Environmental Impacts of Trade Liberalization and Policies for the Sustainable Management of Natural Resources

A Case Study on Uganda's Fisheries Sector

UNEP

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NOTE

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PREFACE

With the recent acceleration of global trade, countries throughout the world have benefited from more investment, industrial development, employment and income growth. Recognising that the benefits of trade can strongly contribute to the improvement of basic living standards, many of the world's developing countries and countries with economies in transition, have sought to actively participate in the global trading regime. For most of these countries, efficient and effective participation in the global economy has required substantial economic restructuring at home. Thus, in recent years, national governments have implemented structural adjustment programmes to stabilise and reorient their economies in order to face the challenges of development. This included in the first instance the restructuring of economies to increase foreign exchange earnings through enhanced trade and trade liberalisation as embodied in the set of agreements of the World Trade Organisation (WTO).

National experiences with structural adjustment programmes have been mixed. Nevertheless, trade liberalisation elements of restructuring programmes have facilitated the rapid growth of targeted export markets, and succeeded in attracting much needed foreign investment to fuel continued economic growth. Recently, however, many undesirable effects of rapid increases in trade have emerged. Affected countries find that inadequately managed economic activities, supporting, or supported by, growing trade, often result in serious environmental degradation. Air, water and soil pollution, and unrestrained natural resource exploitation, grow to levels that jeopardise the viability of the economic activities they support. Trade thereby becomes unsustainable.

The United Nations Environment Programme (UNEP) believes that the potential for negative impacts of trade on the environment can be minimised, if not avoided entirely, by integrating environmental considerations—that complement rather than inhibit trade—into development planning. Over the past two years, UNEP has worked closely with six countries—Bangladesh, Chile, India, Philippines, Romania and Uganda—on comprehensive projects to identify the impacts of trade liberalisation on national environmental resources and the use of economic instruments to sustainably manage these impacts.

These projects have encompassed new action-oriented research on unique trade-related environmental problems and their social and economic implications in diverse sectors and varied country settings. Importantly, projects have involved multi-stakeholder participation in numerous consultations to accurately identify the dynamics of environmental degradation, and to develop innovative and widely acceptable national response strategies. Each study concludes by recommending a set of practical measures—comprising ready-to-apply command and control measures and economic instruments designed to meet national conditions—that promise to effectively halt trade-related environmental degradation, and in turn, ensure that the country's trade remains robust yet sustainable over the long-term. But the projects do not end with published studies, the final component of each country project involves a pilot implementation of proposed measures undertaken by national authorities in collaboration with each project's national team and UNEP.

This report on the Ugandan fisheries sector, is one in a series of UNEP publications presenting country studies implemented under a first phase of "Capacity Building for Integrating Environmental Considerations into Development Planning and Decision-making" projects funded by the Ministry of Foreign Affairs of the Government of the Netherlands and the European Commission. Other projects in the first round examine the shrimp farming industry in Bangladesh, the

Chilean mining sector, the automotive industry in India, the Philippines' forestry sector, and the Romanian water sector.

As we approach the WTO's Third Ministerial Meeting in Seattle, which may mark the launch of the next round of trade negotiations, this report provides a valuable source of information and knowledge on Uganda's experience with the environmental impacts of trade liberalisation and the development of measures to address these impacts and promote sustainable trade and environmental policies.

The complex trade-environment dynamics and innovative strategies to manage emerging environmental problems of the Ugandan fisheries sector are presented and discussed in detail in this report. The insights that this, and other reports in the series provide, make the series an extremely valuable resource for policy-makers and sectoral practitioners aiming to effectively address the emerging environmental impacts of trade in their own countries.

ACKNOWLEDGEMENTS

The preparation of this country report on the Ugandan fisheries sector has been made possible by the cooperation and commitment of many individuals and organisations.

The Ugandan national team—the author of this report—is to be commended for taking the lead in project execution. Led by Godfrey Bahiigwa of the Economic Policy Research Centre in Kampala, the team—with members coming from an array of research institutions, non-governmental organisations and national agencies—worked tirelessly to organise national workshops, gather field data, analyse economic and environmental trends, develop policy recommendations, and report on their activities and research results. Additionally, a National Steering Committee was established to ensure the project remained relevant and on-track, and local citizens' groups helped identify emerging environmental problems, elucidate their causes, and elaborate policy responses.

The work of a varied set of national team members, supplemented with inputs from a wide group of national constituents that participated in consultations, was essential in ensuring that diverse cultural and social perspectives were integrated into the project. Indeed, all of these national actors are to be thanked for their genuine interest and commitment in the project, and for the valuable contributions they made to the project's success. In addition, national authorities are to be thanked for their steadfast support of the project's objectives.

The Economics and Trade Unit (ETU), Division of Technology, Industry and Economics (DTIE) of the United Nations Environment Programme (UNEP), was responsible for the overall coordination and management of all six country projects. Through a joint UNEP-UNCTAD (United Nations Conference on Trade and Development) collaboration, René Vossenaar and Veena Jha provided technical guidance and assistance to the national teams on various aspects of their research. International expert meetings further provided a forum for project implementation review by national teams and representatives of relevant international and United Nations organisations. Additionally, critical reviews of draft reports were provided by Theodore Panayotou of the Harvard Institute of International Development and Konrad von Moltke of the Institute of Environmental Studies of Vrije University.

Once the national team had completed their final report, Eugenia Nuñez, Desiree Leon and Rahila Mughal of UNEP worked closely with an external editor, Robert Hamwey, to process the report for publication.

Finally, it must be recognised that like so many international environmental research projects, funding from interested sponsor governments is the key to their existence. UNEP is indebted to the Ministry of Foreign Affairs of the Government of the Netherlands who generously provided the financing that made this project possible.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This study investigates how Structural Adjustment Programmes (SAPs) have fostered substantial growth of Uganda's fisheries industry and examines both their positive and negative impacts on economic, social and environmental systems. It further identifies an array of policy mechanisms, including economic instruments, that can be implemented to maintain sustainability of fisheries' resources and ensure their continued economic exploitation.

The fisheries sector has evolved to become a major industrial sector in Uganda's economy during the last decade. Fish processing on a large-scale started in the late 1950s, but was interrupted in the early 1970s when the government of Idi Amin came to power. However, with favourable market conditions made possible under the country's SAPs instituted in the late 1980s, fishing and fish processing activity has increased dramatically in this decade.

Uganda's SAPs were established to promote investment through economy-wide liberalisation and reforms in its trade regime. Owing to its rich fisheries resource base—up to 17 per cent of Uganda's geographical surface area is made up of lakes and rivers—fish processing for export in Uganda is one of the industries that has experienced rapid growth as a result of these new investment and trade policies. Uganda fish derives mainly from natural lakes and more than 1 million workers are directly engaged in the harvesting, transport, processing, distribution and marketing of fish. As a source of national employment and export revenue, the fisheries industry has become one of Uganda's most important industrial sectors representing its main foreign exchange earner in the non-traditional agricultural export sector.

The tremendous growth in Uganda fish exports has, however, led to a variety of concerns over the long-term sustainability of the industry:

- overfishing and resource depletion;
- the loss of biodiversity associated with exotic species introductions and unsustainable fishing methods;
- effluent pollution from fish processing and other industries;
- the degradation of coastal ecosystems and environmental health conditions associated with rapid development of the industry; and,
- resource mismanagement due to unharmonised national environmental standards among the riparian parties of Lake Victoria (Uganda, Kenya, and Tanzania).

Concerns of overfishing arose in 1996 following significant declines in fish catches, particularly in Lake Victoria, Uganda's main fisheries grounds. This trend is highly suggestive of fishing at levels above the lake's maximum sustainable yield (MSY). Unfortunately, MSYs for Uganda's fisheries grounds remain highly uncertain, making it difficult to establish harvest limits for this resource. Additionally, fish processing firms have a combined physical capacity of about twice their aggregate approved capacity. There is thus a distinct danger that uncontrolled demand for fish from the fish processing industry could drive harvest levels above current levels, and potentially well above MSYs in many of the country's lakes. An individual transferable quota (ITQ) system constrained by MSYs promises to be an effective economic instrument to address the problem of overfishing. Existing or revised licences that quantitatively limit processing activity could supplement ITQs.

As a result of recent declining fish catches, the use of unsustainable fishing methods has intensified over the past several years with resource depletion as a result. To increase harvests, potentially dangerous exotic species have been introduced into lakes and poison has been used to disable fish bringing them to the water surface for easy catching. Most recently, this latter practice has led the European Union (EU) to impose a ban on fish exports from Uganda to protect the health of its consumers. The Fish Act of 1964, which was designed to protect the fisheries against unsustainable fishing practices is outdated—with fines that no longer represent an economic deterrent—and it has therefore become ineffective.

To guard against the danger of overfishing and resource depletion, this study finds that a range of policy measures—including economic instruments—are needed. These include:

- establishing the level of fish stocks and setting an appropriate MSY for each of Uganda's major water bodies;
- implementing an MSY constrained ITQ system;
- limiting the number of fish processing firms and monitoring the activities of licensed ones;
- revising Fish Act legislation so that it is attuned to current economic conditions, recognises technological change in the fisheries sector and protects the environment;
- involving fishing communities in fisheries resource management by setting up community-based sensitisation and awareness campaigns, in conjunction with the Uganda Fisheries and Fish Conservation Association (UFFCA) and local governments;
- strengthening the capacity of the National Fisheries Department to effectively carry out its regulatory role; and,
- using subsidies to promote and support fish farming so that fish harvests from natural water bodies can be supplemented.

The pollution of water bodies is a growing problem for the Uganda fisheries industry. Most of the country's fish processing plants and industrial facilities—located near Lake Victoria—discharge either untreated or poorly treated effluent into the lake and connected bodies of water. The majority of these installations do not have proper waste treatment facilities needed to comply with standards issued by the National Environment Management Authority (NEMA). The discharged effluents lead not only to biologically toxic water environments for fish, but also to eutrophication and the overgrowth of both algae and water hyacinth that compete with fish for habitat and oxygenated water.

Applying the polluter pays principle, this study recommends strengthened and enforced effluent discharge standards and demonstrates that fish processing firms will remain economically viable under compliance with them. It is shown that a Malaysian model of water pollution control employing effluent discharge fees is an economic instrument that can be successfully applied to water polluting firms in Uganda.

Increased fishing activity and mushrooming communities around landing sites have resulted in a variety of quality problems. The importance of improving quality in the industry is highlighted by two recent bans on fish imports from Uganda by the EU due to quality deficiencies. The competent authority, the Uganda National Bureau of Standards, UNBS, and the Fisheries Department, are responsible for ensuring that quality standards are adhered to by all players in the fisheries sector. However, both organisations have limited capacity to effectively execute their responsibility. As outstanding quality deficiencies remain at all stages of the fish chain—from the lake to the fish processing factories—a market-oriented awareness campaign is needed to make all stakeholders

—fishers, intermediaries, processors, retailers and consumers—aware of their personal interests, roles and potential to improve industry standards.

In Uganda, poor infrastructure hinders quality assurance: landing sites do not have adequate facilities for fish handling; surface transport of fish to processing centres is made difficult for remote landing sites due to poor road conditions; refrigeration facilities to preserve fish after harvest are largely non-existent; and unbridled growth of fishing communities lacking proper sewerage and refuse disposal facilities has led to degraded coastal environments. At the landing sites, the government has plans to provide refrigeration and waste treatment facilities. To further protect quality in the consumer market, a monitoring system should be established to trace fish sources. This would entail local authorities registering all fish distributors and retailers.

Growing social problems also threaten the industry. The economic wellbeing of fisheries communities is dependent on stable export markets for processed fish, yet at the same time, high export levels result in lowered supplies of quality fish—at higher prices—for the domestic population who consume fish as a major source of protein. Currently, much of the local population can only afford to consume rejected fish and fish frames, a trend that has been growing, and increasingly compromises their nutritional status. A national food security policy could help balance the need for foreign exchange and nutritional requirements of the local population. This study examines the scope for policy to address domestic consumption requirements.

Lastly, efforts undertaken to promote sustainable fish resources in internationally accessed bodies of water such as Lake Victoria, can only be successful when regional environmental cooperation is established. Regional efforts to manage the Lake Victoria fisheries must therefore be strengthened and a harmonisation of relevant national environmental policies in the region is desirable.

The report concludes with a thorough discussion of a recommended set of policies and economic instruments that can be developed and implemented in an integrated fashion to ensure the sustainability and future economic potential of Uganda’s fisheries resources.

PROJECT MANAGEMENT AND IMPLEMENTATION

This capacity building project to integrate environmental considerations in development planning and decision-making for the Uganda fisheries industry was launched in February 1998 at a national workshop. The workshop, attended by 50 participants, comprised representatives from key ministries (the Ministry of Agriculture, the Animal Industry and Fisheries, the Ministry of Natural Resources,[1] and the Ministry of Trade and Industry);[2] research institutions (the Economic Policy Research Centre (EPRC) and the Fisheries Research Institute); international development partners (the World Bank, UNDP, UNEP, UNCTAD, CIDA, GTZ, The Royal Netherlands Embassy); local NGOs; the media (TV, radio and print); fish processors; and members of Uganda's parliament. Right from the start, EPRC ensured that the key stakeholders were involved in the project's design and implementation. In fact, the national workshop was opened by the Minister of Natural Resources and closed by the State Minister of the same ministry.

After the national workshop, a joint meeting was held between EPRC, UNEP and UNCTAD to reflect on the workshop's outcome and map the way forward. The project had two components: one on the impacts of trade and investment policies on the environment, and the other on economic instruments for sustainable environmental management. At the joint meeting, research topics were identified for each component to ensure that all relevant information would be obtained. All in all, ten research topics were identified. It was further agreed that a project steering committee would be formed to oversee implementation of the project.

The project steering committee (PSC) was formed and comprised of 14 key organisations, however, during the course of the project, only 9 were active. The PSC met every three months to review the progress of the project and provide guidance on its next phase. At EPRC, a project co-ordinator was appointed to manage and co-ordinate the project. At the first PSC meeting, it was agreed that each research topic would have a lead researcher and a co-researcher, each coming from different institutions (when possible) to allow for diversity in expertise and wider ownership of the project. A contract was signed between EPRC and the lead researchers who were responsible for ensuring timely completion of the research and its quality. Following completion of research, all draft reports were submitted to the project co-ordinator at EPRC who in turn gave them to reviewers from institutions with relevant expertise to provide comments.

After the second draft reports were submitted, all researchers were invited to make presentations to the PSC who discussed the research findings and made further comments on the various reports. After incorporating these comments into the reports, the project co-ordinator compiled all the reports into a single document. It was this document that formed the first project report draft that was presented by the project co-ordinator at a workshop in Geneva in October 1998. The project report was reviewed by international experts from Harvard Institute for International Development (Harvard University) and the Institute for Environmental Studies (Amsterdam). Comments from the experts were incorporated and the final project report was submitted to UNEP.

Forty participants attended a one-day national stakeholders' workshop in Uganda in March 1999. This workshop had two objectives: 1) to present the project research findings, and 2) to select regulatory and/or economic instruments for a pilot phase trial. Following the workshop, a joint meeting was held between EPRC and UNEP to map-out implementation of the pilot phase.

[1] Name was changed to Ministry of Lands, Water and Environment, effective July 1, 1998.
[2] Name was changed to Ministry of Tourism, Trade and Industry, effective July 1, 1998.

It was then agreed that another steering committee be established to oversee the pilot phase and that an appropriate institution be identified to undertake implementation. The role of EPRC would be limited to providing technical guidance, monitoring and evaluating the pilot phase.

INTRODUCTION

Uganda's economy has experienced substantial growth since the country embarked on an economic recovery programme in 1987 achieving an annual average growth rate of over 6.5 per cent. As part of the Structural Adjustment Programmes (SAPs), the government undertook economy wide liberalisation which included pursuing policies to reform the trade regime and active promotion of investment by the Uganda Investment Authority (UIA) which was established in 1991.

Liberalisation of the trade regime and the removal of price and currency exchange controls have created a conducive environment for private sector competitiveness and investment. The ratio of investment to GDP increased from below 7 per cent in 1987 to over 17 per cent in 1996. Fish processing in Uganda is one of the sectors that have experienced rapid growth as a result of the liberal trade and investment policies.

The fisheries sector in Uganda is an important resource not only for nutritional purposes but in economic terms. Fishing provides employment for thousands in the lake regions and has recently become the main foreign exchange earner in the non-traditional agricultural export sector. In 1996, fish and fish products were the country's second largest export earner after coffee.

Investment in the fish processing industry has stimulated the demand for fish and thereby led to growth in fishing intensity. Fish exports grew from a value of US$ 1.3 million in 1990 to US$ 45 million in 1996, but fell to US$ 29.9 million in 1997, due to a temporary export ban by the European Union over quality/health concerns. Some tested fish samples were found to be contaminated by Salmonella bacteria. The ban was lifted in July 1998, although another ban was imposed in April 1999 because of concern over possible contamination of fish by poison that was in rampant use by fishers to facilitate enhanced catches.

Virtually all fish produced in Uganda is from natural water bodies and thousands of people are engaged in the harvesting, processing, distribution and marketing of fish. The quantity of fish harvested from Ugandan waters increased from about 175,000 tonnes in 1985 to about 219,000 tonnes in 1997.

The fisheries resource faces a number of environmental threats and there is a danger that the increased demand could result in over-exploitation. Observation of fish catch statistics indicates that there has been a declining trend in fish catch in Lake Victoria, from 132,400 tonnes in 1989 to 106,600 tonnes in 1997. Lake Victoria is the major source of fish in Uganda. Levels of fish catch in other water bodies have been fluctuating albeit on an upward trend except for Lake Kyoga which has also experienced declining fish catches. Since Lake Victoria is the dominant source of fish for the processing firms, over-exploitation of this water body raises serious concern for the future of the fisheries resource.

The increased demand for fish due to growth in fish exports has led to increased fishing intensity, thus, overfishing may be responsible for the recent signs of reduced catches. This may symbolise the fact that fish stocks are steadily being depleted. Changes in the ecology of a water body can profoundly affect its level of fish stocks and the maximum sustainable yield. Fish stocks in Ugandan lakes have been affected by factors such as pollution by the water hyacinth, harvesting of immature fish and discharge of poorly treated or untreated effluent into the lakes. Fish stocks are also threatened by eutrophication arising from nutrients entering water bodies, degradation of

wetlands, global warming and it's related impact on oxygen levels in the lakes and the invasion of Uganda's lakes and rivers by the water hyacinth.

The effectiveness of environmental protection is further weakened by poor extension services, inadequate enforcement and monitoring of regulations as well as health problems such as water borne diseases in fishing communities. These are the concerns that the project was intended to address. This report contains findings of research addressing various aspects of the fishing industry. The latter include impacts of trade and investment policies on the fishing sector, regulation, quality control, profitability, and market based instruments for effective and sustainable fisheries use and management.

The report is presented in two sections. Section I covers the impact of trade and investment policies on the environment and contains nine chapters. Section II covers the economic and regulatory instruments for sustainable environmental management and has two chapters. This presentation format was chosen instead of two separate documents because the proposed economic and regulatory instruments in Chapter 10 address the critical issues identified in the nine chapters of Section I.

SECTION I

THE IMPACT OF TRADE AND INVESTMENT POLICIES ON ENVIRONMENTAL MANAGEMENT

CHAPTER 1

THE IMPACT OF ECONOMIC REFORMS ON THE PERFORMANCE OF FISH PROCESSING FIRMS AND THE FISHERIES RESOURCE

ACRONYMS

ACP	African, Caribbean and Pacific
COFE	COMESA—Common Market for Eastern and Southern Africa
EAC	East African Cooperation
EAFFRO	East African Freshwater Fisheries Research Organisation
EPRC	Economic Policy Research Centre
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FCSEP	Fish Commodity Systems Economics Uganda Project
FIRI	Fisheries Research Institute
GDP	Gross domestic Product
IMF	International Monetary Fund
LVEMP	Lake Victoria Environmental Management Project
MSY	Maximum Sustainable Yield
NEMA	National Environmental Management Authority
OAU	Organisation for African Unity
PERD	Public Enterprise Reform and Divestiture
UIA	Uganda Investment Authority
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
WTO	World Trade Organisation

ABSTRACT

Uganda has achieved considerable economic success as a result of the Structural Adjustment Programmes (SAPs) pursued over the last decade. The main elements of these programmes involved policies to promote investment, trade liberalisation and privatisation of public enterprises. These have resulted in rapid GDP growth, increased supply of goods on the domestic market and increases in exports.

Fish exports have similarly risen, reaching US $ 45 million in 1996, when fish was second only to coffee among the highest export earners for the country.

However, despite these short-term successes, there has been a lack of clarity on the full impact of SAP policies on the sustainability of fisheries resources. The purpose of this study has, therefore, been to assess the impact of investment promotion, trade liberalisation and privatisation on fisheries utilisation and sustainability, with a view to generating policy recommendations for effective management of fisheries resources.

Current investment promotion policies, introduced in 1991, are aimed at encouraging private local and foreign investment through a package of tariff and tax incentives, profit repatriation and protection of private property. The policies have stimulated investment in fish processing, resulting in higher quality standards in the fishing industry; higher prices and earnings to fishers and other actors in the industry; an outlet for Nile Perch fish for which there was initially limited local market; and a reduced use of wood for fuel.

The negative impacts of promoted investments include the rise of unplanned urbanisation at the lake-side; increased fish harvesting with the emerging threat of overfishing; the danger of pollution through inadequately treated wastes; and deprivation of a role for middlemen in the industry—a traditional a source of livelihood.

Trade liberalisation policies have been instituted to provide a conducive environment for private sector competitiveness. The positive effects of these policies have been increased foreign exchange earnings; higher incomes to fishers and fish traders; and an improved supply of modern fishing gear to the industry.

The negative effects include higher fish prices for the domestic consumers; increased demand for juvenile fish in the domestic market threatening the sustainability of the fisheries; and a high degree of instability in the fisheries market due to over-dependence on a fragile export market subject to significant fluctuations.

Privatisation has had a limited impact on the fisheries industry as the role of government in production has been limited to providing subsidised inputs to the fishers. Divestiture by government of this role in favour of the private sector has restored reliability in the supply of the inputs to the industry.

As a combined result of Uganda's SAP policies, investments in fish processing have been rising, with the number of processing firms increasing from 3 in 1990 to 10 in 1998. Similarly, the total maximum capacities established by the firms in this sector rose from 90 tonnes per day in 1990 to 295 tonnes per day in 1998.

In order to respect resource sustainability considerations, the government set approved capacity limits within which the processing firms had to operate. Over the years, the firms with

approved capacities were able to set up their plants and total approved capacities were raised from 55 tonnes per day in 1990 to 138 tonnes per day in 1998. However, utilised capacity—represented by fish purchases—was initially lower than the approved capacities until 1995 when it almost matched total approved capacity at about 50,000 tonnes per year but thereafter both began to decline as some firms closed down.

There is no up-to-date data on the magnitude of fish stocks in most of the lakes and other water bodies. The only comprehensive stock assessment survey was on Lake Victoria in 1969/71 during which the multi-species fishery was dominated by the haplochromines (*nkejje*). Changes have since taken place in Lake Victoria and other water bodies. On Lake Victoria, the fishery is currently dependent on three fish species, the Nile Perch (*Lates Niloticus*), Nile Tilapia (*Oreochromis Niloticus—ngege*) and *mukene* (*Rastrineobola Argentea*); the Nile Perch dominates the fishery. The relative abundance of fish stocks in Lake Victoria (and other water bodies) has apparently declined from about 800kg/hr trawling in 1969/71 to about 150kg/hr during 1994/97.

The major fish species (Nile Perch, Mukene etc.) produce millions of eggs in order to enable the renewal process of the fisheries resource. The rate of renewal is, however, not absolutely clear as this is influenced by the changing environmental conditions and the effects of human activities on the fisheries.

Currently, fish catches from the lakes have been declining despite increasing fishing effort. National fish production initially increased from 78,000 tonnes in 1983 to 276,000 tonnes in 1993 then declined to 213,300 tonnes in 1994 and has remained at about this level. The initial increase was due to increased catches of the Nile Perch following its establishment in Lake Victoria.

Generally, fish processing capacity has followed a similar trend to fish harvesting. Purchases for processing increased to about 50,000 tonnes in 1995 before declining to about 30,000 tonnes in 1997.

As the information on the magnitudes and dynamics of Uganda's fish stocks is still being investigated, recommendations on the appropriate rate of fish harvests—maximum sustainable yield (MSY)—cannot yet be made at this time. However, during the exploitation of the fisheries resource, the use of illegal and destructive fishing gear and methods, and open access policy practices on most of the lakes, should be addressed.

The following are also recommended under this study: the continued operation of a quota system which should be revised from time to time; promotion of investments to ensure improved quality and the assumption of greater responsibility for maintaining fisheries statistics by the riparian districts; infrastructure development; and planning for the growing fishing settlements. Other measures should include promoting the domestic market and diversifying fish export destinations; restocking of lakes; fish farming; and controlling the growth of water hyacinth by minimising pollution of the lakes.

IMPACT OF ECONOMIC REFORMS ON THE PERFORMANCE OF FISH PROCESSING FIRMS AND THE FISHERIES RESOURCE

1.1.0 INTRODUCTION

The Ugandan economy achieved considerable economic success since the late 1980s when the government initiated measures to restructure and revamp the economy. Initially, an Economic Recovery Programme was formulated and implemented in 1987. This was later supplemented with IMF and World Bank prescribed Structural Adjustment Programmes (SAPs).

A common feature of both the Economic Recovery Programme and the Structural Adjustment Programmes was the institution of the appropriate economic policies to promote investment, trade liberalisation and privatisation of public enterprises. In either cases, government increasingly liberalised the domestic market and floated prices and foreign exchange rates, in addition to divesting public enterprises and trimming the civil service (World Bank, 1997).

The above economic policy measures opened Uganda's economy to foreign competition and technology inflow with a resultant steady growth of the economy (MFPED1, 1998). GDP growth, for instance, was estimated at about 5.5 per cent p.a. for 1997/98 while growth of the manufacturing sector stood at 13 per cent over the same period. The relatively higher growth of the manufacturing sector increased the sector's share of GDP from 0.3 per cent in 1992 to 9 per cent in 1997. The economic policies also encouraged the growth of export markets while liberalisation of the import market boosted domestic demand for imported goods and eliminated the shortages of various goods that characterised the 1970s and first half of the 1980s.

The fisheries sector, like the rest of the economy, experienced substantial growth. The sector's contribution to GDP grew from UShs 51.8 billion in 1990 to UShs 65.5 billion in 1997 at constant 1991 prices elevating the fish export sector to become Uganda's second largest foreign exchange earner after coffee in 1996 (MFPED, 1998).[1]

On the domestic scene the rapid transformation of the fish-processing sub-sector from an initially artisanal sub-sector, with little technological intervention and foreign capital investment, to one dominated by both local and international capital penetration, generated employment and income.

Despite the positive trends observed in the overall performance of the economy, it is important to recognise that the above growth policies had a number of undesirable impacts on both natural and environmental resource bases. Some of the impacts on the natural and environmental resource bases affected the fisheries sector in the following ways:

- Pollution and deterioration of water quality led to direct fish poisoning, water hyacinth proliferation and algae blooms;
- Degradation of coastal wetlands diminished their wastewater filtering, fish breeding and habitat functions;
- Depletion of tree and other vegetation cover caused soil erosion and hastened pollution and siltation of lakes and rivers;

[1] Fish export fetched US $ 45 million in 1996 (6.4 per cent of total exports) (MFPED, 1998).

- Poor sanitation due to poor social service infrastructure led to poor health of lake-side communities.

The above threats have made the fisheries highly fragile, making the need to formulate appropriate management policies and regulations urgent. The aim of this study is to contribute significantly to this effort.

1.1.2 The Study

This study aimed at determining to what extent economic and investment policies in Uganda expanded the fish-processing sub-sector and how this expansion in turn, affected both the environment and fisheries resource base. The study also aimed to estimate the extent to which changes in the processing capacity of fish processing firms influenced the rate at which fishers exploit the fisheries resource, with a view to determining the appropriate overall sector processing capacity for a given a level of fish resource supply.

The study addressed the following specific terms of reference (TORs);

a) Review investment, liberalisation and privatisation policies for the fisheries sector.

b) Determine the number of operational firms and their capacities. Assess if there has been increase in capacity since 1991.

c) Determine the trend of processing capacity and fish purchases and establish the relationship between the two.

d) Determine the level of fish stocks, rate of regeneration, rate of harvesting and relate these to effective fish processing capacity.

e) Make recommendations on the appropriate rate of fish harvests in view of the level of fish stocks.

f) Suggest policies for management to ensure sustainability. The study was implemented mainly through desk research, reviewing a wide range of published materials, fisheries statistics, reports and records from various institutions. Discussions were also held with selected members of the different stakeholder groups and key players in the sector.

1.2.0 THE IMPLICATIONS OF MAJOR ECONOMIC POLICIES FOR THE FISHERIES SECTOR

1.2.1 Investment Promotion

The Government of Uganda embarked on an investment promotion program in 1987. The main strategy for investment promotion was to encourage private investment through tariff reduction and provision of tax incentives. The government also relaxed restrictions on profit repatriation (for foreign investors) and assured investors of the security of their assets against any forms of expropriation.

The above measures were contained in the following policy measures and instruments, among others:

i) The Investment Code which simplified the processes and regulations governing investment in various sectors of the economy;

ii) The Uganda Investment Authority (UIA) which was established in 1991 as a one-stop centre for investment;

iii) Deregulation;

iv) Provision by the government of fiscal incentives and the necessary legal, policy, and physical infrastructure for private investment; and,

v) Return of expropriated properties to their Asian owners under the Departed Asians Custodian Board (resulted in the re-building of confidence among foreign investors).

The above measures stimulated rapid growth of the manufacturing sector in general, and the fish-processing sub-sector in particular, with various positive and negative consequences.

a) Positive Impacts

- The numerous fish processing outlets created increased demand for high quality raw materials. This stimulated investment in infrastructure and landing facilities with the firms themselves contributing resources to these undertakings. More important, the districts and other local authorities which collect revenues from the fish production centres came to see the need to improve infrastructure and facilities at landing sites and have since shown a willingness to allocate budgetary resources towards the development of these facilities and centres.
- Increased demand for raw materials implied higher prices and increased revenue to the fishers. The price of Nile Perch on Lake Victoria, for instance, rose from UShs 300 per kg in 1990 to UShs 1,500 in 1997. (Fisheries Department, various years). This has provided an opportunity for fishers to earn higher incomes from their catch and to improve their standard of living including better health and nutrition.
- The processing firms provided an outlet for the Nile Perch at a time when there was a recommendation by resource scientists and fisheries managers that the species be fished heavily to maintain ecological balance in the fisheries of Lake Victoria.
- Factory demand for Nile Perch of mostly 3-8 kilograms has provided an immense disincentive to the harvest of immature fish further supporting the sustainability of the fisheries resources.
- The establishment of processing factories has diverted interest away from the traditional processing technique of smoking involving the use of wood fuel. This has reduced the pressure on forests which is another positive environmental aspect of the investment policies.

b) Negative Impacts

- Increased demand for fish increased the influx of workers into this fisheries sector. This has led to the unplanned development of urban centres on lake-shores with resultant health and sanitation problems (FCSEP, 1997).
- The increase in numbers of fishers has led to opening of new settlements, often involving the clearing of wetland ecosystems and other shoreline vegetation, exposing the lake to greater pollution through erosion (LVEMP, 1996).
- Increased demand has resulted in increased fish catches, exerting pressure on fish stocks with the threat of overfishing. Over the years, it has been necessary for the Fisheries Department to make contact with the UIA to control the licensing of new processing plants in the interest of sustainability of the fisheries resource base.
- New industries located close to the lake pose a serious threat of water pollution.
- The development of industrial fish processing deprived a large section of the artisanal middlemen of a source of livelihood.

1.2.2 Market Liberalisation Policies

The Government of Uganda increasingly liberalised both the import and export markets after 1987. Three separate policy measures were implemented under this program, namely: liberalisation of trade and marketing of agricultural produce and inputs, liberalisation of foreign exchange,

and removal of price controls. The effect of these three measures was to create a conducive environment for private sector competitiveness and investment.

The main features of market liberalisation included:

i) Easing of customs import and export procedures;

ii) Removing or minimising export taxes by replacing export licensing with export certification;

iii) Replacing import quota controls with tariff-based controls and seeking common market arrangements such as EAC, COMESA, OAU, ACP, WTO, etc;

iv) Dismantling state-trading monopolies;

v) Liberalising foreign exchange allocations and permitting open trade in foreign currency;

vi) Introducing a 100 per cent export retention scheme on non-traditional exports.

Like investment promotion, market liberalisation stimulated rapid growth of the commercial and manufacturing sub-sectors in general, and the fish-processing sub-sector in particular, with various positive and negative consequences.

a) Positive Impacts

- The main effect of the liberalisation policies for the fisheries sub-sector was the expansion of the market for Uganda's fish beyond the neighbouring countries to overseas markets in Europe and the Middle East. This market expansion has resulted in substantial foreign exchange earnings for the country.
- In a similar manner, the legalisation of cross-border trade has provided opportunities for fishers and traders from Lakes Victoria, Kyoga, Albert, George and Edward to earn higher prices from the export of their fish to Kenya, Rwanda and the Democratic Republic of Congo.
- Another immediate effect of liberalisation was an increase in the supply of required fishing gear (of type and size meeting regulations) to the market. Hitherto, fishnet supply was the monopoly of Uganda Fishnet Manufacturers who could only meet 30 per cent of the overall demand for nets. Previously, the shortage of fishing nets led to the use of illegal fishing practices.

b) Negative Impacts

- However, with trade liberalisation, there was a danger of undesirable exotic fish species finding their way into the waters of Uganda due to the difficulties of monitoring all such trade (NEMA, 1996). The sources of such alien introductions included investments in farming of exotic fish species or import of live fish for ornamental purposes.
- Liberalisation exposed the fisheries to higher export prices. While this was a welcome development for the fishers, it deprived many domestic consumers of this source of food as they could not afford the competitive prices set by the export demand. This is evidenced by the shift in consumption patterns of local consumers to relatively cheap fish frames, juveniles and Rastrineobola argentea (mukene). The increased demand for juvenile fish poses a significant threat to the sustainability of the fisheries resource.
- Over-dependence of the fisheries on the export market has exposed the sector to instability arising from external factors over which the country has little control. A recent example is the 1998 ban imposed by the European Union on Lake Victoria fish for reasons related to public health, showing how vulnerable the sector can become under market liberalisation.

1.2.3 Privatisation Policies

The Government of Uganda initiated a massive privatisation campaign in 1991. The campaign aimed to transfer the ownership of business enterprises from government (public) to private hands in recognition of the limited capability of government to effectively deliver quality management for profit making.

Privatisation confines the role of government to enforcing market rules, collecting taxes and providing an enabling environment for business. It thus frees previously tied-up public resources for higher priority uses such as rural development and poverty elimination.

To co-ordinate the privatisation program, government established the Public Enterprise Reform and Divestiture (PERD) Programme in 1992. The program sold off most government owned corporations and eliminated government trading monopolies. The removal of trading monopolies has resulted in the prompt payment of higher prices to producers in the agricultural sector.

With respect to the fisheries sector, there was never a strong state role in fish production or distribution, so the impact of the privatisation policy was not strongly felt as in the crop sector. However, government had hitherto played a big role in the supply of inputs for fish harvesting. Through a system of subsidies, fishing inputs were provided to fishers at subsidised rates. However under the system, the supply of inputs was unreliable and full of bottlenecks. The latest example of such a system is the Artisanal Fisheries Rehabilitation Project (AFRP) funded by the European Economic Community in the late 1980s. The scheme ran into administrative problems and the remaining inputs had to be transferred and administered by the Uganda Commercial Bank under its Rural Farmers Credit Scheme. The Divestiture by government of the responsibility for supply of fishing inputs in favour of the private sector enhanced reliability in the supply of fishing materials as private companies got involved in importation and distribution of these inputs.

1.3.0 FISH PROCESSING FIRMS AND THEIR CAPACITIES

There has been considerable development in industrial fish processing in Uganda since the introduction of the economic reform policies in the country. The number of firms established has been increasing. In 1990 there were only 3 firms established, but by 1997 the number was at 9, after some firms had either quit the industry or closed in the face of major renovations required to meet new sanitation and environmental standards. These remaining firms have been building up capacity for fish processing in recent years. The situation is as summarised in Table 1.1 below.

In the interest of sustainability, total “deregulation” has not been allowed to prevail and the Fisheries Department allocated quotas to firms in the industry. For this purpose, the Committee for Fisheries Exploitation (COFE)— an ad-hoc committee—was formed to set a limit for industrial fish processing and allocate quotas to the applicant firms. Consideration was given to the resource availability and the quantitative fishing requirements of other fisheries resource users, particularly domestic consumers and small-scale cross-border exporters to the region (Kenya, the Democratic Republic of Congo and Rwanda).

Approved capacities of individual firms, allocated by COFE in 1993, have recently been revised, and are based on applications by fish processing firms and the existing knowledge of fish stocks. However, over the years, the firms have been building up their capacities. Maximum capacity in the sector, therefore, is far greater than approved capacity, as can be seen in Chart 1.1 below. Generally, there have been increases in capacity in the industry since 1990.

TABLE 1

Number of Operational Fish Processing Firms, Maximum and Approved* Processing Capacity in the Fisheries Sector, 1990-1997

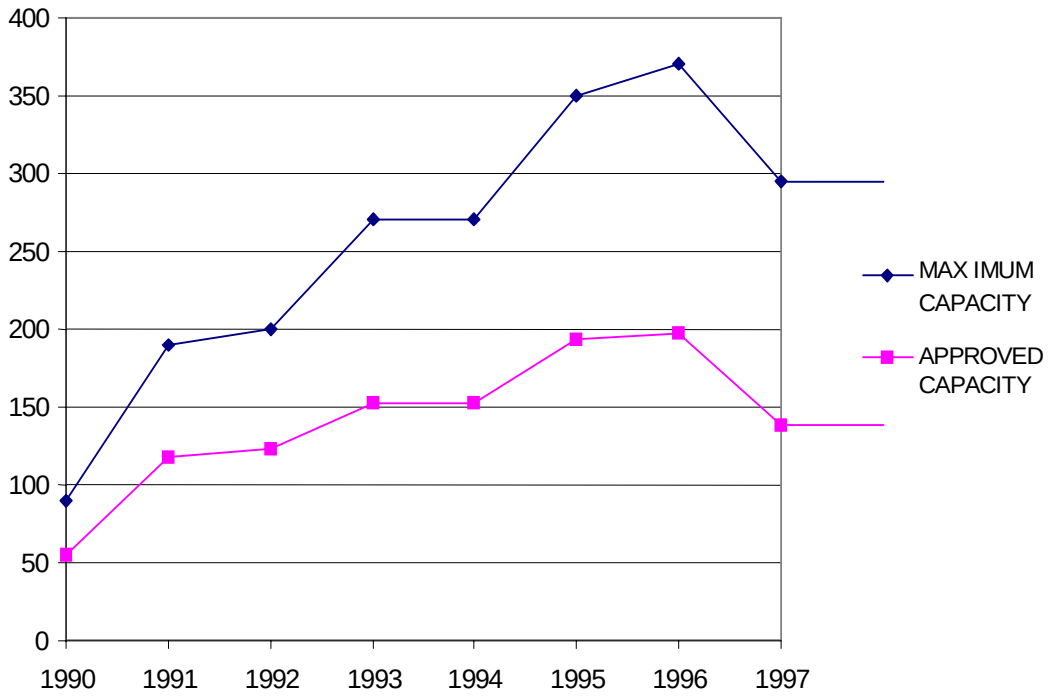
Year	*No. of Operational Firms*	*Total maximum Processing Capacities (Tonnes/day)*	*Total Approved Capacities (Tonnes/day)*
1990	3	90	55
1991	6	190	118
1992	7	200	123
1993	9	270	153
1994	9	270	154
1995	12	350	193
1996	13	370	198
1997	9	295	138
1998	9	295	138

Sources: Fisheries Department & Fish Processing Industries records

* Note that approved capacity is different from utilised capacity. Approved capacity is the maximum processing capacity allowed to the processing firms while utilised capacity (equivalent to fish purchases, Table 1.2) is the actual processing capacity realised by the firms. The latter has been gradually rising over the years, tending towards approved capacities. This trend is examined in Section 1.4 below.

CHART 1.1

The Trend in Maximum and Approved Processing Capacity in the Fisheries Sector (tonnes per day), 1990—1997.



1.4.0 PROCESSING CAPACITY AND FISH PURCHASES

The trend in fish purchases by the processing industries and their processing capacities were examined. The figures are given in Table 1.2 below.

TABLE 1.2

Fish Purchases and Approved Capacities for Industrial Fish Processing, 1990-1997*

Year	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
Fish Purchases (Tonnes/Year)	4 992	14 061	14 553	18 414	19 692	48 138	39 300	30 840
Approved Capacity (Tonnes/Year)	14 300	30 680	31 980	39 780	39 780	50 180	51 480	35 880

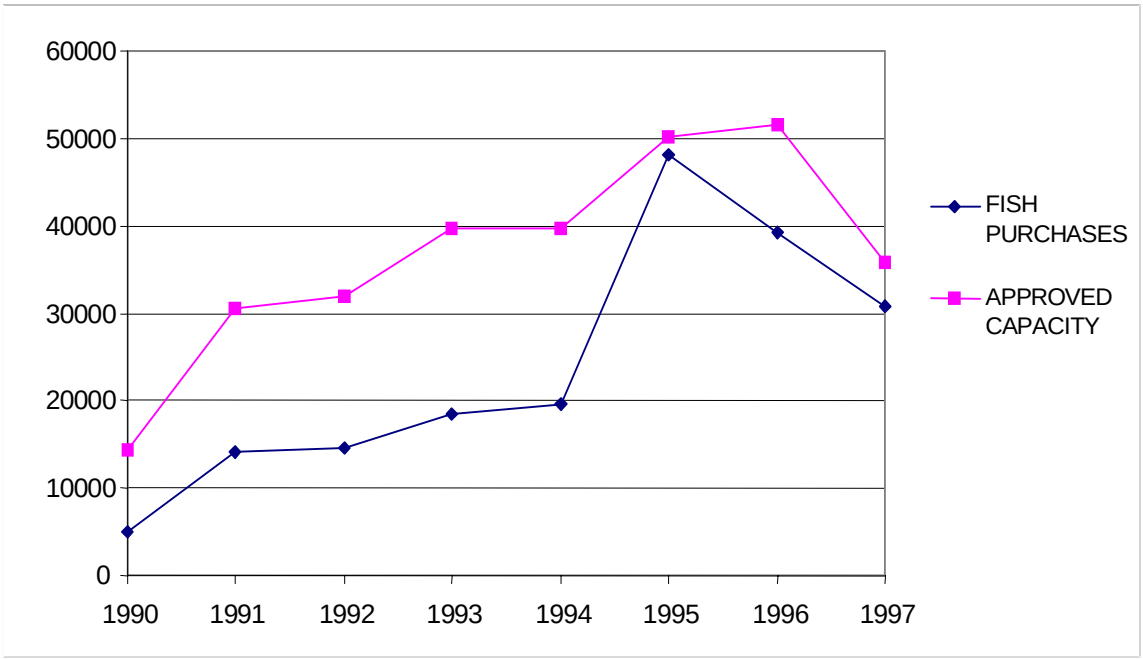
Source: i). MFPED2, 1998; ii) Fisheries Department & Fish Processing Industries' records

* These are annual estimates based on 260 working days in a year.

The figures show that purchases by the industries have been increasing since 1990 as more industries with approved capacities got established. However, the purchases remained below the approved capacities until 1995 when they almost matched approved capacity but thereafter both began to decline as some of the industries closed for renovations while others pulled out of the fisheries altogether. The relationship between fish purchases and approved capacity is illustrated in 1.2.

CHART 1.2

Trend in Fish Purchases and Approved Capacities for Industrial Fish Processing (tonnes per year), 1990-1997



1.5.0 FISH STOCKS, REGENERATION AND RATE OF HARVESTING

1.5.1 Level of Fish Stocks

There is no up-to-date data on the magnitude of fish stocks in Ugandan lakes and other water bodies to guide management decisions on sustainable harvest limits. The only comprehensive stock assessment survey of fish in Lake Victoria was conducted by EAFFRO/FAO with UNDP and East African Community funding in 1969-1971 (Kudhongania and Cordone, 1974). At that time total ichthyomass in the three riparian states (i.e., Kenya, Uganda and Tanzania) of Lake Victoria was estimated at about 679,000 metric tonnes. The haplochromine species flock was the most abundant at 83 per cent, Bagrus docmac at 5 per cent, Clarias mossambicus at 4 per cent, Synodontis at 3 per cent and all other species including the tilapiines made up less than 1 per cent. The Nile Perch was 0.0006 per cent of estimated total lake ichthyomass. The survey results also indicated the following:

- The shallow inshore areas of the lake (4-29 metres depth) carried the highest lake biomass (50 per cent) whereas the deeper waters (60-79m depth) carried about 13.8 per cent of the lake ichthyomass.
- 21 genera of fish species were encountered (excluding the Haplochromis taxa)
- Fish catch rates decreased with increasing water depth. An average of 800 kg/hour was recorded in the 4-29 metre depth zone.

