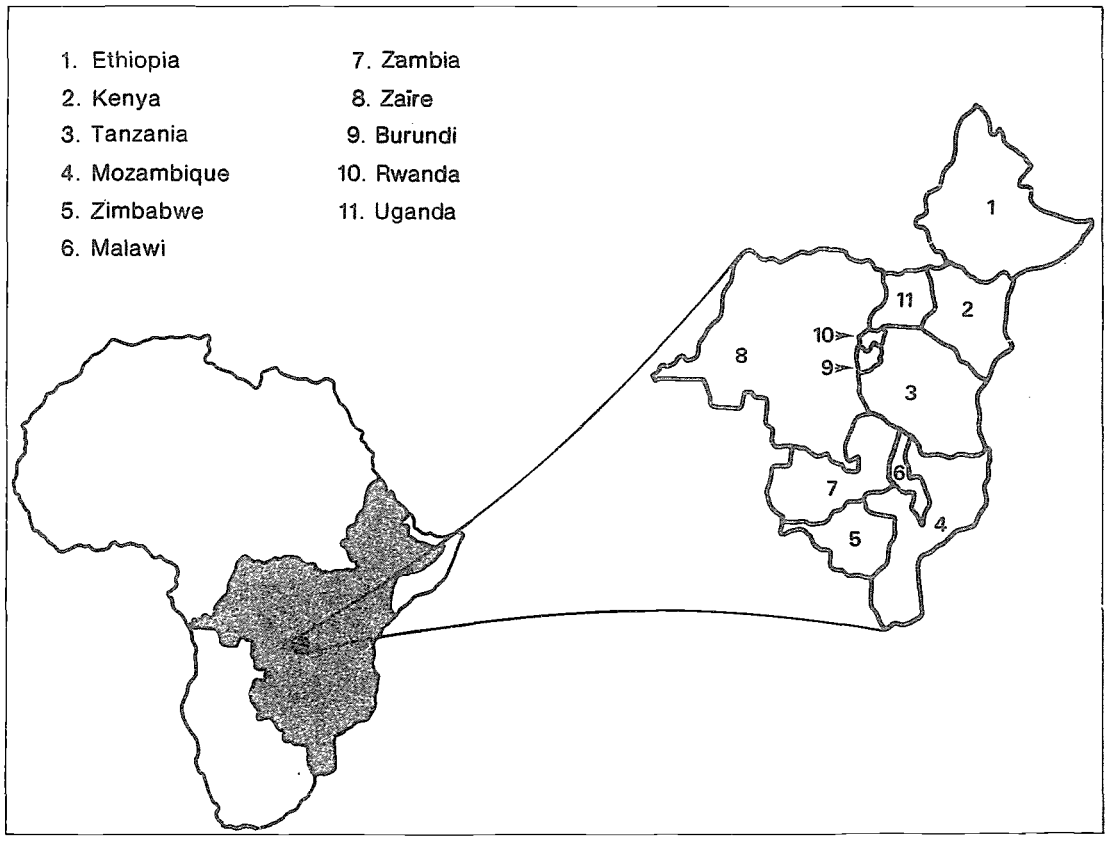
REGIONAL PROJECT FOR INLAND FISHERIES PLANNING, DEVELOPMENT AND MANAGEMENT IN EASTERN/CENTRAL/SOUTHERN AFRICA (I.F.I.P.)

IFIP PROJECT

RAF/87/099-WP/10/92 (En) August 1992

Compilation of the papers presented at the technical consultation on Lakes Edward and Mobutu Shared between Zaïre and Uganda

(17-21 september 1990, Kampala, Uganda)



UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

UNDP/FAO Regional Project
for Inland Fisheries Planning
Development and Management in
Eastern/Central/Southern Africa

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edited by

George Ssentongo
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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
UNITED NATIONS DEVELOPMENT PROGRAMME
Bujumbura, August 1992

PREFACE

The IFIP project started in January 1989 with the main objective of promoting a more effective and rational exploitation of the fisheries resources of major water bodies of Eastern, Central and Southern Africa. The project is executed by the Food and Agriculture Organisation of the United Nations (FAO), and funded by the United Nations Development Programme (UNDP) for a duration of four years.

There are eleven countries and three intergovernmental organisations participating in the project: Burundi, Ethiopia, Kenya, Malawi, Mozambique, Uganda, Rwanda, Tanzania, Zambia, Zaire, Zimbabwe, The Communauté Economique des Pays des Grands Lacs (CEPGL), The Preferential Trade Area for Eastern and Southern African States (PTA) and the Southern African Development Coordination Conference (SADCC).

The immediate objectives of the project are: (i) to strengthen regional collaboration for the rational development and management of inland fisheries, particularly with respect to shared water bodies; (ii) to provide advisory services and assist Governments in sectoral and project planning; (iii) to strengthen technical capabilities through training; and (iv) to establish a regional information base.

PREPARATION OF THIS DOCUMENT

The present document includes scientific background papers presented at the Technical Consultation on Lakes Edward and Mobutu shared between Zaire and Uganda. The Consultation was held from 17 to 21 September 1990 in Kampala, Uganda. It was organized by the Regional Project for Inland Fisheries Planning (IFIP) in collaboration with the Economic Commission for Africa (ECA) and the FAO/UNDP Project UGA/87/007 "Fisheries Statistics and Information Systems (FISHIN). This document is published in English and French.

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IFIP PUBLICATIONS

Publications of the IFIP project are issued in two series:

A series of technical documents (RAF/87/099-TD) related to meetings, missions and research organized by the project.

A series of working papers (RAF/87/099-WP) related to more specific field and thematic investigations conducted in the framework of the project.

For both series, reference is further made to the document number (10), the year of publication (92) and the language in which the document is issued: English (En) or French (Fr).

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The Fisheries Resources of Lake Mobutu/Albert

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1. GENERAL PRESENTATION OF THE LAKE

Lake Mobutu, located in the western part of the Rift Valley, covers an area of 5270 km^2: 2420 km^2 (46%) of which belongs to Zaire and 2850 km^2 (54%) belongs to Uganda.

Located at a height of 618 m, it is a typical lake of the Rift Valley, deeply embedded between mountains that fall from almost 200 m on the Zairian side, leaving practically no road access particularly in its central region. In this area, the coastal strip is shallow and narrow; the mountain running straight into the lake with only a narrow alluvial margin. It is an oblong lake approximately 160 km in length and 35 km maximum width. As it is relatively shallow: with particularly shallow zones in the northern and southern parts of the lake (the latter produced by the Semliki delta). It has a maximum depth of 58m and, with an average depth of 25m. Oxygen is generally available throughout the whole water column.

It is fed principally from Lake Edward through the Semliki River in the south, and from the Victoria Nile in the north. Its outflow, the Albert Nile, is situated close to the start of the Victoria Nile which supplies 70% to 95% of the outflow water (M.J. Holden, 1963). This results in most of the nutrients and mineral salts from the Semliki River remaining in the lake. The lake serves as an evaporation basin, producing waters which are rich in mineral salts with a pH of 8.5.

2. EXPLOITABLE SPECIES

Lake Mobutu is relatively poor in species of fish. In 1964, Greenwood[1] took a census in the lake and came up with 53 species among which 28 were cichlids, 6 (i.e 11%) of which were endemic species.

Most of the cichlids are littoral species. The periphyton, being abundant throughout the lake, provides protection and food for the juveniles.

According to the most recent data[2], there are 46 species, 6 of which

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[1] Greenwood, P.H. 1964: Explosive speciation in African Lakes Proc. Inst. Gr. Br., 40: 256-259.

[2] Fryer & Iles (1972), Greenwood (1984) and Coulter et al. (1986)

are cichlids. The lake therefore still contains very few species in comparison to other lakes of the Rift Valley: for example Lake Victoria contains 288 species of which 250 are cichlids, Lake Malawi contains 548 species of which 500 are cichlids.

The following nine main species or types are economically exploited:

- Cichlidae: tilapias (Oreochromis niloticus, Sarotherodon galilaeus and T. zillii
- Cantropomidae – Lates macrophthalmus
  – Lates niloticus
- Synodontis sp. (S. schall)
- Siluriformes: – Bagrus sp. (B. docmac, B. bayad)
  – Clarias gariepinus.
- Cyprinidae: – Labeo sp. (L. forskalii)
- Characidae: – Alestes spp. (A. baremose, A. grandisquami
- Hydrocynus spp. – (H. forskalii, H. goliath)

The lake contains species that vary greatly in size ranging from small Hydrocynus and Alestes to Nile perches that can live up to 25 years and reach a length of 180 centimetres. Large size species which constitute 85% of the total catch consist of Hydrocynus (35%), tilapias (25%) and Nile perch (25%). As a consequence the exploitation of small size species generally have a bad effect on large species as the juveniles are also invariably caught. For example in the coexistence of 2 species of Lates: Lates macrophthalmus is a species whose average size does not go beyond 1 kg and Lates nilotica can reach 200 to 300 kgs. In Lake Mobutu the average size and age at first sexual maturity is about 25 cms for Lates macrophtalmus and about 40 cms for Lates nilotica[3]. The simultaneous exploitation of these two species can have a drastic effect on the stock of Lates nilotica if the large majority of the stock are caught before their first sexual maturity. The morpho-anatomical differences between small individuals of the 2 species are hard to distinguish which make it difficult to evaluate such an effect. It would therefore be necessary to set up simple specific criteria of determination in order to avoid such risks.

3. DATA ABOUT THE STOCKS

3.1 Potential

There is little information on the stocks present in the lake. The few evaluations on fish potential that have been made are very old and are based on empirical mathematical models which take into consideration morpho-edafic, biological and limnological characteristics, such as the mineral richness of the water, faunal composition and average depth.

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[3] Projet de Développement de la Pêche Artisanale au Lac Mobutu. Rapport Administration Financier et Technique, Année 1988.

The lake is rich in plankton and the primary production is high. However, although fish catches remain moderate, the overall ecological productivity is poor. Studies on the potential of the lake reveal a MSY (Maximum Sustainable Yield) of between 40 and 60 kg/ha/year i.e. 21 000 to 30 000 t/y of which 970 t (i.e. 46%) are produced within Zaire and 11 300 t (i.e. 54%) within Uganda.

It appears that the phytoplankton and zooplankton density increases from south to north up to a level of Butiaba and then decreases further north due to the influence of water from the Victoria Nile which is nutrient poor. The most abundant phytoplankton are the diatoms Stephanodiscus sp. and Nitzschia sp. and the 2 main types of zooplankton are Daphnia sp. and Caridina.

Local blooms of blue algaes of the Anabaena type as well as mass mortality of fish stocks, (particularly of Nile perch), indicate the existence of movements in the anoxic bottom sediments. However it is doubtful whether this has an impact on the total productivity of the lake.

3.2 Production

In 1988, total production was estimated at about 22 500 t of which 10 500 t was produced by Uganda and 12 000 t by Zaire.

However as the figures were established more for administrative purposes than for scientific research purposes their accuracy must be questioned due to the following factors:

(a) a share of the catch is retained by fishermen for their own consumption;

(b) fish may be bartered with salesmen in exchange of other commodities;

(c) fish may be given as "presents" to some civil servants and local notable persons; and

(d) fish may be sold at "clandestine" or not well controlled landing stages.

Table 1: Important data on Lake Mobutu/Albert

	MSY (t/year) (1) min	max	Production 1988 (tons)
Uganda	11 300	16 700	8 464 (2) 12 534 (3)
Zaire	9 700	13 300	12 001 (4)
Total	21 000	30 000	20 465 (2 + 4) 24 534 (3 + 4)

(1): Plan Directeur des Pêches, République du Zaire, 1987
(2): Statistics provided by Regional Fisheries Officers, Uganda.
(3): Fisheries survey, MAIF, Uganda, May, 1989.
(4): Projet de développement de la Pêche Artisanale sur le lac Mobutu, Zaire/France, 1988.

Even taking into account the probable inaccuracy of the statistics it would seem that the lake has reached a level of full exploitation; the production being very close to the MSY.

3.3 Distribution of the catches

Hydrocynus represents nearly 35% of the catches and tilapias and Nile perch 25% each.

The proportion of tilapia in Zairian catches is twice as great as those of the Ugandan catches, (36 % and 16.6% respectively) whereas that of Hydrocynus is less in Zaire than in Uganda (29 % and 39% respectively).

Table 2: Distribution of catches on Lake Albert/Mobutu

	Zaire	Uganda	Total
Hydrocynus sp.	29%	39.0%	33.7%
Lates spp.	22%	24.2%	23.0%
'tilapias'	36%	16.6%	27.0%
Others	13%	20.2%	15.3%

3.4 Seasonal variations

There are seasonal variations in the fish catchability that fluctuate monthly by up to 10%.

Maximum catches occur between September and October and between March and April and, to a lesser extent, between January and February.

This seasonal fluctuation is strongly linked to the climate; the most abundant catches taking place in the rainy seasons.

4. CONSTRAINTS AND RECOMMENDATIONS

4.1 Lack of information

The current fishery statistics are not good enough to be able to apply them to lake populations dynamics models necessary to evaluate the stock(s). There is therefore only a very vague idea of the exploitable stock, (the only available estimates being outdated and resulting from global estimates using empirical environmental models to estimate the resource).

However, the available figures do indicate that exploitation has reached a level close to the maximum sustainable yield (Table 1). Any effort to develop the fishery made without knowing precisely the state of the resource would carry the risk of endangering the stocks to the point of no recovery.

It is therefore imperative to conduct a reliable evaluation of the stocks as a preliminary to the formulation of any coherent development and management policy for the fishery.

This evaluation can be done by a diverse means of investigation (echo sounding, experimental fishing, larval sampling etc.). However there is also a need for the establishment of a reliable system of data collection, which allowing for the lapse of time corresponding to the longest reproduction cycle of the exploited species, would enable a proper study of lakes' population dynamics to be carried out.

Studies need to be undertaken in order to determine:

- if one or more stocks exist;

- the level of exploitation of the different species and/or stocks;

- their geographical distribution;

- the possible migrations and seasonal variations of this distribution.

This last point is very important in considering the differences in fishing effort now put on various parts of the lake (particularly in Zairian waters) and to decide on the best management strategies (including infrastructure facilities) for the continued development of the fishery.

4.2 Protection of spawning grounds and nurseries

At the present time, spawning grounds are not clearly identified or well protected. For example, purse seine fishing takes place during the night in these zones.

Administrative authorities as well as fishermen have to become aware of the danger that this kind of practice presents to the stocks; and measures must be set up for efficient control and protection.

4.3 Harmonization of fishing pressure

Fishing pressure is very unequally distributed on the lake. Some zones that are near large rural areas are intensively exploited whereas other more isolated areas are poorly or are not exploited. The central part of the lake is not exploited by self-employed fishermen because of the instability of their canoes. Finally, Uganda waters are generally less intensively exploited than Zairian ones.

For optimal use of the resources, an effort at harmonizing the fishing pressure on the whole lake must be undertaken including the exploitation of the deeper offshore areas by a small semi-industrial fleet as was present in the sixties.

4.4 Cooperation between Uganda and Zaire

As far as research is concerned, cooperation between Uganda and Zaire can only be advantageous as it would: (a) enable an evaluation of the resources of the whole lake; (b) be more economical in terms of labour (due to economy of scale); and (c) homogenize and cause greater reliability of capture statistics.

Fisheries planning is essential as the management of the resources of this shared lake needs a common management policy. (Any management measure taken unilaterally is likely to be inefficient in light of different and contradictory measures taken by either country.) It is therefore necessary to create a common decision-making and consultation authority in charge of conceiving and coordinating fisheries development of the whole lake.

5. CONCLUSION

Given the level of exploitation already reached, there is an urgent need to conduct an accurate evaluation of the available resources and establish a common planning policy for the fisheries.

