of quality and quantity of fish seeds and development of high value species;

l) Promoting the culture of saving and investment amongst fishing communities by building their capacity in financial management and investment as well as providing facilities for credit through micro-finance service providers;

m) Mainstreaming environment and natural resources management, HIV/AIDS and other water related diseases such as bilharzia, malaria and cholera in the fisheries sector in synergy with health sector;

n) Implementing measures to reduce post harvest losses, improvement of fish handling infrastructure, production of value added products and up-grading of health conditions in the distribution and marketing of fish and fishery products;

o) Reducing transboundary conflicts by supporting ongoing initiatives and interactions to address the root causes of these conflicts where they occur;

p) Enforcement of laws to protect the fisheries resource from abusive harvest and destructive extraction;

q) Promoting inter-agency cooperation at national and regional levels to promote synergy in combating insecurity and enhancing safety on Lake Victoria;

r) Establishing and implementing sustainable funding mechanisms for fisheries research development and management of fisheries resources in the Lake Victoria Basin; and

s) Continuing with implementation of management measures already agreed on by the Council of Ministers of the LVFO including slot size and protection of breeding and nursery areas.

Imperial Resort Beach Hotel Entebbe

25th February 2005

It is well established that the collapse of many fisheries in the world has been due to reduced recruitment caused by low levels of the spawning stock (Cushing, 1975; King, 1995; FAO, 2001). The minimum level of spawning stock required to maintain recruitment is not known in many species. Generally in species that mature early in life and have a high fecundity, recruitment will only decrease at very low stock sizes (King, 1995). Nile perch has very high fecundity (up to 15 million eggs) but still precaution needs to be examined to protect the spawning stock so that it is maintained at a level where the recruitment is not threatened. There is need for further research to establish the spawning stock size needed for good recruitment to support the current level of fishing effort. Enforcement of the slot size regulation (catching Nile perch between 50 cm to 85 cm TL) should therefore continue while possibilities of having aquatic parks in spawning grounds for conservation and ensuring protection of the spawning stock could be explored. However, continuity in monitoring is crucial.

Sustainabilty of the resources will contribute to poverty eradication and sufficient supply of protein. With responsible fishing and an effective Monitoring Control and Surveillance (MCS) system on Lake Victoria, the sustainability of the fisheries resources is assured. Protecting the spawning and nursery bays by implementing closed areas and eliminating undersize nets can ensure the sustainability of Nile perch, tilapia (*Oreochromis niloticus*) as well as the other endemic species recovering.

AKNOWLEDGEMENT

The LVFRP II a EU funded project (LVFRP) supported the research work conducted from 1997 to 2001. The facilitation to the Stakeholders' Conference and for the production of the paper was from the LVFO/ IFMP project. The authors wish to acknowledge financial support

Seasonal variations in hydro-acoustic estimates

Generally, during August surveys, fish abundances in the whole survey area were higher and differences in the standing crop between different grids were more pronounced. There was increase of the standing crop inshore in February and a decrease in August. Sometimes, there was a mixed pattern in the standing crop in inshore and offshore areas between August and February surveys (Fig. 7). This pattern suggests that there is migration of fish within the zones during the course of the year. It depicts aggregated distribution of the species in inshore areas particularly in February. Targeting of inshore concentrations of the species during such periods with the current high fishing effort can lead to over fishing in the long term.

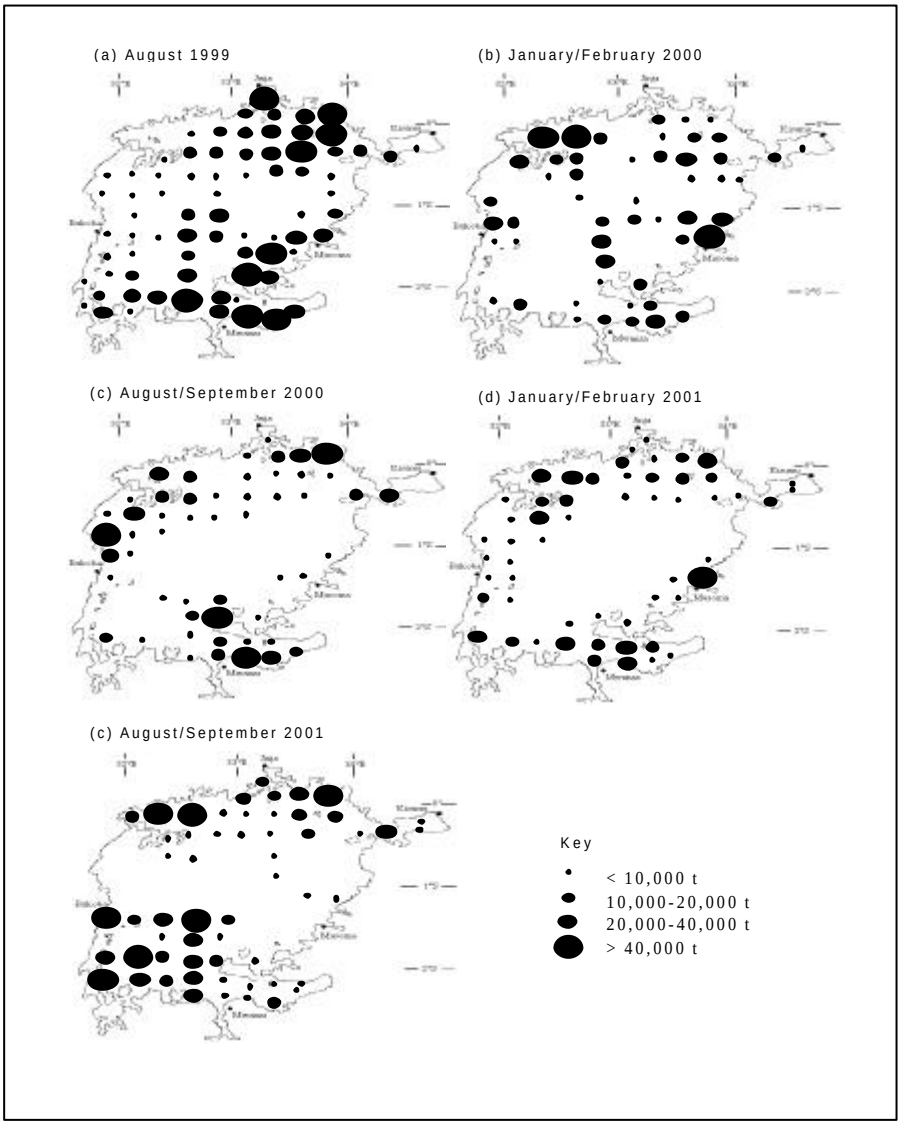


Fig. 7. Spatial distribution of Nile perch in Lake Victoria estimated by hydroacoustic surveys

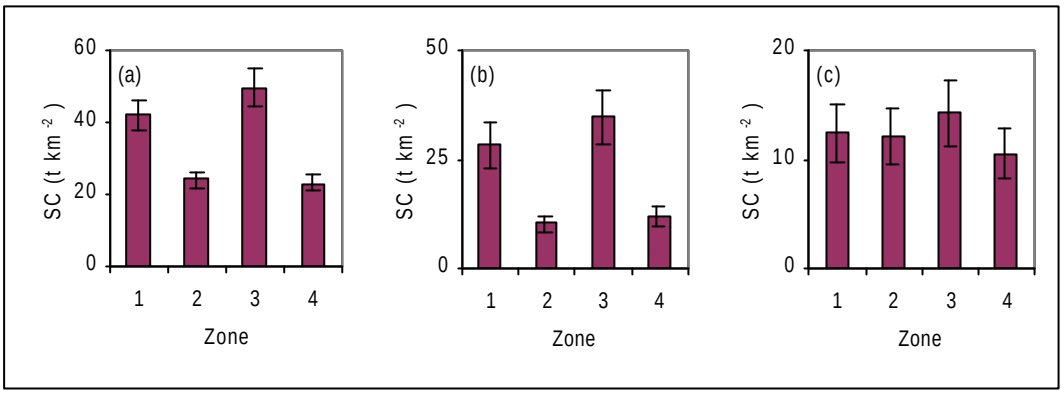


Fig. 4. Abundance distribution in different zones surveyed by acoustic methods (a) Overall densities, (b) Nile perch stock and (c) Pelagic stocks (zone 1 & 3 <= 40 m deep and zone 2 & 4 > 40 m deep)

Stock Abundance

Trawl surveys

A general pattern of low biomass indices in the first quarter increasing to a peak in the third quarter followed by a decline to the fouth quarter was observed (Fig. 5). The total lake wide Nile perch biomass estimates varied from 461 032 t for the fourth quarter in 1998 to a maximum of 912 279 t in the third quarter 1999. An average abundance index of Nile perch for the whole lake between the fourth quarter in 1997 and the third quarter in 2000 was 686,386 t of which 350,143.3 t was estimated for the Tanzanian waters, 267,655.9 for Ugandan waters and 68,586.7 t for Kenyan waters. The estimates are only for Nile perch, which contributed 91.6% of the total catch, thus implying a total abundance of 749,329.7 t for the dermesal stocks in Lake Victoria. *Rastrineobola argentea* "Dagaa" is not included, as the method used for sampling is not applicable for the species.

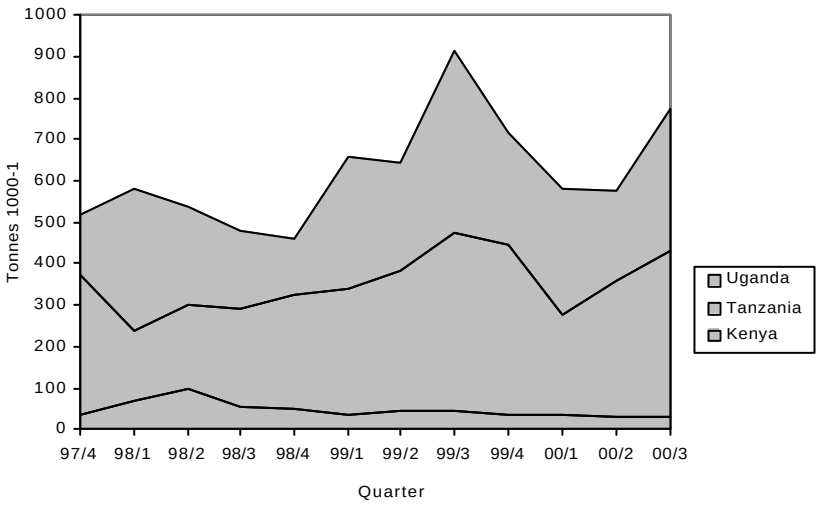


Fig. 5. Spatial and temporal variations in abundance (t*1000) for Nile perch in Lake Victoria by country and quarter from bottom trawl surveys in the period 1997 - 2000

In 1995/1996, Nile perch catch rate increased from 191 kg hr^{-1} (almost 100% of the catch), to 279.9 kg hr^{-1} (91%). In 1999/2000 surveys, haplochromines reappeared and became an important component of the catch (18.8 kg hr^{-1} representing 5.7% of the total catch). Thirteen other species were recorded, i.e. *O. niloticus, R. argentea, P. aethiopicus, Schilbe intermedius, C. gariepinus, Barbus profoundus, Barbus altianalis, B. docmak, Brycinus* spp., *Synodontis* spp. and *Labeo victorianus*. The percentage contribution of all other species by weight was higher in inshore waters compared with offshore waters, except for *Barbus profundus*. *Rastrineobola argentea* was not represented because it is too small to be caught by the type of gear and method used (bottom trawl) even though it is currently the most abundant species in the commercial catches from Lake Victoria (Mkumbo, 2002).

Batho-spatial Distribution of Fish Stocks

Distribution from trawl surveys

Combined catches by depth from the National waters of Kenya, Uganda and Tanzania gave a trend of increase in catch rates with depth to 40 m depth followed by a decrease (Fig. 3). ANOVA showed significant differences in catches between depth ranges (Fs = 3.3631, F0.05 (4,525) = 2.3889, P = 0.0099).

The depth ranges with the highest catch rates were 30-40m for Tanzanian waters with 176.8±46.04 kg hr^{-1} (Mean ± SD), 20-30 m for Ugandan waters with 186.4±97.2 kg hr^{-1} and 10-20 m depth for Kenyan waters with 283.0±75.7 kg hr^{-1}. In the 1969/1970 surveys (Kudhongania & Cordone, 1974) catches in the inshore waters of 10-19 m depth range were the highest (935.3 kg hr^{-1}). An abrupt drop in catch rates was found for the depth range of 60-69 m in the 1969/1970 surveys whereas the drop for recent surveys was at 50-59m-depth. Overall mean catch rates in 1969/1970 surveys were almost twice those of the 1999/2000 surveys (548.66 kg hr^{-1} and 296.1 kg hr^{-1} respectively).

Distribution from Hydro-acoustic Surveys

The distribution of the stocks by depth was similar to the bottom trawl surveys with high abundances in the depth ranges below 40 m (Fig. 4, zone I and zone III) and low abundances in depths more than 40 m for overall mean densities and for Nile perch densities. However for the pelagics i.e. Haplocromines and the "Dagaa", similar distribution patterns were observed in all depth ranges (Fig. 4).

Acoustic Surveys

Acoustic data were collected along pre-designed cruise tracks (Fig. 2) at a speed of 9-10 knots, using a 120-kHz EY 500 split-beam echosounder of 9 beamwidth. Biannual 16 day-surveys were conducted in August 1999, January/February 2000 & 2001, August/September 2000 and 2001. Sampling of echo traces observed on the echogram was done either using a 3.5 m x 3.5 m pelagic frame trawl or a bottom trawl net used in the trawl surveys.

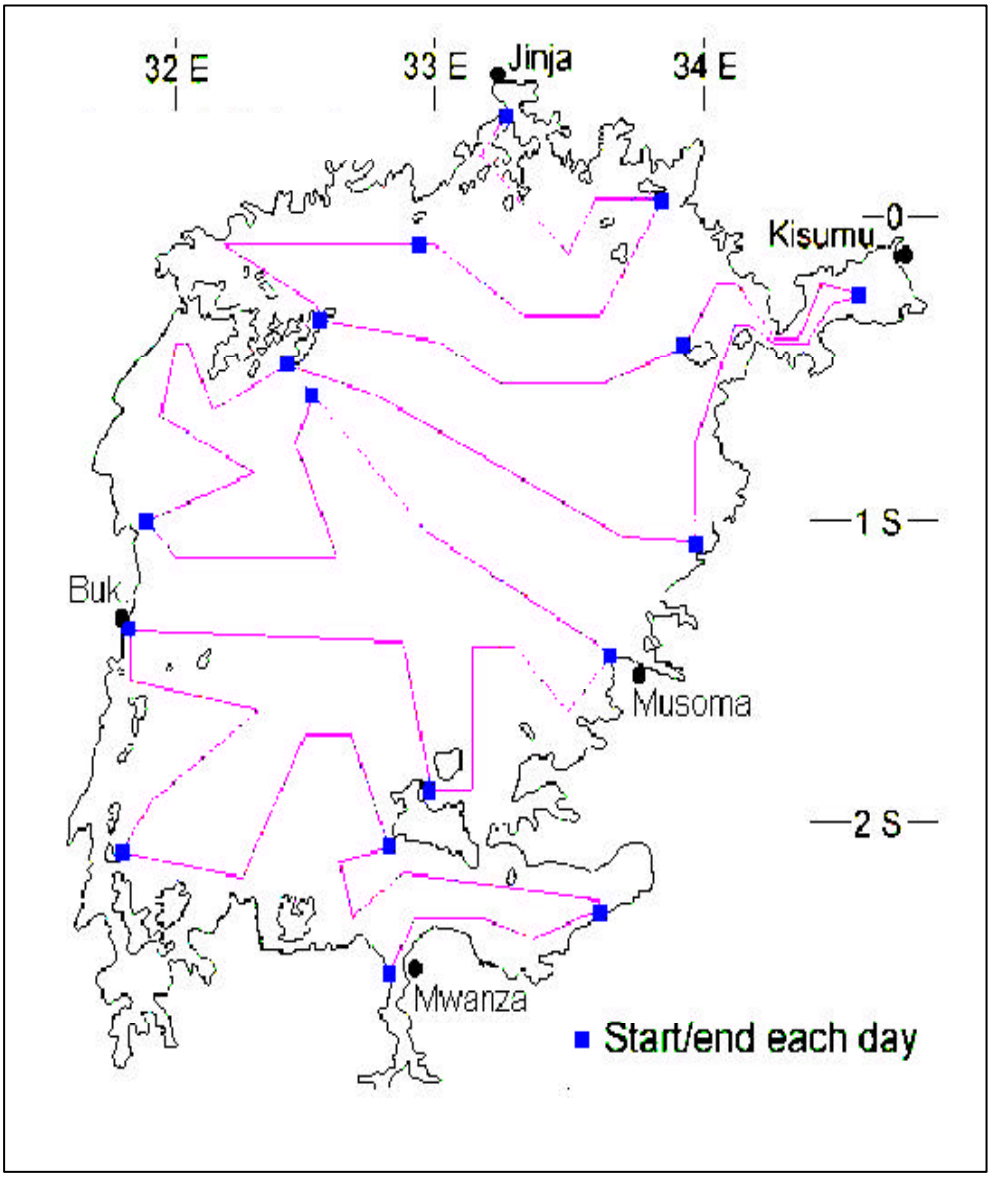


Fig. 2. Map showing the cruising tracks followed during the acoustic surveys in Lake Victoria

in the population implying good recruitment to the fishery. However, very few mature individuals and especially females were observed in the catches and this may affect recruitment in Nile perch fishery. Protecting the juveniles and the spawning stock will ensure sustainability of the fishery, as Nile perch is very fecund although survival rate of juveniles is not known. Size selective exploitation as has been agreed upon by Partner States to exploit only Nile perch of 50 cm - 85 cm has to be enforced to protect both juveniles and the spawning stock.

BACKGROUND

Over the last three decades, the Lake Victoria fishery has been undergoing a series of changes. In the first half of the last century the lake had a very diverse fish fauna with 28 genera and at least 350 species, mostly haplochromine cichilids (Witte *et al.*, 1992). The non-cichlids were 38 fish species. Efforts to develop and manage the fisheries of Lake Victoria started in the 1930s when signs of overfishing were recorded after the survey of 1927-28 (Graham, 1929). Underlying these efforts was the recommended use of 127 mm (5") mesh size for gillnets in early 1930s and the introduction of exotic fish species to boost the production in early 1950s. *Tilapia melanopleura* Dumeril, 1859, *Tilapia zilii* (Gervais, 1848), *Oreochromis leucostictus* (Trewavas, 1933) and *Oreochromis niloticus* (Linnaeus, 1758) were introduced in the lake. Nile perch (*Lates niloticus* Linnaeus, 1758) was also introduced in the late 1950s and early 1960s (Welcomme, 1969; Ogutu-Ohwayo, 1984). The effect of these introductions to the fishery and ecology of the lake was not immediately realised. Catch rates and the total yield continued to decrease for the twenty years that followed. The necessity to define the status of the stocks was raised by the research institution of the three riparian states, EAFFRO (East African Freshwater Fisheries Research Organization), and FAO/UNDP facilitated the first lake-wide bottom trawl survey in 1969/1971. From this survey, the total demersal fish biomass of Lake Victoria was estimated at 750 000 t, of which 80% (600 000 t) were haplochromines (Kudhongania & Cordone 1974). From these findings, bottom trawling and beach seining were recommended to fully exploit the haplochromines. Exploratory fishing for haplochromines in the late 1970s showed that a 13.7 m trawler with 130 hp engine and with a bottom trawl net of 20 mm codend could catch an average of 1 000 kg hr^{-1} (Goudswaard and Ligtvoet, 1988). Highest yields of haplochromines were recorded in 1977 when annual landings were 36 158 t, 6 264 t and 1 560 t; contributed 45%, 32% and 10% of the national catches for Tanzania, Kenya and Uganda respectively. Nile perch at that time contributed only 0.04%, 0.1% and 0.3% to the national catches of the three countries respectively (CIFA, 1982; Annual Fisheries statistics, 1988).

In the 1980s an explosion of *Lates niloticus* stocks was observed, and by 1987, *L. niloticus* contributed 60% of the total yield in Tanzanian waters, (Ligtvoet *et al.*, 1995; Bwathondi, 1990). In Kenya, catches increased from almost zero in 1979 to over 20 000 t in 1982 and Nile perch comprised about 60% of the catch (Okemwa, 1984; Ogari and Asila, 1990). The same trend was reported for Uganda (Okaronon *et al.*, 1985). As Nile perch increased to up to 90% of the total catch in 1990 (Ligtvoet & Mkumbo, 1991), a decling trend in all the other species escalated except for (dagaa) which became the second, and Nile tilapia the third in importance to the commercial fisheries of the Lake. However by late 1990s as investments and fishing effort in the Nile perch fishery increased, cath rates started to decrease. Currently, Nile perch contributes 60%, Dagaa 30% and Nile tilapia 7%. With further decline in catch rates fishermen have moved further offshore concurrently reducing mesh sizes used to catch juveniles or even changing fishing practices by vertically joining gillnets or towing them in order to optimise catches.

The investments and present fishing effort are based on inadequate knowledge of the resource base. There is a general belief that there are non-exploited off shore and deep-water stocks of Nile perch, which will support further intensive fishing. To address such uncertainities fishery-independent methods, trawl and hydroacoustic surveys were selected to estimate the exploitable fishery resources of Lake Victoria with particular regard to their abundance, species composition, geographical distribution and seasonal changes, population structure

predominantly immature fish. It is also noted that motorised boats operating gillnets, which target large Nile perch are concentrating effort at 5-6 inch mesh sizes compared with 7-8 inch meshed nets used 10-15 years ago. This has been coupled to the tremendous increases in the total numbers of gillnets thus exerting heavy fishing pressure targeted to juvenile stages of Nile perch.

Fisheries data collection

There is general lack of consistent time series fisheries data that are essential for making rational management decisions and assessment of the achievements of the implemented management measures especially in Uganda and Tanzania. A systematic catch assessment programme is only in place in the Kenya part of the lake. The ongoing biannual Regional Frame Surveys need to be maintained and strengthened and institutional mechanisms are needed to establish a Catch Assessment Survey programme that is harmonised throughout the region. The collection of baseline catch assessment data to support determination of optimum fishing capacity in order to guide control of access is crucial; this needs a consistent programme to be formulated and funded regionally. These data are necessary for making the right management decisions when supplemented by appropriate harmonised socio-economic and biological monitoring programmes. The current efforts to create strong fisheries beach level institutions; particularly the Beach Management Units (BMUs) around the lake are an opportunity that could be exploited to overcome some of the major constraints in fisheries data collection. This requires building strong partnerships with the BMUs to integrate fisheries data collection in their day-to-day activities. When strengthening fisheries data collection there is also urgent need for training and facilitation of data collectors from all the relevant stakeholders including BMUs, Local government, Fisheries Management and Fisheries Research Institutions.

ACKNOWLEDGEMENT

We acknowledge the East African Community (EAC) and the Lake Victoria Fisheries Organisation (LVFO) Secretariat for coordination of preparing this paper. This paper is based on historical information available in the Fisheries Institutions in the region, and reports of the Frame Surveys conducted in Lake Victoria in 2000 and 2002 with the funding of GEF/World Bank through LVEMP, the European Union through LVFRP and research surveys undertaken under LVFRP. This work was compiled with funding from the EAC and the EU-funded Implementation of a Fisheries Management Plan (IFMP) project for Lake Victoria.

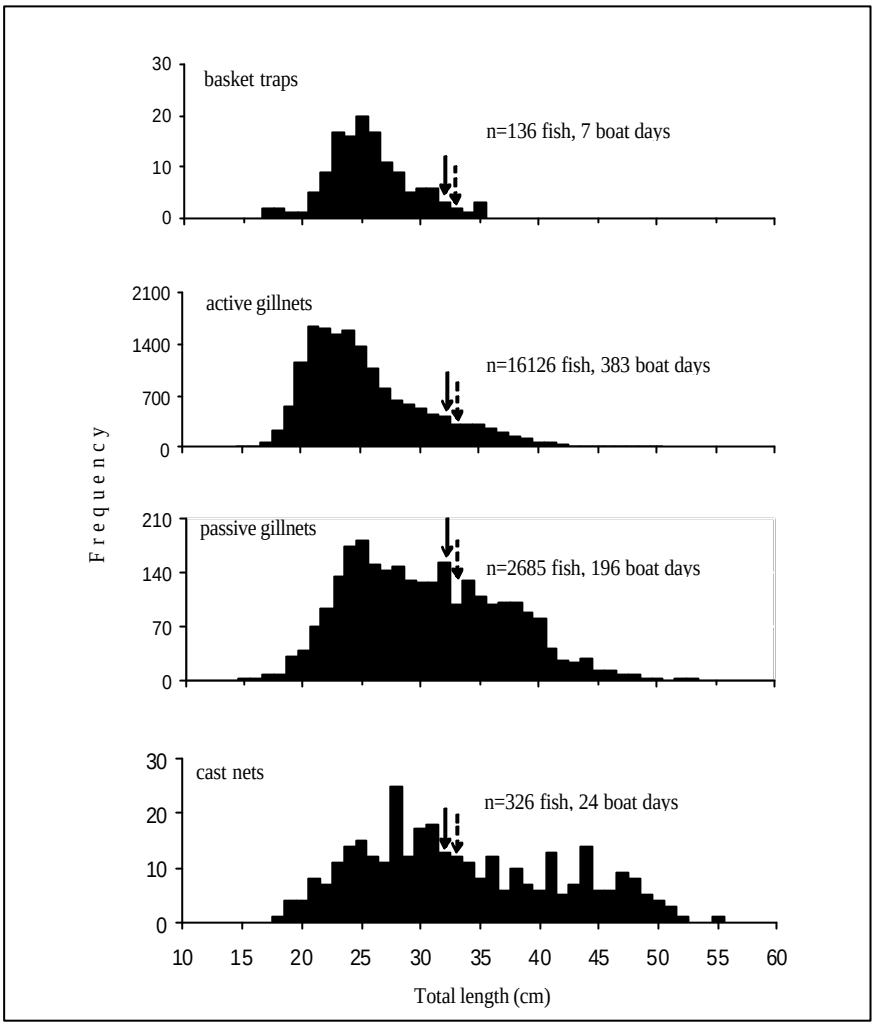


Fig. 11. Length frequency of Nile tilapia caught in the four major fishing gears/methods that target Nile tilapia in the Uganda part of Lake Victoria. The arrows indicate Size at first maturity: males (solid line) and females (broken line) (from Muhoozi, 2002).

CONCLUSIONS AND RECOMMENDATIONS

Excessive fishing effort

There is evidence of excessive fishing effort in recent years. In Lake Victoria as a fishing effort in terms of numbers of fishing boats, fishers and fishing gears have more than doubled in the last decade. Total catches and catch per unit of effort of Nile perch and Nile tilapia have reduced whereas the contribution to total catches of *R. argentea* (Mukene/Dagaa/Omena) is increasing. This is largely the result of inappropriate mechanisms of controlling entry into the fisheries of the primary elements of fishing effort, principally boats, gears and fishers; and the secondary factors like the fish processing factories, which influence fishing effort through market forces. The implication of the increases in fishing effort on the fish stocks should be assessed and appropriate measures taken.

Drift gillnets showed the best selection of Nile perch, with 68.1% of the fish caught larger than the recommended lower limit of 50 cm TL and only 31.9% below it. Nile perch larger than the size at first maturity of females, i.e. 75.6 cm TL, contributed only 1.5% of the catches by drift gillnets. This size composition of catches by drift gillnets can only be maintained if the mesh sizes are not lowered to or domination of 5 inches and below. In contrast, the Nile perch catches by hooks spread over a wide-range of sizes, with 57.8% below 50 cm TL and 14.3% larger than 75.6 cm TL. Thus amongst the fishing gears/methods used to target Nile perch in Lake Victoria, it is the fishery with hooks that catches considerable quantities of breeding females. This has potential consequences of reducing the spawning stock to low numbers that could be inadequate for sustaining the Nile perch stocks in addition to catching large quantities of juveniles

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Factors Affecting Nile perch Size Selectivity of Hooks

The size of Nile perch selected by hooks appears to be affected by the type/size of bait used rather than the sizes of hooks (Fig. 9 &10). However, considering that only three categories of bait, one of them (*Mormyrus kannume*) in insufficient numbers of sampled boats, were encountered in the fishery with hooks in the Ugandan waters (Muhoozi, 2002), the results are not conclusive. *Mormyrus kannume* bait was used exclusively by hand line boats; whereas *Clarias* sp. and haplochromine baits were used by both hand line and long line boats. Small Nile perch <50 cm TL were absent in catches of boats that used *M. kannume* bait but constituted 38.7% and 64.1% of fish in boats using *Clarias* sp and haplochromine bait respectively. Examination of the Nile perch selectivity of different hook sizes in the Tanzanian part of the lake (Mkumbo, 2002) also did not show any clear relationship between hook size and the size of Nile perch caught. The occurrence of small fish in the catch could be directly related to the size of bait but studies of Nile perch selectivity of hooks are inconclusive because fishers use a mixture of hook sizes. There is need to collect data on individual hook sizes and also the range of bait and sizes in use.

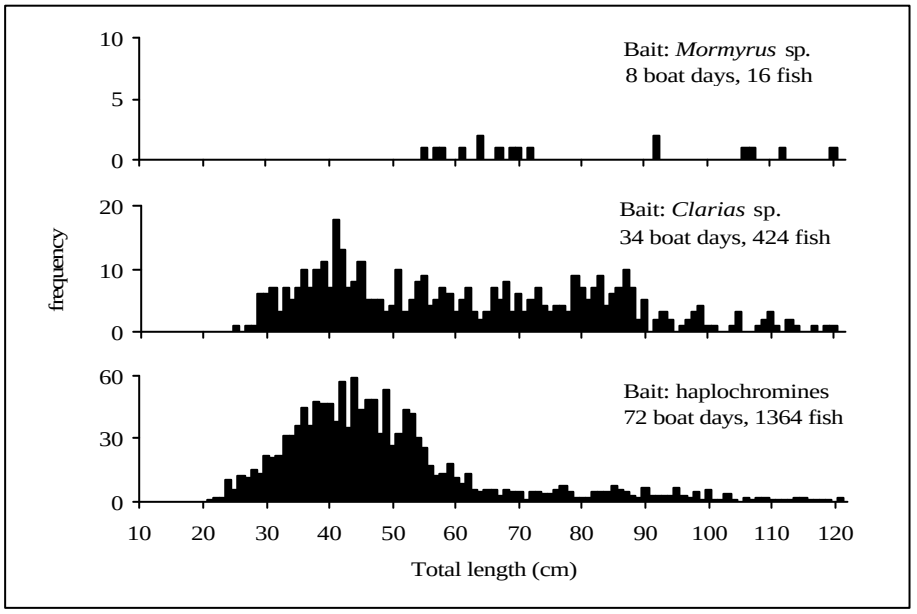


Fig. 9. Length frequency of Nile perch caught by hooks with three different types of live bait in the Uganda part of Lake Victoria (from Muhoozi, 2002).

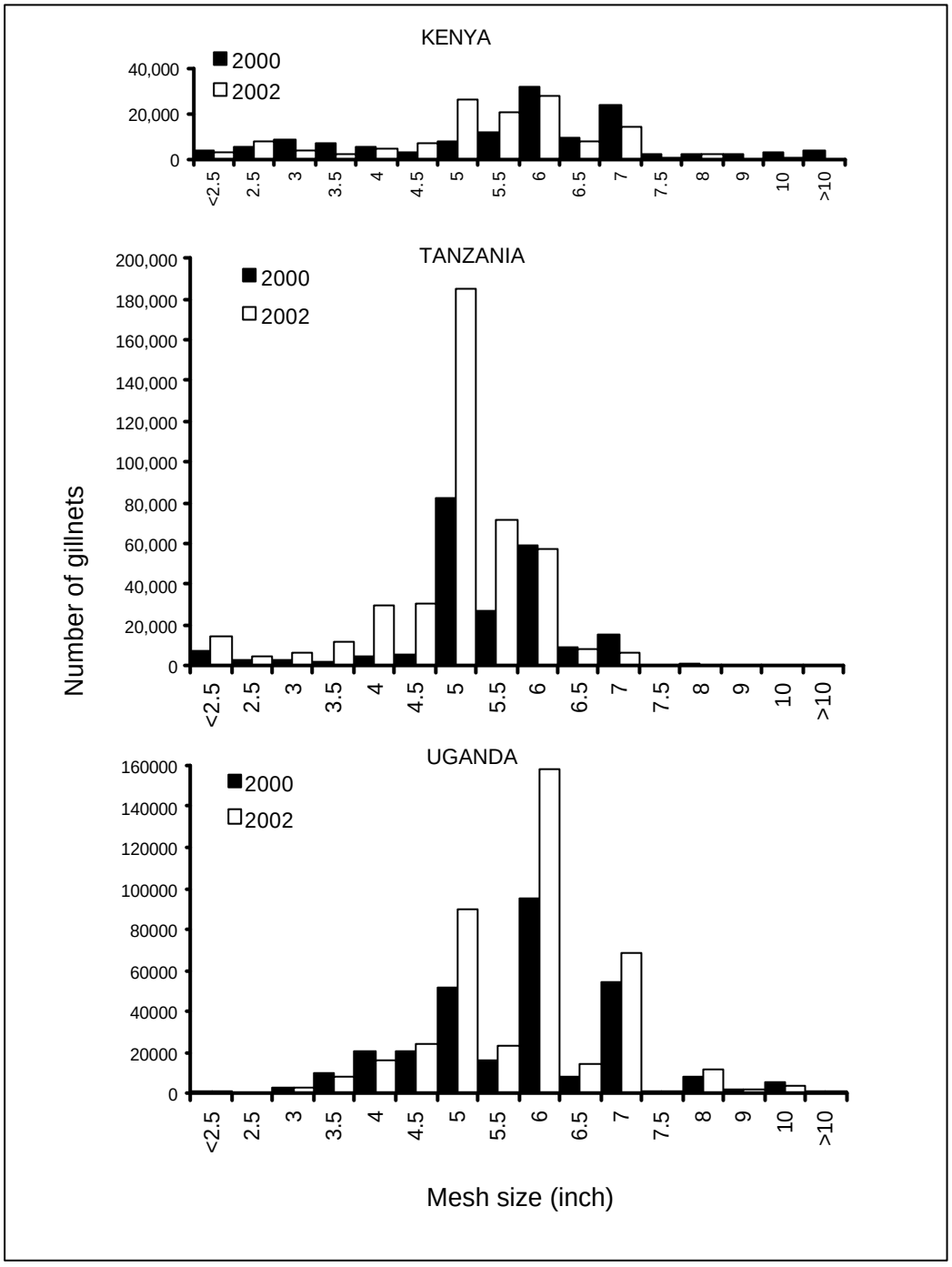


Fig. 7. The gillnet mesh size composition by country in 2000 and 2002 Frame Surveys of Lake Victoria

i) Fishers

In the whole lake the number of fishers increased by 36% from 129,305 in 2000 to 175,890 in 2002. The highest increase (43%) was in Tanzania where fishers increased from 55,985 to 80,053, followed by 41% in Kenya from 38,431 to 54,168, and least in Uganda from 34,889 to 41,674, an increase of 19.4%. Of the total number of fishers recorded in the lake in 2000, 30% operated in the Kenyan part, 27% in the Ugandan part and 43% in the Tanzanian part of the lake. In 2002, 31% of the fishers operated on the Kenyan side, 24% on the Ugandan side
and 45% in Tanzanian side of the lake.

ii) Fishing Crafts

The total number f fishing crafts of the entire lake increased by 23.5% from 42,483 in 2000 to 52,479 n 2002. The Largest increase oof (40.3%) was in Tanzania part of the lake, follwed by an increase in the Ugandan part (20%) and least in the Kenyan part (6%). The increase in number of fishing craft is another indication of an increase in fshing effort in the lake. The least increase (11.5%) was among the paddled boats, an in Kenya the number of paddled boats in the lake actually decreased. The fishing crafts using sails and outboard engines increased susbtantially by 53.6% and 59.5% respectively. Most of these crafts target the Nile perch fishery indicating that the fishery is still profitable and attractive to the new nvestments. It alsosuggests that the fishers have had to go further away as a consequence of a decrease in fish stocks near-shore. The lake wide proportion of fishing crafts operating in Kenyan and Ugandan waters decreased from 27% to 23% and 37% to 35% between 2000 and 2002 respectively, whereas in the Tanzanian waters, the proportion of fishing crafts actually increased from 36% to 42%. This trend shows that fishing effort was more rapidly expanding in Tanzania compared wiith Kenya and Uganda.

iii) Fishing gears

The legal fishing gears permitted by the three Partner States on Lake Victoria are gllnets of 5 inches or more in mesh sze and above, hooks and small seines/Dagaa seines. Gillnets of mesh sizes<5 inches, beach seines, monofilament gillnets and cast nets are not allowed. During the 2000 and 2002 frame surveys, both legal and illegal fishing gears were encountered on the lake. The total number of grillnets increased from 655,053 in 2000 to 984,084 in 2002, an increase of 50.2%. The number of gillnets used in Tanzania and Uganda increased from 224,025 to 425,888 and 297,663 to 427,488 respectively in 2000 and 2002. In Kenya, the number of gillnets remained more or less the same at 133,365 and 130,708 iin 2000 and 2002 respectively.