No further lake-wide stock assessment survey has been conducted since then, but from sporadic surveys, it is known that there have been significant changes in the composition of fish species in the lake.

Limited stock surveys in selected areas of the Lake Victoria have however been conducted using bottom trawling (on a monthly basis) since October 1993 (Okaronon, 1994) and the observations are as follows:

- A total of 17 fish taxa were recorded. These were Bagrus docmac (semutundu), *Barbus altianalis* (kisinja), *Barbus* spp., *Brycinus* sp. (angara/nsonga), *Clarias gariepinus* (male), haplochromines (nkejje), *Labeo victorianus* (ningu), *Lates niloticu*s (mputa), *Mormyrus kannume* (kasulubana), *Oreochromis leucostictus* (ngege), *O. niloticus, O. variabilis, Protopterus aethiopicus* (mamba), *Synodontis afrofischeri* (nkolongo), *S. victoriae, Tilapia zillii* (ngege) and *Xenoclarias sp.* (nsonzi). *Lates niloticus* contributed about 96.5 per cent by weight followed by *O. niloticus* (2.9 per cent), haplochromines (0.3 per cent), *P. aethiopicus* (0.1 per cent) and *S. afrofischeri* (0.1 per cent).
- The bulk of fish (about 90 per cent by weight) was recorded in waters less than 30 metres deep. Lates niloticus and the haplochromines were encountered in all the areas sampled. The tilapiine species were recorded in waters less than 20 metres deep. The highest diversity of 9 fish taxa was recorded in Napoleon Gulf. Oreochromis niloticus were predominantly caught in and around Bunjako Bay (near the mouth of River Katonga), Bomangi Bay, Itome Bay and Ingira Bay.
- The mean catch rates (kg/hour) decreased with depth. During the period 1994/97 the mean catch of 149.12 kg/hour was recorded in the 4-29 metres depth zone where the artisanal fishers operate. The highest mean catch rates of about 200 kg/hour, during the 4-year period, were obtained in Buvu waters and Sari-Kasuri (in 4-9 metres depth zone) and White Stony and MacDonald Bay (in 10-19 metres depth zone).
- The waters deeper than 30 metres were generally without fish at the bottom. The fish and other aquatic life were concentrated between 5 metres and 20 metres from the surface.

Relative to the lake-wide survey of 1969/71 (Kudhongania and Cordone, 1974), the mean catch rates of about 150 kg/hour during the 1994-97 survey in the 4-29 metres depth zone is much lower than about 800 kg/hour in the same zone during the 1969/71 survey. While during 1969/71 the fishery was dominated by the haplochromines which contributed 83 per cent of the ichthymass, Lates niloticus contributed 96.5 per cent by weight of fish caught during 1994/97 survey and 0.3 per cent was contributed by haplochromines. Thus catch rates of table fish during 1969/71 in the artisanal zone (4-29 metres depth) were only 100 kg/hour compared to the average current (1994/97) rate of 150 kg/hour.

1.5.2 Rate of Regeneration

The renewal process in the fisheries resource takes place through the production of eggs which hatch to fry which grow to enter the fishery for harvesting over a period of time.

Lates niloticus, Oreochromis niloticus and *Rastrineobola argentea*—the major commercially exploited species in Lakes Victoria and Kyoga—breed throughout the year with spawning peaks occurring at specific periods of the year. *Lates niloticus* attains peak spawning during the rainy seasons while August and November are the peak spawning periods for *Rastrineobola argentea* (Ogutu-Ohwayo, 1988; Wandera, 1990).

Lates niloticus produce millions of eggs and the young fish are recruited into the fishery at about 3 years old. The young of a mouth-brooding Oreochromis niloticus enter the fishery at about 2 years while R. *argentea* are recruited at 10 months old.

The number of young fish that finally enters the fishery is affected by a number of factors which include;

- Number of eggs that hatch to fry. This is why Lates and Rastrineobola produce millions of eggs and *Oreochromis niloticus* broods its eggs in its mouth to increase the numbers of hatching eggs.
- Predators that eat the eggs, fry and juveniles.
- Environmental factors which include temperature levels, oxygen content and food availability.

In the Uganda water bodies, the threats to regeneration include;

- Cannibalism by *Lates*.
- Water hyacinth mats on the nursery, breeding and feeding grounds.
- Pollution from the degraded catchment and industries.
- Destructive fishing methods (beach seines and cast nets) that destroy nursery grounds.

1.5.3 Rate of Harvesting

Most of the fish in Uganda come from the five major lakes namely Lakes Victoria, Kyoga, Albert, Edward and George. Currently fish catch rates from these lakes have been on the decline despite increased fishing effort (from about 3,200 fishing canoes in 1972 to over 10,000 fishing canoes at the present time on Lake Victoria). National Fish production increased from 60,000 metric tonnes in 1961 to 78,000 tonnes in 1983 and 276,000 tonnes in 1993 before dropping to 219,300 tonnes in 1997. The increase in yield was attributed to increased catches of Lates in Lakes Victoria and Kyoga. During the period 1989-1997, an average of 235,800 metric tonnes of fish was landed annually, with Lake Victoria contributing 50 per cent, followed by Lake Kyoga (36.7 per cent), Lake Albert (8.1 per cent) and Lakes George, Edward and Kazinga Channel (2.4 per cent) (Table 3).

TABLE 3

Fish Catch by Water Body 1990-1997 (000 Metric Tonnes)

Year / *Water Body*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*Mean (1989/97)*
Lake Victoria	119.9	124.7	129.7	134.9	103.0	103.0	106.4	106.8	117.8
Lake Kyoga	94.9	98.7	102.6	106.7	80.2	80.2	80.6	80.1	86.5
Lake Albert	19.5	20.2	21.6	21.8	16.4	16.4	21.9	19.1	19.0
Lake Edward, Lake George and Kazinga Channel	5.5	5.7	5.9	6.4	5.2	5.2	4.8	6.4	5.7
Lake Wamala	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
River Nile	1.4	1.5	1.5	1.6	4.8	4.7	4.6	3.4	2.8
Other waters	4.0	4.1	4.2	4.6	3.7	3.7	3.7	3.7	4.0
Total	**245.2**	**254.9**	**264.9**	**276.0**	**213.3**	**213.2**	**222.0**	**219.3**	**235.8**

Source: Uganda Fisheries Department, Entebbe.

Lake Victoria, once a multi-species fishery, is now dependant on three species for commercial exploitation, namely: Lates niloticus, Oreochromis niloticus, and Rastrineobola argentea. A peak catch of 134,900 metric tonnes (48.9 per cent of the national total) was recorded in 1993 after which time it dropped drastically to 103,000 tonnes (45.3 per cent of the national total) in 1994 and remained at this level thereafter. Previously the catch rose from 10,000 tonnes (6 per cent of national total) in 1980 to 132,400 tonnes (62 per cent of national total) in 1989. During 1995 Lates niloticus contributed to 61.8 per cent of total catch while 23.3 per cent and 12.9 per cent were contributed to by Oreochromis niloticus and Rastrineobola argentea, respectively.

Fish catches in Lake Kyoga increased following establishment of exotic species (Lates niloticus and Oreochromis niloticus), but later declined. Total fish yield increased from about 18,000 tonnes (25.5 per cent of national total) in 1964 to167,000 tonnes (73.4 per cent of the national total) in 1978. Catches however declined to 54,700 tonnes (25.6 per cent of the national total) by 1989 and have remained below 100,000 tonnes since then. The decrease in yield after the 1989 peak may partly be due to the insurgency in the area at the time during which only the southern part of the lake was being exploited.

In 1995, Hydrocynus (ngassa) dominated the catches in Lake Albert, contributing 44.6 per cent followed by Lates spp (12.1 per cent), tilapiines (10.7 per cent), Brycinus (Alestes) spp (angara/nsonga) (10.2 per cent), Bagrus spp. (9.5 per cent) and the rest (Distichodus (wachone), Synodontis, Protopterus and Labeo). Catches in Lake Albert have fluctuated at around 19,000 metric tonnes annually during 1989-1997.

Despite the fisheries being predominantly tilapiine, the fish catches from Lakes Edward, George and the Kazinga Channel were in 1995 composed of Bagrus docmac (37.7 per cent), Oreochromis niloticus (33.5 per cent), Protopterus aethiopicus (18.1 per cent). Clarias spp (9.7 per cent) and others (1 per cent). The combined annual catches from these water bodies fluctuated around 5,700 tonnes during 1989-1997.

During the exploitation of the fisheries in the Ugandan water bodies the following practices were generally evident:

- Overfishing of known fish stocks, e.g., Lates in Lake Kyoga, O. niloticus in Lakes Edward and George and Alestes boremose in Lake Albert.
- Use of destructive gear and methods (beach-seines, cast-nets and small size (under 2 inch gillnets) which destroy nursery grounds and catch immature fish.

The existing data on fish catches is deficient in coverage and reliability. The bulk of fish landing sites on the major lakes are not manned for data collection while the minor lakes and rivers are

not covered at all. The data does not take into account fish caught and smuggled before landing for records and fish that originate outside Uganda's sector of the shared lakes, for example, Rastrineobola from Tanzania.

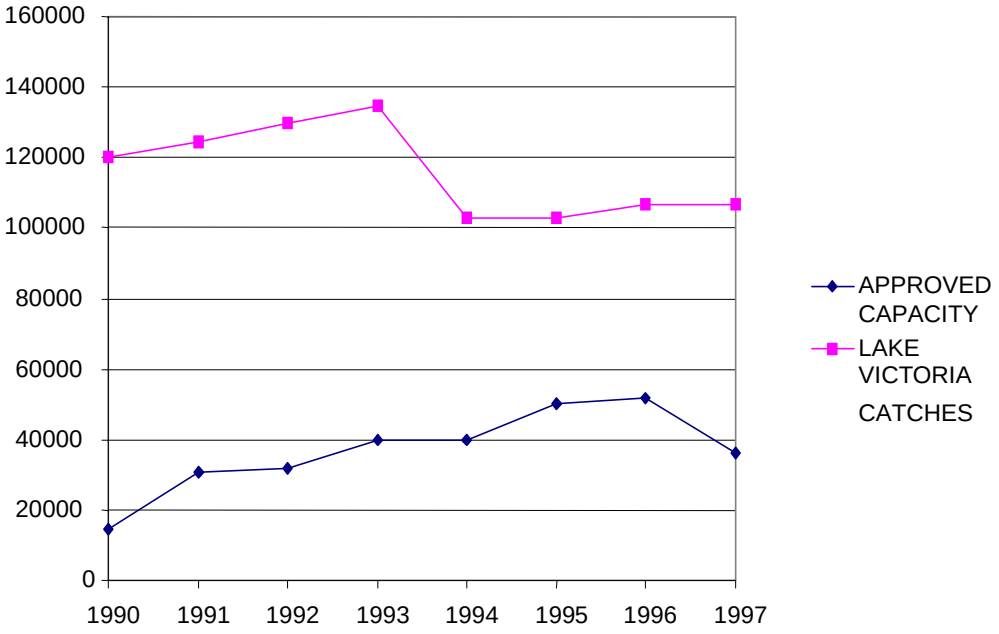
1.5.4 Effective Fish Processing Capacity Relative to Levels of Fish Stocks, Rate of Regeneration and Rate of Harvesting

Generally the fish processing capacity (fish purchases) followed a similar trend to fish harvesting. Both increased up to 1995 when they started declining. The fish processing factories depend almost 100 per cent on Nile Perch, Lates niloticus, which is harvested almost exclusively from Lakes Victoria and Kyoga. The average harvest of Lates during the last 10 years has been in the magnitude of about 103,000 metric tonnes annually (i.e., 73,000 tonnes from Lake Victoria and 30,000 metric tonnes from Lake Kyoga).

Effectively the Nile Perch processed by the processing plants comes from Lake Victoria, i.e., 73,000 tonnes annually. Chart 1.3 gives an indication of the trend in Lake Victoria total catches and approved processing capacity during 1990-1997.

CHART 1.3

Approved Processing Capacity and Fish Catch for Lake Victoria (tonnes per year), 1990-1997



During the period 1990-1997 the fish processing plants consumed an average of 24,000 metric tonnes (range 5,000-48,000 tonnes) annually. The approved processing capacity over this period was 37,000 metric tonnes (range 14,000-52,000 tonnes) annually. From the above data, the processing plants have, according to available records, been operating below the approved processing capacity.

About 70,000 metric tonnes of Lates from Lake Victoria annually includes "a significant" proportion of immature fish. If the regulations to reduce the capture of immature fish are effectively enforced, this figure is expected to decline in the short run. However, if the exploitation con-

tinues as it has been (including the immature fish) the fishery is likely to crash over time. Therefore, fish processing should not relate the processing capacities (approved or actual) to current expected annual harvest figure of about 70,000 metric tonnes of Lates. We would suggest a figure not exceeding 40,000 tonnes p.a..

It is, however, not possible at the moment to relate fish harvesting to the level of fish stocks because of the following reasons.

a) Absolute figures on standing stocks are not available

b) The full impacts of the environmental and other changes on the fish stocks in the recent past are yet to be fully established. The on-going EU funded Lake Victoria Fisheries Research Project is an attempt to address this problem. Some of the main expected outputs of the project will include:

- Stock size
- Distribution patterns and population characteristics.
- Potential yield and sustainable levels of harvest

Although the current absolute figures on standing stocks have not yet been established, a maximum sustainable yield (MSY) of 300,000 metric tonnes p.a. has been suggested based on fish harvest figures (Uganda Fisheries Master Plan study: preliminary Report 1998).

However, the catch figure, on which this MSY figure was based, includes "a significant" proportion of immature fish. If the regulations to reduce the capture of immature fish are effectively enforced, the realistic catch figures will reduce and, consequently, the MSY will go down.

1.6.0 POLICY RECOMMENDATIONS

1.6.1 Appropriate Rate of Fish Harvests

As information on the magnitudes and dynamics of Uganda's fish stocks is still in the process of being prepared, it is not possible at this stage to make recommendations on appropriate levels of fish harvests. At the current time, however, the exploitation of the Uganda fisheries is faced with the following problems:

- Depletion of the fisheries resource base through overfishing and use of destructive fishing gear and methods. This has resulted in the decline and/or disappearance of known fish stocks e.g. Lates in Lake Kyoga, O.niloticus in Lakes George and Edward and Alestes baremose in Lake Albert;
- Open access policy for all water bodies except Lakes Edward and George, Lake Wamala and some minor lakes. While this policy is consistent with the strategy of market liberalisation, it is generally inconsistent with the need to sustainably manage the fisheries resource base. It has for instance resulted in the use of uncontrolled fishing effort especially on Lake Victoria where effort deployment drastically increased from 3,470 fishing canoes in 1989 to 8,000 canoes in 1990 and about 10,000 canoes today.
- Exploitation levels are not based on fish stock information.

Recommendations towards establishing appropriate levels of fish harvests to ensure sustainability, therefore, include:

- Extension of the on-going stock assessment initiatives on Lake Victoria to cover other water bodies of the country thus providing a complete picture of the national levels of fish stocks and help monitor lake-wide changes on a regular basis.

- Improvement of the resource tenure situation over the fishery resource by developing a system for the definition of property rights among fishers. The approach will involve enforcement of a landing site based fishing quota system under which a restricted amount of fish can be caught by fishing boats over a period of time. Appropriate pricing of the quota should also be ensured to raise the cost of harvesting of the resource using targeted user charges. To benefit from the power of the market, resource use rights would have to be transferable.

- Discouragement the open access policies and encouragement of community ownership of the resources. Responsible communities would be encouraged to participate in the enforcement of regulations on fishing gear and other rules and regulations.

- Strengthen fisheries regulations and adopt more effective implementation strategies involving local authorities and the participation of resource users.

- Fish landing statistics should be strengthened by the respective districts through adequate deployment of sufficiently trained and equipped personnel. The authorities should recognise the role of such statistics for resource management in addition to calculations of revenue.

1.6.2 Policies for Management of Fish Harvests

Management of fish harvests should address three important considerations, namely improved earnings through production of value added fish products, social factors, namely nutrition and employment, and thirdly, the environment.

- Given the uncertainties in fish stocks and the declining rates of harvest, the future for fisheries development lies more in value adding than increased quantitative exploitation. Policies should promote this by continuing to encourage investment and promote trade in the products—within the limits allowed by the resource base—facilitated by an efficient quota system. Such a system should address fisheries resource concerns as well as the business needs of the investors and should be reviewed regularly to take account of changing situations. Quotas of inefficient firms which have dropped out of the industry should be reallocated once there is adequate information on stocks.

Fish harvests have in the past played an important role in serving the nutritional needs of local communities by providing a cheap source of protein. Policies should continue to facilitate this by striking a balance with other uses, through a system of quotas and market differentiation based on the different species.

Given that the market mechanism does not necessarily lead to environmentally sound decisions, the policy should be to manage fish harvests through a combination of market forces and environmental regulations that ensure resource sustainability.

Management should address the need to ensure quality and minimise post-harvest losses—estimated at over 20 per cent of total catch. Public and private investments should be promoted in facilities and training at fishing centres for improved preservation and handling of harvests.

1.6.3 Other Appropriate Policies

In view of decentralisation, district authorities should assume greater responsibility for fisheries management and development. Their role should include planning for the growth of fishing settlements to minimise encroachment on shoreline vegetation, investing some of the revenues from the fisheries sector back into facilities and services for the growing lake-side fishing populations.

In order to further address the problem of deprivation of domestic consumers and small-scale trading operators, an integrated program covering restocking of the lakes with the threatened species and development of aquaculture should be promoted.

- Minimise the impact of external factors on the sector by diversifying export destinations and promoting the domestic market through measures to eradicate poverty and strengthen the purchasing power among the population.
- Improve fish stocks by controlling the water hyacinth which mats on the nursery, breeding and feeding grounds.
- Eliminate practices which result in pollution from degraded catchment and industries.

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APPENDIX

GLOSSARY OF TECHNICAL TERMS

Artisanal Fishing: operations by small-scale fishers usually confined to inshore waters

Biomass: The quantity or weight of living organisms.

Decentralisation: Transfer of decision making and planning from the centre to lower levels of the hierarchy.

Degradation: A general lowering of the earth's surface by erosion or transportation by water.

Deregulation: Removal of regulations governing trade.

Fry: Young or newly hatched fish.

GDP: Gross-domestic product a measure of a country's national income, accruing from all production from within its borders, irrespective of whether it is by nationals or foreigners.

Icthiomass: The quantity or weight of fish.

Juveniles: Young fish which have not yet matured

MSY: Maximum sustainable yield—the greatest quantity that can possibly be removed or obtained from a water body continuously without damaging it.

Post-harvest losses: Losses in the number and/or quality of fish after removal from a water body.

Quota: Maximum allocation of a resource that may be utilised by a given firm.

Sanitation: The formulation and application of measures designed to protect public health.

Spawning: Production of eggs or young by fish.

Taxon (plural = taxa): A group of organisms constituting one of the categories or formal units in a taxonomic classification (e.g. species) and having common characteristics.

Trawling: Fishing using a wide-mouthed net (with a bag at the end) dragged by boat (along the lake bottom).

Wetland-ecosystems: Wetland which forms a transition between land and lake ecosystems.

CHAPTER 2

THE IMPACT OF NILE PERCH HARVESTING ON FISH AND FISHERIES IN UGANDA

ACRONYMS

EPRC	Economic Policy Research Centre
FIRI	Fisheries Research Institute
NARO	National Agricultural Research Organisation

Scientific names of some of the fish given in the report with their English and some vernacular equivalents which are available

Scientific Name	***English Equivalent***	***Vernacular Equivalent***
Lates niloticus	Nile Perch	Mputa
Oreochromis niloticus	Nile tilapia	Ngege
Oreochromis leucostictus	Tilapia	
Tilapia zillii	Tilapia	Kajansi
Bagrus docmac	Cat fish	Semutundu
Clarias gariepinus	Mud fish	Male
Protopterus aethiopicus	Lung fish	Mamba
Rastrineobola argentea		Mukene
Haplochromines		Nkejje
Barbus altianalis	Barbel	Kisinja
Hydrocynus	Tiger fish	Ngassa
Alestes		Ngara
Labeo victorianus		Ningu

ABSTRACT

Nile Perch is the most important commercial fish species in Uganda. It is native to Lake Albert, but because of its high economic value, it was introduced into Lakes Victoria and Kyoga to feed on and convert Nkejje (haplochromine species) which were abundant in these lakes into a larger commercial species. Fish catches from these lakes increased four to five times following establishment of Nile Perch. This produced new jobs and provided fish especially suited for export. Fish processing plants were built along the lakes to process Nile Perch for export. By 1996 fish product exports based on Nile Perch ranked second to coffee in export earnings in Uganda.

The demand created by the ready market fuelled rapid increases in fishing effort to an extent that fish catches have started to decline. The fish processing plants have been taking most of the large fish of the most desired sizes of 3 kg to 8 kg (60 cm to 90 cm). This has left less fish for local consumption and has encouraged catching of immature Nile Perch to meet domestic demands. Domestic consumption was previously supported by the large quantities of Nkejje which were abundant in these lakes but which have since been depleted by Nile Perch predation. Nile Perch contributes about 20 per cent to total fishery yield in its original habitat of Lake Albert but in Lakes Victoria and Kyoga, at its peak contributed over 90 per cent to total fish catches after which catches started to decline. The contribution in Lake Kyoga has declined to less than a third of its original level and in Lake Victoria it has recently begun to decrease.

As the Nile Perch stocks in Lake Victoria increased, there was a decline, and in some cases complete disappearance, of most of the native fish species of the lake, some of which were not found anywhere else on earth. The lake has subsequently become dominated by only three species: Nile Perch, Lates nilloticus (mputa); Rastrineobola argentea (Mukene); and Nile tilapia (Oreochromis niloticus, Ngege).

There are fears that Nile Perch might not sustain the very high catch yields initially realised in its new habitats just after its establishment. At the same time there is concern over the loss of fish species diversity due to predation by Nile Perch. The challenge in the management of the fisheries of these lakes is to ensure sustainability of the Nile Perch fishery while controlling predation by the Nile Perch so as to conserve fish species diversity.

Haplochromines formed the main food of most sizes of Nile Perch soon after its establishment into Lakes Victoria and Kyoga. After haplochromines and other fish had been depleted, Nile Perch shifted to prawns (Caridina nilotica), dragonfly nymphs, Mukene, Nile Perch juveniles and Ngege. The types of prey eaten by the predator varies with its length or age. Nile Perch of less than 20 cm total length (<0.1 kg) feed predominantly on invertebrates mainly prawns and dragonfly nymphs, those of 20 cm to 60 cm (0.1 kg to 3 kg) feed on a mixed invertebrates and fish diet dominated by Mukene and Nile Perch juveniles, those of 60 to 100 cm (3 kg to 14 kg) feed on small fish especially Mukene, Nile Perch juveniles and tilapiines, while those of more than 100 cm (> 14 kg) feed on large fish such as the tilapiines. This ontogenic shift in diet can be used to reduce predation pressure on fish prey by selectively fishing Nile Perch of those sizes which feed on fish that need to be protected.

The law on management of fisheries in Uganda is in the Fish and Crocodiles Act of 1964 and its statutory amendments. This law prohibits catching Ngege of less than 28 cm (11 inches) and Nile Perch of less than 46 cm (18 inches) in total length. This law also prohibits use of seine nets and poisons to catch fish on all water bodies in Uganda. In Lakes Victoria and Kyoga, Nile Perch is harvested using gill nets and beach seines. Beach seines although illegal are widely used to fish

on Lakes Victoria and Kyoga. More recently, use of poisons, which is also illegal, has become rampant on Lake Victoria.[2] Different mesh sizes of nets catch different sizes of Nile Perch. Size selectivity of the nets could be used to control predation pressure by selectively fishing those sizes of Nile perch that feed on specific prey.

Investigations on the impact of predation on harvest rates have shown that both harvest rates and the impact of predation vary with the types and mesh sizes of nets used. Large mesh gill nets remove large individuals from the fishery. This has been estimated to reduce total predation to about 40 per cent of that during the 1970s when haplochromines were still abundant in Lake Victoria. Intensive use of small mesh gill nets and beach seines reduces total predation to about 25 per cent while a combination of these methods reduces predation to about 10 per cent of the previous levels.

A range of gill nets from 3 to 16 inches can be used to harvest Nile Perch. Analysis of this size range of gill nets has shown that total biomass of Nile Perch harvested varies more than three times over the range of minimum gill net mesh size between 3 and 16 inches. Maximum harvest occurs from minimum gill net restriction of between 6 and 10 inches. This size range of nets catches Nile Perch most desired by the fish processing plants. Predation rates on fish prey increase with all increases in minimum mesh size. Enforcement of 5-inch minimum mesh size reduces cannibalism and predation on other important fish such as Ngege, Nkejje and Mukene by as much as 44 per cent with a decrease of about 10 per cent in Nile Perch yield. If the fisheries are concentrated on small mesh gill nets of 5-inches to 6-inches, there will be a large reduction in predation on the native haplochromines but at the expense of a large (about 35 per cent) decrease in Nile Perch harvest.

The fisheries of those lakes with Nile Perch contain other fish that need to be harvested sustainably alongside Nile Perch. In Lakes Victoria and Kyoga these consist of the Ngege and Mukene. The 5-inch mesh gill net size limit recommended for Lakes Victoria and Kyoga is aimed at protecting stocks of Ngege. Mukene is exploited using a 5 mm mesh seine net. This net catches juveniles of Nile Perch and Nile tilapia if operated along the shore. It has, therefore been recommended that Mukene fishing should be done using a 5 mm mesh seine net operated away from the shore.

Other factors especially the degradation of the aquatic environment affect the fish and fisheries of Lakes Victoria and Kyoga. These include over-fertilisation of the lake, which is causing excess algal growth, depletion of oxygen and reduction of habitable space for fish. Water hyacinth infestation has also caused loss of critical fish habitats.

Some of the management measures that would benefit the fishery include:

- enforcement of the law prohibiting the use of seine nets;
- enforcement of the 5 inch mesh gill nets mesh size limit;
- stopping the use of poisons; encouraging use of gill nets of 6 inches to 10 inches for Nile Perch;
- controlling fishing effort by controlling the number of fishers, nets, fish processing plants and the capacity of these plants;
- control water hyacinth and over-fertilisation of the lakes; and,
- involving user communities in development and management of the fisheries resources.

There is also need for a nutritional policy to ensure that adequate fish is available for local consumption.

[2] In March 1999, Uganda Government imposed a ban on fishing activities, following excessive use of poison to catch fish and death of people who consumed the fish. However, the ban was lifted, in May following reports that the illegal activity has been contained.

THE IMPACT OF NILE PERCH HARVESTING ON FISHES AND FISHERIES IN UGANDA

2.1.0 INTRODUCTION

Nile Perch, Lates niloticus which is locally known as Mputa in Uganda is a fish of high economic and recreational value. It can grow to a length of two metres and a weight of 200 kg. Because of its high economic value it was introduced into Lakes Kyoga and Victoria from lakes Albert and Turkana during 1950s and early 1960s. Nile Perch is a predator that feeds on other fish. The purpose of the introduction was for the Nile Perch to feed on small sized fish especially haplochromine cichlids (Nkejje) which were at that time abundant but not much commercially exploited, and convert them into a larger fish of higher commercial and recreational value (Graham 1929). It was, however, feared that Nile Perch would feed on and deplete stocks of native commercially important fish species and affect those native predators, which depended on haplochromines for food.

Stocks of Nile Perch started to increase rapidly in 1965 in Lake Kyoga and 1977 in Lake Victoria. This was followed by rapid increases in fishery yield. Increase in stocks of Nile Perch was also accompanied by a reduction and in some cases total disappearance of many native species. Stocks of haplochromines, which were the most abundant species in Lake Victoria and were expected to form the bulk of the food of the Nile Perch, were depleted. Other fish species became very scarce. The food of Nile Perch changed to the extent that it started feeding on its own young. This has raised concern that Nile Perch fishery might not be sustainable as Nile Perch might, through predation deplete all the fish including its own kind.

Nile Perch contributes most to fish catches in Uganda (Table 2.1). In 1991 Nile Perch contributed 45.9 per cent to total commercial fishery yield in Uganda followed by tilapiines (36.3 per cent), Mukene (5.0 per cent), Hydrocynus (4.2 per cent), Protopterus (3.0 per cent), Bagrus (2.0 per cent), Alestes (1.0 per cent), with only 2.6 per cent being contributed by all other fish species. Nile Perch is now the basis of an expanding fish export industry that in 1996 ranked second only to coffee in Uganda's exports. Overall, fisheries are quite important in the Ugandan economy. Up to 17 per cent of the national surface area is made up of lakes and rivers that serve as sources of fish. Fish is the cheapest source of animal protein and is estimated to account for over 50 per cent of the animal protein supply. The industry employs 0.5 to 1 million Ugandans. Most of the fish comes from Lakes Victoria, Kyoga and Albert where Nile Perch forms an important component of the commercial fishery.

This chapter analyses the effect of harvesting Nile Perch on other fish species. Since Nile Perch feeds on other fish, it was deemed necessary to look at the effect of predation by Nile Perch on other commercially important fish species and how different fishing options could affect predation by the Nile Perch. The study also examined how both harvest by human beings (through fishing) and harvest by Nile Perch (through predation) were impacting the fish and the fishery of those lakes to which Nile Perch was introduced.

The central goal in fisheries management is to maximise fish production while conserving the natural resource base. In assessing the impact of Nile Perch harvesting on fish and fisheries, the key issues addressed were:

a) the dynamics and state of the fish and fisheries of different lakes containing Nile Perch in Uganda especially those to which Nile Perch was introduced;

b) the impact of predation by the Nile Perch on the fish especially in the lakes to which it was introduced;

c) how harvesting Nile Perch using different types and mesh sizes of fishing gear would affect the Nile Perch fishery and how this affects stocks of its prey;

d) other factors other than harvesting and predation e.g., hypoxia, water hyacinth and overall habitat degradation that may promote or threaten survival of fish;

e) recommendations on how the Nile Perch fishery can be optimised and at the same time conserve other, particularly, native fish.

The chapter attempts to show that the method of harvesting will determine both Nile Perch harvest levels and its impact on its prey species. This is based on two facts: firstly, that different types and sizes of fishing gear and methods catch different sizes of Nile Perch; and secondly, that Nile Perch of different sizes feeds on different types and sizes of prey. Through use of different types and sizes of fishing gears, one should be able control Nile Perch age population distributions to vary predation pressure on specific species it preys upon.

2.2 Fisheries and Fish Stocks of lakes with Nile Perch

In Uganda Nile Perch is found in the three largest lakes: Victoria, Kyoga and Albert and in several minor lakes in the Victoria and Kyoga lake basins. An understanding of the fish fauna, fish production and fisheries exploitation of these lakes and their relationship to the Nile Perch is important in predicting the effects of harvesting Nile Perch on these fisheries.

2.2.1 Lake Albert

Examination of commercial catches from Lake Albert shows that fourteen fish taxa occur among commercial catches in the lake. These include; Hydrocynus spp, Alestes spp, tilapiines, Lates spp, Clarias spp, Protopterus aethiopicus, Distichodus spp, Labeo, Barbus, Mormyrids and Synodontis. Experimental fishing (Ogutu-Ohwayo, 1994) shows that commercial catch records give a good picture of the fish present in this lake. Nile Perch is native to Lake Albert and unlike the other lakes to which it has been introduced, the fish fauna of Lake Albert has evolved with and are adapted to living with this predator. Examination of commercial fish catch statistics of Lake Albert for the period 1970 to 1990 show that Nile Perch has been contributing 20 per cent to 25 per cent of the total fish catches from the lake. It is possible that if and when the fishery in the lakes to which Nile Perch was introduced stabilises, the percentage contribution of the predator to total fish catches in those lakes could be close to that recorded in Lake Albert.

2.2. Lake Kyoga

Nile Perch and three tilapiine species Oreochromis niloticus (Nile tilapia), Oreochromis leucostictus and Tilapia zilli were introduced into Lake Kyoga from Lake Albert in the mid-1950s. Prior to these introductions, the fishery of Lake Kyoga was dominated by native species comprising of Oreochromis esculentus (Ngege), O. variabilis, P. aethiopicus, B. docmac, C. gariepinus, Schilbe intermedius, Barbus spp and Mormyrids. Haplochromines were also abundant in the lake but they were not commercially exploited.

Major changes took place in the fishery of Lake Kyoga with yields increasing from around 18,000 mt in 1965 to 167,000 mt in 1978. These increases were due to a rise in the contribution of Nile Perch from 660 mt in 1964 to 71,000 mt in 1978 and that of the introduced Nile tilapia from

600 mt in 1964 to 81,000 mt in 1985. However, after having a lucrative fishery for about 13 years, total fishery yield declined to about 55,000 mt by 1989. During this period the yield of Nile Perch dropped from 71,000 mt recorded in 1977 to a mere 15,000 mt in 1989. This decline in the Nile Perch fishery has been attributed to use of small mesh gill nets and seine nets which have been rampant on the lake (Ogutu-Ohwayo, 1994). Fish catches of the Nile Perch and Nile tilapia in Lake Kyoga have declined to the extent that some fishers have shifted to Rastrineobola argentea (Mukene). This will have negative consequences on the Nile Perch fishery because Mukene is a major prey of Nile Perch in the lake and by catching it the food available for Nile Perch is reduced. The 3 mm mesh seine net used to catch Mukene catches juveniles of larger species especially Nile Perch and Nile tilapia. Nile Perch, Nile tilapia and Mukene are the dominant fish species in Lake Kyoga. Other types of fish: T. zilli, O. leucostictus, S. intermedius, P. eathiopicus, C. gariepinus, Barbus spp, S. afrofischeri. Lake victorianus, Mormyrids and Afromastercembelus occur in very small numbers.

Following overfishing of its predator, the stocks of haplochromines and other native species of Lake Kyoga which had been depleted by Nile Perch predation started to increase in the early 1990s. The increase in haplochromines and other native species in Lake Kyoga coincided with the invasion of the lake by the water hyacinth. Floating beds of water hyacinth provide cover from predation, and as they move, disperse haplochromines from one point to another allowing them to recolonise the lake.

2.2.3 Lake Victoria

Nile Perch and the three tilapiine species introduced into Lake Kyoga were also introduced into Lake Victoria in the early 1960s. Nile Perch became well established in Lake Victoria after Kyoga. The native fish fauna of these two lakes were similar and the changes that have so far taken place in Lake Victoria are generally similar to those discussed above for Kyoga. Nile Perch took about twenty years to become well established in the lake. Before it became well established 12 to 14 fish taxa occurred regularly among commercial catches. These included: two tilapiines (O. esculentus and O. variabilis), the catfish, B. docmac and C. gariepinus, P. aethiopicus, and haplochromine cichlids were the major commercial species. Less common species included: Labeo victorianus. R.argentea and Barbus spp, the cat fish, Schilbe intermedius and Synodontis spp, Mormyrids, and the characid Brycinus spp.

Stocks of Nile Perch started to increase rapidly in 1981. During the subsequent period, total fishery yield in the Ugandan part of the lake increased from 17,000 mt in 1981 to a peak of 132,000 mt in 1989. This was again due to an increase in the contribution of Nile Perch from 14,000 mt in 1983 to 100,000 mt in 1989. The yield of most of the native species declined and haplochromines became virtually absent from the catch.

A survey carried out on Lake Victoria in 1970 up to the early 1980s before the Nile Perch became well established showed that haplochromines formed up to 80 per cent of the demersal fish fauna of the lake (Kudhongania and Cordone, 1974) and remained the most abundant type of fish up to 1982 (Okaronon et al, 1985). After 1982, the proportion of haplochromines declined to 76.2 per cent in 1983 and 6.9 per cent in 1985. This happened as the proportion of Nile Perch in experimental trawl samples increased from 16.8 per cent in 1983 to 90.4 per cent in 1985. Experimental fishing using a very fine 5 mm mesh seine net showed that only one native species *R. argentea* remained abundant in Lake Victoria. Changes similar to those discussed above for Lakes Victoria and Kyoga took place in Lake Nabugabo where Nile Perch was also introduced.

The fishery of Lake Victoria seems to be following a pattern described above for Lake Kyoga. Total fishery yields, after increasing rapidly between 1985 and 1990, have started to decline even though fishing effort has continued to increase. Fishers have started switching to smaller mesh gill nets and to seine nets. Some of these changes are likely to make the fishery

unsustainable. The maximum sustainable yield (MSY) from the lake is not known to guide management options and it is not yet clear whether Nile Perch will reach an equilibrium position with its prey and whether the available prey will be able to sustain Nile Perch stocks. Sustainability of Nile Perch stocks and those of prey will depend upon management measures that will ensure a balance in fishing of the Nile Perch itself by humans and reduction in predation pressure to a level that can sustain the fishery. Fishing for Nile Perch can reduce its impact on the prey and this can result in recovery and sustainability of some prey species.

The current fishery of all the lakes (Victoria, Kyoga and Nabugabo) to which Nile Perch was introduced and became well established consists of Nile Perch, Nile tilapia and *R. argentea*. Nile tilapia comes from the same lake as Nile Perch and the two species evolved together. Nile tilapia appears to be resilient due to its rapid growth rate and large adult size. Mukene has an evasive schooling behaviour and undergoes vertical migrations that is thought to enable it to evade the predator (Ogutu-Ohwayo, 1994).

2.2.4 Development in Processing and Export of Fish

Major fishing activities have developed following increase in Nile Perch stocks, most notably industries that fillet, freeze and export Nile Perch to foreign markets.

About 20 factories with the capacity to process 20 tonnes of fresh fish per day have been licensed and 11 of these are operational. Each of the fish processing plants has been allocated an amount of fish which they are permitted to process per day (2.3). However, most of these factories have an installed capacity which is twice the permitted quota. Since there is no strict supervision on how much fish a factory buys per day, some of the plants could be processing more fish than the permitted quota. The sizes of fish most demanded by the fish processing plants are from 3 kg to 8 kg but larger fish are also bought.

This demand by the fish processing plants is thought to have encouraged fishers to use sizes of gill nets and seine nets which catch juvenile Nile Perch for local consumption. This seems to have provided an excuse for fishers to use seine nets which are illegal and gill nets of mesh sizes of less than 5 inches.

The rapid expansion of the fish processing plants has had some socio-economic consequences. Fish has historically been, and remains, the cheapest source of animal protein for the average and poor segments of the Uganda population. The demand by the fish processing plants has raised the price of fish to a level which cannot be afforded by the majority of the local people. For example, the price of Nile Perch more than doubled from about US $ 0.5 to US $ 1.2 per kg (140 per cent increase) between 1990 and 1996 even when there was no significant inflation in Uganda. There is need for a nutritional policy to ensure that there is recurred adequate fish for local consumption.

2.3 The Food of the Nile Perch in different lakes

Nile Perch is a predator which feeds on other fish during certain stages of its development The type, size (length), and numbers of prey eaten by the Nile Perch in the different lakes varies with the length of the predator (Ogutu-Ohwayo, 1994).

2.3.1 Lake Albert

In its native habitat of Lake Albert, Nile Perch feeds on Alestes, haplochromines, prawns, C. nilotica, dragonfly nymphs, its own juveniles, tilapiines and Hydrocynus. Both Alestes and Hydrocynus are absent from Lakes Victoria and Kyoga. The prey eaten by Nile Perch in Lake Albert var-

ies with the size of the predator. Nile Perch of less than 20 cm feed on prawns and haplochromines. Those of 20 to 60 cm on Alestes and haplochromines, those of 60 to 100 cm on Alestes, haplochromines and Hydrocynus and those of more than 100 cm on Alestes, tilapiines and other fish.

2.3.2 Lake Kyoga

Haplochromines were the main prey of Nile Perch soon after its introduction into the lake. After haplochromines had been depleted, Nile Perch switched to three invertebrate prey (Lake flies, prawns and dragonflies), and three fish prey (Tilapiines, its own juveniles and Mukene). The type of prey eaten again varied with the size of the predator in a manner similar to that of Lakes Victoria and Nabugabo. Nile Perch of < 20 cm mainly ate prawns, Mukene and dragonfly nymphs. Those of 20 to 60 cm ate prawns, dragonfly nymphs, Mukene, Nile Perch and tilapiines. Nile Perch of 60 to 100 cm ate Mukene, Nile Perch juveniles and tilapiines while those of > 100 cm depended solely on tilapiines for food. Since 1990 following improvement in the stocks of haplochromines in Lake Kyoga, there has been a shift in types of prey eaten by Nile Perch in Lake Kyoga. Haplochromines again became a major prey of Nile Perch together with lake flies, dragonfly nymphs, prawns, Mukene, Nile Perch juveniles and tilapiines. Haplochromine cichlids were the most important prey in all size groups of Nile Perch of < 100 cm. Nile Perch of more than 100 cm ate tilapiines and juvenile Nile Perch.

2.3.3 Lake Victoria

Just like in Lake Kyoga, haplochromines formed the main food of the Nile Perch soon after introduction of Nile Perch in Lake Victoria. As Nile Perch stocks increased, stocks of haplochromines declined rapidly and became rare among commercial catches. Thereafter, Nile Perch switched to feeding on prawns, dragon fly nymphs, Mukene, its own juveniles, and tilapiines. The type of prey eaten varies with the size of the predator. Nile Perch of less than 20 cm total length feed predominantly on invertebrates especially the prawns Caridina nilotica. Nile Perch of 20 cm to 60 cm feed on a mixed invertebrate and fish diet with Mukene and juvenile Nile Perch being among the most common prey. Nile Perch of 60 cm to 100 cm feed on small fish prey such as Mukene, small tilapiines, Nile Perch, and haplochromines (Nkejje). Large Nile Perch of more than 100 cm feed exclusively on tilapiines, haplochromines and juvenile Nile Perch.

2.3.4 Lake Nabugabo

In Lake Nabugabo, the main food of the Nile Perch consists of three invertebrate types (Ephemeropterans, lake flies and dragon flies) and fish prey comprising Mukene, Nile Perch juveniles and tilapiines. Nile Perch of 20 to 60 cm feeds on invertebrates, Mukene, Nile Perch juveniles and tilapiines. Nile Perch of 60 to 100 cm feed on mukene and tilapiines while that of more than 100 feeds on tilapiines.

2.4 Impact of predation by Nile Perch in Lakes Victoria, Kyoga and Nabugabo

Major changes took place in the fish stocks of Lakes Victoria and Kyoga during the period that the Nile Perch became established in these lakes. A fish stock assessment survey carried out in different parts of Lake Victoria had showed that virtually all the fish species recorded in the lake at the turn of the 20th century were still present at the time that the Nile Perch became established in the lake. The Haplochromine species had been the most abundant and contributed 83 per cent to total fish biomass in the lake. The haplochromines formed the main food of the Nile Perch when the predator first became established in Lakes Victoria and Kyoga (Hamblyn 1966, Gee 1969, Okedi 1970). As the stocks of Nile Perch increased, fish species diversity, especially of haplo-

chromines, decreased rapidly. The contribution of haplochromines to fish biomass in Lake Victoria decreased from 83 per cent recorded during the 1970s and early 1980s to less than 1 per cent from the late 1980s onwards (Kudhongania and Cordone, 1974; Okaronon et al., 1985). About 60 per cent of haplochromine species are thought to have become extinct from the lake during this period (Witte et al., 1992). This has been described as one of the greatest vertebrate extinctions of the 20th century (Kaufman, 1993). Thereafter, fishery of Lakes Victoria and Kyoga became dominated by the two introduced species, namely Nile Perch and Nile tilapia. Only one native fish species, a cyprinid Rastrineobola argentea, initially remained dominant in the two lakes.

2.5 Impact of human exploitation on Nile Perch

Nile Perch is harvested using gill nets, seine nets, hooks, cast nets etc. Among these, gill nets are the most common fishing gear used in harvesting the species.

2.5.1 Gill net selectivity of Commercially Important Fishes of Lakes with Nile Perch

Ogutu-Ohwayo et al. (1998) carried out a detailed analysis of selectivity of fishing gear used to crop Nile Perch, Nile tilapia and Mukene in Lakes Victoria, Kyoga and Nabugabo to determine the impacts of these gear on the fish and recommend suitable sizes of gear to be used on these lakes.