It is likely that in the future, such a development policy would not be directed towards increasing production but rather at rationalising exploitation and increasing market value of the products.

This rationalisation is to be achieved first and foremost through constant cooperation between the two countries, and with the creation of a common commission endowed with decision-making powers. The Commissiont will ensure coherence and therefore viability for development actions to be undertaken.

FISHERIES EXPLOITATION AND RATIONAL MANAGEMENT OF LAKES EDWARD AND MOBUTU/ALBERT

by

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1 GENERAL INTRODUCTION

Lake Edward (Fig. 1) is located in the western arm of the Rift Valley of East Africa lying between 0°04' and 0°39'S and 29°30' and 30°05'E. The lake is shared between Uganda (29%) and Zaire (71%). Lake Edward is connected to Lake George by the Kazinga Channel and hence there is fish species interaction between the two lakes.

Lake Albert (Fig. 2) is located in the northern part of the same arm of the Rift Valley between 2°15' and 1°00'N and 30°21' and 31°25'E and again is shared between Uganda and Zaire. There is an alluvial plain where the Victoria Nile joins the Albert Nile and the western shore along the Zaire border is characterized by a 2000m escarpment. The southern shore is marked by swamps, particularly papyrus which dominate the delta of the Semliki River connecting Lake Edward to Lake Albert.

It is essential to consider Lakes Edward and George in the context of their location with respect to the Queen Elizabeth National Park (QENP), the Parc National des Virunga (PNV) in Zaire, the Parc National des Volcans in Rwanda, the Ruwenzori Forest Reserve, the Mahinga Forest Reserve/Gorilla Game Reserve and the Chamburi Game Reserve in Uganda. This pattern of continuous protected zones stretches for some 300km north to south with the waters of Lake Edward and the Kazinga Channel lying completely within the boundaries of this protected region, and Lake George is three quarters surrounded by the QENP. In fact of a total of some 380km shoreline of Lakes Edward, George and the Kazinga Channel, a length of only some 15 to 20km is not bounded by either the QENP or the PNV. The total area of the Zaire waters of Lake Edward are an integral part of the Parc National des Virunga, and the Kazinga Channel is an integral part of the QENP. However, it is anomalous that the Ugandan waters of Lake Edward and the whole of Lake George, form no part of any protected zone.

2 EXPLOITATION AND MANAGEMENT OF LAKE EDWARD FISHERIES

2.1 Physical and Chemical Characteristics

Physical and chemical characteristics of any aquatic system obviously influence its productivity, and determine its carrying capacity. The fluctuation in productivity is often reflected in fluctuations in fish population.

2.1.1 Morphometric Features of Lake Edward

Uganda	sector	670 km^2	29%;
Zaire	sector	1 630 km^2	71%;
Total	area	2 300 km^2	100%;
Altitude	:	914 m above mean sea level;	
Depth	:	117 m (maximum) 34 m (mean);	
Volume	:	78.2 x 10^9 m^3;	
Maximum length: 90 km;			
Maximum width : 40 km;			
Conductivity : 900-925 µ mhos;			
Total dissolved solids: 521 mg/l;			
pH : 8.5-9.3			

Surface temperature: ca. 26° C

2.1.2 Chemical characteristics of the waters of Lake Edward

Sodium	Na	110.0 mg/l
Potassium	K	9.0 mg/l
Magnesium	Mg	47.8 mg/l
Calcium	Ca	12.4 mg/l
Carbonate/bicarbonate	$HCO_3 + CO_3$	600.0 mg/l
Chloride	Cl	36.0 mg/l
Sulphate	SO_4	31.0 mg/l
Silicate	SiO_2	6.5 mg/l
Nitrate/Nitrogen	NO_3/N	24.0 µg/l
Phosphate/Phosphorus	PO_4P	18.0 µg/l
Total	P	127.0 µg/l

2.2 History of Fishery Exploitation of Lake Edward/George.

Fishing and its associated activities provide the livelihood for most of the people living around Lake Edward. For an individual to fish on these two controlled lakes, they need permission from the Fisheries Department. Each village has a set of licences allocated to it but there are often several licences on transfer from other villages. Fishing canoes are operated by a crew of two or three hired workers, "barias", who work under different agreements. Gill nets are set in the evening and left overnight. The Fisheries Department supposedly maintains a ban on night fishing however there is no evidence to show that the ban is respected. There is also a restriction on basket fishing around Lakes Edward/George but this is reportedly still practised around Ntchwera and Kayanja.

There have been changes in the composition of fish species landed. During the 1950s the tilapiine cichlids, mainly O. niloticus accounted for over 80% but in 1989 they contributed about 40% of the total catch (Dunn, 1989).

There may be a combination of reasons for these changes. It may be that there has been a shift in the proportion of the total fish population made up of these scavenger and predator species. It is also more likely that the fishermen are fishing at greater depths and over substrates where these species are known to be caught in greater numbers in order to satisfy the market for these larger and more valuable fish.

Other fish species contributing significantly to the catch are: Bagrus docmac, Barbus altianalis, Mormyrus kannume, Labeo forskalii, Protopterus aethiopicus, and Clarias lazera. These proportions vary from landing to landing and seem to correspond to the habitat preferences and migratory habits of individual species rather than any targeted fishing activity (See Table 1).

The most important commercially valuable species are Oreochromis niloticus (ngege/tilapias), Bagrus docmac (semutundu/catfish), Clarias lazera (male/catfish) and Protopterus aethiopicus (mamba/lungfish). Seasonally important at specific locations is Barbus altianalis (njunguli/barbel) and of lesser importance but of high market value are Labeo forskalii (Kitumbi/ningu) and Mormyrus kannume (kasalubana/elephant snout fish). In addition to these

commercially important species two other fish are sometimes found in the commercial catches namely O. leucosticta (ngege) and Haplochromis squamipinnis (nkeje).

3 EXPLOITATION AND MANAGEMENT OF LAKE ALBERT (MOBUTU)

3.1 Introduction

Uganda owns 54% and Zaire owns 46% of the lake. Available catch records show that since the early 1950's total annual catches for the Ugandan sector have ranged from 3000 t to about 22 000 t. The total catch magnitudes for Lakes Edward/George and Albert are shown in Table 2. Table 3 gives the variations in total catches by fish landing centres for the year 1989.

3.2 Physical and Chemical Characteristics of Lake Albert

As already described for Lake Edward, the physical and chemical characteristics of a lake influence the productivity of the system.

3.2.1 Lake Albert morphometric features

Lake Albert is characterized by the following morphometric features:

- altitude 618 m above mean sea level (MSL);
- length 160 km along the NW-SW transect;
- width 35 km;
- surface area 5270 km^2;
- mean depth 25 m;
- maximum depth 58 m;
- volume of water 140 km^3 total; 80 km^3 in Uganda;
- water temperature range 27.5-29.0° C;
- transparency in some bays less than 30 cm; and
- transparency in open waters 2-6 m;

3.2.2 Chemical Characteristics of the Waters of Lake Albert

Sodium	Na	91.0 mg/l
Potassium	K	65.0 mg/l
Magnesium	Mg	32.1 mg/l
Calcium	Ca	9.8 mg/l
Carbonate/bicarbonate	$HCO_3 + CO_3$	445.3 mg/l
Chloride	Cl	31.0 mg/l
Sulphate	SO_4	32.0 mg/l
Silicate	SiO_2	<1.0 mg/l
Nitrate/Nitrogen	NO_3/N	-
Phosphate/Phosphorus	PO_4P	-
Total Phosphorus	P	200 µg/l

Table 1 : Estimated annual total production of fresh fish for Lakes Edward/George and the Kazinga Channel for 1989, based on the revords of the Fisheries Department (Uganda)

Débarca-dères	Tila	Bagrus	Barb	Clar	Prot	Mor	Lab	Total
Rwenshama	241,7	388,7	26,2	39,3	53,6	0,3	,01	749,8
Katwe	428,6	328,4	2,0	21,3	56,9	-	-	837,2
Kisenyi	189,5	26,6	1,4	2,7	4,7	-	-	224,9
Kayanja	172,8	184,3	19,1	11,5	15,2	0,1	0,6	403,6
Kasinga	171,3	63,4	1,4	0,7	2,9	-	-	239,7
Katunguru (K)	38,1	14,8	0,5	7,2	57,1	0,1	..	117,8
Katunguru (B)	88,1	18,6	2,1	15,6	22,5	-	-	146,9
Kashaka	83,1	63,0	0,1	10,9	35,1	-	-	192,2
Kasenyi	198,8	81,6	,01	7,3	43,7	-	-	331,4
Kayinja	192,4	145,9	..	18,3	130,3	..	-	486,9
Kahendero	95,6	185,9	..	132,0	684,4	-	-	1097,9
Mayoro	208,6	71,5	0,7	20,9	71,9	-	-	373,6
Hamukungu	238,4	47,9	,02	23,1	40,5	-	-	349,9
Total	2347,0	1620,6	53,5	310,8	1218,8	0,50	0,6	5551,8

N.B. Tila = Tilapia; Prot = Protoptus;
Barb = Barbus; Mor = Mormyrus;
Clar = Clarias; Lab = Labeo.

3.3 Exploited Fish Species

Lake Albert has a variety of exploited species as indicated by the following records obtained from the Uganda Fisheries Department:

Fish species group	Percentage catch composition in 1989
Oreochromis niloticus	38.5
Lates niloticus	11.8
Bagrus spp.	7.3
Clarias spp.	5.3
Protopterus aethiopicus	1.3
Synodontis	3.4
Hydrocynus vittatus	23.7
Labeo sp.	2.0
Alestes spp.	3.6
Auchenoglanis	1.6
Schilbe sp.	0.0
Mormyrus deliciosus	0.0
Distochodus sp.	0.0
Mormyrus spp.	0.0
Barbus spp.	0.1
Malapterus electricus	0.0

The southern part of Lake Albert has less fish species than the northern sector extending from Bugoma (Hoima District) to the Albert Nile.

Table 2 : Fish Catch trends for Lakes Albert (Mobutu) and Edward/George for the period 1952-1988, based on records of the Fisheries Department, Entebbe

YEARS	Fish catches (thousand tons)	
	Lake Albert	Lake Edward/George
1952	3.0	6.5
1953	3.0	6.2
1954	3.0	6.1
1956	7.8	6.8
1957	7.8	6.8
1958	10.3	11.0
1959	10.9	8.0
1960	13.3	11.6
1961	11.8	12.5
1962	12.2	12.1
1963	10.4	12.0
1964	10.2	10.2
1965	12.4	12.6
1966	13.6	12.9
1967	13.2	12.9
1968	13.5	13.0
1969	13.7	11.8
1970	22.4	10.0
1971	9.5	11.7
1972	10.4	12.3
1973	13.0	11.0
1974	3.5	10.5
1975	18.7	13.2
1976	12.3	12.5
1977	20.6	12.0
1978	20.6	11.8
1979	17.0	9.0
1980	13.0	7.0

1981p	6.0	5.0
1982	10.0	6.9
1983	6.0	6.0
1984	6.0	6.0
1985	2.3	5.0
1986	3.2	6.3
1987	8.9	6.5
1988*	1.5	1.3

* The 1988 figures are still provisional

Table 3: Estimated total annual fish production (in tons) for sampled landing sites of Lake Albert for 1989, based on records of the Fisheries Department, Entebbe.

Fishing Villages	Catch (tons)
Kamuga	653
Katolingo/Rukwanzi	493
Ntoroko Kanara	1,083
Songa/Kayanzi	681
Katanga/Kanara	1,348
Wanseko	191
Buhuka	161
Ndaiga	360
Kitebere	225
Buliisa	657
Butiaba	1,499
Kibiro	403
Bugoigo	535
Nkondo	783
Tonya	1,156
Total	10,288

3.4 Fish Species Interactions and Food Types

The population structure of the exploited fish species of Lake Albert vary considerably with differences in maximum size (L max) and size at first maturity (lm). This complicates the task of selecting the gear and optimum mesh size for the multiple species fisheries.

There are many interactions between the exploited species including competition for food and spawning areas. Additionally, there are predator-prey interactions. Table 4 gives the exploited species of Lake Albert, their size range and food items. It is shown that most of the families are predatory except for the Cichlidae and Cyprinidae which depend directly on primary production.

4 FISHING REGIMES, REGULATIONS AND MANAGEMENT PROBLEMS

4.1 Methods of Exploiting the Fisheries of Lakes Edward and Albert

The Uganda sectors of Lakes Edward and Mobutu are mainly exploited with artisanal fishing gear with the available demersal and pelagic stocks being fished with set gill nets, beach seines, various traps and hooks and lines. Fishing with purse seines, lampara nets and trawl nets do not exist as yet.

4.1.1 Set gill nets

On Lake Edward bottom set gill nets of mesh size 102-178mm are utilized to catch mainly Oreochromis niloticus (tilapias), Bagrus docmac, Protopterus aethiopicus, Barbus altianalis and Clarias lazera. Fish species of smaller size are not commercially exploited in the Uganda sector of the lake.

In the case of Lake Albert fisheries the small mesh sized gill nets of 63-89mm are used to catch Alestes macrolepidotus and Hydrocynus forskalii and the larger meshes (of more than 102mm stretch) are used to catch Bagrus bayad, Bagrus docmac, Lates and Oreochromis niloticus, Mormyrus kannume, Protopterus, Auchenoglanis occidentalis, Lates niloticus albertinus and Clarias lazera.

4.1.2 Beach seines

The use of beach seines on Lake Albert is not specifically prohibited. There are not many suitable areas for their use in the southern end of the lake except in the northern end of the lake where there are some shallow sandy areas ideal for beach seines. When used indiscriminately, beach seines (which mostly catch small fish) have destructive effects on most of the fish species shown in Table 4 thereby affecting successful recruitment.

4.1.3 Hook and Lines

Hooks and lines catch the following target fish groups: Protopterus aethiopicus, Hydrocynus spp., Eutropius niloticus, Clarias lazera, Bagrus spp., Auchenoglanis occidentalis, Lates spp. and Malapterurus electricus.

4.1.4 Basket Traps and Fences

Basket traps and fences are not significant in the artisanal commercial fisheries of Lakes Edward and Mobutu Sese Seko. Fishing with baskets and traps

in river mouths and papyrus fringed areas is destructive to Labeo spp, Barbus spp., Alestes spp., Schilbe, Clarias and species of the family Bagridae.

4.2 Fishing Regulations and Control of Effort

It has been noted that good legal provisions exist and these are intended for the conservation of fish stocks. Some provisions are applicable to all water bodies in Uganda whereas some are more specific to the controlled Lakes Edward/George. Lake Mobutu (Albert) fisheries are not as controlled as those of Lake Edward.

Some of the useful legal provision on fishing are the:

- prohibition of the introduction into Uganda or in any of its waters any species of fish, their eggs or progeny not indigenous to Uganda without the prior consent in writing of the Chief Fisheries Officer;

- prohibition of the transfer from any fish pond or any waters of Uganda any species of fish, their eggs or progeny into any other fish pond or other waters of Uganda without the prior consent in writing of the Chief Fisheries Officer;

- prohibition of a non-citizen of Uganda, to fish in any waters of Uganda for the purpose of obtaining fish for sale unless he holds a valid specific licence in that behalf;

- prohibition of transfer of fishing vessel licence to anybody;

- restrictions on the use of basket traps and beach seines in specified area of lakes and rivers;

- restrictions on the use of destructive fishing methods e.g. explosives and of poisons;

- restriction on the number of canoes per fish landing site and the number of gill nets per canoe for Lake Edward.