There was a remarkable increase in the number of long line hooks in all the three Partner States from 3,496,247 hooks in 2000 to 8,098,023 hooks in 2002, an increase of 131.6%. The rise in the number of hooks could be attributed to the increased demand for Nile perch by fish processing plants since this is the main target species of the long-line fishery. The large increase in the number of fishing gears in the lake provides additional evidence of sharp increases in fishing effort which needs to be controlled.

The use of illegal fishing gears had an overall decrease of 54.1% in terms of the number of beach seines that was reduced from 7613 in 2000 to 3491 in 2002. Most of this decrease was recorded on the Kenyan side of the lake where the numbers decreased by 80% from 5803 in the 2000 to 1157 in 2002. In the Ugandan part of the lake, the number of beach seines increased by 8.5% from 811 in 2000 to 880 in 2002; and in the Tanzanian part they increased by 46% from 999 in 2000 to 1454 in 2002. In the whole lake, the proportion of undersized gillnets (< 5 inch mesh size) also increased from 17.3% (113,177 nets) in 2000 to 18.1% (178,205 nets) in 2002 (Fig. 7). However, the proportion of undersized gillnets decreased in the Kenyan

Species Composition of Fish Catches

The Nile perch has continued to dominate the catches in the lake in the three partner states since the early 1980s (Fig. 5). However, despite the recent large increases in fishing effort, the catches of Nile perch have not shown any significant increase. In the Kenyan part of the lake there was a sharp decrease in Nile perch catches between 2000 and 2003. This may be related to uncertainties about the fishing area on which data are based because it coincides with the period when cross boarder fishing had serious hitches. Apart from the Mukene/Dagaa/Omena/Omena catches which increased significantly in the Uganda waters by 2000 and were probably under reported for the Tanzania waters, Tilapia catches increased slightly in the Tanzania and Uganda parts of the lake but decreased in Kenya section while production of other species remained low.

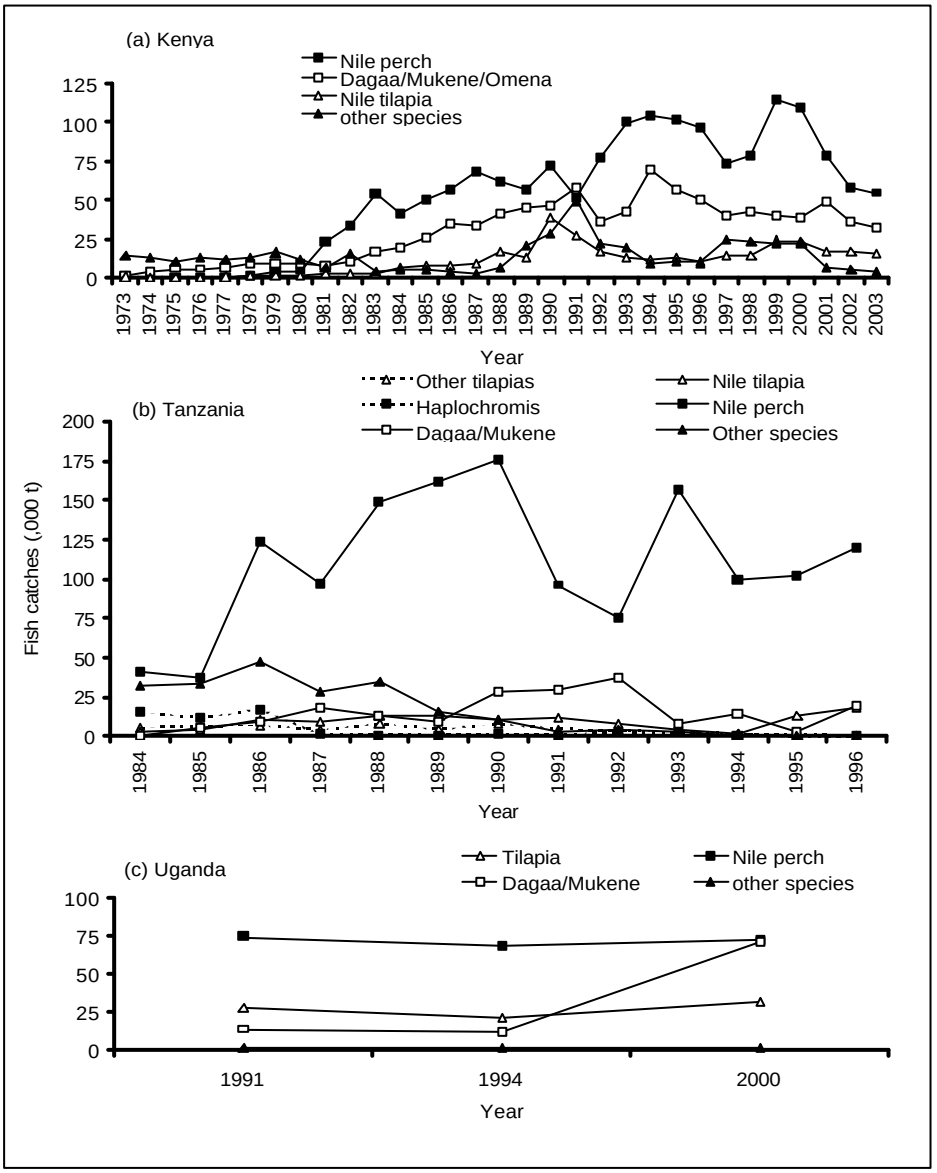


Fig. 5. Contribution of different fish species to fish catches in Lake Victoria in the (a) Kenya part of (1973 - 2003); Tanzania (1984-1996); and Uganda part (1991 - 2000)

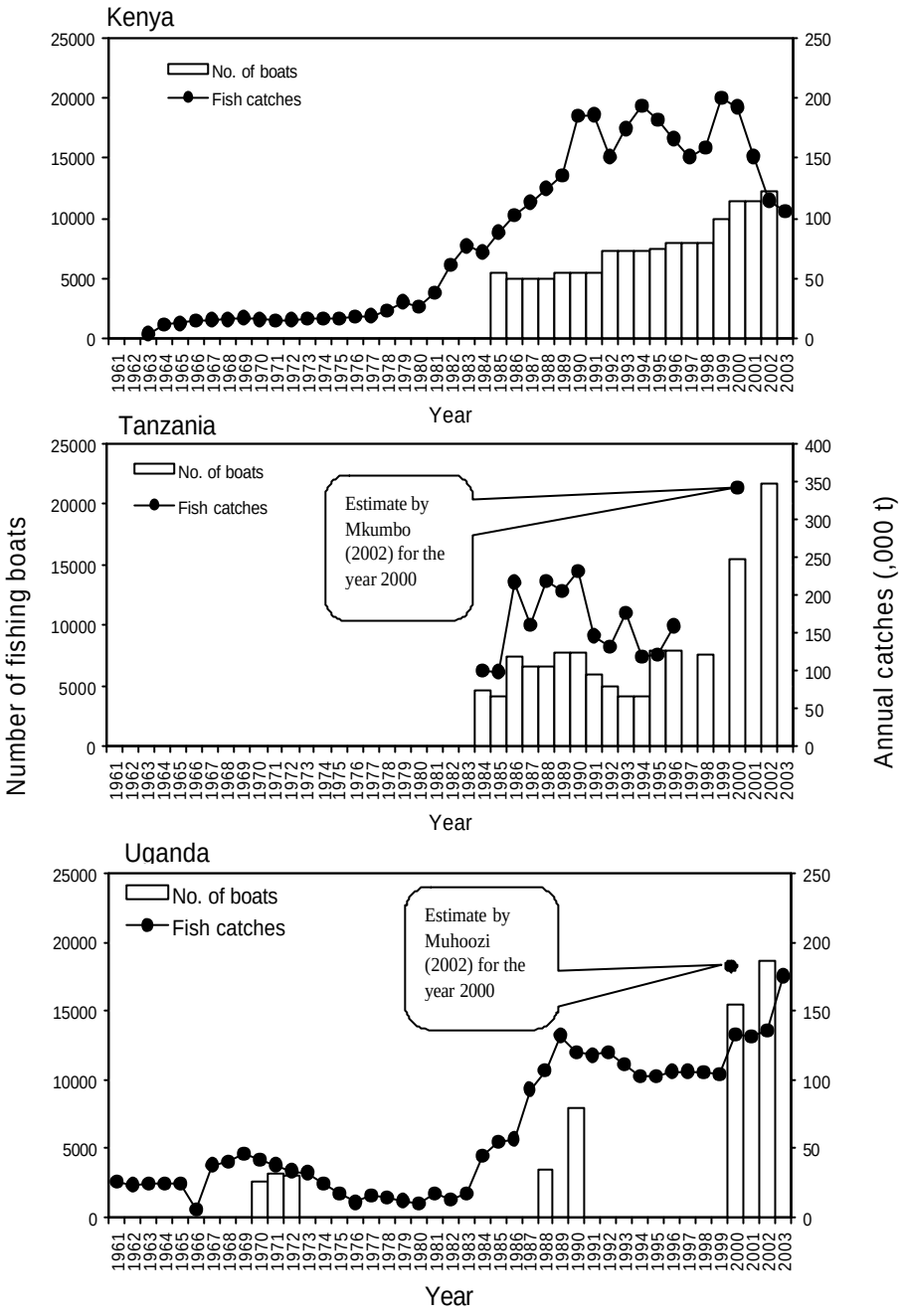


Fig. 2. Fishing effort (No. fishing boats) and overall fish yield in the Kenya, Tanzania and Uganda parts of Lake Victoria.

Table 1. Frame Surveys frequency carried out individually in the partner states before 2000

Country	Year
Kenya	1972, 1990, 1994 & 1998
Tanzania	Annually in the 1970s until 1991; and biannually from 1992 to 1998
Uganda	1970, 1971, 1972, 1988 and 1990.

the fishery for management but they also provide the basis of designing other statistical survey systems like Catch Assessment Surveys.

The three Partner States of the East African Community individually conducted Frame Surveys on Lake Victoria from the 1970s until 2000 (Table 1). These surveys had limited regional purpose but they still provide a benchmark against which subsequent regional surveys can be compared. The first lake wide Frame Survey was conducted on Lake Victoria in March 2000 with the support of the GEF/World Bank funded Lake Victoria Environmental Management Project (LVEMP) and the EU funded Lake Victoria Fisheries Research Project (LVFRP). The second regional Frame survey was carried out in April 2002 with funds from LVEMP. Both Surveys were coordinated by the Lake Victoria Fisheries Organization (LVFO). Subsequent Regional Frame surveys have been planned.

Catch Assessment Surveys

Catch Assessment Surveys involve the sampling of fish catches at selected fish landing sites to provide information on the trends in fish production. The outputs of Catch Assessment Surveys include updates of information for fisheries management, i.e. species composition of the fish catches; patterns of catch rates in space and time; and estimates of annual fish yield using raising factors derived from Frame survey data.

In Lake Victoria, Catch Assessment Surveys have not been given the due attention they deserve despite their importance. There was an attempt to conduct these surveys for the whole lake in 1972 but this did not succeed (Wetherall, 1972). After the breakdown of the East African community in 1977, individual countries continued with their catch data collection but with many problems. In the Kenyan part of the lake Catch Assessment Surveys have been conducted for almost a quarter of a century (Othina & Osewe-Odera, 1996). Catch data are available since 1976 and cover most fishery variables. This has been possible partly because there have been recorders posted to work at the landing sites for a long time. Although consistent, the quality of outputs of the Kenyan catch assessment system has been affected by general lack of resources for supervision and motivation of the poorly remunerated field recorders.

In the Ugandan part of the lake Catch Assessment Surveys have been inconsistent since 1972 with many problems. An extensive Catch Assessment Survey was conducted under the Artisanal Fisheries Rehabilitation Project (AFRP) and the Uganda Freshwater Fisheries Research Organization (UFFRO) in 1989 for only

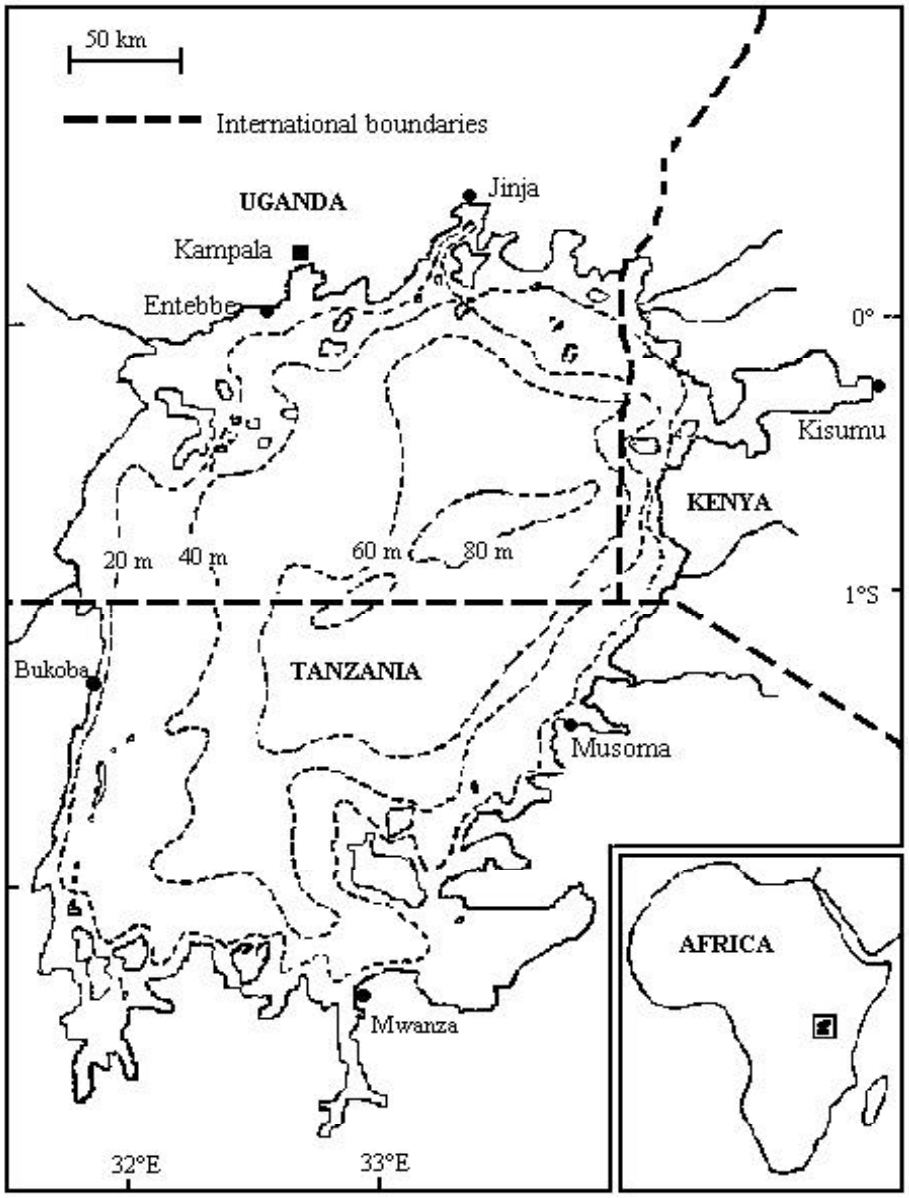


Fig. 1. The location of Lake Victoria in Africa

the development of railways, better roads, thus opening the way for fish to larger markets outside the immediate areas surrounding the lake. Demand for fish was also increased by development of urban centres and increasing human population around the lake. To satisfy the increasing demand for fishery products, fishing effort increased greatly. These events marked the start of commercial fishing in the lake.

With the onset of commercial fishing, problems associated with all commercial fisheries began to be felt. Fish catch rates of large mesh size gillnets e.g. 5 inches decreased quickly with increase of fishing effort, and fishers started introducing smaller mesh sizes, which suggested over fishing. The drastic decline in catch rates prompted the first fishery survey of Lake Victoria in 1927/1928 (Graham, 1929). This survey confirmed that the stocks of tilapia were being over fished and a minimum gillnet mesh size limit of 5 inches was recommended, which was imposed in 1931; the entry of new fishing boats into the fishery was not restricted. Fishing effort continued to increase as more boats entered the fishery along with the increase in human population, and as new markets for fish became available due to improved transport to urban centres (Ogutu-Ohwayo, 1990; Ogutu-Ohwayo *et al*., 1997). Consequently, the catch per net continued to fall and fishers responded by ignoring the 5 inch

will suffice. The three states may not be able to sustain the cost of carrying out surveillance exercises in the long term, but educating the resource users, highly influential people in the region and other stakeholders may lead to understanding and respect to the laid down measures and eventually reduce the frequency of carrying out the otherwise expensive surveillances. With the East African Community spirit for cooperation, there should be identified means to source for sufficient logistical support for sustainable operations, Royalties, trust funds or retention funds from the fisheries are sources that could be tapped.

ACKNOWLEDGEMENT

Thanks go to the Heads of the Fisheries Departments, Lake Victoria Fisheries Organization Secretariat, the East African Community and most importantly the financiers who contributed to the success of the exercise.

v) Develop systems for reporting outcomes of MCS operations including maintaining the databases of outcomes of the operations;

vi) Prepare an Operations Manual for MCS;

vii) Develop strategies for conflict resolution to enhance smooth of fishing and fish trade on Lake Victoria; and

viii) Develop mechanisms for Monitoring and Evaluation of MCS activities.

These tasks are already documented in the final report of the Harmonized Guidelines for the Monitoring Control and Surveillance of the Fisheries of Lake Victoria.
The RWG is thus coordinating the National and Interdistrict Surveillance and Patrol operations, and undertake the regional joint monitoring and patrol mission around the lake.

Guidelines for the Monitoring Control and Surveillance of the Fisheries of Lake Victoria

The RWG has developed guidelines for conducting MCS by the Partner States on Lake Victoria. These guidelines provide for the minimum requirement for MCS in the three states in relation to institutional structures and functions; operational procedures; logistics & equipments; reporting systems; monitoring & evaluation systems; funding systems; training & human resource development. The overall Objective of the document is to outline the agreed minimum guidelines and / or requirements for the conduct of MCS in the three Partner States. The Partner States are required to prepare national guidelines, within these regional concepts, which advance the national MCS systems.

Monitoring, Control and Surveillance Operational Manual

One of the most critical needs identified in the three countries as requiring urgent attention is an Operations Manual to be used by all Authorized Officers/Surveillance officers in the conduct of their patrols and surveillance activities. Many of the areas discussed in the Guideline document require further attention in detail. This will be achieved in the Manual. The Manual will describe actual operational realities and will provide the basis for fishery patrol and inspection, and will be updated as necessary.

Operationalisation of the MCS Guidelines and Manual

Currently the Partner States are operationalising the guidelines and testing the draft Manual under the Implementation of a Fisheries Management Plan. There is now improved community participation through co-management and collaboration with other stakeholders which has resulted in a marked improvement in surveillance. This has greatly boosted community resource
policing, shown in action of taken even in the absence of the enforcement officers. This includes immediate hand-over of items seized or the culprits to the nearest enforcement agency.

Putting in place Harmonized Guidelines for conducting Monitoring, Control and Surveillance in Lake Victoria and operationalisation of a lake-wide joint monitoring and sensitization mission by the Heads of Fisheries Management and Research of the Partner States has demonstrated to the fishers the importance of conservation to the stakeholders. A lot of illegal gears have been removed from the fishery and a number of suspects apprehended in courts of law. Reports from spot checks on fishing grounds and beaches show that there is increased quantity of fish but the fishermen catch them at undersize stage. More education and surveillance is therefore required. For the BMUs to effectively undertake resource policing, there is need to fully operationalise the BMU Legal Framework.

Table 1. Legal capacity of each Contracting Party for the provision of MCS on the lake

Legislative Component	Contracting Party		
	Kenya	**Tanzania**	**Uganda**
Authorised personnel & procedures	?	?	?
Stop aircraft, vehicles & vessels	? - within territorial waters only	? - within territorial waters only	? - within territorial waters only
To inspect & search	?	?	?
To seize &detain	?	?	?
To seize & destroy	? - with a court order	? - with a court order	?- order not necessary/on the spot
To sell seized fish and fishery products	? - perishables only	? - perishables only	?
Powers of arrest	? - without warrant	?	?
To prosecute	?	?	?
Measure & check fish and fishery products	?- without warrant/data collection	? -health & hygiene	? - without warrant/health & hygiene & data collection
Control access to the fisheries	? - licensing system	? - licensing system	? - licensing system
Control illegal use of gear & methods	? • identified illegal gear • gill nets 127mm • 10mm for *Rastrineobola argentea* fishery • Permitted hook sizes 9,10, 11	? • Identified illegal gear • gill nets 127mm • 10mm for *Rastrineobola argentea* fishery Permitted hook sizes 9,10, 11	? • Identified illegal gear • gill nets 127mm • Permitted hook sizes 9,10, 11
Control pollution & habitat degradation	?	?	?
Protect critical habitats & nursery grounds	?	?	?
Regulate & control product quality assurance	?	?	?
Introduction of exotics	?	?	?
Control capture & trade in immature fish	?-*Oreochromis niloticus* < 25cm *Lates niloticus* 50 - 85cm	?-*Oreochromis niloticus* < 25cm *Lates niloticus* 50 - 85cm	?-*Oreochromis niloticus* <25cm *Lates niloticus* 50 - 85cm
Regulate cross border fishing & export trading	? Require export permit	? • Require export permit • Prohibits export of whole *Oreochromis niloticus & Lates niloticus*	? • Require export permit • Prohibits export of unprocessed *Oreochromis niloticus* & *Lates niloticus*
Power to eliminate	?	?	?

that there is collaboration with representatives from the District levels (Resident District Commissioners, Fisheries Officers) and also other national agencies (such as Maritime Internal Security, Police Marine, Special Revenue Police Services (SRPS) and others. Recent national MCS operations in fisheries include the "*Save Samaki*" and "*Operation Clean*" initiatives involving collaboration between national agencies, including the security forces and an emphasis on reducing illegal gears and smuggling across borders. The Marine Police conducts independent patrols to protect national waters and have the authority to implement fisheries regulations. Some of the districts undertake their own patrols either indvidually or collectively in collaboraton with other local partners including BMUs.

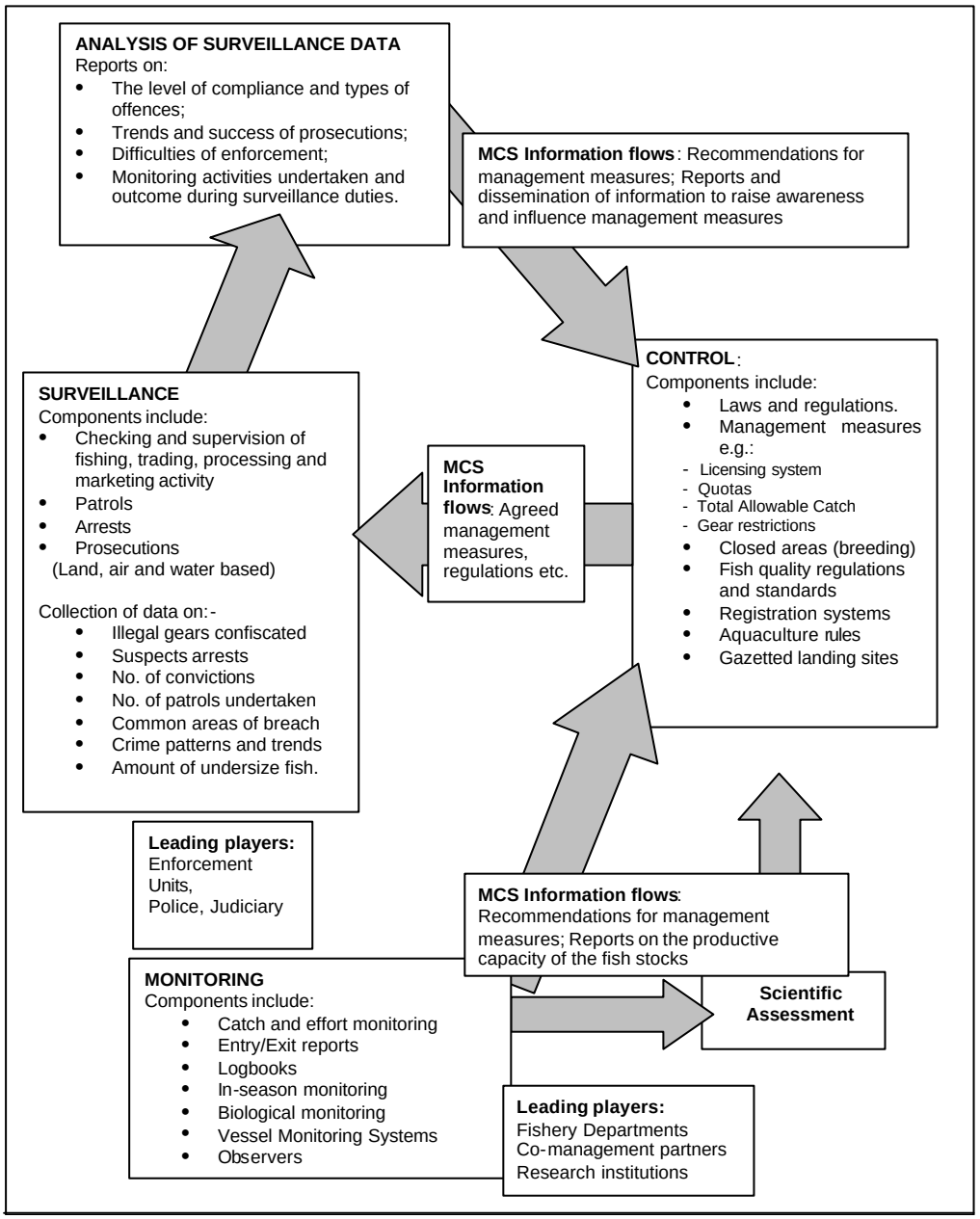


Fig. 1: Linkages and information flows within the MCS process

Fisheries Laws, Regulations and Agreed Measures.

The Partner States Legal Mandates are stipulated in each country's Constitutions, Fisheries Acts (Fisheries Act Cap 378 Laws of Kenya, Fish Act Cap 197 Laws of Uganda, and Fisheries Act No.22 of 2003 - Tanzania) and their subsidiary legislations, Gazette notices and National Policy Papers as they may be reviewed from time to time. These include:

1. The Fisheries Act of Kenya (Rev. 1991) Cap 378 and other subsidiary legislation provide for the development, management, exploitation, utilization, and conservation of fisheries and for connected purposes.

2. The Fisheries Act of Tanzania 2003 and subsidiary legislations provides for sustainable development, protection, conservation, aquaculture development, regulation and control of fish, fish products, aquatic flora and its products, and for related matters.

Ensuring controlled access into the fishery remains another management challenge to the Partner States. Sub-regional or Regional Fisheries Management Organizations and arrangements should, inter alia, adopt appropriate measures i.e. the measures should provide *inter alia* that excess fishing capacity is avoided and exploitation of the stocks remains economically viable (FAO Article 7, 1995). There is thus need to develop and implement a harmonized licensing system and reduce fish landing sites, which can be effectively implemented in all the three countries with the agreed objective of limiting access to the fishery. In the context of the Code of Conduct for Responsible Fisheries and its overall objective of sustainable fisheries, the issue of excess fishing capacities in world fisheries is an increasing concern. Excessive fishing capacities is a problem that, among others, contributes substantially to over fishing, the degradation of fisheries resources, the decline of food production potential, and significant economic waste, (FAO, 1999).

Efforts to control the use of destructive and illegal fishing gears and methods have remained a challenge in the fishery. For one there are the research aspects which use some of these gears. The aquaculture sector also depends very much on the gears which the capture fishery would consider illegal. The fishery enforcement officers confiscate these items from any body in whose possession they are found, for instance as stipulated in the Kenya Gazette Notice No. 7565 of 2001. These are serious management conflicts that need to be keenly handled as they lead to long battles in court sometimes with embarrassing outcomes.

Ensuring compliance to fisheries laws and regulations remains a challenge in shared resource management plans. Within the region the laws and regulations are being harmonized. The challenge ahead is sensitizing the diversified multilingual population with simple to understand translated versions of the regulations. It is only when the whole fishing community understands the laws/regulations that the compliance level may go up. The standard of measure of the compliance levels also needs to be established.

The challenge of controlling Illegal Unregulated and Unreported (IUU) fishing is a concern for the Partner States, FAO (2001), has shown IUU fishing undermines efforts to conserve and manage fish stocks in all capture fisheries, and that when confronted with IUU fishing, national and regional fisheries management organizations can fail to achieve management goals. This situation leads to loss of both short and long term social and economic opportunities as well as negative effects on food security and environmental protection. The existing regional instrument, the LVFO Regional Plan of Action (RPOA) to prevent, deter and eliminate IUU fishing on Lake Victoria and in its basin may not bear fruits due to lack of resources and capacities, although the political good exists in the region.

Controlling capture and trade in immature fish has remained a challenge as the fishery is dominated by artisanal fishermen. Most of these fishermen venture along the inshore waters where most species breed and even the ones who try to go offshore, end up using undersize meshed nets for quick and easy catch. Unless constant surveillance is done, controlling this kind of fishing remains a challenge in the vast and open waters of Lake Victoria. In order to deal with the challenge of smuggling fish across international borders the Partner States have to continue working with well-positioned agencies (including the private sector) to eradicate illegal movement of fish as a lot of revenue is lost.

Regulating conflict in resource accessibility especially along shared borders is another challenge that has been facing the Partner States for some time. There is the need to operationalise the Memorandum of Understandings (MOUs) that have been entered into by the different communities at the regional borders. There is also the existing issue of conflict of interest of fishers using different fishing gears at the same fishing grounds, which needs to be looked into as it has always caused animosity between different groups.

the LVFO through the Implementation of a Fisheries Management Plan (IFMP) project has established the Monitoring, Control and Surveillance (MSC) working group among other technical Working Groups (WG) and the initial activity of this Working Group was to establish Harmonized Standard Operational Guidelines for implementing MCS activities in similar manner in the three countries. This document provides the impetus, scope and development of the Partner States' capacity and capability. It also provides the foundation on which other documents; the Operations Manual, the Strategy and Action Plan will be based. The three states currently undertake three different forms of surveillances on quarterly basis and incorporate members of the Beach Management Units (BMUs) doing the national and interdistrict patrols, and the regional joint monitoring and patrol exercise which is coordinated by members of the Regional Working Group (RWG). A uniform reporting format form for reporting MCS outcomes has been developed to ensure efficient reporting of patrol outcomes.

BACKGROUND

The importance of fisheries surveillance and law enforcement in Lake Victoria cannot be overemphasized. From ancient times fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity. The wealth of aquatic resources was assumed to be an unlimited gift of nature. However with increased knowledge and the dynamic development of fisheries in the recent past, this myth has faded in the face of realization that aquatic resources, although renewable, are not finite and need to be properly managed, if their contribution to the nutritional, economic and social well-being of the growing world's population is to be sustained, (FAO, 1995).

The Partner States have for a long time been protecting the resource single-handedly within their individual jurisdictions/boundaries, yet fish does not know these boundaries. In any case the kind of resource protection that has been for along time carried out within the precincts of the states is surveillance per se, traditionally called patrol. This kind of single state resource protection and management has yielded minimal results since the Lake Victoria fishery is a shared resource among the East African States. The Republic of Kenya, Republic of Uganda and the United Republic of Tanzania, have now collectively put in concerted efforts to ensure that the resource is protected from illegal fishing malpractices, and is utilized sustainably. Where malpractices are observed, there are stringent measures put in place to stop resource abuse. Key issues such as Fisheries Laws and Regulations, Fisheries Policies and the Operational Guidelines for the Monitoring Control and Surveillance in Lake Victoria have been harmonized.

There are also various Council of Ministers Decisions on management measures (e.g. recommended slot size, eradication of beach seines, drift nets etc.) on Lake Victoria. A lot of progress has been observed, for instance, Monitoring Control and Surveillance to enforce the fisheries laws and regulations to curb Illegal, Unregulated and Unreported (IUU) fishing lake wide is being implemented by the Partner States, (LVFO, 2002). To show their commitment, the Council of Ministers have requested the Partner States to deposit with the LVFO Secretariat, their fisheries statutory instruments for implementing the agreed measures, and have directed the implementation of an adhoc inspection missions to check on compliance by Partner States, Lake Victoria Fisheries Organization, 31st October 2003.

Under the Implementation of a Fisheries Management Plan (IFMP) for Lake Victoria, the three Partner States have undertaken to harmonize their surveillance and law enforcement procedures by developing a document on Harmonized Guidelines for the Monitoring, Control and Surveillance (MSC) of Lake Victoria.

RECOMMENDATIONS

For sustainable fisheries management and development of Lake Victoria as a single ecosystem, the following initiatives need to be undertaken:

a) A common Lake Victoria Fisheries Policy and legislative framework should be developed to enable the integral management of the lake as a single ecosystem.

b) Review the policy of open access to fisheries with a purpose to adopt a more restrictive fishing regime.

c) The riparian States should make deliberate efforts to institute a sustainable funding mechanism to maintain and up-keep operational MCS, quality assurance and inspection services; provide extension services; strengthen aquaculture and the Regional Lake Victoria Institutions (LVFO, LVBC).

d) There should be exchange of fisheries information between researchers and management and with close and strong networking amongst the Riparian States.

e) There should be management oriented research and encouraged use of indigenous knowledge.

f) Ensure that there is effective national controls, compliance with conservation and management measures and that fisheries interests are accommodated in the multiple uses of shared resources such as gender equity and prevention of HIV/AIDS;

g) Ensure that decision making is transparent, participatory and there is cooperation through regional fishery organizations;

h) Conduct international fish trade in accordance with internationally agreed standards;

i) Cooperate among Partner States in order to prevent disputes and also combat insecurity in and around the lake;

j) Promote awareness of responsible fisheries through education and training;

k) Ensure there is safe and healthy fishing and fish processing facilities and also good working and living conditions prevail;

l) Protect the rights of fisheries and disadvantaged fish workers;

m) Promote the diversification of income revenue and diet through aquaculture; and

n) Pursue the development of aquaculture systems to relieve fishing pressure on capture fisheries.

l) Climate modulation and source of domestic and industrial water supply;

m) Unifying factor for EAC hence acts as a hub for Economic Growth for the three States and the Great Lakes region; and

n) Bestowed with abundance of human resources with different cultural backgrounds, values, talents and skills.