In fisheries management, the size limit of fish that should be harvested is set at first maturity i.e., the size at which 50 per cent of the members of that species are mature (Beverton & Holt 1957). The logic behind this is that it allows 50 per cent of the individuals to breed before they are cropped and this sustains the fish stocks. The size at first maturity for Nile Perch in Lake Victoria is 50-55 cm for males and 80-100 cm for females (Ogutu-Ohwayo 1988, 1994). The size at first maturity of the Nile tilapia in Lakes Victoria and Kyoga is around 23 cm total length for males and 25 cm for females and by 28.5 cm all fish are mature. The size at first maturity of Mukene is currently 42 mm and by 45 mm all the fish are mature (Wandera, 1993).

2.5.2 The impact of seines

Seines are operated as active gear. The dragging of these gear on the lake bottom especially near the lake's margins where tilapiines breed, destroys tilapia nests and disrupts courtship on breeding grounds of the tilapiines. Sweeping of the lake bottoms also destroys habitats of benthic organisms which affects important food of fish. These gear are also not very selective. As fish are caught, smaller fish than would not normally be retained are caught due to blocking of the meshes by larger fish. On this basis beach seining was banned on all Ugandan lakes. However, seining is still rampant on most lakes in Uganda including those with Nile Perch. Mechanisms of enforcing this regulation need to be developed probably in collaboration with the fisher communities.

2.5.3 The impact of the gill nets

Gill nets are the legal fishing gear used in those lakes with Nile Perch. The size of Nile tilapia caught in gill nets of 76 mm (3") to 178 mm (7") and that of Nile Perch caught in gill nets of stretched mesh 76 mm (3") to 254 mm (10") were examined. Gill nets of less than 5 inches caught large proportions of immature Nile tilapia but those of more than 5 inches caught predominantly mature Nile tilapia. Since the size at first maturity of the Nile tilapia in Lakes Victoria and Kyoga is around 25 cm total length (TL), the minimum size of Nile tilapia that should be permitted should be 25 cm. However, fishing pressure on Lakes Victoria and Kyoga is very high while the fecundity of the Nile tilapia is relatively low. It is, therefore, logical to set the gill net limit for the Nile tilapia

at 100 per cent maturity to preserve enough spawners in the population. In Lakes Victoria and Kyoga, 100 per cent maturity of Nile tilapia is at 28.5 cm TL. This would require a minimum gill net mesh size of 5 inches. This suggests that the minimum gill net mesh size limit in respect to Nile tilapia should be set at 5 inches.

The minimum mesh size that had been suggested for the Nile tilapia would crop immature Nile Perch. However, biological and ecological considerations justified setting the minimum mesh at 127 mm (5 inches). Nile Perch is a predator which during certain stages of its development becomes detrimental to the fishery by feeding on other commercially important fish (Ogutu-Ohwayo, 1985). Increasing fishing pressure on Nile Perch of the size range which feeds on other commercially important fish would be beneficial to the fishery. Furthermore, the species has high capacity to replenish itself; each female produces millions of eggs at each breeding (Ogutu-Ohwayo, 1988).

Nile Perch of up to 50 cm feed predominantly on invertebrates; especially, the prawns *Caridina nilotica* and dragonfly nymphs. At this size, it is not harmful to stocks of other fish because it feeds on invertebrates. Nile Perch shifts to a predominantly piscivorous diet comprising Mukene, juvenile Nile Perch and Nile tilapia after about 50 cm and finally concentrates on the Nile tilapia after about 95 cm. Large Nile Perch are, therefore, destructive to other commercially important fish. Use of mesh sizes which crop Nile Perch of more than 50 cm might, therefore, be beneficial to the fishery by reducing predation pressure on the two other commercially important fish species in Lakes Victoria, Kyoga and Nabugabo. The size range of Nile Perch given above coincides with the mesh size limit suggested for the Nile tilapia.

2.5.4 The impact of mosquito seines

The other fishery of significant importance on Lakes Victoria and Kyoga is Mukene. This is a small fish which attains a maximum length of about 54 mm although it used to grow to 65 mm before it was heavily exploited. This fish is exploited using a fine mesh mosquito seine net which can also harm stocks of the larger species especially Nile Perch and Nile tilapia. Until 1988, Mukene in the Ugandan waters of Lake Victoria was exploited using a 10 mm mesh seine operated as a beach seine. In 1989, a smaller meshed mosquito net (5 mm) was introduced. This net was operated either as a Lampara net or a scoop net. This mesh size and fishing methods are currently in wide use in Lakes Victoria and Kyoga. There is no fishing for Mukene on Lake Nabugabo although the species is abundant in the lake.

While the 10 mm seine cropped mostly mature individuals, the 5 mm net captures a larger proportion of immature Mukene especially during the period when new cohorts are recruited into the fishery. New cohorts enter the fishery twice a year. First recruitment occurs in the months of April to May while the second one occurs in September. During these periods, the 5 mm mesh net catches high proportions of immature Mukene. Mature individuals dominate the catches only during the months of January to March and July to August.

Fishing for Mukene can have negative effects on juveniles of the larger species. When the Mukene net is operated away from the shore, it mainly catches Mukene with negligible quantities of Nile Perch and Nile tilapia. On the other hand, when it is operated as a beach seine along the shore catches are composed of high proportions of juvenile Nile Perch and Nile tilapia as bye-catch. These nets are therefore detrimental to the fishery when operated as beach seines inshore. Fishing for Mukene should, therefore, be done using the Lampara type lift net operated offshore. Also, over 70 per cent of Mukene caught by the 5 mm seine net are immature and this is directly detrimental to the Mukene fishery. However, the 10 mm mesh net is no longer used on Lake Victoria. It is the 5 mm mesh which is now used. Prohibiting the 5 mm seines without providing a suitable alternative may have negative socio-economic consequences. Further research should be done to identify a suitable size for exploiting the Mukene fishery. As an interim measure and to

avoid further deterioration in the Mukene fishery, mosquito seines of less than 5 mm should not be allowed in the fishery.

2.5.5 Impact of harvesting Nile Perch on Fish Prey

Kitchel *et al*. (1997) used an ecosystem bioenergetic model to examine the effects of harvesting Nile Perch using different fishing methods (large mesh gill nets, beach seines only & gill nets plus beach seines). Nile Perch survives best if there is no fishing. When gill nets are introduced, the number of Nile Perch surviving decreases. There is lower survival when beach seines are used in place of gill nets. The lowest survival occurs when both beach seines and large gill nets are employed.

The effect of predation by Nile Perch on other fish is different under different fishing regimes i.e., if there is no fishing for Nile Perch; if Nile Perch is fished using gill nets only; beach seines only or a combination of gill nets and seine nets. If there is no fishing, Nile Perch total predation is very high and peak predation is inflicted by Nile Perch which are 5 years old. Addition of a gill net fishery reduces the predation rate and addition of beach seine reduces the predation rate further with the lowest predation being recorded when both gill nets and seine nets are used. The combination of gill nets and beach seines reduces predation to 10 per cent of an unexploited Nile Perch population.

When predation on haplochromines was considered, it was observed that large Nile Perch had the greatest impact on haplochromines. Fishing, using large mesh gill nets reduced the predation pressure on haplochromines by removing large individuals from the population. The beach seine fishery reduces the predator populations so much that there is minimal predation on haplochromines. A combined gill net—beach seine fishery reduced predation even further. A shift from a scenario of no fishing to fishing with large mesh gill nets, seine nets and a combination of seine nets and gill nets has similar effect on cannibalism. Cannibalism is highest in the absence of fishing, decreases when gill nets are introduced and is least when both gill nets and seine nets are used.

Any fishery for the Nile Perch benefits the prey through reduction of predation pressure but this will vary depending on the types of fishing gear and method used. While addition of the gill net fishery favours survival of juvenile Nile Perch, the beach seine fishery offers the greatest survival for haplochromines. This is probably the explanation for resurgence of haplochromines stocks in Lake Kyoga following an intensive beach seine fishery for Nile Perch. Similarly reports of reappearance of haplochromines have been reported in the Nyanza Gulf of Lake Victoria due to increase in beach seine fisheries for Nile Perch (Riedmiller, 1994).

The three fishery scenarios produce very different yields. The number of fish harvested is lowest when large gill nets are used but this produces the highest total biomass of Nile Perch harvest. Total biomass of Nile Perch harvested is reduced when beach-seine fisheries are practised. Fishing with gill nets alone provided three to four times greater biomass of fish than that from a combined gill net beach seine fishery. Use of large size mesh gill nets, therefore provide the greatest yield of fish.

2.5.6 Consequences of Different Sizes of Gill Nets on Nile Perch Fisheries

Nile Perch can be managed through a range of options. One option is to set the minimum mesh size of gill nets used. The other option is to set the maximum mesh size of gill net. Either option will have a different impact on the prey population and the Nile Perch stocks in general. Schindler et al. (1998) examined how the use of various gill net mesh sizes would affect harvest and predation rates of Nile Perch by examining two scenarios of Nile Perch harvest. The first scenario evaluated how Nile Perch harvest and predation rates would change when the minimum mesh size of gill net is set in the fishery. The second scenario investigated how both harvest rates

and predation rates would be affected through setting of the maximum gill net mesh size. This analysis was based on the fact that the minimum mesh size gill net recommended for the Nile Perch fishery was 5 inches (Ogutu-Ohwayo et al. 1998) and that the size range of gill nets used on the lake was between 3 inches and 16 inches mesh.

The biomass of fish and the number of individual fish harvested varies when the minimum gill net mesh size is set at different sizes. The biomass harvested first increases with mesh size of the gill net up to five inches and decreases in those of more than 10 inches. Maximum harvest is realised when the minimum mesh size of gill net is 6 to 10 inches.

Use of small mesh gill nets were beneficial to the prey population. Cannibalism and predation on tilapiines declined with a reduction in mesh size of the gill nets. Total predation by Nile Perch did not change with minimum mesh size set at 8 inches mainly because of its declining importance in larger Nile Perch. Larger minimum mesh size produce higher rates of predation on haplochromines.

If the minimum mesh size is set at 5-inch mesh nets as suggested by Ogutu-Ohwayo et al (1998), predation rates by Nile Perch will decrease substantially. Harvest rates will increase as larger gill nets are introduced into the fishery and predation rates on all the important fish will increase. For instance, Nile Perch predation rates on haplochromines would be three times higher when a whole range of gill nets of 5 to 16 inches are used than when nets of only 5 and 6 inches are used.

The range of mesh size of gill nets would also affect the number of Nile Perch that would survive to the breeding size. Female Nile Perch mature at 85 cm total length when about 3 years old. Percentage of Nile Perch reaching 85 cm will decrease with reduction in maximum mesh size of the gill nets. If, for example, the fishing effort was concentrated between 5 and 6 inches, only about 1 per cent of the initial population would reach breeding size. This will affect the capacity of Nile Perch to replenish its populations.

2.6 Other Factors Affecting Nile Perch and the Fisheries

There are a number of other factors that effect the Nile Perch Fishery and the abundance of its prey. These factors need to be controlled for Nile Perch fishery to be sustainable. These include: habitat degradation (pollution and eutrophication) and water hyacinth infestation.

2.6.1 Water Hyacinth

Another problem that has developed in Lake Victoria since alien fish species were established in the lake is the invasion of the lake by an obnoxious water weed, the water hyacinth, *Eichhornia crassipes*. This is a beautiful plant that has been introduced in different parts of the world for its ornamental beauty. Water hyacinth thrives in shallow, sheltered bays that are breeding, nursery and feeding grounds for fish. It can, therefore, affect breeding success and feeding by juvenile fish. The zone below extensive water hyacinth mats is low in oxygen, which reduces habitable space for most fish and other aquatic organisms upon which fish feed. Water hyacinth forms dense populations in areas where nutrients are high and the high pH level in Lake Victoria has enhanced its growth. For instance on Lake Victoria, in Uganda, the biggest hyacinth expanses are in the areas where the city of Kampala releases sewage into the lake and its proliferation must have been supported by over-fertilisation of the lake.

2.6.2 Eutrophication and Pollution

There have been changes in the quality of water in the lakes containing Nile Perch especially Victoria. Eutrophication which refers to over-fertilisation of water has increased in the past three decades (Hecky, 1993). The concentration of phosphorus, which is a key element in plant production has doubled. This has greatly stimulated growth of algae. The rate of production of algae has more than doubled and the quantity of algae produced in Lake Victoria has increased 8 to 10 times (Mugidde, 1993). The type of algae produced in the lake has changed from diatoms to bloom-forming and potentially toxic blue green algae. Much of this algae is not consumed and as it decays depletes the water column of oxygen. This has reduced the volume of habitable space for both the Nile Perch and its prey.

2.7 Role of Refuge in Conservation of Fish Species Diversity in the Victoria and Kyoga lake basins

One of the challenges facing the lakes to which Nile Perch was introduced is conservation of the endemic fish species which have been lost in some part of the lakes due to Nile Perch predation. In Lake Tanganyika, which has four Lates spp and many haplochromine species, most of the haplochromines live among rocky areas where they are probably able to evade predation by Lates spp by taking refuge among the rocks. In Lake Victoria the rock-dwelling species have been least affected by Nile Perch predation (Ogutu-Ohwayo 1990, Witte et al 1992). This suggests that rocky areas can serve as refuge for some haplochromine. Papyrus swamps and other fringing macrophytes also act as barriers to the spread of the Nile Perch since the species cannot survive under low oxygen tension. Some native species which can survive under these conditions can therefore take refuge and survive in these areas. There are also many satellite in the Victoria and Kyoga lake basins which have fish species which were previously present in the main lakes. These satellite lakes can also serve as conservation areas for these species. The satellite lakes within the Victoria and Kyoga Lake basins and structural refuge provided by marginal macrophytes and rocks outcrops are important in conservation of fish species diversity. Satellite lakes and appropriate refuge need to be identified and protected to conserve some of the fish species lost from Lakes Victoria and Kyoga.

2.8 The Law on Management of Fisheries of Lakes with Nile Perch

The Law on Management of Fisheries in Uganda is in the Fish and Crocodiles Act of 1964 and its Statutory amendment. One of the main aspects of the law in regard to harvesting of Nile Perch and the other fish in those lakes with Nile Perch prohibits cropping Nile tilapia of less than 28 cm (11 inches) and Nile Perch of less than 46 cm (18 inches) total length but does not specify the types and mesh size of nets to be used. Observations made by Ogutu-Ohwayo et al. (1998) suggests that the minimum size of Nile Perch permitted to be landed should be 50 cm and not 46 cm as in the Fish and Crocodiles Instrument of 1981.

One of the management problems facing the lakes with Nile Perch and indeed all lakes in Uganda with the exception of Lakes George and Wamala is that they are all open access lakes with no control over fishing activity. For instance, any national, or even a foreigner, has freedom to catch as much fish as he can so long as s/he can afford a fishing licence, which is not expensive. Furthermore, gazetted fish landings are absent, permitting fishers to access the lake from any point making any supervision—even of the limited provisions of the law— extremely difficult.

2.9 Conclusions and Recommendations

The above analysis shows that both human exploitation and availability of food for Nile Perch need to be managed well if the Nile Perch fishery is to remain sustainable and fish species diversity conserved since both fishing harvests and the availability of Nile Perch prey will affect the stocks and survival of its prey. There is, therefore, a need to institute measures that will balance both the Nile Perch stocks and the stocks of its prey. Some of the management measures that would benefit the fishery include:

- enforcement of the law prohibiting the use of seine nets;
- enforcement of the 5 inch gill nets mesh size limit;
- encouraging use of gill nets of 6 inches to 10 inches for Nile Perch;
- controlling fishing effort by controlling the number of fishers, nets, fish processing plants and the capacity of these plants;
- controlling water hyacinth and over-fertilisation of the lakes; and
- involving user communities in development and management of the fisheries resources.

There is also need for a nutritional policy to ensure that adequate fish is available for local consumption.

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TABLE 2.1

Relative importance of fish species by lake in fisheries production (000'MT) in Uganda

	Lakes								*Percentage*
Fish Taxa (Species	*Victoria*	*Kyoga*	*Albert*	*Ed/Geo/Kaz*	*Ntungamo*	*Koki*	*Nile*	*Total*	*Contribution*
Tilapiines	21199.70	50437.10	2122.00	1651.70	17.76	456.20	107.30	75991	36.29
Lates niloticus	68436.70	23091.00	4615.80				54.30	96197	45.94
Rastrineobola argentea	11753.10							11753	5.61
Bagrus docmac	117.30	284.20	1881.30	1836.10			33.00	4152	1.98
Clarias gariepinus	381.00	810.00		445.30	3.48	151.50	47.00	1838	0.88
Protopterus aethiopicus	481.00	4334.00		112840	236.30			6180	2.95
Barbus altianalis		4.30	721.90	20.60			27.70	775	0.37
Hydrocynus				8838.00				8838	4.22
Mormyrids	610.30	853.00						1463	0.70
Alestes spp				2078.10			55.00	21330	1.02
Distribution							21.80	22	0.01
*Labeo victoria*e							27.10	27	0.01
Synodontis afrofischeri							13.50	14	0.01
Total	**102979**	**79814**	**20257**	**5082**	**21**	**8440**	**387**	**209384**	**100**
Percentage	49.18	38.12	9.67	2.43	0.01	0.40	0.18	100	0.05

Source: Fisheries Department, 1994 Annual Report.

TABLE 2.2

The relationship between the length and weight of Nile Perch and mesh sizes of gill net used to catch Nile Perch in Lake Victoria

Length (cm)	*Weight (kg)*	*Mesh size (inches)*
20	0.1	2
30	0.3	3
40	0.8	4
50	1.6	5
60	2.8	7
70	4.5	8
80	6.8	9
90	9.9	10
100	13.7	11
110	18.5	12
120	24.2	13
130	31.1	14
140	39.2	16

Source: Ogutu-Ohwayo (1994) and Ogutu-Ohwayo (1998)

TABLE 2.3

The installed maximum production capacity and the approved fish processing capacity of selected fish processing plants as of 1997 (the names of the plants have been with held) Some of these plants may have expanded their capacity since 1997

Fish factory	*Installed maximum Capacity (tonnes)*	*Approved fish processing Capacity (tonnes)*
1	45	20
2	40	10
3	40	20
4	40	20
5	30	10
6	40	20
7	40	10
8	20	5
9	-	20
10	-	20
11	-	10

CHAPTER 3

FISH PROCESSING FOR EXPORT AND UTILIZATION OF BY-PRODUCTS

TERMS AND ACRONYMS USED

Fish maws	Fish air bladder
Fish frame	The head & skeleton when the fillets are removed
E.U	European Union
Middleman	Fish dealers who buy fish from fishers and sell it to buyers
MFPED	Ministry of Finance, Planning & Economic Development
JETTY	A structure extending into the water for boats to land
UNIDO	United Nations Industrial Development Organisation
MSY	Maximum Sustainable yield
FAO	Food and Agricultural Organisation of the United Nations
UNDP	United Nations Development Programme.
KINALA	Transport boat that collects fishers' catch and delivers it to the landing site.

FISH PROCESSING FOR EXPORT AND UTILIZATION OF BY-PRODUCTS

3.1.0 INTRODUCTION

3.1 Resource Base

The fishery industry of Uganda is based on 42,383 km^2 of lakes, rivers, swamps, dam reservoirs and fish ponds. Uganda possesses 165 natural lakes, the largest and most productive are Lakes Victoria, Kyoga, Albert, Edward, and George. The catch from the lakes has been around 220,000 metric tonnes since 1994. Lake Victoria is Uganda's main fisheries resource, accounting for about 55 per cent of its national catch, with Lakes Kyoga and Albert respectively accounting for 27 per cent and 12 per cent of the total national catch.

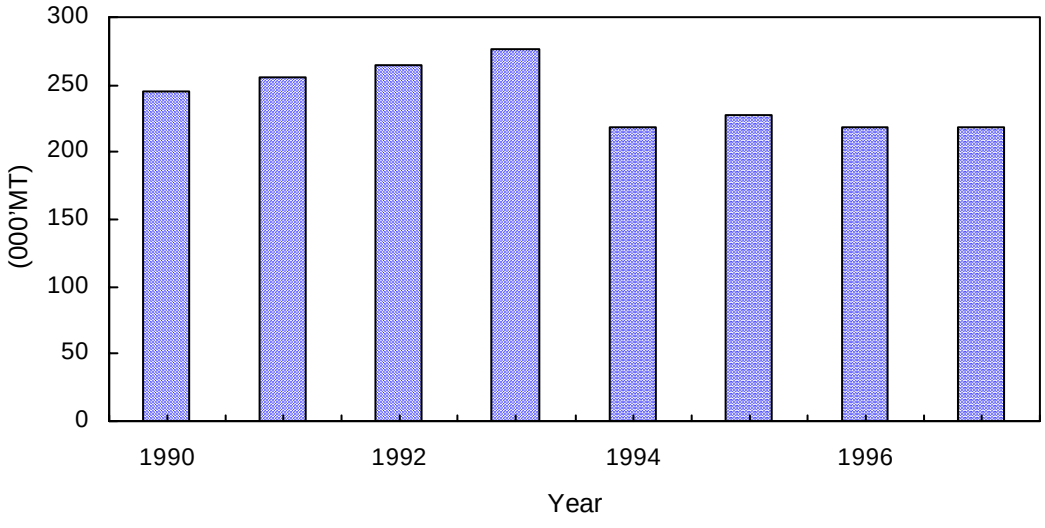
Overall potential fish yield has been conservatively estimated at over 300,000 tonnes p.a.. A study funded by the European Union (EU) is currently being undertaken by the Fisheries Research Institute (FIRI) to establish the present levels of fish stocks in Lake Victoria. Preliminary results are expected sometime in 1999.

The Uganda fishery is purely artisanal, featuring small craft operators using gill nets, seines, long lines and mosquito nets. There are about 17,000 crafts on Uganda waters with 20 per cent of them motorised (Orach-Meza, 1996).

The total catch estimates from the artisanal fishers averages 220,000 tonnes earning over UShs. 70 billion (about US$ 54 million) for the Ugandan fishers. Nile Perch and Nile Tilapia combined, represent the bulk of the catch (Fisheries Department Reports). Figure 3.1 depicts the fish catches in the country from 1990-1997 and reveals that it has been steady at about 220,000 tonnes per year since 1994.

FIGURE 3.1

Fish Catch in Uganda: 1990-1997



Aquaculture (fish farming) activity has seen a resurgence in Uganda lately. There are currently about 4,000 domestic fish farmers working on close to 7,000 ponds of total area of 125,000 hectares. Ugandan Aquaculture started in the period from 1931-1951, with the stocking of Western Uganda's minor lakes that had been previously unproductive (Owori-Wadunde, 1999). Fish farming in ponds, however, started in 1953 with the establishment of Kajjansi Experimental Fish Farm, financed with technical assistance from FAO. The station was established to conduct research in aquaculture, to train farmers and extension agents, and to produce and supply fish seeds for farming.

Aquaculture has great potential for supplying fish in Uganda because at the peak of fish farming in 1968, there were about 11,000 ponds, covering a total area of 410 ha and producing 800-900 metric tonnes (mt) of fish per year (Balarin, 1985—cited in Owori-Wadunde, 1999). However, because of a lack of technical assistance in the 1970s and 1980s, and political turmoil in the same period, fish farming lost its momentum, and by the early 1980s, there were less than 1000 ponds with a yield of only 31 mt per year. The situation has now changed, after realising that fish yield from natural water bodies is on the decline, having peaked at 245,220 mt in 1993. The current yield from nearly 7,000 existing ponds is about 81mt per year and remains largely insignificant compared to the total catch and market requirements. Effort should now be geared towards encouraging medium- and large-scale commercial fish farming to supplement harvest from natural water bodies.

3.1.1 Ugandan Fish Exports

By 1990s, Uganda Fish exports were of a regional nature going through customs posts at Busia, and Kasese. However, beginning 1989, a few companies started exporting limited quantities to Europe. There are now to 11 functional factories. Before 1991, fish processing plants in Kisumu, Kenya were sending insulated trucks with ice to fish landing sites in Uganda in order to collect whole fish and transport them back to Kenya for processing in Kenyan plants. This practice stopped in 1991 when Uganda's Ministry of Trade put a ban on export of unprocessed whole fish. This ban led to an influx of investors coming in to set up factories to process fish that was previously transported to and processed in Kenya.

By 1991 exports to EU markets were about 4,751 tonnes while in 1997 exports were about 4,839 tonnes after declining from 16,396 tonnes in 1996 due to an export ban by EU due to concerns over quality. The main countries in the EU that import Uganda's fish are Belgium, Netherlands, France, Germany and Greece. Also local cross-border trade had a record performance of about 1,515 tonnes in 1990 that subsequently declined to only 418 tonnes in 1997 (see Table 3.4). Figure 3.2 depicts fish exports to EU countries having steadily increased between 1990-96 and had a sharp decline in 1997 due to the EU ban imposed on fish exports from Uganda. The decline in cross-border trade in 1996 and 1997 may be attributed to poor data collection and recording due to thinning of staff by unified extension and retrenchment of field staff from the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), and Districts.

3.2 Movement of Harvested Fish from the Lake to fish Firms

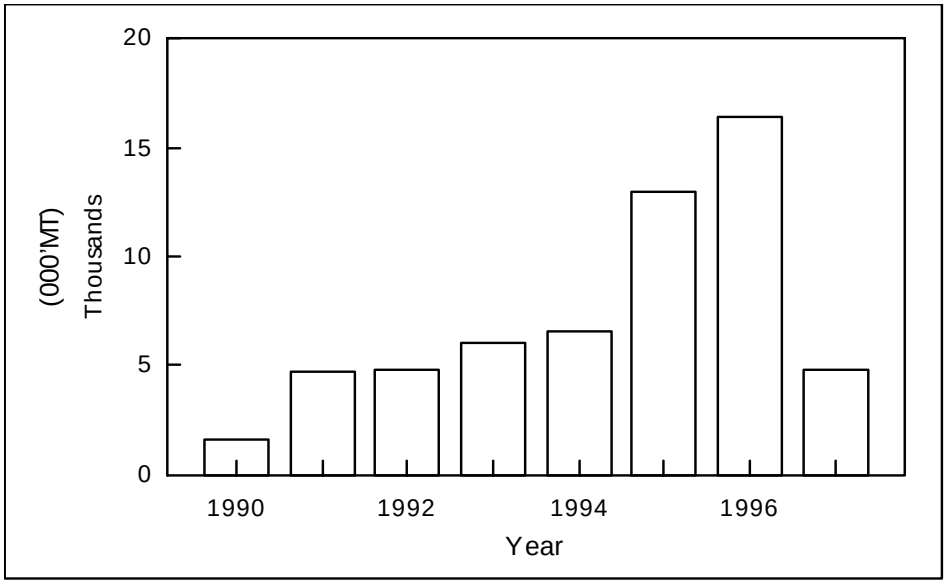
Uganda's Fish industry is an artisanal fishery based on canoes using gill nets and long-lines and traditional gear e.g. basket traps etc. Beach seines are, however, illegally being used in shallow waters. Either before or after landing their catch, fishers primarily sell it to three types of middlemen:

a) Middlemen who buy and sell only at beaches;

b) Middlemen who sell to factories and use insulated boats/ice; and,

FIGURE 3.2

Fish Export from Uganda to the EU: 1990-1997



c) Middlemen who hire transport boats (kinala) to ferry individual fisher's catch to the beaches where it is sold.

Catch delivery to factories depends on whether the factory has its own jetty or not. Factories with private jetties receive fish directly from insulated boats and sometimes from middlemen's open boats. They also receive fish from traditional fishing beaches.

Factories without jetties depend on sending their truck to fishing beaches where they buy fish from the different categories of suppliers. A few factories have made their own insulated boats which go directly to fishers to procure catches and transport them back to the factories.

Not all fishing boats in Uganda are constructed with a fish-hold to hygienically store fish during their fishing operations. Without proper holds the whole catch is exposed on the boat floor. During transportation, the above conditions also prevail. This is made worse by the fact that, in addition to fish, the fishing boat owners also carry other types of contaminating commodities.

There is a positive trend in the industry in which a few insulated boats and ice boats have begun commercial transport operations across the lakes. However, their number is still insignificant and the contribution of existing boats to hygienic transport is seen to be significant if assessed from the perspective of current export levels since each boat carries only up to four (4) tonnes.

Traditional fishing beaches still lack basic infrastructure to handle fish catch. They lack sanitary facilities, jetties, clean water, ice facilities, raised platform for washing/cleaning fish etc.

Fish is simply carried from boats, passed into contaminated waters or sand before being auctioned and loaded on to trucks.

At a few beaches along the shores of Lake Victoria, fish processors have put up semi-permanent sheds made of wood and papyrus mats, or iron sheets, that are used to sort and weigh fish. The lack of clean water at beaches makes it difficult for these temporary sheds to be cleaned. They use the same unclean water from the lake which leads to contamination.

The introduction of insulated trucks with ice has tremendously improved the transportation of fish from beaches to the factories by reducing the rate of fish spoilage. However, the poor state of access roads to the landings has a bearing on the transport of fish to processing sites. Due to poor road conditions the trucks take a long time to reach factories. Moreover, during the rainy seasons a fair number of trucks get stuck in roadway mud giving rise to spoilage and a loss of potential earnings to factories.

3.3 Quantity of Fish Purchased by Each Factory

Table 3.1 shows average quantities of fish purchased by each firm on a weekly basis between July and September 1998.

TABLE 3.1

Fish Purchases by Processing Firms

Firm	*Quantity purchased (tonnes)*	*Market Share*
1. Gomba fishing Industry	124.6	15
2. Green Fields	85	10
3. Marine and Agro	43	5
4. Byansi Fisheries	18	2
5. Uganda Marine Products	28.25	3
6. Ngege Ltd.	106	13
7. Clovergem	70	8
8. Uganda Fish Packers	150	18
9. Hwan Sung	215	26

The data above shows Hwan Sung as the market leader at 215 tonnes, followed by Uganda Fish packers and Gomba Fishing Ltd. Byansi and Uganda Marine are up coming industries in the sector.

The quantity purchased during a given period fluctuates depending on a number of factors:

a) Availability of the raw material

b) The export orders available

c) Storage capacity of the factory

d) The factory cash flow

TABLE 3.2

Fish By-products as a Percentage of a Whole Fish

Description	*Percentage*
Whole (rejects)	2.0
Fish Frames	42.1
Skins	6.3
Red Meat	4.4
Fish Maws	2.0
Rejects (Fillets)	0.5
Fats	3.0
Fillets (good quality)	38.5
Others	3.2
Total	**100.0**

TABLE 3.3

Fish and Fish Product Export Share in National Exports

Fish & Fish Products	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
	0.72	2.69	3.42	3.18	3.18	3.70	5.06	2.6

Source: Statistics Dept., MFPED

3.4 Utilisation of Fish by-products after Processing

As can be seen from Table 3.2, about 60 per cent of the fish bought by the processing firms ends up in form of non-exportable by-products. These are bought by individual dealers who transport them on open pick-up trucks to various markets in Kampala and its surrounding districts. They are sold to two categories of consumers: those who buy them for direct consumption, and fish smokers who smoke and sell them. Only 40 per cent end in the export markets as fillet (38 per cent) and fish maws (2 per cent). Fish maws are usually bought from the fish processing companies by individuals or companies. They are cleaned, fats removed, sun dried and exported to the far east mainly Hong Kong, Singapore and Taiwan.

The skins are usually descaled, rolled and then smoked. Then they are sold for local consumption. The red meat and belly flaps are rolled into a fish ball then smoked or fried in fish oil and sold in that form. The fats are melted to produce cooking fat which is used for frying fish and other fishery products.

Gomba Fishing Industry has been producing fish meal out of the by-products and the fish meal is used in the production of animal feeds. The oil extracted from the fish meal was being used for soap production. Gomba Fishing Industry has a pilot project supported by UNIDO which has been tanning Nile Perch skins to produce leather.

Generally the consumption of fish by-products instead of whole fish has been on the increase as fish exports have risen. This trend seems to be as a result of the rising fish prices due to the high demand for fish by processing firms that leaves only fish by-products for the low-cost domestic market.

3.5 Extent of Post-Harvest Loss at Harvest, Processing and Export levels

Harvest: The Ugandan fishers do not incur post-harvest loss. They normally sell all their fish, including those in an unwholesome state (i.e., in a state of deterioration yet still acceptable to some consumers).

Middlemen: This group too does not incur any loss in their transactions. They normally sell first quality to the factories with what remains is sold to local consumers. What they fail to sell to local consumers is sold to artisanal processors at landing sites.

Processing Plants: Factories get rejects in two ways: at landing sites and at factories. Rejects at landing sites are returned to suppliers to look for alternative markets. Rejects at the factories are sold together with by-products.

At Export: Once in a while a consignment of fish may be rejected at destination because of failure to meet established standards, e.g., bacterial count or presence of pathogenic micro-organisms. Rejection of fish at destination is intermittent, having no established pattern. Quite often the responsible factory is reluctant to give information about rejected fish. Such information is usually obtained from the importing country.

Post harvest loss in the industry has previously been estimated at 20 per cent. However, this is now contestable, as recent observations show that there is negligible post-harvest loss in the sector, notwithstanding the issue of quality at the various levels.

5.6 Ways to Improve the Utility of Harvested Fish: Deriving Maximum Value

a) The gill net catch should be removed from the nets while fish is still alive.

b) Fish in transit should be protected from adverse weather immediately after capture.

c) Implementation of hygienic practices of fish handling e.g., use of ice, clean water and observation of industrial food standards.

d) Percentage flesh recovery should be increased by removing remaining flesh on the carcass after filleting. This can then be used to produce other products, e.g., fish fingers, fish balls etc.

e) Using crushed fish bones to make animal feeds.

f) Using often discarded by-products, e.g., intestines, fins and blood to make animal feeds.

5.7 Recommendations

- Capacity building—the need of a training program for fishers, middlemen and processors on aspects of quality.
- Encourage the private sector to construct improved fish handling facilities at landing sites.
- Encourage processing firms to undertake vertical integration—produce animal feeds from fish processing discards.

TABLE 3.4

Fish Exports from Uganda by Destination

	Exports to EU Countries		*Local Border Exports*	
Year	*Quantity (Tonnes)*	*Value (Million US $)*	*Quantity (Tonnes)*	*Value (Mission US $)*
1990	1589.5	1394.4	15145	266.6
1991	4751	5308.7	1080	1.1
1992	4831	6450.5	587	0.6
1993	6037.1	8806.9	1145.2	1.1
1994	6563.7	14768.9	1924.1	310.1
1995	12970.9	25902.8	2040	842.5
1996	16396.4	39780.9	33.2	0.3
1997	4839	17196.9	418.4	0.4

Source: Fisheries Department, MAAIF, Entebbe.

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CHAPTER 4

AN ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF INDUSTRIAL AND FARM WASTE DISCHARGES INTO WATER BODIES

ABSTRACT

Rapid industrialisation in Uganda resumed in 1990 following the successful implementation of a number of structural adjustment measures in the economy. Considerable industrial output has since been recorded in the manufacturing areas of brewing, soft drinks, sugar, oil, soap, textiles, food processing—particularly fish and meat processing, leather, and tobacco.

Most of these growing industrial sub-sectors, however, produce large quantities of very offensive wastewaters. In pursuance of the rapid industrialisation policy, therefore, it is of utmost importance to increase awareness—both in government and the private sector—of the possible undesirable short- and long-term effects of uncontrolled industrial wastewater discharges to the environment.

Sector specific details on waste generation, treatment and disposal are included in this report. The report also outlines a workable policy for the regulation of the industrial discharges. It is important to note, however, the need to develop manpower and technological capacity to implement the policy.

The study produced the following findings;

(i) at least eight categories of industries and other establishments in Uganda currently generate waste of serious and immediate environmental consequence. They include breweries, tanneries, textile factories, sugar, oil and soap works, meat and fish processors, manufacturers of soft drinks and flower farms.

(ii) industries and other establishments do not treat the problem of waste management with seriousness. This is evidenced by the fact that few industries meaningfully pre-treat their wastewaters. Instead, most of them discharge raw untreated wastewaters to the environment or into public sewers.

(iii) there are currently no legally binding industrial effluent discharge standards, there only being draft regulations and a draft standards schedule.

(iv) even after enacting new regulation and implementing standards, enforcement would likely remain inadequate due to a lack of financial resources and manpower in the governing institutions. The latter also lack monitoring equipment, transport and analytical facilities.

The following measures are proposed to improve the environmental performance of industries in Uganda;

(i) Application of the proposed environmental standards needs to be implemented with a set of reasonable and enforceable regulations. Pollution control agencies should be represented on industrial licensing boards to ensure that environmental considerations are continually taken into account during implementation and monitoring.

(ii) In line with the polluter and user pays principles, government should charge manufacturing firms and other polluters at a level that causes them to improve their effluent management practices. A combined standards and economic incentives approach based on the Malaysian Model for the Control of Industrial Effluents (Section 10 of this study) should be adopted to advance implementation and promote compliance.

(iii) Training in wastewater management should be given a priority. Complete training packages should be developed and offered to industrial technicians and managers, and

also the general public as an awareness and publicity drive for good environmental performance.

(iv) Advice on clean production processes should be freely provided to investors by the main investment and environmental agencies in Uganda. In like manner, firms should be willing to provide information free of charge, to researchers who are seeking better management of the environment.

(v) Standards should increasingly be viewed in three scenarios, first as means of industrial promotion and improvement; second, as a means to protect the health and safety of all citizens; and third, as a partnership between consumers, industrialists, and public regulatory agencies.

(vi) As part of a monitoring strategy, documentation of input-output data on chemical utilisation by manufacturers should be expedited to help monitor releases of such chemicals into the environment.

(vii) All new industrial plans should be accompanied by an environmental impact assessment (EIA) of the likely effects of the proposed development. The EIA should normally detail a management and monitoring plan to guide waste management.

ACRONYMS AND ABBREVIATIONS

BOD3, BOD5:	Biological Oxygen Demand after three and five days respectively
COD:	Chemical Oxygen Demand
DWD:	Directorate of Water Development
NEMA:	National Environment Management Authority
NWSC:	National Water and Sewerage Corporation
ODS:	Ozone Depleting Substances
pH:	refers to the level of acidity or alkalinity of a medium
SS:	Suspended Solids
UFD:	Uganda Fisheries Department
UFSTL:	Uganda Fish Skin Tannery Limited
UNBS:	Uganda National Bureau of Standards
UNIDO:	United Nations Industrial Development Organisation

A REVIEW OF THE ENVIRONMENTAL IMPACTS OF INDUSTRIAL AND FARM WASTE DISCHARGES INTO WATER BODIES

4.1.1 INTRODUCTION

Uganda's economy is estimated to have grown by 5.5 per cent during the 1997/98 fiscal year. This was a slight improvement over the growth rate of 5.2 per cent in 1996/97 when it began to slow down from 10.5 per cent and 8.1 per cent in the previous two years respectively.

The rapid growth in the economy, however, had to be supported by increased exploitation of natural resources and processing capacity. Increased processing capacity generated an increasing amount of wastes while increased demand for manufacturing inputs implied progressively higher raw material prices. This paper will therefore assess the pollution impacts of increased industrial activity. It will begin by documenting the pollution impacts of the fish processing sub-sectors, and then discuss the contribution of other processing facilities to effluent loading of the main water bodies in Uganda.

4.1.2. CONCEPTUAL FRAMEWORK

The manufacturing sector is rapidly expanding in Uganda. The sector in 1996/97 grew by 14.2 per cent p.a. with the index of industrial production experiencing growth of almost 17 per cent from 330.9 in December 1995 to 385.8 in December 1996. The index of the manufacturing sector based on eight major sub-sectors (sugar, beer, soft drinks, cigarettes, textiles, cement, electricity, soaps and food oils) rose from 230.5 in February 1996 to 303.5 in February 1997 registering an increase of 31.7 per cent.

The above developments, however, had various environmental implications. The main environmental concerns included gas emissions, effluent discharges and resource over-exploitation. Specifically, cases of gas and dust pollution were reported for the coffee, cotton, plastic, and cement processing firms; while cases of poorly managed effluent discharges were reported in the fish processing, breweries, tanneries, textiles, sugar refineries, oil and soap, paint, and foam industries.

To address the above pollution problems, the government prepared air and water quality standards; standards for the discharge of effluent into water; standards for the control of noxious odours, noise and vibrations; oil quality standards; and other pollutant discharge levels in their sectors. The government also moved to draft effluent discharge regulations to promulgate the effluent discharge standards.

This study sought to analyse the effluent discharge contributions of the fish processing, brewery, tannery, textile, soap, paint, soft drinks, agrochemical and flower farming industries against the proposed effluent discharge standards with a view to proposing policy measures to improve the environmental performance of industry.

4.1.3 OBJECTIVES OF THE STUDY

The study aimed to assess the problem of waste discharges into water bodies by:

(i) determining the number and type of operational fish processing firms and their location in relation to water bodies;

(ii) determining the number and type of operational non-fish processing firms and their location in relation to water bodies;

(iii) characterising effluent discharges and determine the likely level and effects of compliance with the proposed effluent discharge standards and regulations;

(iv) assessing current waste management measures and practices with an aim to make short- and long-term policy recommendations for the management of wastes and discharges, particularly those in proximity to water bodies.

4.1.4 ECONOMIC POLICY CHANGES AND THEIR IMPLICATIONS FOR THE MANUFACTURING SECTOR

The Government of Uganda repealed the Foreign Investment (Protection) Act and the Foreign Investment Decree (1972) in 1991 and replaced them with the Investment Code (1991). The main function of the new code was to create incentives for foreign investors and to establish the Uganda Investment Authority.

The incentives enshrined in the Investment Code enabled the share of the manufacturing sector in the GDP to rise from 5.8 per cent in 1986 to 9.0 per cent in 1997. This growth was further demonstrated by growth in the manufacturing sector when a growth rate of 13 per cent was recorded in 1997/98 compared to 13.5 per cent and 19.7 per cent in 1996/97 and 1995/96 respectively. This growth occurred despite disruptions to vital infrastructure (feeder roads, bridges and raw material production) associated with the El Nino weather phenomenon occurring during this same period.

Similar growth was reflected in the fish processing sub-sector particularly after 1989 when industrial scale fish processing resumed. The sector actually grew from two processing facilities in 1991 to twelve in 1995 with a total raw materials input requirement of 73,000 tonnes p.a. (UFD, 1996).

With this increase in fish processing activity, fish products grew to become large foreign exchange earners of the Ugandan economy. Fish exports increased from 1,664 metric tonnes—worth about US$ 1.4 million in 1990—to 10,260 metric tonnes—worth about US$ 30 million in 1994. In 1996, further growth in the fisheries sector raised this figure to US $ 45 million, elevating fish exports to become the second largest foreign exchange earner after coffee (MFPED, 19998).

Without appropriate management instruments in place, this growth in the fish processing sub-sector increased the fisheries sector's contribution to pollution in the country. The sustainability of the sector was therefore undermined.

4.1.5 ENVIRONMENTAL PERFORMANCE OF MANUFACTURING FIRMS

4.1.5.1 FISH PROCESSING PLANTS

This category of processing plants produces chilled and frozen fish fillets for export to mainly European markets and to markets in the Middle East, Japan, China and Korea. The plants process Nile Perch (Lates niloticus) and Tilapia (Oreochromis niloticus). The principal fish processing plants of environmental concern in the Lake Victoria area include:

(i) Four Squares Ltd. in Kisubi on the shores of Lake Victoria;

(ii) Greenfields (U) Ltd. in Entebbe also on the shores of Lake Victoria;

(iii) Ngege Ltd in Luzira, near LakeVictoria

(iv) Marine and Agro Export Processing Co. Ltd in Jinja on the shores of Lake Victoria;

(v) Hwang Sung Ltd. in the Ntinda Industrial area in Kampala;

(vi) Gomba Fishing Industries Ltd. in Jinja on the shores of Lake Victoria;

(vii) Uganda Marine Products Ltd. in Kanyanya off Gayaza Road, Kampala

(viii) Victoria Fresh Foods Ltd. in Munyonyo on the shores of Lake Victoria;

(ix) Clovergem Fish and Foods Ltd. in Entebbe on the shores of Lake Victoria;

(x) Uganda Fish Packers Ltd. in Nakawa Industrial area in Kampala;

(xi) Masese Fisheries Ltd. in Masese in Jinja.

4.1.5.2 GENERATION OF WASTEWATER

The following is a general description of the process flow and the process waste contributions at each stage of processing. Plant specific details are provided in Appendix I.

Fish processing plants in Uganda use about $80m^3$ of water per day on average. Most of the water used is for process water that eventually becomes industrial wastewater. Most of the processing plants obtain water from the public water supply system. Additionally, some plants have alternative emergency water supply lines.