5 MAIN CONSTRAINTS TO RATIONAL DEVELOPMENT AND MANAGEMENT OF LAKES EDWARD AND ALBERT

The fisheries of Lakes Edward and Albert are characterized by the conflicts of shared resources exploited by the two countries. There are also conflicts concerning the multi-purpose use of water resources between the different users. Rational development and management are constrained by the following factors:

- lack of reliable biological data and fishery statistics due to inadequate sampling of landing sites and fish species around Lakes Albert and Edward;

- lack of fishing gear and safe canoes for use on the hazardous rift valley lakes in areas where wood is limited;

- inability to control the fishery and enforce regulatory measures even for the controlled Lake Edward;

- lack of national and external funding for fish processing and resource evaluation for the two lakes;

- lack of coordination and consultation between the different users of the fishery resources, the parks and the national game reserve;

- poor access roads to fish production centres particularly for several villages on Lake Edward and many villages on Lake Albert/Mobutu;

- post-harvest loss of fish products in an area where fuel wood is restricted by the national park and game reserve authorities;

- lack of new data on the biological productivity of Lakes Edward and Albert as well as the lack of new estimates on biomasses and yield potential on these lakes;

- lack of adequate data on pollution hazards from copper, cobalt, etc., from the Lake George watershed (particularly from Kirembe mines) which is connected to Lakes Edward and Albert; and

- lack of periodic technical consultations between the Zaire and Uganda authorities on the intricate management problems of Lakes Edward and Albert located in national parks and game reserves.

Table 4 : The fish species of Lakes Edward and Mobutu and their biological and ecological attributes

			L Max (cm)	
MALAPTERURIDAE	Malopterurus electricus	Singa-Singa/Ntera	-	small fish
BAGRIDAE	Bagrus bayad	Munama/Lanya	40	small fish/insect larvae
	Bagrus docmac	Munama/Ssemutundu	100	small fish/crustacea
	Chrysichthys sp.	Barua/Bubu	-	small fish/crustacea
	Auchenoglanis occidentalis	Djokodjo	50	insect larvae/crustacea
MOCHOKIDAE	Synodontis schall	Fodofodo/Wahrindi	40	molluscs/small fish/insect larvae
	Synodontis frontosus	Fodofodo kidogo/Kokwe	35	bottom feeder (Fish/insect/molluscs)
CICHLIDAE	Oreochromis niloticus	Ndakala, Gege, Tsé, Ngege	-	herbivore/detrivorous
	Sarotherodon galilaeus	Kisoro, Ngege	-	herbivore/detrivorous
	Tilapia zillii	Ngege	-	herbivore/macrophytes
	Haplochromis albertianus	Angara, Ngara	-	-
CENTROPOMIDAE	Lates niloticus albertianus	Capitaine Isa, Esa, Mputa	182	fish, crustacea
	Lates niloticus macrophthalmus	Esa, Mputa		fish, crustacea
LEPIDOSIRENIDAE	Protopterus aethiopious	Mbamba	100	molluscs, fish
POLYPTERIDAE	Polypterus senegalus	Kambanloka	42	fish, small frogs
MORMYRIDAE	Mormyrops anguilloides	Tsungma	60	insects/lake flies
	Marcusenius petherioi	Muzundanio	22	insects/lake flies
	Gnathonemus cyprinoides	Musindani	30	insects/chironomid
	Mormyrus kannume	Muzundanio/Kasulubana	40-60	lake flies
	Mormyrus cashive	Kasulubana	100	lake flies
	Mormyrus niloticus	Kasulubana	50	lake flies
	Hyperopisus bebe	Kasulubana	47	molluscs/insects
CYPRINIDAE	Labeo horie	Kitumbi/Karuka	40(72)	detritus
	Labeo coubie	Kitumbi/Kwangurameli	74	plant debris
	Barbus bynni	Bulaya/Kisinja	82	aquatic plants/molluscs/insects
	Barilius niloticus	Muzizi	10	zooplanctonic
	Rastrineobola bredoi	Mukene/Dagaa	4-5	plantonic crustacea
CHARACIDAE	Hydrocyon forskali	Ngasa	26-60	small fish/insects/lates
	Hydrocyon lineatus	Niarongassa	-	small fish, etc.
	Alestes baremose	Sardinea/Ngara	30-55	crustacea/insects
	Alestes macrolepidotus	Mungezi/Waraga	40-55	insects, detritus/small fish
	Alestes grandisquamis	Ngele	-	-

Table 4 : Continued

FAMILY	SCIENTIFIC NAME	LOCAL NAME	L Max (cm)	FOOD ITEMS
MALAPTERURIDAE	Malopterurus electricus	Singa-Singa/Ntera	-	small fish
BAGRIDAE	Bagrus bayad	Munama/Lanya	40	small fish/insect larvae
	Bagrus docmac	Munama/Ssemutundu	100	small fish/crustacea
	Chrysichthys sp.	Barua/Bubu	-	small fish/crustacea
	Auchenoglanis occidentalis	Djokodjo	50	insect larvae/crustacea
MOCHOKIDAE	Synodontis schall	Fodofodo/Wahrindi	40	molluscs/small fish/insect larvae
	Synodontis frontosus	Fodofodo kidogo/Kokwe	35	bottom feeder (Fish/insect/molluscs
CICHLIDAE	Oreochromis niloticus	Ndakala, Gege, Tsé, Ngege	-	herbivore/detrivorous
	Sarotherodon galilaeus	Kisoro, Ngege	-	herbivore/detrivorous
	Tilapia zillii	Ngege	-	herbivore/macrophytes
	Haplochromis albertianus	Angara, Ngara	-	-
CENTROPOMIDAE	Lates niloticus albertianus	Capitaine Isa, Esa, Mputa	182	fish, crustacea
	Lates niloticus macrophthalmus	Esa, Mputa		fish, crustacea
CITHARINIDAE	Distichodus niloticus	Mayoli	83	aquatic plants/molluscs/crustacea
	Citharinus citharus	Mpoi	50-80	macroplankton, diatoms
SCHILBEIDAE	Eutropius niloticus	Pendakula/Taital	35	small fish/insect larvae
	Schilbe mustus	Kara-Kogere	30	small fish
CLARIIDAE	Clarias lazera	Kosso/Mali/Male	140	omnivorous/small fish
	Heterobranchus longifilis			insectivorous/small fish

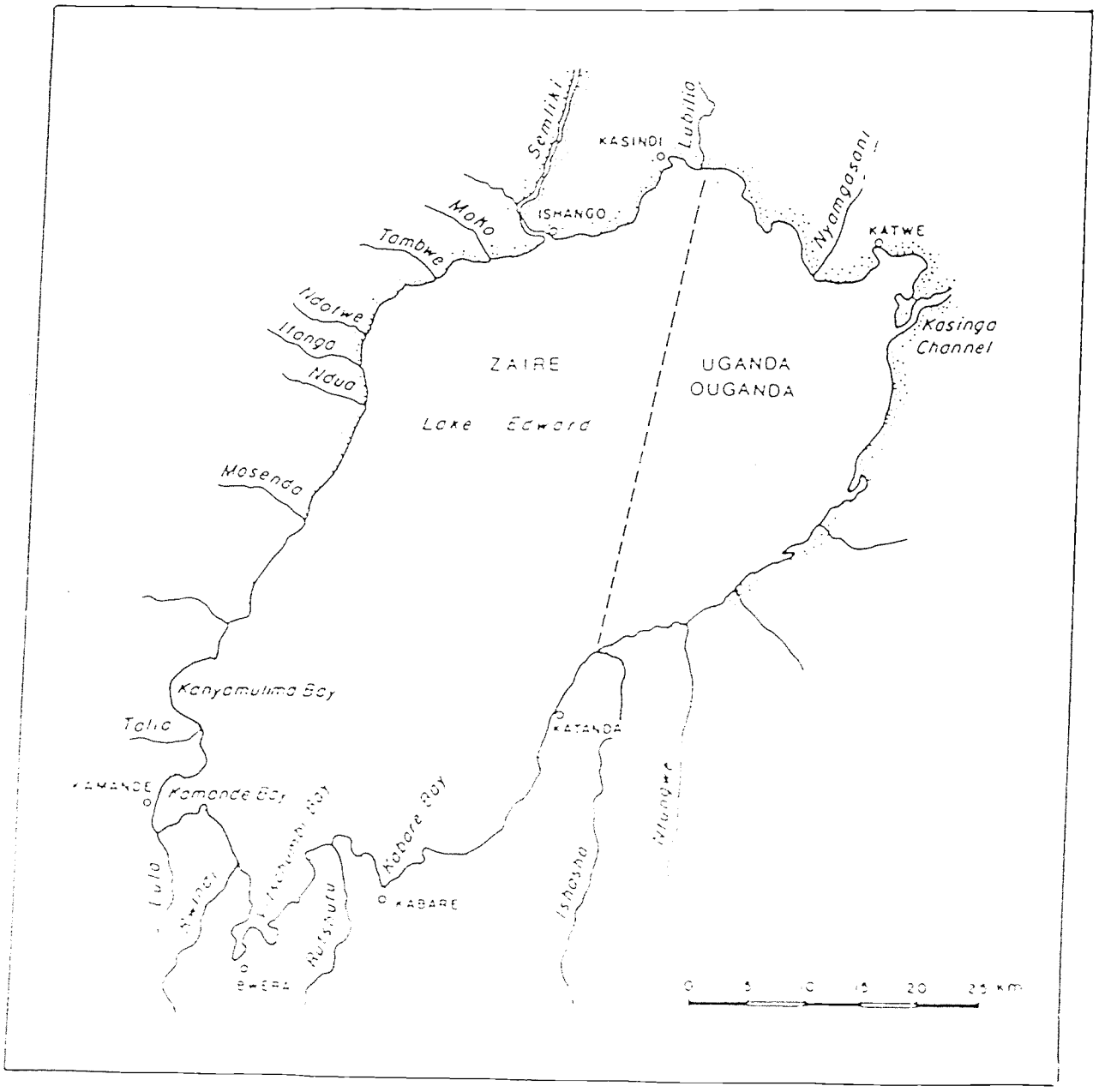

Fig. 1 : Map of Lake Edward and the major rivers

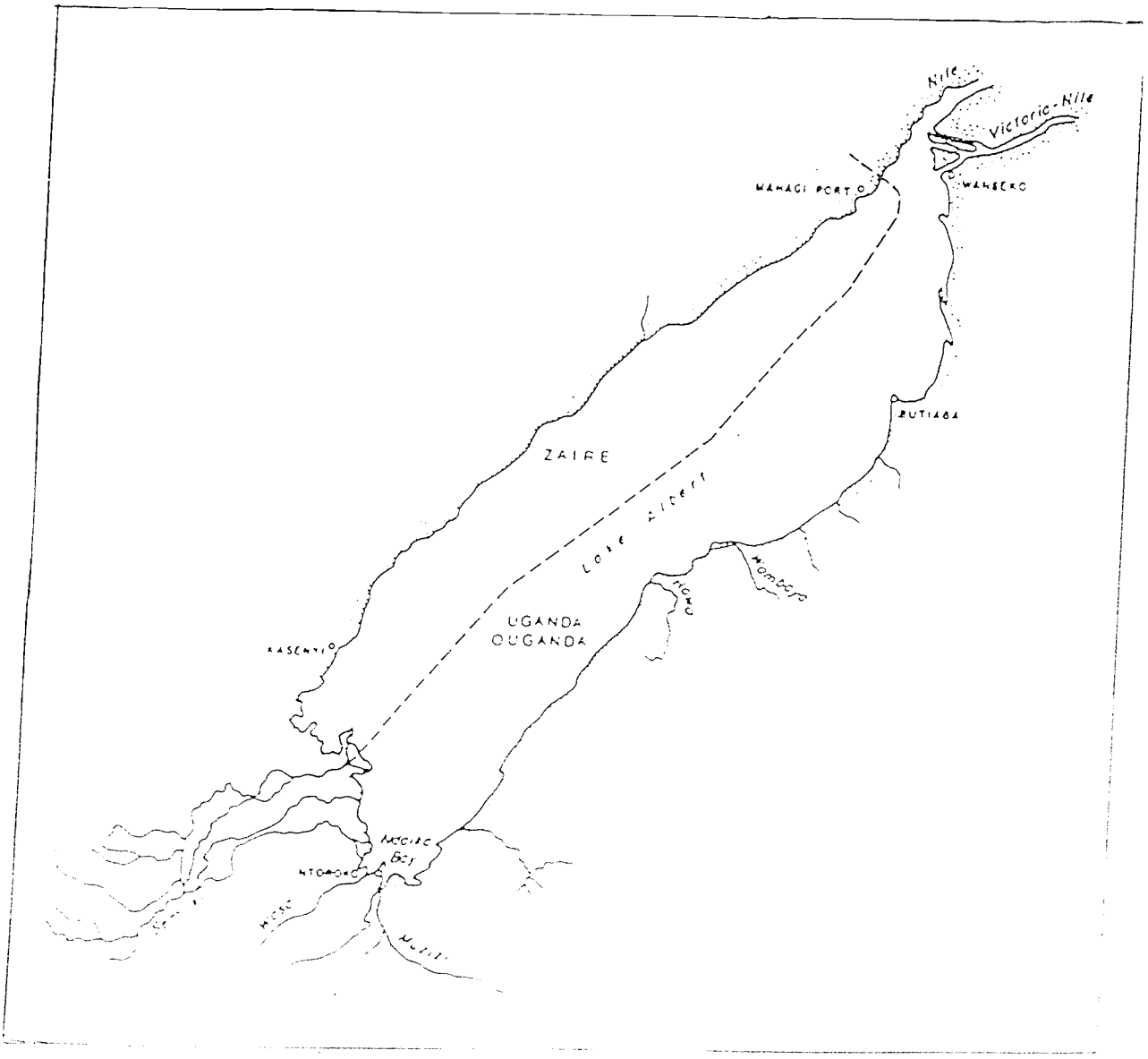

Fig. 2 : Map of Lake Albert and the major rivers

THE FISHERY RESOURCES OF LAKE EDWARD (THE UGANDA PORTION), MODE OF EXPLOITATION AND MANAGEMENT.

by

J.R. Kamanyi and P. Mwene Beyanga

1 DESCRIPTION OF THE LAKE

Lake Edward, shared between Zaire (71%) and Uganda (29%), is located in western Uganda within the West African Rift Valley at an altitude of 912 metres. It is a deep lake (maximum depth 117 metres, average depth 34 metres) and has a total surface area of 2300 km^2. The lake is connected to Lake George by a 30km long channel, the Kazinga Channel, which flows into Lake Edward; its outflow is the Semliki river.

The Uganda portion of the lake (about 667 km^2) has five recognized fish landing sites: Katwe, Rwenshama, Kishenyi, Kazinga and Kayanja situated along the lake shoreline and within the Queen Elizabeth National Park.

2 FISHERIES OF LAKE EDWARD

There is little research information available on the Uganda portion of the lake and the statistical data collected by the Fisheries Department is, in some cases, not complete. The fish stocks have not been assessed for a long time and the potential for a deep water fishery is unknown.

The state and size of the fishery and degree of exploitation can be indicated however by fish landings and numbers of fishermen operating on the lake. FiRecords for the last 20 years from the Fisheries Department indicate a decline in fish production. The Ugandan portion of the lake produced 5,294 metric tons (mt) in 1970 and declined to about 2,450 mt by the year 1989 (Uganda Fisheries Department records). The Uganda Freshwater Fisheries Research Organization (UFFRO) and Artisanal Fisheries Rehabilitation Project (AFRP) Catch Assessment Survey (January 1989) estimated the total annual catch for the year at 2600mt while experimental analysis of commercial catches for the same year gave an estimated figure of 2320mt. The UFFRO/AFRP figure obtained was only based on gill net catches only the Fisheries Department and experimental commercial catch analysis combined gill net and long line catches.