OBSERVATIONS

A harmonized applicable affirmative action in the three riparian countries to address the management and utilization of the fisheries resources that shares the same lake ecosystem and catchment areas are still wanting. Apart from this, there are still gray areas, which need further clarification and actions. The following are the key observations and concerns that are made based on the aforementioned: -

a) Though co-management has been adopted in the management of the lake resources through Beach Management Units (BMUs), their integration into operational management leaves a lot to be desired;

b) There is still insufficient exchange of information on cross-border fisheries data;

c) Joint regional MCS operations and synchronization of management activities are not yet operationalized;

d) Capture fisheries is a potential agent to improve the social-economic well being of the fishers whose poverty levels are not readily seen to be alleviated by the overall accrued benefits;

e) In capture fishery systems, one of the primary and most dynamic components of the system are people and their behaviors; which is intriguing to grasp;

f) Fishers operate only out of their own interests, so managers' main role is to take care of the fish. Over fished stocks do not speak nor cry but trends of depletion are the external signs of stress;

g) The managers advocate for the rights of the fish because they understand the fish dilemma hence the need to manage the people from inflicting pressure on fisheries. To save the fish stocks, the managers have to apply minimum reasonable force to controlthe fleets, the amount and type of catch effort, and where necessary prosecute offenders;

h) Fisheries management is typically multi-sectoral with a variety of social, cultural, political, economic and ecological elements, all of which must be integrated;

i) Monitoring, Control and Surveillance operations are expensive but are necessary as they form an executive arm of fisheries management and although that success is never immediate, it is an assurance of fisheries sustainability;

j) The penalties relating to fisheries offences among Partner States are not proximate and deterrent enough, hence demanding urgent review; and

k) The phenomenon of the tragedy of commons is still an over riding fallacy which largely mars common sense in fisheries resources use. The "GOD" given legacy predisposes impunity in mismanagement of the fisheries resources by the resource users; and the impact of explosive human population growth on inelastic water bodies exerts excessive fishing pressure. Such a trend leaves the fisheries resources at the mercy of the exploiters as demonstrated in Fig.1.

Implementation of National Mandates in various areas

Laws and Regulations should be effective and efficient otherwise the purpose for which they were enacted will never be realized and may perpetrate perpetual breach of law with impunity. The three Partner States have within their respective competencies and capacities tried to develop policies, make laws and regulations in order to promote and guide fisheries management measures in the following areas:

a) Protection and conservation of fisheries diversity in protected aquatic areas, fish breeding areas, closed seasons, rivers, dams and wetlands;
b) Prohibiting the introduction of exotic species of flora and fauna in the lake and put in place mitigation measures where such introductions have incidentally occurred;
c) Limiting open access to fisheries through regulating fishing efforts, licensing and downsizing the numbers of fish landing sites;
d) Ensuring safety of fish consumers and controlling the supply of good quality fish and fishery products;
e) Effective collection, analysis, storage and transfer of fisheries data and information;
f) Involvement of the fisher communities in the management of the fisheries in partnership with governments;
g) Encouragement of fisheries management driven research and promoting applicationof indigenous knowledge in the management;
h) Collaboration and strengthening linkages with other relevant stakeholders;
i) Effective and efficient Monitoring, Control and Surveillance including curbing insecurity on the Lake;
j) Reactivating and diversifying aquaculture systems;
k) Adoption of new appropriate science and technology and regulating genetically modified organisms (GMOs);
l) Minimizing conflicts in resource use and management of straddling fish stocks;
m) Development of human resource and institutional capacities;
n) Addressing on the concerns relating to gender equity, HIV/AIDS and waterborne diseases around the lake;
o) Sourcing for logistical support and resources to support extension and enforcement services through avenues such as establishment of royalties, levies and a common trust fund;
p) Modernizing the fisheries industry and providing alternative income generating activities and indoctrinating a culture of saving and credit schemes among fisher communities;
q) Internalizing socio-economic interconnectivities; and
r) Ensuring a health Lake Ecosystem as a critical fish habitat.

CHALLENGES

The ideal situation expected in and around the lake is to have sustainable management and development of the fisheries resources that can meet the needs of the present time without compromising the ability of future generations to meet their own needs. However, the dilemma the management institutions have is to balance people's needs and activities, their growing economic insatiable desires and the health of the entire ecosystem. In pursuit to this challenge, a number of problems have been encountered and include and are not limited to:

a) Inadequate or outdated policies and legal frameworks;
b) Inadequate data collection, storage and dissemination systems;

b) *Regulation 27* (i) controlling pollution of fishery waters either through liquids, gases solids or any other pollutants.

c) *Regulation 26 and GN 223 of 22/6/2000* outlaws possession of poison for killing fish or poisoned fish.

iii) *G.N No. 370 of 7/10/94, GN 189 of 6/6/97 Reg. (7) and Government Notice 624 of 9/10/98*; setting minimum mesh sizes of gill nets to be not less than 5 inches for Nile tilapia and "Dagaa" nets of not less than 10mm. It also prohibits the manufacture, sell or otherwise, possess, import or use beach seines for catching fish.

iv) *G.N No. 300 of 22/9/2000 Fish Quality Standards* providing codes of practice for Quality Assurance, fish Inspection and fish handling infrastructure.

Offences and penalties within the current legal framework attract a fine of Tanzanian shillings (Tsh.) 300,000 or imprisonment of 3 years or both such a fine and imprisonment and for subsequent offences, a fine of Tsh. 500,000 or to both the fine and imprisonment and the fishing vessels involved in the commission of the offence be forfeited to the state. Offences under Kenyan legal framework governing Lake Victoria have no fixed minimum fine but attracts a maximum fine of Kenya shillings (Ksh. 20,000) approximately US $ 260 or imprisonment to a term not exceeding one year or to both the fine and imprisonment and movable articles used in the commission of the offences forfeited to the state.

Regional and International Cooperation

a) ***Regional Cooperation***

The first fisheries survey of Lake Victoria done between 1927- 1928 by Dr Graham became an eye opener for collective responsibility to manage the fisheries resources therein as one resource. As a result of this, the East African Fisheries Research Organization was established at Jinja, Uganda in 1949. Interestingly, when the East African Community collapsed in 1977, the three East African countries continued to collaborate in joint fisheries research and management. This culminated in the formation, ratification and signing of Lake Victoria Fisheries Organization (LVFO) Convention in 1994 by the three States. This cooperation has been strengthened as evidenced by the joint regional projects namely; Lake Victoria Environmental Project (LVEMP) Phase I, 1997- 2005; and Lake Victoria Fisheries Research Project (LVFRP) Phases I and II. All these have subscribed to the current development and implementation of Fisheries Management Project (IFMP 2003-2008), mothered in LVFO. The Treaty for the establishment of the EAC, 2000; the East African Community Development Strategy (EACDS) 2001-2005; protocols especially on the Environment and Natural Resources Management; Customs Union and many others legal mandates to nurture and propel the aspirations of the development of the Lake Victoria Basin.

The Council of Ministers of LVFO is the supreme body of this regional Organization and is responsible for policy decision-making. This organizational structure helps in the making of decisions which bind the three States, and the decisions made are therefore required be domesticated and upheld by three countries. For instance, the underlisted decisions have been made under these arrangements:

i) The Dar es Salaam June 1999 Decision to address the fish poisoning in Lake Victoria and decision to speed up harmonization of fisheries legislation, implementation of management measures, enforcement and national actions to ensure the quality of fish from the lake through a collective strategy;

of fisher communities and also addressing the issues related to gender and HIV/AIDS. The outcome of this process will inevitably lead to the development of a Fisheries Master Plan and will result into the revision or amendment of the Fisheries Act Cap. 378 including subsidiary legislations made there under.

Uganda National Fisheries Policy

A new National Fisheries Policy 2004, has been developed and approved in compliance with macro-economic and national social reforms. Business Plan for the implementation of the National Fisheries Authority and a new Fisheries Bill, 2004 are on going as one of the means to revamp fisheries management. The elements of this national policy take into account sustainable management and development of fisheries; decentralization and community involvements; funding mechanisms; investments, planning, policy making and information management, environment, aquaculture, reduction of post harvest losses, marketing, research and human resource development.

Tanzania National Fisheries Policy

The Tanzania policy focuses on promoting sustainable exploitation, utilization and marketing of fish and fishery products in order to provide food, income, employment, foreign exchange earnings and to provide effective protection of the aquatic environment to sustain fisheries development for the present and future generations. It also directs how the management of currently exploited fisheries is to be conducted.

National Legal Mandates

The three Partner States have Constitutions, which provide for the protection and conservation of natural resources on behalf of their citizenry and promote their rational utilization. In this regard, applicable and effective municipal laws have been put in place and in some cases they operate in cross-reference to each other.

The Fisheries Act Cap. 378 of 1989 (Revised 1991) for the Republic of Kenya

The scope of this law covers the legislation on the management, development,, exploitation, utilization and conservation of the fisheries resources within inland lakes, public dams, swamps, rivers, and marine waters. However, due to emerging new management concepts that are from time to time changing, it was deemed necessary to come up with subsidiary legislation to support the Fisheries Act Cap. 378. These new subsidiary legislation are:

i) *The Fisheries (Fish Quality Assurance) Regulations, 2000. Legal Notice No.100/2000)* sets conditions for hygienic handling and processing of fish and fishery products and confers *Competent Authority* (CA) to the Fisheries Department;

ii) *The Fisheries (General Amendment) Regulations, 2001* (Legal Notice No. 18/ 2001) prohibiting presence of trawl vessels, possession of trawl nets and trawling in Lake Victoria;

iii) *The Kenya Gazette Vol. CIII, No. 69 of 9th November 2001, containing Gazette Notice No. 7565* which introduced fisheries Management Measures. The management measures in this instrument provided for closed seasons, designated fish breeding areas and prohibited use of destructive fishing gears and methods;

iv) *Kenya gazette Supplement No. 105 of 24th December, 2003, containing Legal Notice No. 214; The Fisheries (Prohibitions) Regulations, 2003*. This legislation introduced slot sizes of Nile perch,

citizens are yet to be legislated in the three partner states as at the present time such licence fees are too high to be afforded by all the citizens of the partner states and they need to be reviewed. The penalties relating to fisheries offences are not proximate and deterrent enough among the legislations of the partner states and may call for urgent review to be commensurate to the offences committed.

The LVFO is the arm of the EAC responsible for implementing regional policies on the management of fisheries resources of Lake Victoria. The Council of Ministers of the LVFO is the supreme body of the Organization responsible for policy decision-making and directions. A lot of decisions have been made and some of them made under these arrangements are: Dar es Salaam Council of Ministers Decision (CMD) (June 1999) to address on the fish poisoning in Lake Victoria; speeding up the harmonization of fisheries laws, regulations, management measures, and enforcement; ensure the quality of fish; Nairobi (CMD)(June 2002 to institute harmonious measures to regulate cross border fishing and fish trading in Lake Victoria; Jinja (CMD)(October 2003) to put into place slot sizes of Nile perch; prohibit smuggling of fish across borders; conduct joint Monitoring Control and Surveillance (MCS); Bagamoyo May 2004 Joint Communiqué banning drift nets; encouraged practice of responsible aquaculture and adapted LVFO Regional Plan of Action (RPOA-IUU) fishing for Lake Victoria.

Appreciable efforts in the implementation of such decisions have been achieved with success but availability of financial resources has not been readily there when mostly needed, hence the need for concerted efforts from EA States to provide the same.

The Partner States have not been left behind in the initiative on international collaboration in relation to international accord on the conservation of natural resources and protection of the environment. Some of the major international conventions and treaties relating to the management of fisheries resources and their attendant critical habitats that have been ratified and domesticated by Partner States among others include the FAO Code of Conduct for Responsible Fisheries, 1995; UN Conventions on the Law of the Sea (UNCLOS) of October 1982; Conference on Environment and Development, 1992, Compliance Agreement by Fishing Vessels on the High Seas of 1993; Fish Stocks Agreement of 1995; Convention on Biodiversity; FAO (IPOA-IUU) fishing; World Summit for Sustainable Development (WSSD) (2002); Ramsar Convention) 1987; CITES of June 1979 ; and Agreement on Tariff Barriers to Trade, 1994.

There are however, a number of challenges that still need to be addressed. Among the most critical of these being overcapacity, approximation of fisheries legislations in the three Partner States; harmonization of licensing regimes for Lake Victoria, effective enforcement of fisheries rules and regulations, assurance to the supply of good quality fish and fishery products; interstate exchange of fisheries data and information; enhanced co-management in fisheries management; introduction of regional joint MCS; addressing on HIV/AIDS and gender issues in fisheries; introduction of the culture of saving and rural credit schemes among fisher communities; enhancement of funding to fisheries management and development activities; introduction of appropriate science and technology in fisheries; and enhanced advocacy and strategizing fisheries management and development.

BACKGROUND

Policy and legal frameworks are interlinked processes. Both operate as an engine for directing strategic course of actions and laying down laws and regulations for attaining social justice and sanity in equitable distribution and sustainable use of resources. The two frameworks including inputs from high levels of the

at all levels. For effectiveness in management of the fisheries resources the BMUs will require a lot of support from the government and all related development partners. The support required is in terms of:

a) Development of a training manual for capacity building in organisational, financial management, conflict resolution and decision-making skills.
b) Establishment of a strong BMU network to enable them communicate on issues of direct importance (security, fisher movements, and prices, among others).
c) Involvement in fisheries management measures such as participation in licensing of fishers and registration of crafts.
d) Translation, production and distribution of the fisheries regulations into easily understood language (the local languages) for ease of implementation.
e) Provide information and skills in alternative livelihood that will ensure that fishers diversify their investments.
f) Provide incentives in the form of working tools.
g) Give priority to BMUs in revenue collection by the local authorities.
h) Encourage the BMUs to form saving and credit schemes.
i) Sensitize stakeholders at all level on the roles of BMUs in resource management.
j) Speed up the development of legal tools for BMUs where they are not yet empowered.
k) Strong linkages between the managers, the BMUs and the Regional Fisheries coordinating body (LVFO) so as to ensure coordination of co-management policies among Partner States.

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Existing Institutional Linkages in Co-Management

The linkage between the BMU, the fisheries managers and other existing institutions in the beach are as follows; at beach level the BMUs are made of all stakeholders and are linked to the staff of Fisheries Department (FD), and/ or Local government and other development lead agencies (Fig.2).

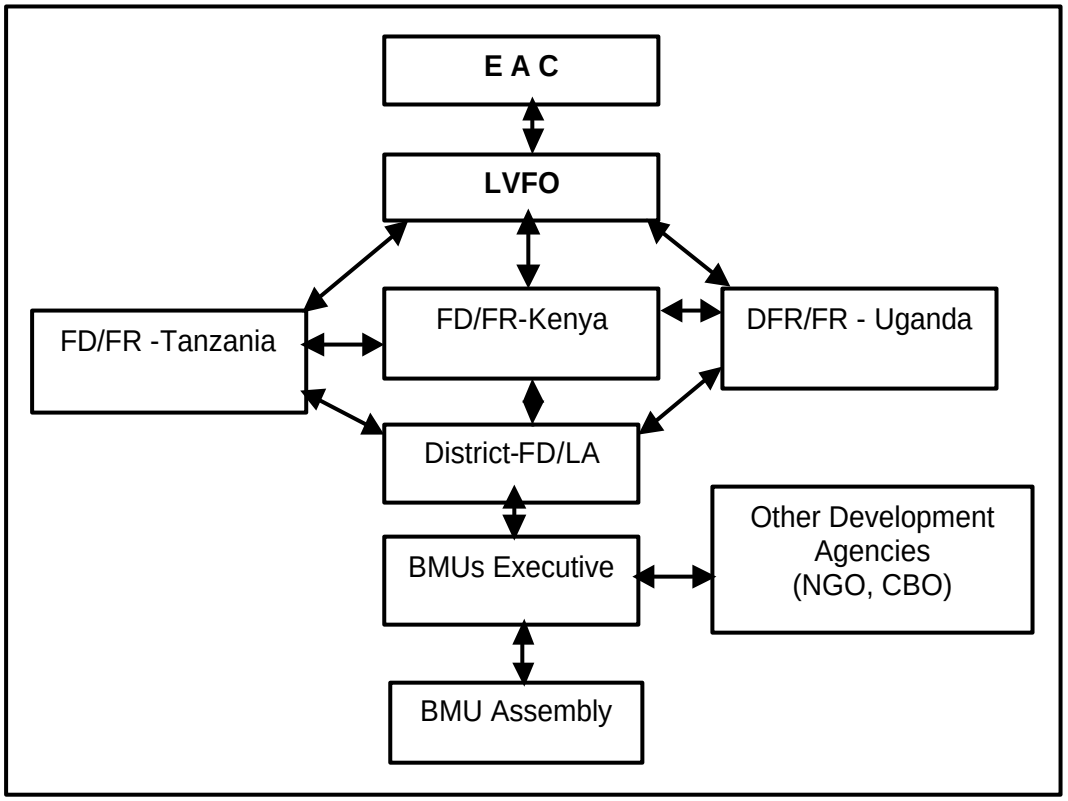


Fig. 2. Institutional Linkages BMU, Fisheries Department (FD) /Fisheries Research (FR), Local Authorities (LA) and other development agencies (Community Based Organizations -CBOs, NGOs) and Lake Victoria Fisheries Organization (LVFO)/ East Africa Community (EAC).

BMUs' Effectiveness in Fisheries Management

Despite their varied levels of skills and capability the BMUs have effectively participated in data collection. MCS activities have become more successful because of the accurate information and participation of the BMUs. They carry out the day-to-day surveillance of the fishery resources, are involved in conservation measures by conserving the breeding areas. On the ground they are actively involved in improving the beach hygiene, reduced child labour in the fishery industry, handle emergencies at beach level, resolving conflicts, improving their social welfare, has increased sense of ownership of the resource and hence sustainable exploitation, reduced conflicts between the government fisheries managers, fishers and other stakeholders. They serve as entry points for other development agencies such as HIV/AIDS interventions and fish banks among others.

CHALLENGES

There was good performance observed since the establishment of the BMUs in the region. Post implementation

In Kenya the number of BMU increased from the initial 245 to 306. The Draft Harmonized BMU guidelines are being used to reconstruct these committees. The national legislation supporting the BMUs is due to be completed in 2005; meanwhile they operate with the powers delegated by the Director of Fisheries under the Fisheries Act 378 (Rev.1991). In Tanzania the initial number of 481 BMUs dropped to 371. This has been blamed on the formation process, where sensitization was only for a day, which was a very short time to adequately equip them with the required basic skills. The revised Fisheries Act 22 (2003) empowers the BMUs to execute their roles. In Uganda, the establishment of the BMUs was limited; the initial number of 17 went up to only 20 BMUs in Lake Victoria. This slow pace was because emphasis was laid on the process of enacting the supporting legislation and providing the detailed guidelines.

A lot of work has been done to ensure that these beach institutions become functional. Initially there were no legal tools for the BMU; now these are in place or in draft form while the National Standard Operating guidelines (SOPs) for operations of BMUs have been developed and are in the process of being harmonized at the regional level. These give clear roles and responsibility of each player and structure of these units hence uniformity. Furthermore, training manuals for BMUs have been drafted, cross border BMU networks have been developed and Memorandum of Understanding (MoU) signed by the border riparian districts; the same is in the process of being co-opted lake wide. Tools such as translated copies of some key fisheries legislation have been developed in three local languages (Dholuo, Luganda and Kiswahili). Capacity building programmes are also being implemented.

Harmonized Arrangements for the Formation and Support of BMUs

The three Partner States have made considerable progress towards agreement on harmonized BMU guidelines, which prescribe a common set of procedures for BMU formation and operation; define roles and responsibilities for BMU members, executive committees, and clarify the roles of other supporting institutions such as the local government, Fisheries Management, Fisheries Research and Non-governmental institutions. These will assist in the convergence of both the concepts and practices of BMU formation and development around the lake, though differences will inevitably persist due to national variations in institutional arrangements.

Roles of the BMU

The local communities were given the responsibility of electing their BMU leaders (Executive Committee) and implementing their roles as stipulated. The stakeholders agreed that the roles of BMUs should include:

a) Enforce the Fisheries Act and Fisheries Regulations
b) Prepare bye-laws to facilitate the implementation of the National laws
c) Ensure beach sanitation and hygiene
d) Collecting fisheries data/information
e) Educate other stakeholders on the negative impact of illegal fishing practices and other environmental issues that affect the fishery resources and the general environment
f) Maintain and keep a register of all boat owners, their fishing equipment and fishers
g) Participate in vetting of boat owners for licensing and ensuring the licenses are issued to members of BMUs thus limiting access to the fisheries resource
h) Formulate funding proposals
i) Other responsibilities, which would be found relevant to BMUs.

e) Smooth data/information exchange among stakeholders (Fishers and Government Authorities are willing to share data and their understanding of fishery resources).

f) Maximum use of indigenous knowledge in traditional resource management and utilization.

g) More control over fisheries by fishers, which they effectively own as a Community.

h) Greater trust between fishers and Government because there is security of tenure (fishing rights).

i) More incentive for fishers to take a long-term management perspective (Sustainability).

j) More effective in enforcement of bye-laws as the laws have a high level of acceptance; compliance and self-enforcement are high.

k) Guarantees rapid recovery of fish species, which are otherwise in danger of extinction.

l) Provision of power to the fishing communities to decide on wise use of resources.

m) Provides a powerful lobbying force within a larger lake wide management, which can influence National policies and regulations.

n) Ensures security of people, gears and safety of fishing operations.

o) The BMU structure involves all gender groups and focuses on poverty reduction within the fishing communities.

p) BMU enables other service providers to build capacity across a wide range of issues including HIV/ AIDs, alternative income generating activities and saving mobilization.

The Need for Co-management in Lake Victoria

Community based fisheries collaborative management (co-management) in Lake Victoria was necessary because it allows the knowledge and view of all stakeholders to be incorporated in the decision-making process. This gives rise to better policy and plans whose adherence level by fishers is high, as opposed to the "t*op-down"* management used by the Partner States earlier.

There were inadequate trained fisheries staff and budgetary constraints to police the Lake, which meant that response to problems in the Lake, were not addressed adequately and timely. Resource users have a greater indigenous knowledge of their local environment and the fishing practices employed there. Once empowered and given the skills and sense of ownership of the resource, they are better placed to respond to signs of overexploitation or destructive fishing activities faster than the distant administrator. To give stakeholders a chance to work in partnership with the Government to conserve, protect and manage the fishery resource.

Co-management and Development of BMUs in Lake Victoria

The three Partner States embraced co-management in Lake Victoria in 1999 with the formation of BMUs as the local entities at the beach level that enable the fishing communities to participate in co-managing the fisheries resources.

Beach Management Units (BMUs) means "*a group of stakeholders whose livelihood is dependant directly or indirectly on the fishery resources and whose main function is management, conservation and protection of fish in their locality in collaboration with the Government*".

participation in licensing of fishers and registration of crafts, encouragement to form savings and credit schemes. Additional effort will be required to ensure that adequate support is given for the co-management structures at the village, BMU, sub-county, district, national and regional levels.

BACKGROUND

Enforcement of regulations by Government has not been successful due to inadequate trained fisheries personnel and budgetary constraints. The top-down approach of management has made the resource users view the resources as belonging to the Government. Regulations are thus violated further threatening the sustainability of the fish stocks. There was therefore need to make a paradigm shift in the management style from that of imposing from above to that which involves the resource users. This approach is co-management, which recognizes the need to include stakeholders in both the formulation and implementation of the fisheries management measures. a lake-wide approach to co-management in Lake Victoria was introduced between 1998 and 2000 in the three riparian states by establishing 743 fisheries community based management units (Beach Management Units (BMUs) at beach level made of artisanal fishermen, boat owners, small scale fish processors and traders, farmers, among others. At that time, there were neither operational guidelines and institutional framework nor legal tools to back them in the Partner States. This therefore resulted in formation of BMUs that varied in composition and with no clear definition and roles. However there have been recent efforts to harmonize, train and empower them legally.

Concept of Co-management

Co-management is a partnership that harnesses the capacities and interests of the local fishers and community with the Government providing enabling legislation, enforcement, conflict resolution and other assistance. Co-management recognizes the importance of involving user groups in the development and implementation of management policies. The overall goal is to ensure a sustainable Lake Victoria fishery resources management for the benefit of the present and future generations.

Co-management can be defined as "an arrangement where resource users and the government share responsibility in the management of fishery resources" (Baticados and Agbayani, 2000). It is a management system that employs two or more groups of stakeholders in the management of a resource base and in which all stakeholders have equal opportunity to make decisions. It relies on the active participation of the local communities in the management of the resources. The concept of co-management is in line with the Fisheries Policy Objectives of three Partner States and the FAO general principals of Code of Conduct for Responsible Fisheries (CCRF) which states that "*the local people have a fundamental right to participate meaningfully in the management of local resources on which they depend and that such participation must be embedded within a legal framework which regulates the access, control and use of the fisheries resources*".

Principles of Co-management

The principle of co-management is based on the good will and co-operation between all partners (Government and the local communities) having a stake in fishery resources. Therefore, all partners are required to have equal opportunity of giving views on the best approach to manage the resources using current and past experiences. The Co-Management Units should comprise all stakeholders because they are the direct beneficiaries and first to suffer when the resources are depleted.

During the establishment of fisheries co-management in Lake Victoria the socio-economic and cultural values of the fishing communities in the riparian districts were taken into consideration. The most widely cited set of

The Resource, Environmental and Socio-economic Research and Monitoring Program has four WGs: A Catch Assessment (CAS) and frame survey to provide information on the fisheries including catch composition and fishing effort; A fish stock assessment (trawl and acoustic survey) WG to provide information and monitor the biomass, composition, distribution and population structure of fish stocks; A fisheries, pollution and environmental monitoring WG to provide information on the biology and ecology of the fishes, lake productivity processes and on the health of the fish habitat and how they relate to fish production; and A socio-economics research and monitoring WG to provide information on fisheries socio-economics.

The Aquaculture Research and Development Program still operates as one WG but covers both aquaculture research and development. It develops and provides guidelines for aquaculture research and development.

The Database, Information Communication and Outreach Program has two WGs: A database development and management WG to develop and manage databases to be used as decision-support tools (DSTs); and An information, communication and outreach WG to package and disseminate information to resource users and managers.

The Capacity Building Program has two WGs: An Infrastructure capacity building WG to develop infrastructure for development and management of fisheries resources; and A human resources development (HRD) WG identify human resource capacity needs and develop human resource capacity through training.

The activities of the programs are implemented through projects. Current projects include: The Implementation of a Fisheries Management Plan Project for Lake Victoria (IFMP); The Socio-economics of the Nile Perch Project; and The Production and Marketing of Value-added Fishery Products in Eastern and Southern Africa Project.

CONCLUSION AND RECOMMENDATIONS

There are institutions at both national and regional levels for development and management of the fisheries resources of Lake Victoria. The functions of different players are generally well defined. There are adequately defined institutional processes for development and management of the fisheries resources. The effectiveness of the institutions is hindered by inadequate infrastructure and human resources capacity, and limited financial allocation by Government for activities of the sector. There is therefore need to improve both human and infrastructure capacity and provide adequate funds allocations to the sector.

of Directors of Fisheries Research Institutes who identify research requirements, review research methodologies and ensure dissemination of research results. There are Regional Working Groups (RWGs) to harmonise national activities into a regional perspective and National Working Groups (NWGs) to implement activities at national level. The activities of the LVFO are coordinated by a Secretariat located at Jinja in Uganda. The Secretariat is staffed by an Executive Secretary assisted by a Deputy Executive Secretary, A Fisheries Management Specialist, A Senior Scientist, and Information and Database Officer, but the Secretariat has no experts in training/outreach and capacity building.

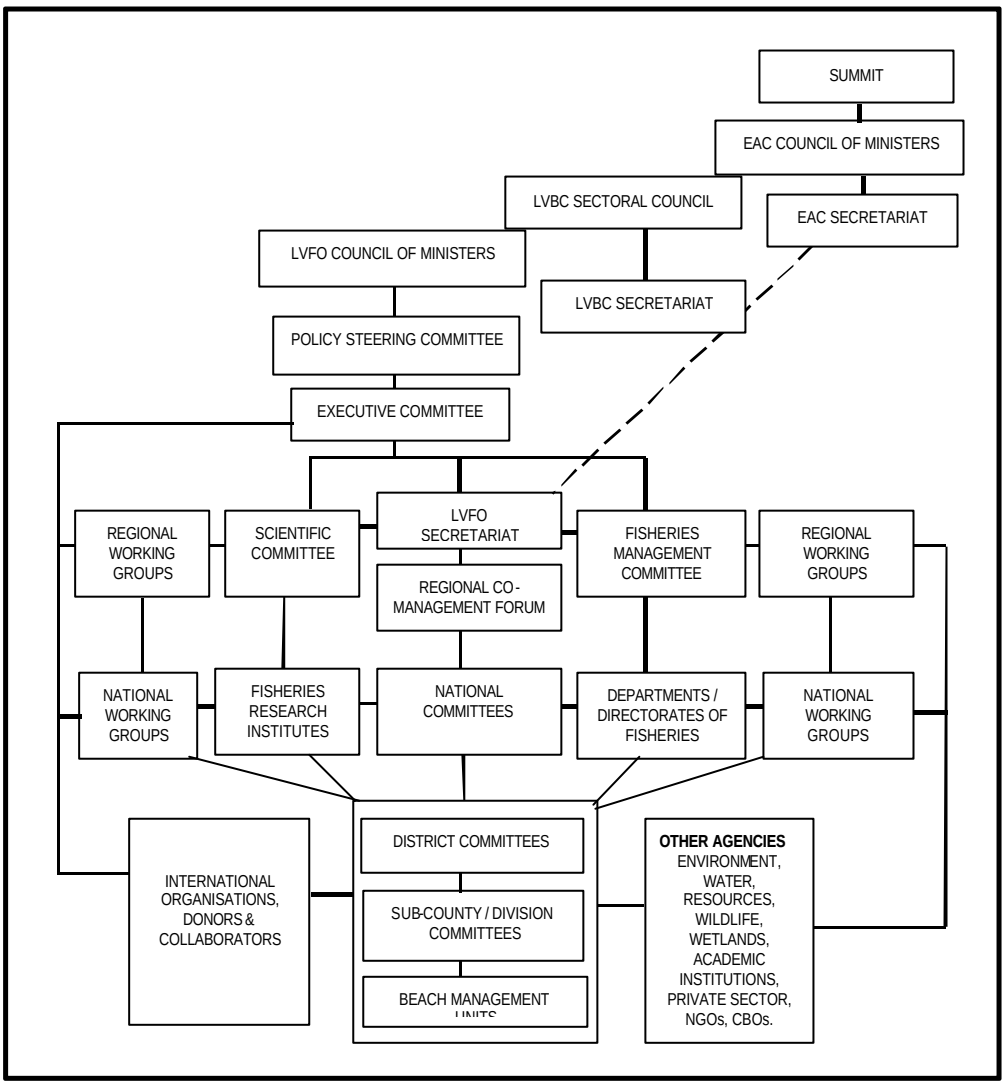


Fig. 1. Institutional Structure of the LVFO including the linkages to the different institutions involved in development and management of fisheries resources on Lake Victoria

The Institutional Structures, Functions, Processes and Linkages for Development and Management of the Fisheries Resources

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SUMMARY

Lake Victoria is shared between the East African Community (EAC) Partner States of Kenya, Uganda and Tanzania. The fishes of the lake move freely between the boundaries of the Partner States and because of this the Partner States have, for a long time, cooperated in development and management of the fisheries resources of the lake. Currently, there is a regional institution, the Lake Victoria Fisheries Organization (LVFO) which is responsible for coordination of development and management of the fisheries resources of Lake Victoria. The LVFO has a well-defined institutional structure comprising of a Council of Ministers, a Policy Steering Committee, an Executive Committee, a Fisheries Management Committee and a Scientific Committee and Working Groups WGs at regional and national level all of which have clearly defined functions. There is also a Secretariat to coordinate activities of the LVFO. The core function of the LVFO is to harmonize national measures, develop and adopt management measures for fisheries management, fisheries research, aquaculture development, information and databases and capacity building. To do this, LVFO has formed programs and WGs within each program to implement activities of specific thematic areas within each program. There are Regional Working Groups (RWGs) which harmonize national measures into regional measures and develop procedures and guidelines that are then adopted and implemented at national level by National Working Groups (NWGs). Implementation of the LVFO activities is undertaken at national levels according to the EAC Principle of Subsidiarity where issues are agreed upon at regional level but implemented at national level. The national Departments/Divisions of fisheries implement management measures and national fisheries research institutions conduct research and provide the information and databases to guide management. The management of fisheries is being broadened through development of co-management institutions by formation of Beach Management Units (BMUs). The fisheries management institutions also work with other government and non-governmental institutions including Police, the judiciary and civil society institutions. The structures of fisheries management institutions vary slightly between the Partner States but all include village, sub-county/division, district and national levels therefore, there seem to be regional and national institutions with well-defined functions and some of them appropriately linked to relevant institutions in other sectors. The effectiveness of the institutions to sustainably manage fisheries is affected by a number of factors especially inadequate infrastructure and human resources capacity, and limited financial allocation to undertake the activities. There is therefore need to improve both human and infrastructure capacity and provide adequate allocation of financial resources to the sector.

BACKGROUND

East Africa is rich in aquatic resources especially fisheries. Most of the fisheries resources come from Lake Victoria. The overall fisheries sector goal of the Partner States is to ensure increased and sustainable fish production and utilization through proper management of wild fish stocks, reducing post harvest fish losses and adding value, promoting aquaculture, and overall improvement of the sector to contribute poverty reduction.

The extent and degree of conflict in a fishery is an indication that there is problem somewhere with the management system. A management regime should be able to cope and meditate between stakeholders and their divergent objectives. The disease burden, especially high incidences of diseases especially HIV AIDS and bilharzia is a concern that impact negatively on sustainable fisheries objectives and poverty reduction in fishing communities. There is urgent need to characterize the threat and to regionally adopt a collective response.

Fisheries Institutional

Those fishers and others conducting Illegal Unregulated and Unreported (IUU) fishing and dealing in other illegalities do not behave responsibly. By ignoring fishing rules, they create unfair advantages over responsible fishers and dealers who play by the rules. [2] The Regional Plan of Action on IUU was adopted by the LVFO Council of Ministers in 2004 and is being implemented. The legislation in the riparian states has largely been harmonised. However, fishing licences and permits are issued by the multiple jurisdictions such as BMUs, Local and Central Governments. Each BMU may have a bye-law. In some cases, Local Governments may make fisheries regulations or ordinances applicable to their jurisdiction. [3] Under the circumstances, the LVFO must conduct joint operations to improve coordination among various law enforcement agencies for efficiency and effectiveness. The law enforcement agencies could include the police, navy, intelligence services, local administration police, BMU enforcement teams and fisheries law enforcement officers. It is recognised that the lake is important to the riparian states not only for fisheries, but also as a corridor for transportation of goods. The different agencies must work together to provide maximum security possible, while minimising any disruption in fishing and commerce on the lake.

WAY FORWARD

There is urgent need for concerted effort to manage the fisheries of the lake towards increased efficiency, profitability and sustainability. As a prerequisite, all parties must work together to ensure that fisheries are afforded a defined user rights to resources within the jurisdiction of their BMUs. This will promote a perception of ownership, responsibility and accountability amongst fishers and ensure equity. The BMUs must operate under a co-management arrangement with other stakeholders under different jurisdictions and mandates. It is expected that a better compliance regime will ensure that resources are protected from abuse when there is a mechanism for communication and cooperation between and amongst stakeholders. The fish stocks especially Nile perch, already resilient, will respond and increase in biomass to supply the increasing demand for food fish for national, regional and international markets sustain ably.

A conducive policy framework under the EAC, LVFO and national governments is required to ensure that new investments are leveraged. The private sector and governments working together in partnership will spur development. The stakeholders could form associations or cooperatives organised by commodity around technology that adds value to ensure collective benefits.

[2] *" The US Coast Guard is first and far most a military service and a branch of the armed forces. It is also the US governments lead maritime law enforcement agency. Protecting against illegal activity along the commitment to the border including terrorism is critical to US economic prosperity, ability to project military power, democracy" Telich, 2003.*

[3] *"Protecting Great Lakes fish stocks is everyone's jon and is in everyone's interest. While Law Enforcement officers work hard to enforce the law, they cannot be everywhere at once. By taking an active interest in fisheries laws, fishers can help protect the fishery for today and for the future. Poarchers are people who, for whatever reason, break fishery regulations. Fish harvest regulations are in place for one purpose: to protect the fishery. Those who flout the law deplete the resource for everyone" Leonard, N. 2003.*

and secondary production. This has in effect assured a thriving fish export trade given constant supply of the raw material of the volume that can support international trade.