Fish processing involves a number of processes. The section below describes the processes and their contribution to industrial wastewater.

(i) Preparatory work

On receipt of fresh fish, the fish is scaled and washed with brushes under chilled running water. This is followed by selection and grading of the fish according to size and quality, before it is manually cut into fillet. A lot of water is used to flush and wash the fish and utensils. The wastewater resulting from this process is thus loaded with scales, fish off-cuts and fat and has a high BOD and suspended solids contents.

(ii) The skinning process

After filleting, the fish fillet is transferred to the skinning machines for skinning. Skinned fillets are thereafter manually trimmed and washed under running chlorinated water, before getting packaged into cartons for freezing at -40°C or chilled in cold storage at -18°C.

(iii) Quality control

Most of the processing plants operate well-equipped laboratories that carry out visual checks, organoleptic tests, TVB-N tests, tests to verify chemical/pesticide residue loads, and tests to establish the level of bacteriological load. A number of chemicals including sodium hypochlorite solution (liquid chlorine 10 per cent p.v.); non-scented liquid soap, oxonia solution, Vim-powder, and agar media are used in the above quality management and control tests. They are however, eventually disposed of in the water without proper treatment.

(iv) Refrigeration

Refrigeration is a largely dry process that could generate ODSs. ODS management is outside the scope of this report.

4.1.5.3. MANAGEMENT OF WASTEWATER

Two out of the eleven fish processing plants in the Lake Victoria area have fair to good wastewater treatment facilities (Gomba Fishing Industries and Clovergem Fish and Foods Ltd). The remaining nine plants have no wastewater treatment facilities and dispose untreated wastes into the environment. The wastewater treatment plant at Gomba Fishing Industries, however, is poorly maintained, implying that effectively, only Clovergem Fish and Foods Ltd. adequately treats its wastewater before discharging it to the environment.

Characteristically, fish processing wastewater treatment plants have the following unit operations:

They have central drainage systems to drain process and sanitary wastewater into a wastewater treatment facility. The wastewater treatment facilities may handle up to 100m3 capacity of wastewater. The above capacity should handle the $80m^3$ daily wastewater generation per plant. Wastewater treatment involves the following stages:

(i) primary sedimentation;

(ii) lifting and equalisation;

(iii) screening;

(iv) oxidation;

(v) final sedimentation;

(vi) chlorination;

(vii) slime/sludge thickening.

Primary Sedimentation

This stage aims to separate out large sediments before they are sent to the desiccation beds. Wastewater from this facility is then sent on to the lifting tank.

Lifting and equalisation

In the lifting and equalisation process, the organic load is distributed in the effluent evenly before screening.

Screening

At the screening stage, solids larger than 2 mm in diameter are screened off. The suspended solids are then pumped into sand beds where the liquid component percolates living solid waste comprising of mainly fish scales. The scales are thereafter disposed of in Municipal Disposal Facilities. In case of screening inefficiency, provision is usually made for reverse pumping to ensure that sufficient screening is attained.

Oxidation

In the oxidation tank, three air blowers are used to aid aeration. Retention time in this facility is usually 48 hours.

Final Sedimentation

At this stage final sedimentation takes place before the effluent flows to the discharge tank where chlorination will take place.

Chlorination

At this stage, the wastewater is perfectly purified and only needs bacterial sterilisation. Chlorine solution is then applied before water is discharged into the public sewer system or the lake in other cases. To discharge wastewater, fish processing plants have to seek discharge permits from the Directorate of Water Development (DWD) in compliance with the Water Statute of 1997.

Slime/Sludge thickening

In this process, excess water is removed in desiccation beds. Two beds are normally provided for the purpose. The drained water is usually re-conveyed into the lifting tank before further purification takes place.

4.1.6 ENVIRONMENTAL IMPACTS OF THE FISH PROCESSING SUB-SECTOR

Most fish processing plants studied had fair to adequate screening facilities. However, they had the potential to develop screening inefficiencies due to poor maintenance.

The aeration basins have an average retention time of 10-12 hours. Some of the waste treatment facilities have aeration compressors and a considerable build-up of micro-organisms, others, however, had poorly aerated treatment facilities implying low bacterial biomass build-up and hence partial oxidation of the effluent.

This study noted that effluents from the aeration basins in one facility settled into vertical flow settling tanks of $12m^2$ area. On the basis of a 24 hour a day plant operation, the surface overflow rate was noted to be 0.3-0.4 $m^3/m^2/hr$. This rate of overflow was found to be too fast to allow adequate oxidation of the effluent.

Effluent discharge from the processing plants contain chlorine. The chlorination of the wastewater introduced new problems. Chlorine combines with organic compounds to produce chlorinated organic compounds, some of which are harmful to human health. Furthermore, chlorinated organic compounds are difficult to eliminate through conventional water treatment works, implying that they remain in the water even if such water is treated for domestic use. Use of chlorinated water in the sector should therefore be reviewed.

This survey revealed that most fish processing plants disposed of effluents after treatment of BOD, conductivity, pH, and total suspended solids of 300 mg/l, 1045 (S/cm, and 10 and 30mg/l respectively. Compared to maximum permissible discharge limits (Standards for Discharge of Effluent or Wastewater) the pollutant levels were found to remain quite high despite treatment (maximum limits being BOD5 = 50 mg/l, pH = 6-8, total suspended solids = 100mg/l).

The study noted that some plants did not treat their wastes at all. Besides causing offensive odours in public water supplies that have intake points close to disposal points, the wastewaters are also associated with eutrophication of the lake leading to the overgrowth of water hyacinth and algal blooms on Lake Victoria.

4.2 NON-FISH PROCESSING PLANTS

4.2.1 BREWERIES

There are two breweries in Uganda, the Nile Breweries Ltd. in Jinja, and Uganda Breweries Ltd in Luzira. Both breweries are located on the shores of Lake Victoria and generate very large quantities of concentrated wastewater originating mostly from the bottle washer, washing out of yeast, barley and sorghum from storage bins, and the cleaning out of fermentation vats and the various beer storage vessels and conduits in the brewery. The other source of wastewater are dis-

charges from boilers. This is periodic and clean, but of high temperature, which causes thermal pollution.

The wastewater from the brewing industry is characterised by high suspended solids, BOD, and depending on how the different waste streams are mixed, high pH and temperature levels as well. Brewery wastewater also contains high concentrations of long-chain hydro-carbons. These industries are also characterised by irregular wastewater releases, leading to shock hydraulic and organic loads in receiving waters and wastewater treatment works.

Characteristically, the BOD and suspended solid loads in the wastewater generated by Nile Breweries and Uganda Breweries Ltd. exceeded 3500 mg/l, had a pH above pH 11 and was discharged raw without any form of pre-treatment into Lake Victoria.

4.2.1.1 UGANDA BREWERIES, PORT BELL, KAMPALA

The factory is located at Port Bell in Kampala. It produces about 17,000 crates of beer per day at full capacity. The factory takes its water supply from the public system. The main raw materials are barley, yeast, hops and sorghum, most of which are imported.

Wastewater Production Characteristics

Uganda Breweries Ltd. produces an average of 3,750m^3/day of wastewater of the following characteristics;

	Characteristics			
Source	*BOD level*	*SS*	*pH*	*electrical conductivity*
Bottle washer	toxic level	17mg/l	10.2-11.6	418-785uS/cm
Fermentation vat	3,494mg/l	3033+299mg/l	5.4-6.5	213-386uS/cm

Note:Wastewater flow from the fermentation vats was found to vary widely on the same day, implying an equally variable hydraulic and organic load and associated shocks.

Wastewater effluent from Uganda Breweries Ltd is currently discharged untreated into the inner Murchison Bay. The waste stream finds its way directly to the open body of the water in the bay. There is evidence of fish kills in the immediate locality of the effluent following discharges of fermentation vat and storage bin wash outs. This is obviously due to the de-oxygenation of the water due to heavy organic loading, the effect of the high pH and temperature of the water.

The environmental impacts of the discharges are measured against the proposed maximum permissible discharge limits indicated in the table below.

Storage bin wash out	*Maximum Permissible Level*	*Sample Pollutant Level*
BOD	50mg/l	735mg/l
SS	100mg/l	1,490mg/l
pH	7	4.9-6.3
Electrical conductivity	-	110-620uS/cm
Bottle washer		
BOD	50mg/l	none due to excessive toxicity
SS	100mg/l	17mg/l
pH	7	10.2-11.6
Electrical conductivity	-	418-795uS/cm
Fermentation vat washout		
BOD	50mg/l	3,494mg/l
SS	100mg/l	3,033+299mg/l
pH	7	5.4-6.5
Electrical conductivity	-	213-386uS/cm

4.2.1.2 NILE BREWERIES LTD., NJERU

The factory is located in Njeru Town Council near Jinja. The brewery currently produces about 20,000 crates of lager a day and is expanding installed capacity following a partial share buy-up by South African Breweries (SAB). Like Uganda breweries, the main raw materials are barley, sorghum, yeast and hops, most of which are imported. The factory obtains its water supply from the Nile and has a private water treatment unit. The plant produces 18,000-21,000m^3 of wastewater per day.

The wastewaters are currently discharged untreated into the Nile. Previous laboratory analyses indicated that the wastewater had high levels of BOD and suspended solids (400mg/l and 60mg/l respectively)

4.2.2 MUNICIPAL ABATTOIRS

Three main city abattoirs warrant the concern of this report. They include the Municipal Abattoir in Kampala, the Uganda Meat Packers Abattoir adjacent to it, and the Municipal Abattoir in Jinja. Municipal abattoirs are facilities where livestock is slaughtered, dressed, inspected and their meat is sold. The main water use in abattoirs is to clean and wash out dirt. The wash out normally contains blood, offal wastes, waste meat, bones, fats, and grease. The water usage and strength of the wastewater vary according to the number of animals slaughtered per day and whether the blood is recovered or simply discharged as waste. The present practice is to discharge the blood into the waste streams.

The wastewater characteristics from the three major abattoirs are as follows:

Municipal Abattoir, Kampala	*Maximum Permissible Level*	*Sample Pollutant Level*
Wastewater Discharge	-	45m^3/day
BOD	50mg/l	2,500mg/l
SS	100mg/l	800mg/l
Uganda Meat Industries, Kampala		
Wastewater Discharge		68m3/day
BOD	50mg/l	2,750mg/l
SS	100mg/l	800mg/l
Municipal Abattoir, Jinja		
Wastewater Discharge	-	14m^3/day
BOD	50mg/l	3,000mg/l
SS	100mg/l	700mg/l

The wastewaters from the above facilities are discharged untreated into the public sewerage treatment facilities at Bugolobi in Kampala and Tirinya in Jinja. The facilities were found to perform poorly, the poor performance being attributed to overloading of the plant, the poor condition of the operational units, and the excessive strength of the sewage. This excessive strength will get worse as the effluent load from abattoirs and other serviced industries increases.

4.2.3 NYANZA TEXTILE INDUSTRIES

Nyanza Textile Industries Ltd. was assessed in this category of manufacturing plants. The facility is the largest textile industry in Uganda. It has an average monthly labour force of 400 workers and an installed production capacity of 100,000 linear metres of cloth per day. The factory currently operates at full installed capacity. It obtains its water supply from the River Nile, and has its own water treatment plant.

Wastewater Production and Characteristics

The factory discharges up to 10,000m^3 of process wastewater per day. The wastewater has the following characteristics:

Parameter	*Value*
BOD_5	600mg/l
SS	140mg/l
Temperature	80oC
pH	11
Colour	bright green colour

The factory used to pre-treat its waste to remove toxic metals, pH, suspended solids, colour and some of the BOD through chemical coagulation, pH adjustment, and sedimentation. It also provided balancing storage to mix the wastes and cool them. This plant has however, been out of operation for over 25 years. At present the factory, therefore, discharges raw wastes into River Nile. Whereas no serious questions have been advanced on this issue because the flow in the Nile is high (630m^3/s), and therefore provides a high dilution rate, there is still urgent need to enforce discharge standards into the river system. This is because the level of faecal matter in the water for domestic usage, and the level of toxic metals and substances for industrial usage, need to be regulated. Besides this, the growth of white water rafting on the Nile implies that floating matter and coloration the water have negative aesthetic impacts. Furthermore, low concentrations of toxic metals originating from textile industries concentrate in the food chain and reach toxic levels in the tertiary level of the food chain.

Laxity in discharge requirements at this location has already been blamed for the relocation of polluting industries to this point. There is therefore an urgent need to better enforce the effluent discharge standards for water and land at this location.

4.2.4 LEATHER AND TANNING INDUSTRIES

A number of establishments dealing in hides, skins and leather have been established and operating in Uganda for over ten years. Most of them deal in making leather wears or packing hides/skins for export. Some of the hide exporting establishments preserve hides in chemicals that contain arsenic, and generally discharge the liquor to storm water drainage or foul sewers. Arsenic is toxic. These problem will become significant as the numbers these factories increases.

Of more important environmental significance are leather tanning industries. There are currently two tanneries in operation in Jinja, while the others in Kampala and Mbarara have been closed due to poor environmental performance.

Tanneries produce very offensive wastewaters resulting from the following plant processes:

(i) ***Soaking and cleaning of hides***

This process involves the application of detergents and bactericides. The resultant liquor containing detergents, animal hair, waste meat and fat is drained as waste. The waste has high BOD levels, suspended solids and is toxic to micro-organisms.

(ii) ***Unhairing of hides***

To remove hairs, sodium sulphide and lime are applied to the skin/hide. This completely dissolves the hair. The waste liquor has a high pH (12-13), and BOD resulting from dissolved hair.

The waste is also dangerous and toxic to animals and plants, due to its high pH and the sodium sulphite content.

(iii) ***Fleshing***

This involves removal of remaining meat and fats from the hides. The hides are treated with ammonium sulphate to reduce fats and proteins from the hides. The resulting liquor is washed to waste. The waste stream has a high BOD resulting from dissolved organic materials (fats and proteins), and unstable suspended material consisting of fleshings.

(iv) ***Tanning Process***

This process involves the addition of water, salt, acid and chromium sulphate. The pH of the liquor drops to about 3. The resulting liquor is drained to waste. The waste stream is toxic due to its chromium content and high salinity, corrosiveness and acidity.

(v) ***Finishing***

This involves various processes including shaving, splitting, drying, conditioning, kneading, dyeing, printing etc. The main wastes here include dye house liquor. This contains heavy metals, colour and possibly dissolved and suspended organic material.

Chemicals used for the tanning, crusting, dying and finishing of leather products are as follows:

Process	*Chemical Application*	*Remark*
Tanning	Bactericide, Sodium Sulphide, Lime, Sodium Chloride, Ammonium Sulphate, Sodium Bisulphate, Formic Acid, Sulphuric Acid, Chrome Sulphate, Sodium Bicarbonate	
Crusting	Wetting Agent, Bate, Sodium Bicarbonate, Sodium Frmiate, Fat Liquor, Basyntan, Formic Acid, Ammonia	
Dying Chemicals	Ammonia, Dye, Fat Liquor	
Finishing	Aerylic binder, Polyurethane binder	

Two tanneries were assessed to highlight the specific raw material and environmental implications of tannery operation indicating the following discharge characteristics;

Parameter	Value
Sulphides	present
Permanganate value	80mg/l
BOD5	660mg/l
pH	6.5
Colour	blue/grey

4.2.5 SOFT DRINKS

The soft drinks industry produces large quantities of wastewaters with organic loads comparable with domestic wastewater. The BOD sometimes reaches 450 mg/l. The pH may sometimes

be high, reaching a value of 11. These wastewaters originate from the bottle wash line and washings from the syrup rooms. All the soft drinks factories in Uganda do not provide any treatment beyond inadequately designed septic tanks and/or soak aways. Some actually discharge into storm water drain systems. Discharge of such organic loads without pre-treatment is detrimental to natural water bodies, yet with some pH correction, the discharges would be acceptable to public wastewater treatment plants.

The location of the factories implies that the wastewaters eventually find their way into the inner Murchison Bay of Lake Victoria. Wastewater characteristics have an average BOD level of 450-500mg/l, an SS level of 30—50 mg/l, and a pH level of 10.

4.2.6 OIL AND SOAP INDUSTRIES

The main industrial categories of concern in this group are the edible oil and soap processing plants. They produce comparatively small quantities of very strong wastewaters. The BOD, suspended solids and oil/grease concentrations in the wastewaters however, can be as high as 25,000-30,000 mg/l, 800-1000mg/l and 5000-6000 mg/l respectively. The pH of the wastes may be as high as 12. Most of the plants produce both oil and soap. None of them provides any form of treatment to their wastewater.

Mukwano Soap Industries in Kampala for example uses about 60m3 /day of water and claims to re-use it. It claims therefore purports not to generate any wastewater—a seemingly unlikely claim. The National Water and Sewerage Corporation has not permitted the plant to connect to public sewers. It appears that the plant discharges into the sewer illegally or into storm water drains. This contributes to the pollution of the inner Murchison Bay.

4.2.7 FLOWER FARMS

Commercial cut-flower production started in Uganda in 1992 as part of a USAID/IDEA, ANEPP project. Since then, production has expanded steadily. Export value grew from 27 billion to 61 billion shillings between 1995 and 1996, although there was a fall in value in 1997 to 12 billion shillings due to the El Nino weather phenomenon.

The main cut-flower farms are located within 45km of Kampala and Entebbe Airport. Three companies are located in Mukono District. Projections indicate that due to its requirement for high investment and skills, cut flower production will remain largely an estate farm production system. However, significant spreading of the activity to outdoor outgrowers using suitable species has been encouraged. This is reflected in the current estates' farm policy of promoting outgrowers by providing them with technical and marketing services (Bagoora, 1996).

Flower farming has a number of environmental implications, among them, the possibility of encroachment on wetlands, forests and open rangelands by the farms; and the possibility that flower farming could unduly out-compete other crops for farmer resources. The impact on production methods, however, is by far the most important impact of cut-flower growing on the environment. Besides the impact of tilling the land using tractor ploughs which may not be so serious due to the small area normally opened up, cut-flower growing involves heavy use of agrochemicals at every stage of production including packing for export.

A survey of Nile Roses Ltd, for example, indicated that a total of more than 100 different types of chemicals, many of them very toxic, are available for use to solve 12 different problems ranging from soil fertility to control of the numerous pests and diseases that attack cut-flowers. Notably, the control of nematodes through fumigation of soils, and control of mildew and red spider mites are critical to flower farming in Uganda.

Agrochemicals have negative impacts on the soil and water bodies. Indeed most of the cut-flower farms are located on gently sloping land adjoining to water systems mostly wetlands. Possible leakage of chemicals into these water systems is not doubted although farm management claimed that irrigation water, which is the main vehicle for chemical leakage, was not released into the environment.

The planned expansion of outdoor flower varieties which use less chemicals may reduce the risk of pollution and poisoning if the less experienced outgrowers begin using the chemicals. The issue of concern here, however, remains that whereas floricultural production is the most polluting form of agriculture in the world, farm managers were very reluctant to disclose the amounts and rates of their agrochemical applications. They also did not seem to benefit from technical and extension services of the Ministry of Agriculture, Animal Industry and Fisheries.

4.2.8 THE AGROCHEMICAL INDUSTRY

One main establishment, namely Twiga Chemical Industries operates in this sector in Uganda. The company is a limited liability company operating under the Twiga Chemical Industries Group of Companies of Kenya. The company supplies agricultural and industrial chemicals manufactured by the parent company in Kenya. Some of the chemicals distributed by the company are imported from South Africa and the United Kingdom. The main products are Ambush, Karate, Sulphuric Acid, Dithane, and Soda Ash.

The main environmental concerns in this sub-sector arise due to breakage of containers and other poor handling of the various agrochemicals. Solid chemical refuse is also disposed of in the city council refuse bins while liquid chemical spillage is washed down the water and sewage drains. Although the quantities of these chemicals are small, they are extremely hazardous and have a potential to damage the water environments which they migrate to.

4.2.9 DISTILLERIES

Only one industrial scale distillation plant for consumable alcohol, the International Distilleries Uganda Ltd is operational at Port Bell, in the Lake Victoria area. The factory re-distils traditionally distilled liquor (enguli). It has discharge volumes of about 135m^3/day of hot cooling water wash and bottle wash water. It has the same bottle wash operations as in the brewing industry. It also discharges distillation residues to waste. These are in small quantities (usually less than 5 m^3/ week) since the plant essentially re-distils liquor. The waste characteristics include residues of BOD of 20,000mg/l and SS of 30mg/l while wash water BOD was 80mg/l and SS 100mg/l.

4.2.10 BATTERY MANUFACTURE AND RECHARGING

There are several establishments that deal in battery repair, reconditioning and re-charging in Uganda. These discharge small quantities of wastewater containing mainly acids (low pH) and lead. There are two large-scale motor vehicle battery manufacturing plants in Uganda, namely Uganda Batteries Limited and Kampala Battery Factory. They are both located in Kampala.

UBL is a private limited liability company. The factory employs 68 people and produces mainly automobile batteries. UBL also sells de-ionised water and mixed acid. The two factories together have production capacity in the range of 500 batteries per day.

The wastewater from the two plants is strongly acidic and contains lead. The quantities vary but are generally less than 10m^3/day. The problem with this wastewater is that its toxic lead content which has the ability to concentrate in the food chain. Wastes are only partially treated by neutralising the 1 per cent acid with sodium carbonate. The lead is also partially recovered in the neutralisation tanks where it sinks to the bottom of the tanks and is tapped. Thereafter the wastewaters

are discharged into the public sewer. While the high dilution rate may neutralise the effects of low pH, there is need to carry out analysis of this discharge to estimate the lead load, and suggest methods of pre-treatment.

4.2.11 THE PAINT INDUSTRY

The paint industry in Uganda consists of eleven major manufacturers. A small number of small-scale plants used by construction firms and private contractors also exists. The main manufacturers increased from only 4 in 1989 to 11 in 1997.

The paint industry comprises of resin manufacturers, resin traders and small and medium scale paint manufacturers who supply small and medium construction works. Large paint manufacturing companies supply large construction works. Also notable are the importers of paint who mostly supply medium and large construction works.

The chemical raw materials used in the paint industry in Uganda include alkyd resins, pigments, thickeners, solvents, dryers and whiting. The main factories include Peacock Paints, Rainbow Paints Ltd, Professional Paints Ltd. Robbialac Paints Ltd., Sadolin Paints Ltd., International Paints Ltd., BPC Chemicals Ltd., and Cock Paints Ltd.

The main environmental considerations related to paint manufacture are the emission of vapours from the solvents during dispersion. The liquid effluent that may be spilled during manufacture and handling contain organic solvents and heavy metals; specifically cobalt and lead. Notably, for most paint manufacturers in Uganda, liquid effluent containing the above pollutants are collected in ponds and discharged without pre-treatment to the public sewer system.

4.3 STANDARDS FOR THE DISCHARGE OF EFFLUENT OR WASTEWATER

The need for environmental standards in Uganda is stipulated in the National Environment Statute (1995) Section 3 (2a). The section stipulates the principle of environment management to assure all the people in Uganda the fundamental right to an environment supportive of their health and wellbeing. The implication of the above principle is that there is need to establish criteria and procedures for the measurement, elimination, reduction or management of various environmental problems for the wellbeing of the people of Uganda. The implementation of this principle requires by necessity, reform in some sectors with the aim to stimulate industrial efficiency and competitiveness nationally, regionally and internationally.

The specific concern for water quality and the subsequent development of the *Standards for the Discharge of Effluent into Water* is aimed at avoiding concentrations of pollutants in the water or land that would produce adverse effects on the health, safety or wellbeing of plants and animals. Other standards referred to in the statute of relevance to this assessment include *Water Quality Standards, Standards for the Control of Noxious Smells and Soil Quality Standards.*

4.3.1 STATUS OF ENVIRONMENTAL STANDARDS IN UGANDA

Existing standards in Uganda are inadequate, inconsistent and limited only to potable water. The National Water and Sewerage Corporation (NWSC), Uganda National Bureau of Standards (UNBS), the Directorate of Water Development (DWD) have to ensure that the people of Uganda have access to good quality drinking water. The Directorate of Water Development concentrates on ensuring the provision of good quality drinking water to the rural areas of Uganda. The NWSC is entirely concerned with urban water and sanitation, while the Uganda National Bureau of standards is responsible for the general standards.

Previous observations common to all the three institutions were that the discharge of effluent into the water bodies and on land is outside their domain of operation. This has necessitated the formulation and harmonisation of new sets of standards by the National Environment Management Authority (NEMA) to regulate and monitor other environmental parameters in the country. NEMA is the principal agency in Uganda that is vested with powers to manage the environment. During formulation of the standards, standards of other countries were referred to model Ugandan standards for water quality. This was due to the lack of a clear reference point at the national level.

The proposed sets of environmental standards have not yet received cabinet approval. They also lack legal backing since the regulations to enforce them have not yet been gazetted. The other standards referred to in this study are the Directorate of Water Standards for Water Quality.

The standards are based on rural water sources, especially underground water and protected springs for human usage.

No data were available for water quality parameters from neighbouring countries especially those with whom Uganda shares water resources.

It was also noted that no standards or guidelines for water quality intended for the use of wildlife and fisheries exist. No data on chemical and physical parameters of the water bodies in Uganda are available.

4.3.2 STRATEGIES FOR THE ENFORCEMENT OF STANDARDS

In order to enforce the proposed standards the following strategic approaches have been proposed for planning purposes:

(i) enforcement of environmental standards should begin with the most polluting or degrading establishments over which NEMA or the appropriate lead agency will receive public support and endorsement;

(ii) implementation should involve institutions that already have equipment, logistical support and personnel;

(iii) polluters should be brought to a negotiating table so that they commit themselves to reform over a reasonable period;

(iv) the public should be educated to participate in enforcement; and,

(v) economic instruments appropriate to Uganda's socio-economic environment under the general framework of the polluter pays principle (PPP) should be investigated and appropriately applied.

Due to the toxic nature of effluent from tanneries, separate regulations to enforce the detoxification of effluent and chemical discharges from tanneries have been proposed. These conform with the National Environment Statute (1995), the Water Statute (1995), the Water (Wastewater Discharge) Regulations (1998) and other relevant policies and laws in Uganda.

4.4 CONCLUSIONS AND RECOMMENDATIONS

4.4.1 CONCLUSIONS

(i) About eight categories of industries and other establishments in Uganda currently generate waste of serious and immediate environmental consequence. They include breweries, tanneries, textile factories, sugar, oil and soap works, meat and fish processors, manufacturers of soft drinks, and flower farms.

(ii) Industries and other establishments do not treat the problem of waste management with the seriousness. This is evidenced by the fact that few industries pre-treat their wastewaters. Most of them discharge raw wastewaters to the environment or into public sewers.

(iii) There are currently no legally binding industrial effluent discharge standards, there only being a draft standards schedule and draft regulations.

(iv) Even after the passing of the standards and regulations by parliament, enforcement will remain inadequate due to lack of financial resources and manpower in the responsible institutions. The institutions also lack monitoring equipment, transport and analytical facilities.

4.4.2 RECOMMENDATIONS

(i) Enforcement of the proposed environmental standards needs to be initiated with the implementation of enforceable and reasonable regulations. Pollution control agencies should be represented on the industrial licensing boards to ensure that environmental considerations are taken into consideration during implementation and monitoring.

(ii) In line with the polluter and user pays principles, government should charge manufacturing firms and other polluters with discharge fees high enough to cause them to improve their effluent management practices. A combined standards and economic incentives approach based on the Malaysian Model for the Control of Industrial Effluent (see Section 10 of this study) should be adopted to improve compliance in the above regard.

(iii) Training in wastewater management should be given a priority. Complete training packages should be developed and offered to industrial technicians and managers, and also the general public as an awareness and publicity drive for good environmental practice.

(iv) Advise on clean production processes should be freely provided to investors by the main investment and environmental agencies in Uganda. In like manner, firms should be willing to provide information free of charge, to researchers who are seeking better management of the environment.

(v) Standards should be increasingly viewed in three ways, first as means of industrial promotion and improvement, second, as a means to protect the health and safety of all citizens, and third, as a partnership between consumers, industrialists, public sector regulatory agencies

(vi) As part of a monitoring strategy, documentation of input-output data on chemical utilisation by manufacturers should be expedited to help monitor releases of such chemicals into the environment.

(vii) All new industrial plans should be accompanied by an environmental impact assessment of the likely effects of the proposed development. The EIA should normally detail a management and monitoring plan to guide waste management.

APPENDIX I

Operational Fish Processing Firms Close to Lake Victoria

Name	*Year of Commission-ing*	*Location*	*Pollutant Characterisation*	*Comments*
Four Squares Ltd.		Kisubi approx. 100m from the lake	(i) wastewater = 120-150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	formerly closed by UNBS have now renovated the premises. No waste treatment facilities at the plant
Greenfields (U) Ltd	l1991	Entebbe	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	drains into Lake Victoria, had French drains but have added treatment ponds, treatment facility inadequate
Ngege Ltd		Luzira	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	have a very poorly aerated wastewater treatment facility. Have developed a generally poor waste management plan. Drain directly into Murchison Bay
Marine and Agro Export Processing Co. Ltd		Jinja, on the shores of Lake Victoria	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	have absolutely no wastewater treatment facility. Claim to discharge into the NWSC drains but may be discharging into the lake
Hwang Sung Ltd	1991	Kampala, Ntinda Industrial Area	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	discharge process and human wastes into nearby streams. These find there way into the Kinawataka-Nakivubo Channel Complex
Gomba Fishing Industries Ltd	1989	Jinja, on the shores of Lake Victoria	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	have constructed a modern wastewater treatment facility which finally discharges into the NWSC system Unfortunately the facility is poorly maintained
Uganda Marine Products Ltd		Kanyanya off Gayaza Road	(i) wastewater = 120 -150m3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	discharges into the Nsooba-Lubigi wetland system. This wetland sytem is part of the Lake Kyoga wetland system which is drained by River Mayanja
Victoria Fresh Foods Ltd.		Munyonyo on the shores of Lake Victoria	(i) wastewater =120-150m3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	is a very old processing facility, was formerly closed by UNBS but re-opened after renovations has poorly aerated wastewater treatment facility with a direct drain into Lake Victoria. a rich water hyacinth bloom grows at the discharge point

APPENDIX I (*continued*)

Name	*Year of Commissioning*	*Location*	*Pollutant Characterisation*	*Comments*
Clovergem Fish and Foods Ltd	1993	Entebbe	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	have a good and modern wastewater treatment facility discharge in the ground to a subterranean backflow
Uganda Fish Packers Ltd.	1992	Nakawa	(i) wastewater = 120 -150m^3/day (ii) BOD-300mg/l (iii) SS-30mg/l (iv) pH-10	poor effluent treatment, poor occupational conditions (ventilation) drains into the Kinawataka swamp through flood drain
Masese Fisheries Ltd.	1988	Masese, Jinja	30m^3/day of process and sanitary wastewater of BOD-300mg/l, SS-30mg/l and pH-10	have a wastewater treatment plant and discharge into the NWSC central discharge system
Landing Sites	-	Bwodha-Iganga	chemical fishing using endosulphur	inspections have been done to find out the problem
		Kagave-Entebbe	fuel spills	
		Lambu-Entebbe	chemical fishing	

Operational Non-Fish Processing Firms Close to Lake Victoria

Name	*Location*	*Pollutant Characterisation*	*Comments*
Uganda Breweries Ltd	Luzira	wastewater vol. = 3,750m3/day, BOD = 3,494mg/l, pH =7, electrical conductivity = 213-386uS/cm	waste effluent is discharged untreated into the inner Murchison Bay of Lake Victoria. The factory expanded production capacity 1995/96
Nile Breweries Ltd.	Jinja	wastewater vol. = 18,000-21,000m^3/day, BOD = 400mg/l, SS = 3,033+299mg/l, pH = 7, electrical conductivity = 250 (µS/cm	waste effluent is discharged untreated into River Nile. The factory expanded production capacity after a business merger with SAB in 1997
Municipal Abattoirs	Bugolobi	wastewater vol. = 45m3/day, BOD = 2,500mg/1 SS = 800mg/l	wastewater is discharged untreated into the public sewerage system, and could occasionally break through the treatment works at Bugolobi and on into Lake Victoria
Nyanza Textile Industries	Jinja	wastewater vol. = 10,000m3/day, BOD5 = 600mg/l, SS = 140mg/l, colour = bright green due to dyes and bleaching agents, pH = 11 strongly alkaline	discharges raw waste into River Nile. The factory closed but reopened in 1995/96

APPENDIX I (*continued*)

Name	*Location*	*Pollutant Characterisation*	*Comments*
Leather and Tanning Industries	Jinja	wastewater volumes at 50% processing capacity = 420m^3/day, BOD = 660mg/l, Sulphides = present, colour = blue/grey, permanganate value = 80mg/l, pH = 6.5, chromium = present	discharge liquor to storm water drains and foul sewers. The factory re-opened after privatisation to the Agha Khan Foundation in 1995
Soft Drinks	Kampala	wastewater volumes = large approx. = 450m3/day, BOD = 450-500mg/l, SS = 30-50mg/l and pH = 10	have no wastewater treatment facilities beyond poorly designed septic tanks. This factory was privatised and increased production capacity in 1993
Oil and Soap Industries	Kampala	wastewater vol. = small quantities of very strong wastewaters (aver.=60m^3/day), BOD=25,000-30,000mg/l, SS = 800-1,000mg/l, pH = 12, grease/oil content high	Mukwano Soap Industries discharges illegally into the NWSC public sewers. The sector increased productivity between 1995/97
Flower Farms	Kampala (45km radius)	farm runoff with fertilisers, and other agrochemicals mainly against mildew and red spider mites	mainly farm runoff including agrochemicals and sediment directly into Lake Victoria since many farms are very close to the lake. This sector began production in 1993
Agrochemical industry	Kampala	Ambush, Karate, Sulphuric Acid, Dithane, Soda Ash	main problem is with the management of waste containers, and spillage, normally are washed down the water and sewerage drains
Distilleries	tPort Bell, Kampala	Discharge vol. = 135m3/day BOD = 20,000mg/l SS = 30 mg/l	the facility has no wastewater treatment plant
Battery Manufacture	Kampala	mainly lead which is toxic and has ability to concentrate in the food chain	only partial treatment is done by neutralising the wastewater using sodium carbonate
The Pain industry	Kampala	resin based paints with heavy metals like cobalt and lead that could spill into the wastewater drains system	liquid effluent is discharged without pre-treatment to the public sewer system

APPENDIX II

Schedule One

Standards for discharge of effluent or wastewater (*maximum permissible limits*)

1.	1,1,1-trichloroethane	3.0 mg/1
2.	1,1,2-dichloroethyelene	0.2 mg/l
3	1,1,2-Trichloroethane	0.06 mg/l
4.	1,2-Dichloroethane	0.04 mg/l
5.	1,3-dichloropropene .	0.2 mg/l
6.	Aluminium	0.5 mg/l
7.	Ammonia Nitrogen	0 mg/l
8.	Arsenic.	0.2 mg/l
9.	Barium	10 mg/l
10.	Benzene	0.2 mg/l
11.	BOD5	50 mg/l
12.	Boron	5 mg/l
13.	Cadmium	0.1 mg/l
14.	Calcium	100 mg/l
15.	Chloride	500 mg/l
16.	Chlorine	1 mg/l
17.	Chromium (total).	1.0 mg/l
18.	Chromium (VI)	0.05 mg/l
19.	Cis-1,2-dichloroethylene	0.4 mg/l
20.	Cobalt	1.0 mg/l
21.	COD	100
22.	Coliform Organisms	10,000 counts/100 ml
23.	Colour:w	300 TCU
24.	Copper	.1.0 mg/l
25.	Cyanide	0.1 mg/l
26.	Detergents	10 mg/l
27.	Dichloromethane.	0.2 mg/l
28.	Iron.	10 mg/l
29.	Lead	0.1 mg/l
30.	Magnesium	100 mg/l
3.	Manganese	1.0 mg/l
32.	Mercury.	0.01 mg/l
33.	Nickel	1.0 mg/l
34.	Nitrate-N	20 mg/l
35.	Nitrite-N.	2.0 mg/l
36.	.Nitrogen total	10 mg/l
37.	Oil and Grease	10 mg/l
36.	pH	6.0-8.0
37.	Phenols.	0.2 mg/l
38.	Phosphate (total).	10 mg/l
39.	Phosphate (soluble)	5.0 mg/
40.	Selenium	1.0 mg/l
41.	Silver	0.5 mg/l
42.	Sulphate	500 mg/l
43.	Sulphide	1.0 mg/l
44.	TDS	1200 mg/l
45.	Temperature	20-35 oC
46.	Tetra Chloro ethylene	0.1 mg/l
47.	Tetrachloromethane	0.02 mg/l
48.	Tin	5 mg/l
49.	Total Suspended Solids	100 mg/l
50.	Tricholoroethylene	0.3 mg/l
51.	Turbidity:	300 NTU
52.	Zinc	5 mg/l.

APPENDIX III

Schedule Two

Tannery Effluent Discharge Limits

pH		6-10
BOD	Discharge to Surface Water	50mg/l
	Discharge to Sewers	500mg/l
COD	Discharge to Surface Water	150mg/l
	Discharge to Sewers	1500mg/l
Sulphide	Discharge to Surface Water	1mg/l
	Discharge to Sewers	2mg/l
Chrome (III)	Discharge to Surface Water	3mg/l
	Discharge to Sewers	5mg/l
Chrome (VI)	Discharge to Surface Water	0.1mg/l
	Discharge to Sewers	0.5mg/l
Ammonia	Discharge to Surface Water	10mg/l
	Discharge to Sewers	60mg/l
Sulphate SO4	Discharge to Surface Water	500mg/l
	Discharge to Sewers	500mg/l
Chloride	Discharge to Surface Water	2,000mg/
Discharge to Sewers		2,000mg/l
Oils and Greases	Discharge to Surface Water	10.0mg/l
	Discharge to Sewers	10.0mg/l
Phenols	Discharge to Surface Water	——
	Discharge to Sewers	——
Temperature	Discharge to Surface Water	——
	Discharge to Sewers	——

APPENDIX IV

Schedule Three

National Water and Sewerage Corporation Guidelines for the Composition of Industrial Discharges to Public Sewers

	Parameter	*Maximum, mg/l*
(i)	Biochemical Oxygen Demand (5 days, 20oC)	250
(ii)	Settleabe Solids (1 hour's quiescent settling)	400
(iii)	Dichromate Value	600
(iv)	Ammonia (Free, as NH3)	50
(v)	Grease, oil or fat	300
(vi)	Synthetic detergents	30
(vii)	Sulphates (as SO3)	1500
(viii)	Sulphides (as S)	20
(ix)	Cyanides (as CN)	20
(x)	Toxic Metals (Ni, Cu, Hg, Zn, Pb, Sn, Si)	50
(xi)	Tarry matter	10
(xii)	Chlorine (as Cl)	10
(xiii)	Formaldehyde (as HCHO)	10
(xiv)	Permanganate Value	200
(xv)	Available Sulphur Dioxide (SO2)	10
	Volume of discharge per day	m3/day
	Rate of Discharge to the Sewer	m3/day
	pH value	6-8
	Temperature	43oC

CHAPTER 5

REVIEW OF NATIONAL ECONOMIC POLICIES AND ENVIRONMENTAL STANDARDS OF THE THREE RIPARIAN STATES (KENYA, TANZANIA AND UGANDA) WITH A VIEW TO STREAMLINING FISHERIES MANAGEMENT

5.1 INTRODUCTION

The Lake Victoria Basin has great opportunities for sustainable socio-economic development. Prospects for future growth and the wellbeing of its increasing population, now at about 30 million, are good. It is, therefore important to make any planned development sustainable.

Sustainable development in the Lake Victoria Basin must include socio-economic and environmental aspects. As an important pre-requisite for sustainability, the carrying capacity of the natural environment must be respected. The richness of the natural resources and a healthy environment within the basin should prevail as the fundamental basis for socio-economic development. The tools to make this possible are, however, of a socio-economic nature. Well-functioning societies require, as does a regional economy that is globally competitive, new technological solutions that do not contradict sustainable development, and the application of new consumption and production systems and practices.

Several research papers and scientific reports are regularly written about the state of the Lake Victoria basin in the areas of fisheries, limnology, water quantity and quality, geo-physical and bio-chemical characteristics, and socio-economics. Several development projects are also routinely being implemented, some of which are on-going and others being planned. The need to integrate all these efforts at both national and regional levels for focussed and sustainable development in the basin cannot be over-emphasised.

The purpose of this chapter is to provide brief descriptions of *(a)* macro-economic policies of the Governments of Kenya, Tanzania and Uganda and their implications for fisheries in these countries, (*b*) general and specific environmental standards applicable to fisheries in Kenya, Tanzania and Uganda identifying common features and differences, and (*c*) suggested ways to harmonise standards. The review is based on scientific knowledge contained in various papers and work done within the region to monitor and evaluate development activities, processes and events in the lake basin. It is, therefore, the expected output of this paper that the conclusions and recommendations of the review shall contribute positively to the development of economic instruments for environmental management of the fisheries sector of in Uganda.

5.2 LAKE VICTORIA REGION

Lake Victoria with a surface area of 68,800 sq. km, and an adjoining catchment area of 193,000 sq. km, is an international water body that is of great economic importance to the three riparian countries of Kenya, Tanzania and Uganda and of great scientific and cultural significance to the global community, mainly in respect of its water uses, unique waterborne biodiversity and fisheries. The Lake basin is used as a source of food, energy, drinking and irrigation water, shelter, transport, and as a repository for human, agricultural, municipal and industrial waste. It supports an estimated population of 30 million people at annual incomes in the range of US$ 120—300 per capita, and a gross economic product in the order of US $ 3-4 billion annually. The basin thus provides for the livelihood of about a third of the combined populations of the three countries, and provides about the same proportion of the combined gross domestic product.

With the populations of the riparian communities growing at about 6 per cent p.a., which is among the highest in the world (World Bank, 1996), the multiple activities in the lake basin have increasingly come into conflict. The lake ecosystem is undergoing substantial changes, which have in fact accelerated over the last three decades. Massive blooms of algae have developed, water borne dis-

eases have increased in frequency, and water hyacinth, absent as late as 1989, has begun to choke important water ways and fish landings, especially in Uganda. Increased fishing effort and intensity, and oxygen depletion at lower depths of the lake (Hecky et. al., 1988) threaten the artisanal fisheries and bio-diversity.

The lake is, in fact, a "commons" of water, biota, nutrients, pollutant and the human activities which use the resources in the basin and impact upon them. In matters such as fishing, the addition of nutrients to the lake, pollution of the lake and its tributaries, the economic characteristics of behaviour in a common property resource apply. This is evident in that the incentives perceived by the individuals and the individual countries involved are conducive to actions which may be in the best short-term interests of the individuals concerned, but not in the best interests of the whole group of countries, nor of the global community.

Although there are many features of Lake Victoria which are of intense interest to scientists and socio-economists, it is fish that receive the most attention. The policy of the riparian states has, therefore, been to see that the aquatic biological resources are used sustainably and environmental quality is maintained in order to achieve conservation of biodiversity for future generations.

5.3 ANALYSIS OF MACROECONOMIC POLICIES OF THE RIPARIAN STATES AND THEIR IMPLICATIONS ON FISHERIES

5.3.1 Main Issues

The Lake Victoria ecosystem has changed since the beginning of this century. These changes are, by and large, caused by human activities. There is increased agricultural and urban runoff in the lake's watershed, and discharge of domestic and industrial waste into Lake Victoria and their effect on the ecology of the lake has been profound. Further conversion of wetland areas around Lake Victoria for agricultural and/or other uses has had detrimental effect on the lake ecosystem. The water quality of the lake is deteriorating due to widespread agricultural, industrial and urbanisation activity in the catchment and this has impacted on riparian communities. The lake's fauna and flora have changed drastically and this has been followed by changes in the species composition, loss of biodiversity and changes in the fishery. These changes have had far-reaching socio-economic consequences on the riparian peoples of East Africa. Moreover, there are institutional and financial deficiencies otherwise needed to formulate remedial policies and to implement these lake-wide.

Whereas the riparian communities have depended on the lake for livelihood for centuries and there has been increased fish yield from Lake Victoria, the life style of lake-side communities has deteriorated. Thus water supply and sanitation, health and disease, transportation and communication have all continued to be huge problems for the riparian communities despite the ready availability of fish for food and water for domestic use and lake transport. Thus, fishing and small holder farming communities around the lake have remained dogged by poverty and have continued to be largely overlooked, under-rated, and often little understood by governments and policy makers. Consequently therefore, fishers and small holder lake-side families have tended to be largely illiterate and least mobilised for development.