The trends in commercial catches on the lake are indicated in Table 1 and Appendix A. Due to the war the 1979 catch records are for only seven months but the monthly averages obtained were used to estimate the annual catch. Drastic changes in the catch occured in 1979 and continued into 1980 probably due to the 1979 war and its after effects. A slight increase was registered in 1983, and since then, there has been a decline despite efforts to the reconstruct the fishery.

The main commercial landings contain:

- Tilapiines represented by:
  - Oreochromis niloticus (ngege);
  - Oreochromis leucostictus (ngege);
- Bagrus docmac (semutundu);
- Protopterus aethiopicus (mamba);
- Clarias lazera (male);
- Labeo forskalii (lingu);
- Barbus altianalis (junguli); and
- Mormyrus kannume (kasulubana)

Although they are used for bait several species of Haplochromines (nkeje) which form the major food item for the larger carnivorous fish are not exploited as they are presently regarded to be of no commercial importance.

The major decline in commercial catches was due to the decrease in tilapiine catches mainly represented by O. niloticus. The tilapiine catch alone declined from 4027mt in 1970 to 1205mt in 1989 and with an average decrease in size from 0.60kg to 0.52kg. In the early seventies, the tilapiines were contributing on average 78% of the total fresh fish landed but by late eighties their contribution had declined to about 43%. In contrast, during the same period, Bagrus species increased from 15% to 46% (see Appendix A).

The average catch per canoe obtained from an analysis of commercial catches during March 1989 was 57kg for gill net catches and 21kg for long line catches. During the same time the UFFRO and AFRP Catch Assessment Survey obtained an average of 51kg per canoe for gill net catches.

3. Mode of Exploitation and types of fishery

In the early 1950s, the Lake Edward fishery was basically subsistence with a small number of fishermen using various inefficient gear.

The main gear presently utilised for exploiting the fisheries are nylon gillnets of 127.0 mm (5"), 114.3 mm (4.5") and occasionally 152.4 mm (6") mesh sizes mostly used for harvesting tilapiines. Long lines are used for catching the large species of fish: Barbus, Bagrus and especially Protopterus and Clarias although Bagrus is presently on high demand. According to the 1988 Frame Survey there are about 340 fishermen operating 139 canoes 30 of which are used for long lining and the rest used for handling a total of 2445 nets. The author however considers these figures an underestimate. The recommended mesh size for gill nets is 127.0 mm with 10 nets per canoe but generally on average 114.3mm mesh size gill nets with 24 nets per canoe are in use. Hooks utilized ranged from No. 7 to No. 9 and average 550 per canoe. The use of gill nets with small mesh sizes has been investigated and have been found to seriously affect the fishery, harvesting immature fish, reducing the breeding stocks and ultimately the number of young produced. For a 88.9 mm (3.5") mesh

size, for example, the average size of O. niloticus caught is around 24-25 cm (i.e. about 2 years old); the range at which most fish of this species are mature and start to breed. For a 101.6 mm (4") mesh size O. niloticus caught are around 20 cm: the size that has been breeding for less than a year. Tilapiines in general have been reported to live for a period of about 6 years (Fryer and IIes, 1972) therefore the use of small mesh sizes greatly affect the increase of subsequent fish population.

The stock potential of the Haplochromine species which occur in shallow inshore waters and probably also in deep open waters still remains unknown and unexploited.

The catch characteristics of the various mesh size gill nets and hooks, the average catch per net or hook as observed by the UFFRO/AFRP Catch Assessment Survey 1989 and the experimental analysis of commercial catches are shown in Table 1 and Table 2. Although fishermen may give wrong information as regards mesh size or number of nets used as well as not giving data obtained from illegal fishing activities, there is an indication that larger sized fish are caught in the 127.0mm mesh size nets than in 114.3mm mesh size nets (Table 1). However the total weight landed per net is lower in the larger mesh size nets (Table 2).

The corresponding results for Lake George nearby was 4.15 kg/net (for 114.3mm mesh size nets), 1.7 kg/net for 114.3mm and 127.0mm mesh size nets and 0.17kg/hook. Large size fish (on average 9.5 kg) are occasionally landed: C. lazera (average weight 32.0kg), B. altianalis (average weight 2.4kg) and L. forskalii (average weight 1.2kg) were recorded from gill net catches and P. aethiopicus (32.0kg) from longline catches.

Beach seining is essentially not practised on the Uganda portion of Lake Edward and long lining may gradually gain momentum for harvesting large fish. The distribution of different fish species and their relative abundance for different gear as observed in commercial and experimental catches are indicated in Table 3.

4. Research Needs

Unlike neighbouring Lake George, very little recent research work has been done on the Uganda portion of Lake Edward. Experimental fishing, commercial catch analysis and limnological investigations were only conducted recently in March 1989 and therefore the trends and state of the fishery have been unknown for a considerable time. There is a need therefore to:

- Intensify research into fish stocks in all parts of the lake (including deep water).
- Thoroughly investigate the taxonomy, biology and ecology of the haplochromine species for a potential fishery.
- Investigate the lake chemistry and productivity as an essential tool for proper understanding of the fishery.
- The lake is far away from the main research station (about 300 miles) and continuous monitoring is very difficult

especially when there is no land transport. This could be solved by establishing a substation nearby.

- Provide adequate essential research inputs.

- Improve on the fisheries statistics collection system; presently all the landings lack weighing. Recently the Government initiated a UNDP/FAO project to elevate this constraint.

5. Management

The fishery of Uganda's portion of Lake Edward has been managed as a controlled fishery for about 50 years. Since the fishery is predominantly made up of tilapiines, it is highly sensitive to fishing pressure. Fishing effort has been controlled by limiting the number of fishing vessels licensed to fish, limiting the number of gill nets per canoe, governing the mesh size of gill nets used and monitoring the number of fishing villages (which directly relate to fish landings).

The Fisheries Department employs trained field personnel which, although hindered by a number of constraints, implement management measures. Field staff who are stationed at every fish landing station monitor the exploitation of the fishery by collecting fish landing statistics.

Currently the fisheries are supposed to be exploited using 127.0 mm mesh size gill nets with 10 nets/canoe and No. 7 hooks with 1000 hooks/canoe. The tycoon fishing practice and beach/purse seines are prohibited. It is felt that to improve implementation of management policies, the following measures should be taken:

(a) Regulations regarding the number of fishing canoes and the quantity, size and type of gear need standardisation and should be enforced; fishermen should be encouraged to use long lines which would enable the recovery of the tilapiine fishery. The Governments should be encouraged to continue making available appropriate inputs into the fishery.

(b) Fishing close to the lake shoreline should be prohibited as these are breeding habitats and nursery grounds for most fish species.

(c) Marketing of undersized fish specially the tilapiine species should be discouraged.

(d) Illegal landing sites and fishing canoes should be abolished.

(e) The Fisheries Departments of the two countries have to be strengthened and bilateral help increased. Improvements should be made to include land and water transportion systems, statistical data collection systems, field equipment and accommodation for fisheries field staff.

(f) For proper understanding and management of the fisheries of the shared lakes, it is vital to carry out cooperative research and exchange information. This can be achieved by setting up a forum in form of a commission similar to, for example the CIFA Sub-

committee, to look after the two lakes with the bilateral body made up of Zairean and Ugandan members. Through this forum, researchers could present their findings and recommendations to fisheries administrators and managers.

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Maif, (1989): Fisheries Survey, 1988 Ministry of Animal Industry and Fisheries, Planning Department. Mimen May 1989.

MAIF, Uganda Fisheries department catch records 1970-1989.

Table 1: Catch characteristics of various mesh size gillnets and hooks per fish species on Uganda portion of Lake Edward (1989)

Fish species	Gillnet mesh size mm	n	Total/Forklength cm			Weight kg		
			Av.	Min.	Max.	Av.	Min.	Max.
O. niloticus	114.3	40	28.4	25.2	32.4	0.55	0.38	0.80
	114.3	668	29.1	22.7	38.8	0.52	0.28	1.20*
	127.0	26	27.7	25.7	29.8	0.47	0.38	0.64
	127.0	29	29.5	25.0	35.0	0.67	0.40	3.48*
B. docmac	114.3	30	42.7	34.1	60.0	1.18	0.50	2.92
	114.3	156	45.1	25.5	76.0	1.02	0.20	5.90*
	mixed	31	42.8	32.1	60.2	1.14	0.45	2.04
	127.0	15	51.6	42.0	82.0	1.61	0.92	2.26*
P. aethiopicus	114.3					1.50		
C. lazera	114.3					1.10		
P. aethiopicus	Hooks size No. 9					6.80		

Key: * = UFFRO/AFRP Source

Table 2: Average catch of Lake Edward - Uganda (1989)

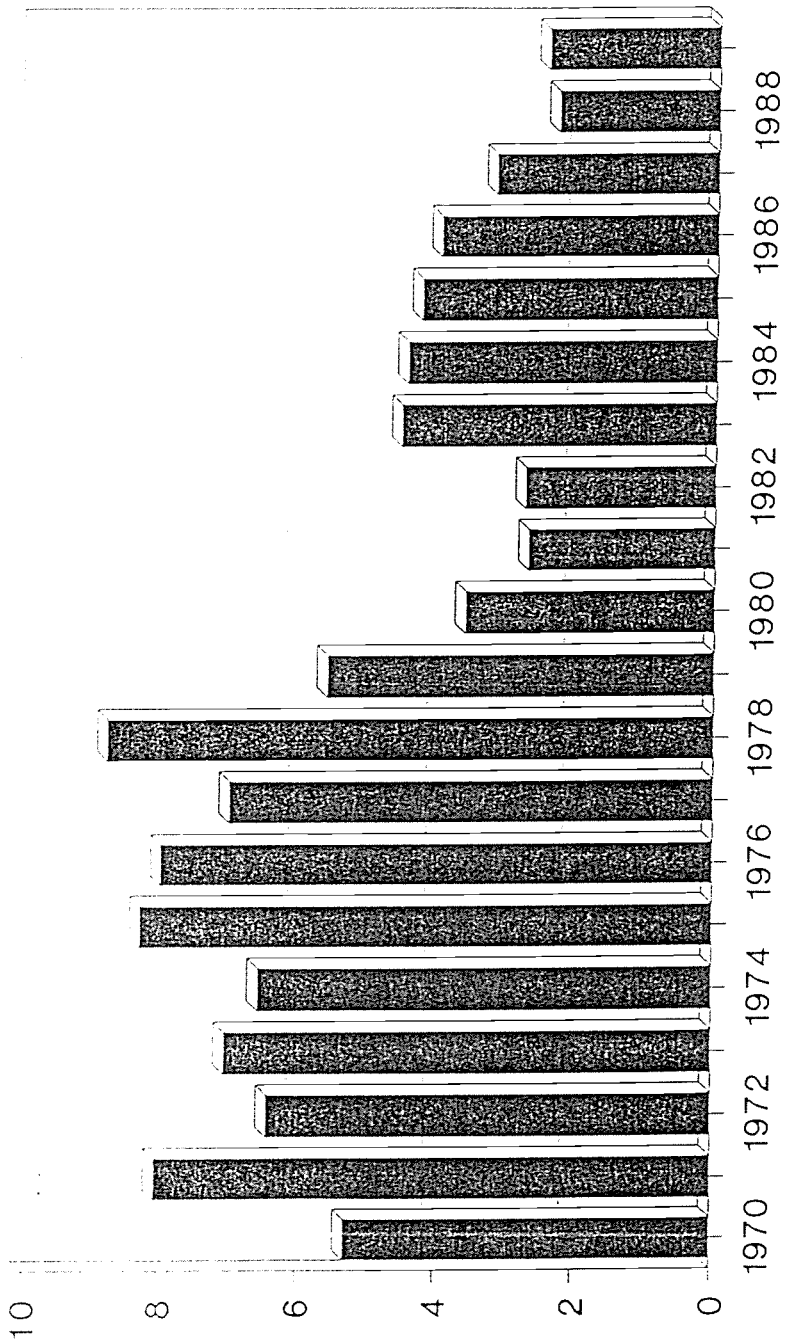
Gillnet mesh size mm or Hook number	No. of canoes samples	Total No. of nets or hooks used	Catch Kg/net or Kg/hook	Source
114.3	8	188	2.80	
114.3	22	493	2.36	UFFRO/AFRP
114.3 & 127.0	6	160	2.10	
127.0	3	76	1.44	UFFRO/AFRP
Hook number 9	2	1100	0.04	

Table 3: Distribution and relative abundance of fish species encounted on Uganda portion of L. Edward in 1989

Species	Gillnet mesh sizes mm 114.3-127.0	38.1-76.2	Experimental beach seine	Hooks No. 7-9
O. niloticus	***	**	***	NC
O. leucostictus	P	*	***	NC
B. docmac	***	**	*	*
P. aethiopicus	**	P	P	***
C. lazera	**	**	P	**
B. altianalis	**	P	***	NC
L. forskalii	*	P	P	NC
M. Kannume	*P	*P	*P	NC
Haplochromines	R	***	**	NC

Key:
*** = abundant; ** = of secondary abundance; * = present in small quantities; R = rare; NC = not easily caught by the gear; P = present but was never caught

Appendix A : Commercial Catches (1970 - 1980) of the Uganda Sector of Lake Edward



FISHERY RESOURCES OF LAKE EDWARD/IDI AMIN

by

F. René and P. Daniel
ECA/Addis Ababa, Ethiopia

1. INTRODUCTION

Lake Edward is one of the great lakes in the western branch of the African Rift Valley situated at a height of 914 ms. It covers a total area of 2300 km^2: 1630^2 km (71%) in Zaire and 670 km^2 (29%) in Uganda and is egg shaped with length and width 90 km and 40 km respectively.

Its average depth is 34 m but is unevenly distributed: the Uganda waters have an average depth of 17 m, and do not go beyond 40 m in depth, the Zairian waters are deeper with an average depth of 40 m and maximum depth of 117 m reached only 5 km away from the east side of the Zairian shoreline. Towards the shore the depth decreases dramatically the gradient continuing steeply upwards from the shore to an altitude of 2500 m.

These deeper waters are less productive than those of the Uganda side whose slope is much gentler.

Its main tributaries are the Nyamgasani river in the north, which drains the south-western part of the Ruwenzori Mountains and the Ishasha, Rutshuru and Rwindi rivers in the south. It also drains Lake George situated in Uganda through the 25 m long Kasinga canal but the contribution is small in comparison with that of the rivers. It drains into the Semliki River which flows towards Lake Mobutu.

Lake George, geographically an appendage to Lake Edward, covers an entire area of 250 km^2, and is located in a very shallow basin of the Rift. It has an average depth of 2.4 m and a maximum depth of 7 m. Its main tributaries are the Nzonge Mukubu and the Bumlikwesi Rivers and a branch of Mpanga river. Its waters, as those in its outflow, the Kasinga Canal, are characterized by very strong turbidity and enormous primary production.

The two lakes are partly enclosed by national parks: the Queen Elizabeth National Park on the Uganda side and the Virunga National Park on Zairian side. Nevertheless, it should be noted that Zaïre considers the waters of Lake Edward as being an integral part of the Park, whereas Uganda considers it as an autonomous entity.

2. EXPLOITABLE SPECIES

The present number of recorded species varies from 26 to 47[4] of which 28 are cichlids (see Greenwood[5]). However only 5 species are actually commercially exploited. These are:

Cichlidae: Tilapias (Oreochromis spp., Sarotheradon sp.)

Siluridae: Bagrus docmac

Clarias gariepinus

Protopterus aethiopicus

Cyprinidae: Barbus altianalis

Other species namely Labeo forskalii, Mormyrus kannume and Haplochromis squamipinnis which are of considerable adult size (i.e. >15 cm) do exist but even though they have a great economic value in other lake fisheries they have little economic value in the region and are not exploited.