The growth in international markets for Nile perch (*Lates niloticus*) has propelled the sector in to unparalleled development along the value chain with increased use of ice. Nile perch export is in excess of US$ 300 million annually in international trade. Gross traded commodities in fish and fisheries product is in excess of US$ 650 million. The fisheries inspection services in the riparian states are some of the best in Africa as they guarantee quality and safety of fish and fisheries products to facilitate trade. Nearly 900,000 people, including the majority of poor men and women, are directly involved in fishing, fish processing and trading in the basin and at least 3 million people are directly dependent on the fisheries sector as the main source of household income.

The private sector has played a leading role in industry growth over the past decade with investments in modern processing lines, refrigerated vessels and trucks and improved input supply infrastructure. Labor force has been on the increase as citizens take opportunity for employment in the various businesses along the supply and market niches. The existence of infrastructure such as good roads, power and communication in the basin was an opportunity for citizens to cash into enterprises that support the growing fishery industry. Governments have responded under the auspices of the East African Community (EAC) and Lake Victoria Fisheries Organization (LVFO) in particular, to rise to increasing demands by sector players to regulate these developments in response to the challenges. Emergence of regional institutions around the lake is supportive and an opportunity for synergy.

The LVFO is in the process of establishing over 1000 BMUs in communities around the lake to delegate responsibility and empower the community to manage the fragile neighborhood fisheries. Co-management has replaced previous command control management approaches. Fishing laws have been harmonized and inter agency approaches to protect fisheries resources from abusive harvest offers hope for sustainable fisheries. Standard Operating Procedures for Beach Management Units (BMUs), MCS, Surveys and quality assurance certification have been developed. Implementation is underway. The lake is scenic and still largely pristine with immense unexploited opportunity for eco-tourism and sport fishing.

CHALLENGES

There are a number of challenges to sustainability of the fisheries resources of Lake Victoria. These include fisheries, environmental, biological, economical, social and institutional challenges.

Environmental and Biological

The basin has been bedeviled by vagaries of deforestation, poor land use, unplanned settlements, urban sewage and fishing village sanitation, ineffective regulation of basin industries leading to localized eutrophication, algal blooms, and water hyacinth infestation as a result of nutrient loading. These environmental stressors work to the detriment of ecosystem functions that support fisheries production. It is recognized that these are externalities to fisheries management. The LVFO needs to work in synergies with other lead agencies responsible for environment, water, pollution, sanitation, land use, afforestation and urban planning to address these concerns. Increased fishing pressure on certain stocks especially *Lates niloticus* presents a special challenge to the management of fisheries in the lake. Over capacity in the Nile perch fishery, preponderant use of illegal fishing gears and methods, harvesting, dealership and processing of undersized fish and Illegal, Unregulated and Unreported (IUU) fishing in general have led to decline in catch per unit effort and off take.

Lake Victoria including fisheries, it seems now imperative to invoke a cross sectoral training program which must of necessity take care of emerging issues in fisheries management. Training and capacity needs have to be built at several levels for the management of the fisheries of Lake Victoria along scientific, management and community levels.

In the past the training of a Fisheries Officer, for example, in the University of Michigan or University of British Columbia required the trainee to be a Biologist. This is because there were many fish waiting to be caught or else they would die of old age. In that time, there were no major issues of environment, pollution, diminishing resources, higher human population and increased human activity. But now this is no longer tenable. Therefore, a fisheries manager, researcher or a Beach Management Community leader needs to have a broad understanding of these issues albeit at different levels of comprehension. So today, a fisheries manager requires know-how in Fisheries Biology, Water Quality, Sociology, Economics, Public Health, Food Science, Information, Security and Education Techniques. Hence the training of a fisheries manager calls for an all round education system which exposes the manager to the Natural Sciences, Economics, Sociology, Public Health, International and National Affairs, Public Speaking, Sports as well as many other issues. A fisheries manager now requires to be an ecosystem manager, knowledgeable in issues such as:

a) Human and social factors including: rapidly rising populations; food security; urbanisation; decreasing and dwindling natural resource capital; increasing incidence of diseases; droughts; famine; wars and civil strife; improving and bigger human demands; Increasing social standards and affluent tastes; better transport and communication;

b) The natural resource base parameters including: dwindling fish stocks; over fishing; loss of biodiversity; decreasing soil and land productivity; optimum sustainable yield; catch quotas; fishing seasons; fishing areas; acceptable fishing gears; and permissible gears and sizes;

c) Environmental issues impacting on the water habitat and the fish stocks: deforestation; irrational agriculture; over grazing; bush burning; eutrophication; chemical and heavy metal pollution; agricultural chemicals; siltation; aquatic weeds; human and parasitic diseases;

d) Economic factors: the market, local, national, regional and local demands; the foreign market, quantity and quality aspects; fish quality assurance; product value addition; product transportation; and labour and employment

Labeo victorianus. The other fishery involving certain Cyprinidae, *Protopterus, Synodontis, Clarias* and *Mormyrus* have virtually collapsed. Hence, although in the past, Lake Victoria fishery brought home annual catches of a large variety of species, the fishery is now dominated by three species, namely, Nile perch (*Lates niloticus*), the Nile tilapia (*Oreochromis niloticus*) and the Dagaa, *R. argentea*.

The potential for Lake Victoria as a viable fishery is clearly demonstrated by the continued high annual fishery yield. As an example, in 1999, the annual yield was 500,000 metric tons of fish worth between US$ 400-550 million. By 1999, the new fishery around the lake had 12 modern fish processing plants in Kenya, 11 in Uganda and 12 in Tanzania, the Lake Victoria fishery formed 95% of the Kenya's total fish catches comprising of 103,000 mt of Nile perch, 58,000 mt of Dagaa and 12,000 mt of tilapia. A total of some 38,340 fishermen were directly employed in the fishing sector. Interestingly, the total fish catch in Uganda in 1999 was 212,000 m. tons, 96% of which was Nile perch and nearly half of the catch coming from Lake Victoria alone. The fishing industry employed 34,927 fishermen in 1999. In Tanzania, the fish catch in 1999 was 120,000 mt of fish where 56,000 fishermen were employed full time.

Lake Victoria has great potential not only as a source of a viable fishery but also as a source of freshwater water, transport and trade routes, tourism and sport. Its capacity for biodiversity conservation is well attested through the cichlid explosive speciation. Lake Victoria, therefore, with its amiable climate, huge freshwater and expansive wetland coverage, has enormous potential for fisheries and aquaculture. This fishery has catapulted in the recent past but it has capacity to recover as evidenced by the re-appearance of fish species in the main lake.

The Lake Victoria fishery has demonstrated a very high degree of resilience. It can indeed be argued that although some species of fish in Lake Victoria have disappeared for several reasons, the Lake Victoria fishery in total has not undergone complete collapse. The fishery has, therefore, continued to be a very important source of food, protein and employment and thus, supporting local community livelihoods. Further, the Lake Victoria fishery has potential to support greater investment in related enterprises such as in the construction and repair of boats, manufacture of fishing gear, construction and operation of cold storage facilities. Thus, Lake Victoria has a demonstrated capacity to eradicate poverty and assure food security. The lake has more interestingly the ability to bring the peoples of East Africa to greater unity and higher levels of socio-economic cooperation.

Political and International Good Will

The ability of the fisheries of Lake Victoria to recover will largely depend on a positive geopolitical environment, conducive and realistic management policies, laws and regulations at local, national, regional and international levels. This environment exists. As a shared regional and international water body, there is a degree of good political will amongst the EAC Partner states, and the international community. Within the EAC itself, there are structures to promote greater cooperation for the management of Lake Victoria resources such as the Lake Victoria Fisheries Organization, the Committee on the Environment and the Lake Victoria Basin Commission. There are also regional projects and the various projects supported by the EU and the Lake Victoria Environment Management Program. Similarly, the existence of National Institutions like Fisheries Departments, Fisheries Research Institutions, Regional, District and Community organizations like Beach Management Units (BMUs) are all intended to coordinate the management of fisheries at various levels in Lake Victoria. Further, there is overwhelming positive international good will supporting research and management activities in Lake Victoria. This is evidenced by projects aided by the EU, Sida, the World Bank, NORAD and IUCN. The

basin such as breweries, fish processing plants, beverage and soft drink factories, dairies, oil and soap works, abattoirs, sugar factories, tanneries, bakeries and batteries manufacturing factories. These urbanized centers also spew out large quantities of sewage which in the majority of cases is not treated or at best is partially treated. Many of these are located in the Lake Victoria catchment often close to the shoreline for reasons of cost saving, easy availability of water as well as easy means of effluent disposal. Mott MacDonald (2001) and COWI (2002) reported 18 industries in Uganda as the main sources of point source pollution from the Ugandan catchment of Lake Victoria. COWI (op.cit.) gave a resulting total pollution load from several industries in Kampala, Jinja and Entebbe as BOD 2,355 kg. d^{-1}, Total-N as 155 kg. d^{-1} and Total-P as 126 kg.d^{-1}. Rutashobya (1996) quoted pollution loads from Mwanza Town alone into Lake Victoria as Nitrate-Nitrogen 28 kg per day; Ammonia-Nitrogen as 47 kg.d^{-1}; Phosphate-Phosphorus as 7 kg.d^{-1} and a BOD of 190 kg. d^{-1} These are large quantities by any comparison even for Lake Victoria.

Municipal Point Source Pollution

A review of point source pollution of Lake Victoria cannot be complete without a mention of municipal point sources. The Ugandan case provides a lucid example of how serious this is in terms of pollution loading of the Lake Victoria waters from municipal centers COWI (2002) summarized this as BOD 5,876 kg.d^{-1}; Total- N as 2,100 kg d^{-1} and Total-P as 1,327 kg d^{-1}. On an annual basis, this could mean pollution loading of BOD 2,144,740 kg.yr^{-1}; 766,500 kg y^{-1} of Total-N kg.yr^{-1} and 484,355 kg of Total- P kg.yr^{-1}.

Non-point Source Pollution

The Lake Victoria catchment has rich soils and a conducive climate for agricultural production. Hence, the area has been subjected to intense cultivation and livestock farming over time. The catchment has large agricultural estates of tea, sugar cane, coffee and flower farms. These use large quantities of agro-chemicals (fertilizers and pesticides). Also found within the catchment are small-scale farmers practicing peasant type subsistence farming. These too use agro chemicals to improve their crop yields. All the agrochemicals are discharged into Lake Victoria through runoff. Rutashobya (1996) in summarizing the figures gave the annual nutrient in puts resulting from agriculture and rainfall as T-N 25,985.8 kilo tons, T-P 11,373.9 kilo tons for Kenya; T-N 16,860.4 kilo tons, T-P 5,564.1 kilo tons for Tanzania and T-N 11,479.9 kilo tons, T-P 664.9 kilo tons for Uganda. It has also been established that there is high atmospheric loading of nutrients particularly phosphorus originating from bush fires and livestock farms which is transported by wind and through volatilization.

Water hyacinth

The water hyacinth *Eichhornia crassipes* (Liliales, Pontederiaceae), has its origin in the Amazon basin in South America but has since been introduced to many tropical and sub-tropical parts of the world including East Africa (Julien, *et al.*, 1999). In Africa the plant first appeared in Egypt in 1879, in South Africa in 1910, in the Congo in 1952 and in Nigeria in 1987 (Rutashobya, 1996) East Africa, the weed was first observed in Lake Naivasha in 1982. In Uganda the water hyacinth was first seen in Lake Kyoga in 1988 and in Lake Victoria in 1989 (NARO, 2001). The water hyacinth invaded the Kenyan part of Lake Victoria in 1992. In Tanzania waters it was observed in 1990 (Rutashobya, 1996). The weed has since spread to natural and man-made waterways, lakes, rivers, dams, wetlands, irrigation canals and hydroelectric reservoirs. This plant proliferates extremely fast through mainly daughter vegetative stolons but the plant can also reproduce through seeds. The weed is known to be able to double its population every 5 to 15 days under optimum conditions of temperature (usually between 25 - 28^{o}C) and high nitrogen and phosphorus nutrients concentrations.

accounting for 82% and the rest coming in through drainage from the catchments. Lake Victoria is thought to be relatively young, formed through tectonic forces some 750,000 years ago but the lake has suffered periods of complete desiccation as recently as 12,000 years ago. The lake has a short flushing period of 23 years.

Threats to Lake Victoria Resources

The fisheries of Lake Victoria have declined in time due to threats manifested by: disappearance of endemic fish species; decline in catch per unit of effort; reduction in size at first maturity for the fishes; fall in minimum mesh size for gill nets; presence of young juvenile fishes in the catches; prevalence of illegal irrational fishing gears; fish kills; appearance of algal blooms; occurrence of toxic algal types; eutrophication; lowered Secchi Disc readings; prolonged periodic stratification; off shore and in shore conflicts.

CONCERNS ON LAKE VICTORIA FISHERIES

Depletion of Fish Stocks

The first systematic fish stock assessment of Lake Victoria was by the FAO/UNDP/ EAC in 1970s. These studies (Kudhongania & Cordone, 1974) revealed that the estimated total standing stock of fish in the whole of Lake Victoria was 679,007 mt with a density of 92.7 $kg.ha^{-1}$. The haplochromines contributed up to 83% of this fish biomass followed by *Bagrus* ((5.8%), *Clarias*, 3.97% and *Synodontis* 3.4%. The tilapiines together made up less than 0.3 per cent. At that time, the mean trawl catch rates averaged 463 kg. ha^{-1} for all species. A fishery survey conducted through the EU Lake Victoria Fisheries Research Project (LVFRP) from 1997 to 2000 indicated that the Nile perch was the most dominant with the tilapines and haplochromines contributing a minor segment of the ichthyomass. These surveys showed Nile Perch with a biomass of 700,000 metric tons thus contributing 85% of all the fish biomass for the whole lake. This however, did not include the cyprinid, *Rastrineobola argentea* which is abundant but could not be retained by the trawl net. This scenario is the exact opposite of the situation in the 1960s when it was the haplochromines which dominated the biomass. The picture observed is that there has been a serious depletion of many other species of fish from Lake Victoria especially haplochromines leaving only the Nile perch to proliferate. However, the species which are no longer abundant may not be completely extinct as many of them are found in refugia such as satellite lakes in the lake basin and in sheltered bays, inlets, and rocky habitats.

Decline in Fish Species Diversity

Prior to the 1960s, Lake Victoria boasted of a rich fish biodiversity similar to that of Lakes Malawi and Tanganyika with 400-500 species of fish most of which were the cichlids against non-cichlids which were only about 50 species. Current observations from commercial catches indicate that the species composition of the Lake Victoria fish stocks has been reduced to a three commercial species fishery of the Nile perch, *Rastreneobola argentea* (Dagaa/Omena/Mukene) and *Oreochromis niloticus*. Thus atleast 200 species of fish have been depleted in Lake Victoria in only the last 40 years. Most of the species that have disappeared are of the haplochromine species stock and native tilapiines and several cyprinids. Hence, one of the main concerns today is about the alarming rapid decline of fish species from Lake Victoria and the destruction of its biodiversity.

Implementation of a Fisheries Management Plan (IFMP) Project 2003 to 2008, mothered in LVFO. In addition to the projects, the states re-established the East African Community (EAC), 2000 and also set up the EAC Protocols on the Development Strategy (2001-2005), especially on the Management of the environment, natural resources, customs union and many others. These have given the states the legal mandates to nurture and propel the aspirations of the development of the Lake Victoria Basin.

The lake fishery has the capacity to recover as evidenced by the resurgence of disappeared fish species in the main lake and the satellite lakes surrounding it. However, the ability of the fisheries to recover will be largely dependent on positive geopolitical environment and conducive, realistic management policies, laws and regulations and actions at local, national and regional levels. This environment exists today as demonstrated by national and regional commitment to managing the lake. As a shared regional and international water body, there is now a degree of good political will amongst the EAC Partner States, with a possibility of Rwanda and Burundi, joining the EAC partners. Within the EAC itself, there are structures which are promoting greater cooperation in the management of Lake Victoria resources such as the Committee on the Environment and the Lake Victoria Development Program. The existence of regional institutions like the Lake Victoria Fisheries Organization and regional projects like the Lake Victoria Environment Management Program provides opportunities for ensuring sustainable exploitation of the natural resources of the lake including fisheries. Similarly, the existence of National Institutions like Fisheries Departments, Fisheries Research Institutions, Regional, District and Community Organizations like Beach Management Units (BMUs) provide opportunities for management of fisheries at various levels. Further, there is overwhelming positive international good will supporting research and management activities in Lake Victoria. This is evidenced by number of projects aided by the EU, Sida, the World Bank, NORAD and IUCN. The existence of international institutions such as the Nile Basin Initiative with its subsidiary program for the Upper Riparian States is another example of how the international community is ready to support programs in Lake Victoria for sustainable use of the lake's resources including fisheries. It is worth recognizing that a pool of well trained scientific and management manpower to implement fisheries programs and projects now exists in the riparian countries but what they require is facilitation in terms of additional training, equipment, and operational funds.

The main concern today is about the alarming rapid disappearance of fish species from Lake Victoria, the decimation of its biodiversity, the rapid increase in fishing effort, the decline in fish catches and the deterioration of its water quality and fish habitats. The rapid rise in fishing pressure has in the main led to over fishing and trans- boundary conflicts and delivery of fish of poor quality. Another woe eye-catching fact of serious concern is the high incidence of diseases particularly HIV/AIDS, malaria and bilharzia among fishing communities.

Thus, the real threats to the well being of the ecosystem and fisheries of Lake Victoria have come from a number of scenarios including the rapid rise in the human population growth rate (2.5% to 3.5% per annum) of the lake basin. The rapid rise in the demand for fish for export has tremendously exacerbated the looming picture of the state of Lake Victoria fisheries. Undue pressure unknown in the history of the lake is being exerted on the already diminishing fish stocks creating huge demands for natural resources particularly fish as food. Consequently, there has been an increase in fishing effort and over fishing in leaps and bounds. This is evident from the rapid rise in the number of landing sites, number of fishermen, number of fishing craft, and fishing gears on Lake Victoria over the last 50 years. Destructive fishing gear and irrational fishing methods have led to the capture of immature fish.

Exotic fish introductions, exploitation and environmental degradation have contributed to changes in the biology and population characteristics of Lake Victoria fishes (Muhoozi, 2002, Mkumbo, 2002; Njiru, 2003). To adapt to the dynamic Lake Victoria ecosystem the fishes have responded with a reproductive and growth strategy, which probably have enabled them to survive. Reproductive potential and growth of Nile perch and Nile tilapia have been increasing over time (Lowe McConnell, 1958; Welcomme, 1968; Lung'ayia, 1994; Balirwa, 1998; Mkumbo, 2002; Muhoozi, 2002; Njiru, 2003). Dagaa reproductive potential has been decreasing but its generation time has reduced (Wandera, 1992; Manyala, 1993,1995; Wanink, 1999; Wanink *et al.*, 1999). There is thus evidence to suggest that Lake Victoria fishes are displaying life history strategies to survive the prevalent stressful conditions.

Knowledge of the reproductive behaviour and growth parameters of fishes is essential in prediction of population stability and fluctuations. Information on breeding, nursery grounds and growth can be used in fisheries management such as closed fish grounds or seasons. For fishes of Lake Victoria such knowledge is particularly important because most of the species depend on shallow areas especially during the early stages of life. This paper reviews literature and compiles unpublished information from surveys in lake.

Nile Perch

Entry to the fishery

Recent bottom trawl surveys conducted in the lake indicate that the majority of fish caught are between 3 and 50 cm TL (Fig. 1) (UNECIA, 2002). Young fish less than 50 cm TL dominate the population, suggesting good recruitment (entry to the fishery). There is seasonal recruitment in the lake especially in the rainy months. This pattern is shown by seasonal trends in the number of age groups (cohorts) in the size distribution of Nile perch. These age groups entering the fishery are well indicated peaks in November and December in Tanzania, July, August and September in Uganda (Mkumbo, 2002).

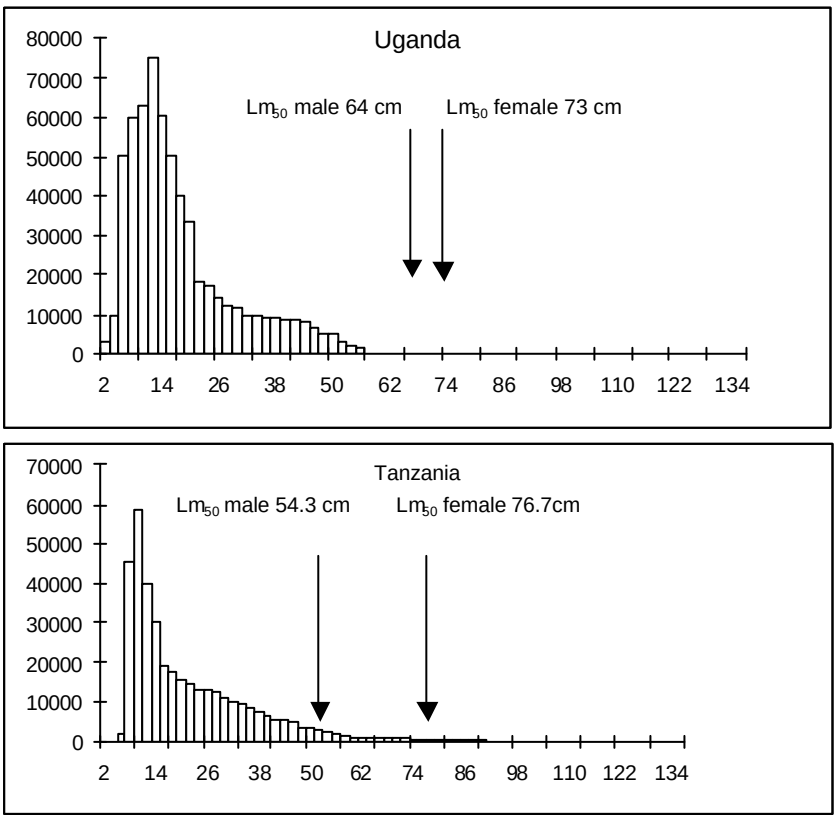


Fig. 1. Length frequency catch of Nile perch in trawl catches from Lake Victoria Arrows indicate length at fifty percentage maturity (Lm 50) and the bar represent the recommended slot size (50-85 cm TL). *Source:UNECIA, 2002.*

Egg production

The number of eggs produced by Nile perch depends on environmental factors particularly food resources and size of the individual. Egg production increases with size and this is probably the reason why females grow to a much larger size than the males. Delay in maturity to a larger size could be an adaptation to gain egg production under a situation of food shortage. High egg production is also beneficial in a dynamic ecosystem like that of Lake Victoria as enough young have to be produced to compensate for high mortality and sustain the stocks. In the Kenya waters of Lake Victoria, Asila and Ogari (1998) found the perch to produce between 3 and 15 million eggs. Mkumbo (2002) found Nile perch of 66 cm and 84 cm TL to produce between 556 000 and 13 847 640 eggs respectively in Tanzania waters.

Breeding time

In Tanzania waters of Lake Victoria ripe males and females were found in every month of the year (Ligtvoet and Mkumbo, 1990; Mkumbo 2002). Based on seasonal changes in proportions of ripe individuals the highest numbers of males in advanced stages of maturation are in November and December (Mkumbo, 2002). There is also increased gonadal activity in May and June. In Uganda waters, Nile perch shows a major breeding peak in July to August and a minor one in February to March (Muhoozi, 2002). The peaks coincide with the start and the end of the rainy seasons respectively.

Spawning areas

Spawning is probably in shallow sheltered areas (Ligtvoet and Mkumbo, 1990). Ripe running females are more common in shallow inshore areas, spawning in open waters cannot be ruled out. Ripe females and males have been caught in both the shallow inshore and deep open waters.

Nurseries grounds

The highest concentration of small fish (<5 cm TL) is found in shallow near-shore areas. In Nyanza Gulf fish measuring 1.2 cm TL occur in vegetated near shore areas (Asila and Ogari, 1988). In Mwanza area, young fish (<20 cm TL) occur over a wide depth range (2-57 m).

Migration

Limited-tagging by Ligtvoet and Mkumbo (1990) indicated extensive movements of the Nile perch in Lake Victoria. Results of a tagging programme in Mwanza Gulf revealed movements of individuals up to 50 km within a week, 100 km within 2 months and 150 km in 6 months. One individual tagged at Mwanza was recaptured in Jinja.

Nile tilapia

Entry to the fishery

There is good recruitment (entry to the fishery) by Nile tilapia (Fig. 2a). A majority of the fish caught are between 4 and 20 cm TL, which is below the length at 50 % maturity for the population (Njiru, 2003). However, there is also a substantial number of fish caught that are above the mature group (i.e >30 cm TL).

largest fish in a sample and the size differences in fish over the lake may be due to fishing pressure and the mode of collection of the data. The commercial samples represent a near true population in the lake compared to experimental catches obtained during trawling.

Table 2. Maximum length and growth of Nile tilapia from Lake Victoria

Maximum Length (cm)	Growth rate (yr^{-1})	Period	Data	Area and Source
59	0.56	1998-00	Commercial	Kenya (Njiru 2003)
67	0.38	2000	Commercial	Uganda (Muhoozi 2002)
75	0.40	1998-00	Trawl	Uganda (UNECIA 2002)
63	0.35	1989-90	Trawl	Kenya (Dache 1994)
65	0.25	1985-86	Trawl	Kenya (Getabu 1992)

Maturity

The smallest ripe Nile tilapia found by Welcomme (1968) were male of 15.5 cm SL and female of 15.8 cm SL. Observations by Ogari and Asila (1992) give the size of the smallest ripe male as 27.5 cm TL and female of 23.7 cm TL. Recent studies in the Kenya waters of the lake show that the smallest ripe male and female *O. niloticus* were 21 cm TL and 23 cm TL respectively all recorded in the 5-10 m depth zone (Njiru, 2003). Ogari and Asila (1992) found that the size at which 50 % maturity for females and males at 27.5 cm and 31.5 cm TL respectively. Njiru (2003) recorded the size at 50% maturity at 31 cm TL for females and 35 cm TL for males.

Nile tilapia shows first signs of maturity at about 25 cm TL in Uganda waters (Balirwa, 1992). However, even among large fishes, a certain proportion may still be immature depending on several environmental factors (Lowe-McConnell, 1958). Recent studies show that the overall size at first maturity of female Nile tilapia in the Uganda waters of Lake Victoria was 33.1 cm TL whereas that of males was 31.7 cm TL (Muhoozi 2002). The difference in length at 50 % maturity is attributed to the use of maturity stages with earlier studies regarding stage III as mature whereas current studies use stage IV.

Breeding time

Breeding occurs throughout the year with two seasonal peaks. In Kenya waters the highest percentage of mature individuals during the different months of the year was the criterion for determining the spawning period (Njiru, 2003). The data indicates that the species spawns throughout the year with breeding peaks in March to May and October to December . In Uganda waters, Nile tilapia shows breeding peaks in the months of March to May and September to November (Balirwa, 1998). Recent studies in Uganda waters show the major peaks are in May to August and the minor in February (Muhoozi, 2002).

A major environmental factor influencing peak reproduction in Lake Victoria fishes appears to be the cyclic bi-annual increase in the water level, and its physical and biological effects. During rainy seasons the lake mixes and more food becomes available for the young fish (Lowe-McConnell 1958). Since the patterns of dry and wet seasons do not run concurrently in all parts of the lake, the breeding cycle of fishes may not be identical over lake.

Spawning areas

Eggs are laid mainly over hard bottoms composed of sand or gravel mostly in 3-10 meters depth (Welcomme, 1968). Balirwa (1998) found fish of < 3 cm more abundant in areas of 10-50 cm deep. The sandy habitat

Egg production

Dagaa produces floating eggs in the lake (Graham, 1929). Egg production (fecundity) of dagaa increased with fish size (Okedi, 1974). Unlike the other commercially important fishes in the lake, there has been a decrease in the number of eggs produced by dagaa over time. Okedi (1974) estimated mean fecundity at 2 292 ova (range 582?4771). Wanink (1988) found that the fecundity (F) of *R. argentea* was related to the total length (TL) according to the relationship: F= 5.875 X 10-3 X TL2.95. Manyala et al. (1992) found egg production to vary from 170 to 1350 eggs for specimens of 41-60 mm SL with the relationship expressed as F = 3.3 X 10-7 X TL5.376.

Table 3. Maximum length and growth rate of dagaa in Lake Victoria

Maximum Length (mm)	Growth rate (yr^{-1})	Period	Data	Area and Source
64	1.04	1998-2000	Commercial	Kenya (Unecia 2002)
69	0.99	2000	Commercial	Uganda (Muhoozi 2002)
65	1.08	1988	Commercial	Tanzania (Wandera & Wanink 1995)
65	0.99	1987-88	Commercial	Uganda (Wandera & Wanink 1995)
64	0.94	1990-91	Commercial	Kenya (Manyala 1993)

Table 4. Size at 50% maturity of dagaa in Lake Victoria

Males SL (mm)	Females SL (mm)	Region	Source
36-37*	34-44	Uganda waters	Muhoozi (2002)
39	39	Kenya/Uganda waters	Marshall (2001)
39	40	Tanzania waters	Marshall (2001)
40-41	43-44	Pilkington Bay	Wandera (1992)
63.0	54.0	Winam/Mwanza Gulf, Musoma, Bukoba	Okedi (1974)
34	36	Winam Gulf	Manyala *et al.*, (1992)

*N/B: SL = 0.90*TL - 1.74 (Manyala, 1995) * size at 50% maturity*

Spawning areas and breeding time

Dagaa spawns all over the lake (Graham, 1929; Manyala, 1995, Wanink, 1999). Egg and larval surveys in Kenya part of Lake Victoria yielded only larvae and not a single egg was encountered (Manyala, 1995). In Mwanza Gulf the fraction of mature fishes (> 32 mm SL) from the trawl catches near the shore amounted to 66%, while only a few were present at offshore stations (Wanink, 1999). This suggests that dagaa move to shallow areas to spawn. The absence of eggs in hundreds of zooplankton samples made in the offshore waters between 1977 and 1989 disproves the theory that dagaa is a pelagic spawner (Wanink, 1999). Although larvae were occasionally caught at all sampling stations, their numbers were always very low in the offshore stations. Large numbers of larvae were only caught with the mosquito seine near the sandy shores (Wanink, 1999). Knowledge of the distribution of dagaa eggs in the water column is probably limited to allow effective egg surveys. However, it has been shown that breeding occurs throughout the year with peaks which differ in different parts of the lake (Table 5). Unlike Nile perch and Nile tilapia, dagaa breeding does not seem to be strongly correlated to seasonal rainfall patterns.

rate is known to increase with the size of the fish with the highest infestation above 40 mm SL (Fig. 4). Many adults caught at the surface during daytime have the highest rate of infestation. Most of the adults are found in the deeper waters during the day and only come to the surface to feed at night. It is estimated that as much as 10% of the adult dagaa fish population could be infected with *L. intestinalis* (Manyala, 1995).

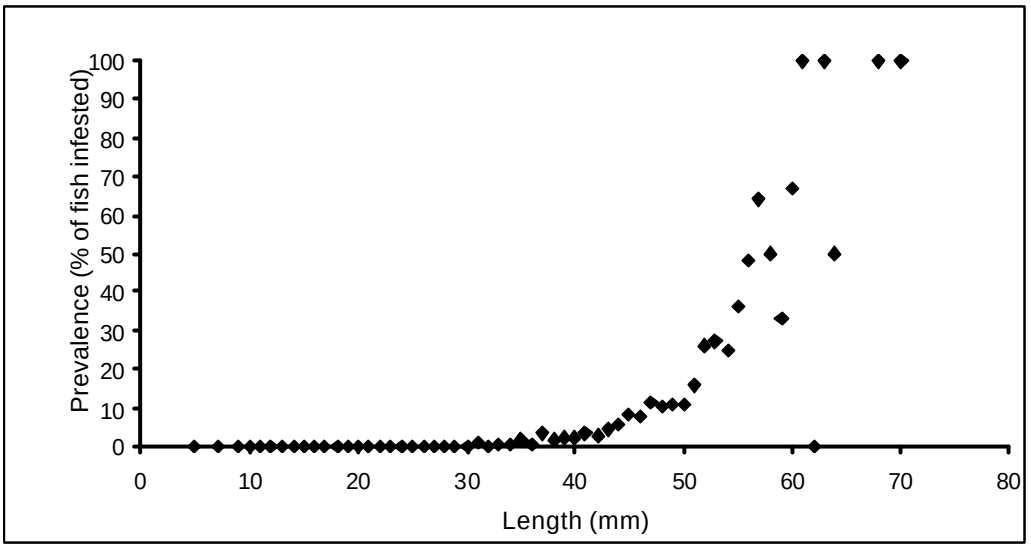


Fig. 4. Relationship between fish length and prevalence of *Ligula intestinalis*. ***Source*: Marshal (2001).**

DISCUSSION

Nile perch, Nile tilapia and dagaa in Lake Victoria show a well-defined reproductive strategy which probably has contributed to their success in the lake (Balirwa, 1998; Wanink, 1998; Mkumbo, 2002; Muhoozi, 2002; Njiru, 2003). These species have protracted egg producing periods. The multiple egg-producing behaviour has advantages in highly stressed environments like Lake Victoria. Entry to the fishery (recruitment) is a highly risk event due to predation, especially on the young stages, which could potentially wipe out the reproductive output if only one spawning event occurred each year. To spawn more than once reduces the risk. The individual egg producing capacity for Nile perch and Nile tilapia has also increased. However, the average size and egg production by *R. argentea* has decreased by 50% since the introduction of Nile perch but this has been offset by an increased generation time (Wanink, 1991; Wanink *et al.*, 1999). The reduced generation time of dagaa must have been an important factor in its survival of the increased exploitation by both man and animal predators (Wanink, *et al*., 1999).

There has also been a reduction in sizes at first maturity since these species were reported to mature at bigger sizes (Wandera and Wanink, 1995; Balirwa, 1998; Mkumbo, 2002, Muhoozi, 2002, Njiru, 2003). The increase in egg production and earlier maturation of these fishes is an adaptation to maximize reproductive success possibly linked to a population response to over fishing (Cowx *et al.*, 2003). Most of Nile perch, Nile tilapia and dagaa are harvested at a size before attaining their maturity and fully contributing to their next generation (Fig. 1 and 2). This tactic contrasts with that adopted in stable environments where smaller fish put more effort into somatic (body) growth and less into gonad development compared with larger counterparts, a mechanism that is more likely to increase their chance of survival and reproduction in subsequent years (Cowx, 1998). Overexploitation is attributed to increase in boats, gears and fishers in the lake. Boats in the lake have been on the increase from 4000 in 1950s to over 52 000 in 2002 supporting 12 000 and 175 000 fishers respectively (Asila, 2001; Unpublished frame survey 2002). There is also a substantial amount of illegal and undersized nets in the lake, which mostly target juvenile fishes of all the species (Asila, 2001; Njiru, 2003).

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Haplochromis Ecology Survey Team (HEST) between 1977 - 1995 and studies by Seehausen (1999) leading to a recognition of at least 500 haplochromine species in the lake. Inferences on native tilapia habitats are reported by Lowe-McConnell (1957,1958,1959), Trewavas (1983) and Welcomme (1967) while for the cyprinids studies by Whitehead (1959, 1960); Cadwalladr (1965) and Balirwa (1984) report aspects of the biology and ecology of the fishes including their habitats even though prior to 1992, most fishery research in Lake Victoria generally, included studies of inshore shallow (5 - 10 m depth zones) habitats of the lake without specific reference to distance or the type of vegetation at the shore (Balirwa, 1998). There are thus many areas in the lake that can be considered as hotspots of fish biodiversity.

In many parts of Lake Victoria, water quality has deteriorated through eutrophication, sedimentation and siltation due to deforestation and poor agricultural practices, the discharge of untreated wastes and urban industrial water with high nutrient and other chemical wastes leading to loss in habitat quality (Hecky, 1993; Mugidde 1993). The shallow (less than 5 m deep) inshore zone has been known to be the main area of the artisanal fisheries but the previously unoccupied offshore scattered island clusters (e.g. Ukerewe, Ringiti and Ssese) with features that are similar to those of the shallow zone, have become densely settled and increasingly occupied by commercial fisheries enterprises. The proliferation of water hyacinth, which at its peak in 1998 covered 12,000 ha of lake surface, is a symptom of water quality deterioration. Conservation of the lake's biodiversity and fish habitat quality and quantity faces growing but competing socio-economic demands on water and terrestrial resources.