5.3.2 Assessment of Macroeconomic Issues

Administrative responses by the riparian governments to changes in the ecosystem and socio-economic problems of the fishers and small holder farmers have had varied degrees of success but have on their own brought about undesirable socio-economic implications. The main macro-economic issues affecting the three countries are, therefore, highlighted in the following paragraphs:

Kenya (For the period up to 1995)

(*a*) Kenya remains a low-income country. Even though its population growth rate, which has historically been very high (averaging 3.4 per cent p.a. as recently as 1987-91), dropped to about 3 per cent in 1993, and although Kenya is one of the few countries in Africa that experienced a decline in fertility in the eighties (from 7.7 in the early 1980s to 5.2 in 1993), a significant and sustained increase in per capita income proved to be an elusive goal in Kenya during the past decade. Despite a few years of relatively good growth during the second half of the 1980s, the performance of the economy had been particularly inadequate in generating new jobs, and there has been no significant improvement in the incidence of poverty. Overall, the economy has generated only marginal increases in per capita output over the past decade; during the last four years, per capita income has actually declined, from $340 in 1991 to $260 in 1994 (at current prices and exchange rates).

(*b*) The economy is heavily dependent on agriculture, which employs 70 per cent of the labour force and contributes about one quarter of Gross Domestic Product (GDP). Coffee, tea and horticultural crops account for over 50 per cent of merchandise exports. Between 1991 and 1993, Kenya's macroeconomic performance was poor. In April 1992, the government agreed with the International Monetary Fund (IMF), on a program of actions necessary to re-establish a sound macroeconomic framework which included deficit reduction and liberalisation of the foreign exchange regime. Until mid-1993, the implementation of the actions required was unsatisfactory: although fiscal targets were met, monetary targets were exceeded and the liberalisation of the foreign exchange regime proved to be unsustainable.

(*c*) Sustained government effort since mid-1993 to tighten fiscal and monetary policy resulted in effective economic stabilisation and the revival of economic growth. The fiscal deficit (exclusive of grants) was sharply reduced over two years from over 11 per cent of GDP in FY93 to about 2.5 per cent in FY 95. Combined with a generally tight monetary stance, these policies resulted in the reduction of inflation.

(*d*) Rising population pressures, migration and rapid urbanisation have increased the need for urgent actions to address Kenya's environmental problems. The more critical problems are related to soil and land degradation, water resource management, biomass and household energy issues, and the protection and management of fragile ecosystems, including national parks. Rapid urbanisation and inadequate physical planning have also caused a significant deterioration in the urban environment. The government adopted a comprehensive National Environmental Action Plan (NEAP) in June 1994. The challenge since its completion has been to translate the NEAP's broad concerns about environmental management into an operational program of effective policy, legislative and institutional action. Areas for priority action include the development and adoption of a comprehensive environmental policy, the establishment of an effective institutional and legal framework, and the formalising of a requirement for environmental impact assessments for all development projects.

Tanzania

a) By the early 1980s, Tanzania had come to be a heavily state-controlled economy, whose rigid economic system was battered by numerous shocks, and whose inadequate policies led to economic stagnation and a fall in per capita income lasting almost a decade. Beginning in 1986, the government embarked on a program to reform and fundamentally change the existing approach to economic development by dismantling the system of pervasive economic controls and encouraging more active participation of the private sector in the economy. Structural reforms, particularly relating to traditional exports and the financial sectors, were not fully completed, and macroeconomic stabilisation remained elusive. Nevertheless, the economy responded well to the reforms that were implemented

(notably, liberalisation of food crop marketing and progressive improvements in foreign exchange management) and the accompanying increased availability of external resources. Official estimates indicate that GDP growth averaged about 4 per cent per year and exports grew by more than 4 per cent per year during 1986-94 (versus a 5 per cent p.a. decline during 1979-85), with a marked increase in food production, increased sales of traditional exports, and doubling in non-traditional agricultural exports since 1985.

b) Recent household surveys have shown that the adjustment program has been successful in reducing the incidence of poverty. The devaluation of the shilling and removal of restrictions on the marketing of food crops boosted production and incomes of small-holder agricultural families. The increased availability of consumer goods stemming from liberalisation, has directly benefited the rural poor (as well as the urban poor who also benefited from increased supplies of food from liberalised agricultural marketing), and liberalisation facilitated surveys for the preparation of a Poverty Profile which suggested that the percentage of poor declined from about 70 per cent of the rural population in the early 1980s to about 50 per cent in the early 1990s. The liberalisation program increased the access of small-scale enterprises to production inputs which facilitated expansion of low-wage employment in the informal sector.

c) Progress has been made in reforming the foreign exchange and trade systems over the last two years. Tanzania has moved to an inter-bank market and has abolished all export retention and import licensing, except for items related to health and national security. Excessive monetary expansion has been fuelled by worsening fiscal management. The fiscal deficit (including grants) was about 6 per cent of GDP in FY 93 and 5 per cent in FY 94, after broadly balanced positions in the previous four years. This reflected widespread and increasing custom duty exemptions, an increasingly inefficient tax administration and the failure of the expenditure control system. Efforts were made in the 1995 fiscal year (among them a public sector hiring freeze, and reduced transfers to parastatals) to reduce the fiscal deficit below 4 per cent of GDP. Inflation, which had accelerated above 25 per cent p.a. was targeted by efforts to bring it down to 22 per cent within the next fiscal year. Real GDP growth averaged about 3-4 per cent per year during FY92 to FY94. Growth in FY94 was seriously compromised by weak economic management, and severe power shortages caused largely by less-than-average rainfall. These developments limited the scope for generating employment and, in particular, the high inflation rates resulting from macroeconomic mismanagement continued to erode the real incomes of the poor.

d) The National Environmental Action Plan focussed on the need for action in the key areas of land degradation, water supply, environmental pollution, marine and freshwater resource management, habitat conservation and bio-diversity, and deforestation. The action program for implementation includes revision of the legislative framework to enable local participation in environmental management more fully. Policies will support the environment in various ways, including applying the forest and wildlife protection acts; developing the means for assessing environmental quality, including water and air pollution; and strengthening environmental awareness programs. Some government policies are oriented towards using incentives, such as implementing the new land policy to enhance the security of tenure; pricing policies for fuel, including oil; and water rights to encourage efficient use and environmentally sensitive practices.

Uganda

(*a*) With a per capita income of about US$200, Uganda is one of the poorest countries in the world. Its weak economy and poor social indicators are the legacy of nearly 15 years of political turmoil and economic decline. Since 1987 the government has been implementing an economic reform program supported by a large number of donors. The program aims to promote prudent fiscal and monetary management, improve incentives to the private sector, reform the regulatory framework, and develop human capital through invest-

ment in education, health and other social services. Economic recovery and stabilisation have been successful; hard-won macroeconomic stability has been maintained for the past several years. The stability is precarious, however, and continuation of good policies and further improvement are, therefore, required.

(*b*) A number of the structural reforms are now well advanced and appear to be accepted in Uganda. Nonetheless, the reform program has its detractors, and is still very fragile. Achieving higher investment, growth, and increased employment opportunities are critical for the sustainability of the program. Macroeconomic stability remains fragile also, notwithstanding the progress that has been made in curtailing public spending and strengthening the shilling. With widespread poverty and massive unmet public needs, it will be difficult to maintain expenditure constraints. The key is to mobilise additional tax revenue, which is a very low proportion of GDP in Uganda. Doing so has not proven easy. A large part of the economy is in the informal sector and enforcement can help in the short run, but any significant gains in revenue will come at best only in the medium-term. Uganda's current balance of the external account is also fragile. While internal price and exchange rate stability, together with good prospects for extended political calm, has generated a substantial inflow of private capital over the past several months, these flows could be reversed quickly if inflation or exchange rate volatility were to reappear. The dilemma facing policy makers is to get the economy moving ahead more rapidly, without generating inflation which could unravel the entire adjustment program.

(*c*) Uganda's economic growth since 1987 has been good, but not spectacular. Real GDP grew by an average 5.4 per cent p.a. from FY 87 to FY93, a gain of about 2.5 per cent p.a. in per capita terms. To a large extent this growth was the result of bringing land and capital back into production, made possible by increased peace and security in some parts of the country. More recently, growth has also been fuelled by some private investment and by the impact of trade, exchange rate and crop marketing liberalisation. Preliminary indications are that real GDP rose by 5 per cent in FY94, mainly due to strong performance by the manufacturing and construction sectors. The point has now been reached where further growth will depend on increased private investment.

(*d*) The NEAP was approved by the government in January 1994. The National Environmental Policy that was adopted subsequently calls for re-aligning sectoral development strategies so that they address priority environmental concerns relating to, among others, land degradation, deforestation, loss of wetlands, and dwindling fish stocks, several of which are directly related to environmental management of the Lake Victoria basin. The policy also emphasises strategies cutting across sectors such as the need to control population growth and enhance security of land tenure. It also advocates environmental education and a system of environmental impact assessments as essential means of promoting rational resource use. The National Environmental Management Authority (NEMA) established recently is serving as the central policy advisory body on the environment, and coordinating implementation of the NEAP.

5.4 THE FISHERIES SECTOR

5.4.1 The Importance of the Fisheries of Lake Victoria

Sustainable exploitation of a common property resource such as fisheries requires education of the local communities, monitoring of the resources and enforcement of regulations in order to ensure the capacity of the resource to renew itself. Biodiversity conservation ideas are more easily acceptable to local communities only if they answer immediate and tangible needs. Whereas almost all conservation practices could be enforced through legislation, additional and more appro-

priate approaches to achieve this include dialogue, education, technical assistance and stakeholders' participation.

Each of the riparian states has a government policy framework through which the fisheries resources are managed. The regulation of fisheries is supported by the Fisheries Act of 1990, in the laws of Kenya, the Fish and Crocodiles Act of 1964 in the laws of Uganda and the Fisheries Act of 1970 and Fisheries Principal Regulation of 1989 in the laws of the United Republic of Tanzania. The fisheries sector forms three natural divisions: marine capture fisheries, inland capture fisheries and aquaculture. It is assumed that the development of this sector should take cognisance of these divisions and of the fact that the socio-economic aspects of the industry encompass all the three divisions. It is further assumed that the sustainable use of Lake Victoria resources and conservation of biodiversity cannot be achieved without taking into consideration other lakes e.g. Kyoga, Edward, Albert in Uganda, Tanganyika and Nyasa in Tanzania and Turkana, Baringo and Naivasha in Kenya.

Some commercial fishing, though somewhat artisanal, picked up in the fifties and was well under way on Lake Victoria at independence, and increased in all water bodies. For instance fish production in Lake Victoria has now reached 400,000 to 500,000 metric tonnes with Tanzania landing 40 per cent, Uganda 25 per cent and Kenya 35 per cent (this accounts for over 90 per cent of Kenya's total national fish production). Fishing as a means of earning a living is also practised in the major bodies in the three countries and also on the coast in the case of Tanzania and Kenya. In all cases fishing continues largely at artisanal level with a very limited use of outboard engines. Most of the catch is marketed both within and outside the areas through middlemen.

The importance of fishing in the national economies has grown rapidly following the growth in foreign exchange earnings from Nile Perch (Lates niloticus) fillets exported to European countries in the recent years. For instance, from Kenya fish exports, in 1987 were 3,290 tonnes, the following year 5,149 tonnes and in 1989, 7,279 tonnes of Nile Perch fillets alone. In the three countries, there are about 100,000 fishers using about 21,000 planked canoes of which about 270,000 fish traders depend. An estimated 3,000,000 to 6,000,000 people depend directly on the fishing industry generated by the lake. The accompanying auxiliary fish industry related services such as boat building, net manufacture, fish transportation, fish processing, local and export trade and fish pond construction bring the number of people to over three million.

The fisheries in the three countries employ an open access system which attracts profit motivated fishers with heavy investment threatening the small artisanal fishers. The Nile Perch (Lates niloticus, Nile Tilapia, (Orechromis niloticus) and Dagaa/Omena (Rastreonobola argentea) are the three species of fish presently targeted for commercial exploitation.

5.4.1.1 The Fisheries Policies

The Fisheries Policy in the three countries is geared to regulate, protect, promote, conserve, develop and sustainably exploit and utilise fish and fishery products to provide food, employment, income and foreign exchange earnings through export of surplus fish and other fishery products. The policy recognises the roles of small-scale fishers (artisanal fishers) who catch more than 85 per cent of the fish landed and consumed in the region and for the export market. The policy is silent on the development of industrial fishery in the lake.

Most if not all of the artisanal fishery is confined close to the shoreline because the fishery deploys small short range fishing crafts. The crafts have to land their catches daily as they are not equipped with freezing facilities. But it should be realised that if the countries have to sustainably exploit their fishery resources, there must be some encouragement into distant water fishery, which at the moment is not exploited.

The main objectives of the fishery policies of the riparian states are summarised as follows:

Tanzania

(*a*) To put into efficient use the available resources in order to increase fish production so as to improve the nutritional standards of the people and at the same time contribute to the growth of the economy. The policy is to increase the per-capita fish consumption from the present 10 kg. to 15 kg at least by the year 2,000.

(*b*) To promote employment opportunities through fishing, fish processing, fish marketing and distribution, fish farming, fishing gear manufacture and boat building.

(*c*) To increase foreign exchange earnings through increased utilisation of under utilised resources, improving quality of fish and fishery products, increasing exports of surplus production and increased utilisation of unpopular fish species.

(*d*) To promote and strengthen international collaboration and cooperation with neighbouring states so as to sustain shared fish resources. This policy is particularly applicable to the Great Lake (Lake Victoria, Lake Tanganyika and Lake Nyasa/Malawi).

(*e*) To promote, maintain and improve environment conservation measures by preventing water pollution and illegal fishing using detrimental methods such as use of fish poisons, dynamite, etc.

(*f*) To improve the quality and enhance availability of both fishing crafts and gears.

(*g*) To improve fish catching methods.

(*h*) To promote and propagate aquaculture in order to increase fish production and provide income to farmers.

Uganda

(*a*) To sustainably utilise available aquatic resources and to increase fish production so as to improve the nutritional standards of the people while contributing to the growth of the national economy.

(*b*) To promote employment opportunities through fishing, fish processing, fish distribution and marketing, fish farming, fishing gear manufacture and boat building and other supplementary activities.

(*c*) To earn foreign exchange through export of fish and fish products.

(*d*) To encourage utilisation of unaccustomed fish species and products, and improve on traditional processing methods.

(*e*) To protect the environment, and recognise and promote the multiple use of lakes and rivers.

(*f*) To promote and strengthen international collaboration and cooperation with neighbouring states so as to sustain the shared fish resource and the environment.

(*g*) To improve the quality and enhance availability of sea worthy fishing crafts through mechanisation and improved gears.

(*h*) To promote and propagate aquaculture in order to enhance fish production from lakes, swamps, reservoirs and rivers in order to provide income to the fishers.

(*i*) Promotion of Tourism in fisheries.

Kenya

(*a*) Increasing fish production in order to help towards attainment of self sufficiency in nutritional food supply.

(*b*) Provision of employment opportunities in rural areas and thus help curb rural-urban migration.

(*c*) Enhancement of income to improve the purchasing power of rural folk and thus help boost economic activities in the rural areas and raise the living standards of the rural people.

(*d*) Maximising resource utilisation and economic returns from the same on a sustainable basis by promoting resource conservation and minimising post harvest losses.

(*e*) Generation of foreign exchange earnings through export of fish and fish products.

(*f*) Promotion and strengthening of domestic and international linkages and exchanging of information on the management of fisheries resources.

Objectives not met

Due to financial and man-power constraints some of these objectives have not been achieved as elaborated below.

(*a*) Although the main objective is to increase fish production and per capita consumption it is realised that even the little that is produced, quite a substantial percentage is lost after harvesting. Currently post harvest losses in the fishery sector run at between 20 per cent and 25 per cent. Efforts are being made to reduce this loss by improving on fish handling and processing techniques. The recent establishment of fish processing plants in the Lake Victoria region has reduced post harvest losses on Nile Perch to a mere 4.1 per cent in Tanzania. Although this is a great achievement the consequences of it are that a large percentage of Nile Perch is being removed from the local consumer market to the external market (not as surplus) thus creating a decrease in the annual per capita consumption of fish protein locally. Further efforts should be made to ensure that all the landed fish are handled properly at all stages before sales to consumers so as to enable both quality and value of fish supply in the market.

(*b*) The export of Nile Perch from Lake Victoria is removing the fish from the local market to fetch foreign exchange. In some places, Nile Perch or fish, is no longer a readily available commodity. Most low income groups can no longer afford Nile Perch. Efforts must be made to draw up a balance between the amount of Nile Perch to be exported and the amount of fish that should remain in the region for local consumption like the case being experimented in Uganda.

(*c*) The concept of environmental protection although quite good, remains unappreciated at the grassroots level as evidenced by use of poisons, explosives and prohibited fishing methods. There is need therefore, to sensitise the stakeholders and incorporate them in the programmes for management of the lake resources.

(*d*) There is an absence of statutory environmental standards with well defined limits of pollutants and levels of degradation including the respective punitive actions.

Fisheries Policy is implemented through fisheries development research and management strategies which include, training of appropriate fisheries personnel, encouragement of trade in fish and fishery products, development of aquaculture and execution of fisheries research. The artisanal fishers carry out fishing on subsistence level. Left alone, they may not improve. It is necessary therefore, to assist the artisanal fishers to look for favourable credits from the banks, NGOs or other financial institutions. The research results ought to be implemented if the fishery is to develop. Aquaculture is important in increasing fish production in rural areas and should be encouraged amongst the rural communities.

5.5 ENVIRONMENTAL STANDARDS IN THE REGION

Considering the above initiatives regarding the National Environmental Action Plans (NEAP) by the three countries, it is clear that each country has taken appropriate steps to prevent and eliminate pollution through legislative, administrative and other relevant measures in order to

promote the ecological restoration of their national environments including the Lake Victoria Basin and the preservation of their ecological balance. Each NEAP emphasises the taking of preventive measures where there are reasons to assume that substances or energy introduced, directly or indirectly, into the environment may create hazards to human health, harm living resources and aquatic ecosystems, damage amenities or interfere with other legitimate uses of the lake water even when there is no conclusive evidence of a causal relationship between inputs and their alleged effects. It is also spelt out in each NEAP that the countries shall promote the use of "Best Environmental Practice" and "Best Available Technology". Polluter pays principle occurs in each NEAP, so is the "Precautionary principle".

In order to protect the environment including the Lake Victoria Basin from hazardous or harmful substances, each country is endeavouring to

(*a*) identify and evaluate such substances basing it on their intrinsic properties;

(*b*) prohibit totally or partially the use of substances banned for all final uses except for drugs, substances banned for all uses except in existing closed system equipment until the end of service life or for research, development and analytical purposes, and substances banned for certain applications and;

(*c*) minimise and, whenever possible, ban the use of identified pesticides in the Lake Victoria region and within its basin.

Other criteria have been mentioned in the three countries including the following:

(*a*) criteria for the use of the best environmental practice and the best available technology;

(*b*) criteria and measures concerning the prevention of pollution from land-based sources, naming the specific requirements and the principles for issuing permits for industrial plants;

(*c*) criteria for the prevention of pollution from ships, etc. within the aquatic systems listing cooperation, assistance in investigation, discharge of sewage, etc;

(*d*) criteria for the exemptions from the general prohibition of dumping of wastes and other matters in water stipulating specific regulations;

(*e*) criteria for the prevention of pollution from offshore activities such as exploration and exploitation of oil and gas; and

(*f*) criteria for response to pollution incidents such as oil spills and other disasters.

The concepts reflected in the three NEAPs are being implemented by each state at varying degrees. While Uganda has gone far with the implementation of the issues raised in their NEAP, both Kenya and Tanzania still have to enact the statutes for implementation.

5.6 CONCLUSIONS AND RECOMMENDATIONS

5.6.1 On the Importance of the Fisheries and the Need for Rational Exploitation

The above analysis illustrates the fact that the Lake Victoria basin is abundantly endowed with natural resources whose harnessing is central in advancing the region economically. Indeed the last 30years have witnessed intensification in the utilisation of these natural resources. This use has been prompted by factors such as the high incidence of poverty and the consequence of over-reliance of large segments of the region's inhabitants on the natural resource, and government policies which have aimed at promoting export and foreign investments and industrialisation. This trend can be expected to continue into the foreseeable future. The problem noted is that several adverse consequences have accompanied the use of the region's natural resources. If unmitigated, these side effects shall continue to have the potential to undermine economic development and lower the living standards of the region's inhabitants.

There are legitimate reasons for exploitation of natural resources which include the creation of wealth and the production of goods and services for human use. The manner of utilising resources is, however, one which is now featuring prominently in development concerns largely because of the adverse consequences associated with certain patterns of resource use. This is amply demonstrated in the Lake Victoria region where human economic activities have resulted in environmental degradation and threaten to undermine the welfare of the inhabitants and prospects for economic development.

Among the risks obtaining from other socio-economic activities, overfishing has resulted from the commercialisation of the lakes fisheries. Though the purpose of intensifying the exploitation of the fisheries has been to create more jobs, improve the incomes of the local communities and generate foreign exchange, these very objectives are endangered by the present unsustainable fishing methods. Though precise data on the fish stocks are still being generated following the upsurge of Nile Perch and Nile Tilapia fisheries, the predominance of juvenile fish in the catches and the transformation of a previously multispecies fisheries into a three species fishery constitutes strong and compelling proof that there is overfishing in the lake. If left unmitigated, the collapse of the fishery can result in the not too distant future.

5.6.2 On Sustainable Development in the Lake Victoria Region

The concept of sustainable development is a way to reconcile two different and sometimes conflicting sets of objectives: "development—progress—growth" and "stability—security—environment". This dilemma can be approached by describing the goal of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Addressing poverty, health, economic growth and equity is as necessary as a clean environment in this respect.

It was on this basis that the Rio Declaration and the Global Agenda 21 which was adopted in 1992 at the United National Conference on Environment and Development (UNCED), outlined a comprehensive action plan for the global transition to sustainable development. The Global Agenda 21 is more indicative than operational, and several efforts have subsequently been made to translate its intentions and perspectives into concrete policies and actions. National Environmental Action Plans (NEAPs) and the LVEMP consist of action plans addressing the transition to sustainable development in the three countries.

5.6.3 On Strategic Action Plans

General Strategic Plans for sustainable development which are being recommended in this chapter for implementation in the three countries include:

- Establishment of demonstration areas and pilot projects for proving sustainable development in practice;
- Increasing consumers awareness;
- Development of a database and information;
- Use of regional fora and networks;
- Increasing production and use of bioenergy and other renewable energy;
- Procurement of technologies;
- Cooperation on sustainable development issues at the regional level and among riparian communities.

With respect to the fisheries sector in particular, it is recommended that:

- Long-term strategies for the fisheries sector particularly for the major fish stocks should be developed;
- Habitats important to fish and fisheries should be restored;
- Sustainable aquaculture should be achieved;
- Other sector specific strategic plans issues would include those for Agriculture, Energy, Forestry, Industry, Tourism and Transport to mention but a few.

The need to keep development within the limits of the ecosystem and the resource base is a long-term necessity for achieving sustainable development and should be recognised as the long-term overall strategy, which must prevail as a basis for the development aspirations of future generations. The tools to make this possible are however of an economic and social nature and require well-functioning societies, a riparian economy that is competitive in the global context, the search for new solutions (technological and other) that do not contradict sustainable development, identification and application of sustainable consumption patterns, and the abandonment of non-sustainable systems and practices.

The overall and sector specific goals for sustainable development should therefore, be clearly defined for the Lake Victoria Region. For instance, the goal for sustainable fisheries could be achieved when high probability of fish stocks being able to replenish themselves over a long period of time within a sound ecosystem are assured, while offering stable economic and social conditions for all those involved in the fishing activity. This means development of economically and socially sustainable, environmentally safe and responsible fisheries by:

- Maintaining biologically viable fish stocks, the aquatic environment and associated biodiversity;
- Within these limits, establishing maximum fishing possibilities and appropriate selective fishing techniques for harvesting stocks, and
- Distributing the direct and indirect benefits of the fishery resources among riparian communities in an equitable manner.

5.7 Conclusions

It is now clear that there is need for an enhanced national and regionally harmonised regulatory framework in the Lake Victoria Region where sustainable aspects are clearly incorporated. It is also clear that one such aspect concerns the improved efficiency of resource use, another concerns the reduction of emissions and discharges and a third concerns the implementation of regional and international agreements relevant for the Lake Victoria Basin environment. Perhaps the implementation of harmonised economic and environmental instruments are other prerequisites. It is also necessary to incorporate the Polluter-pays Principle and the Precautionary Principle in the relevant national regulations. In this connection, efforts must be made at all levels to avoid decisions that contradict sustainable development objectives.

Based on the above, fisheries development should focus on securing the sustainable use and preservation of the Lake Victoria resources with an ecosystem approach. This involves improving wetlands management and cooperation, supporting development of sustainable aquaculture, improving the data situation and quality of fisheries and stock-assessment, and ensuring the long-term economic and social viability of the fisheries sector. In addition, there is need to improve the management of resources in the catchment areas, to increase cooperation in the field of quality control and enforcement of fisheries regulations, and to improve the economic and social stability of the fisheries sector.

CHAPTER 6

INVESTIGATING QUALITY CONTROL ISSUES IN THE FISHERIES SECTOR

ABSTRACT

Over the past few years, the export of fish products has assumed a central role in Uganda's economy, rising to second position after coffee in foreign exchange earnings. This position, however, was threatened by the application in global markets of strict product hygiene standards that the Uganda fish processing industry was not adequately equipped to meet.

Prior to the introduction of industrial fish processing in Uganda, the fish processing sector was largely dominated by artisanal processing technologies that could not guarantee quality products comparable to those required in international markets. In addition, the artisanal fisheries operated without national standards specifically formulated for quality control.

With the introduction of industrial and export oriented fish processing, the need to comply with regulatory and quality control requirements for fish products could no longer be taken for granted.

In order to protect their consumers from food poisoning and intoxication, the international market, including the European Union (EU)—Uganda's export market for fish exports—adopted several measures to restrict affected imports from exporting countries. Such measures include testing for pathogenic micro-organisms and toxins in fish products entering the EU.

In an effort to comply with these international requirements, the Government of Uganda, through the Uganda National Bureau of Standards and the Fisheries Department, has since instituted measures to ensure that the fisheries sector conforms to required standards. These efforts included a formulation of national standards in line with international norms, and requirements for the fish processing sector to institute measures to bring the sector to a satisfactory level of standards compliance. The Fish Quality Assurance Rules, 1998, stipulate the requirements for fish handling and quality assurance at various stages of the fish production chain. Fish processors have since undertaken major renovation works to refurbish their fish processing facilities to the required standards and specifications as per national and EU requirements under Regulation 91/493.

Yet despite of these improvements, much remains to be done to ensure that satisfactory hygiene and quality fish production is maintained at all times. This report has identified a number of areas where improvement is still required:

- Ensuring that the handling of fish by vendors before purchase for processing is done in accordance with acceptable practice. This should include ensuring that equipment necessary to maintain high levels of hygiene are provided at landing sites, including toilet facilities, acceptable landing jetties and provision of clean potable water;
- Improvements in processing plant layout and structural design in some establishments to avoid product cross contamination, and;
- Conducting hygiene training programmes for actors in the sector.

Because it is clear that the required quality control mechanisms can be attained through improved housekeeping and hygiene practices, it is recommended that the fish processing establishments should seriously consider institutionalising self-monitoring and audit services so that any temporal departure from acceptable practice for quality control is immediately corrected.

INVESTIGATION OF QUALITY CONTROL ISSUES IN THE FISHERIES SECTOR

6.1 INTRODUCTION

Uganda exports a variety of processed fish products to various parts of the world, including the European Union, Asia and the Middle East. The main fishery products exported include chilled fillets (at -4o C to 0o C) and frozen fillets (at -18o C or below). The Nile Perch (Lates niloticus) constitutes the bulk of the fish product exports, while Tilapia, (Oreochromis niloticus) contributes a smaller fraction of the exported products.

At the national scale, over 250 tonnes of fish products can be processed at full production capacity by the ten fish processing plants in the country, although current production capacity is far less than the installed capacity. The production capacity from each of the existing processing plants shown in Table 6.1.

TABLE 6.1

Current production levels from existing fish processing establishments

Factory	*Nature of fish products*	*Current production capacity (Tonnes/day)*	*Full production capacity (Tonnes/day)*
Masese Fisheries Ltd.	Chilled and frozen fish fillets	-	35
Ngege fish factory	Chilled and frozen fish fillets	15	45
Uganda Marine Products, Gayaza road, Kampala	Fresh and frozen products	5	10
Clovergem Fish and Foods Ltd., Entebbe	Chilled and frozen fish fillets	10	25
Greenfields (U) Ltd., Entebbe	Chilled and frozen fish fillets	15	35
Gomba Fishing Co., Jinja	Chilled and frozen fish fillets	15	40
Hwang Sung Ltd.	Chilled and frozen fish fillets	15	60
Marine and Agro. Export Processing Co. Ltd., Jinja	Chilled and frozen fish fillets	15	30
Byansi Fisheries Ltd, Masaka	Chilled fillets	8	15
Uganda Fish Packers Ltd.	Chilled and frozen fillets	15	40

6.1.2 Quality control issues related to European Union requirements

In early 1990s, the EU adopted several measures for fish product imports to restrict imports and protect the health of EU consumers from food poisoning and intoxication. Among the measures adopted was testing for pathogenic micro-organisms in fish products entering the EU. However, at about the same time, Uganda had established a market for its fish products, including a market for chilled and frozen fillets before any national and international quality standards had been formulated. When EU standards were established, Uganda had no prior national standards in place to satisfy the requirements of the EU market.

However, the failure of Uganda fish processors to comply with the EU requirements at the time was not only due to a lack of national standards. The threat to the Uganda fish exports had already drawn the attention of fish processors and the government as early as 1992. Additionally, due to the large investments required to effect changes to the fish processing factories, the industry delayed paying attention to the EU Directive since the importer (EU) continued to accept their exports.

In pursuance of their own requirements to which all countries exporting to the EU were required to comply, the EU veterinary authorities failed to investigate the conditions in which Ugandan products were being handled, prepared or processed and transported. A first investigation was made only in a May 1997 visit of EU inspectors.

Following this visit, the EU delegation was dissatisfied with fish processing practices in Uganda and a series of recommendations for improvement were made. Consequently, in December 1997, a second visit was made to verify the improvements were effected. Unfortunately this visit coincided with the peak of a national cholera epidemic. Thus, although satisfactory improvements had not been accomplished in the industry, the cholera outbreak provided a more plausible reason for the EU to impose a temporary ban on chilled fishery products to EU since cholera bacteria can survive at -2 C, a temperature recommended for storage of chilled fish. Imports of frozen fish products (with storage temperatures of -18 C) were, however, permitted.

Since these inspection visits by the EU officials, several improvements have been put in place both by the industry and the concerned authorities, namely; the Uganda National Bureau of Standards and the Fisheries Department. These improvements also led to the lifting, in July 1998, of the ban on imports of chilled fish products by the EU.

6.1.3 Objectives

The main objective of this chapter was to investigate the gaps that exist in maintaining or upgrading standards and suggest ways and means of addressing these gaps.

Specific objectives were to:

- Review existing guidelines on the quality standards of fish at all stages of the production and marketing chains as provided for by Uganda National Bureau of Standards (UNBS), the National Environment Statute and determine any problems encountered at each stage.
- Review guidelines of quality standards as specified by the importing countries (EU, etc.) and assess whether there are any divergences between international standards and those of UNBS and the National Environment Statute.
- Examine fish handling from landing sites to processing plants to the point of export, with a view to assessing the hygiene conditions of landing sites, handling facilities (containers, transport vehicles, personnel), airport facilities, etc. Suggestions for quality improvements could thus be made.
- Make any other appropriate policy recommendations.

6.2 THE REGULATORY FRAMEWORK AND QUALITY CONTROL FOR FISH PRODUCTS

Because of the highly perishable nature of fish products, and given that more often than not it takes several hours before fish products reach targeted domestic markets, there is a need for strict hygiene and routine quality control checks to ensure quality standards are met and consumers'

health is protected. The attainment of quality fish product standards depends on a number of factors, including, among others:

- freshness and suitability of raw materials,
- absence of pathogens, particularly Salmonella,
- quality of other process ingredients added,
- time/temperature considerations,
- personal hygiene practices of workers,
- sanitary conditions of processing equipment used and of the general factory environment, and,
- methods of handling raw materials and finished products.

In Uganda, a regulatory framework has been put in place aimed at meeting not only national quality control requirements, but also satisfying requirements of major importers of fish products, notably the European Union (EU). Besides the quality control regulations that are designed to improve sanitation and hygiene through sound practices throughout the processing chain, other measures that are required by regulation include conducting quality control tests for the following:

- organoleptic checks to examine if fish products are fresh and fit for human consumption,
- parasite checks,
- chemical tests for contamination by, for example, heavy metals or other chemical pollutants that may be present in the aquatic environments where fish are caught, and,
- microbiological analysis, for bacterial contamination, including presence of Salmonella.

6.2.1 Objectives of the regulatory framework and associated inspection programmes.

In general terms, hygiene and quality control requirements seek to ensure that a high degree of cleanliness and hygiene is required for staff, premises, equipment and working conditions. Fish processors are required to identify any steps in their activities which are critical to ensuring safety and sound product quality, and to ensure that adequate safety procedures and measures are put in place, implemented and maintained at all times. Specific objectives of the quality control regulatory framework are to:

- improve process and quality control,
- improve and assure customer product satisfaction, and,
- ensure production of safe food products.

A joint task force comprising UNBS, the Food Science Research Institute (FOSRI) and the Fisheries Department, carries out periodic and routine inspections of fish processing plants in order to:

- evaluate operating procedures,
- assess state of hygiene of the processing plants in line with national standards, and,
- audit and verify compliance to set standards and regulatory requirements.

6.2.1.1 Uganda National Bureau of Standards (UNBS)

The quality of processed fish products in Uganda is regulated by the Uganda National Bureau of Standards (UNBS), the authority responsible for all quality standards in the country. The regu-

lation for quality standards is intended to ensure that the fish processors handle, produce and distribute safe fish products to the market. It covers the following major areas:

- formulation of fish quality standards,
- evaluation and rating of factories for approval in accordance with national requirements and the European Union (EU) Directive 91/493,
- audit inspection and verification of the fish factories and activities of the inspectorate, and,
- assignment of a Certificate Reference Number (CRB) to factories that satisfy requirements of EU Directive 91/493 and export to EU.

6.2.1.2 Fisheries Department

The Fisheries Department, on the other hand, oversees an inspection programme mandated by the Fish and Crocodile Act of 1964, and delegated by the National Bureau of Standards. In September 1998, the Fish (Quality Assurance) Rules were gazetted. They stipulate the regulatory framework for fish handling and quality assurance at various stages of the fish products production chain.

Under the Department's inspection programme, all stages of industry production from the in-lake environment, fishing and transportation vessels and fish landing sites, to processors and other distribution channels, are inspected to ensure a clean and healthy handling and distribution chain. These inspection programmes focus on the hygiene, sanitation and environmental conditions at critical points and stages in the handling chain where fish contamination is likely, and they include inspections of fishing vessel conditions, handling at landing sites, and hygiene in the fish processing factories. These inspections take a pro-active approach to fish/fish product food safety which ensures a preventive control of safety factors is in-built into the handling chain rather than relying on the end-product quality testing. Other regulatory functions of the Fisheries Department, through its Fish Regulation and Control Unit include:

- Inspection of fish factories on routine basis to ensure compliance with general standards required by fishery Regulations and UNBS,
- Licensing of premises for industrial fish processing using existing guidelines,
- Certification of consignments of fish (dead or live) and fishery products destined for export,
- Training of fish handlers and processing plant labourers on minimum general food hygiene and sanitary practices in factories,
- Evaluation and rating of fish factories jointly with UNBS and NARO (FOSRI) for approval in accordance with national requirements and the EU directive 91/493.

The Inspectorate of Industries under the Ministry of Tourism, Trade and Industry is also mandated to carry out inspections of industrial establishments, but with more focus on the occupational safety and hygiene of workers.

6.2.1.3 Regulatory Requirements in accordance with the European Union Regulations (EEC Council Directive)

The EEC Council Directive 91/493/EEC of July 1991 stipulates that fish should be processed, stored and transported under satisfactory conditions of hygiene.

Article 6 of the EU Regulations requires that member states shall ensure that persons responsible for fish handling and processing take all necessary measures, so that, at all stages of production of fishery products, the specifications of the EEC Council Directive are complied with. To this

end, the EEC Directive expects that the management of fish processing establishments carry out their own quality checks based on the following principles:

- identification of critical points in the establishment on the basis of the manufacturing process used,
- establishment and implementation of methods for monitoring and checking such critical points,
- taking samples for analysis to an approved laboratory for purpose of checking for compliance with the requirements established by the Directive,
- keeping written records with a view to submitting them to the competent authority, so that appropriate measures can be taken if there is any departure from expected performance.

The EU Directive requires that the inspection and monitoring of establishments shall be carried out regularly under the responsibility of the competent authority, (i.e.,. UNBS for Uganda), which shall at all times have free access to all parts of the establishment, in order to ensure compliance with the requirements of the Directive. In the event that such inspections and monitoring reveal that the requirements of the Directive are not being met, the competent authority shall take appropriate action.

The EU Directive also expects that other countries that export fish products to the European Union must fulfil the specific import conditions in accordance with the procedure laid down in Article 15 of the Directive, depending on the health situation in the country of origin, among other factors. It is required that the provisions applied to imports of fishery products shall be at-least equivalent to those governing the production and placing on the market of European Community products.

The rules, principles and conditions laid down in the EU Directives apply to the following areas of the fish production chain:

- conditions applicable to factory vessels,
- requirements during and after landing,
- general conditions for establishments on land,
- special conditions for handling fishery products on shore,
- health control and monitoring of production conditions,
- packaging, and,
- storage and transportation.

6. 2.1.4 Management framework at landing sites

Currently, management of landing sites lies entirely on District authorities. They oversee fishing activities through District Fisheries Officers (DFOs).

Fish landing activities are managed by the fish landing committees headed by Assistant Fisheries Officer who is, among other things, mandated to:

- Oversee hygiene and sanitation on the landings.
- Regulate and control exploitation of resources through effective use of appropriate fishing gear, and,
- Undertake the day-to-day running of the landing sites.

6.2.1.5 The Interrelationships between fishers, Fish Landing Committees, fish distributors and fish processors

Fish processors are simply clients of fishers, they go to specific landing sites to collect fish in their insulated trucks containing ice. However, the processors occasionally provide ice to the fish distributors who go to the islands to purchase fish, and they also pay the landing site authorities a fee for each truck that carries away fish from the landing site.

Fish processors have little control over fishers, since fishing activities are not done by employees of the fish processing companies.

Fish processors may present their views to Fish Landing Committees but have no powers over them. There exists an association, the Uganda Fisheries and Fish Conservation Association (UFFCA) that is mandated to oversee fish industry conservation and utilisation. Although membership to the association is open, stakeholders are not obliged to belong to it.

6.3.0 ADDRESSING QUALITY CONTROL GAPS

Establishing and maintaining a good and sound sanitation programme is an essential prerequisite for effective quality control, regardless of the size or complexity of a facility or its operations. A well-designed sanitation programme is a preventive measure that can aid in controlling sources of contamination that can render a product unsafe.

Following the visit of the EU fish inspectors in May 1997, the Uganda National Bureau of Standards and the Fisheries Department, instituted a number of measures and requirements to ensure that all fish processors comply with national and EU requirements in order to meet the desired market quality standards. The measures were further revised and intensified after receiving feedback, following the second visit of the EU fish inspectors in December 1997.

Standard procedures require that each fish processing plant implements a sanitation and effective manufacturing programme aimed at eliminating or minimising sanitation related risks to product quality. Such programmes require that each facility stipulate measures, procedures and practices to monitor for and control potential sources and causes of hazards and sanitation risks through good manufacturing practices or sanitary practices and operations programmes.

A summary of the requirements that were instituted to ensure sound sanitation and quality control is presented below.

6.3.1 Fish Handling at the lake and fish landing sites

One of the biggest quality control problems is that hygiene standards of fish handling by fishers in the lake and at the fish landings is very poor, and this undermines raw material quality. However, at the moment, this problem is beyond the control of most fish processors, since it is the responsibility of government to provide facilities for fish handling at the landing sites. Some processors, however, have taken the initiative to construct their own landing jetties at some fish landings. Those that have constructed jetties close to their factories include Clovergem Fish and Foods Ltd., Masese Fisheries Ltd., Marine and Agro Export Industry Ltd., Gomba Fishing Industry Ltd. and Greenfields (U) Ltd. Those fish processing firms with reception slabs for their fish transporting trucks at Kasenyi include Hwang Sung Ltd.; Ngege Ltd.; Uganda Marine products Ltd.; and Uganda Fish Parkers Ltd.

It is required that fish is washed at the landing sites with clean potable water before it is transported to the factories. Sufficient icing is recommendable to inhibit microbial proliferation.

6.3.2 Fish handling in the factories

6.3.2.1 Plant layout and design

The Competent Authority (UNBS) and the Fisheries Department have formulated basic national standards in accordance to the European Union (EU) Directive 493/91 of 22nd June 1991. The standard requirements specific to plant structure layout and design include:

Plant layout — Each processing building should have properly gazetted area for each processing operation, and ensure that each processing stage precludes cross contamination from other sections. For example, processing equipment should not be stored in the equipment washing room after washing.

Walls and doors — Walls of factory buildings should be water proof, with inner walls washable, and free of unnecessary projections.

All doors and entry points to the processing hall should have foot dips with adequately chlorinated water.

Premises — The factory premises should be vermin proof.

Floors — This is expected to be surfaced with corrosion resistant terrazzo of smooth, even surface, but not slippery and should be dust proof. The floor should also be free of open joints. The floors should be water-proof and easy to clean and disinfect, and should be laid down in such a way as to facilitate the drainage of the water.

Drainage channels should be designed to cope with the maximum expected flow of water, without causing overflow or flooding. Waste-water drainage systems at the fish reception areas should be covered.

Ventilation — This should be designed to keep the air fresh by removing excess water vapour and preventing excess heat.

Temperature — The processing halls should be maintained at ambient temperatures not exceeding the recommended temperatures. Appropriate cold temperatures help to slow down the petrifaction of fish products through slowing down the reproduction of bacteria. It is thus expected that each of the processing factories maintains adequate cold rooms and refrigeration facilities for this purpose. Each fish processing facility should have sufficiently powerful freezing equipment to achieve rapid reduction in temperatures to meet the temperature requirements laid down in national and EU Regulations.

Processing speed — Each processing stage should ensure fast product flow.

6.3.2.2 Reception and pre-filleting handling

Washing of fish — It is recommended that after reception of fish in the factories, it should be thoroughly washed with potable water before filleting. The use of chlorinated water not exceeding the recommended 0.5 ppm of residual Chlorine is acceptable. A staged washing process is recommendable, allowing up-to 4 stages of washing and rinsing before the fish is finally ready for filleting.

6.3.2.3 Filleting facilities

Filleting tables These should be made of cleanable, rust-proof stainless material.

6.3.2.5 Quality control

- All raw materials should undergo quality inspections, including organoleptic and visual checks, and temperature should be reasonably low (4o C or less). All aspects of quality control should be mandatory and closely supervised by trained and qualified supervisors whose responsibilities, among others things, should include overseeing hygiene and sanitation in the production hall, among employees and of the facilities.
- Laboratory tests: It is expected that each fish factory should operate a well equipped and managed laboratory which should regularly carry out tests to establish the levels of salmonella, staphylococcus, E. coli, Vibrio cholera bacteria, streptococcus bacteria and total plate counts. The same laboratory should also monitor water quality and workers' hygiene.

6.3.2.6 Hygiene Practices

Some of the quality control problems in the fish processing factories arise as a result of poor hygiene practices in the production and working environment. The Uganda National Bureau of Standards and the EU demand basic hygiene requirements to be satisfied and these include:

- Provision of wash hand basins and knee operated taps at entrances to the production hall and toilet exits. At every entrance and/or departure from the factory production area during work, employees shall first wash their hands with water and detergent and thoroughly rinse before resumption of work.
- Provision of footbaths at each entrance to the processing hall, and these should be designed in such a way that they can be easily drained. It is recommended that water in these footbaths should be adequately chlorinated for purposes of disinfecting the foot wear before entry into the fish processing rooms.
- Provision of a washing bay, with proper drainage, for cleaning and disinfecting of portable equipment.
- All factory equipment and the floor be cleaned with detergents and soap and disinfected chlorinated water.
- It is essential that all aprons, slipovers, and gloves are cleaned at each time of removal and as frequently as necessary.
- Use of sound transportation vehicles that are well designed to enable easy cleaning and well protected from outside environmental influences is required. These should be regularly cleaned under supervision.