A great number of smaller sized species, mainly Haplochromis and Aplocheilichthys, but also Rastrineobola (Engroulicypris) are also presently not exploited.

Here, in contrast to what happens on Lake Mobutu, the size of fish caught is relatively homogenous.

3. DATA ON THE STOCKS

3.1 Potential

Similarly to Lake Mobutu, the only evaluations of potential production are based on environmental models.

In 1989, Jean Michael Vakily, applied the Henderson and Welcomme models (see Appendix 1) and Schlesinger and Régnier's applied their own model (see Appendix 2) to estimate the maximum sustainable yield (balanced maximal production) of the lake producing results of 15,000 tons and 16,000 tons respectively.

3.2 Geographical distribution

The profile of the bottom of Lake Edward is stepped: it has a 30 m long shallow coastal zone next to Uganda and deep zone, situated next to Zaire.

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4 Hulot, A. 1956. Aperçu sur la question de la pêche industrielle aux lacs Kivu, Edouard et Albert. Bulletin Agricole du Congo Belge, 47(4): 68p

5 Greenwood, P.H. 1964. Explosive speciation in African lakes Proc. R. Inst. Gr. Br.: 256-269.

Although there may be some migration between the two zones, the two zones harbour two distinct stocks of fish.

3.2.1 The shallow zone

This zone is the richest and produces the majority of the resources with virtually all the economically exploited species located there: the most abundant being tilapias.

3.2.2 The deep zone

Echosounding trials in this zone have detected concentrations of fish down to a depth of about 40 m below which they are scarce. This is because the 40 m level represents the limit of oxygen diffusion (broken up annually due to climatic conditions in August).

This indicates therefore that there is a level, about 10 m deep, that is not at present being exploited. The revival of semi-industrial fishing trials by COPEVI (sponsored by a 20 million FB grant by CEBEMO) have still not produced very significant results for the moment.

It is desirable to evaluate the stock constituting small size species (adult size: 15 cm) namely Haplochromis and Aplocheilichthys which are present in large numbers. These species have a short life span and thus have a very high P/B (Production/Biomass) ratio.

Pauly's empirical formula[6], considers that the MSY increases exponentially when the individual weight of fish decreases.

$$MSY\ (kg/ha/year) = 2.3^{-0,26w}\ (g)\ Bv\ (kg/t)$$

This stock, which is only 'exploited' by predators at the moment, could possibly serve to support a small semi-industrial fishery and provide limited complimentary production to the Zairian Fishery.

Like data from Lake Mobutu, however,these statistics are not very reliable and are probably under-estimates for the following reasons:

- Catches are registered according to number and not weight and a conversion factor is used which is not accurate. (This method is acceptable for species such as Tilapias or Bagrus that have a relatively homogenous size/weight when caught.);
- Conflict between DAFEC (Department of Land Affairs, Environment and Conservation of Nature of Zaïre) and fishery committees (created by MPR) lead to separate and incomplete reports;
- Data not collected from a certain number of catches due to:
  a) Direct sales to some merchants before unloading;
  b) Share saved by fishermen for their own-consumption;

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6 Pauly, D., 1982. Studying Simple-species dynamics in a tropical species context ICCARM conf. Proc. (9) : 33-70
in: Marshall, B.E., 1984. Small pelagic fishes and fisheries in African inland waters. CIFA Tech. Pap. (14): 25p.

c) "Tax" paid to different local public authorities (fishery committee, Navy, Police, etc.);

- Lack of means and of any real motivation for data collecting;

- Staff in charge of the collecting data are often among the recipients of the "tax", which encourages fishermen to hide a part of their catch during declarations;

- Existence of a certain number of clandestine and not well controlled unloading points on the lake inside the limits of the National Parks supplying neighbouring villages.

Based on studies carried out at Vitshumbi, Vakily (study already cited) estimated the systematic under-estimation of the catches at about 30% bringing the total production of the lake to about 18,000 tons: above the limit of estimated biological exploitation.

Two studies carried out in 1989, one for Zaire[7] and one for Uganda[8], have come to the same conclusion, that is, even in the absence of accurate information and reliable statistics, it is thought that the lake had reached its maximum level of exploitation, and may have even reached that of over-exploitation for at least some of the species.

Table 1: Principal data on production

Lakes	Area km (sq.)	MSY (t/y) min.	MSY (t/y) max.	Production 1988 (tons)	Noumber of boats
Mobutu	5,270	21,000	30,000	22,500	3,300
Edward	2,300	15,000	16,000	14,300	1,700
George	250	4,000	5,000	2,500	200

7 Vakily, J.M., 1989. Etude du potentiel Halieutique du lac Edouard: Zaïre/CEE.

8 Dunn, J. 1990. Fishery Management Study in the Queen Elizabeth National Park.

Table 2: Comparison of the yields of the various water bodies

	MSY (kg/ha) min.	MSY (kg/ha) max.	Production 1988 ($t/km^{2)}$	Production per boat (t/y)	Number of boats per km^2
Mobutu	40	57	4.27	6.82	0.63
Edward	65	70	6.22	8.41	0.74
George	160	200	10.00	12.50	0.80

The above figures indicate that Lakes Edward and Mobutu are almost as productive as each other with Lake Edward only being slightly more productive. Lake George is exceptional productivity being one of the most productive natural inland waters of the world.

Table 3 : % distribution of catches

Species	Zaire	Uganda	Total/Lake
tilapias	71	36	59
Bagrus	15	28	19.5
Protopterus	7	22	12.1
Clarias	3	6	4
Barbus	2	2	2
Others (misc.)	2	6	3.4

Tilapias are mostly exploited representing about 60% of the catches, followed by Bagrus (about 20%) and Protopterus (about 10%).

As in the case of Lake Mobutu, tilapia represents a much greater portion of the catch in Zaire (i.e. 70%) than Uganda (i.e 35%) whereas Bagrus and Protopterus are proportionally more represented (30% as opposed to 15% and 20% as opposed to 7%) in Zaire.

3.3 Seasonal variations

Vakily established monthly "coefficients of catches" based on data collected at Vitshumbi from January 1987 to June 1988, where seines and undersized mesh nets were used, establishing that the monthly production from the two types of gear were similar even though the catchability variations were less pronounced for the nets than for the beach seines. This may be due to the fact that the latter are used along the coast, often in spawning grounds which are more dependant on the reproductive behaviour of fish.

Capturability is minimal in January and reaches a maximum around March-April, declining up to July and peaking again in October.

This seasonability is strongly influenced by the climate, the best catches being realized during rainy periods which also correspond to the highest surface water temperatures.

4. CONSTRAINTS AND RECOMMENDATIONS

4.1 The level of exploitation

As seen in 3.2.2, the lake has now reached its maximum level of sustainable exploitation. Coastal resources of tilapia even show signs of over-exploitation indicated by a reduction in the average size of the catches and on average the relatively smaller sizes of fish at first maturity. (However this may also have to do with the tendency to reduce the mesh size of beach seines and to an increase in the amount of illegal fishing in spawning grounds.) It also should be noted that if the exploitation of deep resources did appear to be economically profitable this would only produce a moderate increase in the total volume of the catch.

Increased production is therefore not possible in the future of the fishery and it is therefore necessary to carry out an immediate accurate evaluation of exploitable stocks and to set up a common policies for the management of the fishery which, as in the case of Lake Mobutu, should develop towards rational management and preservation of the resources in order to strengthen production at its current level.

4.2 Spawning grounds and nurseries' protection

Currently protection of the spawning grounds and nurseries is inefficient. Illegal fishing (mostly at night using very fine mesh beach seines), in these zones causes considerable losses among the young populations of tilapias.

In Zaire for instance, these beach seines are practically all registered at Vitshumbi, where the zones to which they have access are almost exactly exclusively spawning grounds. In April 1989, ECN services (Environment and Conservation of Nature) ordered the destruction of beach seines, but although their use has been reduced, this practice has not yet disappeared.

To avoid the potential danger of this fishing method the fisherfolk themselves, have to be educated a long and exacting job. At the present time, even when offences are curbed, the fine is not heavy enough to be dissuasive.

The best way of assuring efficient protection would be (as proposed by M. Vakily), not only to make a better inventory of the stocks but also to make them less inaccessible to seine fishing by the immersion of heavy obstacles which would snare the nets.

4.3 Exploitation of deep resources

These resources could bring a noticeable increase to the total production of the fishery.

Nevertheless, before their exploitation (already started in Zaïre by the COPEVI) it would be wise to check whether their abundance is in sufficient quantity to sustain a small, semi-industrial fishing. This initially requires a biological study of the stock and then an economic feasibility study.

5. CONCLUSION

In the same way as Lake Mobutu, Lake Edward's resources are exploited to the maximum. This stresses the urgency for an accurate evaluation of the available stocks and for the development of a common policy of rational management of the fishery.

As a matter of fact, any excessive increase in the fishing effort that is without prior evaluation of resources is likely to create a situation of over-exploitation that is harmful to the whole fishery.

Until the present day, the fishing pressure has been limited 'naturally' limited supply of fishing gear (including life span of nets, safety of boats), the weight of 'taxes' due to the extreme isolation of the region and through the difficulties resulting from supply of fishing inputs and marketing of products.

An effort at development, including the improvement of infrastructures and equipment, and thus of the fisherfolk's standard of living, will inevitably result in a tendency to increase fishing pressure, which will in itself stop this development.

As a consequence, a limit to fishing effort will fairly soon be indispensable.

The best approach to development is to be as least repressive as possible, educating the fisherfolk and initiating change in attitudes and development from the communities themselves.

Appendix 1

Estimation of the potential production according to Henderson and Welcomme model[9]

This model is based on the morpho-edaphic indice deduced from water conductivity (c) and the average depth (P).

$$MEI = \frac{c}{-} = \frac{900..mhos/cm}{34\ cm} = 26.5$$
$$p$$

Annual catches are deduced

MSY = 14,3136 MEI exp. (0,4681)= 66 kg/h
MSY = 15.000 t/year

Appendix 2

Estimation of lake Edward optional yield according to Schlesinger and Régnier model[10]

The Morpho-Edaphic Indice (MEI) depends here on the sum total of the dissolved solids (s) and on the average depth (p). This model also takes into account the annual average temperature of the air (T= 25,6°C)

$$MEI = \frac{s}{-} = \frac{521\ mg/l}{34\ m} = 15.3$$
$$p$$

Log M.S.Y = 0,05 T + 0,28 log MEI + 0,23 t MSY = 70 kg/ha.

MSY = 16.000 tons/year.

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9 Henderson, H.F. et R.L. Welcomme 1974. Relation entre la production, l'Indice Morpho-Edaphique et le nombre de pêcheurs des pêcheries des eaux continentales d'Afrique. CIFA Occas. Pap. (1)

10 Schlesinger, D.A. & Regnier, 1989 H.A., Climatic and morpho-edaphic indices of fish yield from natural lakes. Transactions of the american Fisheries Society 111: p 141-150

FISH PROCESSING AND MARKETING IN UGANDA:

INSTITUTIONAL ASPECTS

by

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Assistant Commissioner for Fisheries, Entebbe

Abstract

Fish production from Uganda waters in 1988 was estimated to be 214,291 tonnes 50% of which was sold fresh and 50% was processed. There is hardly any refrigeration and the fresh fish distribution is therefore restricted to urban areas a short distance from water bodies. Fish marketing is monitored through licensing by the local authority, which license fish mongers, and the Fisheries Department, which licenses fishing vessels and issues specific licences to fish wholesalers. Fish exporters have to obtain specific licences in addition to the export licences issued by the Uganda Advisory Board of Trade through the Central Bank. Fish for export also has to be issued with a health certificate. There is, therefore, need to harmonise fish trade with Zaire to ensure revenue to both Governments.

1. INTRODUCTION

It was estimated that 214,291 tonnes of fresh fish worth Ushs 14 232 was harvested from Ugandan waters in 1988: the type and quantity of fish landed from each body of water is shown in Table 1.

Fish is caught using canoes and mostly using gill nets, long lines, beach seines and basket traps. Recently trawling was introduced on Lake Victoria but this is practiced by only two paired trawlers. The fish landed from the canoes is at ambient temperature while generally the paired trawlers carry flake ice and chill the fish immediately after harvest.

Uganda is a tropical country and at ambient temperatures (22-28 °C) there is a tendency for fish to spoil very fast and, except for the small amount of fish (less than 1000 tonnes) caught in purse seines, fresh fish is distributed without refrigeration. Naturally, this limits its distribution as the fish has to be disposed of within short distances from the shore. Fortunately, the urban centres of Kampala, Jinja, Masaka and Mbale, which are the major fish consuming centres are near water bodies and are supplied with fresh fish.

Fish is mainly processed for preservation reasons so that it can be distributed to rural and urban areas far from their source. The main processing methods are hot smoking, salting, sundrying and fish frying and the proportions of methods of disposal of fish is shown in Table 2.

2. INSTITUTIONAL ASPECTS

Fish processing and marketing in Uganda is monitored by local authorities as well as the Fisheries Department through the issue of licences. The local authority issues a fishmongers' licence which is specific to an applicant who must be certified medically fit. The fishmongers' licence is valid within the jurisdiction of the local authority and the licensees are normally small operators who transport the fish by bicycle, taxi, buss or pickup. The licensee can engage in either fresh or processed fish or both. The fish mongers' licence is issued under the Public Health Act and the licence fee varies with each local authority. The fishmonger can buy fish direct from

the fisherman if the fish landed is within that local authority but the fish monger can also dispose of the fish only within that local authority.

The Fisheries Department issues two sets of licences used in fish marketing. The two licences issued under the Fish and Crocodile Act 1964 are the fishing vessel licence and the specific licence.

The fishing vessel licence is issued to a fisherman for a specified body of water after he has presented a seaworthy boat and has paid the appropriate income tax. The fishing vessel licence allows the licensee to fish and dispose of his catch on the shore.

The specific licence (see Appendix 1) is issued only by the Commissioner for Fisheries after the applicant has filled in an application form (see Appendix 2), has paid the prescribed fee and has obtained an income tax clearance certificate.
The specific licence restricts the licensee to purchase fish only from specified fish landings sites and only in the form specified in the licence. The licensee may engage either in the marketing of fresh or processed fish; the same licence may also authorise the licensee to process his fish. Industrial fish processors also require this specific licence. The specific licensees do not have to undergo any medical examination. However, all specific licensees can dispose of their fish anywhere in Uganda provided they have appropriate licences from the local authority at the point of disposal.

The specific licence holders are generally wholesalers of fish and they transport the fish in bulk on lorries, pick-ups and by train. They are required to submit monthly returns of their transactions to the Commissioner for Fisheries.

3. FISH EXPORT

All those intending to engage in fish trade are required to obtain a specific licence outlined above. After obtaining the specific licence an applicant can be recommended to the Uganda Advisory Board of Trade, Ministry of Commerce to obtain an import/export licence for the goods being exchanged. With regard to the good being imported the applicant must supply particulars which include:

- Address of the importer;
- Names and address of applicant;
- Mode of transport;
- Place of loading;
- Port of discharge;
- Country of origin;
- Place and destination in Uganda;
- Terms of payment;
- F.O.B. value; and
- Shipping costs;

After obtaining the export licence the licensee obtains his fish and packs it. He then presents his product for inspection to an authorised officer who will issue an appropriate fish inspection certificate (Appendix 3) prior to export. These certificates are issued at the ports of exit i.e. Busia for goods destined to Kenya and Entebbe for fish being air freighted. Arrangements are being made to deploy staff at Kasese and Katuna for fish destined for the Zaire and Rwanda markets respectively.