Table 1. Critical habitats for large-bodied native species of fish in Lake Victoria and inflowing inferring rivers (in order of maximum total length (cm) recorded).

Species	Local Name	Max.TL	Critical habitat features
Protopterus aethiopicus	Mamba	210	Shallow inshore regions especially in vicinity of swamps; occasionally in deep waters.
Clarias gariepinus	Male - U	150	Inshore waters; also found in the marginal water lily and papyrus swamps.
Bagrus docmak	Semutundu-U	110	Both shallow and deep waters.
			Mbofu - T
			Sew - K
Mormyrus kannume	Kasulu	120	Both coastal and offshore waters down to depths of at least 30 m; less frequent in areas of dense plant growth.
Barbus altianalis	Kisinja - U		
			Kuyu - T
			Fwani - K 100 Inshore waters and affluent rivers
Labeo victorianus	Ningu	50	Shallow inshore waters; open waters away from the water-lily zone; affluent river.
O. esculentus	Ngege - U	50	Shallow (< 20 m deep) inshore sheltered bays where bottom is composed of soft algaceous mud.
Oreochromis variabilis	Ngege- U	40	Mainly shallow (< 20 m deep) inshore waters and particularly on exposed shores; inshore waters with a surface covering of water-lily leaves.

NB: U - Uganda; T - Tanzania; and K - Kenya.

macrophytes cover. A majority of the species are abundant along the shoreline and decrease outwards into the offshore waters. The inshore areas with aquatic macrophytes and low oxygen have been found suitable refugia for prey species of the Nile perch particularly the haplochromines since *Lates niloticus* will hardly inhibit low-oxygen conditions (Fish, 1956; Chapman *et. al.*, 1995). Similarly, some recovering zooplanktvorous species like Haplochromis pyrocephalus have evolved expanded gill apparatus compared to the pre-Nile perch counterparts in an attempt to colonize hypoxic habitats (Katunzi *et. al.*, 2003). Structural components of the lake's littoral zone (Fig. 1) such as riparian vegetation or even depth are important for fish populations (Balirwa, 1995; 1998), and in stripping nutrients from wastewater (Okia, 1993; Lizhibowa, 1995; Sekiranda, 1996; Sonko, 1996; Kaggwa, 1998; Kansiime & Nalubega, 1999).

The extent of Nile perch influence

When the introduced predatory Nile perch had decimated most of the native fishes especially the haplochromines from the early 1980s, it was considered that the lake would retain only three species (Nile perch, Nile tilapia and the native cyprinid, *Rastrineobola argentea* (Mukene/dagaa/omena). It is now known that the lake's riparian wetland buffers are as important for water quality and biotic communities as they are for fisheries and the Nile perch influence cannot totally eliminate all the native fishes. Apart from macrophyte-dominated shoreline habitats, there are other habitats in the lake and the satellite lakes that favour fish survival because they have not been influenced by Nile perch (Table 2). They include rocky areas, rivers streams, sandy and muddy beaches.

Table 2. Species distribution by habitat types based on combined samples from gill net and beach-seine surveys conducted from November-December 2000 in the Tanzanian part of Lake Victoria (Bayona *et al*., *2001)*

Species Collected	Shirati Bay				Mori				Mara			Grants Bay				Mwanza Gulf				Emin Gulf Gulf			Rubafu Bay				Kagera River
					BAY			RI	BAY		RI																
	M	S	RO	V	M	S	RO	V	M	S	RO V	M	S	RO	V	M	S	RO	V	M	S	RO	V	M	S	RO	V	
L. niloticus	x	x			x	x			x		x	x	x	x	x	x	x			x	x			x	x			
O. niloticus	x	x			x				x				x	x	x	x	x			x	x			x	x		x	
Haplochromines	x	x			x	x			x			x	x	x	x	x	x			x	x			x	x		x	
C. gariepinus					x	x			x		x		x			x												
B. sadleri	x				x	x			x		x			x		x	x			x	x			x				
B. jacksonii	x								x							x	x			x	x			x				
S. intermedius					x				x		x					x	x			x								x
S. victoriae					x				x		x					x				x	x			x				
S. afrofischeri	x				x				x		x		x	x	x									x				
T. zillii													x		x	x	x			x	x				x		x	
T. rendalli																x					x							
O. leucostictus																x	x			x	x			x	x		x	
O. esculentus																x				x								
L. victorianus					x							x				x	x							x	x		x	
G. longibarbis									x																			x
M. rheni									x		x					x	x							x				x
Barbus spp.					x				x								x			x				x	x			
P. aethiopicus									x		x						x			x	x							
B. docmac																x	x											
P. catostoma																x												x
R. argentea													x		x		x											
Mormyrus kannume												x																
Species Count			**6**			**10**		**13**	**8**		**8**			**12**				**19**				**13**				**12**		**4**

NB: M - Muddy habitat; RO - Rocky habitat; RI - Riverine habitat; S - Sandy habitat; V - Vegetated habitat

rock dwelling Mbipi species have been identified and many species described (Seehausen, 1996, Seehausen *et al.,* 1998) and these are considered to be among the least affected by Nile perch predation (Witte *et. al.,* 1992). In the northern region of the lake more than 150 haplochromine species have so far been recorded from the rocky habitats (Wandera, pers. comm.). In the Mwanza gulf, it is reported that, the rock-dwelling fish species were least affected by Nile perch predation (Witte *et al*., 1992a, b).

Satellite Lakes

Satellite lakes or small water bodies (SWB) constitute important reservoirs for many of the haplochromine species that have either not been identified or have disappeared from Lake Victoria. In Uganda, the richest of these lakes in terms of haplochromine species diversity, are the Kyoga satellite lakes, with a total of 41 haplochromine species. The highest number of species was recorded from Lake Nawampasa (29), followed by Gigati (26), Agu (17), Nyaguo (16), Kawi (20) and Lemwa (12). In Lakes Nabugabo and Nakuwa (Uganda) where Nile perch was introduced, most of the haplochromine cichlids live among submerged macrophytes especially water lilies where they are probably able to evade predation by Nile perch (Ogutu-Ohwayo, 1993). In Lakes Ikimba and Katwe, (Tanzania) the molluscivorous and fish eating haplochromine species survive but have hardly been found in the main lake. The rest of the surviving haplochromines are found mostly in the other satellite lakes and dams. The Yala swamp in Kenya, with Lake Kanyaboli provides refugia to the endemic *Lipochromis maxillaris* and other relic populations of *Xystichromis phytophagus, Astatotilapia nubila* and the widely distributed *Astatoreochromis alluaudi.* Recent studies in the pelagic parts of Lake Victoria also reported an increase in the zooplantivorous haplochromines and the piscivorous, *Prognathochromis* sp. hitherto thought to be extinct from the lake (Ojwang & Kaufman 2004). These can be regarded as biodiversity hotspots. Because of their small size, isolation and diversity these water bodies can be regarded as biodiversity hotspots and serve as a living museum of East African ecological history (Mwanja 2000; Kaufman *et al.*, 1997; Ogutu-Ohwayo *et al.*, 1998). They offer management options with respect to the fisheries since fishing activities can be regulated and monitored more easily.

The Role of Water Transparency

Disturbances resulting from rapid population growth in the Lake Victoria basin (e.g. extensive devegetation, increase in livestock, discharges from urban areas) over the past several decades have led to increased nutrient loads and eutrophication that are associated with massive algae production, and water hyacinth proliferation (Hecky 1993; Bootsma & Hecky 1993; Melack 1979; Ochumba & Kibaara 1989). These factors have led to reduced water clarity. Water transparency is one of the environmental factors that have an impact on the ecology of Lake Victoria haplochromine species (Seehausen *et al.*, 1997a). This group of cichlids is characterized by their distinct male nuptial coloration. Males of different species have different conspicuous colours that are more pronounced in breeding. Females have relatively dull colours but choose from among conspecific males for mating on the basis of the male nuptial coloration. This sexual selection is strongly disruptive for haplochromines and therefore influences the process of speciation (Seehausen *et al.*, 1997a) and the study also showed that closely related haplochromine such as *Pundamilia pundamilia x P. nyererei*, have hybridised in turbid waters in the southern part of the Mwanza Gulf where water transparency is very low (= 1.0m Secchi depth). In clear water stations such as Makobe Island at the entrance of Speke Gulf (transparency c.a. 2m Secchi depth), five distinct species within the genus *Neochromis*: *N. omnicaeruleus* (*H. "blue scraper*"), *N. gigas* (*H. "giant scraper*"), H. "unicuspid scraper", *N. nigricans*, and *N. rufocaudalis* have been found. Of these, *N. omnicaeruleus* exists in four colour morphs: 'blue', 'yellow', 'orange blotched' (OB) and 'white-blotched' (WB) (Mrosso *et al.*, 2004). Studies to the north of the lake have shown influence of water transparency on haplochromine catch rates (Table 3). The relatively clear waters facilitate coexistence of many fish species (Seehausen *et al*., 1997b). Other studies in the pelagic part of Lake Victoria also reported increases in the zooplantivorous

Human Impacts

Agricultural practices

With agriculture and animal husbandry as major activities for the densely populated catchments, there are demands on water resources for the various human activities that in combination impact on the quality and quantity of fish habitats. Major threats from agricultural and urban influences include pollution, siltation, eutrophication and reclamation of wetlands. The rapid spread of water hyacinth was influenced by favourable water quality conditions especially in the shallow inshore areas that are also critical fish habitats. Alien introductions especially of Nile perch and tilapiines are known to have led to a reduction in species diversity and increased competition (for food, space, mating) among the cichlids but the impact of these introductions is likely increased through changes in habitat availability.

Fishing pressure

Increased fishing effort (number of fishers, number of nets, number of fishing hours, etc) and use of illegal fishing gears and methods (undersized meshes, beach seines, use of poisons, etc) are carried out mostly in critical fish habitats with potential damage for example to nest building fishes.

The bait fishery

Fishing for ornamental fish species especially the haplochromines of the satellite lakes and the heavy exploitation of rocky haplochromine populations for bait in the Nile perch fishery are recent developments that add considerable stress to the satellite lakes and the rocky shore habitats. The massive angling in rocky refugia and muddy swampy habitats targets robust haplochromines and *Clarias* used in the long line Nile perch fishery. The transfer of rock-restricted cichlids from one population to another can lead to potential hybridization and consequent loss of haplochromines species diversity.

Conservation Challenges

Critical habitats for biodiversity conservation are widely dispersed and have been impacted by diverse human activities in fisher communities. Fishing pressure in densely settled areas and pollution from the catchment cannot be halted by legislation alone. Conservation of these habitats requires determination and active participation of grassroots stakeholders. Major conservation challenges related to critical habitats can be summarised as:

a) Inadequate conservation knowledge in the communities hampers the process of conservation.
b) BMUs and CMUs identified as management and law enforcers lack financial and management skills to undertake conservation tasks
c) User conflicts at local, national, or regional levels (e.g. closure of certain areas or seasons to protect the fishery) lead to problems with the fishers
d) Lack of effective surveillance due to widespread dispersion of critical habitats.
e) Unlimited and unregulated access to fisheries resources in general.
f) Limited awareness of the extent and importance of these habitats
g) Lack of capacity for effective extension services (human, physical, and technological support) to fisher communities.

Status of Water Quality and its Implication on Fishery Production

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SUMMARY

Within the past five decades, it has been realized that people significantly influence the water quality, which, in turn, affects the fisheries. Since the 1960s, Lake Victoria and its basin have come under increasing and substantial pressure from a variety of human activities. These include deforestation, over-fishing, intense cultivation, animal husbandry and introduction of exotic fish species. Human activities have disrupted biogeochemical cycles with have consequences for the water quality and fisheries of Lake Victoria. Measurements and theoretical analyses have clearly connected observed changes in the watershed and water quality and conclusions have been drawn that aquatic biota including fisheries are strongly influenced by disturbances around and within Lake Victoria

The Lake Victoria basin has clearly shown signs of population pressure and associated land use changes to and within the lake. Nutrient enrichment in the water column, sediment and in rainfall over Lake Victoria accelerated after the 1960s. Phosphorus concentrations have risen by a factor of 2 to 3. Atmospheric loads of nutrients, especially of nitrogen (N) and phosphorus (P) have increased due to biomass burning and deforestation in the catchment. These high nutrient concentrations support elevated algal primary production and algal biomass that have risen by factors of 2, and 6 to 8 respectively. Algal and invertebrates species composition have responded to changes in water quality. Algae are now dominated by the blue-greens with types that are potentially toxic. Elevated algal production probably supports the 4 to 5-fold rise in fish production in the lake since the 1950s.

Increased fish production is good as more local people have turned to the lake for their livelihood and fish exports to international markets earn foreign exchange for the riparian states. But problems associated with nutrient enrichment (eutrophication) impacts of elevated algal biomasses and proliferation of the obnoxious water hyacinth (Eichhornia crassipes) threatens continued beneficial use of the lake resources. High algal biomass and increased sediment have contributed to a 4-fold reduction in the lake transparency since the 1960s. Reduced lake transparency is believed to have accelerated hybridization of some cichlids that are picky in choosing mates and use visual cues of bright male coloration to identify suitors of their own species.

Deoxygenation of deep waters is another undesirable change that has precluded a stable demersal fishery. Seasonal bottom oxygen deficiency created by decomposition of algal biomass and aggravated by stronger thermal stability directly affects the distribution of organisms including invertebrates and fish. Low oxygen has led to loss of approximately 50% of aerated fish habitat since the 1960s, and also lowers potential fish production. Among the invertebrates, Caridina nilotica has become a keystone species as it is resilient to low oxygen conditions. Low oxygen conditions (anoxia) and algal blooms are often associated with fish kills in Lake Victoria. Overall,

used to be in the 1960s (Mugidde, 2001). These elevated water temperatures accelerate temperature-dependent chemical reactions and microbial processes such as denitrification-nitrification, thus affecting nutrient cycling and availability as well as algal biomass development. Low oxygen conditions allow return of P from bottom to surface waters, but not nitrogen (Hecky *et al*., 1996, Hecky, 2000, Mugidde, 2001). Continuous N loss to denitrification during persistent thermal stratification leads to high N demand and favors growth of blue-green including N-fixers as light in the euphotic zone is often adequate during this time of the year.

More stable thermal stratification makes the lake less able to mix effectively and promotes low oxygen conditions in deep waters during the stratified period between September and April (Tables 1 & 2). Decomposing organic matter that includes high algal biomass consumes oxygen leading to oxygen-depletion (anoxia) of deep waters when the lake is thermally stratified. Anoxia has spread horizontally into the inshore shallow bays and gulfs such as Napoleon Gulf, and vertically into the water column to as high as 30 m to 40 m deep from the bottom in offshore waters. Low oxygen conditions affect nutrient distribution, and distribution of organisms including fish in Lake Victoria. There has been loss of about 50% of the oxygenated water volume in Lake Victoria since the 1960s, which reduces fish habitat, and subsequently lowers the potential fish production. Seasonal low bottom water oxygen conditions are thought to have forced haplochromine species into the surface waters where they were exposed to heavy predation by the Nile perch.

Table. 1. Temporal variation of temperatures and dissolved oxygen from inshore waters (Napoleon Gulf) of Lake Victoria.

Month	Temperature (^{o}C)		Dissolved oxygen (mg L^{-1})		Mixing depth
	Surface	Bottom	Surface	Bottom	Z_{mix} (m)
January	27.4	26.4	8.3	2.1	12.0
March	28.1	26.9	9.7	4.4	8.0
July	25.3	24.3	10.6	6.2	20.0
August	25.9	25.3	6.6	0.04	10.0
October	25.6	25.4	5.8	1.3	6.0
November	27.7	25.8	9.8	0.5	6.0
December	26.8	23.9	7.0	0.6	8.0

Table 2. Temperature and dissolved oxygen from offshore (70 m) waters of Lake Victoria

Month	Temperature (^{O}C)		Dissolved Oxygen (Mg L^{-1})		Mixing Depth (M)
	Surface	Bottom	Surface	Bottom	
March	26.7	24.4	8.2	0.4	25.0
May	26.6	25.7	7.7	5.6	40.0
July	25.4	25.1	6.1	6.0	65.0
September	26.6	24.4	9.0	4.7	40.0
November	27.7	25.8	11.0	2.2	30.0
December	25.2	24.7	7.4	2.4	30.0

there is no single polluter to prosecute or blame for non-point pollutants into the lake and this will need new regional legislation.

Status of Phytoplankton Primary Production

Rates of algal primary productivity in near shallow waters to the north in Lake Victoria are two times the rates at the deeper open regions of the lake. Algal photosynthesis occurs in a shrunken euphotic depth of 4 m to 10 m. Phytoplankton primary productivity was in the range 8 to 50 g O_2 m^{-2} d^{-1}, with are average of 18.3 g O_2 m^{-2} d^{-1} that was twice higher than the values recorded in the 1960s (Mugidde 1992, 1993). Overall, the algal photosynthetic efficiency is now lower as indicated by average productivity per unit biomass of 18.1 mg O_2 mg $chl^{-1}h^{-1}$ in the 1990s compared to 25 mg O_2 mg $chl^{-1}h^{-1}$ in the 1960s. The current Lake Victoria is inefficient in using nutrients, as algal primary productivity is light limited most of the time. However, algal primary productivity supports remarkable levels of secondary production including fish production in Lake Victoria.

Algal Biomass

The higher primary productivity throughout the year has been accompanied by elevated algal biomasses evaluated as chlorophyll-a and wet-biomass. Chlorophyll-a concentrations are in the range 3.0 to 656.0 mg $L^{-1,}$ average 45.7 mg L^{-1} (Table 3) that is five times higher than values of the 1960s. The high algal biomass has reduced lake transparency by a factor of four. Lake transparency as a measure of light availability is in the range of 0.5 m to 7.0 m but usually less than 1.0 m inshore water and about 2.0 m offshore waters.

In both inshore and offshore zones of the lake, the lowest algal biomass occurs during periods of low light conditions around July when the lake is most deeply mixing (Tables 1 & 2). During this period, light restricts algal standing crops to levels below the potential provided by the available nutrients during the mixing period. Light limitation constrains algal biomass in the offshore compared to the shallower and more protected inshore surface waters. As a result, phytoplankton biomass and productivity are always higher in the shallow regions than offshore due to better light conditions inshore. Algae contribute to suspended nutrient concentrations (carbon, nitrogen and phosphorus) which are 2 to 5-fold higher inshore than offshore (Table 3). The consequences of high suspended nutrient concentrations and loading depend on the degree to which the phytoplankton are light limited.

Status of algal Species Composition

The very fertile conditions favour dominance of blue-green algae dominated by *Cylindrospermopsis*, *Anabaena* and *Microcystis*. Overall, there is seasonal succession in species composition of algae with increasing dominance of N-fixing blue-green algae during the early stratified period followed by non-fixers later in the stratified period and during the deepest mixing period in June-July. Some of the blue-green algae produce toxins that can be dangerous to aquatic life and land-based animals that use the water. Large green algae such as *Pediastrum* are rare to absent. There has been a 10 -fold reduction in soluble reactive silica, which has been accompanied by a shift in diatom dominance from *Aulacosiera* (*Melosira*) to *Nitszchia*. *Aulacosiera* formed the main food of the native commercially important tilapiine *Oreochromis esculentus* and its reduction might have affected stocks of this species as dominance of cyanobacteria including toxic forms, could have led to reduction of preferred food for the native fish species. Besides, cyanobacteria are less digestible and provide poor quality food that may have contributed to the reduction or loss of planktivorous haplochromines and tilapiines that once flourished in Lake Victoria. It is therefore reasonable to conclude that changes in the fishery may have resulted in part, from dramatic shifts in phytoplankton species composition in Lake Victoria.

Changes in phytoplankton biomass and species composition have been attributed to general increases in P and N loading, changes in fish communities and climate change in Lake Victoria (Lehman *et al.*, 1998). In Lake Victoria, P loads are dominated by external sources that include rainfall, dry-fall, rivers, industrial and municipal inputs. However, in situ biological nitrogen fixation is an extremely important source of nitrogen

CONCLUSIONS AND RECOMMENDATIONS

Human settlements in the numerous urban and rural centers along the shoreline enhance pollution in the inshore regions, where nutrient loads from municipal and agricultural effluents are high. In light of these observations we recommend that an effective water quality monitoring system and research be facilitated to ensure collection of accurate data and information for informed decision-making. There is need for reduction of nutrient loads and pollutant input into the nearshore areas through treatment of municipal and industrial effluents. We further recommend reduction of waste into the lake through promotion of cleaner production practices, promotion of good land-use practices in the catchment area, and conservation of the natural wetlands as well as promotion of constructed wetlands (CWs) as tertiary treatment systems for industrial and municipal effluents to include management of sources of nutrients contributing to atmospheric deposition. The communities should be sensitized with regard to benefits of sound environmental management and harmonization of policies and laws on environmental protection and management. There is need for enhancement of analytical capability necessary to address emerging issues such as algal toxins, monitoring atmospheric deposition particularly phosphorus to establish amount that originate outside the basin boundaries, monitoring atmospheric and riverine loadings of potential toxic contaminants particularly mercury which may originate from small-scale gold mining areas of Mwanza and Mara regions. There is further need for improvement of sanitary conditions in shoreline settlements and capacity for water quality management with the aim to enhance co-management of the lake waters. Finally, management should include setting water quality objectives primarily focusing on drinkability, fishability and minimization of water-borne and other water related diseases as well as harmonization of environmental policies and laws among the Lake Victoria riparian states.

ACKNOWLEDGEMENTS

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water balance for the lake over the period 1950-2000 is considered in order to establish the water budget of Lake Victoria basin, i.e. all discharges to and from the lake on a daily basis. The estimates are required for (i) rainfall onto, and evaporation from the lake surface. (ii) discharges into the lake from all rivers and catchments around it, and (iii) flow from the lake into the Victoria Nile.

Lake circulation is the horizontal and vertical movement of lake water within the body mass of the lake. The movement involves very small to sometimes big velocity components as a result of driving forces. Although there are many causes of lake circulation, one of the main stimulants of lake circulation is thermal stratification. This situation arises when different layers of water in the lake have different temperatures. Surface waves caused by friction between wind and lake surface then stimulate the movements. This results in surface seiches that is the to and fro movement of the body of water as a result of internal movements due to waves. The horizontal and vertical wind can then generate circulation within the lake. Understanding lake circulation allows patterns of movement of nutrients and organisms within the lake, and to develop simulation models of dynamics for nutrients, phytoplanktons (small lake plants), benthic biota (lake bed organisms), suspended sediments and dissolved nutrients.

METHODS

The process of developing a water balance model for the lake involved generation of data for the different water balance components to cover a period of 50 years. Rainfall and evaporation gaps were filled using correlation with a reference station, and record extension was done using the "*typical year*" concept (dry, average and wet year) basing on water level records at Entebbe.

Discharges in rivers were calculated using rating equations and curves that relate measured water levels to the discharges corresponding to that level. Extension and filling in of missing data of river discharge records in the reference period was done using rainfall-runoff modelling that simulated catchment characteristics, rainfall and flow for periods of good data. This relationship was then used to compute the final discharges for each individual river catchment or basin. The water balance for the lake was then calculated as the sum of all inflows from all rivers and rainfall falling directly on the lake surface and outflows as flow at Jinja taking into consideration evaporation as losses.

Rainfall

For each individual river catchment or basin 2 to 6 representative rainfall stations were selected, depending on the area and the rainfall characteristics. The rainfall measurements were then subjected to various quality control checks to identify erroneous data. This included visual examination of raw and plotted data, calculation of statistical properties (means, running means, maximum, minimum, standard deviation etc). Comparison with data at adjacent stations and calculation of cumulative mass curves to identify changes in

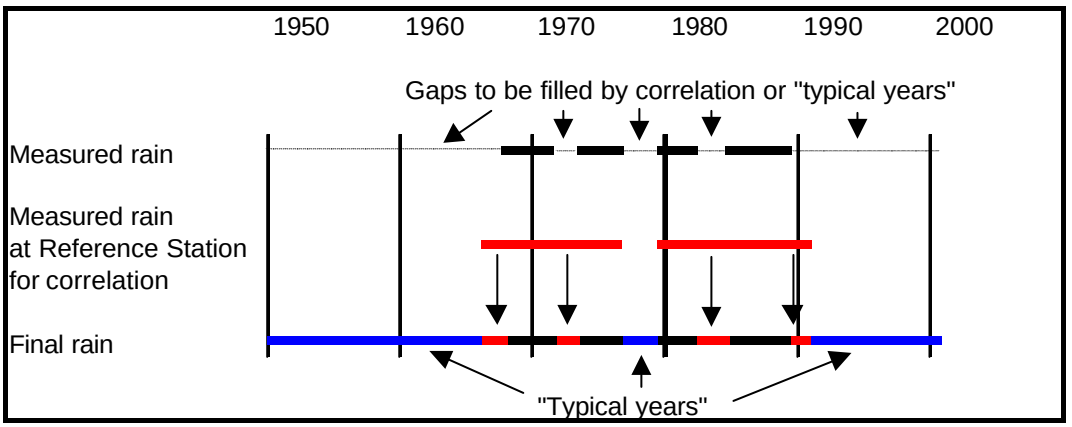


Fig. 1. Procedure for filling gaps in rainfall records

Table 1. List of wet, average and dry years.

Hydrological Year (1 Oct - 30Sept)	Typical Year (1 Oct - 30Sept)	Hydrological Year	Typical Year	Hydrological Year (1 Oct - 30Sept)	Typical Year
1949-1950	Average	1969-1970	Average	1989-1990	Wet
1950-1951	Average	1970-1971	Average	1990-1991	Average
1951-1952	Wet	1971-1972	Average	1991-1992	Dry
1952-1953	Dry	1972-1973	Average	1992-1993	Dry
1953-1954	Average	1973-1974	Average	1993-1994	Average
1954-1955	Average	1974-1975	Average	1994-1995	Average
1955-1956	Dry	1975-1976	Average	1995-1996	Average
1956-1957	Average	1976-1977	Wet	1996-1997	Dry
1957-1958	Average	1977-1978	Wet	1997-1998	Wet
1958-1959	Dry	1978-1979	Wet	1998-1999	Dry
1959-1960	Average	1979-1980	Dry	1999-2000	Dry
1960-1961	Average	1980-1981	Dry	2000-2001	Dry
1961-1962	Wet	1981-1982	Wet		
1962-1963	Wet	1982-1983	Average	Special Cases:	
1963-1964	Wet	1983-1984	Dry	Oct.61-Dec 61:	
1964-1965	Dry	1984-1985	Average	Use wettest Oct-Dec. recorded	
1965-1966	Average	1985-1986	Average		
1966-1967	Dry	1986-1987	Average		
1967-1968	Wet	1987-1988	Wet	May 89& May 97 - Oct 97:	

Evaporation

The method for the development of a continuous evaporation record followed the same principle as that for the rainfall. However, in practice there were some differences caused by the fact that there are fewer evaporation stations because it is only recorded at meteorological stations. Also the use of correlation to an adjacent station is frequently not relevant because the stations are so far apart.

There is no well-defined method of choosing evaporation for wet, average and dry years, so the daily (or monthly) mean evaporation was used to fill gaps in the record, i.e. the mean of all measurements on 1st January are used to fill all 1st January gaps, etc.

River Discharges

In this step the objective was to generate the measured river discharges on the basis of the rating curve and the measured daily gauge heights (river water levels).
Each river basin in the Lake Victoria catchment has several gauging stations located at various places on the main stream: near the confluence of major tributaries and near the river mouth. Since the main interest in the Lake Victoria Environmental Management Project (LVEMP) Water Quantification Study waste discharge of water nearest to the lake, we concentrated on the stations nearest the mouth.

In the next phase of LVEMP it would be of interest to compute the discharges from the various sub-catchments of each river to determine the distribution of the water and pollution loads. This could identify specific areas where remedial action is required.

The rating curve for each chosen gauging station was developed on the basis of the measurements of level and flow (m^3/s) at the station. The standard power formula was used in all three countries:

The first method is preferred since it uses the measured discharges at the gauging station in a more direct way. However, the choice may depend on the specific case. For example, if additional rainfall stations are needed to cover the full river basin, then the second method must be used.

Water Mass Balance

The final step was to sum all the inflows to, and outflows from Lake Victoria to generate the water mass balance for 1950-2000.

Inflows: Discharges from rivers.
Rainfall over the lake.

Outflows: Evaporation from the lake.
Discharge to the Victoria Nile.

The rainfall and evaporation were evaluated as a weighted sum of the records at stations around the lake and on islands in the lake. The summation is expressed as the daily/monthly change in water level in the lake and is compared with the recorded water levels (at Entebbe).

Rainfall over Lake Victoria

The rain falling on the lake surface represents by far the largest input of water to the lake. Additional qualitative knowledge of the regional meteorology and rainfall patterns was required to be able to estimate rainfall over the lake. The wind patterns are sketched in Fig. 4.

Figure 5 shows the rainfall stations in the lake catchments with their mean annual rainfall based on measurements alone and the corresponding isohyets. It also shows the division of the lake into a number of boxes or polygons that form the basis for estimating the total rainfall over the lake. Each box has a reference rainfall station. The following procedure was applied.

1. The mean annual rainfall in each box is estimated on the basis of the isohyetal curves.
2. The daily (or monthly) rainfall in each box is calculated using:

$$R_{box} = R_{ref} * MAR_{box} / MAR_{ref}$$

where
R_{box} = Daily rainfall in box
R_{ref} = Daily rainfall at reference station
MAR_{box} = Mean annual rainfall in box
MAR_{ref} = Mean annual rainfall at reference station

3. The average daily rainfall for the lake is calculated as the sum of the area weighted means of the of the daily box rainfalls (R_{box}).

The values are listed in Table 2.

Lake Victoria Water Mass Balance

The Lake water mass balance for the period 1950 to 2000 is finally presented in Fig. 6 and in Table 3.

Table 2. Rainfall over Lake Victoria

Box No.	Name	Weight	Mean Annual Rain for Box	Mean Annual Rain for station
1.	Muhuru	0.074	1250	964
2.	Musoma	0.065	1300	839
3.	Ukerewe	0.124	1600	1502
4.	Mkula	0.019	886	886
5.	Mwanza	0.045	1000	958
6.	Bukerebe	0.091	2400	2609
7.	Kahunda	0.083	1450	1163
8.	Izigo	0.023	1950	1731
9.	Bukoba	0.008	2400	2060
10.	Rubafu	0.022	2300	1710
11.	Kalangala	0.179	2100	2085
12.	Bumangi	0.037	1800	2086
13.	Entebbe	0.041	1950	1629
14.	Buvuma	0.095	1696	1696
15.	Rusinga	0.076	1230	1053
16.	Homa Bay	0.008	1204	1204
17.	Kisumu	0.010	1220	1357

Table 3. Average inflows to and outflows from Lake Victoria

Average 1950 - 2000	Volume (mcm)	Flow rate m^3/s	Percentage %
Input			
Rain over the lake	143,134.0	3631	82
Basin Discharges	30,668.8	778	18
Output			
Evaporation from the lake	131,268.6	-3330	76
Victoria Nile	41,233.4	-1046	24
Sum	1,041.4	33	

As indicated above, the lake level has consistently dropped. From lake level records (DWD, database), this downward trend commenced in July 2003, before which there was a brief rise. Otherwise, since the El nino rains of 97/98 which peaked in April of 1998 at 1135.77 metres above mean sea level (mamsl), the trend of the lake level has been dropping steadily. This drop is not uncommon as it is the natural regime of the lake as indicated in Fig. 7 below showing 104 years of Lake Victoria Levels.

From Fig. 7, the lake exhibited the following low scenarios in the order of extreme, summarized in Table 4.

The low level scenario has been recurring in a cyclic manner. However, our concern today is that this drop is uncharacteristically steady and consistent and coincided with the commissioning of the Kiira Hydro-power Station. This has led suspicions on the operation of this facility as being the main cause of the drop.

The following attempts to explain the decline in lake levels:

Table 4. Historical low flow scenarios

No.	Year	Month / Day	Level in mamsl
1.	1923	March	1133.19
2.	2004	September	1133.99
3.	1961 (before the famous flood)	January	1133.70
4.	1994	February	1134.18
5.	1997	October	1134.21
6.	1986	September	1134.26

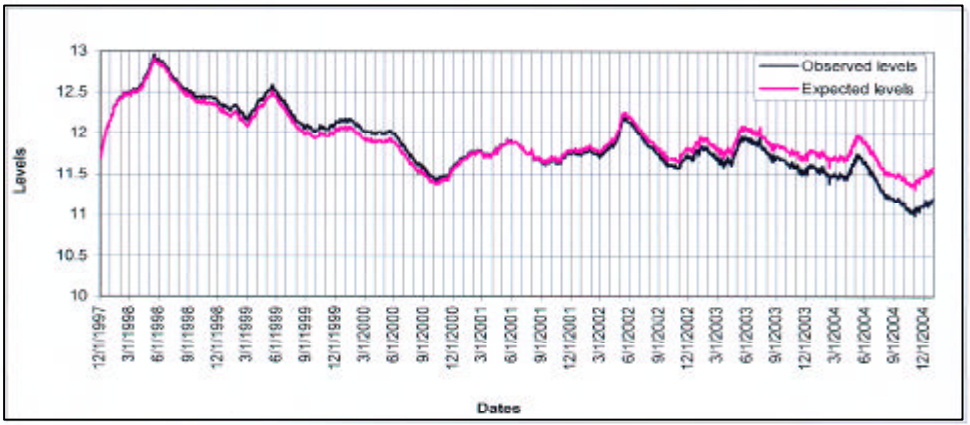


Fig. 8. Lake Victoria observed and expected levels 1997 - 2004

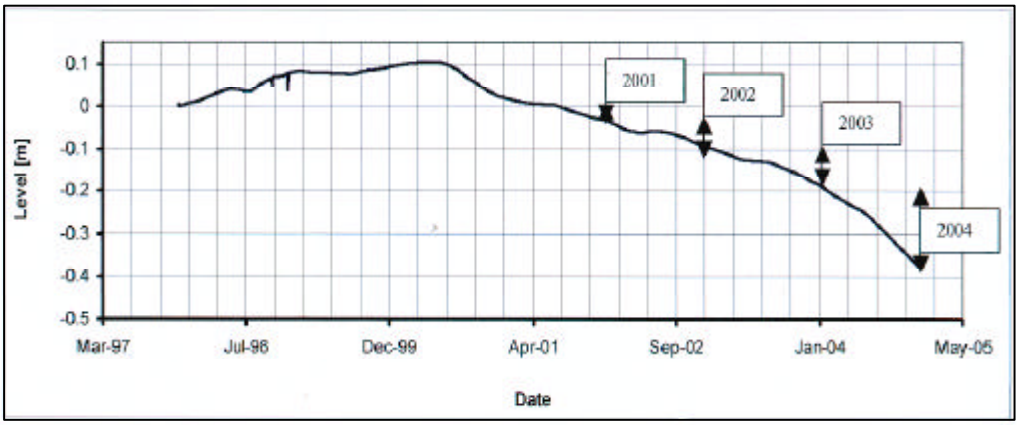


Fig. 9. Lake level drop scenario from 1997 - 2004 (Nov)

LAKE WATER CIRCULATIONS

Key Circulation Patterns within the Lake

In the period September to December, there is observed rapid warming of the water column, slow heat dispersal (surface to bed) and no strong thermocline (breaks in temperature profiles) gradient. In the period January to May, thermocline develops between 30 and 60 metres of depth, maximum surface

Distribution of Economic Benefits from the Fisheries

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SUMMARY

The Lake Victoria fishery contributes immensely to the socio-economic development of the riparian states. The East African Community has designated the lake basin as an 'economic growth zone', with the potential to develop into a major economic region. The fisheries are vital in creating employment opportunities, mostly rural-based, thereby helping to reduce rural-urban migration. Fish is also a rich source of animal protein for human consumption and provides raw material (fishmeal) for processing animal feeds. The fish industry contributes to GDP and has continued to be an important source of foreign exchange earned from fish exports. Besides, the fish industry contributes to the national and local government revenues through levying of various taxes, levies and license fees. The sector has also contributed directly and indirectly to the improvement of physical infrastructure and social facilities, such as roads, schools and hospitals, particularly in remote fishing communities.