6.3.3 Packaging

Packaging must be carried out under satisfactory conditions of hygiene to preclude contamination of the fish products. Unused packaging materials must be stored in premises away from the production area and be protected from dust and contamination. Storage should preferably be on racks/shelves or on pallets not directly on the floor and away from the wall. For purposes of tracing, and for inspection purposes, packaging must be adequately labelled to indicate origin, consignment number, etc. A dry environment must be provided to store packaging materials.

6.3.4 Storage and transport

During storage and transportation, fishery products must be kept at temperatures laid down by the regulations i.e., frozen products at -18° C and chilled products at 0° C. Vehicles used for transport of fishery products must be constructed and equipped in such a way that the temperatures laid down in the regulations are adhered to and maintained throughout the period of transportation. If ice is used to chill the products, adequate drainage must be provided in order to ensure that water from melted ice does not stay in contact with products. Containers used for dispatch or storage of fresh fish or processed fish products must be designed in such a way as to ensure both their protection from contamination and preservation and storage under sufficiently hygienic conditions, and they should have free drainage of melt water.

6.3.5 Other hygiene requirements and corresponding process requirements

Raw material quality:

For quality assurance, the raw materials upon which the fish industry is based should be maintained under icing conditions during transportation. Where possible, fishing programmes should aim at shorter fishing trips with hygienic handling while in-lake.

Process water:

The water used for washing, rinsing or conveying fish, or for ice manufacture should be safe and of adequate sanitary quality in accordance to the EEC Council Directive 80/778/EEC.

Condition and cleanliness of food contact surfaces:

Food contact surfaces should be designed, fabricated, maintained and installed to be adequately cleanable, and should be able to withstand the use-environment and cleaning compounds. These should also be smooth enough to guard against introduction and harbouring of micro-organisms.

Prevention of cross contamination:

Those involved in fish processing should conform to hygienic practices, adequate personal cleanliness to the extent necessary to prevent contamination. Hands should be washed and sanitised if necessary before start of work, after absence from work or when any contamination occurs. Hand sanitising facilities should be at each location where good sanitary practice dictates their use.

Waste products and other parts that may constitute a danger to contamination of fish products must be separated and removed from the vicinity of fish process products intended for human consumption.

Maintenance of toilet facilities:

There should be adequate sewage disposal system, with adequate and readily accessible toilet facilities, maintained in good sanitary condition, and with self closing doors.

Control of employee health conditions:

Routine medical check-ups should be conducted for all personnel involved in fish processing so that those found ill or with open lesions, or other source of microbiological contamination that presents reasonable possibility or risk of contamination of the products, contact surfaces or packaging materials should be excluded from any such processing operations.

6.4 A SITUATIONAL ANALYSIS OF EXISTING SANITATION AND QUALITY CONTROL ENVIRONMENTS

A survey of the fish factories and discussions held with fish processors revealed that the biggest source of quality control problems relates to contamination of fish products by Salmonella bacteria and Vibrio cholera. The EU Directive demands that the Salmonella bacteria should not be present in any fish consignment, i.e., the Salmonella count should be nil.

It is worth noting that fish handling, processing and transportation process if not conducted in an environment of high hygiene often leads to contamination of fish products with Salmonella and Cholera bacteria. Major sources of contamination include poor hygiene practices by workers that lead to introduction of bacteria into the working environment.

6.4.1 Gaps that still require to be implemented

The Uganda manual for inspecting fresh fish at landings, markets, transportation and at fish processing plants, issued by the Fisheries Department spells out a code of conduct to be followed by all those who handle fish at various stages from the lake to the fish processing factories. However, field visits carried out during this study revealed that the following aspects contained in that code are not implemented:

6.4.1.1 In-lake Practices

- Whereas the code stipulates that fishing vessels should be maintained in a clean fashion at all times, and that fish should be put in containers or receptacles that are clean and devoid of visible contamination, and should be easy to clean, the actual practice is contrary to this. Some people use Kinala, un-insulated boats.
- Whereas the National and EU Requirements provide specific design criteria for fishing vessels, most fishing in Uganda is still largely done by artisanal fishers who cannot afford the highly sophisticated fishing vessels with all the design specifications and equipment as required in the EU regulations.
- Whereas use of grass or other materials likely to contaminate fish should be discouraged, it is not uncommon to see this being done.
- If long distances and time are involved before catch is landed, ice free from contamination should be used to maintain temperatures at 0o C. Most fishers, however, do not have facilities for icing their fish before sale.
- Many fishers/fish distributors are not sensitised on sound fish handling practices.
- Need to install/provide ice supply source to transporters of fish.

6.4.1.2 Fish handling at landing sites

Contrary to the requirements stipulated in the code of practice, few fish landing sites have the following facilities:

- toilet facilities
- adequate sheds with raised platforms which are easy to clean
- landing jetties
- portable water for cleaning fish

- receptacles for disposal of wastes
- drainage system for run-off water from collecting trucks
- adequate and clean containers for fish reception

The lack of, or poor condition of, such facilities is often responsible for transfer of bacteria to fish being handled. For example, whereas the national and EU requirements provide that unloading and landing equipment must be constructed of material which is easy to clean and disinfect and must be kept in a good state of repair and cleanliness, most fish landing sites have very poor hygiene conditions with rudimentary landing facilities or none at all. Most fish landings are inadequately equipped to safeguard fish contamination due to lack of amenities and proper sanitary environments.

In addition, the national and EU requirements provide that fishery products be placed in protected environments at the temperatures required for a particular product without delay, and where necessary this should be in ice-in transport, storage or market facilities. These facilities remain largely lacking and unavailable to the ordinary fishers, in whose domain fishing operations and landing rely. Where they exist, they are often insufficient.

6.4.1.3 Gaps applicable to factory design and layout

Plant layout and structural design in some establishments does not guarantee safety of the products from possible contamination. It is therefore critical that all factories re-structure their factory layout and modify their process flow charts to ensure no cross contamination of fish during processing can occur.

6.4.1.4. General problems related to failures to meet the required standards

- **Competent Authority (UNBS)**
  - lack of certain national standards: It was reported that these standards are now at advanced stage of formulation and will soon be gazetted as law.
- **Fish inspectorate (Fisheries Department)**

  Inadequate Capacity for inspection due to:
  - under staffing both at the headquarters and district levels.
  - lack of qualified staff to man the landing.
  - poor facilitation: lack of transport and testing kits.
  - low and irregular funding.
  - previous inadequacies in existing legislation, however, the Fish (Quality Assurance) Rules were gazetted in September 1998.
- **Fish processing establishments**

  Deficiencies due to:
  - unsatisfactory sanitary and hygiene conditions in some instances. However, following the bans by the European Union on fish exports in 1997, most factories have over-hauled their systems and have undertaken major renovation works to upgrade their factories in order to comply with national and EU requirements.
  - lack of qualified quality controllers;

- improper transportation;
- improper plant layout;
- laxity in implementation and supervision by employers regarding the sanitation programmes.

- **District Administrations**
  - lack of qualified staff to man the landings.
  - lack of facilities for hygienic handling of fish, including sheltered aprons, acceptable receptacles, clean water, well maintained access roads, adequate and proper toilet facilities, and drainage systems for run-off.

- Fisher communities
  - improper fishing boats with no provisions for chilled storage.
  - improper fishing methods.
  - lack of facilities for hygienic handling of fish as food.
  - limited awareness on sound hygiene and sanitation practices.
  - inadequate self checks.

- **Landing sites and transportation**
  - lack of sheds and platforms in most landing sites.
  - lack of satisfactory toilet facilities.
  - lack of clean portable water.
  - lack of jetties.
  - poor personal hygiene by fish handlers.

- **Export drawbacks**
  - inadequate equipment installation.
  - improper labelling of finished product.
  - inadequacies in export certifications systems.
  - lack of general guidelines.
  - previous lack of cold facilities at the airport. (These are now available).
  - dishonesty of fish processors in declaring the production dates of the fresh chilled fish products.

Requirements for further improvement for effective quality control

Quality management programmes need to be instituted at all critical points in the handling chain, particularly at the fish landing sites and in the fishers' boats while still in the lake. In order to ensure satisfactory fish quality, below is presented the critical quality control points and gaps and areas that require further improvement if satisfactory product quality and handling is to be attained:

TABLE 6.2

Areas requiring further improvement for quality control

Critical Control Point	*Current Status*	*Required Improvement*
In-lake fish handling Handling in vessels	• Refrigeration often lacking • Lack of fish handling ethics	• Hygienic handling of fish: Mandatory icing (Insulated vessels required) • Sensitisation of stakeholders
Handling at fish Landings	• Under direct management and control of landing site Committees. These, however, do not have food/fish handling guidelines • Lack of fish handling facilities that ensure safety and wholesomeness of the fish. These include landing jetties and portable water	• Establish minimum hygiene criteria and requirements which must be met at each Fish landing site • Install appropriate fish landing and handling facilities at landing sites These should include toilet facilities, provision of potable water and landing jetties
Handling while in transit on land	• Most fish processors have insulated (refrigerated) fish transportation trucks, however, most without cleaning programmes in place • Fish sandwiched between ice and floor of trucks • Ice frequently spread on top of packed fish over 1 meter high from the base, i.e., 1:3 ratio of ice : fish • Loading of ice on floor of trucks without container	• Transportation of iced fish in easily cleanable containers in trucks. • Use of adequate ice for fish transported i.e., 1:1 ratio of ice to fish to rapidly lower temperature. • Loading and transportation of ice on containers in accordance to EEC Council Directive 80/778/EEC
Handling at Fish processing factories	• Most processing plants now have well documented standard operating procedures (SOPs) aimed at quality control and hygiene maintenance • Most processing plants have recently undertaken major renovation works to ensure sound hygiene and process flows which ensure no cross- transfer of products between sections • Architectural design and layout of most fish processing plants still do not conform to the national and EU requirements, thus posing possible risk of product contamination	• Practical implementation, documentation and monitoring of the actual activities stipulated in the SOPs • Define satisfactory process plant layout to minimise cross contamination of fish between processing or production stages • Ensure that any plant layout re-structuring conforms to UNBS and EU requirements • Product and process • Monitoring and analysis for hygiene at each operational step (control point) required • Identify product quality risk factors to be controlled • Ensure quality checks through laboratory tests and effective quality control • Regular awareness and training programmes for workers on SOPs
Post processing handling (e.g., during transit to export markets)	• Refrigeration facilities at airport terminal previously lacking. These now exist but charges said to be prohibitive • Improper and sometimes over-stacking of cartons during transportation	• Use pallets for stacking fish during transportation • Maintenance of recommended temperatures during transit • Enforcing obligatory storage of fish products pending air freight
Regulatory framework and enforcement	• Regular quality control tests of random samples from the production line carried out by UNBS • Active factory inspections by Fisheries Department carried out • Enforcement not adequate in in-lake handling and landing sites	• Record keeping to verify performance of quality control mechanisms • Factory audits should be introduced • Improved inspection at in-lake and landing control points
In-plant training of employees	• Evidence of training programmes lacking.	• Regular training and documentation of training programmes required • Adopt consultancy services from competent authorities.

6.5 GENERAL RECOMMENDATIONS AND CONCLUSION

- All fish processing establishments are encouraged to develop their own Environment Management Systems (EMS) and policies through which issues of sound environmental and sanitary management will become part and parcel of the day-to-day corporate and business management.
- Because it is clear that the required quality control mechanisms can be attained through improved housekeeping and hygiene practices, the fish processing establishments should seriously consider institutionalising self-monitoring and audit system so that any departure from desired standard practice for quality control is corrected in time.
- The Government should review the modalities to effectively institute a realistic application and handling of the fishery products and fish through the production and marketing chains. In particular, emphasis should be put on the lake-based water transport and handling. There is also need to update the inspection procedures (and the inspection manual) to fill the critical gaps identified in this report.

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CHAPTER 7

REVIEW OF LEGISLATION RELATING TO MANAGEMENT OF FISHERIES RESOURCES IN UGANDA

ABSTRACT

The management of fisheries in Uganda is heavily dependent on the type of legislation in place at any given time and how effectively it is enforced. There are a number of laws in Uganda, old and recently enacted ones, which contribute to how fisheries are managed. Key among the laws is the Fish Act 1964, which was enacted to ensure that fisheries are sustainably managed.

A review of the laws related to fisheries management shows that most of the laws are not sufficient to ensure sustainable management of the fisheries sector. This is due to the fact that the enforcement mechanisms contained therein are not adequate. The existing law does not have incentives and disincentives which will ensure the proper utilisation and conservation of fisheries resources. The use of non-selective and destructive fishing gear and methods such as trawling and beach seining, the use of small gillnet sizes and use of chemicals is attributed to outdated laws, poor enforcement and non-compliance.

The laws also appear to cover some water bodies while omitting others. This creates a lacuna in the implementation of the law. Penalty charges are too low to deter infraction. It is not yet clear how the fisheries sector will operate given the decentralisation of resource management as contained in the 1995 Constitution and the principle laws affecting the fisheries sector.

This chapter provides a number of policy recommendations aimed at improving management of the fisheries sector. The chapter recommends that there is a need to review existing laws and up-date the regulations in line with Constitutional provisions and other statutes enacted in the post-1995 period. Such laws should involve all the stakeholders in the enforcement process, especially local communities, NGOs, central government, local government, the private sector and other interested parties. The laws should be able to protect breeding and nursery grounds from all kinds of deleterious human activity. Incentive and disincentive schemes should be introduced through licences, restoration orders, permits, charges, subsidies, taxation, performance bonds and orders of merits. This is notwithstanding the fact that criminal sanctions should remain in operation.

REVIEW OF LEGISLATION RELATING TO MANAGEMENT OF FISHERIES RESOURCES IN UGANDA

7.1 INTRODUCTION

The economic importance of fisheries in Uganda has not been fully appreciated, nor fully assessed. The full range of economic activities generated by fish is not accounted for in most of the reports and studies on the sector's performance.

The legal provisions relating to fish also fall under the same situation in that they only cover certain aspects such as taxes, vessel registration, fees, licences, fish size, etc. Enforcement and compliance is not adequately covered by the laws. The consequence of all these inadequacies is that there is a high level of destruction of the fisheries and unsustainable harvesting.

7.1.2 Review of Legislation Relating to Fisheries in Uganda

The laws relating to fisheries resources in Uganda are distributed in too many disparate bodies of legislation. The Constitution, as the supreme law of the land, deals with the management of fisheries resources. The principle legislation is to be found in the Fish Act, cap 228 and Trout Protection Act, cap 229 (1964), and, under these two acts, subsidiary legislation has been made. Several other statutes have a direct bearing on the management of fisheries resources namely: the National Environment Statute, No 4/1995; Wildlife Statute, No. 14 of 1996; Water Statute, No. 9 of 1995; Forest Act, cap 246; Investment Code Statute, No. 1 of 1990; Income Tax Act, No. 11 of 1997; and the Judicature Statute No. 13 of 1996. It should be noted that customary law and practices continue to play an important role in the management of fisheries resources.

7.2.1 Constitutional Matters

The Constitution of the Republic of Uganda (1995) includes in its national objectives and directives that the state shall protect natural resources, including land, water, wetlands, minerals, oil, fauna and flora on behalf of the people of Uganda. Article 237 (2) b of the same Constitution, provides that the national government or a local government shall hold in trust for the people and protect for the people, and protect for the common good of all citizens, natural lakes, rivers, wetlands, forest reserves, game reserves, national parks and any land to be reserved for ecological and touristic purposes. Under Article 245 of the Constitution, Parliament is empowered to provide for measures intended: to protect and preserve the environment from abuse, to control pollution and resource degradation; to manage the environment for sustainable development and to promote environmental awareness. The concept of sustainable development encompasses optimal use of the fisheries resources.

Article 189 (a) states that that the functions and services specified in the Sixth Schedule to the Constitution shall be the responsibility of the government and included in the Sixth Schedule are land, mines, minerals and water resources and the environment. The sixth schedule is vague in that it does not clearly state how the government is supposed to manage land, mines, minerals, water resources and the environment. Is the central government required to manage these

resources? Or is it that the central government role will be policy and standards development with management left to the local governments?

Article 189 (2) of the Constitution provides that the District Councils and the Councils of the lower local government units may, on request by them, be allowed to exercise the functions and services specified in the Sixth Schedule or if delegated to them by the government, by law enacted by Parliament.

Although the Sixth schedule also provides for any matter incidental to, or connected with, the functions and services mentioned therein, it does not specifically identify fisheries resources. Should it be presumed that fisheries resources are part of water resources? Are fisheries resources to be managed by the central government or should this function devolve to the local government authorities? Such uncertainties create problems for efficient resource management.

7.3 PRINCIPLE LEGISLATION

Fish Act and Trout Protection Act—The Fish Act (formerly known as the Fish and Crocodiles Act Cap 228 as amended by Act 3/1967 and the Wildlife Statute No. 14 of 1996) provides for the control of fishing, the conservation of fish, the purchase, sale, marketing and the processing of fish.

The Fish Act does not apply to trout or to any vessel belonging to, or being used by, the government so long as the vessel is on fisheries duty.

The Act is limited in its scope as it restricts basket fishing only in Lake Edward, Lake George or the Kazinga Channel. In section 7 of the Act, reference is made to the District Commissioner whose approval is required by the Chief Game Warden before a vessel is licensed.

Restrictions are imposed on non-Africans by requiring special licences before obtaining fish for sale, engaging in the marketing, purchase, sales processing, canning or freezing. Section 9 of the Act limits the use of poison, explosives or electrical devices for the capturing, killing or injuring of fish.

Section 14 of the Fish Act prohibits the introduction of certain fish and fish eggs into Uganda or any waters thereof. According to the provisions of Section 15 of the Fish Act, licences to fish and those for fishing vessels may be issued by the government of a **federal state** (whose administrative structure no longer exists) or the administration of a District. Sections 18, 19 and 20 prohibit the transfer, assignment or borrowing of licences.

Section 32 vests in Fisheries Officers the powers of public prosecutors subject to the express directions of the Director of Public Prosecutions.

Section 41 of the Fish Act establishes a general penalty or **fine not exceeding ten thousand shillings (UShs 10,000)**.

The Fish Act is more concerned with preventing the over-harvesting of fish resources and the introduction of alien fish species. It does not aim at ensuring conservation of the whole ecosystem but is more concerned with the control of fishing, the conservation of fish stocks, purchase, sale, marketing and the processing of fish.

The fees and fines it imposes are not in tune with current economic trends. This is evident from the value of the fines such as one thousand shillings (UShs 1,000), two shillings (UShs 2) and ten thousand shillings (UShs 10,000). The highest fine of UShs 10,000 is under US $10 at the current exchange rate. The Fish Act does not vest in the enforcement officers, powers to search and inspect vessels or to arrest culprits which results in poor enforcement and compliance with the law.

This amount was high at the time of enactment of the law but is now very low and negligible, hence ineffective as a deterrent instrument to non-compliance.

The Trout Protection Act (Cap 229) was first enacted on 15 December 1936, specifically to make provision for the protection of trout which is any fish of the Salmon family. The Act renders unlawful the fishing, capture, killing, being in possession of, or introduction of trout except with the prior consent of the Chief Fisheries Officer. Section 6 of the Act provides for the method of capture which involves the use of a rod and a line held in the hand, the only other accepted method being the use of a landing net to remove from the water any trout lawfully taken.

It also provides that trout fishing licences may be obtained for a fee. The powers of any authorised officer to call for the licence, to arrest, to seize and to enter upon any land are laid down in sections 11-14. Section 16 of the Act provides a penalty of a fine not exceeding one thousand shillings for offences committed under the Act.

The Act principally aims at the protection of trout yet there are no provisions for conservation of the environment in which trout are found. In addition, the authorised officer is not empowered to prosecute offenders, so this greatly reduces the effectiveness of law enforcement.

The fine to be imposed on any offender is not to exceed one thousand shillings (UShs 1,000) which is currently a very minimal amount and thus does not achieve the desired deterrent effect.

7.4 REGULATIONS GOVERNING THE MANAGEMENT OF FISHERIES RESOURCES

The Fishing Rules SI 228-6

These rules prohibit the use of all other types of nets except gill nets and seine nets except with written authorisation from the Chief Fisheries Officer. The prohibited nets are of the following measurements: gill nets of length greater than 100 yards and depth greater than 30 yards, meshes except gill nets not greater than 3 inch mesh size and depth not greater than 12 feet and seine nets of a length greater than 250 yards.

A prohibited zone of 100 yards is marked on the shore of Butiaba Island on Lake Albert. The use of small mesh gill nets and other gill nets is limited.

The landing of fish is restricted to hours between sunrise and sunset and is permitted only at authorised landing sites listed in the 1st schedule. Dealings by non-Africans are restricted if they desire to participate in large-scale fishing. These rules require fishing vessels to be licensed.

Although the Fishing Rules restrict landing of fish between sunrise and sunset, there is lack of manpower and financial resources to ensure enforcement of this rule.

Fish and Crocodiles (Non-Application of Specific Provisions) Order SI 228-1

The order provides that the provisions of Section 7 (1) of the Fish Act requiring approval of the District Commissioner before a vehicle is licensed, are not to apply to Lake Edward, Kazinga Channel, Lake George, Lake Nakivali, Lake Albert, Albert Nile, Lake Victoria, Lake Kyoga, Lake Kwania, Lake Salisbury (Bisua), Lake Nangabo, Lake Kijanebalola, and Lake Kachira.

It is not clear whether under the current administrative set up of local governments, the required approval under this order should be of the LCV Chairman or the Resident District Commissioner or any other officer.

Exemption from the Provisions of the Act SI 228-2

This order exempted Wardens of National Parks from the provisions of the Act in respect of areas and waters within the parks. There are many waters in Uganda which fall under the National Parks. Monitoring the activities of these officers may be difficult.

Limitation of number of nets per vessel SI 228-4

This order limits the number of gill nets that may be carried in or used to fish from any fishing vessel on Lake Edward (10); Lake George (10); Kazinga Channel (10); Lake Nakivali (2).

Limitation of numbers of Licences S1 228-5

This order limits the number of licences to the following: Lake Edward (208); Lake George (145); Kazinga Channel (44); Lake Nakivali (55).

These orders were made a long time ago. Should the number of licences and nets per vessel continue to be limited to these figures? Can the same order be extended to apply to other water bodies so as to prevent overfishing? Are the regulated numbers respected by enforcement officers? Do the regulated numbers actually regulate sustainable harvesting in light of heavy overfishing in the water courses?

The Fishing (Amendments) Rules SI 32/1966

Among others, it substitutes the fees payable on Lake George, the Kazinga Channel and Lake Edward as provided in the Fourth schedule to 100/= (less than US $0.1). The fees payable are too low.

Fishing Amendment (No. 2) Rules SI 133/1966

These rules amended the 1st schedule to the Fishing Rules 1951 by adding "5. Lake Victoria within the boundaries of Jinja Municipality, Masese".

The Fish and Crocodiles (Non Application of specific provisions) (Amendment) order SI 134/1996. This order amends the Fish and Crocodiles (Non Application of Specific Provisions (No.2) order 1960 by adding "14. Lake Wamala".

Fishing (Amendment) Rules SI 26/1968

This amendment substituted the figure "20" for the word "Nil" in respect of the Albert Nile and added at the end "Lake Wamala, 30".

Limitation of the Number of Nets per vessel (Amendment) instrument S1 91/1968.

This instrument added "Lake Wamala, 20" in the schedule relating to the maximum number of nets permitted per vessel.

Limitation of Number of Licences (Amendments) Instrument of S1 92/1968 . This instrument amends the schedule by adding "Lake Wamala 250".

The Fishing (Amendments) NO.2 Rules S1 118/1968

These rules amend the Fishing Rules S1 228-6 by adding "(e) Lake Wamala"

Fish and Crocodile (Immature Fish) Instrument S1 (5) 1981

This instrument sets out the length of immature fish. For Tilapia Nilotical (Ngege) it is 280 mm (11 inches) in the following water bodies, Lake George, Lake Edward, Kazinga Channel, Lake Wamala, Lake Kyoga, Lake Kwania, Lake Bisinia, Lake Victoria and R. Nile. For macropthalmus (Nile Perch Imputa) it is 44 m (18 inches) in the following water bodies; Lake Albert, Lake Kyoga (mas) R. Nile, R. Semliki, Lake Kwania, Lake Bisinia and Lake Victoria.

Fish and Crocodile (Limitation of the Number of Licences) Instrument of S1 29/1991

This instrument establishes the maximum number of licences at given landing sites on various water bodies as indicated below:

Licences

Lake Edward	Katwe	118
	Kayanja	25
	Kazinga	25
	Rwenshama	55
	Kishenyi	25
Kazinga Channel	Katunguru	33
	Katunguru	20
Lake George	Kashaka	32
	Kasenyi	40
	Kamukunga	32
	Kahendero	25
	Mahyoro	28
	Kayinja-Bukurengu	20
Lake Wamala		250

Fishing (Amendment) Rules S1 10/1992

This amendment replaced rule 3 of the principle rules by substituting seine-nets of any length on the authorisation by the Chief Forestry Officer for use in specified waters of Uganda.

Waters open for the purpose of Trout Fishing S1 229-1

These areas are listed and include the former Sebei and Toro areas and trout fishing can only be carried out by the named angling societies.

Baits and Lures for Trout Fishing S1 229-2

It is provided that only artificial flies can be used as bait for trout fishing. The existing regulations prohibit cropping of Nile Tilapia of less than 28 cm total length and Nile Perch of less than 46 cm total length. The regulations also set the size limit of fish to be cropped at the size at first maturity.[1]

[1] Ref. Report of National Working Group No. 1 on Fisheries Management and Control of Water Hyacinth and Other Invasive Weeds—Uganda, June 1995.

7.5 RELATED LEGISLATION

The National Environment Statute, No. 4 of 1995 interprets " Environment" to mean the physical surroundings of human beings including land, water, atmosphere, climate, sound, odour, taste, the biological characteristics of animals and plants, and the social factor of aesthetics including both the natural and built environment. By this definition, fisheries resources are part of the environment.

The Statute also provides for principles of environmental management to:

- ensure all people in Uganda have the fundamental right to a decent environment.
- encourage maximum participation of the people of Uganda in the management of the environment.
- use and conserve the environment and natural resources of Uganda equitably for present and future generations.
- require prior environmental impact assessments of proposed projects
- ensure environmental awareness.
- ensure that the true and total costs of environmental pollution are borne by the polluter
- promote international cooperation in the field of the environment.

Section 20 of the Statute requires a developer of a project described in the Third Schedule to submit a project brief and to carry out an environmental impact assessment. Among the projects described in the Third Schedule are fish processing plants, commercial exploitation of natural fauna and flora and introduction of alien species of fauna and flora into the ecosystem.

The Statute prohibits the introduction of any animal or micro-organism whether alien or indigenous in any river or lake, or on, in or under its bed except with written permission from the Authority. The same is provided for wetlands in Section 37 of the same Statute.

Under the provisions of Section 68 and Section 73 environmental restoration orders and environmental easements may be issued or granted respectively so as to prevent the commencement or continuation of the degradation of the environment.

The Statute lays down penalties ranging from a fine of not less than one hundred and twenty thousand shillings to thirty six million shillings for offences related to fish.

Section 107 specifically makes provision for Uganda's international obligations most especially in regard to conventions and treaties and the environment. The Statute provides for the creation of incentives and under Section 89 for a National Environment fund where sectors such as fisheries can obtain financial resources to use to ensure sustainable management of the resource.

Although the National Environment Statute introduces better management principles, there may still arise a problem of law enforcement because the Authority cannot prosecute offenders.

Further it is not clear how far the role envisaged by the District and Local Environment Committee extends in the management of fisheries resources.

The Statute vests in the District Environment Committee, the duty to coordinate the activities of the District Local Council relating to the management of the environment and natural resources. The Local Environment Committee is also empowered to monitor the same activities.

Since the Constitution does not clearly indicate where fisheries resources lie, their management in the decentralisation process may prove to be difficult to implement.

The Wildlife Statute (14/1996)

The Statute amends the Fish and Crocodiles Act by deleting from it all provisions with reference to crocodiles, and it instead becomes the Fish Act

The Uganda Wildlife Authority is given the mandate to manage all natural resources in the national parks, game reserves and conservation areas.

Since the Uganda Wildlife Authority's mandate is to manage fisheries resources which are located in protected areas, the Department of Fisheries cannot then be involved in law enforcement in the protected areas.

This increases the problem of legislation when policy on fisheries resources is found in several pieces of legislation.

The Water Statute (9/1995)

The Statute interprets a "subsistence fish pond" to mean a fish pond appurtenant to, or used in connection with, a dwelling or a group of dwellings for subsistence of the residents thereof, the produce of which is predominantly consumed by the residents and is not sold or bartered. It establishes a Water Policy Committee (WPC) which consists of, among others, the Director responsible for Animal Industry and Fisheries.

The functions of the water policy committee are to:

- assist the Minister in the coordination of hydrological and hydro geological investigations
- coordinate the preparation, implementation and amendment of the Water Action Plan and to recommend the same to the Minister
- advise on issues of policy relevant to investigations, use, control, protection, management or administration of water, and to review law relating to water and advise Minister on amendments required
- advise on any dispute between agencies involved in water management
- undertake any other functions conferred upon it under the statute.

Among the objectives of this statute is allowance for the orderly development of water resources for purposes other than domestic use, such as fishing. The Statute empowers the minister to declare a controlled area and establish a comprehensive and integrated plan for managing land, water and natural resources within that area. It should be noted that this Statute concentrates more on water supply than other natural resources so it is not easily discernible as to how fisheries resources can be managed under the Water Statute.

Forest Act (Cap 246)

This Act interprets a forest reserve to mean an area declared to be a central forest reserve or a local forest reserve under the provisions of the Act. The management and control of such areas is vested in the Department of Forestry and local authorities. Fish farming is prohibited in forest reserves save as may be permitted by rules under the Act.

In the definition of "Forest produce" under the Act, fish is not included. Though fish farming may be permitted, what should be done with fisheries resources naturally existing in the water bodies in forests still remains a question.

If there are fisheries resources in forests, are they for the forest officers and local authorities to manage or the fisheries officers appointed under the Fish Act?

Local Governments Act (1/1997)

This Act sets out to provide for decentralisation and devolution of functions, powers and services at all levels of local government.

According to Part 1, Second Schedule, the Central Government is responsible for land, mines, mineral and water resources and the environment, forest and game reserve policy.

The Second Schedule provides that District Councils are responsible for forests and wetlands, fisheries husbandry, and extension services. It provides that the District Executive Committee shall, among others, initiate and formulate policy for approval of council and oversee the implementation of the government and council's policies. The lower local government councils are also involved (see S-27, 31 of the Act). It can be noted that although the management of water resources vests in the central government, the local councils are to be involved in overseeing the implementation of the policies. However, there is no clear provision in this Act and the Constitution, for the decentralisation of fisheries resources. This means that the management of fisheries resources is to be undertaken by both the central and local government establishing a management system.

While policy formulation, legislation and ecological standards remain with the central government, their day-to-day implementation is to be undertaken by the local government. This arrangement could lead to proper management of the fisheries resources as a result of increased participation and involvement of local communities and other stakeholders.

There is need to develop a well co-ordinated system as failure to do so could lead to conflicts between the centre and the district. The fact that the management of fisheries resources is provided for in many laws makes implementation uncoordinated.

Vessels (Registration) Act Cap 349/1964

The Act defines a vessel to mean any description of vessel used in navigation. The law makes it an obligation to register vessels and for purposes of registration, numbering and lettering, vessels are divided into three classes.

On failure to register, the owner and master of the vessel shall each be liable to a penalty not exceeding six hundred shillings.

After registration, the name of any vessel should not be changed. This Act does not address natural resources conservation issues, therefore its connection with the Fish Act is very minimal although very relevant as most fish is harvested using vessels. The implementation of this law is poor as few vessels are actually registered and the fines imposed are too low, which defeats their purpose.

Ferries Act Cap 350/1964

The Act defines a boat to mean any vessel which is not a ship as defined for the purposes of the Inland Water Transport (control) Act.

A licence is required before any boat can ply for hire upon any public ferry, failure of which attracts a fine not exceeding one hundred shillings. All licensed ferry boats are required to carry a special flag. On contravention of any of the conditions upon which the licence is held, the licensee shall be liable to the forfeiture of his licence.

This Act does not make any provision for proper management of the environment by ferry users. It is outdated and out of touch with current economic trends as the fines imposed are minimal.

Inland Water Transport (Control) Act Cap 348/1964

This Act sets out to restrict and control the carriage of goods and passengers by water within Uganda.

It provides for the licensing of ships conveying goods for hire or reward, or for or in connection with any trade or business carried out by the person conveying the goods.

A ship is defined to include every description of vessel used in navigation not propelled by oars or hand paddles and every lighter, barge or like vessel used in navigation, however propelled. The licences granted may be exclusive to particular areas and are generally not transferable except with the written consent of the Board.

It should be noted that the law relating to inland water transport is currently under review.

This Act has a direct bearing on the Fisheries Resources most especially as fish can be classified as goods. However, the definition of vessel excludes those propelled by oars and hand paddles yet these are used by a reasonable number of the fishers. It therefore puts these people outside the range of this Act.

Like all the other legislation, this Act lacks provision for the management of natural resources and the environment and is more focussed on inland water transport issues like tonnage of ships, weight of goods and number of passengers. For instance, this Act does not require the ship master to ensure the disposal of waste from the ship in an environmentally sound manner.

The implementation of this Act has been poor and the fees imposed are too low to deter interaction. The Act is outdated and has to be amended so as to bring it in line with current environmental management principles and economic realities.

The Investment Code Statute 1 of 1991

Although the Code establishes a liberal framework for purposes of attracting local and foreign investment, conditions are imposed on every investment licence.

S.19 (2) d of the Code requires the investor to take necessary steps to ensure that the operation of his business enterprise does not cause injury to the ecology or environment. This implies that whoever seeks to invest in the fisheries industry will have to comply with the environmental considerations required by law. This read with the requirement for carrying out Environmental Impact Assessment in the National Environment Statute indicates a change towards considering environmental issues in investment and development activities.

Customary Law

The Judicature Statute 13/1996 empowers the High Court of Uganda to apply, inter alia, subject to any written law and in so far as the written law does not extend, to apply in conformity with any established and current custom or usage".

The customs of a given people have been found to affect their utilisation of natural resources and the management of the environment. The common belief that a given species of fish causes deafness when consumed which leads to increased demand for other species, thus causing a depletion.

It is important that customary law and practice should evolve to adopt sound principles of environmental management and practice and this can be done through enhancement of community participation and awareness.

7.6 REGIONAL MATTERS

It should be noted that the Lake Victoria Fisheries Organisation (LVFO) was set up basically to promote better management of fisheries resources on the lake and to coordinate fisheries management with conservation. Uganda is a party to this convention which was adopted on 30 June 1994. However, there are other shared water resources, namely Lake Albert and Lake Edward which are not provided for and so the management of fisheries resources remain uncoordinated. The Kagera Basin Organisation was established in 1977 by agreement entered into by Burundi, Rwanda, Tanzania and Uganda. The agreement was aimed at, among others, the integrated conservation and development of the fisheries industry but it is yet to be fully active.

Other shared water bodies which have fish in them, such as Lake Albert, Lake Edward, are regulating bodies. Hence their status remains only under international law. The Nile river also falls under the same category.

The Lake Victoria Fisheries Organisation and convention is more of an advisory, coordinating and liasing body and is not actually involved in actual utilisation of the fisheries resources.

Since the Convention does not affect the sovereignty of contracting parties in respect to what portions of Lake Victoria fall within their respective boundaries, its legal authority is weakened.

This means that a state can over exploit these resources un-hindered by placing emphasis on fisheries resources management at the expense of other water resources. Lake Victoria Fisheries Organisation cannot be relied upon for sustainable fisheries resource management.

The Kagera Basin Organisation has been rendered inoperable due to political instability in the region, lack of funds and lack of a focused mandate. This means that though the organisation and conservation of fisheries resources remains within the national scope of member states which encourages over exploitation.

7.7 FINDINGS

- The laws relating to fisheries resources (enacted before 1995) are outdated and do not reflect recently developed principles of environmental and natural resources management such as those of the polluter pays principle, environmental impact assessment, inter-generational equity, international cooperation, and public participation
- The fees and fines in most fish related Acts and Statutes are too small in light of the interim inflation and devaluation caused by currency reforms. The fines are not effective as a sanction to deter offenders
- In some instances the scope of the law is limited as reference is made only to a few of the water bodies existent in Uganda. Some sections of the law specifically refer to Lake Edward, Lake George and the Kazinga Channel only. It may be necessary to expand these to include other water bodies.
- The law makes reference to administrative offices and units which are no longer existent or which became federal states. This may create confusion as to who is supposed to implement the provisions of the law. There is need to remove obsolete provisions.
- Current law does not address the issue of conservation of fisheries resources and their surroundings (it generally only addresses their utilisation). Issues like water pollution, waste management etc. are not addressed.
- Previously, the law relating to fishing envisaged fishing from natural water bodies only. However, the Water Statute takes need of economic and technological advancements and makes reference to fish ponds. This should be integrated into the new laws.

- The existing law does not have incentives and disincentives, which will ensure the proper utilisation and conservation of the fisheries resources. Save for the provision that informers will be rewarded, no other incentive is provided.
- There is poor enforcement of the existing law mainly due to lack of administrative machinery, lack of resources and apathy.
- It should be noted that many landing sites are operating outside the gazetted ones; fishing is done at night outside the authorised hours of between sunrise and sunset; there are no patrol boats to transport fisheries officials on duty, there is a lack of trained personnel and scarcity of financial resources.
- The use of non-selective and destructive fishing gear and methods such as trawling and beach seining, use of wrong gillnet sizes and use of chemicals is attributed to outdated laws and poor enforcement and non-compliance.
- There is destructive exploitation of fisheries resources partly because of inadequate regulation of fishing effort. In order to conserve fish stocks and other aquatic organisms and ecosystems, regulations should be enforced.
- The laws portray fish as a resource which must be exploited as a source of food, without providing legal components designed for sustainability and conservation.
- Prohibited fishing areas in the Fish Act have not been fully set out. This leads to overfishing of certain species of fish in certain areas.
- Legal measures governing small-scale processors and traders are vague as presently constituted and licensing requirements need to be enlarged in scope and enforcement made vigorous. There is now effective licensing in the post harvest sector (industrial).
- There are no gazetted places on Lake Victoria for landing of fish.
- The rules on fish sizes only cover Nile Perch and Tilapia whereas there are other commercially exploitable species of fish in need of similar harvesting restrictions.
- The inadequacy of cooperation in relation to some of the shared water resources undermines law enforcement and encourages smuggling. This is mostly in respect to Lake Albert and Lake George which Uganda shares with the Democratic Republic of Congo.
- Other factors affecting regional matters have affected enforcement. It has been noted for example in regard to the Kagera Basin Organisation that its mandate was too broad, it had little capital and was affected by political instability. If these are not sorted out, it will become increasingly difficult for regional cooperation to succeed.
- The law does not recognise the inter-relationship between fisheries resources and other natural resources, thus maintaining its delimited sectoral nature. This brings about a lack of collaboration and thus affects enforcement.
- There is a lack of adequate budget provision rendering government commitment to fisheries law enforcement low.
- There is lack of involvement of local communities in the management of fisheries resources.
- There is ignorance of the laws and standards by fishers, chiefs, local administrators and others which increases infringement.
- Problems of attitude are existent as people seek to utilise natural resources without concern as to their renewal and sustainable use.
- Inadequate finances, transport facilities and number of personnel affect enforcement of legislation as the fishers continue using destructive fishing methods and capture undersize fish with the full knowledge that enforcement officers cannot patrol.

- Ignorance of or lack of appreciation of the law and policy by the fishers has led to low response to compliance. Fish is viewed as a common property resource hence under the common law.

7.8 POLICY RECOMMENDATIONS

- There is need to have a detailed study on the laws governing fisheries and other aquatic resources of Uganda with an aim of improving laws, making appropriate institutional changes and up-dating regulations.
- The laws should involve all the stakeholders in the enforcement process.
- Quality control of all types of fish activities, including hygiene at landing sites, need to be instituted so as to increase quality yields.
- There is a need to create more closed seasons and areas, and prohibit certain fishing gear and methods.
- There is also a need to enact laws to protect all breeding and nursery grounds from all human activities.
- There is need to institute intervention measures aimed at increased and sustainable fish production while at the same time ensuring conservation of the whole ecosystem.
- There is need to provide sanctions which are in line with current economic reality.
- Other incentives and disincentives should be introduced through the use of licences, restoration orders, permits, charges, subsidies, taxation, performance bonds and orders of merits.
- More resources should be allocated to the fisheries sector to ensure proper management.
- The law on fisheries should be amended so as to take into consideration the Constitutional provisions and those statutes enacted in the post 1995 period. This will serve to avoid confusion and will consolidate as many provisions as possible. In addition the law should also be brought in the line with the provisions of International Conventions and treaties which Uganda is a party to.
- The enforcement officers should be endowed with more powers such as to stop and search vessels, inspect fish, gear and documents and arrest culprits.
- All fisheries resource stakeholders should be involved in deliberations before laws relating to fisheries resources are amended. Stakeholders such as researchers, the fishers, investors, law enforcement officers etc. can provide the required insight.
- There is need to harmonise and strengthen existing legislation on fisheries resources.
- The law should clearly enable the involvement of local communities, NGOs, central government, local government, private sector and other interested parties to ensure better results.
- Effective law enforcement machinery should be developed.
- There is need to educate all stakeholders about the law so as to increase their knowledge and involvement in the management of fisheries resources.
- The enforcement machinery should be revitalised to play an enforcement role rather than advisory role. It should be able to prosecute defaulters.
- Transport facilities and financing should be made available to fisheries personnel to improve their ability to enforce laws.

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CHAPTER 8

ECONOMIC OF FISH MARKETING: IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT IN FISHERIES

ABBREVIATIONS AND ACRONYMS

ERP	Economic Recovery Programme
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
NEMA	National Environment Management Authority
PTA	Preferential Trade Area
US$	United States Dollar
UShs	Uganda Shilling

ABSTRACT

This study aimed to determine fish price differentials and profit margins in the Lake Victoria fishery to establish pricing levels for the various types of fish in both the local and export outlets; to determine whether there are any market distortions in the domestic fish market; to determine the transaction costs and margins in both local and export fish markets; to determine how the profit margins identified above can be redistributed to improve resource utilisation and environmental management in the sector; and to make appropriate policy recommendations towards the improvement of resource use and environmental management in the sector.

Results of the study show that:

- all stakeholders engaged in the fishing industry make profits.
- no losses have been recorded for any fish species, market place or method of processing at any stage of the marketing chain.
- price differentials based on the use of fish are required.

The study could not establish seasonal differences in profit margins owing to the limited time of study research, scanty data and the fact that fish processing and exportations have been disrupted in the recent past. Furthermore, it was difficult for the study to apportion any monetary value to be charged as tax owing to the fact that environment costs were difficult to derive.

ECONOMICS OF FISH MARKETING: IMPLICATIONS FOR ENVIRONMENTAL MANAGEMENT IN FISHERIES

8.1 INTRODUCTION

Uganda's fish market outlets vary depending on the method of fish processing used. Fish processing methods include hot smoking, sun drying, salt drying, frying and industrial scale fish filleting. Hot smoked fish is mainly destined to long distance internal markets, while fillets of mainly Nile Perch and tilapia go to the European export market and the local premium supermarkets (NEMA, 1996).

The major fisheries in Uganda over a long time have represented the whole range of processing methods. Fish filleting was however, temporarily disrupted in the 1970s. This left hot smoking and salt drying as the main fish processing methods. After resumption in the early 1990s however, fish filleting has rapidly grown to account for 90 per cent of all fish processing activities in Uganda. Export of smoked and salted fish has also recently grown particularly to countries in the neighbouring Preferential Trade Area (PTA).

Non-processed fresh fish is on the other hand sold in nearby markets in the main towns of Kampala, Jinja, Entebbe, Masaka and Mpigi and also directly to fish processors who process the fish before export.

Overall, the export of fish and fish products has grown steadily since 1991. This, as already noted, was encouraged by price increases in the international market, a general trend towards healthier fish-based diets, and the low cost of fish compared to beef as a source of dietary protein. Exports continued to grow in the 1995/96 export period following short-term elasticities in the beef market due to fears of the mad-cow disease in most of Europe (UEPB, 1996). By 1996, over 20 Ugandan firms, four of which satisfied the minimum import product standards of the European Union, were involved in the fish and fish products export business in the country.

The above increases in exports, however, were made possible through increased exploitation of the fisheries' resources. At the same time, increased processing capacity generated an increasing amount of wastes and increased demand implied progressively higher prices. The Fisheries Sector has thus accordingly gained prominence in Uganda's economy as it is the country's second foreign exchange earner after coffee (accounting for 2.2 per cent of total GDP, MAAIF 1998/99).