Table III gives export data of the types of fish, mode of preservation and country of destination in 1989. It is clear from this table that some of the fish exported to Kenya is well documented. The air-freighted fish is well documented. However, there is still a lack of information regarding fish exports to Zaire as it is known that more fish is exported to Zaire than is reflected in this table.

Table 1 : Estimated National Annual Fish Production for 1988

LAKES	WT/VAL.	LATES	TILAPIA	HYDROCYNUS	ALESTES	BAGRUS	BARBUS	DISTICH.	SYNOD.	CLARIAS	PROTO.	AUCHENO.	LABEO	MORYMUS	SCHILBE	HAPLOCHR.	RASTR.	TOTAL
ALBERT	WEIGHT	2997.77	2657.58	39.06	478.72	740.35	132.16	13.46	278.83	312.86	364	373.76	294	10.11	4.98	0	0	12534.58
	VALUE	180	148.93	259.09	46.56	50.59	6.79	0.82	21.03	15.08	18.56	19.43	17.69	0.87	0.13	0	0	785.61
VICTORIA	WEIGHT	92031.99	1569.66	0	0	206.01	30.01	0	5.46	429.44	314.85	0	3.84	21.95	31.37	415.51	2032.55	97092.6
	VALUE	5838.7	857.15	0	0	30.37	2.98	0	0.1	56.41	24.27	0	0.9	2.6	1.01	21.22	90.41	5926.12
KYOGA	WEIGHT	14322.44	66281.67	0	0	12.22	25.97	0	0	2141.69	3814.88	0	0	148.47	0	0	0	86747.84
	VALUE	1014.54	4310.57	0	0	0.15	1.42	0	0	299.45	367.85	0	0	24.09	0	0	0	6017.08
EDWARD/GEG. & KAZINGA	WEIGHT	0	2243.13	0	0	1725.77	75.81	0	0	386.14	1504.25	0	0.38	0.79	0	0	0	5936.27
	VALUE	0	159.08	0	0	123.33	5.24	0	0	21.76	58.11	0	0.06	0.16	0	0	0	367.74
WAMALA	WEIGHT	0	289.8	0	0	0	0	0	0	39.37	83.14	0	0	0	0	0	0	412.31
	VALUE	0	12.52	0	0	0	0	0	0	2.1	3.41	0	0	0	0	0	0	18.03
ALBERT NILE	WEIGHT	42.06	123	141.8	177.6	19.36	19.36	4.68	23.52	5.4	1.56	13.8	22.8	12.42	1.2	0	0	608.56
	VALUE	4.44	10.2	11.52	17.64	1.38	0.61	1.2	0.36	0.36	1.62	1.08	1.62	0.59	0.05	0	0	52.12
OTHER WATERS	WEIGHT	0	456.09	0	0	0	0	0	0	145.43	349.58	0	0	0	0	8.5	0	959.6
	VALUE	0	32.04	0	0	0	0	0	0	11.69	19.33	0	0	0	0	2.3	0	65.36
TOTALS	WEIGHT	109394.2	83620.43	4077.8	656.32	2703.71	284.31	18.14	307.81	3460.33	6432.26	327.56	320.52	193.74	37.55	424.01	2032.55	214291.2
	VALUE	7036.69	5530.49	270.61	64.2	205.82	17.81	1.49	22.33	406.85	491.56	20.51	20.27	28.31	1.19	23.52	90.41	14232.06

4. CONCLUSION

There is an urgent need to regularise fish exports between Uganda and Zaire. The customs requirement of a health certificate will assist in monitoring the volume of fish crossing the border. It would also help if the Zaire authorities demand that all transactions be carried out through the Central Banks in order to minimise the loss of revenue to both Governments.

TABLE 2 : Percentage Disposal of Fish by Bodies of Water

Fish product	National Average	Victoria	Kyoga	Edward, George and Kazinga Channel	Albert & Albert Nile
Fresh	50	60	60	50	30
Smoked	40	38	40	45	30
Sundried Salted	9.5	2	-	4	40
Fried	0.5	-	-	1	-
TOTAL	100	100	100	100	100

TABLE 3 : 1989 Export of Fish & Fish Products

Type of Fish	Mode of Preservation	Country of Destination	Quantity in Kgs.
(*Oreochromis niloticus*)	Fresh chilled	Belgium	265
"	"	Holland	5,460
"	"	United Kingdom	2,340
Nile perch (*Lates niloticus*)	Fresh chilled (fillets or whole)	Belgium	1,130
"	"	Holland	11,705
"	"	United Kingdom	3,000
"	Frozen (whole)	Zaire	2,500
"	Frozen (fillet)	Sweden	12
(*Oreochromis niloticus*)	Hot smoked	Zaire	200
"	Smoked and sundried	Kenya	196,500
"	Salted	Zaire	2,000
Nile perch (*Lates niloticus*)	Hot smoked	United Kingdom	295
"	"	Nigeria	7,000
"	"	Zaire	2,800
"	Sundried air bladders	Hong Kong	13,915

SUMMARY

Type of fish	Mode of preservation	Quantity (Kgs.)
Tilapia	Chilled	8,065
Nile perch	Chilled	15,835
Nile perch	Frozen	2,512
Tilapia	Smoked & Sundried	196,700
Tilapia	Salted	2,000
Nile perch	Hot smoked	10,095
Nile perch	Air bladders	13,915

FISH PROCESSING CAPACITIES

Industry A

Capacity : 4 tons/day = 1,040 tons p.a

Products :

- smoked fillets;
- fresh fillets
- fresh whole fish.

Industry B

Capacity :

- fish meal = 12,000 tons p.a;
- smoked fish = 105 tons p.a;
- fillet = 142.5 tons p.a.

Industry C

Capacity : Frozen fillets 20 tonnes/day = 7,200 tonnes p.a

Products :

- fresh fillets;
- smoked

Industry D

Capacity : 2 tons/week = 104 tons p.a

Products :

- whole fish
- smoked products

TOTAL (i) Fish fillet 8,487 tons valued at $ 23 million

(ii) Smoked fish 3,155 tons valued at $ 6.3 million

NB - Fish meal is for local consumption.

Appendix 1

FISHERIES DEPARTMENT
APPLICATION FORM FOR SPECIFIC LICENCE

Part I to be completed by Applicant

1. Applicant's full Name.....
(In Block Letters)

2. Age.....

3. Address.....

4. (i) Graduated Tax Receipt No.....Passport No.....
Travel Document No. .....
OR
Company Registration No.....
(ii) Issued by.....
(iii) Name of Manager.....
(iv) In case of Company.....
Previous years Licence No.....

5. Nationality.....
(In case of an individual)

6. Landings or Markets from where fish is to be bought.....

7. Name of the Lake .....District.....

8. Type of fish to be bought.....(Fresh, Smoked, Sundried or Salted)

9. Approximate weight of fish in Kgs. that can be bought per month.....

10. Intended markets for fish.....

11. Mode of transport of fish to the market.....

12. Income tax Certificate No.....

13. General Receipt No..... .....
Signature of Applicant
Date.....

PART II (for Official use Only)

Application recommended (reasons for not recommended).....
.....
Date.....
.....
Regional Fisheries Officer

PART III (for Official use Only)
Application approved (reasons for not approving).....
.....
Date.....
Licence No.....Issued on.....
.....
COMMISSIONER FOR FISHERIES

Appendix 2

FORM VI

THE REPUBLIC OF UGANDA

THE FISH RULES, 1951

0 0 6 8 4 8

LICENCE

(Under section 8 (b) of the Ordinance (under rule 11)

Name.....

of.....is licensed to engage in the:-

Marketing and/or Smoked
purchase and/or,
sale and/or,

(a) generally:

.....

in.....till 30 June 19.....

.....

Commissioner for Fisheries

FEE: Shs. 2,000/=

Date of issue.....

This licence is issued subject to observance of the provisions of the Sleeping Sickness Ordinance, or any Ordinance amending or replacing the same and any Rules made thereunder.
ORIGINAL to Licensee; DUPLICATE to Accounting Officer; TRIPLICATE to remain in book.

Appendix 3

FISH TECHNOLOGY LABORATORY

FISHERIES DEPARTMENT

P.O. BOX 168

THE REPUBLIC OF UGANDA

ENTEBBE, UGANDA

Date of Issue.....

FISH INSPECTION CERTIFICATE

This is to certify that the consignment of fish specified below is *fit/unfit for human consumption.

1. Species of fish (Common name).....
   (Scientific name).....

2. Weight.....

3. Mode of preservation.....

4. Country of origin.....

5. Mercury content.....

6. Name and Address of Exporter.....

7. Final destination of consignment (Name and address).....

8. Time of inspection.....

9. Date of inspection.....

10. Signature of Authorised Officer.....

    Title: Senior Fisheries Officer, C.M. DHATEMWA, B.Sc, M.Phil, MIFST (UK)

    Official Stamp.....

    * Delete whichever is inapplicable

c.c The Commissioner for Fisheries
P.O. Box 4,
ENTEBBE - UGANDA

MANAGEMENT STRATEGY AND MEASURES FOR LAKES MOBUTU AND IDI AMIN

by
Bete Da Sembali
Chief, Fisheries Station/Centre Lake Mobutu Zaire

1. GENERAL INTRODUCTION TO THE FISHERY

Lake Mobutu is located 618 m above sea level with a maximum length of 160 km and width of 35 km making a total area of about 5270 km^2 (2420 km^2 of which belong to Zaire). On average it varies around 25 m in depth although, in the Djugu region, near Zega, it reaches a maximum of 58 m.

1.1 Fisheries Administration

The Government service in charge of controlling the fisheries on Lake Mobutu is called the Fisheries Board and its duties are as follows:

- collecting statistics;
- applying the current fishery legislation on the Zairian part of the lake;
- introducing and implementing improved fishing techniques;
- supervising fishermen;
- controlling theft of fishing nets on the lake;
- levying taxes through the issue of fishing licences for the treasury; and
- up-dating the census on fishermen and fishing gear.

Given the lack of (material and manpower) support, the Fisheries Board has failed to evaluate the fishing effort and units on the lake. In order to be able to carry out these functions, it is imperative to provide the necessary equipment and staff (by the appointment of 10 fisheries inspectors for controlling the fishery and 7 surveyors for statistics collection for research).

Presently, the operating staff consists of only 4 persons one fisheries officer and three petty-officers (i.e. one petty-officer per lakeside zone).

1.2 Fishing effort and exploitable potential

The exploitable potential for the Zairian side of the lake is estimated between 9700 and 13 300 tons per year and is carried out only by means of boats and canoes. However, the fishing effort is unevenly distributed over the lake owing to the concentration of fishermen in some big rural centres such as Kasenyi, Tchomia, Gobu, Mokambo and the port of Mahagi.

By 1983, the catch was at 3800 tons per year i.e. a production of 15 kg per hectare and; an exploitation rate of 28.5%. The total number of fishermen was 6500, therefore each fisherman exploited about 0.58 tons of fish.

Since the implementation of the fishery project on Lake Mobutu in 1984, the official statistics of the 3 lakeside zones (Irumu, Djugu and Mahagi) have indicated gradual increase in production. It reached 3800 in 1985, 9200 tonnes in 1986, 8400 tons in 1987, 12 000 tons in 1988 and finally 25940 tons in 1989.

By 1989, catches had almost doubled and the estimated exploitation potential was 25 940 tons. This production increase was due to the fact that, part of the Ugandan production was marketed in Zaire; in fact practically all the salted fish produced in Uganda were unloaded in Zaire. The Zairian production was impossible to evaluate because the Zairian Government was

unable to distinguish between fish from Zaire and fish coming in from Uganda. The quantity of fish illegally unloaded from Ugandan fishermen or Zairian traders (in order to escape customs duties) has created a problem in the estimating catches.

1.3 Types of fish caught

There are numerous species of fish in the lake but only the following are harvested:

- Hydrocynus forskalii (ngassia)
- Hydrocynus lineatus (nyarugassa)
- Alestes baremose (sardines)
- Lates niloticus (big capitaine)
- Lates macrophtalmus (small capitaine)
- Oreochromis niloticus (ndakala)
- Other species:
  - Bagrus (munama)
  - Synodontis (fodofodo)
  - Labeo (kitumbi)

1.4 Fishing techniques and types of gear used

The gear used all over the lake are mainly surface mesh nets (with a total length of 556 289 m), bottom mesh nets (with a total length of 619 529 m), (112) beach seines, (205 720) hooks and lines and (an unknown number of) traps. (Data collected from the number of the different types of gear licensed in 1989).

The total number of fishing craft licensed in 1989 was 345 canoes, 1084 planked boats and 156 outboard engines.

1.5 Organisation of the fishery

The fishermen are grouped into camps. There are, in total, 94 camps which are divided up into the three lake zones.

- Irumu: 25 camps
- Djugu: 36 camps
- Mahagi: 33 camps

In 1989, the total number of identified fishermen was 1615 but this was an underestimate as it did not take into account fishermen from every part of the lake.

1.6 The objectives of Lake Mobutu Fisheries Board:

The primary objectives of the centre are as follows:

- to increase the total production of the lake by regulated increase and better distribution in the fishing effort;
- to improve the socio-economic conditions of the fishermen of the lake, by supplying them with fishing tackle and other inputs and by involving them in a fisheries cooperative.

However, during the third part of 1989, the executive council of the Fisheries Board split with the French Cooperation and from then on had to take on the total running costs of the project. It was decided to reorganise the project, and, rather than studying the hydrobiology of the lake, effort would be made to enhance the offshore fishery and improve processing techniques such as salting and smoking.

2. FISHERY MANAGEMENT

2.1 Search for balanced exploitation - general approach

Following various studies, it has been recognised that the potential production of the lake was between 9700 and 13 300 tons per year. Presently all observers agree that they have witnessed a clear improvement of the fishing effort over the last few years, and it is supposed that the project has been responsible for this: the statistics in the 1987 Annual Report indicated the total production to be 10 000 tons of whole fish and 8400 tonnes of gutted fish. It is, however, supposed that these figures are not totally accurate due to the following reasons:

- When fish are landed in Zaire it is impossible to distinguish whether the fish was originally caught in Ugandan or Zairian waters which has the effect of over estimating the actual quantity of fish landed;

- In the extreme south of the lake fish consumed within the villages and fish transported by foot to the rural centres (arriving at unset times, generally not corresponding with the main fish landings), are not registered in the surveys;

- The share sold to the old marketing companies is evaluated according to declarations made by the people concerned (within the companies) without any verification by the surveyors.

The lack of data increases the amount of inaccuracy in the fisheries statistics. It is not unreasonable to assume that the actual production may have reached or may even be greater than the estimated potential, and may be in the region of 10 000 and 13 000 tons or more.

Conversely, limited credibility must be given to the estimated potential assessment if no signs of over exploitation occurs at this production level. It is therefore imperative to be extra vigilant to discern and prevent over exploitation and also to update the official data that led to these estimates so that the estimates may be revised. To do this, 2 different approaches are possible:

2.1.1 The Quantitative Approach

A quantitative approach is used in order to compare the acknowledged production and the calculated potential (9700 to 13 000 tons per year). This approach supposes that there are sufficiently reliable statistics for the total lake production. There are two methods of calculation:

(i) **Integral interception** which consists of making a deduction of all fish landed at a given level of the commercial chain.
For the processed products, the weight should be converted into the corresponding fresh one. This is the technique that has been used to far, but it is difficult to apply on Lake Mobutu and inland continental waters in general;

(ii) **Stratified sampling** consists of carrying out a poll as shown in the following example:

Average number of monthly fishing trips : 20.4
Average catch per trip : 54 kg
The annual production per fisherman is then deduced as follows:

$$p = 54 \text{ kg} \times 20.4 \times 12 \text{ months} = 13\,219 \text{ kg}$$

If, moreover, the total number of fishing 'captains' had been censured, then the total production for the Zairian part of the lake will be:

$$P = \text{Average individual production} \times \text{no. of fishermen}$$

This approach has to be applied across all groups and sub-groups in order to take into account all the possible causes in variation such as different gear, species, seasons, zones etc..