Based on current stock estimates, the lake has the potential to yield fish valued at over US$ 800 million annually. Further processing and marketing the fish in the local and export markets could provide opportunity to generate additional earnings. Currently, however, only about 500,000 tonnes of fish is landed annually, with an average landing value of approximately US$ 600 million. However, the distribution of these benefits at the regional, national and individual levels is often not equitable. High disparities in distribution of benefits is considered undesirable as it creates a sense of social injustice among the beneficiaries; can be an obstacle for self-sustaining growth; is a limitation in uplifting the resource users out of poverty; leads to low compliance to fisheries regulations and hinders attaining sustainable fisheries exploitation. The paper assesses the distribution of economic benefits from the fisheries, using selected indicators. It reveals disparities in the benefits at the regional as well as at the local levels, with more benefits accruing to the upper levels of the fish marketing chain.

The disparities are attributed to unequal distribution in production assets such as capital, skills and credit facilities; free-market price determination mechanisms; inadequate access to market and other useful information; limited investment horizon and opportunities among fishers; inadequate policies to deal with disparities in distribution and insufficient data for distribution analysis to feed into the policy process. In order to streamline distribution, the paper proposes, among other things; establishing suitable savings and credit schemes, empowering BMUs to organize fishers for marketing, improving market information flow through electronic and print, operationalising the Fish Levy Trust Fund for infrastructural and social facility development, improving policies and improving data availability.

BACKGROUND

The Lake Victoria fishery contributes immensely to the socio-economic development of the riparian states. The East African Community has designated the lake basin as an 'economic growth zone', with the potential to develop into a major economic region. The fishery is vital in creating employment opportunities, mostly rural-based, thereby helping to reduce rural-urban migration. Fish is also a rich source of animal protein for

disparities in the distribution of economic benefits from Lake Victoria. The specific objectives are as follows:

i) To identify the main economic benefits from the fisheries of Lake Victoria.
ii) To explain the concerns with disparity in distribution of the benefits.
iii) To show how the benefits are distributed between the riparian countries of Kenya, Uganda and Tanzania.
iv) To show how the earnings are distributed between boat owners and crew, between the sub-sectors and by gender.
v) To identify the challenges in ensuring equitable distribution of economic benefits on Lake Victoria.
vii) To recommend the way forward in improving the distribution of benefits.

METHODOLOGY

The information presented in this paper was generated through different methods. Secondary data search was conducted by reviewing records of fishery related institutions at the local, national, regional and global levels. Literature review was carried out, involving reports from various studies in the region. Expert consultations were conducted with key informants at the different levels.

Definition of Economic Benefits

Generally, the benefits to the region, riparian states, communities, households and individuals accruing from the fisheries can be grouped under the following categories:

i) Economic
ii) Social
iii) Institutional, and
iv) Environmental

This paper is primarily concerned with the economic benefits. These are defined as the gains in relation to wealth acquisition and its distribution to the nations, households and individuals.
At the national level, the economic benefits include:

i) Production, and its contribution to GDP, through primary, secondary and tertiary activities within the fisheries.
ii) Balance of trade as given by the difference between foreign exchange earnings and expenditures in fisheries, compared to the national levels.
iii) Public revenues less public expenditures in fisheries, compared to national budgets.
iv) Employment and job creation as indicated by the numbers directly and indirectly involved in the fisheries.
v) Food supply, given by the per capita fish quantities as well as the contribution of fish to animal protein at the national level.

At the household level, economic benefits include:

i) Earnings from fish production, processing, marketing and ancillary activities.
ii) Jobs accessed by communities by category of activities.
iii) Fish consumption as contribution to food security and protein intake.

At the individual level, the benefits are very much the same as at the household level. However, distinction needs to be made concerning access to the benefits by gender and age group.

ii) Within fishing, motorized fishing generates more earnings than non-motorised fishing.

iii) Among processors, those engaged in sun-drying earn more that those in smoking.

iv) In fish trading, earnings of bicycle operators and market stall-holders realize similar earnings.

As a result of inadequate data, other sub-sector enterprises could not be compared.

Table 2. Average monthly earnings by sub-sector

Sub-sector	Earnings (US$)
Fishing	
Motorized	257
Non-motorised	110
Processing	
Smoking	179
Sun-drying	126
Trading	
Bicycle trader	25
Market stall-holder	24

Source: Odongkara, 2001

Distribution of Earnings by Type of Fishers

Different types of fishers earn different levels of income, depending on the facilities influencing the prices they receive and the species they target. Table 3 gives indications of the disparities in earnings of fishers of different species operating at beaches served with different transport facilities. The table reveals that: truck beaches are sources of higher earnings to fishers than non-truck beaches, mostly due to the more readily available market and higher prices of fish. However, there is little impact on the earnings of tilapia fishers as much of it is ferried away by bicycles rather than trucks.

Figure 1 shows disparities in earnings by species targeted. The figure shows that fishers of Nile perch earn highest incomes, followed by those of dagaa while fishers targeting tilapia earn the least.

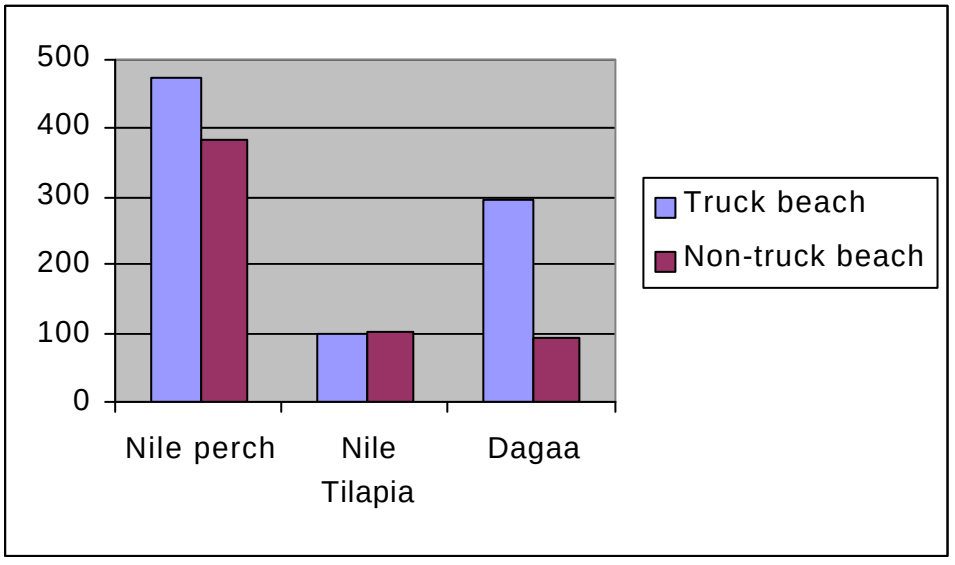


Fig. 1. Mean monthly incomes of fishing enterprises by species (US$)

the areas of contribution are highlighted in Table 6. The table shows that development of the fisheries has stimulated development in the areas of industrialization, infrastructure and social facilities.

Table 6. Key areas of national contribution of fisheries

Industrialization	Infrastructural Development	Social Development
US$ 150 million investments in fish factories	Rural infrastructure (roads, landing facilities, water supply etc)	Schools, health centres and recreational facilities.

Challenges in achieving equity in distribution of benefits

In order to identify the challenges in overcoming the disparities in benefit distribution, the major underlying factors were identified and analysed. They included:

i) Unequal distribution in production assets of fishermen, fish processors and traders. These include capital, equipment and skills.

ii) Free-market price determination mechanism, where the poor are subjected to unfavourable trading conditions and low prices.

iii) Inadequate access to sufficient market and other useful information, limiting the opportunities and choices among fishers.

iv) Lack of fishers' organizations to strengthen their market bargaining power and support their activities.

v) Limited investment horizon and opportunities among fishers, which hinders their capability to re-invest the surplus earnings from the fisheries most profitably.

vi) Lack of access to credits especially to fishermen to enable them improve on their operations and invest in alternative income sources.

vii) Lack of appropriate savings avenue and a savings culture among fishers for better utilization of earnings and saving for the future.

viii) Poor physical infrastructure to the fishing villages that limits the market for fish and results in low prices to the producers.

ix) Inadequate post harvest handling facilities and skills to ensure quality maintenance for better market and prices.

x) Inadequate policies to deal with inequitable distribution of benefits, for the good of the disadvantaged groups.

xi) Insufficient data and skills for distribution analysis to support the policy process.

CONCLUSIONS AND RECOMMENDATIONS

The main economic benefits from the fisheries of Lake Victoria at the regional level are production and contribution to GDP of riparian states, employment, foreign exchange earnings, contribution to diet. At the household and individual levels, the benefits take the forms of earnings, employment and consumption.

Socio-economic Impacts of Fish Trade

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SUMMARY

Trade in fish from Lake Victoria has since the late 1980s, become a major activity in the Partner States, due to increase in stocks of the introduced fish species (Nile perch and Nile tilapia). The dominance of the introduced species has transformed the fishery from subsistence into a major commercialised artisanal fishery for domestic, regional and international markets. The main economic benefits from fish are employment, income and food. Regionally, trade in fish is contributing a significant proportion of protein intake for the majority of the Lake Basin inhabitants including those in major urban centres. The supply for this market is mainly Omena/Mukene/Dagaa, Nile perch, and Tilapia. The traded fish regionally is mainly salted Nile perch and dried Dagaa which are exported mostly to Congo, Zambia and other Southern African countries. The growth of International trade in Nile perch has led to the establishment of several fish processing plants for export to destinations mainly in EU and the Far East countries. Currently there are 29 operational fish processing plants regionally. At the base of this trade are some 175,890 men and women operating 52,479 crafts.

The resultant socio-economic impacts of fish trade are many and varied. Growth in fish trade has provided the region with the much-needed foreign exchange. Fish processing for export has provided employment opportunities for those involved directly and indirectly in the fisheries sector. There are thousands of people involved in the marketing and distribution of fish and fisheries products. There are many auxiliary services that are heavily dependent on fish trade (breweries and soft drinks industry, transport, net manufacturing, boat building, petroleum products, packaging materials, e.t.c.) and which have led to economic growth and an increase in households' incomes, and poverty reduction.

The increase in prices of Nile perch products has prompted fishers to increase fishing effort in order to maximize opportunities. New entrants with declining opportunities elsewhere have also joined the fishery resulting in numerous fishing villages which threaten the lake basin environment. As trade in fish grew, some fishers adopted unscrupulous fishing methods, gears and practices (e.g. under-sized nets, water diving, beach seining etc.). However, trade in Nile perch has resulted into demand for other by-products previously not traded in (e.g. fish swim bladder, fish skin and fish frames). The expansion in trade has introduced new scenarios such as private ownership of beaches or plots near the lake making it impossible for government to plan for public utilities. Insecurity in the lake has increased because of the remoteness of some of the beaches, which offer protective grounds for those escaping from justice. Some fishers have turned to stealing and robbing other fishers across the borders causing concern.

asDeclining stocks of target fish species for international trade and for food security coupled with rapid population growth that is solely dependent on the fisheries require urgent attention. The undesirable harvesting methods threaten the fisheries and are bound to have far reaching effects if not checked. Lack of financial advice and banking facilities has left the fisher community with a lot of daily disposable incomes, and the fisher associations and institutions particularly the co-operative movements have failed. Fisher communities have thus become targets of infectious diseases such as HIV/AIDS and Sexually transmitted Diseases (STDs as careless spending has emerged.

significantly between late 1980s and early 1990s reaching a peak in 1996, with the EU accounting for over 90% of the export volumes. In Tanzania it started in 1992 and to-date, over 60% of the Nile perch products are exported to the EU member countries. In Uganda, fish exports started in 1990 and reached a peak in 1996 before a ban was slammed on the exports by the EU. Figure 2 shoes the trend of fish production for the three riparian states of Lake Victoria from 1976 - 2000.

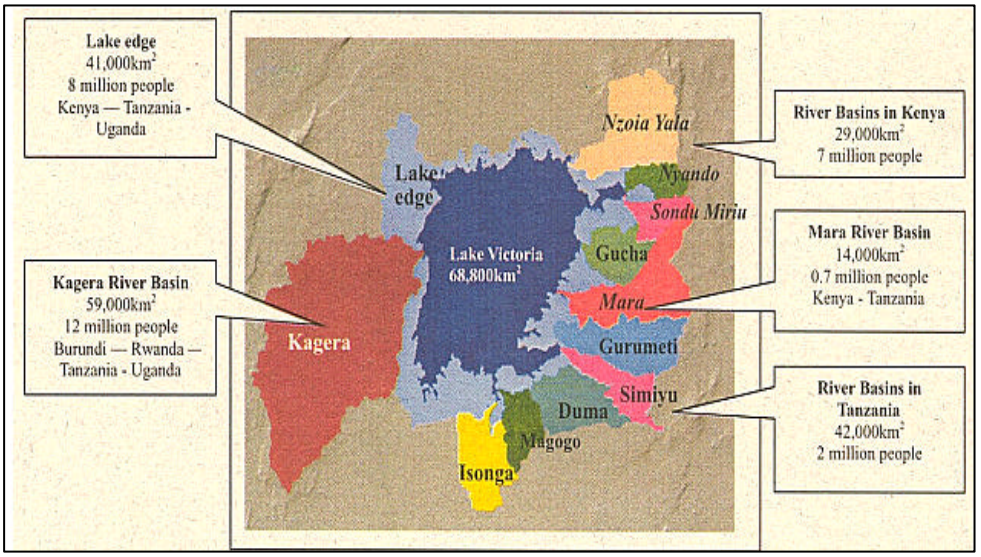


Fig. 1. Lake Victoria Catchment

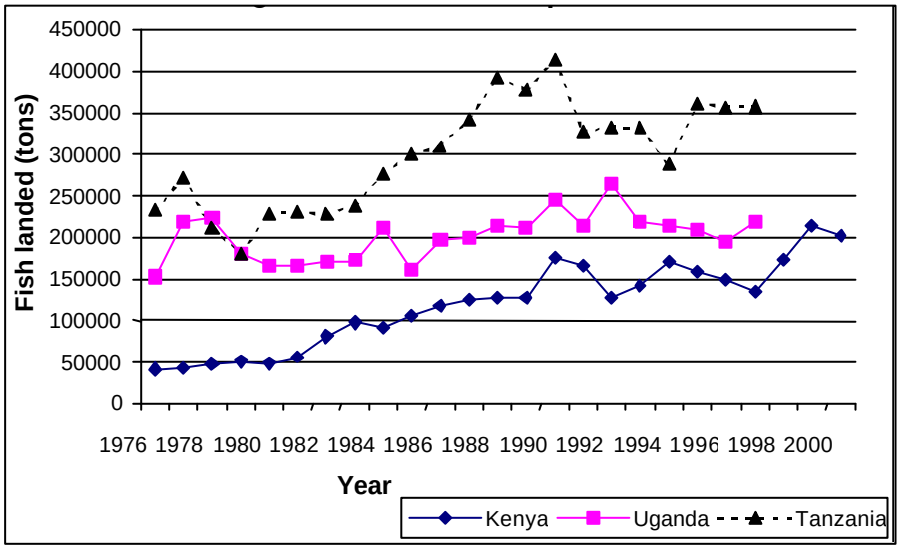


Fig. 2. Total Annual Fish Production

Socio-economic Importance of Fish

Recent estimates indicate that fish exports from Lake Victoria earn the riparian state about US$ 250 annually (Table 2). Fish is also a source of nutrition and protein to many people within the basin. There are approximately 1,498 landing sites on Lake Victoria with 124,369 fishers, 41,091 canoes and over 1,540,000 gillnets (Table 1) . Each year about 400,000 - 600,000 mt of fish is landed, valued between US$ 300-US$ 500 million. Inspite of these economic assets benefits, most fishers remain poor, and infrastructure such as fish landing beaches, sanitation facilities and dispensaries need major investments to bring them up to required standards.

the fish contributes approximately 2% of national GDP on average. Yaron and Moyini (2003), using Banks (2003) data for Uganda, estimates fisheries contribution to be 5.8% of GDP. The authors have noted that, more often, policy makers use such data to allocate resources for fisheries management. In the process few resources are allocated to fisheries sectors as a result of this under estimation.

Food Security

Although there are no explicit estimates of people who are food secure from fish in the three countries, the ratios of the number of people depending on fish to total national populations provide some idea on the number of people who depend on fish for food security. National estimates on per capita fish consumption per adult also provide good indicators on fish consumption. Nonetheless, fish is a major source of animal food protein (Table 3).

Table 3. Contribution of fish in animal protein

Year	% of fish in animal proteins		
	Kenya	Uganda	Tanzania
1976 - 1978	6.1	38.5	34.4
1979 - 1981	6.3	33.8	31.0
1982 - 1984	9.2	34.8	32.8
1985 - 1987	9.8	36.1	35.6
1988 - 1990	9.9	37.8	38.3
1991 - 1993	10.2	33.6	31.3
1994 - 1997	10.6	29.7	32.6

Source: FAO database

Foreign exchange earnings

Records on fish exports from the three countries indicate that fish earns the riparian states over US$ 250 million annually. All the three countries (Uganda, Kenya and Tanzania) recognize that foreign exchange from fish is important in their economies. In Uganda fish exports contributed US$ 87million in 2003 competing with coffee as number one foreign exchange earner while in Kenya, US$ 58.8 million was earned and the contribution to GDP is rising significantly while in Tanzania, the contribution was about US$ 112 million. Keizire (2003).

Major commercial fish species from Lake Victoria

Nile Perch

The Nile perch (*Lates niloticus)* has dominated Lake Victoria fisheries over the past two decades accounting for 60% of the catches by volume (MAAIF, 2002; Abila, 2003). Other major species harvested include Dagaa, at 20%, the Nile tilapia (*Oreochromis niloticus*) at 10%. Other species of the genera *Alestes, Bagrus, Barbus, Synodontis, Protopterus, Clarias* and *Haplochromis* account for the remaining 10% (MAAIF, 2002; Abila, 2003). Some species such as *Clarias* are becoming important especially as bait in the Nile perch fishery (Yongo, 2000).

Nile perch is the most tradable fish species from Lake Victoria. It is exported mainly to Europe, Far East, Middle East, the United States and South America in fresh, chilled and frozen forms. The by-products,

sanitary facilities, roads, and portable water. Trade has further triggered off other multiplier effects such as in the mining and building sectors, trade in oil and oil products, airline industry, breweries, soda industry, net manufacturing, and packaging industry among others. The growth of international trade in Nile perch has led to the establishment of fish processing plants for export to destinations mainly in EU and the Far East countries. At the base of this trade are some 175,890 men and women operating 52,479 crafts. Related to these outcomes, trade in fish, and fisheries products, has also changed the attitude of the local communities on the resource ownership. Formally, communities regarded the resources as belonging to the States (SEDAWOG, 2000). At the moment all stakeholders have seen the need for involving local communities in the management of the resources for sustainability. This change in attitude is very important for fisheries managers when designing rules and regulations for the management of the fisheries resources.

Fish trade has further enhanced social, economic and political relationships among the three East African States. The fisheries of Lake Victoria have been the architect of the present East African Community. For decades even when there was animosity among member statess for example during the dictatorial regime in Uganda in the 1970s on one hand; and the different philosophies pursued by Kenya and Tanzania on the other, the lake kept the regional researchers and institutes on their toes and scientists and officials concerned with the lake met more often than their leaders on scientific and socio-economic maters relating to Lake Victoria. Indeed it is the lake that has been the precursor to the present economic good will among member states. Fish do not recognize boundaries; fishers and traders pursued them across the borders and availed them to any communities that depended on the lake resources. As a result of fish and fish trade, the EAC has been formed as an economic union and with the neighbouring states (Rwanda and Burundi) joining a major trading block is being developed. These countries are already attending EAC meetings of and their membership might be ratified in the EAC by 2008.

There an emergence of fish farming as a result of fish trade. Entrepreneurs with small-scale to medium scale enterprises are gradually picking up fish farming on a commercial basis. This is because fish has become one of the most tradable items, thus prompting many people to look at feasible alternative ways of producing fish than relying on capture fisheries.

Negative Impacts of Fish Trade

Trade in fish, and fish products, has caused technological change towards more destructive methods of exploitation. Commercial trawling, drift nets, beach seines and several forced-capture methods have been directly linked to fish trade. Declining catches is prompting fishers to invest more on fishing outfits than ever before (e.g. engines and stronger boats; changes in the mode of gear operation and longer hours of fishing trips) thus increasing fishing effort but still ending up with same or less catch. In general terms, there has been a serious decline in Catch Per Unit Effort (CPUE) for all fishing gears in Lake Victoria (Muhoozi, 2002). The *per capita* fish supply has declined in all three countries in the last decade, with a faster rate of decrease being observed in Tanzania and Uganda (Abila, 2003). Trade in the main commercial species has created concerns on the stocks of those species. This requires further research on existing stocks and their sustainability.

The expansion of fish processing capacity (in terms of number and individual factory capacity) has led to excess capacity and presently factories operate at less than half of the installed capacities, largely owing to insufficient fish supplies. Most factories are now beginning to take Nile perch as low as one kilogram in weight and lower than the minimum slot size. As a result fishers have resorted to using unscrupulous methods of fishing such as beach seining, *Ochwado*[1] and *Seke-seke*[2] (Yongo, 2000) to meet the growing market demand. In the recent past the Nile perch processing and exporting industry has been characterized by frequent closures, takeovers and changes in ownership of processing firms, a sign that it is not a very stable industry, leading to a waste of scarce human and financial capital (Abila, 2003).

Other social impacts include fast spread of communicable diseases such as HIV/AIDS, which are a result of trade, and income flows amongst fishing communities and fish traders. In Uganda for example, the first AIDS/HIV victim was identified amongst fishing communities in Rakai district. Moreover, there are reported cases of prostitutes migrating from towns to fishing villages in search of wealthier but rather redundant fishers (DFR, 2004). A mortality study conducted in rural Mwanza (Tanzania) among fisher communities indicated that about 35% of all deaths among adults of 15-60 years were attributed to HIV/AIDs (Urassa *et al.*, 2000). Fishers are considered high-risk groups for the STDs/HIV because of their work environment, prostitution and the liquid cash economy, the practice of multiple partners and the low to non-use of condoms. Reduction in the rate of HIV/Aids spread among the fisher communities is another challenge because an infected individual will not value the sustainability of fisheries resources and hence will always tend to use illegal and destructive gears. The most affected labour force in this sector is the working youth below the age of 25 years.

Other diseases prevalent among the riparian lake communities include malaria, typhoid fever, bilharziasis and diarrhearal diseases. The increase in the incidences of these diseases is related to fast growth of lake-side settlements due to the growth of the fishing industry. In part, it is also a reflection of the poor performance of agriculture as well as the limited and poorly performng altarnative economic opportunities around th lake bansin.

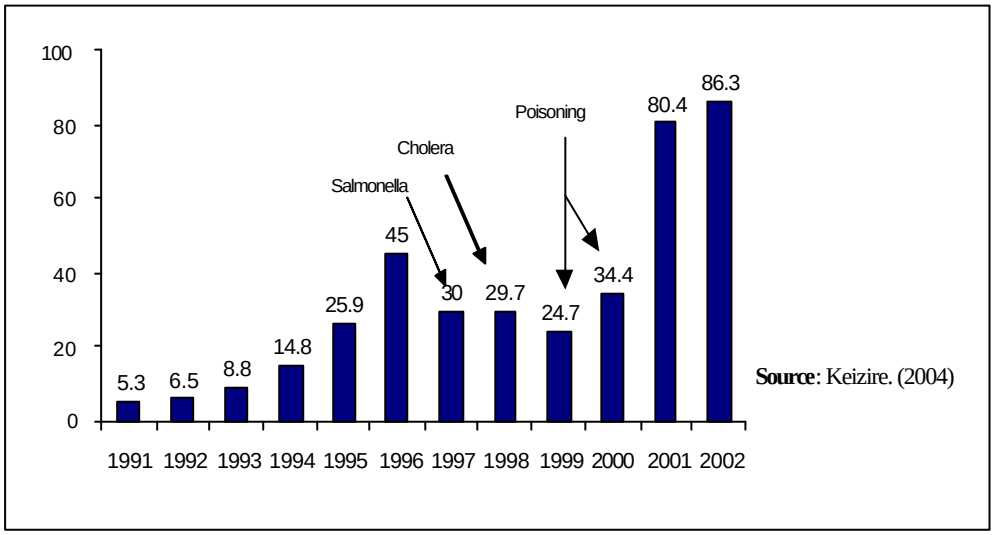


Fig. 3. Impact of fish ban on volume of trade

CHALLENGES AND OPPORTUNITIES OF FISH TRADE IN LAKE VICTORIA BASIN

Challenges

There are concerns that as a result of fish trade, the fish stocks have continued to decline. Although scientific surveys may not have provided good estimates of the existing stocks, the commonly used methods of estimating stocks, such as catch assessment and frame surveys, and CPUE all indicate declining catches for every extra unit of fishing effort applied. This is a big challenge especially for fisheries managers for the fish trade within the region.

Funds and revenue collected from the industry is not ploughed back into the fisheries sector to develop the infrastructure. More often, financial resources earmarked for fisheries management have been less that 10% of annual requirements in this sector. Although there has been significant support through donor programs, these programs are unsustainable and depend on the political environment in individual countries.

Agricultural Sanitary and Phytosanitary Sanitary (ASPS) is an added advantage to fish trade from the region.

Strengthening the Positive Impacts and Mitigating the Negative ones

It is important that the positive impacts are strengthened while responding or mitigating the negative impacts of fish trade. There is need to emphasize on a harmonised and effective fisheries management regime within the riparian states. The issues of fish quality control measures (infrastructures, roads, ice plants etc) need to be strengthening to facilitate further fish trade.

There are other options for innovation, in the industrial sector, with support from governments to look at issues of, and promoting value addition on fish products. For increased fish production, countries need to promote and strengthen aquaculture practices to boost fish production and release pressure from the capture fishery. The last and most important is the involvement of communities in the fisheries management and environmental protection. This is a fundamental strategy and there all indications that fisheries management will improve if all stakeholders are involved in the management of their resource. This can be done through strengthening and facilitating Beach Management Units (BMUs).

There is also need to create trade incentives and policies that narrow the unequal profit margins in the fisheries sector through appropriate mechanisms and provision of market information. The government should empower the co-operative societies, by restructuring them so that fishers saving are driven back to positive investments. An effort to investment in infrastructural facilities such as roads and landing berths will promote direct fish exports of fish from the nearest airports thus enabling fish to reach markets abroad when still fresh and competitive.

The last and not least is that countries need to create effective and harmonized policies, laws ad regulations. The policies and regulations must define and put in place relevant and effective fisheries management institutions, with adequate funding. There is need to take advantage of rent-rich fisheries for ploughing back to fisheries management and research.

WAY FORWARD

For increased trade and together with associated sharing of benefits of trade, countries need to develop or harmonize and implement effectively the existing agreed positions for management and policies, legislation and standard operating procedures

ACKNOWLEDGEMENT

This paper benefited from a wide rage of studies by projects. The contribution of the Lake Victoria Environmental Management Project (LVEMP), the Lake Victoria Fisheries Research Project (LVFRP) studies conducted under the World Conservation Union of Nature (IUCN) and the Norwegian AID (NORAD) in addition to individual studies supported by other bodies such as FAO are all highly appreciated.

processes. Post-mortem quality changes occur very rapidly hence the need for preventive and control measures to curtail loss of quality and reduce the negative consequences of spoilage. Application of a Fish Inspection and Quality Assurance (FIQA) system for Lake Victoria is aimed at reducing fish post-harvest losses, optimizing utilization and adding value to the available catch, controlling health hazards, maximizing socio-economic benefits, meeting consumer requirements, and guaranteeing product safety (FAO, 1998). Fish Quality Assurance is the process of providing fish consumers with reasonable guarantees that the fish or fishery products released into the market meet freshness criteria. Fish safety assurance is the process of providing guarantees to fish consumers that a particular fish or fishery product is free from contaminants of public health significance such as disease-causing bacteria; bio-toxins, heavy metals and pesticide residues.

The assurance is provided through systematic and planned actions such as inspection, process controls, quality auditing, environment monitoring, good manufacturing practice, application of Hazard Analysis Critical Control Point (HACCP) approach and end product testing (Sara *et al*., 1998).

Various preservation methods are used to maintain fish quality; they include chilling, freezing, smoking, sun drying frying and salting (FAO,1998). The choice of method depends on the facilities available to the processor and the target market for the final product. The main commercial fish species from Lake Victoria are Nile perch, Nile Tilapia and Dagaa. Most of the Nile perch is processed either as chilled or frozen fillet for international export with limited quantities smoked. Most Nile tilapia is eaten fresh. Dagaa is sun-dried for direct human consumption and for feed production.

Consequent to the emergence of industrial processing of Nile perch in the 1990s, a regional strategy on quality and safety of Nile perch product was developed to facilitate compliance with market requirements. Fish quality control systems have been put in place to ensure that fish exports from the region continue to have a good reputation in the international market place. There is no strategy similar to that of Nile perch for processing Dagaa, which is currently one of the three most important commercial species on Lake Victoria. Most Dagaa is sun dried on bare ground and to a limited extent on rocks yet it is currently the most affordable fish for both the urban and rural poor and its value can be more than doubled when processed for food for distribution in the national and regional markets.

Although fish quality systems have been set up especially at fish factories there are still many challenges for fish quality along the production and marketing chain which need to be addressed in order for the partner states to continue assuring the quality and safety of fish. The authorities responsible for control and monitoring of fish production conditions in the region are also faced with many other challenges, which, together with those already mentioned require immediate attention. The opportunities and the strategy for addressing these challenges so that FIQA continue to have a positive impact on the socio-economies of the people of East Africa.

Why Fish Inspection and Quality Assurance (FIQA) is Necessary

Fish quality assurance is aimed at prevention of post harvest losses and control of health hazards associated with fish (EU Directive 91/493 EEC). Effectively implemented fish quality assurance will lead to optimal utilization of scarce fisheries resources and maximization of financial benefits to fishermen, small-scale fish traders, fish processors and fish exporters. It is also intended to ensure that the fish industry continues to guarantee fish and fishery product safety so as to minimize customer complaints and sustain consumer confidence (FAO, 1994).

Historical Events Leading to Development of FIQA

Although trained fish inspectors existed by the 1990s, fish inspection and quality assurance was only being carried out on a limited scale (KEBS, 1998). Efforts to streamline FIQA were constrained by lack of documented inspection and quality assurance procedures and clearly defined policy and legal framework for effective operation of fish inspection services. The fish was mainly marketed locally and in the regional

h) Developing cold chain facilities for improving fish handling and preservation. Currently ice is not widely used to chill fish especially that which is destined for the local market.

i) Upgrading facilities in the local markets. Hygiene conditions in the local markets are generally poor thus exposing fish to contaminants.

j) Control of pollution and and monitoring of fishing grounds for biological and chemical contaminants so as to demonstrate their absence in fish intended for human consumption.

k) The need to respond to the increasing market demands for quality and safety guarantees especially in Europe and the USA e.g. complying with Bio-terrorism prevention standards of the United States and the Traceability Directive 178/2002 EEC of the European Union.

Current status of Fish Inspection and Quality Assurance (FIQA) in East Africa

The East African states have made great strides in putting in place the necessary structures, processes, mechanisms and institutions to facilitate the development and implementation of FIQA programmes and activities as outlined below:

Policy on Fish Inspection and Quality Assurance (FIQA)

The riparian states have National Fisheries Sector policy statements for implementation of Fish Inspection and Quality Assurance. The policies provide for monitoring of health conditions throughout the fish supply chain.

Legal framework for FIQA operations

The riparian states have put in place appropriate regulations to govern FIQA. The legal structures provide the basis for the implementation of fish inspection activities.

Institutional framework

Fisheries Division/Departments of the riparian states have been designated as the Competent Authorities (CAs) responsible for control and monitoring of fish production and marketing conditions. Beach Management units (BMUs) have been set up at most of the landing beaches to among other roles compliment the efforts of the Competent Authorities.

Fishing crafts

Efforts are being made to improve the design and construction of fishing crafts to guarantee the quality and safety of fish on board the vessel. Studies have been carried out to determine the appropriate design and construction of boats that will allow chilling of fish on board the fishing vessels.

Fish landing beaches

The riparian states are in the process of upgrading fish landing beaches. The beaches have been fenced and basic hygiene facilities put in place in order to achieve compliance with the requirements for landing beaches. Further improvements to bring them to international standards are planned. However, most of the beaches especially those receiving fish for local consumption still lack basic hygiene and sanitary facilities.

Fish transport practices

Insulated/refrigerated trucks mostly owned by fish processing establishments are being used for transportation of fish intended for the export market. For the local markets fish is still being transported in open vehicles, bicycles and public service vehicles thus exposing the fish to contamination

Role of Stakeholders in Assuring FIQA

Fish is moved along the supply chain, which comprises many players. All of them have a duty to ensure that the fish reaching the consumer is wholesome and safe for consumption. Fishers, fish transporters, and fish traders can assure fish quality through good hygiene and good handling practices. Fish processors can guarantee the quality and safety of fish through implementation of good manufacturing practice (GMP). The Competent Authorities would achieve this goal by way of inspection; factory audits infrastructure developments and capacity building. Testing laboratories, which analyze fish-related samples, can assure the safety of fish by carrying out accurate end product testing to determine compliance with specific standards.

Preservation Methods used to Maintain Fish Quality

The methods currently in use for preserving fish are chilling, freezing, smoking, sundrying, frying and dry salting. The method chosen depends on the facilities available to the processor and the target market for the final product. Nile perch species, which is the target species for industrial processing and export, is preserved by chilling and freezing. Most Nile tilapia is eaten fresh; however limited quantities are either smoked or deep-fried. Most Dagaa is sun dried on bare ground and to a limited extent on rocks (Mungai *et al.*, 2003). Dagaa is currently the most affordable fish for both the urban and rural poor and its value can be more than doubled when processed for food. Drying and storage practices need to be improved in order to process Dagaa into a good quality product for national and regional market.

Determination of Quality and Safety of Fish

Fish quality and safety is determined through sensory evaluation of freshness, chemical testing for heavy metals and pesticide residues and microbiological testing for Salmonella, V. cholera and other pathogenic/ spoilage bacteria (FAO, 1994). Sensory assessment is undertaken at the landing beaches, fish processing establishments and markets. Chemical and microbiological tests are carried out in accredited laboratories.

OPPORTUNTIES FOR IMPROVING FIQA

The opportunities, which can be exploited to improve FIQA, are the existing institutional framework for ensuring compliance with market requirements, the large regional fish market that provides an alternative to the EU markets and the ever-growing demand for white meat. Availability of raw material for production of value added products and the potential for upgrading of traditional fish preservation; packaging and storage practices also provide an impetus for further improvement of FIQA.

Furthermore the existence of the LVFO as a regional coordinating body and the international interest in Lake Victoria coupled with the prevailing political goodwill for lake activities represent additional opportunities for development of FIQA.

WAY FORWARD

A lot has already been done to put in place an inspection and quality assurance system however additional measures described below must be taken in order to sustain or even surpass the current level of success in implementation of FIQA activities.

a) Completion of regional harmonization of FIQA in order to provide a uniform approach to inspection, quality/ safety assurance and certification processes. The harmonized positions should then be implemented as a way of strengthening FIQA practices.

Challenges of HIV/AIDS and Other Communicable Diseases Among Fishing Communities

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SUMMARY

Fishing communities living on the islands and along the shores of Lake Victoria constitute about 3 percent of the combined population of Kenya, Tanzania and Uganda. The communities interact with the lake ecosystem on a daily basis and their activities influence the state of the fisheries resources. Likewise, the state of the lake is directly linked to their livelihoods and has a major influence on water borne and related communicable diseases. Despite being the hub of the fisheries sector, many fishing communities are at the margins of national development, in general, and fisheries development in particular. Available empirical data suggests that these communities are disproportionately affected by HIV/AIDS, bilharzia, malaria, cholera and other waterborne diseases. A combination of factors including: poor sanitation, poor nutrition, limited access to medical care, daily exposure to contaminated water, daily cash income and relative mobility, make fishing communities vulnerable to these diseases. The implications of doing nothing to address the situation on fisheries development and national poverty reduction strategies are many, and undesirable. The cumulative impact of increased health care costs, loss of skilled labour, loss of women's productive time, the loss in productivity of the fisheries sector, carry substantial cost to the economy and pose a real challenge to national poverty alleviation strategies. Member states should thus respond to the situation as a matter of priority through specific impact mitigation targeting as well as improvement of the living conditions of the communities.