Most fish processing factories depend on Lake Victoria for their raw material. The lake also increasingly acts as a recipient of the effluent discharge from the nearby fish processing plants. As indicated by NEMA (1996), the lake alone has over 4,000 landing sites on the Uganda side supporting a total of 12 fish processing plants. This assessment will therefore, conceptualise the important impacts that increased export marketing of fish has had on the stock of fish in the lake. It will also investigate how changes in the stock of fish have in turn affected prices and profit margins in the fish market with a view to recommending an appropriate financing mechanism to mitigate negative impacts on fisheries resources.

8.1.1 CONCEPTUAL FRAMEWORK

Fish processing and marketing are rapidly expanding sub-sectors in Uganda. The fisheries sector itself has in the recent past, however, continued to be dependant on Lake Victoria. The lake

produces a variety of fish that include the Nile Perch (Lates niloticus), Tilapia (Oreochromis niloticus, O.esculenta), Mukene (Rastrineobola argentea), Nkeje (Haplochromis spp), Mamba (Protopterus ethiopica) and Semutundu (Bagrus documac).

Fish by-products generated in processing factories are sold in the local markets, and to a lesser extent exported. Appendix 1 gives a list of fish factories around Lake Victoria. The by-products include among others; skeletons, the skin, fats, maws (bladders), belly flaps, cheeks and red meat. These by-products earn some income for the processors therefore contributing to their profitability.

Fish marketing and distribution involve a wide network of transactions, attracting different prices for different species and types of fish. The whole process also involves an array of secondary supporting market infrastructure. Fish distribution requires an efficient transportation network while processing, particularly by hot smoking requires an efficient supply of firewood.

This report discusses the various transaction costs and calculates both the export and domestic marketing margins with an aim of determining appropriate policy recommendations to improve resource use and environmental management in the sector.

8.1.2 OBJECTIVES OF THE STUDY

The study to determine fish price differentials and profit margins for the Lake Victoria fishery aimed to:

(i) establish the pricing levels for the various types of fish in both local and export markets;

(ii) determine whether there are any market distortions in the domestic fish market;

(iii) determine the transaction costs and profit margins in both local and export fish markets;

(iv) determine how the profit margins identified above can be redistributed to improve resource utilisation and environmental management in the sector; and,

(iv) make appropriate policy recommendations towards the improvement of resource use and environmental management in the sector.

8.1.3 METHOD OF INVESTIGATION

An initial desk study was done to review the changes and developments in the fishing, and fish processing industries of Uganda. The desk study aimed to help identify important parameters to investigate in this sectoral analysis. A review of the relevant trade policies and sector regulations was also made. These two reviews helped among other things, to generate a list of the main landing sites supplying the two industrial towns of Kampala and Entebbe. It also helped to identify the costs and revenue elements for both factory and artisanal processors and distributors of fish in the Lake Victoria area.

The review identified the following fishing, processing and distribution cost elements in the artisanal fisheries sector;

(i) actual cost of fishing;

(ii) transport and handling;

(iii) artisanal processing;

(iv) packaging, and,

(v) taxes, permits and licenses.

The formal fish processing sector had the following additional cost elements:

(i) cost of machine operations and maintenance;

(ii) energy and water;

(iii) skilled and unskilled labour costs; and,

(iv) waste management and other environment-derived costs.

The revenue elements included the sale of fish and fish products for various species of fish.

Having completed these phases, wide consultations were made with staff of the Fisheries Department of the Ministry of Agriculture Animal Industry and Fisheries (MAAIF) for their technical guidance.

Through market surveys, the above cost and revenue elements were quantified and an analysis performed to determine profit margins and identify market distortions. This was effected by employing an open-ended checklist and a market survey data sheet. For the factory processing, most of the data on the volumes and values of raw materials used and the quantities and values of processed fish were obtained from the Department of Fisheries of MAAIF. Quotations for freight charges to different destinations were obtained from Alliance, Sabena and British Airlines. The relevant data was then analysed and documented. The outputs of the analysis are presented under the section on results and discussions of the study.

8.2 FISH MARKETING CHANNELS

There are many categories of stakeholders involved in the processing and/or marketing of fish and fish products. The distinct categories are:

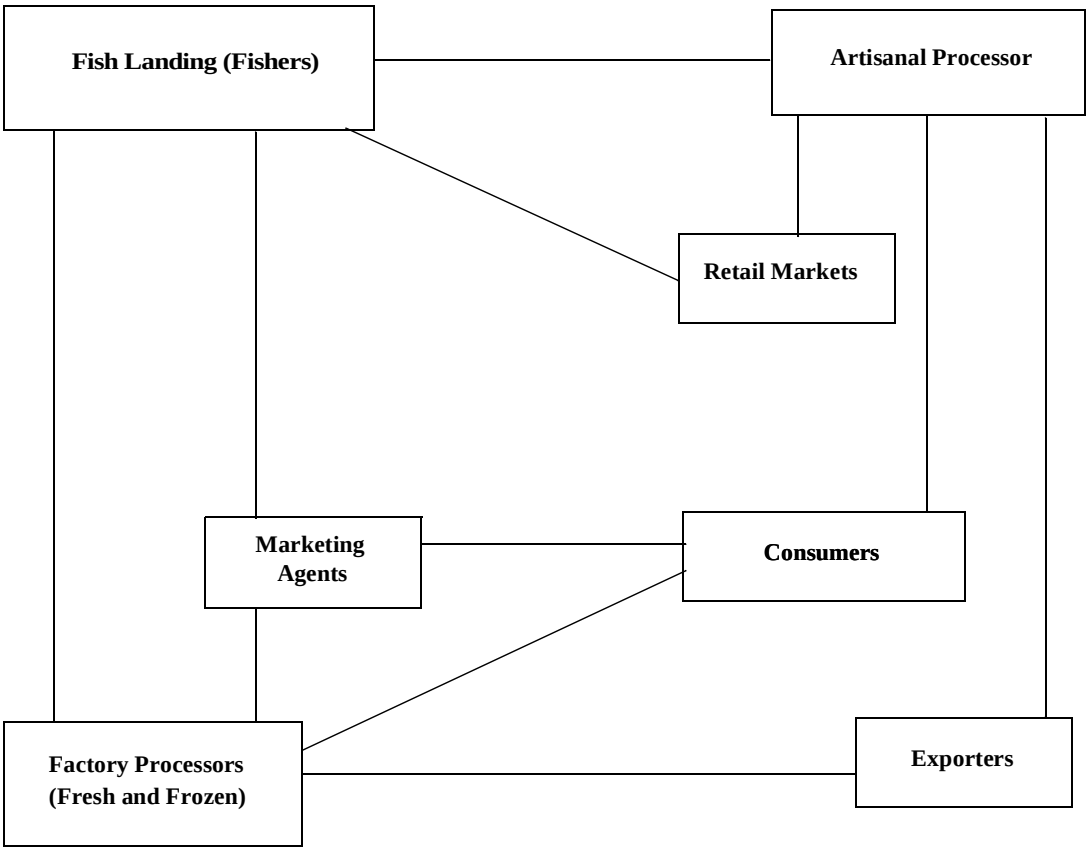
- Fishers are the first category on the marketing chain. They catch the fish from the lake and sell it fresh and whole to any of the other stakeholders;
- Marketing agents are the second category along the chain. They buy fish from the fishers and sell either to the processing factories or directly to the consumers;
- Retailers and other marketing agents buy from either the fishers or artisanal fish processors and sell to the consumers;
- Factory fish processors buy from either the fishers or the marketing agents. They in turn sell their products and by-products to either the consumers or the exporters;
- Exporters who are in most cases the factory processors, and, finally;
- The consumers who are the last category of the stakeholders on the marketing chain. They encompass both the local and foreign

Some of the fish processed by the artisanal processors is also exported. The chain involves different categories of consumers. They include those who buy fish directly from fishers and markets, then those who buy fish products from factory processors and agents. The cost and profit implications vary with the levels of transactions at each level of the market chain. The inter-linkage that exits in the marketing and processing chain is illustrated in figure 8.1.

On the other hand, the by-products after treatment are exported to the neighbouring countries especially the republic of Congo. There, marketing starts when consumers buy them right from the factory premises. The prices of these by-products are set by the factories themselves under free market forces of demand and supply.

FIGURE 8.1

Major Fish Marketing Channels



Source: Keizire (1996).

8.2.1 CAUSES OF PRICE DIFFERENTIALS

There are different causes of price differentials in the fish marketing industry in Uganda. Section 8.3 on results and discussions of the study shows some of the causes of price differentials. However, wide consultations with the technical staff of the Department of Fisheries of MAAIF and some other fish marketing stakeholders identified the following as major causes:

- The market forces of supply and demand affect fish prices. When the demand for fish on either or both the domestic and foreign markets is higher than the supply, suppliers take advantage and hike prices. On the other hand, excessive supply floods the fish market, which in turn brings about reduced competition for the fish, hence prices drop.
- Some socio-economic situations also have a big influence on the demand, supply and the price of fish and fish products. This is explained by the situation that prevailed during 1994 when a big proportion of the population stopped eating fish due to fears of contamination associated with the presence of human corpses found floating on Lake Victoria. Again in 1998, a large portion of Uganda's population were scared of fish poisoning inflicted upon the fisheries' resource by unscrupulous fishers that had started to employ poison to catch fish.

- The accessibility of the sources of fish also determine fish prices. Where the sources are near to the market, prices fetched are higher for the catch than for those that are remote. In his thesis, Keizire (1996) revealed that fish prices vary from landing site to landing site as verified from different factory collection prices. He went further to show that Nile Perch from Iganga sold at UShs 889 per kilogram compared to that from other landing sites near Kampala and Entebbe that went at prices ranging from UShs 1,050 to UShs 1,500 per Kilogram.
- The profitability of the fish whether sold fresh or processed inevitably depends on the source of the raw materials.
- Seasonal differences in fish catch determine fish prices. It is known that during summer, demand for fish and fish products especially in Europe is very limited. The explanation for this is that during this period, local production in the European countries is high compared to winter periods. This results in reduced demand for fish by the fish processors exporting to Europe and other temperate consumer countries. This ultimately floods the local market with fish eventually lowering fish prices in Uganda. The eventual effect of this is a fall in profit margins along the entire marketing chain.
- The mode of transport used coupled with the cost of handling charges also determine the price levels that can be fetched. The lower the transportation and handling charges, the lower is likely to be the price as opposed to when these costs are higher. Data obtained during the study revealed that fish traders that use bicycles to transport their merchandise pay less than those that use public transport, who in turn pay less than those that hire private transport.

It is clear that the price differentials are a function of the physical and socio-economic environment within which fish marketing channels operate.

8.3 RESULTS AND DISCUSSION OF THE STUDY

8.3.1 FISH PROCESSING AND EXPORT

The analysis was mainly based on the Nile Perch whose data was readily available for the last three years during which some reasonable levels of fish processing and export were done. Information about other species of fish such as Tilapia was scanty and therefore considered very unreliable for the study. Besides, very small volumes of these species are indicated to have been processed with no clear indication of the volumes or values of the exported fish and fish products. Analysis of the data on fish processing and export showed that the business is profitable. Results of the study are contained in Table 8.1.

Table 8.1

Range of Profitability of Fish Processing and Export per ton

Item	*Lowest[a] value in Ush'000 per tonne*	*Highest[b] value in UShs'000*	*Range in UShs'000*
Price of by-products (P_b)	100	800	700
Price of Processed Fish (P_p)	2,600	3,700	1,100
Total Revenue (T_r)	2,700	4,500	1,800
Cost of Raw materials (R_c)	700	1,100	400
Freight Charges (F_c)	1,300	1,800	500
Processing and handling costs (PH_c)	230	300	70
Profit Margin (P_m)	*470*	*1,300*	*800*

Source: Compiled from field data.

[a] Lowest value recorded in the three years.

[b] Highest recorded value in the three years.

The profit margin was calculated from the formula:

$P_m = (P_p+P_b)-(R_c+PH_c+F_c+K_c) = Tr-T_c$

where:

P_m is the Profit margin,

P_p is the price of the fish product,

P_b is the price of the by-product,

R_c is the cost of the raw materials,

PH_c are the processing and handling costs and

F_c is the Freight Charges

K_c is the cost of Capital

$T_r = P_p+P_b$

$T_c = R_c+PH_c+F_c+K_c$

and K_c is calculated from the formula:

$(Ic*T*r)\ 100*1/T_p$

where:

I_c is incurred costs

T is time, (1/12) on a monthly basis,

r is interest rate charged on borrowed money (at 18 per cent p.a.)

T_p is average tonnage processed per month.

For ease of estimation, data for Gomba Factory for1997 were used as the factory has consistently been in production compared to many others. All calculations assume the current bank interest rate of 18 per cent p.a., and that all the incurred capital costs are borrowed capital.

The study adopted the assumption of Dyson (1992) that fixed costs do not bear any relationship whatsoever to the specific units (or processes) being produced, and it is impossible to apportion them amongst specific units because no direct relationship exists.

The analysis shows that fish processing and export generates a reasonable profit margin. The figures in the last row show the lowest possible profit margin of UShs 450,000 and the highest possible profit margin of UShs 1,450,000 profit margin per tonne during the period 1995-97.

The results of the study also revealed that there was no significant difference in the costs and prices of the raw materials and products for a period of three years starting 1995. Table 8.2 summarises the findings.

Results in Table 8.2 demonstrate that during the entire period, the estimated average annual prices of processed fish remained between UShs 3.1 and 3.2 million per tonne. The average annual price of the by-products remained between UShs. 0.3 and 0.4 million per tonne. On the other hand, the average cost of raw materials fluctuated between UShs. 0.8 and 1 million while processing and handling costs are estimated at UShs 0.3 million per tonne. The average freight charges were estimated at UShs. 1.5 million per tonne. The estimated profit margins[2] on the other hand range between UShs 0.7 and 0.8 million per tonne.

[2] The profit margins were estimated using averages of freight charges obtained from three different airlines. Besides, some costs were estimated as there was no reliable documented information.

TABLE 8.2

Average Annual Profitability in Uganda Shillings Per tonne of Nile Perch Fish Processing and Export during the period 1995-97

Item	*1995*	*1996*	*1997*
Ave. price (UShs '000) of processed fish	3,100	3,200	3,100
Average Price (Ush'000) of by-products	300	400	400
Average cost (Ush'000) of raw materials	800	1,000	1,000
Processing and handling costs (UShs ‹000)	300	300	300
Freight Charges (Ush'000)	1,500	1,500	1,500
Cost of capital	.06	.07	.07
Total cost	2,600.06	2,800.07	2,800.07
Profit Margin (Ush'000)	800	800	700

Source: Compiled from field data

By-products generated from both the processing factories and the artisanal processing, especially fish maws and oil, are either sold locally at the factory premises or exported to neighbouring countries. According to disaggregated data obtained during the study, fish maws fetch as high as UShs 8,000 to 10,000 per kilogram while the fish oil fetches UShs 600 per litre. Details are contained in Table 5. These by-products therefore make a contribution to the profitability of the fish processing factories. This clearly demonstrates that profitability of fish processing and export does not only depend on the processed fish alone but also on the by-products.

Data from the Department of Fisheries (MAAIF) and some fish processing firms, listed the major importers of Ugandan fish as the European countries (Belgium, Holland, Germany, Greece, Spain and United Kingdom), Africa (Egypt, South Africa) and the Middle East (Israel). Other countries include those in Asia (Hong Kong, Australia, Japan and Singapore). However, there was no disaggregated data to show what quantities of the products go to which country.

The profitability of the fish products and by-products is dependent on destination countries since factors such as freight charges will affect profitability.

8.3.2 ARTISANAL FISH PROCESSING FOR THE LOCAL MARKET

The artisanal processors handle products that fetch different prices depending on their demand and supply in the market. They basically purchase grade II Nile Perch fish (factory rejects) as their raw materials for their production processes. This grade is not stale, but fish considered unfit for factory processing. Besides this source, the artisanal processors purchase the fish that lands late after the factory agents and local market traders have left the landing sites.

The prices of these raw materials are ultimately lower than during normal operating periods falling in the range of 3/4 to 1/2 the price of grade I fish. This ultimately determines the profitability of the fish business.

8.3.2.1 Profitability of Different Species of Fish on the Domestic Market

Data from selected landing sites namely Kasenyi, Kigungu and Nakiwogo within Entebbe and then markets within Kampala and Entebbe revealed price variations between different fish species. The type and level of processing done on each species of fish were also found to affect the profitability of the fisheries' industry. The same data showed the profit margin variations associated with proximity of the market to the source of fish, especially the landing sites. More details are discussed under section 3.2.2.

8.3.2.2 Profitability of Fresh fish on the domestic market

Further interpretation of the data showed the profitability of different species of fish. Details of the data are contained in Table 8.3 below.

TABLE 8.3

Profitability of marketing fresh fish on a per Kilogram Basis

Fish species or or state	*Average price per kg*	*Average transport + other costs per kg*	*Cost of capital*	*Total cost*	*Average profit Margin/kg*
NILE PERCH					
1. Fresh	734	200	0.005	200	534
2. Grade II	354	200	0.005	200	154
TILAPIA	1,071	200	0.005	200	871
BAGRUS	2,500	200	0.005	200	2,300
CLARIAS	2,000	200	0.005	200	1,800
PROTOPTERUS	800	200	0.005	200	600

Source: Compiled from field data

Table 8.3 demonstrates the species-specific price and profit margin differentials. Considering that the average transport and handling costs are on average UShs 200 per kilogram regardless of species, the profitability is highest for Bagrus, seconded by Clarias, and then Tilapia at UShs 1,071, Protopterus at UShs 800 per kilogram respectively. This is followed by fresh Nile Perch at UShs 734 and lastly the grade II Nile Perch at UShs 354 per Kilogram. It is worth noting that the factory processors basically buy fresh Lates with a few buying a little Tilapia. The artisanal processors buy the grade II Lates and the rest of the other species that they market.

TABLE 8.4

Profitability of marketing Cured fish

	Smoked			*Sun-dried*		
Species/types	*Price/kg*	*Associated costs/kg*	*Profit margin/kg*	*Price/kg*	*Associated costs/kg*	*Profit margin/kg*
LATES						
1. Piece	1,200	200	1,000			
2. Whole	1,300	200	1,100			
TILAPIA	1,500	200	1,300			
BAGRUS				3,000	200	2,800
MUKENE						
1. Human consumption				621	200	421
2. Animal feed				356	200	156

Source: Compiled from field data.

Table 8.4 shows the profitability of the different fish species according to their form and type of treatment or processing. It mainly compares the sun-dried with the smoked fish. It also estimates the associated costs regardless of the fish species at UShs 200 per kilogram. The costs include transportation, handling and storage. Accordingly, the table indicates the following:

Nile Perch and Tilapia are mainly treated by smoking as compared to Bagrus and Rastrineobola (Mukene) that are treated by sun-drying. Nile Perch when whole has a higher profit margin of UShs 1,100 per kilogram as compared to pieces which fetch UShs 1,000 per kilogram. On the other hand, Tilapia has the highest profit margin of UShs 1,300 per kilogram of all smoked species.

Of the sun-dried species, Bagrus has a profit margin of UShs 2,800 per kilogram while Rastrineobola has a profit margin of UShs 421 per kilo when used as human food compared to UShs 156 per kilo for animal feeds. Based on this analysis, Bagrus has the highest profit margin, followed by Tilapia, then Nile Perch while Rastrineobola generates the lowest.

TABLE 8.5

Profitability of by-products

Type of by-product	*Price per unit*	*Costs per unit*	*Profit margin per unit*
Sun-dried maws (kg)	9,286	200	9,086
Fish oil (litre)	600	200	400

Source: Compiled from field data

Details of the profitability of the different by-products are already discussed under section 8.3.1.

Profitability of the different fish species in different localities was also estimated from field data. Details of this analysis are contained in Table 8.6.

TABLE 8.6

Comparison of profitability per kilogram of fresh fish for different species in different localities

Species	*Source*	*Price at source*	*Associated costs*	*Profit margin*	*Kasenyi lading site*	*Associated costs*	*Inland markets*	*Profit margin*
Lates	Kome, Sese	350	100	250	600	100	1,000	300
Tilapia	-do-	750	100	650	1,250	100	1,500	150
Clarias	-do-	900	100	800	1,300	100	2,000	600
Bagrus	-do-	1,300	100	1,200	1,700	100	2,500	700

Source: Compiled from field data.

Table 8.6 is based on field data obtained from Kasenyi landing site and from the Department of Fisheries (MAAIF). It is assumed that transport and other handling charges for each kilogram of fish stands at UShs 100 from Kome to Kasenyi and then UShs 100 per kilo from Kasenyi to the inland markets in Kampala and Entebbe.

8.3.3 CONSTRAINTS FACED BY FISH TRADERS

Discussions with the fish distributors and traders revealed that profit margins in fish marketing are often affected by a number of factors. They include among others:

- High taxation by government in form of income tax, licences and daily market dues. Data from the field indicates that the traders pay taxes and market dues ranging from UShs 5,000 to UShs 20,000 per month.
- High operational costs of fuel, working space, labour, transport (both land and water borne), storage and handling facilities.
- Post-harvest losses mainly arising from fish rotting especially during excessive heat and rainy conditions, thefts and attacks by vermin such as cats, dogs and ants.

Any efforts to strengthen the sub-sector performance must generate appropriate policies or interventions to address these constraints.

8.4.0 LIMITATIONS OF THE STUDY

Limitations encountered during the study included:

- Some of the fish processing factories were unwilling to provide data on their operations and the industry at large. This made it rather difficult to correctly estimate processed volumes, handling and transport costs and the prices paid in the international market. In some cases, some factory processors concealed information on the nature, quantities and value of the by-products of their production processes.

- Discussions with the Fisheries Department of MAAIF revealed that some of the information provided by the factory processors/ exporters was questionable considering the business culture that believes in withholding business information from outsiders. It is for example believed, that while the exporters indicate their export prices at an average of US$ 3.6 per kilo of processed fish, the actual price is up to or even more than US$ 5 on the export market,

- Information on freight charges was based on quotations obtained from two airlines with the assumption that they were representative of all the airlines. In addition, the applied freight rates were an average of the obtained figures since it was difficult to calculate precisely the volumes of different fish products to specific destinations.

8.5.0 POLICY RECOMMENDATIONS

In view of the profitability of the fish processing and marketing sub-sector in Uganda, and noting the important quality, hygiene, natural resource and environmental impacts in the sub-sector, the following policy recommendations should be considered for implementation:

- The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) in collaboration with respective local authorities should undertake to improve and maintain fish marketing infrastructure particularly feeder roads, landing sites and other lakeside facilities. Feeder road improvement will facilitate easier access to markets, reduce post harvest spoilage and transport costs, besides improving profitability even at lower consumer prices.

- The Government of Uganda plan to construct and equip at least ten fish landing sites on Lake Victoria at a cost of UShs 2 billion (US $ 1.5 million) p.a. for the years 1999-2001 should therefore be implemented. Further improvement will however be secured if government facilitates private investors to acquire land for infrastructure development at gazetted landing sites.

- Following improvements, the government should tender out landing sites to private operators on a user fee basis. This will improve efficiency and reduce on operational and administrative costs. The landing sites may however, remain under the direct management oversight of District Local Authorities.

- Regarding pollution management, the government should charge fish processing firms and other polluters fees just high enough to cause them to improve their effluent management practices. A combined standards and economic incentives approach based on the Malaysian Model for the Control of Industrial Effluent (Chapter 10 of this document) has been proposed to this effect.

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APPENDIX I

OPERATIONAL FISH PROCESSING FIRMS CLOSE TO LAKE VICTORIA

Name	*Location*
Four Squares Ltd.	Kisubi, approx. 100m from the lake
Greenfields (U) Ltd	Entebbe
Ngege Ltd	Luzira
Marine and Agro Export Processing Co. Ltd	Jinja, on the shores of Lake Victoria
Hwang Sung Ltd	Kampala, Ntinda Industrial Area
Gomba Fishing Industries Ltd	Jinja, on the shores of Lake Victoria
Uganda Marine Products Ltd	Kanyanya off Gayaza Road
Victoria Fresh Foods Ltd.	Munyonyo on the shores of Lake Victoria
Clovergem Fish and Foods Ltd	Entebbe
Byansi Fishing Company	Kalisizo-Rakai
Uganda Fish Packers Ltd.	Nakawa
Masese Fisheries Ltd.	Masese, Jinja
Landing Sites	Bwodha-Iganga Kagave-Entebbe Lambu-Entebbe

Source: Department of Fisheries-MAAIF

CHAPTER 9

AN ASSESSMENT OF THE ABILITY AND WILLINGNESS TO PAY FOR ENVIRONMENTAL COMPLIANCE IN THE FISHERIES INDUSTRY IN UGANDA

ABSTRACT

This study assessed the ability and willingness of fisheries industry agents to pay for environmental compliance in Uganda. It further reviews the likely effects of environmental regulation on the competitiveness of the fish processing industry.

The assessment involved the comparison of pre- and post-environmental compliance cost revenue streams of representative fish processing firms in the country with a view to determining if major measures of project value including Net Present Value (NPV) and Internal Rate of Return (IRR) changed significantly between the two situations.

The results of the sensitivity tests indicated zero change in firm IRR and a small change in the positive NPV. This confirmed that current compliance requirement costs do not harm firm viability and competitiveness.

The conclusions of the study were, however, cautious of the long-term implications of environmental compliance on competitiveness, indicating that input and output price increases and decreases respectively, could shift comparative advantage against Ugandan fish exporters. To allay the above fear, a discussion of the dynamics of the international non-traditional exports market was performed. Special reference was made to European import restrictions and their likely effect on European market access of Ugandan fish products.

While clear incremental costs are associated with environmental compliance, the study identified agents' long-term ability to pay for such compliance. Yet although an ability to pay can be empirically demonstrated, a significant level of unwillingness to pay was identified. This study thus recommends that the National Environment Management Authority, and other relevant enforcement agencies, be strengthened to effectively monitor and supervise against non-compliance. The study also recommends vigorous publicising of environmental standards and education on cheap compliance mechanisms and self-regulation. The long-term effect of the above measures will be a clean and efficient industry that still generates broad economic benefits.

9.1 INTRODUCTION

9.1.1 Background to the Study

In the last 10 years of liberalisation of the economy and implementation of the Economic Recovery Program, Uganda has achieved significant economic progress.

However, various pressures including population growth, economic reforms, the desire for higher per capita incomes, and other pressures of the development process have increasingly put pressure on Uganda's environment, despite of the country's high natural resource potential (MNR, 1994).

This strain has been characterised by increased soil degradation, deforestation, renewable resource depletion including overfishing, loss of bio-diversity, reduced rangeland carrying capacity, fuel-wood shortages, increased pollution, and increased incidence of environmentally related diseases (MNR, 1994).

While in the past the above environmental effects were neither monitored nor reported in a systematic, consistent and quantified manner, today, the need to monitor development efforts so as to improve the quality of the environment for Ugandans is clear. Hence a system to effectively monitor and evaluate the impact of policies and actions on the environment, as well as the population and the economy, has been set up within the National Environment Action Planning Framework.

9.1.2 Conceptual Framework

The National Environment Action Planning Process developed a number of outputs including an institutional, policy and legal framework. One of the outputs of the process, the National Environment Statute was enacted in May 1995 as the first comprehensive law on the environment in the country. The statute requires all developments to comply with prescribed environmental standards and procedures and to undertake Environmental Impact Assessments (EIAs) of their proposed activities. Regular environmental audits are anticipated.

The statute further requires processing firms to reduce or eliminate pollution, but firms may pay to pollute if they are unable to eliminate pollution in excess of prescribed standards. This behaviour is in line with the standard Polluter Pays and User Pays Principles and represents an essential feature of economic instruments to promote agents' improved environmental performance (National Environment Statute, 1995; Pezzey, 1988).

As a result of the above requirements there have been a number of new environmental costs experienced by industry, many of which were not identified in an initial feasibility assessment of Uganda's environmental policy development (UNDP, 1997).

The study examined the effect of incremental environmental costs on the two indicators of project value—Net Present Value (NPV) and the Internal Rate of Return (IRR)—with a view to determining whether firm viability will be undermined by environmental compliance.

9.1.3 Environmental Compliance and Firm Competitiveness

The concept of competitiveness involves the ability of a sector to penetrate and retain adequate export market share to ensure earnings growth for its export transactions. This study notes that because fish export transactions are costly, it is necessary that market clearing prices are high enough to cover export transaction costs to ensure profitability in the industry (Centre for the Development of Industry, 1991).

In view of liberalised market conditions where market prices are determined by exogenous competitive market forces, it is noted that individual enterprises now have increasingly less power to influence profitability through pricing (Sutton and Webb, 1988; Varian, 1993). Firms, however can minimise costs of production and marketing to ensure profitability to enhance competitiveness (UEPB, 1996). Most firms have already adopted this strategy as a competitiveness tool.

It is noted, however, that the fisheries sub-sector in Uganda experiences several cost constraints to competitiveness (UEPB, 1996; UNDP, 1997).

First, the total cost of production in the sector is high compared to the prices offered for the sector's products in the international market—this being mainly due to the prohibitive internal transport costs. Besides, electricity tariffs in Uganda are higher than elsewhere in the region. Electricity supply is also erratic and telecommunication services unreliable (UEPB, 1996).

High standards of product quality and acceptability also introduce a range of additional cost factors. Firms, therefore, need to invest in quality control expertise, buildings and equipment, all of which are costly.

Despite the above cost implications, incremental costs for environmental compliance do not have a significant effect on competitiveness. Agents, therefore, have an ability to pay for such costs as demonstrated below.

9.1.4 Cost Implications of Environmental Compliance

Compliance constraints for the fish processing industry in Uganda revolve around its nature as a primary processing sector. It also has to do with the fact that most of the fish processing firms are located along the shores of Lake Victoria and the lake serves as a reservoir of waste effluent from the factories and its sink capacity is now being overrun.

The primary nature of fish processing factories implies that they discharge large quantities of wastes into co-located lakes, waterways and sewer systems. The new national environmental regulation framework in Uganda seeks to put an end to this. In the above regard, the National Environment Statute presented a set of actions to reduce environmental pollution. They include the following:

(i) construction of adequate effluent treatment facilities with capacity to reduce effluent pollution loads to levels that are acceptable and that do not overload the national sewer line.

(ii) improvement of the production process to minimise waste generation.

(iii) installation of screening machinery to separate solid waste off-cut from liquid effluent.

(iv) reduction of the odorous smell generated by decomposing discharges.

(v) implementation of regular and comprehensive environmental audit plans.

(vi) improvement of occupational conditions for factory workers,

(vii) implementation of internal compliance promotion and environmental awareness programmes.

Whereas the above measures can save money in the medium term through increased recycling of valuable materials and decreased charges for the discharge of waste streams, this was not found to be the experience of Ugandan industry. This is because most plants do not have provisions for the recycling or re-use of wastes and can not benefit from waste recycling and re-use (Muramira, 1997).

9.1.5 Sensitivity Analysis of the Fish Processing Sector

A sensitivity analysis was performed to test the ability of fish processing firms to pay for environmental compliance. A medium size processing firm, of 30 tonnes/day processing capacity was studied for the purposes of the analysis using historical data and projections from 1989 to 1996. To satisfy the objectives of the study, changes in the total cost of production were limited to those due only to environmental compliance, to determine and compare pre- and post- compliance NPVs and IRRs.

9.2 RESULTS AND DISCUSSION

9.2.1 Changes in the Production Costs.

The study found an overall increase in the total cost of production of fish processing firms. These costs began to appear in 1995 when the newly promulgated National Environment Statute (1995) started to demand a cleaner environment. The various incremental costs are illustrated with their percentage increases since 1995:

(i) environmental restoration audits (35 per cent)

(ii) effluent treatment facilities (22.5 per cent)

(iii) solid waste disposal costs (22.5 per cent)

(iv) gas emissions reduction (5.4 per cent)

(v) chemical elimination of odorous gaseous emission (5.4 per cent)

(vi) education and routine environmental audits (8.8 per cent)

In real terms, incremental costs due to environmental compliance contributed up to 0.7 per cent to the total production costs. Their percentage contribution to total costs of production increased to 0.8 per cent of the total costs by the end of 1997 and will rise to 1 per cent by the year 2000. The percentage contribution of compliance costs to the total costs of production, however, was noted to be quite low (production costs were adjusted to 1990 US$ factor prices).

9.2.2 The Fish Revenue Scenario

Like costs, revenues were calculated using 1990 base prices. Prices in real world markets, however, increased rapidly particularly after 1990 when new export outlets were established in Japan, China, Taiwan, Singapore, Korea and Malaysia. Real price increases of over 80 per cent were recorded in the space of less than 2 years for some markets including the European Union market. This trend continued following short-term distortions in the European beef prices over fears of the mad-cow disease (UEPB, 1996).

The main source of revenue examined in this study was sale of fish products. Other auxiliary sales, like the sale of waste oil and carcasses were not included because of their irregular and informal nature. In some cases, however, the latter contributed a significant 5 per cent to total revenue. This omission was, however, taken care of by comparing the sensitivity calculation with the base

case calculations which do not include informal sales. Even with their inclusion, results indicated a negligible effect on the sensitivity scenario, justifying their omission.

9.2.3 Base Case and Sensitivity Scenario NPVs and IRRs.

The Base Case and Sensitivity Scenario values of the firm NPV and IRR, were calculated using the assumptions described above in section 9.1.5 (See Gittinger, 1982; Harvey and Keer, 1978; Kohli, 1993; Richard and Dobbins, 1986).

The Net Present Value for the Base Case was US$ 54,160 while that for the Sensitivity Case was US$ 47,150. There was therefore a 12.94 per cent fall in NPV. In both cases, however, the firm is viable realising positive NPVs.

The IRR also remained healthy at 21 per cent. This is higher than the 20 per cent IRR level that was quoted as the benchmark for export fish and fish products trade to the European Union, implying negligible impact on firm viability and competitiveness (CDI, 1988). This result indicates that fish processing firms in Uganda can invest in environmental protection without necessarily compromising their competitiveness.

9.3.0 POLICY IMPLICATIONS AND RECOMMENDATIONS

9.3.1 Policy Implications

This study confirmed that though a number of new environmental compliance costs have been added to the total production costs in the fisheries sector, they do not significantly affect firm NPVs and IRRs. The fish processing sector can, therefore, endogenously meet the cost of environmental compliance.

9.3.2 Policy Recommendations.

The following recommendations are targeted to help both the fish processors and pollution regulating agencies to implement environmental regulation and compliance programmes in a more cost-effective manner.

The starting point should be a comprehensive sensitisation process on cost-effective compliance measures. This will introduce the various standards, regulations and compliance procedures, and reveal to industry the benefits of better environmental performance.

In line with the polluter and user pays principles, and in view of the demonstrated ability to pay, the government should charge fish processing firms and other polluters at a sufficient level to cause them to improve their effluent management practices. A combined standards and economic incentives approach based on the Malaysian Model for the Control of Industrial Effluent (Chapter 10) should be adopted to improve compliance in this regard.

The level of charge should be carefully determined to balance the need for a clean environment and that for a continued competitiveness of the fish processing industry. The government therefore needs to know what environmental standards the industry can afford to meet.

Finally, supervision, monitoring and regulation of the fish processing industry needs to be improved. The National Environment Management Authority (NEMA) which is the agency mandated to monitor and supervise all environmental activity in Uganda, must be strengthened to expedite proper implementation of its mandate. The long-term effect of the above measures will be a clean and efficient industry that still generates broad economic benefits.

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SECTION II

ECONOMIC INSTRUMENT FOR SUSTAINABLE ENVIRONMENTAL MANAGEMENT

CHAPTER 10

ECONOMIC INSTRUMENTS FOR SUSTAINABLE FISHERIES MANAGEMENT

ABSTRACT

The Government of Uganda implemented an economic recovery programme in 1987 to strengthen the national economy and promote economic growth. The fisheries sector has benefited considerably from the new economic policies. Following rapid growth of fish harvesting, processing and exporting, a number of valid resource conservation and environmental management concerns have emerged, indicating that new and revised environmental policy mechanisms are needed to manage Uganda's fisheries resources.

In order to develop appropriate mechanisms for the sustainable management of fisheries resources this study identified three main issues to be addressed, namely: (i) the possibility that overfishing is occurring; (ii) discharge of poorly treated or untreated effluent into water bodies by fish processing and other firms, especially those located near Lake Victoria; and (iii) quality concerns at various stages in the fish marketing chain from the lake to landing, to processing, and finally to export.

This section presents a range of economic instruments (EIs) and other measures for the sustainable management of the fisheries environment, natural resource base, and product quality. Specifically, the EIs address the three main concerns outlined above. Some of the proposed economic instruments are:

- a combination of quality standards and differential pricing of fish to encourage and finance the fitting of fishing boats with cold storage facilities;
- partial privatisation of landing sites and charging of a user fee to generate revenue for the installation and maintenance of improved facilities at landing sites;
- a system of effluent discharge fees, based on the Malaysian Effluent Charge System;
- implementation of a transferable, landing site based fish quota system whereby officials based at landing sites will supervise and allow fishing boats a maximum fish catch per year;
- targeting taxes, particularly at the processing and export levels, to generate revenue for resource management and to induce possible relocation of excess capital in the sector to other productive sectors of the economy.
- limiting licensing of new fish processing firms until the size of fish stocks are clearly known.

The section also emphasises the need to strengthen the supervisory, monitoring, regulatory and research roles of government. It argues that greater participation of communities in the management of fisheries resources should be fostered. The long-term effect of the above measures will be the sustainable use of fisheries resources in Uganda.

10.1.1 Introduction

This section proposes measures, mainly economic instruments, to improve the state of Uganda's fisheries resources and the environmental performance of agents active in its fisheries industry. The section presents a number of economic instruments to improve compliance with both effluent discharge and product quality standards, and to reduce the risk of overfishing. Specifically, the section focuses on the following aspects:

- the nature and applicability of market-based instruments for fisheries resource management in the Lake Victoria Fishery;
- the nature and applicability of market-based instruments for environmental and quality management in the fish processing sub-sector;
- the nature and applicability of incentives for better product and process quality across the entire fish handling and processing chain;
- the size and nature of incremental costs of firm compliance with raised environmental and quality standards;
- the role of various stakeholders and lead agencies in introducing and operationalising the proposed economic instruments.

10.1.2 Uganda's fisheries resource base

Most of the fish in Uganda comes from five major lakes, namely: Lakes Victoria, Kyoga, Albert, Edward and George. Currently, fish catch rates from these lakes have been on the decline despite increased fishing effort (from about 3,200 fishing canoes in 1972 to over 10,000 canoes presently on Lake Victoria). National level aggregate measures of fish production increased from 60,000 tonnes per year in 1961 to 78,000 tonnes per year in 1983 and subsequently 276,000 tonnes per year in 1993 before recently dropping to 219,300 tonnes per year in 1997. The initial increase in yield was attributed to increased catches of Lates niloticus in Lakes Kyoga and Victoria. During the period 1989 to 1995, an average of 235,800 tonnes of fish was landed annually, with Lake Victoria contributing to over 50 per cent of the annual catch, followed by Lake Kyoga (36.7 per cent), Lake Albert (8.1 per cent) and Lake George and Edward and Kazinga Channel (2.4 per cent). The average catch, however, dropped to just under 200,000 tonnes of fish per annum between 1995 and 1998.[1]

TABLE 10.1

Fish catch by Water Body 1990-1997 ('000 Metric Tonnes)

Year/Water Body	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*Means (1989-1997)*
Victoria	119.9	124.7	129.7	134.9	103.0	103.0	106.4	106.8	117.8
Kyoga	94.9	98.7	102.6	106.7	80.2	80.2	80.6	80.1	86.5
Albert	19.5	20.2	21.6	21.8	16.4	16.4	21.9	19.1	19.0
Edward & George	5.5	5.7	5.9	6.4	5.2	5.2	4.8	6.4	5.7
Other waters	5.4	5.6	5.7	6.2	8.5	8.4	8.3	7.1	6.8
Total	**345.2**	**254.9**	**264.9**	**276.0**	**213.3**	**213.2**	**222.0**	**219.3**	**235.8**

Source: Uganda Fisheries Department, (MAAIF), Entebbe

10.1.3 Regulatory Measures in the Fish Processing Sector

Regulatory (or command-and-control) measures are fixed standards intended to achieve government set health or ecology-based environmental objectives. In the fisheries sector, regulatory measures specifically aim at regulating the level and methods of fishing, the methods and quality of fish handling and processing, and environmental performance standards for the sector.

[1] Note that Lake Victoria is the main commercial fishery in Uganda. The Lake Victoria Fishery currently supports all the fish processing facilities in Uganda due to its large size and closeness to air, sea and road outlets to export markets.

The command-and-control approach also specifies schedules for meeting standards, permitting and enforcement procedures, liability assignment, and penalties for non-compliance. The responsibility for defining and enforcing these standards are usually shared in legislatively specified ways between relevant sector agencies and local governments.

Command-and-control measures in other countries have led to substantial progress in reducing pollution and resource abuse. The approach has, however, been criticised for not achieving various legislative mandates and deadlines and for being economically inefficient and difficult to enforce because of the following reasons:

- command-and-control measures require detailed information on production processes and the suitability of various pollution control processes before they can be implemented. With diverse industries, it is extremely expensive and time-consuming to obtain the necessary information and expertise on each industry.
- they are prescriptive, usually demanding the use of expensive technologies across the industry which leaves little opportunity to take advantage of economies of scale.
- they require polluters using the same production process to meet the same standards regardless of the fine differences between age and type of facility. This denies polluters who can marginally reduce pollution at a lower cost the opportunity to do so beyond levels prescribed by the set standards.
- as prescriptive approaches, they do not leave any flexibility to polluters who already have invested in some type of pollution control system. Consequently, the approach provides very little incentive for innovation in pollution control technology once the standards are met.
- moreover, this approach is insufficient or ineffective in addressing many of the more recent pollution control and waste management problems, such as non-point source pollution, solid waste disposal, and global environmental problems.

10.1.4 Economic Instruments for the Sustainable Management of Fisheries Resources in Uganda

Economic instruments affect economic agents in such a way that agents undertake action in an efficient manner that leads to desirable environmental outcomes (Emerton, 1997). Economic instruments operate through flexible sets of incentives and disincentives to polluters and other resource users, who as rational economic agents, choose the most efficient and cost-effective means to achieve environmental targets imposed upon them by regulation.

To various degrees, economic instruments incorporate the polluter pays and user pays principles into the market mechanism. The polluter pays principle demands that polluters pay high financial penalties for higher levels of pollution and low financial penalties (or none at all) for lower levels of pollution. The user pays principle, on the other hand, demands that resource users pay the full social and environmental costs of exploiting a given natural resource (OECD, 1994).

Economic instruments, in contrast to direct regulations, allow polluters and/or resource users the freedom to respond to certain stimuli in ways they themselves think is most advantageous. Indeed, if certain environmental or natural resource management targets are desired, economic instruments, at least in theory, induce cost-effective behaviour.

In recent years therefore, many countries have adopted a range of economic instruments including pollution charges, tradable permits, subsidies, deposit and return systems, and enforcement incentives to introduce more flexibility, efficiency, and cost-effectiveness into pollution control measures (Bernstein, 1993).

Economic approaches to environmental management have the following advantages when properly implemened:

- they promote cost-effective means for achieving acceptable levels of pollution;
- they stimulate acquisition of pollution control technology, and pollution reduction expertise in the private sector;
- they provide government with a source of revenue to support pollution control programs;
- they promote the development of pollution control technologies;
- they eliminate government requirements for large amounts of detailed information needed to determine feasible and appropriate levels of control for each plant or product (OECD, 1989).

10.1.5 Regulatory Measures for Quality Management of Fish Exports

The fish product quality and standards compliance framework in Uganda is guided by the EEC Council Directive 91/493/EEC of July 1991 which stipulates that all fish products from Uganda should be processed, stored and transported in a hygienic manner. EU regulations (Article 6) require that EU member states ensure that persons responsible for fish handling and processing take all necessary measures to comply with the specifications of the EEC Council Directive. To this end, the EEC Directive expects that persons responsible for fish processing establishments carry out self-checks based of the following:

- identification of critical quality points on the basis of the manufacturing process used;
- establishment and implementation of methods for monitoring and checking such critical points;
- sample analysis at approved laboratories by the competent authority for the purpose of checking the cleanliness and effectiveness of disinfection methods; and for the purpose of checking compliance levels of establishments with the requirements of the Directive;
- keeping written records with a view to submitting them to the competent authority, so that appropriate measures can be taken if there is any departure from expected performance.