This approach provides a lot of information. However its application requires a lot of resources, a great number of trained and equipped surveyors and a central information processing unit supervised by a bio-statistician. In the present state of the Fisheries Board, this approach is impossible.

2.1.2 The Qualitative Approach

The aim of this approach is to collect the type of information necessary to recognise the type of development to put in place. The type of necessary information includes:

(i) The average size of a given species in the catch over time: an increase in fishing effort is always proportional to a decrease in the size of fish caught;

(ii) An observation in the evolutionary tendencies of the change in mesh sizes of nets used: generally there is a tendency for mesh sizes to decrease when there is over-exploitation. Thus, in 1985, the 2 cm meshes were forbidden. This measure seems to be respected, indicating that many fishermen understand the dangers of over-exploitation;

(iii) An estimation, even though it may be approximate, of the different fishing efforts being applied in each of the zones: this would allow the identification of the least exploited areas and hence, the degree of exploitation inshore and offshore in order to develop the current mechanisation policy of small boats.

This qualitative approach costs less than the quantitative approach and therefore would seem to be the most appropriate.

2.2 Search for balances in exploitation - specific approach

2.2.1 Exploitation of Nile Perch (Lates niloticus)

The majority of Nile Perch is caught in 2.5" (16 cm) or 3" (20 cm) mesh size nets. Fish caught in these nets hardly reach 150 - 300 g which is very surprising considering its general size.

It is likely that more than one species of Nile Perch exists in the lake. The most common variety is Lates niloticus albertinus which can reach around one hundred kilos. The second most abundant is Lates niloticus macrophtalmus which is smaller, having a maximum weight of one kilo.

It is therefore important to determine the presence of these 2 species in the lake and, if so, what are their proportions. This has not been undertaken as it is almost impossible to determine the difference between the two species. The Zairian government plans to pursue studies already initiated in this field.

2.2.2 Protection of ecologically vulnerable zones

A few regulations are in place which, by limiting mesh sizes and the size of seines and banning fishing by mesh nets within 1000 metres of the bank, are intended to limit the fishing effort both along the banks and also in the river outlets which are considered fish reserves. This very severe controls requires important, difficult and expensive enforcement.

Some biological studies, such as the recognition of spawning grounds, would allow better estimates of the effort to be devoted to the application of these measures.

2.3 Improvement of catching techniques and fishing vessels

2.3.1 Introduction of new fishing gear

It would be technically possible to introduce onto Lake Mobutu "modern" equipment such as winches, mechanised cranes and even moving seines and semi-pelagic trawl nets without actually harming the environment and it is even possible that such techniques could actually lower production costs in return for regular training and credit. However such a development would have two bad effects:

- It would lead to the disappearance of many jobs in fishing and its related industries e.g. a winch takes the place of many people. Also investment and running costs would not be reduced in these conditions unless they go hand in hand with high levels of catch or with a reduction in workers;

- It would require money and imported materials which is always difficult for the Zairian national economy.

The intensification and modernisation of fishing activity is tempting but this does not seem a worthwhile objective to pursue given the types of problems that intensification would bring about.

The introduction of new fishing gear would not be justified unless it is established that a part of the fishery resource is unexploited because of a lack of adequate gear. A possible example would be the exploitation of large Nile perch if this population is really abundant and if it can sustain harvesting pressure. However, it does seem apparent that the low catch is not due to insufficient technology linked perhaps to financial constraints but more to do with social constraints. Apparently there is no problem in catching large Nile perch using large meshed nets. The major problem identified is the high cost of this type of net and, associated with this, the great risk of loosing it through theft.

2.3.2 Improvement of fishing gear

One of the possible improvements would be the use of synthetic floats. Presently, mesh nets are rigged with floats made of light and porous wood. This material has many disadvantages: it seems that it is becoming increasingly rare, the life expectancy of the floats are very short and, after the float have become sodden with water, they sink resulting in the surface nets entangling with the deep water nets. (Some fishermen however consider this an advantage as after the net has caught fish near the surface it sinks to catch different fish species lower down.)

A synthetic float would solve this problem with the advantage that they can use a variety of different colours which will allow the identification of nets in the case of theft. The only disadvantage would be the abandonment of locally made and cheaper floats. An approach has been made in Goma to start manufacturing plastic covered polystyrene floats.

The increase in the size of the fibres used in net making is another possible improvement. The fibres used at present are generally very thin (210/2) using mesh sizes of 3" (20 cm) or less and the nets must be repaired often. It is therefore necessary to find out what would be more appropriate for the fishermen (remembering that the fishermen require the cheapest nets that limit loss in the case of theft).

2.3.3 Improvement of fishing craft

Three types of locally made fishing craft exist:

(i) The fishermen's traditional monohulled pirogues;
(ii) The professional fishermens' simple nailed planked barques;

(iii) The more sophisticated boats used for transportation of goods and people called skools.

A development that must be considered in light of the development of balanced exploitation in all zones of the lake is mechanisation. The establishment of simple outboard engines on original fishing vessels does not seem to cause too much problems as it does not require fundamental modifications to the hull as would the installation of inboard diesel engines.

One development that does need addressing is the preservation of the wood used for boat building. Presently only paint is used. It is thought that the use of pitch and tar would certainly delay decay but it is thought before any changes are made a specialist should be consulted.

2.4 Structure of the Fisheries

Lake Mobutu fishermen, although from different areas and ethnic groups, exploit the same stocks of fish, meet the same supply difficulties, share the same markets, are faced with the same problems in every day life and are exposed to the same dangers. As such they constitute a well defined socio-economic group that should have its own structure to:

(i) offer a framework which would enable the internal collection and circulation of information;

(ii) have a central administration which could also act as a lobbying body;

(iii) settle disputes within the profession;

(iv) defend the interest of the profession against other socio-economic groups; and

(v) participate in the development of legislation. (This function is particularly important given the size of the lake and the limited means of the local fisheries administration.

This politico-administrative syndicate structure exists for the 3 Fisheries Zones and 94 fishing camps but it lacks central organisation. Despite the problems raised by competition within the fishery, it is very important that when the socio-political organisation exists, that it remains to function and develop.

3. UPGRADING AND MARKETING FISHERIES PRODUCTS

This aspect of the development of the fishery on Lake Mobutu has not yet been undertaken and not all the elements of the problems are understood. However two aspects will be discussed.

3.1 The Quality of the Product

The most common treatment for preserving fish is by salt-drying. This technique, if applied well, physically and chemically stabilises the product. However it is recognised that fish prepared in this way is of very poor quality, sometimes too poor for consumption due to:

- The most common fishing gear used are set gill nets and longlines. Some of the fish caught die immediately and begin to decay before being recovered from the gear;

- Lake transportation between the fishing areas and villages often takes a long time throughout which the fish begin to decompose. This is greater for the fish stored on top of the catch, exposed

to the sun and fish stored on the bottom of the catch, usually in the dirty water in the bottom of the fishing vessel;

- The market in Bunia is supplied with fish brought in by traders pushing bicycles loaded with fish which, depending on the distance of the fish landing from Bunia, they have transported for 7 to 8 hours. Although the state of the fish, once it has reached Bunia is in a very poor condition, due to the present shortage of fish, it still finds a market;

- Due to the overwhelming work of the authorities in charge of fish quality, the quality of the fish marketed cannot be maintained;

- Negotiations between the salesmen and consumers are based on weight and thus the fish is not always necessarily fully processed (which actually causes it to lose weight). It is reported that salt-dried tilapias, arriving at the port of Mahagi from Uganda, are actually sprinkled with water before being unloaded;

The actions necessary to improve this situation are to:

- carry out a feasibility study on the viability of a fish freezing plant;

- investigate different gear to replace the set gill nets and longlines that would not cause serious socio-economic or ecological damage;

- protect the catch from the direct sun and water in the bottom of the boat by installing some kind of protection system;

- retrieve the set gill nets and longlines a lot more frequently than at present, ideally throughout the night;

However these measures are very constraining and, given the small amount of profit that the fishermen make, these changes will not be possible.

The marketing of dry fish based on its weight is detrimental to the quality of the end product. A campaign to encourage the practice of selling fish based on its 'looks' rather than weight has been initiated. It has also been suggested that the dried fish should be taxed according to its weight and the cost of transportation, which would encourage fish processors to improve processing to achieve as light a weight as possible.

3.2 The Supply of Good Quality Fish to Bunia

Apart from salt-dried or smoked fish, the market in Bunia is supplied with 3 other types of products:

1) "Fresh" fish transported on bicycles, the quality of most of which is too poor for consumption;

2) Frozen fish, supplied by the local purchasing agencies e.g. "KOSKINAS", of varying quality but generally most of which is too poor for consumption;

3) Large frozen Nile perch for the upper end of the market, but deliveries are limited and irregular.

It is acknowledge therefore that Bunia, the major town in the region, less than 3 hours away from the lake is basically not supplied with adequate fish for consumption. It is thought however that it would be fairly easy to supply better quality fish to Bunia, and at such a price that it would be available to the greater part of the population.

The project could help in the implementation of a simple and economic system according to the following principals: The unloaded fish is mixed with ice then put in one or more ice-boxes of 80 to 100 litres capacity. The ice boxes are then transported to market by independent commercial means (e.g. pick-ups). On arrival at Bunia, the driver delivers the ice boxes to a highly recommended female retailer who owns refrigerators. This organisation can be coupled with the transportation of cold drinks which is presently done in reverse. It would mean a balance between the empty packages (ice boxes and bottle racks) and full ones in the pick-up. The organisation to initiate such an operation once the means have been found to provide ice at Kasenyi-Tchomia.

4. FISHERIES LEGISLATION

As far as legislation is concerned, the fishery sector is still governed by the April 21st decree on hunting and fishing. Since then, a report has been submitted to the Sub-Regional Commissioner of Ituri to be added to the decrees of February 22nd 1988 which contains a lot of amendments to make the legislation far more applicable to Lake Mobutu. These decrees are:

1) Decree No 320/006/BUR/PSR/MPR/CSRI/88 stating a measure on legal seizure of fishing equipment, products and by-products;

2) Decree No 320/007/BUR/PSR/MPR/CSRI/88 stating measures on the modalities of fishing on Lake Mobutu;

3) Decree No 320/007/BUR/PSR/MPR/CSRI/88 stating on fishing regulations on fishing on Lake Mobutu;

4) Decree No 320/007/BUR/PSR/MPR/CSRI/88 stating a measure on spawning sites and fishing reserves;

5) Decree No 320/007/BUR/PSR/MPR/CSRI/88 modifying and completing the decisions of decree No 320/034/E.41/70 of June 23rd 1979 and No 320/018/BUR/PSR/MPR/CSRI/86 of May 12th 1986 stating measures against theft of fishing nets and on the creation of fishing village committees on Lake Mobutu respectively;

6) Decree No 320/007/BUR/PSR/MPR/CSRI/88 stating measures on the cutting of fishing nets and the picking up of fishing gear.

4.1 Current Fisheries Regulations

The authorised sizes for each type of fishing net is:

- Surface gill nets (sardines)
  Minimum mesh size : 2.5 cm
  Maximum length : 2000 m (2 km)

- Set gill nets (Guba)
  Minimum mesh size : 3.5 cm
  Maximum length : 2000 m (2 km)

- Beach seines (Ndia)
  Length : 220 m
  Central area : 3.5 cm (minimum mesh size)
  Wings : 5 cm (minimum mesh size)

The use of beach seines is prohibited at certain places such as in spawning grounds, all along the banks of the lake and also at certain times during the year to allow the brood stock to approach the shore for spawning. Prohibition can also be extended to places such as river estuaries or any bays where spawning grounds are found.

4.2 Prohibited Mesh Sizes

All fishing nets with mesh sizes under 2.5 cm are strictly prohibited on the Zairian part of the lake and, since 1985 according to the decision of Ituri's Sub-Regional Commissioner, the control has to be carried out in all the fishing communities and markets by fisheries agents.

4.3 The System of Control

It is a very important task to enforce the various fisheries legislations and guard the designated spawning sites and spot check them. However many difficulties have been encountered due to insufficient man-power as well as a lack of fast transporters to oversee fishing and protection of the fishing reserves.

As a consequence of these difficulties and since the fishery reserves are isolated and are thus difficult to police, fishermen can get away with using prohibited mesh size nets. It is therefore necessary to:

(i) arrange for the development of new fishing legislation as the present legislation is almost null and void;
(ii) propose a common legislation for Lake Mobutu for the two countries; and
(iii) recruit fisheries officers to police the lake.

4.4 Theft of Fishing Nets

One of the most difficult problems for Lake Mobutu fishermen (which has become one of the major constraints to the development of the fishery in this region) is the theft of fishing nets, mostly be rival fishermen during the night. This has the effect of:

(i) decreasing the number of fishermen (who are discouraged to invest in costly fishing nets);

(ii) over-exploitation around the shore (where fishermen are concentrating their efforts so as not to have to go far away from their villages.

For thieves living in Zaire, according to Article 69 of 21st April 1937 on hunting and fishing, and by the Ituri Sub-Regional Commissioners decree No 320/010/BUR/PSR/MPR/CSRI/88 of 22nd February, the Zairian government can seize the nets back. The Zairian government should therefore apply the law:

- to reinforce the control in fishing villages by a bimonthly or quarterly basis to find out those responsible for the stealing;
- withdraw the fishing licence from every fisherman who would otherwise be arrested for theft according to the legislation; and
- chase the thieves away from the fishing areas.

It is also common that Ugandan or Zairian fishermen (living in Uganda) steal fishing nets from the Zairian part of the lake. These thieves operate during the day using arms. The Zairian government, having no authority on these fishermen, would like to solve this problem and encourage free fishing between the two countries concerned. Freedom in fishing would bring several advantages including:

- The verification of the fishery administrations of the two countries (Zaire and Uganda) in order to eradicate theft of fishing nets;
- The coordination of legislation between the two countries to the extent of them becoming common; and

- The equal distribution of fishing effort along the lake.

5. PROPOSALS FOR THE COLLABORATION BETWEEN ZAIRE AND UGANDA IN THE FISHERIES OF LAKE MOBUTU

1) Evaluate the present level of exploited stocks in order to determine the potential of the lake through the establishment of joint scientific research program ;

2) Reinforce the surveillance of the lake and of its spawning areas by the recruitment of fisheries officers and by providing them with adequate gear (outboard motors, vessels etc.);

3) Adopt common fisheries legislation valid for Uganda and Zaire;

4) Increase the means of protecting the fishery resources and their rational exploitation;

5) Introduce fishing licences with quotas for different species;

6) Adopt the same methods of surveying, statistical data collection and exchange of information;

7) Establish free exploitation of the lake in order to decrease the amount of theft;

8) Set up periodic meetings of Ugandan and Zairian experts;

9) Create a permanent committee for the coordination of the measures to be taken for the development of the fisheries of the lake.

FISH PROCESSING AND MARKETING IN LAKES MOBUTU EDWARD AND GEORGE REGIONS

by

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1. INTRODUCTION

Apart from some local features, the characteristics of the fisheries of Lakes Edward and Mobutu are the same and can be summarised as follows:

- techniques for fish processing are very traditional and are mainly carried out by the wives of the fishermen;
- marketing is very developed, well organized and informal; and
- the lake fisheries suffer from great isolation and poor communication.

2. FISH PROCESSING

2.1 Fresh fish

The sale of fresh fish is the most cost effective way of processing fish and affords the greatest nutritional value. However this system of processing is greatly discouraged by the poor state of the roads and gives way to traditional methods of processing e.g. salting, smoking and drying which have a greater shelf life.