BACKGROUND

There are an estimated 3 million people in the countries in the communities living on the islands and along the shores of Lake Victoria who derive their livelihoods directly or indirectly from the lake. This constitutes about 3% of the combined population of Kenya, Tanzania and Uganda, and 10% of the lake basin (Fig. 1) population. In Kenya, fishing communities are located in Nyanza and the western provinces. In Tanzania, they are in the Kagera, Mara and Mwanza regions, while in Uganda they include 10 districts in the central and eastern regions of the country. Fishing communities, comprising of boat and net owners, fish crew, processors, traders and service provider, are at the centre of the fisheries sector, the locus of production, subsistence and small scale processing as well as marketing.

The communities interact with the lake ecosystem on a daily basis in fishing as well as collecting water for domestic and commercial purposes. The activities of the communities influence the state of the fisheries resources. Likewise, the state of the lake is directly linked to their livelihoods and has a major influence on water borne and related communicable diseases. Several questions arise from the interactions: Are fish more important than the people? Why are fishing communities more susceptible to HIV, bilharzia, malaria and intestinal worms, than the rest of the population? Why can't fishing communities cope with the impact of these diseases? What strategies can be put in place to address the situation?

Using empirical evidence from Kenya, Tanzania and Uganda, the paper identifies some of the factors that predispose the fishing communities to risk of infection and those that make it difficult for them to cope with the impact of the diseases. It argues that despite the fishing communities being the hub of the fisheries sector, many are at the margins of national development, in general, and fisheries development in particular. As a result, HIV/AIDS, bilharzia, malaria, cholera and other waterborne diseases continue affecting the

farming and pastoral communities in Uganda established that fishing households experienced more AIDS-related deaths than households in other communities (NAADS, 2003 cited in Tanzarn and Bishop-Sambrook, 2003).

Fishing communities are amongst the population worst hit by malaria. Transmission in the lake region is intense and often coincides with the rainy season. Overall prevalence rates in the communities range from an average of 21% in under-fives to over 50% amongst the school-going children (Muro, 2004). Studies undertaken in the region also show that more than half of the pregnant women had anemia during the peak malaria season. Available statistics (1999) show that malaria constituted approximately 32% of the total outpatient cases in Nyanza and the western provinces in Kenya (LBDA 2004). Malaria is also ranked as a number one cause of mortality in the Tanzanian lake region (Mwanga *et al.*, 2004) and of morbidity in fishing communities in Uganda (Grellier *et al.*, 2004)

Empirical data show high levels of water contamination especially along the inhabited shores of the lake. Water samples from the beach landing sites contain high levels of faecal/bacterial contamination, sometimes causing sudden large outbreaks of cholera and dysentery (LVEMP 2001). Transmission of the intestinal form of bilharzias tends to be confined to narrow zones along the shores of large water bodies such as Lake Victoria where the intermediate host is found (Kabatereine *et al*., 2001, Handzel *et al.*, 2003). Handzel *et al*., (2003) estimate the prevalence rates of bilharzia in the lake basin at between 40 to over 9%0, much higher than the internationally acceptable prevalence levels of 18%. A study conducted amongst 235 adults drawn from 17 fish landing sites of the northern shores of Lake Victoria to establish symptoms of bilharzia showed that half of the respondents had persistent abdominal pain, 25% had schistome eggs in the stool and 50% had an increase in eosinophilis (Ogutu-Ohwayo *et al*., 2002).

Intestinal helminthes and diarrhea diseases are also very common among residents of fishing communities, the most widespread of which include amoeba, hookworms, roundworms, and tapeworms. Incidences of one or more intestinal worms' infection range from 30% to over 60% A sample of 1556 people drawn from 12 sites on the lakeshores showed that hookworms were the most prevalent ranging from 28.4% incidence in Tanzania to 42% in Kenya (Muro, 2004) (Table 1).

Despite the unacceptable situation, actions taken on HIV/AIDS, malaria and bilharzia have not specifically targeted fishing communities. For example, in Uganda, recent studies show that there has been limited specific attention and national focus on fishing communities throughout the history of HIV/AIDS regarding epidemiological data collection, policy development, prevention and mitigation strategies and HIV/AIDS activism (Grellier, *et al*., 2004, Tanzarn and Bishop-Sambrook, 2003).

Table 1. Prevalence of Helminthes in the Fishing Communities

Helminthes	Tanzania (%)	Kenya (%)
Entamoeba histolytica	21	-
Giardia lambria	4.8	-
Hookworms	28.4	42
Ascariasis	14.6-40	22.3
Trichuris trichiura	12.7-37. 5	17.9
Strongyloides stecoralis	4.2	-

Source: Muro (2004) and Handzel et al., (2003)

Fishermen earn cash on a daily basis and view the lake as "an endless natural resource with unlimited access by all". Further, that it is "the potential basis of promiscuous behaviour since many young people spend their earnings recklessly, certain that they will be able to continuously make a living from the lake" (Tanzarn and Bishop-Sambrook, 2003 p.25). Fishing is also a risky livelihood involving moving out to the deep-waters at night in small boats and without warm clothing. When they return to the shore, the fish crew are freezing cold. They warm themselves and celebrate the survival of drowning through drinking which in many cases results into engagement in unsafe sex.

We cast the nets in the night and collect the catch very early in the morning. Throughout the night, the wind is blowing and the water is very cold. We have no warm clothing and yet the kind of fishing gear and boats we use necessitate that we stand in the water for long periods. By the time you leave the lake you are frozen and the alternatives to warm you up in order of preference are a woman, alcohol or a fire. (Tanzarn and Bishop-Sambrook 2003, p24). Chart 1 illustrates of the drivers of susceptibility to HIV/AIDS in fishing communities.

Fishing communities are relatively isolated from the outside world due to inaccessible roads, inadequate means of transport as well as inadequate access to HIV/AIDS information and support services. The mass media, more specifically the radio, is ranked as one of the most frequent sources of information about HIV/AIDS in Uganda (45%) and Kenya (21.4%) (Grellier *et al.*, 2004, MoLFD/NACC 2004). Other sources of awareness include public campaigns and peer deaths. Health facilities, voluntary counselling and testing centres as well as Not for Profit Organizations (NFPOs) are ranked least, implying that the communities are inadequately supported by these services. For example, in Uganda 56% of the lakeshore communities are not aware of any HIV/AIDS support services that they can access (Grellier *et al*., 2004).

A study conducted in Kenya revealed that whereas all the people, living along the lake Victoria shores, who were interviewed, had heard of HIV/AIDS, 37.6% associated HIV infection with "contamination of blood, natural disease from God, small animal which can eat anything and curses for breaking social norms" (MoLFD/NACC 2004, p21).

Other communicable diseases

Apart from HIV/AIDS, fishing communities are affected by malaria, bilharzias and intestinal parasites. The lake basin experiences high rainfall resulting into stagnant water, which are potential breeding grounds for mosquitoes. The rains in the region are recurrent and the number of breeding sites is high making it difficult and expensive to control malaria. Further, like any other rural communities, acquiring insecticide treated materials including mosquito nets, is unaffordable. Besides, there are more pressing and competing demands for the limited resources that the communities have.

Fishing involves intense physical contact with the lake water. This predisposes fishermen to bilharzia infection, which is transmitted by a fresh water snail. The nearer the fishing communities are to the lake, the more prone they are to infection. The prevalence rates amongst communities living within a 10 km radius of the lakeshore line are between 50% to 100% Lwambo (2004).
Helminthic infections in fishing communities are linked to inadequate access to potable water (Toure, 2004). Drinking the contaminated lake water and the practice of sharing latrines between multiple households have been shown to increase the risk of bloody diarrhea (Brooks *et al.*, 2003). In Uganda, whereas nearly half of the fishing communities are within easy access to potable water, less than 20% have more than three accessible latrines (Grellier *et al.*, 2004).

Impact of HIV/AIDS and other Communicable Diseases

Communicable diseases have serious socio-economic consequences on fisheries in general and on the fishing communities in particular. Fishing is a labour-intensive activity and as the fishermen get infected, they become too weak to fish. This results into a reduction in fish catch and incomes, as well as declining nutritional levels. A NAADS (2003) study conducted in the Lake Victoria crescent agro-ecological zone

size have the potential to promote more sustainable fishing, an even higher proportion (50%) argue that this has resulted into a loss of livelihoods and reduced incomes (Grellier *et al*., 2004). The communities' coping mechanisms involve trade-offs between survival and sustainable use of fisheries resources. Empirical evidence from Uganda suggests that the communities continue using illegal gear thus sacrificing the future of the resources to resolving "priority" concerns of earning a living (Tanzarn and Bishop-Sambrook, 2003).

The relatively high levels of poverty, the lack of savings opportunities in the communities coupled to the poor savings culture (Grellier *et al*., 2004, Tanzarn and Bishop-Sambrook 2003, means that once they are infected, the majority are unable to pay for health care. Free antiretroviral drugs are not yet universally available. In Kenya, while fishing communities are aware that condoms can protect them from getting infected with HIV, many cannot afford the 10 Kenya shillings it costs to purchase one.

Whereas the communities complain of high and multiple taxation, the respective governments do not plough back the revenue generated from the industry. Most fishing communities are characterised by poor road infrastructure, inadequate health and education facilities and services, as well as poor water and sanitation (Grellier *et al.*, 2004, MoLFD/NACC 2004, Tanzarn and Bishop-Sambrook, 2003). In Kenya, an average of 21.7% of households in the Lake Victoria basin live at least 8 kilometres away from a health facility (LBDA, 2004). The poor infrastructure and services make it difficult for residents in many parts of the basin to access health services.
Human waste disposal consists of temporary pit latrines. Water for domestic use is fetched directly from the often-contaminated lake. As indicated earlier, this results into severe worm infections with deleterious consequences such as iron deficiency anaemia, protein energy malnutrition, stunting, wasting, listlessness, and abdominal pains, all of which have negative implications on the coping abilities of the fishing communities against HIV/AIDS. Surveys conducted in the Lake Victoria basin show that more that 30% of the under-fives are stunted, and more than 15% are underweight (LBDA, 2004).

Policy Implications

The consequences of HIV/AIDS and other communicable diseases in these communities are many. Due to the mobile nature of the fisher folk, the impact of HIV/AIDS is not localised but is diffused to all other communities that the fishing communities interact with, both within and across national borders. Therefore, if the spread of HIV is not arrested in the fishing communities, it may undermine national efforts to control the spread of the epidemic elsewhere in the country.

HIV/AIDS drains labor and capital from the sector and causes reductions in fish catch thereby contributing to poverty and malnutrition. HIV/AIDS typically strikes the most productive members of the household first, immediately putting a strain on the family's ability to provide basic necessities. As the fisher folk become infected, many engage in inappropriate fishing practices thus undermining fisheries resources management and development efforts.

High prevalence rates of HIV/AIDS and other communicable diseases have budgetary implications; the cumulative impact of increased health care costs, loss of skilled labour, loss of women's productive time as many increasingly get involved in taking care of the sick, as well as the loss in productivity of the fisheries sector, carry a substantial cost to the economy and pose a real challenge to national poverty alleviation strategies.

Other factors are related to a high degree of mobility, lack of social cohesion, ease of access to cash, limited savings, gendered power relations, inadequate community support, frequent contact with contaminated water, limited diversification of livelihoods and (inappropriate) national and fisheries policy and regulations that are perceived to be contributing to their impoverishment. Therefore, interventions designed to mitigate the impact of HIV/AIDS and other communicable diseases needs to take into consideration, the multiplicity of factors that predispose fishing communities to infection and make it difficult for them to cope with the impact of disease. Likewise, fisheries management and development interventions should be designed in such a way that they do not increase the vulnerability of fishing communities.

Measures should be put in place to incorporate HIV/AIDS and other communicable diseases in regional and national fisheries policy and institutional frameworks. Kenya and Tanzania should prepare strategies to respond to the impact of HIV/AIDS in fishing communities. Resources should be allocated to implement the HIV/AIDS strategies that have been prepared by the respective member states.

BACKGROUND

Aquaculture is a form of food production whereby fish, animals, seaweeds can be produced in water under controlled conditions. Aquaculture is one of the fastest growing economic production sectors in the world. Generally, there has been an increase in aquaculture production as compared to capture fisheries globally (Fig.1). Global fish production from aquaculture increased from 5.3% in 1970 to 33.2% in 2000. Global aquaculture production grew from 42,994,417 metric tones in 1999 to 45,715,599 metric tones in 2002. Most of this production came from Asia, which produced 41,724,469 metric tones (91%) of the 2002 world aquaculture production.

The African continent aquaculture production in 2002 was 399,390 metric tones, less than 1% of the global production, of which 85% came from Egypt (increased from 226,276 metric tones in 1999 to 340,390 metric tones in 2002). Kenya, Uganda and Tanzania had a combined production of less than 10,000 mt (less than 0.02%) of the global production. The history of aquaculture development in Africa started in the 1920's. Aquaculture was started in East Africa from 1950's to early 1960's (Ngugi, 1999). The species initially farmed included the Nile tilapia (*Oreochromis niloticus* (Linnaeus, 1758)) and *Tilapia zilli* (Gervais, 1848) and freshwater prawns (*Macrobrachium rosenberg*). Subsequently some foreign species which included the Mirror carp (*Cyprinus carpio*), the Grass carp (*Ctenopharyngoidon idella*) the Black bass (*Macropterus salmoides*) and the Rainbow trout (*Oncorhynckus mykis*) were introduced. The Cray fish (*Procambarus clarkii*) was introduced in Kajjansi Aquaculture station and some minor lakes in western Uganda. Of all these species Mirror carp and Nile tilapia became the most popular aquaculture species. However, there has been some increase in aquaculture production in East Africa during the period 2000 to 2002 (Fig. 2).

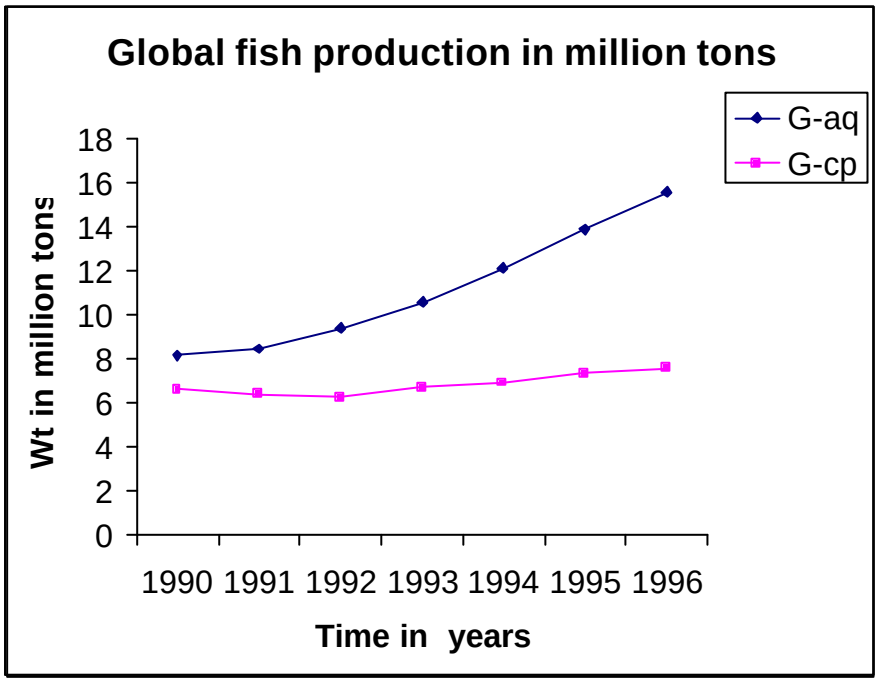


Fig. 1 Capture fisheries landings (data obtained from FAO, 2004 CIFA meeting).

The Governments of East Africa have put several efforts to promote aquaculture development in the region. Such efforts include recruitment and training of aquaculture extension and research staff at different levels, provision of free aquaculture extension services, establishment of fingerling production centers, national fish farming campaigns, establishment of Fisheries Research Institutes responsible for fisheries research including aquaculture research and development. Other initiatives include provision of fish farming guidelines, pamphlets and manuals. The governments have gone further to develop several policies and strategy papers on food security and poverty alleviation, and selection of species suitable for aquaculture.

There is need for aquaculture development in the region to meet the demand for fish, to alleviate pressure on natural stocks and to realize its contribution to the livelihoods of the community and to the national and regional economy as a whole. To achieve this need, there are key requirements, which need to be addressed. As a first initiative, The Council of Ministers of the Lake Victoria Fisheries Organisation (LVFO) directed that measures be adopted to promote and support aquaculture development in the Lake Victoria Basin. Following this directive, LVFO set up a Regional Working Group responsible for aquaculture research and development. This paper reviews the status and the potentials of aquaculture in the and what is required to boost its development in the Lake Victoria basin.

METHODOLOGY

The authors sourced information through reviews of the existing information and data, conferences, workshops, National Aquaculture Research and Stakeholders meetings.

The Current Status

The fast growing human population (global and regional) has impacted negatively on the natural fish stocks in most of the global waters. The world population has increased from 1.6 billion in 1750 to 6.1 billion in 2000 with annual increase of 85 million. The East African regional population is over 90 million people with the Lake Victoria basin having 30 million. The Environmental Net Work Staff (ENWS) (1998), reports that 11 out of 15 major waters are in decline while 60 % of the major commercial species are over-exploited. In East Africa the landings from capture fisheries are in a decline (FAO, 2004) (Fig.4).
There is an increasing demand for fish in the region mainly due to:

i) Decline of natural fish stocks (global and regional);

ii) Changing eating habits of the riparian communities;

iii) Increased local and international markets through fish processing;

iv) Increased demand for fish by other immediate markets in the region (e.g. Sudan, Rwanda, DRC, Malawi);

v) Use of fish meal in animal industry; and

vi) Active promotion of fish consumption for health attributes.

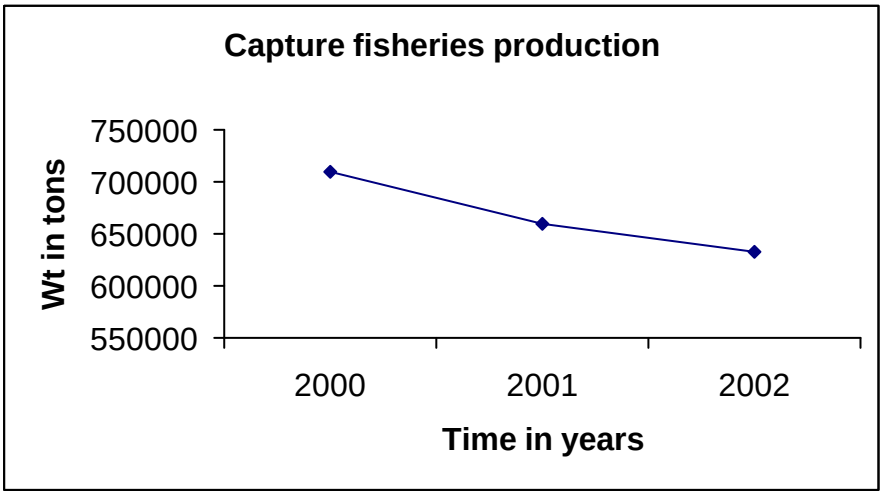


Fig. 4. Inland global fish production from aquaculture and capture fisheries. (This indicates that aquaculture grows faster and is producing more).

c) There are trade liberalization policies and protocols meant to remove trade barriers which will allow for import of inputs and export of fish regionally and internationally;
d) Population explosion in the basin; the East Africa as a whole and the region offer a growing internal and regional markets to support aquaculture production;
e) Decreased supply of fish from capture fisheries offers opportunity for the growth of the aquaculture sector.

Principal Constraints

a) Insufficient supply of quality fingerlings for farmers, in quantity and constantly available to support commercial aquaculture production enterprises;
b) Lack of commercial 'complete fish feed';
c) Weak extension services and very limited transfer of research and technologies to intending and practicing farmers;
d) Limited number of fish species to tap the diversified existing markets;
e) Lack of timely, well researched and applicable information for aquaculture planning and management;
f) Weak private sector and over dependence on slow and rigid public institutions to drive the aquaculture growth;
g) Insufficient clear-cut aquaculture legislation and framework on which strategic aquaculture development plans can be periodically formulated;
h) Limited incentives and motivation to fish farmers.

Other constraints

a) Over 95% of the existing aquaculture production in the region and Lake basin specifically is for subsistence. There is need to bring in new players that will serve as nucleus farmers to the progressive already existing subsistence farmers so as to move them into profit oriented aquaculture production;
b) Many of these small-scale subsistence fish farmers are quite distant from each other for meaningful delivery of services and promotion of aquaculture development;
c) The production units are very small, poorly maintained and extensive production in nature, with owners largely poor and rural to support development of viable commercial enterprises;
d) There is lack of experience with high volume production technologies such as cages in the region, and there are very few experienced technical service providers in such systems to support the intended and emerging commercial aquaculture production in the Lake Basin;
e) Lack of appropriate aquaculture development strategies and plans to foster evolution of a vibrant commercial aquaculture industry in the basin;
f) Lack of financing and reluctance of funding institutions to support commercial aquaculture in the basin due to the lack of appropriate information and experience of such production in the region.

CONCLUSION AND RECOMMENDATIONS

There is need to establish a sub regional network for coordinating aquaculture development efforts as part of the continental wide thinking of regional network. Through FAO sponsored mission it has been recognized that many of the principal constraints of aquaculture development in Africa can be addressed through regional collaboration and networking as has been the case in Asian countries.

The mission found that there is readiness and overwhelming support for establishing a Regional Intergovernmental Aquaculture Network Organization for Africa similar to that of Asian countries to facilitate and hasten aquaculture development. The government agencies responsible for aquaculture, view the network as an effective vehicle for coordinating aquaculture technical information exchange, technology transfer, training and collaborative research in agreed priority aquaculture areas. In this light it was suggested that sub regional intergovernmental organizations should be established to coordinate and allow for collaboration in aquaculture development.

Combating Insecurity and Enhancing Safety of Navigation

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SUMMARY

The role of security in the socio-economic transformation of society cannot be taken for granted. Any programme, however good it may be, can achieve little without security. Fishing, transport, tourism, trade and agriculture are the major economic activities on Lake Victoria. The large size and shared nature of the Lake, coupled with limited resources, has adversely affected security deployments and regular lake patrols. These limitations have been exploited by criminals to undermine the above activities through acts of smuggling, piracy, illegal entry across national borders, use of prohibited fishing gears and methods, and proliferation of Small Arms and Light Weapons (SALW) among others. Safety measures have further been thrown to the wind, often resulting in accidents and several losses of lives and properties. The above scenario poses serious challenges that need to be pragmatically addressed, taking advantage of existing opportunities. There are institutions and structures of Partner States such as Regular Police, Marine Police, Fisheries Department, Immigration Department and other Central and Local Government structures that operate on the Lake. There is further an enabling institutional framework under the East African Community (EAC) umbrella, which include the Regional Peace and Security Committee, the Committee on Interstate Security and the Meeting of Police Chiefs within the EAC. The insecurity on Lake Victoria can be effectively managed through deployment of security personnel with the requisite equipments and logistics. It is imperative that a common strategy is adopted by the Partner States of the EAC, who share this important resource. Harmonization and coordination of security operations on Lake Victoria have been identified as the best course of action. This is intended to avoid displacement of criminality from one Partner State to another, especially during special operations. Unilateral actions that often result in more conflicts would also be avoided. Potential criminals would further see the futility of such acts and thus refrain from committing offences, as they will have nowhere to run or hide.

BACKGROUND

Lake Victoria stands out as an important economic resource shared by Partner States of the East African Community. However, the optimum utilization and enjoyment of this shared resource by the Partner States have been interrupted by a number of factors, such as insecurity and inadequate safety measures. This paper examines the problems of insecurity and safety concerns on Lake Victoria and in its basin. An overview of the policy initiatives on security at the EAC level has been made, taking into account the existing institutions and operational guidelines on law enforcement at national levels. The challenges and opportunities have been explored to chart a way forward. Finally, recommendations have been made for required actions to address and mitigate these problems.

Security Concerns on Lake Victoria

Security concerns on Lake Victoria assault from omissions that call for remedial action to ensure safety of life and property. There are specific acts or omissions under the existing fisheries legislations, Police Acts and Criminal Procedure Codes of the Partner States that are expressly prohibited. Any person who

Table 1. Cases of drowning reported in Uganda, 2001 –2004

Year	No. of cases reported	No. of survivors	No. of bodies recovered	No. of bodies not recovered
2001	30	27	41	12
2002	29	24	146	Not established
2003	15	32	35	3
2004	19	19	40	Not established

S*ource: Uganda Police Marine Unit Statistics*

Note: Most of the accidents occur on Lake Victoria and Lake Albert, and some cases go unreported.

Table 2. Incidents/ crimes reported to police on the Tanzania territory of Lake Victoria, January 2000 - November 2004*

Region	Incidents/ crimes reported and recorded					
	Robbery	Homicide	Theft of Outboard Engines	Theft of Fishing Nets/ Boats	Misc Incidents	Total
Kagera	8	27	_	8	74	117
Mara	56	10	17	132	152	377
Mwanza	268	12	297	111	269	956
G. Total	332	49	314	251	495	1450

Table 3. Breakdown of miscellaneous incidents: January 2000 to November 2004

Region	Miscellaneous incidents reported and recorded				
		Illegal fishing methods			
	Marine accidentsor	Dynamite and/ poison	Prohibited fishing nets	Others	Total
Kagera	50	_	_	24	74
Mara	56	56	40	_	152
Mwanza	129	16	_	124	269
Grand Total	235	72	40	148	495

Source:*Tanzania Police Annual Crime Statistics*

* See also Table 3 for detailed breakdown of these incidents

Regional Perspectives on Security

Under the Treaty for the Establshment of East African Community, it is acknowledged that peace and security is a prerequisite for socioi-economic develpment. It should be noted that the level f crime in an area directly relates to the level of soci-economic activities.

Economic activities such as fishing (both commercial and artisanal), tourism, trade and agriculture are thriving within the Lake Victoria basin. The temptation by the various actors to maximise profits and

CHALLENGES OF POLICING LAKE VCTORIA

Lake Victoria covers an area of 68,800km^2, with a total shoreline of 3,440 km. The wide geographical coverage calls for massive deployment of human and non–human resources to undertake patrols and surveillance. However, equipment such as speedboats, helicopters and other aids to navigation are either totally lacking or grossly inadequate. The current navigation maps in use were drawn in 1900 and last updated in 1955. To date, no corrections have been made to the maps despite several topographical and hydrological changes that have taken place within the Lake Victoria basin. There are islands, especially at border points that do not feature in these obsolete maps, sometimes creating controversies as to which country they belong. It is further difficult and risky for Police Marine personnel to undertake rescue operations with their limited level of training in Search and Rescue (SAR). There are numerous islands on Lake Victoria that cannot be effectively covered by security agencies due to limited manpower and logistics. Kalangala District in Uganda, for example, is made up of 84 islands. Criminals evading justice often find these islands (some uninhabited) a safe haven. The long and complex judicial administrative processes pertaining in the EAC are also prone to creating more problems than solving them. This is reflected in the increase in incidences of mob justice (or injustice?), where the aggrieved party feels they are being denied justice, as the saying "justice delayed is justice denied" goes

There is need to intensify and coordinate lake patrols and surveillance by the Partner States as a way of addressing the security and safety concerns on Lake Victoria. Sharing of intelligence, interaction by the relevant security agencies within the EAC is of paramount importance in the above respect. The establishment and institutionalization of interagency cooperation among the security agencies and the grass root committees can go a along way in monitoring, control and surveillance of security related issues. Partner States need to avoid unilateral actions on matters of shared concern(s). Decision-makers at national levels need to appreciate the unique nature of marine operations, especially involvement of expensive equipments and high operational costs. A patrol boat on average costs US$ 210,000.00 whereas a patrol pick-up costs about US$ 30,000.00. The implementation of the EAC Search and Rescue Agreement needs to be expedited to ensure safety of navigation on Lake Victoria.

Existing Opportunities for Improving Security and Enhancing Safety on Lake Victoria

The Regional Peace and Security Committee of the EAC provides an excellent institutional framework for combating insecurity on Lake Victoria. Once operationalized, the Tripartite Agreement on Inland Waterways Transport would greatly enhance safety of navigation on Lake Victoria. There are various security and law enforcement agencies operating on Lake Victorian that only need to be strengthened. The Dar es Salaam Maritime Institute would further provide the necessary training in maritime operations. This Institute, when compared with overseas training, is relatively cheap. The meeting of the Police Chiefs and Committee on Interstate Security are additional platforms for articulating security issues within the EAC. Memberships to the Interstate Security Committee include the following:

i) Commissioners of Police/Inspector General of Police;
ii) Police Directors of Operations;
iii) Anti-terrorism Departments;
iv) Anti-narcotics and Proliferation of Illicit Small Arms Department;
v) Trade and Customs Department;
vi) Disaster Preparedness and Management;
vii) Immigrations Departments; and
viii) Lake Victoria Fisheries Organization (LVFO).

Comprehensive guidelines on measures to enhance security at ports and aboard vessels are provided by the *International Ship and Port Facility Security Code (ISPS Code*). These ISPS Code guidelines have been incorporated into the Tripartite Agreement on Inland Waterways Transport of the EAC.

Strategies for Management of Transboundary Conflicts on Fishing and Fish Trade

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SUMMARY

Before the emergence of fish processing for export, fishermen from Partner States generally moved freely and landed fish even across common borders. Increased commercialization especially for Nile perch exports led to intensification of law enforcement by individual Partner States to protect raw material for their industries. This sparked off conflicts in cross border fishing and fish trade on Lake Victoria which became most pronounced in 2001. The conflicts caused significant socio-economic disruptions to the fisher communities, particularly those along the common borders. The causes of the conflicts included fishers being denied access to fishing grounds and markets across national borders. In collaboration with IUCN, the Lake Victoria Fisheries Organization initiated a process to resolve the conflicts. The process involved identifying the causes of the conflicts, setting up a strategy and action plan to resolve the conflicts, promoting dialogue between fisheries managers, district authorities and fishermen, and providing them with relevant information.

Field investigations revealed some of the underlying causes of the conflict. The industrialization of the Nile perch fishery and its high demand on the international markets increased the demand for raw material across national boarders. The high demand for fish fuelled an increase in fishing effort and use of illegal fishing gears and methods on the lake. Other problems such as use of armed guards by influential fishers to "zone off" rich fishing grounds, carrying weapons such as clubs, catapults and pangas by fishers, as well as theft of fishing gears and equipment, and piracy emerged on the lake. These led to strengthening of law enforcement by individual Partner States to curb the illegalities and resulted into arrest of a cross-section of fishers of different nationalities who were using wrong gears/methods, those fishing without appropriate licence, and those traversing national boundaries in search of raw material. Limited understanding of the legal requirements to fish across the borders in another Partner States rendered the fishers victims of law enforcement.

The Fisheries Management Committee, the Executive Committee and the Policy Steering Committee of the LVFO held a series of meetings and agreed on modalities for addressing conflicts in cross-border fishing and fish trade. The LVFO Council of Ministers adopted a regional strategy for cross border fishing and fish trade in June 2002, which is being implemented by the Partner States.

At the national level, local authorities in borders districts and District Fisheries Officers held regular security meetings to address the conflicts. Non-governmental Organizations (NGOs) and Community-based Organizations (CBOs) were involved in advocacy for improvement of the fisher communities' livelihood. A strategy for community involvement in tranboundary fishery management was drawn up for implementation by the Partner States at the borders. The strategy encompasses investigating causes of the conflicts; sensitization of resource users; carrying out needs assessment of the resource users; establishing of formal communication arrangement between the communities along a common border; initiating agreements to work together; provision of simplified information on fisheries policies, laws and regulations; sharing of experiences and ideas

Fisheries management is a particularly valid case for TBNRM, as many of the world's major fishing grounds are shared by more than one state. Fisheries management on shared water bodies has to deal with competition between riparian states and requires explicit management mechanisms to avoid destructive resource use. According to Gébroval and Munro (1999) it is now recognized that, if nations that are jointly engaged in the exploitation of a fishery resource refuse to cooperate, the outcome is similar to a domestic fishery operating under conditions of "pure" open access. On the other hand, if the joint exploiters of the transboundary resource are able to cooperate effectively, then, by definition, is possible for them to agree upon resource target levels and optimal harvest programmes through time.

A Transboundary Fisheries Management Strategy on Lake Victoria is being implemented through and/or with LVFO – a regional inter-governmental institution under the umbrella of the East African Community (EAC). LVFO was established by the three East African States through a convention signed in 1994. It has the mandate to manage the fisheries of Lake Victoria with the following objectives:

1. To foster co-operation among the three countries;
2. To harmonize national measures for the sustainable utilization of the living resources of the Lake Victoria;
3. To develop and adopt conservation and management measures to assure the lake's ecosystem health and sustainability of the living resources.

Furthermore, the Treaty for the Establishment of EAC, signed in 1999, commits the Partner States "to take concerted measures to foster co-operation in the joint and efficient management and sustainable utilization of natural resources within the Community" (Art. 111, para. 1, sect. a), and to provide "*relevant information to each other on natural and human activities that may or are likely to have significant trans-boundary environmental impacts*" (Art. 111, para.1, sect. d). With respect to fisheries management, the Treaty specifies that the Partner States agree to co-operate through "*the adoption of common policies and regulations for the conservation, management and development of fisheries resources*", and "*the establishment of common fisheries management and investment guidelines for inland and marine waters*" (Art. 114, para. 2, sect. b (ii - iii)).

According to Blatter *et al.*, (2001) the natural sciences have provided valuable models of ecosystems and resource-based perspectives on NRM. The social sciences now have to come in to help with the development of workable institutional mechanisms for transboundary resource management through approaches like network analysis, environmental mediation, discourse analysis, decision making analysis and conflict resolution. TBNRM is still a relatively new field of research and management with no specific model to guide the process towards an integrated approach. It is therefore important to analyze local case studies and draw lessons about enabling conditions, risks, and possible institutional mechanisms.

Strategies for Management of Transboundary Conflicts on Fishing and Fish Trade on Lake Victoria

To address the challenges in order to control the conflict, the current opportunities provide for development and implementation of strategies through institutions at the regional, national and community levels such as: the EAC Summit, Council of Ministers, Interstate Security Committee, Legislative Assembly, Lake Victoria Basin Commission and/or Lake Victoria Development Programme (LVDP), Lake Victoria Fisheries Organization (LVFO), the National Governments, Districts and Local Authorities and Beach Management Units (BMUs).