In addition to self-checks, the EU Directive requires a formal auditing, inspection and monitoring mechanism to ensure that processing establishments remain in compliance with desired quality standards over time. This mechanism involves the designation of the Uganda National Bureau of Standards (UNBS) as the competent national authority for monitoring. As a designated competent authority, the UNBS is allowed free access to all parts of processing establishments to ensure compliance with the requirements of the Directive. It is also mandated to take appropriate action, including closure or de-certification of any establishment, in the event that inspection and monitoring assessments reveal that the requirements of the Directive are not being met.

The EU Directive expects countries that export fish products to the European Union to fulfil the specific important conditions in accordance with the procedure laid down in Article 15 of the Directive, subject to the health conditions in the country of origin. The Directive requires that the provisions applied to imported fish products be at least equivalent to those governing the production and placement of European Union products on the EU market.

To improve compliance, an incentive mechanism has been built into the import-export arrangements between EU member states and fish exporting countries. Exporting countries are classified into Class I-III exporters.

Class I exporters are free to export to the European Union under a multi-lateral arrangement; Class II exporters have to engage in discussions with importing countries to satisfy their concerns over quality performance; while Class III countries are not allowed to export chilled fish products to the EU.

BOX 10.1

Scope of the EU Directives on Fish Handling

The rules, principles and conditions laid down in the EU Directives apply to the following areas of the fish production chain:

—conditions applicable to fishing vessels;

—requirements during and after landing;

—general conditions for establishments on land;

—special conditions for handling fishery products on shore;

—health control and monitoring of production conditions;

—packaging;

—storage and transportation.

Source: EU Regulations: EEC Council Directive 91/493/EEC, July 1991.

10.1.6 Economic Instruments for Quality Control and Management

Hygiene and sanitation measures on the lake and at landing sites are the responsibility of individual economic agents (fishers), noting that better and more acceptable quality fish production and marketing is in their own economic interest. Quality management in this regard needs to be tackled at two points, i.e., on the lake and at the landing sites.

10.1.6.1 Quality Management on the lake

A system of differential pricing of fish landed at landing sites needs to be established to reward fishers who invest in better sanitation and hygiene through cold transportation. Differential pricing as a performance incentive will be based on the objective evaluation of organoleptic, parasitic and microbial load results of fish landings, noting that cold transportation improves the chance for better performance in this regard.

A willingness to pay for this investment has already been demonstrated by a number of stakeholders in the fishing and fish processing industry:

- The Government of Uganda under the Plan for the Modernisation of Agriculture intends to invest US $ 1.5 m per annum (1999-2001) to construct and improve landing sites. This investment has to be supplemented with improved hygiene and sanitation conditions throughout the fishing and fish handling chain.

- Fish processors occasionally provide fish distributors with ice for cold transportation of fish from the islands. This is a revealed cost towards cold transportation and hence lowered organoleptic and parasite loads.

- During this study, fishers stated a willingness to pay for cold transportation to attain higher fish prices, at least to the value lost due to poor organoleptic performance and the related differential pricing by fish processors. Normally on landing, fish is sorted based on organoleptic tests into good, medium and bad fish, with each category fetching a different price.

- Fresh table fish consumers stated a willingness to pay a limited incremental cost of UShs 200-500 per kilogram of fish if better organoleptic performance could be verified and guaranteed.

10.1.6.2 Proposed Operationalisation of Economic Instruments for Quality Control and Management

Fishers will be required to invest in cold transportation to improve the sanitation and hygiene standards of their fish.

The above initiative will need to be supplemented by the UNBS, fish processors, fishers and other stakeholders through the use of a system of fish product differentiation (and hence fish price differentiation) based on product quality standards (relying on organoleptic performance and product grading).

Many fishers, however, cannot afford insulated boats. In this regard, acquisition of insulated boats will need to be subsidised or facilitated through loan arrangements between fishers, fish processors and the Government of Uganda. Fishers therefore, need to get organised preferably into a fishing community based organisation like the Uganda Fishing and Fish Conservation Association (UFFCA), to articulate the demand and need for credit for the acquisition of insulated boats. The financial worthiness of this investment is illustrated in Box 10.2 below.

BOX 10.2

Cost-Benefit Analysis of Cold Transportation for 30 per cent of the Annual Catch

1997 Data Lake Victoria-Uganda Side

Total Landing	=	101,000 tonnes
Price per Kg	=	UShs 1,200
Catch/boat/day	=	26.81 kg
Differential pricing per kg	=	UShs 200 (proposed)
Level of Investment	=	30 per cent of catch cold transported (i.e., 30,300 tonnes/year)
Cost of Cold Storage per boat	=	UShs 4 mn

The number of boats with cold storage that are needed to achieve a 30 per cent annual penetration is computed as follows:

Days of active fishing per year = 264

Catch cold transported per day = 30,300 X 1/264 = 114.773 tonnes or 114,772.70kg

Estimated catch per boat/day = 26.81kg/boat/day

Therefore 4,281 boats (43.5 per cent of the total fleet of fishing boats) would need to be fitted with cold transportation .

The cost of fitting boats with cold storage is UShs 4mn; the desired level of investment therefore is equal to cost of technology multiplied by the number of boats fitted with cod storage = 4 mn X 4,281 = UShs 17.124 billion

The revenue scenario

30,300 tonnes per year is cold transported to capture an incremental revenue of UShs 200 per kg for cold transported fish.

i.e., incremental revenue = 30,300 X 1,000 X 200 = UShs 6.06 bn per annum.

The return on the capital investment in the first year would be 35.4 per cent which is very good. At the sector level, therefore, an investment of UShs 17.124 bn would be fully recovered in under three years at an annual return on investment of 35.4 per cent per annum.

Source: Calculations based on survey data

This is a feasible investment. It will, however, have to be financed through credit from either the public sector or from fish processing firms. The latter should have interest in this because at fish landing sites, the rejection rate by physical inspectors can be as high as 50%. Reduction in the rejection rate would mean that the processors can obtain a higher tonnage of fish for processing, and therefore attain higher capacity utilisation and revenue.

10.1.6.3 Product Monitoring and Consumer Protection

A system of product monitoring, quality assurance and differential pricing already exists for transactions between fish processors and fishers. This only needs to be improved to reflect the added advantage of investments in cold transportation. At landing sites, representatives of processing firms purchase only the fish that pass the physical inspection, rejecting the rest which will be used for domestic consumption.

The challenge however, lies with product monitoring and protection of consumers of table fish.[2] The following measures should be implemented to tackle this challenge.

- UNBS and the Uganda Consumer Protection Association should extend their traditional mandate of quality assurance and consumer protection to cover fresh table fish;
- consumers should be sensitised to quality measures and quality assurance and the associated differential pricing of table fish to stimulate their vigilance.

10.1.6.4 Landing Sites

The main problem at landing sites is infrastructure. Landing sites therefore, need to be equipped with clean and sanitary landing jetties, reception slabs, chilled and clean portable water with sufficient icing to inhibit microbial proliferation, in addition to toilet facilities for the fishing communities.

The Government of Uganda in its Modernisation of Agriculture Plan intends to invest UShs 2 billion (US $ 1.5 million) per annum for the years 1999-2001 to construct and equip at least 10 fish landing sites in the Lake Victoria area. This investment will improve quality performance and hence secure a more confident and larger market share in the lucrative but high quality demanding EU market. Government should, however, facilitate private investors to acquire land for investments in infrastructure at gazetted landing sites to supplement the above investment (1998a).

The Government intends to tender out the facilities at landing sites to private operators to reduce its cost of administration and improve business efficiency, under a user fee arrangement and under the direct management oversight of District Local Governments (GoU, 1998a; 1998b).

10.1.6.5 Factory Handling, Processing and Packaging of Fish

The National Competent Authority (UNBS) and the Fisheries Department formulated and adapted basic national standards in accordance with the European Union (EU) Directive 493/91 of June 1991 in 1993. The standards articulate EU requirements on plant structure, lay-out and design of premises; the condition of the floor, ventilation, temperature, processing speed and reception. The standards also articulate the requirements regarding pre-filleting handling, filleting facilities, quality control, hygiene practices, packaging, storage and transport, raw materials quality, process water, condition and cleanliness of food contact surface and prevention of cross-contamination.

[2] Note that daily fish landings are roughly split 50:50 between purchases for table fish consumption and industrial processing, based on quality differences. Table fish consumers get fish rejected by processors.

Finally the regulations also specify maintenance standards for toilet facilities and control of employee health conditions basing on the Hazard Analysis of the Critical Control Point (HACCP) procedure.

Besides the competent authority and certification system established by the EU, a number of economic instruments for performance improvement at the factory handling, processing and packaging level exist. They include the "Investor of the Year Award", which is based on annual performance auditing by the Uganda Investment Authority (UIA).

The above measures can be further strengthened by instituting a performance certification system, published in the local press to indicate the best and worst performing fish processing plants regarding product quality and standards compliance.[3]

The EU Directives on quality monitoring will support the above proposed incentive framework and probably further encourage better performance, particularly if the competent authority (the UNBS) develops better and more reliable inspection and monitoring capacity.

10.1.7 Economic Instruments for Pollution Management

The strategy for the management of pollution in Uganda is outlined in the National Environment Management Policy (1994), the National Environment Action Plan (1994) and the National Environment Statute (1995).

The underlying principle for environmental management in Uganda is the Polluter Pays Principle (PPP) which requires that polluters and resource users meet the full-cost of their actions. The principle demands that polluters or resource users internalise the external costs of pollution and/or resource use.

The National Environment Management Policy in line with the PPP states in part that the pollution management objective for Uganda is to control the pollution of water, land and air from domestic, industrial and other emissions and discharges, and to promote environmentally sound management of wastes and hazardous materials. These objectives, it states, will be achieved by:

- establishing environmental standards for permissible levels of pollution;
- strengthening institutional and technical capacities for waste management;
- enhancing institutional co-ordination;
- establishing a system for monitoring compliance with water, land and air pollution control standards and regulations;
- requiring waste generators to pre-treat their effluent before discharge according to established standards; and,
- conducting regular environmental audits to ensure the adoption of environmentally sound practices etc.

In this regard, the National Environment Management Authority (NEMA) developed: air and water standards; standards for the discharge of effluent into water; standards for the control of noxious smells; noise, vibrations and soil quality standards; and emission discharge levels in their sectors. NEMA has moved on to draft effluent discharge regulations to enforce some of these standards.

[3] A comparable and extremely comprehensive certification system based on environmental performance, product quality and occupational health performance was developed and adapted in Malaysia with many good results particularly for pollution management.

The National Environment Statute (1995) Section 99 on offences relating to environmental standards and guidelines, states that any person who:

— contravenes any environmental standard prescribed in Part VI of this Statute;

— contravenes a measure prescribed under the Statute; or

— uses natural resources in a wasteful manner contrary to measures described under Part VII of the statute;

commits an offence and is subject to prosecution, to imprisonment for a term not exceeding eighteen months, or to a fine not less than one hundred and eighty thousand shillings (US $ 133) and not more than eighteen million shillings (US$ 13,333) or both.

However, environmental compliance involves the adoption of costly process and technology modifications. This cost implication determines whether firms voluntarily comply with environmental requirements or risk penalties due to non-compliance. The management decision to comply will follow if the monetary penalty for non-compliance is equal to or exceeds the amount of money polluters save by not complying. An opportunity cost of compliance (OCC) framework has been developed to examine how management decisions are reached to comply or not to comply, for cost adverse firms. Firms compare the level of private benefit they forego by complying with the potential private cost of non-compliance including fines, penalties and indirect losses.

Firms normally comply to avoid the private cost of non-compliance if it is greater than the net benefit of polluting; that is, if the opportunity cost of compliance is zero or negative (EPA, 1992; Pearce and Turner, 1990).

Administration and enforcement of penalties, however, requires that the polluters are caught by the regulatory agency. With under-capacity inspection and auditing capabilities like the Uganda National Environment Management Authority (mainly due to shortage of manpower), the process of inspection and apprehension of defaulters becomes very difficult. This is exacerbated if there are many uncooperative firms (EPA, 1992; Roberts and Spence, 1992).

The economic decision to comply, therefore, also depends on the comparison of the probability of facing the penalty with the net benefit of polluting. The decision by firms to comply, following an opportunity costs comparison decision matrix can be summarised by the following inequality;

$$P1 \geq f\,(p \times P1 + OCC)$$

where

P1 = penalty;

p = probability of facing penalty

OCC = opportunity cost of compliance

As suggested by the above theoretical opportunity cost of compliance (OCC) arguments, environmental compliance of point source polluters is economically undesirable at the firm level. However, polluters must invest in compliance technology. The question therefore, is whether the marginal net private benefit of compliance is empirically comparable with the marginal cost of compliance (MCC) to encourage voluntary compliance.

In studies elsewhere, the marginal net private benefit of compliance was found to be more often lower than the marginal cost of compliance (Batabyal, 1994; EPA, 1992; Pearce and Turner, 1990). This variance between costs and returns undermines voluntary compliance. The undermining effect has been explained by the fact that most point source polluters generate large amounts of waste of low recycling value while compliance equipment is expensive and is usually not sub-

sidised. Besides the above reasons, the marginal net private benefit of compliance diminishes at a rapidly increasing rate as environmental cleanliness levels are approached.[4]

In Uganda, voluntary environmental compliance is further undermined by the empirical fact that NEMA has limited capacity to ensure temporal and spatial inspection coverage. In practice, therefore, the certainty that polluters will be caught and penalised runs at less than 100 per cent (i.e., the probability is less than 1).

Firms therefore risk and unlawfully pollute (knowing well that the chances of being caught and penalised are low) rather than incur the costs of environmental compliance. A combination of regulatory measures, induced self-regulation and economic instruments, need to be designed, developed and implemented to offer a source of incentives for a behaviour change towards compliance.

10.1.8 The Malaysian Model for the Control of Industrial Effluents

The Malaysian Environmental Quality Act of 1974 included provisions for using economic incentives and disincentives in the form of effluent charges in support, rather than replacement, of regulatory controls on discharges. The act requires that all firms discharging effluents pay a fee to obtain a license to discharge waste into public water bodies. Because the license fee varies with the level of waste discharged, it is effectively a discharge fee (Panayotou, 1998). The Malaysian fee varies according to one or more of the following factors:

- the class of the premises;
- the location of such premises;
- the quantity of waste discharged;
- the pollutant or class of pollutants discharged; and
- the existing level of pollution.

In 1977, the discharge fees provided by the Act were combined with discharge standards into an incentive-supported regulatory regime for controlling pollution from palm oil mills. The standards were announced in advance, spurring firms to make early capital investments in treatment facilities. The first discharge fees were collected in 1978. With the standards becoming more stringent over time and the discharge fees becoming larger with the quantity of waste discharged, the results were dramatic. Despite a 50 percent increase in the number of palm oil mills between 1978 and 1982 and a steady increase in palm oil production, the total waste released into public water bodies dropped steadily from 222 tonnes per day in 1978 to 58 tonnes in 1980. This was reduced further to 19 tonnes in 1982 and 5 tonnes in 1984 (Ong et al, 1987).

Despite of a number of weaknesses, and to some extent because of them, the Malaysian mixed regulation-incentive system holds valuable lessons for developing countries that are contemplating the introduction of economic instruments in support of their environmental regulations (See Appendix 1). The model can be modified and adapted to manage pollution problems in the fisheries sector in Uganda.

Uganda has already developed standards for effluent discharges. The standards approach could be combined with an economic incentives approach of effluent charges based on the empirical calculation presented in Box 10.3.

[4] Whereas the marginal cost of compliance is overly high, it increases at a rapidly increasing rate as environmental cleanliness is approached. Voluntary environmental compliance would therefore attract increasingly negligible returns to compliance investment. This is simply because it is technically more difficult to remove the last units of pollution, and at that level, the benefits of increased cleanliness are rapidly diminishing.

BOX 10.3

Effluent Charge Equivalent Using the Malaysian Model

For a daily effluent charge of UShs 24,658 per 120m^3 of effluent discharge of 300mg/l BOD, each fish processing facility would be paying (for polluting above the 50mg/l standard) UShs 82,193 per tonne of BOD (or US$ 61) calculated as follows:

For 120m^3 of waste water of 300mg/l BOD, daily BOD loading beyond the standard will be

120 X 250 X 1000/1,000,000 X 1,000 = 0.3 tonnes BOD;

The cost per tonne of BOD, therefore, will equal to the daily effluent charge (UShs 24,658) divided by the number of tonnes of BOD discharged into the environment;

24,658/0.3 = UShs 82,193 per tonne of BOD. This is equivalent to US$61 at the 1998 exchange rate of US$1 = UShs 1,350

Fish processing firms generate an average of 120-150 m^3 of waste water of about 300mg/l BOD (i.e., biochemical oxygen demand) content per day. The management objective in the sector is to reduce the amount of discharges in volume and BOD pollution loading to less than 25 m^3 of waste water discharge of BOD = 50mg/l per day. Firms that cannot achieve this environmental performance level, however, may pay an effluent discharge fee. The fee will vary according to:

- the quantity of waste discharged (m^3);
- the pollutant or class of pollutants discharged; and
- the existing level of pollution.

Effluent charges will be structured such that each processing firm pays up to UShs 9 million (US$ 6,593) per annum or, on average, UShs 24,658 (US$ 18) per day. Nine million shillings is the average capital cost of constructing an anaerobic lagoon treatment facility for a medium sized fish processing plant at 1997 prices. The above surcharge is comparable to the US$ 100 per tonne surcharge imposed per tonne above the standard for the Malaysian Oil Palm Industry, See Appendix 1.

10.1.9 Economic Instruments to Reduce Overfishing

The management of fisheries resources in Uganda is provided for under;

(i) The Fish Act (formerly the Fish and Crocodiles Act of 1964);

(ii) The Trout Protection Act of 1964; and

(iii) The Fishing (Amendment) Rules, 1998.

The Fish Act of 1964 and the Trout Protection Act 3/1967 provide for the control of fishing, the conservation of fish, the purchase, sale, marketing and processing of fish. The Fish Act does not apply to trout or to any vessel belonging to, or being used by, the government so long as such a vessel is on fisheries duty.

The principal management tool for the sector under the two Acts is the licensing system, and the control of fishing gear.

The fisheries resource is also regulated through Administrative Orders. Here the Minister responsible for fisheries is given wide powers to impose extra controls and restrictions as s/he deems fit. The Minister may:

(i) prohibit the use of a particular fishing method if it is considered destructive;

(ii) declare specific periods of the year to be closed to fishing in any specified area through an order.

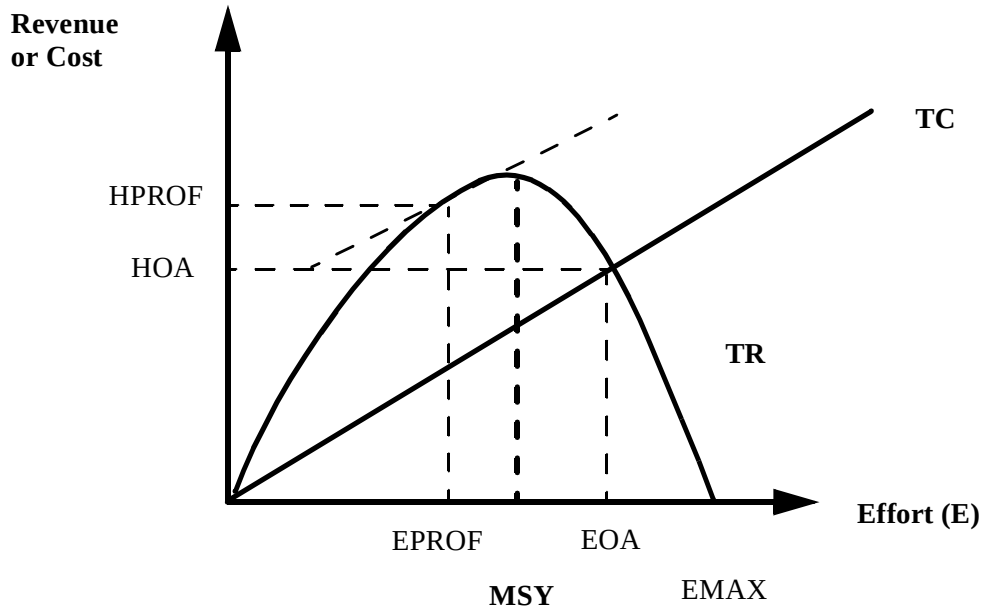
These orders, however, do not carry the force of law and are thus not enforceable in court.

The problem of resource over-exploitation in a fishery is theoretically related to the variance between private property and open access sustainable yield equilibria. The private property sustainable yield equilibrium is well below the maximum stock of a fishery, while the open access equilibrium is very close to it (See figure 10.1)

The single private owner of a fishery (PROF) always aims to maximise profits. He thus sets his harvest effort HPROF at a point that maximises the difference between Total Revenue (TR) and Total Cost (TC). Starting from unity, such a point is reached at some effort level EPROF to the left of the theoretical Maximum Sustainable Yield (MSY), where the slope of the TR curve equals that of the TC curve, i.e., where marginal revenue is equal to marginal cost.

FIGURE 10.1

Profit Maximisation: Open Access and Common Property Equilibria



In an open access (OA) fishery (like Lake Victoria), where there are no defined owners and no rules for using the resource, everyone who realises, or will realise a profit enters the fishery. Accordingly, as long as the Total Revenue (TR) exceeds Total Cost (TC), new entrants come to harvest the resource. They only stop when Total Cost (TC) exceeds Total Revenue (TR), which it does later after the theoretical MSY, close to the maximum carrying capacity i.e., at points beyond EOA (which is the open access equilibrium). This equilibrium at effort level EOA, and harvest level HOA, is even closer to the maximum stock level the cheaper the cost of harvesting (when the Total Cost curve is flatter).

The risk of resource over-exploitation associated with open access conditions is referred to as the tragedy of the commons (Hardin, 1968). It should be noted however, that the tragedy does not always occur. Use of common property is usually governed by rules and regulations. In the case of Lake Victoria, local fishing communities have developed rules through the century which regulate the fisheries. These rules stipulate who may fish, in what season, in what area, what types of fishing gear are acceptable and what type or size of fish can be caught. Local communities have also developed institutions to enforce these regulations. The rules and nature of enforcement "institutions" however, vary from one area to another. They also change over time. In some places the rules are detailed, explicitly expressed and well-known in the community. In other areas the rules are vague, cover less issues related to the fishing effort and may not be generally recognised in the community.

Could the resource use problems of Lake Victoria be simply related to the ineffectiveness of the system of local management alone? No, the system of local management collapsed under the pressure of commercial fishing (Ogutu, 1994; Geheb, 1996; Jansen, 1996), and the more significant problems of open access, market liberalisation and collapse of the regulatory capacity of the Government Fisheries Department.

A comparison of the private property and open access equilibria suggests that two measures could be critical to fisheries resource conservation:

(i) a property rights definition over the resource needs to be instituted to confer to a group of people common property rights ownership over the resource;

(ii) the cost of harvesting of the resource must be raised through appropriate resource user charges;

(iii) to benefit from the power of the market, resource use rights should be transferable.

The transferable quota and licensing system/model that has been applied to the management of high sea fisheries with successful results should be modified and adopted in this case.

This introduction of property rights at the resource level (i.e., stock level) followed by the institution and enforcement of rules for better resource management, should relieve exploitation pressure on the fishery.

BOX 10.4

Estimated Quota Sizes—Lake Victoria Fishery

Between 1994 and 1998 the total catch level (landings) on the Ugandan side of the Lake Victoria Fishery stabilised at 103,000 tonnes of fish having declined from 129,700 tonnes in 1992 and 134,900 tonnes in 1993. The catch per unit of effort also stabilised at about 28 kg per boat per day between 1994 and 1998 with total effort deployment peaking at 9,900 fishing boats in 1998.

Basing on the above estimations and noting that fishing boats are associated with particular landing sites, a landing site based annual fishing quota can be calculated. It will equal to the number of fishing boats that land at any particular landing site times the sustainable catch per unit of effort times the number of active fishing days per year.

10.2 The Benefit and Cost Implications of Improving the Management of the Lake Victoria Fishery

Lake Victoria is an important source of food, energy and water for domestic, irrigation and industrial uses. It also acts as a repository for human, agricultural, municipal and industrial waste. The lake is a very important waterway linking the three East African states Uganda, Kenya, and

Tanzania. It is currently estimated that Lake Victoria supports a riparian population of 30 million people with mean average incomes ranging between US$ 120 to US$ 300 per capita per annum. The lake basin's gross economic product is approximated to be US$ 3-4 billion per year.

Besides providing the direct economic benefits mentioned above, the Lake Victoria fishery maintains the potential for new economic activities that may be carried out in the future as regional economic development proceeds. The total quantifiable annual economic potential of the lake fishery is therefore much higher than the estimated US $ 3-4 billion of current benefit quoted above.

To maintain or enhance the ecological and economic potential of the fishery, this study proposes a number of policy actions. The policy actions aim at improving resource utilisation through the use of more sustainable fishing methods.

The implementation of policy actions will, however, imply incremental management and opportunity costs. As dividends, better resource management will maintain, and likely enhance, economic benefits of the Lake Victoria fishery.

In this section, an attempt is made to estimate both the incremental economic costs and benefits that will accrue to the Ugandan economy as a result of implementing the policy actions proposed in this chapter:

- individual transferable quotas (ITQs) for fishing;
- a system effluent discharge fees (SEDFs); and,
- a cold transportation programme for fish product quality improvement.

The approach involved partial valuations of both direct and indirect costs and benefits (gross values at landing site based prices) and option and existence benefits. The potential annual direct benefits include revenue streams from ITQs, quality improvement, and effluent discharge fees.

Revenue from ITQs

The estimated sustainable catch per boat per day for Lake Victoria is 28 kilograms of fish. If this figure is used to calculate the annual individual transferable quota per boat (see Box 10.4 above), the annual quota per boat will be 10,220 kilograms (10.22 tonnes).

Survey data indicate that the profit margin on one kilogram of fish at the landing site is UShs 250. If the price of an ITQ permit is set to be 17 percent of the total profit margin on the annual quota for a single boat permit (i.e., 17 per cent of UShs 250 times 10,220 kilograms), the price of an annual ITQ boat permit will be UShs 434,350. It is estimated that for the Nile perch fishery alone (with a sustainable catch estimate of 6,385 tonnes), the total revenue (gross) generation capacity is UShs 2.8 billion.

Incremental revenue due to quality improvement

Currently, approximately 50 per cent of fish landed is rejected due to quality deterioration during on-lake transportation. This study proposes that transport boats be fitted with cold storage to prevent such deterioration. It is estimated that the investment would increase total catch acceptability from 40 to 90 per cent over a period of three years. The benefit is that at least a 40 per cent increase in fish acceptability would be realised to capture the price differential of about UShs 380 (e.g., at the Kasenyi landing site, rejected fish is sold for only UShs 354 per kg while grade 1 fish is sold at UShs 734 per kg).

The annual gain to the economy (Nile perch fishery alone) would be equal to UShs 9.9 billion which is calculated as follows: 40 per cent times 65,250 tonnes (the total annual Nile Perch catch from Lake Victoria) times 380 UShs/kg times 1,000 kg/tonne.

Revenue from effluent discharge fees

It is proposed that each polluting firm pays in the range of UShs 9 million per year as effluent discharge fees (the Malaysian Model).

There are about 40 major polluting firms on the Ugandan side of Lake Victoria in Kampala, Jinja and Entebbe. The total revenue contribution from this source therefore will be UShs 360 million.

Summary of the potential quantifiable economic benefits of improving the management of the Lake Victoria Fishery (Ugandan side, annual)

Incremental Economic Benefits (Annual)	*UShs (billion)*	*US $ (m)**
Revenue from ITQs	2.773	1.90
Incremental Revenue due to quality Improvement	9.918	6.84
Revenue from Effluent Discharge Fees	360	0.25
Total Benefit	**13.051**	**9.90**

Source: Survey Data.

* For a June 1999 exchange rate of UShs 1450 to 1 US $.

Despite the large potential benefit of implementing the proposed policy actions, the implementation of the plan will give rise to the following economic costs.

Expenditures associated with resource and ecosystem management, and opportunity costs associated with the preclusion or interference of the operation of marginal but polluting economic activities.

Based on available data, the total quantifiable annual economic costs associated with the improved management of the Lake Victoria fishery was estimated to be UShs 8.5 billion. This figure was derived based on the following considerations:

- Incremental management expenditure comprising of staff, equipment, infrastructure, running costs and other physical inputs associated with implementing the proposed policy plan (ITQs, SEDF, and cold storage). These are costs incurred by government agencies (Fisheries Department, the National Environment Management Authority, the Lake Victoria Environment Management Project, and the Uganda National Bureau of Standards), business enterprises, particularly polluting firms, non-governmental organisations, fishing communities and external donors. For the government alone, the quantified value of costs per year is in excess of UShs 561.4 million. Costs to other agents are estimated from government estimates and survey data in the table below.
- Opportunity costs would range from missed employment by fishers to reduced profitability of marginal processing firms. Opportunity costs were, however, not valued due to lack of reliable data.

Summary of quantifiable economic costs of improving the management of the Lake Victoria Fishery (Ugandan side, annual)

		UShs million	*US $ (m)**
Management Expenses	Government	561.4	0.387
	Business Enterprises	268.0	0.185
	Fishing Communities	5,708.0	3,937
	External Donors	2,000.0	1,379
Opportunity Costs		Nil	Nil
Total Cost		**8,537.4**	**5,888**

Source: MFEP (1997) Background to the Budget; MFPED (1999) Plan for the Modernisation of Agriculture; Survey Data.

* For a June 1999 exchange rate of UShs 1450 to 1 US $.

The net annual economic benefit of the proposed policy package to the aggregate Ugandan economy is therefore:

Net annual economic benefit

= UShs (13,051,000—8,537,000)

= UShs 4.5 billion

= US $ 3.1 million

10.3 Conclusions and Recommendations

A variety of economic instruments have been applied as practical and innovative approaches to environmental management in many countries. Where they have been applied, economic instruments generally succeeded. In Uganda for example, economic instruments have been applied in mainly post-processing sub-sectors to ensure better management of used packaging and bottles (beverage containers) through a deposit-refund scheme.

Whereas the range of economic instruments of relevance to the management of fisheries resources are many and varied, including indirect fiscal and financial instruments, direct incentives like differential pricing and transferable quota systems, together they can be applied as an integrated package to improve both resource and environmental performance in the sector. The discussion in this paper demonstrates how various economic instruments can be applied through regulatory and incentives based policy mixes.

The proposed policy actions however, need to be supplemented with demand-side management involving the careful assessment of expected fish harvest levels and their ability to sustain the actual (or allowed) processing and export capacity. Further dis-incentives (tax policy mixes) can be applied at the fish processing level whereby the Section on ability to pay demonstrated a capacity to pay of up to 21.94 per cent of the net annual cash flow of fish processing firms. One effect of such taxation could be the relocation of productive resources to other sectors with lower saturation levels and correspondingly higher absorptive capacities.[5]

The regulatory measures in the mix, including supervision, monitoring and regulation of fishing effort, and behaviour also need to be strengthened and fisheries research and monitoring must be modernised. Community participation in the management of the resource, however, should be emphasised, with a clear plan to re-equip fishers and fish conservation associations to drive this effort. The long-term effect of these measures will be a sustainable use of the Lake Victoria Fishery that still generates broad economic benefits.

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APPENDIX I

The Implementation Mechanism of the Malaysian Model

The Malaysian combination of economic charges and standards to reduce effluent emissions from the Malaysian palm oil production industry is herein described.

In the first year (1978) of implementation of the system, the standard was set at 5000 mg BOD per litre and was not mandatory, in recognition of the initial difficulties that would be faced by the industry. The effluent emission license fee was set at US $ 3 per tonne of BOD discharged up to the limiting standard.

In the following year, 1998, the BOD standard was made stricter (2000 mg/l) and mandatory and progressive effluent charges were imposed to provide an incentive for the establishment of waste treatment facilities. If the BOD concentration exceeded the prescribed standard, a surcharge was imposed equal to US $ 100 per tonne above the standard. This is equivalent to a non-compliance fine or a compliance incentive. The rates were set such that the annual fees for untreated discharge exceeded, at a minimum, the capital costs for building treatment facilities based on cost estimates for an anaerobic lagoon treatment facility.

Note that this departs from the theoretically correct effluent charge which should set equal the marginal environmental damage, not the costs of installing a discharge treatment facility. Nevertheless, the system performed fairly well in managing pollution problems in the palm oil industry as long as the charges maintained their real value and were fully collected.

By 1984, when the effluent standard was tightened further to 100 mg/l, the BOD load discharge by the palm oil industry was down to only 4 tonnes per day out of 1640 tonnes of total waste load generated per day. A similar system was adopted for the control of pollution by the rubber industry, apparently with equal success. By 1984, most rubber factories were discharging BOD under 100 mg/l and the total BOD load discharged was down to 5 tonnes per day out of a total waste load of 200 tonnes generated per day.

The combined effluent standard-charge system, however, was more effective than efficient due to several inherent problems associated with the system.

First, the charge is not set on the basis of marginal environmental damage costs, as the economic theory of externalities requires for optimal pollution control, but rather is based on the cost of capital investment in treatment facilities. The apparent objective is the construction of waste treatment facilities rather than the control of pollution to optimal levels. This assertion is also supported by the fact that the basic effluent charge is no longer enforced, yet the surcharge for effluent above the standard remains enforced.

A second problem with the Malaysian effluent standard-charge system, with regard to efficiency, is the imposition of the charge on BOD load rather than volume of discharge. This misplacement would clearly provide a perverse incentive for some firms to dilute their effluent to avoid the charge, without actually reducing the total BOD load entering the river. Evidence of this behaviour is lacking, but some developed countries, such as the Netherlands, base their effluent charges on a combination of effluent volume and BOD concentration which discourages dilution (Opschoor *et al*, 1994).

A third problem with the Malaysian system is the implicit incentive for inter-media substitution. While both a basic charge and a surcharge are levied on discharges on land, the basis for the charge is volume, not concentration, while the basis for the surcharge is BOD load above the standard. While this is an effort to address the weakness with the BOD-only based charge system for disposal in water bodies (identified above), it results in a higher discharge level for land disposal and encourages a shift of disposal from land to water. Again, the fee structure does not reflect marginal environmental damage from disposal in different media, but was an attempt to offset the higher cost of waste treatment for discharge into waterways.

Vincent and Ali (1997) analyse in detail the economic efficiency (cost-effectiveness) of the Malaysian effluent standard and charge system, using an economic model of cost-minimising abatement and disposal behaviour by palm oil mills. The authors compare this result with alternative policies, such as command-and-control only (aggregate BOD standard allocated amongst mills according to output) and subsequent emissions trading between mills.

This was a pioneer system for a developing country, and despite its inefficiencies, it did not result in loss of competitiveness for the Malaysian palm oil industry. According to Rahim (1991), Malaysia's palm oil export sector "lost only 5 per cent of the value of output as a result of environmental regulations from 1982-1986 that reduced allowable BOD discharges by 90 per cent. The CPO (crude palm oil) sector lost even less-only about 1 per cent of the value of production ... despite the highly competitive nature of world palm oil markets (cited in Vincent, 1993; p.24)."

In contrast, Rahim (1991) found large losses among the primary input producers, the oil palm plantation sector, which bears over two thirds of the total welfare losses of the industry.

The Malaysian combined effluent standard-charge system is still in effect but has apparently lost part of its original rationale—to promote waste treatment facilities—and its potency. With treatment facilities becoming a licensing requirement and standard feature of palm oil mills, the basic charge is no longer enforced. The surcharge for effluent above the standard is still enforced but it is so low (having lost much of its real value to inflation) that it no longer acts as a compliance incentive. Some mills find it more advantageous to pay the surcharge than treat their effluent sufficiently to meet the standard.

There is no disputing the environmental success of the system. "In 1975, the BOD load discharged by CPO mills was equivalent to the BOD load in the raw sewage of 12 million people. ... By 1985, however, the population-equivalent BOD load fell to only 80,000 people" (Vincent and Ali, 1997, p.320). This decrease is even more remarkable when one considers that at the same time, CPO mills more than doubled and the industry's output of crude palm oil more than tripled (Vincent and Ali, 1997). However, it is extremely difficult, if not impossible to disaggregate the effect of the charge from the effect of the standards, making it a less compelling testament to the potential environmental effectiveness of economic instruments over command and control instruments.

CHAPTER 11

MEASURES TO IMPROVE MANAGEMENT AND USE OF FISHERIES RESOURCES

MEASURES TO IMPROVE MANAGEMENT AND USE OF FISHERIES RESOURCES

This final chapter presents a synthesis of the main issues identified in the study, and recommendations for strategic policy action. There are six issues discussed in this chapter, namely: overfishing, outdated law, quality concerns, regional cooperation, infrastructure, and water pollution.

11.1 Overfishing

The decline in fish catches since 1993 from about 276,000 tonnes in that year to an annual average catch of about 210, 000 tonnes per year over the last five years (24 per cent decline) has led analysts to suggest that the declining catches reflect overfishing. This decline has emerged despite the fact that fishing effort has increased over the same period. Fishing effort is largely uncontrolled because of an open-access policy, which basically means that anyone can go to the lake and fish. Lack of fish stock data further compounds the problem because it is not possible to determine and set sustainable limits on the amount of fish to be caught over a specified period of time. In addition, the use of illegal fishing methods such as the wrong size of gear (nets and seines) leads to harvesting of immature fish and compromises stock regeneration.

11.1.1 Proposed measures

- Various stakeholders (MAAIF, Fisheries, NEMA, Local Authorities, etc.) should develop a system for the definition of property rights of fishers by evolving landing site based quota systems under which a restricted amount of fish will be caught over a specified period of time. The challenge is to ensure proper management, especially by local authorities together with local fishing communities. The quota would be based on parameters such as sustained catch, number of boats and number of fishers. The price of the quota should be based on market prices for fish and fishing inputs used by fishers. Revenue generated from sale of quotas should be used to hire sufficiently trained personnel to routinely collect fish landing statistics, inspect sites, and assist in the management and use of fisheries resources. For transborder lakes, there is need for common practices on all sides of the border to avoid distortions in markets.
- Establish ecosystem based organisations to help stakeholders harmonise their interests and manage resources, e.g., Lake Victoria already has the Lake Victoria Fisheries Organisation (LVFO) and one is also needed for Lake Kyoga.
- Extension of the on-going stock assessment project for Lake Victoria—that is being conducted by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)— to cover all water bodies with a view to obtaining a complete picture of the national level of fish stocks and lake-wide changes, which can then be used to determine the MSY.
- Support private sector development in aquaculture by providing district-based aquaculture support centres, and providing support to the Kajjansi Experimental Fish Farm to develop appropriate fish farming technologies, for transfer to owners of fish ponds.
- Support and promote other sectors that provide alternative sources of protein, e.g., poultry and pork farming, in order to lessen domestic dependency on fish as a source of dietary protein.

11.2 Outdated Law

The Fish and Crocodiles Act 1964 is outdated. It was enacted at a time when the population was low, fish processing and export activity was minimal, and the ecosystem was different from what it is today. The economic circumstances have changed so much since then that the fines in the Act,

which were deterrent instruments at that time, are no longer effective. Additionally, the law is fragmented— it appears in several Acts and Statutes, making effective implementation difficult.

11.2.1 Proposed measures

- There is need to revise the Fish and Crocodiles Act of 1964. New laws that are cognisant of the current status of fisheries are required. The government must enact a new law that recognises the current needs of the fisheries sector and aligns it with current economic conditions. Seminars and workshops should be held to sensitise and consult all stakeholders in the preliminary stages of drafting a new bill to be submitted to parliament. The bill should establish new regulatory measures (e.g., minimum recommended sizes of various fishing gear) and economic instruments (e.g., individual transferable quotas) for sustainable fisheries management. Non-compliance fines and charges must be upwardly revised to reflect the country's changed economic conditions. For example the fines and charges could be pegged to the United States dollar (US$) to lessen the effect of high Ugandan inflation on the real value of fees and fines. The Fisheries Department in MAAIF would be responsible for drafting the bill.
- Local fishing communities are key to the survival of the fisheries. How they perceive the sector and exploit fisheries resources is crucial to sustainability. Community-based education programmes are vital in this respect. The communities can also be assisted to form associations or cooperatives to better manage the resource on which their livelihood depends.
- The new law should be very clear, articulating who is responsible for fisheries resources in areas that are managed by various of jurisdiction bodies, e.g., game parks, forest reserves, etc.

11.3 Quality Control

Continued demand for fisheries products in both domestic and international markets depends on consumer satisfaction, which in turn depends, on the quality of fish products. The fisheries sector in Uganda has difficulty maintaining quality standards. First, it is only recently that a competent government authority has been mandated to establish quality standards for fish. Second, the infrastructure base of the Ugandan fisheries sector makes it vulnerable to poor quality standards: the majority of fishers use canoes that are not fitted with proper handling and cold storage facilities; landing sites lack adequate facilities; and roadway conditions are poor.

11.3.1 Proposed measures

- An education campaign/programme needs to be designed to sensitise all stakeholders to the benefits of quality enhancement. This can be done by the competent authority (Uganda National Bureau of Standards, UNBS) in collaboration with the Fisheries Department, NEMA, UFFCA, and the Ministry of Health.
- Fish processing firms should be encouraged to undertake vertical integration by making them aware of the industries that would use the secondary (or waste) products from their processes. The fishmeal industry is one example that would benefit from poultry and pig production. As Uganda's population rises, and incomes improve, poultry and pork demand will rise.
- In accordance with the EU directives, factories should be made to conform to recommended facilities adjustments.
- Prevention of cross-contamination. This requires plant layout to be certified by UNBS working together with the Fisheries Department, who are mandated to ensure quality.
- The inspection and audit system should be strengthened through institutionalising self-monitoring and audit systems.
- In view of rampant fish poisoning, to strengthen the testing capacity for chemical presence in fish samples, in addition to organoleptic tests.

11.4 Regional Economic and Environmental Policies

About half of fish caught in Uganda come from Lake Victoria which is a shared resource of Uganda, Kenya and Tanzania. For effective and sustainable management of the fisheries resources, the three countries have to cooperate and harmonise their economic and environmental policies.

11.4.1 Proposed measures

- An officially observed memorandum of understanding requiring the three countries to harmonise their economic and environmental policies to avoid distortions in the fisheries sector. The Lake Victoria Fisheries Organisation (LVFO), East Africa Community (EAC) and UNEP should work together to ensure that regulations are put in place for cooperation and compliance. The starting point would be an assessment of pertinent economic and environmental policies in all three countries and their implications for fisheries. On the basis of that information, differences in policies would be identified and bilateral discussions held to harmonise them.

11.5 Infrastructure

Poor infrastructure remains a constraint to much of Uganda's economic activities, especially the marketing of agricultural and other goods in the economy. For the fisheries sector, poor infrastructure at the landing sites leads to poor quality fish, and poor roads lead to high transaction costs (transport cost, wear and tear, time loss) which taken together translate into a loss of efficiency and possibly higher prices to the consumer or lower profits to fishers.

11.5.1 Proposed measures

- MAAIF (Fisheries Department) working together with local authorities and other relevant ministries should develop fish marketing infrastructure.
- Fisheries activities are profitable and hence a tax can be assessed based on the value of product sales. Tax administration would be handled by local authorities and the tax revenues could be used to improve infrastructure at each market level (landing site, roads, and retail markets).

11.6 Pollution

Discharge of poorly treated or untreated effluent into water bodies by fish processing and other factories poses great danger to the fisheries resources. Besides toxicity, the high nutrient load has contributed to proliferation of the water hyacinth, making its control an expensive undertaking.

11.6.1 Proposed measures

- Gazetting standards for effluent and wastewater discharge and regulations to enforce them should be finalised by NEMA, in collaboration with the Directorate of Water Development (DWD).
- A comprehensive environmental audit system should put in place by NEMA, and auditing should be done regularly.
- An education and awareness campaign is needed to sensitise polluters, and also the general public, to the environmental damage caused by pollutants and the tangible benefits of reducing pollution. This could lead to a demand for a cleaner environment. Particular emphasis should be placed on standards, regulations and procedures. Firms should train their employees to uphold the standards. Higher institutions of learning should be encouraged to develop tailored programs on environmental performance improvement at the corporate level.

- In line with the polluter pays principle (PPP), polluters should begin to be charged. NEMA and DWD should work out the modalities for collection of polluter fees and how they would be utilised. NEMA & DWD should begin to levy pollution charges in line with the PPP. The National Environment Statute (NES) gives NEMA the mandate to charge such fees.
- Use should be made of a combined standards and economic incentives approach based on the Malaysian model of pollution control (see chapter 10 for details). This study established that firms are able to pay for environmental damage. Analytical results indicate that firms can remain viable with investment in waste treatment facilities that meet required standards.

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