The LVFO Council of Ministers adopted a regional strategy for cross border fishing and fish trade in June 2002, which is being implemented by the Partner States and included the following:

e) Training is an essential ingredient of human capacity building, based on the needs assessed. The strategy being used is to develop the training materials/manuals, use these materials to train trainers (ToTs) from within the BMUs, government and non-governmental extension staff who interact with the communities on a regular basis. Subsequently, these trainers will train and disseminate information to members of their communities. The technical staffs to develop the training materials/manuals are drawn from the fisheries departments, fisheries research institutes, NGOs, training institutes as well as some programmes operating on the lake.

f) Sharing of experiences and ideas from other relevant shared water bodies. An international workshop in October 2003 brought together BMU members, district and regional fisheries officers, and senior members of the Fisheries Research Institutes and Fisheries Departments from the 3 Partner States. Participants heard about managing shared water bodies from elsewhere in the world and the workshop contributed to development of a common vision for managing Lake Victoria.

g) Signing of the Memorandum of Understanding (MoUs) on areas of cooperation and collaboration following the cross border exchange visits proved important in cementing cross border relations and resolving conflicts. During subsequent cross border meetings, BMUs agreed on common areas for collaboration, signed memorandum of understanding (MoUs) for collaboration and made recommendations on areas requiring direct government intervention i.e. areas beyond their control. The areas for collaboration included: sharing of information on registration of fishers and their fishing inputs, 'lost and found' fishing inputs, fish prices at the beaches, fishers arrested, and fishers using illegal gears and methods; providing letters of introduction to migrant fishers; arbitrating conflicts arising from net entanglement; assisting fishers who have drifted by wind across the border; convening regular (quarterly) cross border meetings and reviewing the MoUs after every two years.

h) Developing implementation plans for agreed activities in a harmonized manner is crucial in addressing transboundary issues. The BMUs, which participated in the crossborder exchange visits and the signing of the MoUs together developed collaborative work plans, tailored to the specific needs of each border. Some of the activities to be implemented include: registration of fishers; registration and marking of fishing inputs; encouragement of fishers to report to local BMU official(s) in case of emergency landings due to bad weather or lack of fuel; identification of youth and other vigilant groups to assist the fisheries staff and other authorized officers in monitoring, control and surveillance (MCS); assistance to fisheries and other authorized officers in identifying law-breakers to be punished for their wrongdoing; conflict resolution arising from entangled gears; and production of legal identification cards in collaboration with the fisheries department for the BMU committees. The implementations of the work plans are being monitored and evaluated by the District Fisheries Officers (DFOs).

i) Establishing cross-border BMU Network to strengthen collaboration among the communities sharing the common borders. The BMU network is anticipated to formalize the partnership arrangement of fisher communities, which are organized, legalized and linked together by geographical proximity and/ or common interests. The objectives are to:

a) Bring together Cross-border BMUs in a formal management system, linking these community-based organizations to district, national and regional institutional frameworks;

b) Improve cross-border relations and fisheries management among the fishing and fish-trading communities on Lake Victoria by promoting the acquisition and sharing of information, the culture of informed and transparent debate, negotiations and consensus building;

c) Plan, monitor, evaluate and review the implementation of the cross-border BMUs MoUs and work plans, training programme and support BMU development and participation in fisheries management;

d) Represent the local fishing communities in national and regional fora related to Lake Victoria fisheries; and

e) Ensure effective Networking to meet the set objectives.

Micro-Finance Opportunities and Access to Credit Facilities

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SUMMARY

The fisheries of the Lake Victoria basin are dominated by capture fisheries from the lake itself. Efforts are however being made to develop aquaculture in the lake basin, and the potential for cage culture in the main lake is being explored. Both capture fisheries and aquaculture were originally subsistence and required low-cost inputs. The situation has changed. Capture fisheries have become commercialized requiring heavy investments in fishing gear, boats, outboard engines, refrigerated vehicles, landing facilities, ice, and factories. Similarly, it has been recognised that for aquaculture to be profitable, it has to be commercialized. This requires investments in pond construction, procurement of cage materials, seed production and purchase feed production and purchase of drugs.

The businesses in the fishing industry range from subsistence to Small-to-Medium Enterprises (SMEs). The present over-capacity in the fisheries is partly a result of the fishers' lack of investment culture and access to appropriate credit facilities. For the industry to optimize its operations, it is essential to have a well-developed financing mechanism that addresses the needs of the various categories of operators. This paper highlights credit opportunities available to the fishers and other fishery-related SMEs, and provides a basis for policy makers to appreciate the measures required to improve credit access.

The main sources of credit in the fishery industry are banks, micro-finance institutions and in the case of Lake Victoria fisheries other stakeholders such as fish factory owners. The conditions for providing credit varies between these institutions. Micro-finance institutions (MFIs) operating among fisher communities in the lake basin include AGAFTA, UFISACCO, FAULU, UWFT, PRIDE and OSIENALA. In comparison to commercial banks, these institutions are the more appropriate sources for lending to SMEs in fisheries because of the size of business and mode of operations. Besides, these micro-finance institutions tend to be sector-owned and less profit-motivated. The type of services offered include loans, accounts operations, and safe custody. The loans in this category target small borrowers without complex requirements and collateral. Purposes for the loans tend to cover costs for nets, boats, engine repairs and fuel for fishers; boats, containers, ice, final and working capital for fish traders, and, insulated trucks/vans, ice and working capital for fish agents. However, borrowing for consumption is also common among the target categories in the sector.

Accessing credit among fisher communities poses a number of challenges. Some MFIs include a compulsory saving of 25% to 30% of the loan before disbursement. Others require collateral security including household items, short loan repayment periods of up to only 12 months with weekly repayment schedules. These conditions are cumbersome, carrying hidden high interest rates and risky because of the nature of fishing and fish farming thus leading to concealment of genuine reasons and requirements by borrowers. In turn, MFIs face problems ranging from high operational costs, bad debts, migrations of fishers, low saving culture to diversion of loans and concealment of information on assets. In order to ensure adequate supplies, fish processing establishment provide credit to agents (insulated vans, ice, fuel, capital and guarantees to commercial banks), Fish Traders (insulated boats, fishing gear, ice fuel and working capital) and to fishers and boat builders. The main concerns of processors with respect to credit include lack of absorption capacity, absence of

METHODOLOGY

The following methods were used in preparation of this paper:

a) Review of reference material related to; socio- economic status of the fishers, literature on the financing mechanism in the region, the vision of the Lake Victoria basin.
b) Sample interviews with providers of credit and also the recipients were conducted. The interviews were carried on both physically and electronically. The following groups were targeted for the interviews: Micro Finance Institutions (MFI's), Fish processors, Saving and Credit Cooperatives (SACCO's), Fishermen, Fish Traders, Fish Agents. Also interviewed was the manager of the ADB Fisheries project in Uganda.
c) A one-week workshop held in Mukono and brought together various experts in the fisheries did enrich this paper.

Status of credit opportunities available to the fishers in East African Lake Victoria basin

Microfinance has evolved as an economic development approach intended to benefit low-income women and men. The term refers to the provision of financial and social services that otherwise poor communities may not be able to access. It provides insurance, payment of services and gives the poor self-confidence. This is a very important development tool that if used properly can change the livelihood of many poor communities. Most of the parts of Lake Victoria basin and Islands are not well supplied by commercial banks and therefore farmers and fisherfolks find it very difficult to access banking facilities. Microfinance is very suitable to the fishers who have limited time and ability to access commercial banks. The Microfinance practitioners are very flexible and can support income generation for enterprises operated by low-income households in remote villages. It sometimes mimics traditional Mary-go-round system making it a fun for the poor fishmonger to enjoy. The services are very affordable and sometimes negotiated at low level.

The micro finance institutions of recent have proved to be an appropriate lending institution to the SME's including the ones that deal in fisheries in the basin. They fill the financing gap always caused by the commercial banks inability to deal with SME's because of their modest sizes and mode of operation. Most micro finance institutions in the basin are private sector owned and are profit motivated. Few international NGOs are also coming up driven by donor funds. The sustainability is another question that needs to be addressed. The private ones do charge very high interest for their services while donor driven ones are only effective when funds are provided and immediately the donors stop supporting and the project is left for the communities then the programme collapses.

Different institutions now operating micro-finance to fisherfolks have different institutional goals or corporate missions. Some goes to build equity and building profit to the owners. These groups consider the fishers as easy target with lots of money with nowhere to spend. They take advantage of the target that has been neglected by the government plan to facilitate their poverty reduction endevours. NGOs based institutions have also their own problems. Although they are service organization rather than profit making, for the sustainability of their programme they need to make profit to service the micro-finance and cover their cost. This eventually becomes very expensive to the clients. The NGOs who have ways of subsidies find it a lot easy to put minimum cost target to services their members. Some good lessons can be learnt from OSIENALA (Friends of Lake Victoria) where the running of Beach Bank is supported from the funds from Radio Lake Victoria, a FM 92.2 radio broadcasting station that reaches over 3 million people of the Lake Victoria basin. While the Radio is used to educate and entertains the fishers, the funds collected also subside the running of the Beach Bank.

Application fees, Insurance and Commission charges: On average registration fees is a flat fee of about US $ 3, but some institutions charge 3% of the loan value. Again these charges are part of the loan on which interest is levied. Again in most MFIs surveyed, commission of 2% of the loan value is charged. As in application fees the interest charged in real terms includes this figure. On average insurance is 1% of the approved loan value, and it caters for among others accidental death.

Late Payment Management: This is particularly steep, often with the group members made to suffer, sometimes up to US $ 7 per day remitted to recover the loan. It is a zero tolerance condition. Apart from group loans, individuals also are also offered credit facilities. The beneficiaries tend to be those who have had a fair track record of dealing with credit providers. Other access conditions which includes; Interest rates, commission, compulsory savings, application fees tend to be similar with those of the group loans. However, because of lack group guarantee, they charge monitoring fees of up to US $ 13 equivalent.

Broad procedures for acquiring the loans

Though the procedures vary slightly based on the credit procedures, and borrowers, in broad terms it involves the following; The intending borrower joins or becomes a member of the microfinance group by fulfilling relevant requirements including application fees, opens an account and begins training. The training is always continuous, but borrowers must satisfy the credit provider of minimal understanding of how to manage their business and most important the credit to be provided.

When the intending borrower is ready to apply for the credit, he/she has to deposit a compulsory amount which is at least 30% of the amount of loan to be requested. It is after the deposit is made that an application is made. The application is always simple with the following information; the amount, security, business to operate and its feasibility/ profitability and repayment proposal.

The application is then appraised by the credit provider who concentrates on verifying facts provided by the applicant. As soon as the credit providers satisfy themselves with the application they immediately disburse the funds.

Problems which Credit Providers face

Microfinance institutions explain that in the process of providing and recovery of credit, they face many problems which may explain why they cost of their money tends to be high. These include; high operational costs, migratory nature of the fishers, low savings culture, diversion of loans, false information declaration, and misrepresentation of asset owners.

Microfinance institutions incur costs relating to training and sensitization of their members. This is not a core activity of credit providers this therefore becomes an additional cost which has to be factored in the calculation of the cost of the credit. Microfinance institutions believe if this activity was relived off their operations, the cost of lending would reduce. Landing sites are generally located in areas without good infrastructure and cut off from the main cities and towns. The implication of this is the high costs related to services. The cost of transport is much higher and this impact negatively on all products and services provided and include office operations which in turn increases the cost of the microfinance institutions which is passed on to the credit borrowers. Another problem is the low saving nature of the fishers. Fishers, it is said, because of the daily income they do not get the incentive to save. Instead this income is an incentive to spend heavily and the main result is that fishers do not have the money to pay back the credit, this leads to high monitoring costs, high bad debt portfolios which regrettably contributes to the high cost of lending. Related to the nature of the nature of the fishers, they are found to be highly migratory and this leads circle of bad debt management and high cost of money. Diversions of loans, misrepresentation of assets owners all lead to the increase of monitoring costs and bad debts leading to the same circle mentioned above.

MoneyLenders

These are both registered and un- registered. They strictly lend to individuals with interest rates ranging between 10% and 30% per month and have neither minimum nor maximum loan amounts. The money disbursed depends on individual requirements and by coincidence of availability.

The rates are negotiable depending on the people involved. Securities vary from simple household properties to registerable properties like working equipment including boat engines, boats etc.

Other lines of Credit Available

African Development Bank: Fisheries Development Project

Is loan provided to the Ugandan Government to a tune of about US $ 33 million. It is a five-year program which commenced in July 2003. It has five components which include: fisheries revolving credit fund of about U$ 2 million; infrastructure and Quality assurance; aquaculture, research and development; capacity building including training of fishers; project management. The spirit of this program seems to capture the whole process of development of the fishers in the Ugandan side of the lake basin. It seems to be an integrated process that not only provides credit but also attempts to remove hindrances to provide credit as has earlier been mentioned.

Problems so far encountered prior to implementation

It was planned that funds be channeled through the Micro Finance Support Centre, a Government owned organization that sources funds and disburses it through other Micro- Finance firms. However, it was realized that operating through one firm may result in creating a monopoly with all its negative consequences.

It has now been decided that more direct lending micro finance Institutions be invited to bid competitively in providing the services of administering the credit. The Department of Fisheries Resources will sign a Memorandum of Understanding with the successful firms for implementation.

Analysis of Fishers - The Credit Users

After examining the credit providers this paper examines the credit user and underscores their position in the credit facilitation process in the Lake Victoria basin. The fishers as alluded to earlier include; boat fishermen; fish traders, factory agents, boat builders, fish farmers to a limited extent. The credit is secured for various uses as illustrated in the table for use of credit by group.
The fishers have been characterised as migratory in nature; low savers; fund diverters, big spenders in unproductive activities, limited in education and with a life style very conducive for HIV infection.

The use of Credit by Group

Credit use

Fisherman (boat): The credit that is to be applied for:

- Boats, nets and other fishing gears, engine, repairs, fuel and ice Fish Trader: The credits are usually for:
- Working Capital and support to boat fisherman (all costs for fisherman above)

*Factory Agen*t: These loans are used as:

- Working capital to buy fish and Ice, Fuel, Van/ Transport and Support to fishermen and fish traders.

Boat builder: Timber, Plain iron sheet, Tube rubbers, Nails, Working tools/ Carpentry and Labor.

Aquaculture: Site survey, Site clearing, Building of Production system (e.g. Pond construction), Water access, Fertilization, Stocking (fish seeds), and Production System Management (e.g. Fish feeding).

RECOMMENDATIONS

There is need for an integrated approach of various interventions to realize desired results. Some of the interventions which will improve the delivery of credit include the following:

Legal framework for Microfinance

Since microfinance do collects money from the public, there is need for a legal frame to monitor the operations of MFI. The legal framework should be harmonized and putting place urgently. Without proper monitoring, the MFI's may easily collapse with depositors' money and such an occurrence will discourage savings and make fishers loose confidence in the credit providers.

Infrastructure development

As already alluded to earlier, there is need for deliberate efforts to develop the infrastructure in the lake basin with the view of reducing cost of doing business and developing the basin. There is need to integrate and link landing sites to the rest of the countries. There is need for access roads, proper landing sites, power, portable water, power, fuel stations, ice-making plants etc

Institutional frame work

There is need for the establishment of legal entities for the fishers like the BMU's with a view of helping pool resources together to be able to market their product more effectively and improve their barging power. Such a framework would also assist improve security and check unsustainable fishing practices.

Training of Fishers

Training is considered un-core to the microfinance institutions and it increases the cost of credit provision. Other more relevant institutions and Non Governmental Organizations should work hand in hand with microfinance institutions to help train fishers on simple business skills management, encourage savings, investment guidance etc.

Control of HIV

Efforts should be made to combat HIV Treatment be made available and affordable for the infected. Continuous sensitization of the fisher folk be made. East African Development Bank as the regions own bank prepare special products for the SME's, including the fishers. The model of the African Development Bank line of credit to Uganda may be a learning experience. Projects from other development partners which are initiated should consider including the credit component. The fish levy, could be a more reliable source of funds. Part of it, could be used to kick start a revolving fund.

Sustainability

Efforts should be made to ensure sustainability of the source of the fish, the lake and these efforts should be made known especially in the market. It could be one of the things to market (Uganda Fish Processors Association Website: www.lakevictoriafish.com). To build on the above there is need to carryout activities which lead to certification of lack Victoria as a sustainable source. This will appeal to the growing market of the environmentalists to enable the fish to fetch a premium.

Sustainable market

Provision of credit is pegged to the viability of the business. A lucrative market is an important condition for a viable market. There is need to stay a head of competition in the international export markets. There is need to develop new export fish products like value added products. There is also need for continuous joint promotion in the international export markets.

The Fisheries Co-management Regime in East Africa

Co-management is defined as a partnership arrangement in which Government, the community of fisheries, resource stakeholders and external change agents (CSIs) share the responsibililty/ authority for management (Fig. 1). Co-management covers various partnerships and degrees of power sharing and intergration of local and centralized government management systems. However, there is no universal form of co-management as it differs depending on country, and site specific conditions. For the Ugandan case, the decentralisation policy transferred fisheries extension and service delivery to local governments. The state delegated the mandate for fisheries law/order enforcement to local governments. Government has also, in its bid to share power with local authorities together with the communities, formulated and passed the law; The Fish Beach Management Rules 2003 under Statutory Instruments (SI) 2003 No 35. The recent legislation (BMU-SI) has institutionalized BMUs as a co-management function to developing, conserving and sustainiing the fisheries resources.

BMU as CSIs Contributing towards Poverty Reduction

Unitl recently, Fishing communities in East Africa were excluded from managment of the resources that they derive their lvelihoods from. According to the new BMU Statutory
Instruments in the case of Uganda, a Beach Management Unit means an organisation of fishers(boat crew or fishing labourere), Boat /Gear owners, Managers, caterers, artisanal fish processers, fish mongers, boat builders, local gearmakers,or repaires and fishing equpment sellers. BMUs too are CBOs(Community Based Organisations),

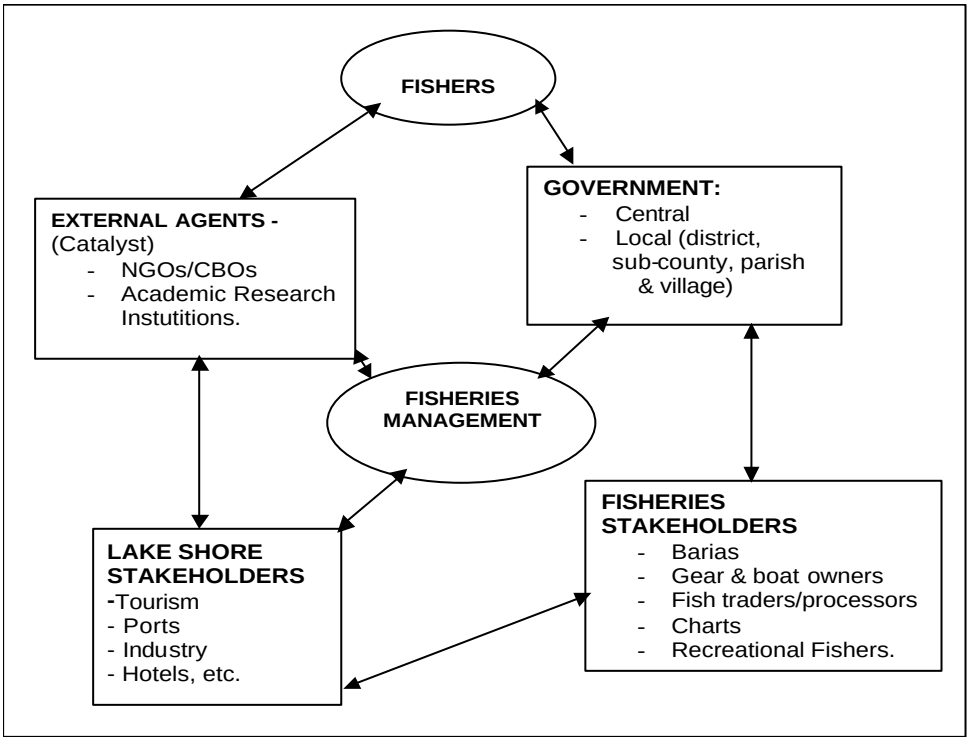


Fig. 1. Fisheries co-management in partnership with CSIs as catalysts

in the region through designated programs that include Resource environmental and social economic research and monitoring; Database Information Communtication and Outreach; Fisheries Policy Legislation for fisheries management; Human Resource and Infrastructure Capacity Building and Aquaculture Research and Development.

CSIs are therefore working with the Lake Victoria Fisheries Organization (LVFO) for the IFMP to consider channeling resources to various CSIs in order to embark on extensive outreach programmes involving national, district, sub-county and community levels. The outreach programmes will facilitate stakeholders to participate effectively in the co-management process throughout the Lake Victoria Basin. This strategy will also promote strong partnerships in sustainable management of Lake Victoria resources through co-management between fishing communties, CSIs and the Governments of Kenya, Uganda and Tanzania.

MATERIALS AND METHODS

In order to prepare this paper, several approaches were used, the study area covered the riparian communities in Kenya, Uganda and Tanzania, National Secretariats of ECOVIC in Kenya, Uganda and Tanzania based at Homa Bay, Jinja and Mwanza. The Resource Centres collected and compiled information through desk studies during the period January 2003 to January 2004. Discussions with member organizations in Kenya (80), Uganda (78) and Tanzania (100) were also held. The second step involved documentation and discussions with the key member organizations actively involved in the Fisheries Sector of Lake Victoria (Table 1).

Development patners and other key Stakeholders in Lake Victoria Basin (EAC, Forum Syd and MS Uganda) Swedish International Agency for Development SIDA, Lake Victoria Environment Management Program LVEMP, Lake Victoria Regional Local Authorities Cooperation LVRLAC, UN Habitat for Settlements, VI AgroForestry were also consulted.

The third step involved collecting information through visits, National Review Workshops and Capacity Building/Training workshops during the period 1998-2005. The fourth step involved a Regional Stakeholders Civil Society Confrence (RSCSC) of 90 Regionally based Civil Society Organizations from Uganda, Kenya and Tanzania during Lake Victoria Symposium 2001 and Kisumu 100 Years Celebrations (ECOVIC, 2001). Important resolutions were made that affect the Fisheries Sector of Lake Victoria and these provided further indepth discusions during the sixth step.

The fifth step involved gathering Information and preparing views from 30 regionally based Youths from youth organizations drawn from Kenya, Uganda, Tanzania and Sweden during a Regional Youth Workshop at Hotel Triangle Jinja, Uganda from 19-20 March 2004. The Youth Resolutions formed the Lake Victoria Jinja Strategy 2004 and have been discussed at most fora under Forum Syd/ SIDA Support.

The sixth step involved gathering Information and preparing Community Views from 50 Regionally based Civil Society Organizations drawn from Kenya, Uganda and Tanzania during a Regional Civil Society Workshop at Sports View Hotel Kireka in Kampala. The Community views were presented at the Regional Stakeholders Workshop at Imperial Resort Beach Hotel Entebbe, 24-25 February 2005.

4. Fisheries Departments in Kenya, Uganda and Tanzania facilitate the set up of well-established and legalized BMUs.
5. ECOVIC is willing to work towards improving the BMUs through mobilization, sensitization, training (Capacity Building) for action.

HIV/AIDS

CSIs looks at fisherfolk as a special unique group that has for long been affected by HIV/AIDS in that respect, there is need for the governments to;

1. Intensify awareness/sensitization of HIV/AIDS on the beaches through the BMUs.
2. Discourage some cultural practices that expose the communities to HIV/AIDS and other STDs.

Community Participation

The Governments of Kenya, Uganda and Tanzania should strengthen and enhance community participation, respecting and acknowledging that the communities and CSIs are the custodian of knowledge related to water resource management (LVFO, 2005). Adequate community consultation and participation should precede major laws and policy changes. Government and donors need to work with the community in the whole process so as to ensure success of all development programs in the fishing industry. Community participation should be tied to decentralization system. In addition, positive leisure activities that keep the communities away from drunkenness and drug-abuse should be encouraged.

Corruption

CSIs appreciate the giant steps taken by the governments especially in enacting laws and establishing institutions to curb corruption. However, it is noted that corruption still permeates several sectors of society, especially in the lake basin. It is essential that the established institutions should be harmonized, granted explicit autonomy and sufficient resources.

Conflict Management

CSIs appreciate that Lake Victoria is a shared resource, which should have harmonized laws and policies for management and conservation. Government is urged to expedite the movement across the lake in the context of one unifying law such as a Lake Victoria Act, through effective consultation of the communities around Lake Victoria. Governments are encouraged to provide space where CSIs can operate without any interference and also exist in a sustainable manner.

Alternative Incomes

The Governments of Kenya, Uganda and Tanzania provide the information on the researches carried out in the fisher folk communities. There should be information/data banks in the fisherfolk communities more to that, research and community linkages should be developed. Governments provide CSIs with access to information for repackaging.

Government should support thermal or solar power refrigerators at the BMUs on top of electrification. Fisherfolk communities come together, form co-operatives to access support. Support Micro-finance institution conditions should be suitable to the fisherfolk Government make deliberate efforts on fish farming (aquaculture) and irrigation

Education and Illiteracy

CSIs acknowledge that there is Universal Primary Education UPE in the three countries, however the system does not fully take care of the education needs of fisherfolk. Government is encouraged to ensure that there is a well-established schools on all-major landing site/BMUs and island.

An Option for Sustainable Funding of Fisheries Research Development and Management

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SUMMARY

The fisheries sector is currently funded from national budgets. The funds allocated to the sector by the national governments are, however, not adequate to meet both research and management requirements. As a result, most funding of fisheries development and management activities including that of Lake Victoria, are through donors' support, which is not sustainable. There is, however, considerable revenue generated by the fisheries sector some of which if ploughed back could provide the required resources. A sustainable funding mechanism could therefore, be developed from within the sector through a cost recovery system whereby a levy is imposed on the revenues generated at different stages of fisheries exploitation and marketing. The funds generated would then be ploughed back in development, research and management of the fisheries resources.

Through the Lake Victoria Environmental Management Project (LVEMP), the EAC Partner States commissioned a Fish Levy Trust Fund Study to asses the taxation and licensing systems that existed in the fishery of Lake Victoria, as a basis for imposing a fish levy fund to finance fisheries activities on the lake. The study revealed that about 554,986 tones worth US$ 558 million at the landings with an export value of US$ 243 million was landed from Lake Victoria in 2003. The central governments collected taxes on larger vessels, registration fees and export royalty. The local governments collected taxes in form of fishers' licenses, vessel registration fee, vessel licenses, trading licenses, service levy, parking fees and landing fees. The total revenue accruing to the central and local governments in the Partner States through this taxation was estimated at US$ 15.8 million in 2003. The revenue collected by the central and the local governments in Kenya and Uganda was transferred fully to the treasury of the central and local governments and is not directly used for fisheries development and management programs. The revenue collected in Tanzania is retained and used in fisheries research, development and management. The study determined from the available data that a total of US$ 21 million could be generated if a levy of 2% were imposed on fishers, fish traders and exporters as part of boat licensing fees, landing fees, export inspection certificate fees and other categories of fishing, fish processing and trading permits.

It is, therefore recommended that the Partner States should establish a Fish Levy Trust Fund by imposing a 2% levy. The Levy should be taken as a contribution by the direct beneficiaries from the fishery for development and management of the fisheries and should be ploughed back into the sector for research, development and management of the fisheries resources. The funds would be collected through existing institutional mechanisms at national level and deposited in a Trust Fund to be operated and managed by a Board of Trustees. A Technical Advisory Committee should provide backing to the Board and both the Committee and the Board should be facilitated and serviced by the Secretariat of the Fund. It is further recommended that the Partner States should consider, adopt and implement the recommendations of the Fish Levy Trust Study. In addition, the Partner States are urged to increase the budgetary allocation to the fisheries sector from their national budgets given the current contribution of fisheries to the economies of the Partner States

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generally poor, and infrastructures such as fish landing beaches, sanitation facilities, schools and dispensaries still need major investments to bring them up to required standards.

Since the LVEMP is comprehensive in that it is multi-disciplinary and multi-sectoral, and aimed at the rehabilitation and development of the lake ecosystem for the benefit of the riparian communities who live in the catchment, the national economies of which they are apart, and the global community, the riparian States decided to include the study and implementation of the FLTF within the scope of the Fisheries Management Component of the LVEMP. A sub-component was therefore designed to focus on Fish Levy Trust studies. Studies that were carried out recommended the establishment of FLTF to collect levies from the fishing industry and use them in support of fisheries and ecosystem management in the lake and its catchments in order to ensure the sustainability of research, development and management activities on the lake.

Benefits of an Independent Fish Levy Trust Fund

The Fund was considered beneficial because the public sector generally suffers from chronic, inadequate and unreliable operational funding. Besides, levies raised from the sector may be more dependable and advantageous in improving governance particularly if the contributors are involved in the management of the Fund. The Fund also enhances the financing of research, development and management activities on sustainable basis. Availability of the Fund can achieve added benefits by mobilizing other funds. In addition, the Fund increases justification for governments to also contribute to the sector in fulfilment of its stewardship role.

CONCERNS

In order to lay a foundation for generating revenue from fishing and use the funds to support fisheries development and environmental conservation within the LVB, the following concerns need to be addressed:

a) In spite of economic benefits accruing from the fisheries and other resources within the LVB, most fishers and households living within the LVB remain in a vicious cycle of poverty and, infrastructures such as fish landing beaches and sanitation facilities are mostly in a sorry state.
b) Up to 200 species of fish, mostly of haplochromine species and some tilapiines and cyprinids, many to have disappeared from the lake in the last 40 years alone due to indiscriminate introductions of exotic species.
c) The current fishery is based on only three species: Nile perch, Nile tilapia and the Mukene or Dagaa.
d) Deterioration of water quality and fish habitats, high incidence of diseases particularly HIV/AIDS, malaria and bilharzias among the fishing communities, low investments in fisheries technologies and poor access to financial sources as well as inadequate credit facilities particularly to community level fisher folks and craftsmen and women are being encountered.
e) Funding for much of the research, development and management activities in the fisheries sector and within the lake ecosystem is dependent on support from development partners and which is not sustainable.

CHALLENGES

In order to sustain environmental conservation and socio-economic development with the LVB, there is need to have permanent and assured source of funding locally. However, the following challenges should be overcome:

1. Lack of common financing mechanism for research, development and management within the LVB.
2. Regional policies that are not clear and without serious political commitment for sustainable funding of fisheries research, development and management.

study would be discussed and agreed among the three Governments and a system to collect and disburse levies would be established in the third year.

Between 2000 and 2003, consultants from three consulting firms that were contracted nationally, gathered views from stakeholders at all levels, i.e. from the beach level to national levels from fishers, local authorities and national scientists and managers in each country. They also reviewed current taxes and levies charged or proposed for the fish processing industries, fish products and fishers from Lake Victoria. The consultants then recommended to the Governments the establishment of a new system of revenue collection from the fisheries activities. In Kenya, Messrs. SMEC International of Australia (LVEMP, 2003) proposed the establishment of *National Fish Levy Trust* under a new enabling legislation: "*The Fish Levy Management Trust Act*". In Uganda, Messrs. Norconsult International A.S. of Norway (LVEMP, 2002) proposed the establishment of The National Fish Levy Trust under a new enabling Act: "*The Fisheries Act*" that establishes a National Fisheries Authority, while in Tanzania, Messrs. MacAlister Elliot and Partners of the United Kingdom (LVEMP, 2001) proposed the establishment of a special fund: "*The Lake Victoria Environment Fund*" with a new legislation under the Fisheries Act.

The findings and recommendations of the studies were subjected to national discussions before the Regional Policy and Steering Committee of the LVEMP reviewed, discussed and recommended that the three studies should be harmonized to give a regional perspective. National consultants from the Partner States harmonized the findings and recommendations of the studies and produced a single report together with business plans that the RPSC reviewed before forwarding its recommendations to the Governments of the Partner States for consideration before decisions can be made at the EAC level for implementation.

We have reviewed and analysed the findings and the recommendations for presentation at the Conference so that participants can exchange views on the assessment and make decisions to strengthen the recommended position that the Governments are considering for implementation.

RESULTS

The study established that the current estimated annual fish catch from Lake Victoria is 555,986 metric tonnes worth US$ 558 million at the Fish Landing sites with an added export value of US$ 318 million in 2003. Kenya's highest catch was 219,469 metric tonnes in 1990 but is now averaging 158,000 metric tonnes worth about US$ 158 million at the landing with an export value of US$ 86 million. Tanzania caught 231,000 metric tonnes in 2003 but its highest catch of 340,000 metric tonnes was in 1990. The current landed value in Tanzania is US$ 258 million with an export worth US$ 131 million. Uganda's catch is averaging at 166,110 metric tonnes with landed value of US$ 160 million and an export worth US$ 101 million.

The total revenue accruing to both central and local governments is about US$ 15.8 million from the three countries of which US$ 3.8 million is for Kenya, US$ 6,00 million is for Tanzania and US$ 6.00 million is for Uganda. The study observed that the revenue collection systems in Kenya and Uganda were not very efficient and effective while the Tanzanian one using the retention scheme was found to be very efficient but the collection at the Local Government level was found to be rather inefficient.

There are 7, 9 and 14 fish processing plants in Kenya, Tanzania and Uganda respectively. The total fishery yield and value as well as the number of fishermen, fishing boats and fish landings in the three Partner States on Lake Victoria are given in Table 1.

Apart from Tanzania that generate about US$ 6 million annually through the Revenue Retention Scheme for fisheries, the total revenue of US$ 9.8 million annually generated at both local and central governments' level in Kenya and Uganda is paid into local government collection accounts of the central consolidated

iv) This being a pilot project, once proven successful, the fund should be expanded in future to cover other water bodies and other sectors;

v) That once expanded the Fund should remain under one Management Trust but with different windows or chapters each with its own different account for different water bodies or sectors.

Management of the Fund

i) The Fund should be managed by a Board of Trustees;

ii) The Board of Trustees should be assisted by a Technical Committee; and

iii) A small secretariat should service both the Board of Trustees and the Committee.

Composition of the Membership of the Board of the Trust Fund

The Board of Trustees shall be composed of 7 members of impeccable and distinguished character with extensive experience in fisheries and related issues. Its members would be drawn from:

i) One Member from the Ministry of Finance;

ii) One Member from the Ministry responsible for Fisheries matters;

iii) One Member from a National Fisheries Association representing the NGOs;

iv) The Head of the Authority, Department or Directorate responsible for Fisheries in the country;

v) A representative of the BMUs representing Civil Society;

vi) A representative from a national public university with a strong fisheries research and training background; and

vii) A representative from the Ministry responsible for environment;

At least two members of the Board must be women.

Composition of the Technical Committee

It is recommended that the Board of Trustees be backed by a Technical Advisory Committee whose membership shall be 5 from the following institutions:

i) One Member from the Fisheries Research Institute

ii) One Member from the Fisheries Department;

iii) One Member from the Water Resources Management Department; and

iv) One representative from a riparian district.

v) A legal representative.

Composition of the Secretariat

Both the Board and the Technical Committee will be serviced and facilitated by a small but efficient Secretariat of not more than 5 persons composed of the following:

i) An Operations Manager;

ii) An Administrative Officer;

iii) A Financial Officer/Accountant;

iv) A Personal Secretary; and

v) A Typist/ Records Clerk.

Exclusions

The following should be excluded from accessing Trust Funds:

i) The credit schemes;
ii) Funding for activities that are peripheral to sustaining the fisheries of Lake Victoria;
iii) Funding activities of the Fisheries Departments or Local authorities.

Monitoring and Evaluation (M&E)

Monitoring and Evaluation shall be comprehensive through:

i) Internal and External Evaluations;
ii) Routine monitoring of implementation success by recipients of Trust funds;
iii) Routine monitoring by the Board on recipients of Trust funds;
iv) Annual evaluations of effectiveness of projects;
v) External evaluations and Audits of accounts and fund disbursement efficiency
vi) Progress reports on monthly, semi-annual and annual basis;
vii) All reports to be made available to the Board of the Fund, the RPSC and to the supervising Government Ministries.

CONCLUSION

This study reviewed, analysed and assessed the findings and recommendations of the consultants and that of the country positions as well as the Tanzanian Retention Scheme that is currently in use before recommending the option of Fish Levy Trust Fund as the best for sustainable funding of fisheries research, development and management and other activities within the Lake Victoria Basin.

Considering the advantages and the benefits to be derived, it is a necessity for the three Partner States to establish the Fish Levy Trust Fund in each country within the scope of their respective Fisheries Acts that are already undergoing transformation. The funds for the Trust Fund should be from a 2% levy to be collected directly from fish producers (fishers), fish traders and fish exporters/importers, and the funds generated should be invested into eligible and approved fisheries research, development and management activities with the Lake Victoria Basin. The levy of 2% shall be an agreed upon contribution from fishers, fish traders and fish exporters/importers and shall not be part of the prevailing taxes that the local and central governments are imposing.

There shall be a Board of Trustees to operate and manage the Trust Fund in each country. It is being recommended that the Board of Trustees should be backed by a Technical Advisory Committee and that both the Board and the Committee would be serviced and facilitated by a lean Secretariat of the Fish Levy Trust Fund. The mechanism of revenue collection at the local level should be strengthened through the use of the Beach Management Units the three countries are establishing.

The three Partner Governments are therefore urged to consider, adopt and implement the recommendations for the establishment of the Fish Levy Trust Fund. In addition, the Partner States are urged to increase the budgetary allocation to the fisheries sector from their national budgets given the current contribution of fisheries to the economies of the Partner States.

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