2.2 Salting-drying (Heavy-salting in Uganda)

This is the most usual way of fish processing on both lakes. Fish are sprinkled by hand with salt and then laid in the sun either directly on the ground, or, more frequently, on mats or concrete slabs. Sometimes, they are laid in drying sheds, but these are fairly scarce in the region. In all cases they have to be regularly turned over so that they dry uniformly.

The time needed for the drying is variable: during the dry season, tilapia takes 2 or 3 days to dry. The amount of salt varies between 14% to 20% of the weight of the fish and the efficiency of this processing varies between 40% to 60%[7].

After salting and drying, the fish are stored often in unfavourable conditions, for example in damp, un-ventilated premises.

2.3 Pickling (light-salting in Uganda)

This processing is semi-industrial and consists of immersing previously cut fish in brine vats for 24 to 72 hours generally followed by sundrying.

[7] The example given by Vakily is 40% efficiency with 18% weight of salt.

2.4 Sun-drying

During this process fresh fish are dried without salting: the flesh is stretched out into thin strips without being completely cut, resulting in what Ugandans call "sheet-fish". The sun-drying takes on average 2 to 3 days.

2.5 Smoking

This processing method is done by heat, either in traditional kilns or more often over open fires. Fish are smoked whole or split into two, depending on their size and depending on the product required, the smoking process varies from 2 hours to 2 days.

Short smoking produces a smoked fish product locally called moto-moto which has a short (2 to 3 day) shelf life. Clarias and Protopterus are generally treated in this way. Clarias, in particular are almost always sold smoked because the presence of many parasites gives them an unappetizing appearance. Sometimes, at Vitshumbi for example, tilapias are also smoked but only for 30 minutes. This fish is sold to neighbours.

Smoking fish for a long time can allow fish to be preserved for up to 3 months; the loss of weight is between 40 to 60%.

After salt-drying, smoking was previously the second most common method of preservation. However, due to the present limited supply of firewood this method of preservation is now reduced.

3. Marketing on Lake Idi Amin/Edward

Marketing on Lake Edward is greatly affected by its location which is in the middle of National Parks with the number of unloading places severely restricted, both in Uganda as well as Zaire.

Salesmen from Zaire side, who buy the majority of the fish come early in the morning from Goma, Lubero, or Butembo, in vans rented from Kyavinyonge or Vitshumbi and avoiding Nyakakoma because of the dilapidated state of the roads. They load on average 2,500 tilapias per van which they sell to female retailers at the markets. Clarias and Protopterus are often transported live to the market or are smoked for 2 hours (moto-moto) and sold to people in the surrounding areas. At Kyavinyonge, COPEVI (Vitshumbi Fishermen Corporation) generally sell 24 hours pickled and 2 days dried fish to a salesman from Goma.

All the fish landed in villages situated a long way from the major markets are processed in such a way as to ensure that they have a long enough shelf life to get them to market.

Ugandan fishermen sell a great part of their catches in Zaire, where there is a great demand. Some fish from Lake Mobutu is also sent to markets in Kisangani and Kinshasa.

4. Marketing on Lake Mobutu

There are more fish landing stations on Lake Mobutu than on Lake Edward. This is because the villages are much more isolated due to the geographical features of the lake which lies between two chains of the Rift Valley almost totally isolating it from the main towns, especially on the Zairian side. In the central part of the lake, the hillside slopes so steeply that it is not possible to maintain a road. This is one of the greatest marketing constraints of the fishery and as a result almost all the fish is processed: 80% being salted, the rest frozen, pickled or smoked although the quantity of frozen

fish has been severely reduced to about 10% (according to Corsi[8]) due to breakdown of equipment. A small quantity of fish is also sold fresh on landing-stages to small merchants on bicycles ("red soup"), who for instance, buy fish in the morning at Kasenyi to sell in Bunia.

On Lake Mobutu, 60% to 70% of fish is salted, even though the demand from the Uganda consumers for the product seems fairly low. This is due to marketing constraints imposed by the extreme isolation of fishing villages where road transportation is not available and transportation is limited to small fishing boats.

On the Ugandan side, the processing and marketing of fish is greatly regulated by the taste and demand of the Zairian consumers to whom the majority of the catch is sold: salted fish are often of bad quality (even to the extent of being fermented) but seem still acceptable to Zairian consumers.

At Kasenyi, 3 common purchasing agencies and 10 regular wholesale dealers exist who buy salted dried fish for retail in Bukavu, Béni, Kisangani and Isoro markets. At Mahagi, there are 5 permanent salesmen among whom 4 own lorries.

5. CONSTRAINTS TO DEVELOPMENT

5.1 Communications

The deplorable state of the existing communications is recognised as the most significant handicap to the improvement of marketing and of the fisheries as a whole.

The poor state of the roads and the minimum 3 to 5 hours drive to cover the 50 to 70 km that separate fishing villages from their closest towns have completely impeded development. This situation is more apparently on the Ugandan side than the Zairian side. On the Zairian side, the main trade routes join Bunia to Kasenyi and Tchomia in the south (which is a 55 km/3 hours drive) and Mahagi to the port of Mahagi in the north. On the Ugandan side there are routes from Fort-Portal to Ntoroko in the south and from Masindi to Butiaba and Wanseko in the north.

Also almost all the tracks are dead ends generally reaching only one or at the most a few lakeside villages making any public authorities' investment for their maintenance not cost effective. Another factors is that the villages, due to fishing industry, have only developed around the lake resulting in the fishing villages being isolated from the rest of the region by a kind of no-man's-land of 30 to 50 km.

The only reasonable transportation route is to use the lake itself which now maintains an important although not always legal trade route, especially trans-national, from Uganda to Zaire.

5.2 The loss in profit in the processing

The poor transportation/marketing facilities have also affected the quality of transported products by causing post-harvest losses of up to 30%.

The Lakes Mobutu and Edward region is characterized by a consumers preference for fish products, but the isolated nature of the fishing villages means that the majority of the fish has to be processed. The amount of resources (time, wood, salt) is not always justified by the value added for processing these products.

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[8] Corsi, F. 1990. Evaluation des pêcheries zaïroises des lacs Idi Amin/Edouard et Mobutu Sese Seko, Projet Régional PNUD/FAO pour la Planification des Pêches continentales (PPEC). RAF/87/099-TD/08/90 (Fr): 64p

Table 5: Price of the different products in Ushs/kg

Species	Fresh	Sundried	Smoked
Hydrocynus	57	140	110
Lates	54	120	120
Oreochromis	50	125	105
Bagrus	64	140	90
Auchenoglanis	45	100	100
Alestes	117	140	-
Labeo	42	120	120

Source: Fisheries Department - Masindi (1988).

For example, dried fish is approximately 0.25 of the weight of the fresh equivalent and they are sold 1.5 times cheaper (by weight) than if they are not processed.

5.3 Processing infrastructure

Onloading/offloading equipment (e.g. cranes) on the two lakes is almost nonexistent. The best equipped village is Katwe on Lake Idi Amin. It has a cemented and covered area for unloading, weighing and packaging fish. Some permanent processing facilities like smoking rooms and salting vats are also present but these are abandoned most of the time as the fish is sold fresh.

On Lake George, a processing factory belonging to the TUFMAC (The Ugandan Fish Marketing Corporation) was built by the British company in 1953 and exported to Kenya, Zambia, the Middle East and even Europe. The factory collected fish from different unloading points and made them into fillets which were sold either fresh or frozen. Further to the political changes of the 70's and to the nationalisation in 1973, its financial situation deteriorated until it closed in 1977. It is presently totally abandoned.

There is virtually the same sort of situation on Lake Mobutu where experimental station was built by the government at Wanseko on the northern part of the lake. Today, none of the facilities are still in use with fish being directly unloaded on to the sand and filleted without washing. Smoking is carried out using traditional kilns dug just near the cemented installation, salting is done on the ground and, although rarely carried out, drying is carried out on wooden hurdles (racks).

In Zaire, mainly due to work done by semi-industrial private fisheries, the situation is better. A certain number of unloading areas, warehouses and cold rooms remain. Nevertheless, due to a total lack of maintenance since the bankruptcy of private companies, a great part of the facilities are now out of order.

5.4 Tax pressure

Tax pressure encourages salesmen to use informal, but well organized commercial infrastructures that exist which have a limited number of intermediaries but a large number of fish merchants and assures the fishermen of the greatest marketing potential possible.

The creation of marketing cooperatives is a fairly well accepted idea and will continue provided that these cooperatives can be inserted into the

distribution net work on non-monopolistic basis, and that the state allows the private sector to develop without hindrance.

Another distinctive feature of fish marketing in the region is the existence of a well developed and organized bartering system where fisherfolk trade their products in exchange for fishing inputs (nets, hooks etc.).

The major constraint for Lake Idi Amin is its location in the middle of National Parks. The consequences of this situation is: the development of unloading points is strictly regulated; the exploitation of firewood (used for processing) in the parks is prohibited; in Zaire there is an extra levy of taxes that fisherfolk have to pay to the park authority for being in the park; and, the necessity of supervising and protecting National Parks has caused the authorities to make a policy that fish marketing on the lake has to be the monopoly of only one company.

5.5 The price differential between Zaire and Uganda

The distribution flows are very unbalanced: virtually all of the production of the two shared lakes is sent to Zaire where there is a greater demand for fish.

Three other factors also have an impact on the distribution flows including the greater Zairian economy that results in more beneficial terms of exchange, the greater variety of consumer goods and the greater isolation of the Ugandan fishing villages.

This last point is well illustrated by the following example taken from Lake George: At Kahendero, a village located in the west and relatively well connected to Kasindi (near by the Zairian border), the purchase price of fish is on the average twice as much as at Kashanka, an isolated village situated on the eastern bank of Lake George.

Zaire markets nearly 90% of the Ugandan production, transported either by coastal shipping or by road. For shipping, the products are either transported fresh or already processed and stored until the quantities have become large enough to justify coastal shipping to Zaire. It is estimated that 45% of the Ugandan production is thus transported to Zaire. Transportation by road via the Zairian border is the second means of exportating Ugandan products to Zaire; markets are situated in villages which lie on the major road that links Mombasa in Kenya to the interior of Zaire. This trade link deals with 45% of the Uganda production. Products are sent to Ugandan markets and from there, most is sent to Zaire by informal routes.

Only 10% of the Ugandan production from the 2 lakes is officially distributed in Uganda, besides the large proportion may be consumed within the fishing villages and is not recorded.

5.6 The consumers purchasing power

The actual purchasing power of consumers is in itself a very serious constraint concerning the development of the fishery; and any new investment or improvement plan must take into account the new selling price which the consumer will have to bear. (Obviously, if the consumers purchasing power is too weak, the consumer will refuse to pay for the higher quality product.)

An example of this is provided by the failure of the ice factory project initiated by the Chinese Cooperation in Kampala. This installation was originally planned to provide fisherfolk and merchants (who sell their fish in Kampala), with ice to improve the quality of their products. However, these investments were made without sufficiently taking into account the consumer's purchasing power and the elasticity of the demand with regard to the price. Once the fish was iced, the price became too high to the point that customers

could not pay and icing had to stop. Presently, the ice produced by the factory is used to cool drinks sold in town.

Therefore, even if the first investment relating to the establishment of the new infrastructures, e.g. the processing unit, is paid for by the project, it is still necessary to ensure that, in general, the consumers will be able to bear the increased costs caused by the value added to the product.

Very little information is currently available on the exact level of the available purchasing power. However it is known that in rural zones surrounding the lakes, this power is very weak. In these regions therefore, it would be difficult to market any value added product whose costs are anything more than the previous product/market cost.

However various market outlets should be researched because a market may exist, in, for example, the capital cities like Kinshasa or an export market, for a high quality product that could afford to pay the increased costs.

6. RECOMMENDATIONS

6.1 Development of basic facilities

The fisheries of Lakes Idi Amin and Mobutu suffer from serious commercial problems to do with the level of supply and sales.

The first remedy is the necessary improvements to the road system. This could be done by initiation of activities involving small financial suppliers and with significant participation of locally recruited labour. These micro-projects to restore the roads, particularly those which link main fishing villages to main cities could be developed at a minimum cost.

In order to open up the fishing villages around the lakes, it is necessary to develop lakeside transportation as well. Coastal shipping, in addition to its positive impact on fish businesses, has the advantage of facilitating communication between fishing villages, and of creating access to basic social security benefits such as schooling and health care.

Presently, the general opening up of the lakes to markets should be one of the major points of any policy on rational development of the fisheries of Lakes Mobutu and Amin.

6.2 Socio-economic study

The consumers' purchasing power and demand for different types and quality of proposed products has to be taken into account if fish is to be processed for the domestic and possible export market. This can be investigated by running a socio-economic study of the area.

The results of a socio-economic study, for example, might indicate that the restoration or building of factories, such as the factory that worked on Lake George until 1973, may not be worth considering, owing to: demographic growth (affecting local demand) and to the lack of transportation and associated prohibitive costs.

The local market itself remains unknown to a very large extent. It is known however that there exists some very marked preferences. For example, at Bukavu, in Zaire, the demand is exclusively for Hydrocynus and tilapias.

In addition to the purchasing power previously mentioned, it is important to evaluate: the elasticity of the price of fish and the suitability of different products, prior to feasibility studies concerning possible technical and/or commercial improvement of the fishery.

6.3 Improvements to processing technique

As it will take a certain period to improve communications to the lakes, the processing of the majority of the catches remains a priority and it is, therefore, necessary to improve processing techniques in order to reduce losses and get a better end product.

For salt-drying, an effort has to be made to improve processing methods by the actual processors. This should include turning techniques (to get more uniform drying) and better systematic drying on high and well ventilated drying sheds.

For smoked fish the scarcity and expensiveness of firewood should encourage the adoption of more economic smoking-rooms, for example Chorkor or Altona ovens, which are simplified and made with local materials.

It is also important to improve storage conditions of the end products which should be properly stacked in well-ventilated warehouses.

6.4 Local "sporadic" markets

The various accesses to the lakes are in a very bad state and costs of transportation are consequently relatively high. By increasing the selling price to allow collection of fish it indirectly increases the purchase price for people living around the lakes and makes the supply of fish for their own consumption more difficult.

This kind of paradox exists, for example, on the Zairian side of Lake Edward, where a certain number of markets considered as 'clandestine', exist in parts of the Virunga National Park and supply villages situated on the Park, where COPEVI puts pressure on fisherfolk to bring their products to Vitshumbi.

In these situations, it is preferable to get sporadic markets around the lake, which are already well organized and meet the needs of the local populations.

7. CONCLUSION

Owing to the present levels of exploitation of the lakes, it is not likely that the total production will increase in a significant way.

Among the actions to be taken for the development of the fisheries, priority should be given to the improvement of the techniques used to process fish (to include improvement of handling techniques, reduction of wood consumption and minimisation of post-harvest losses).

STRUCTURE AND PROFITABILITY OF THE FISHERIES OF LAKES EDWARD-GEORGE AND ALBERT (UGANDA)

by

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1. Introduction

The total 1988 catch in Lakes Albert, Edward and George was estimated at 34.000 T and the potential annual reproduction capacity (MSY) is believed to be between 40,000 T and 51.000 T. Fishing done with modest equipment using canoes with or without engines is one of the main economic activities in this lake region. These lakes, shared between Uganda and Zaire, have, as yet, no common resource management system. Moreover, the data available, are inadequate to plan for the rational use of these stocks.

Taking into account the lack of reliable data, the present study's sole intention is to give an impression of the profitability of the fishing done on the Ugandan side of the lakes. It has been undertaken on the basis of statistical information gathered by the FAO/UNDP Project UGA/87/007 and data collected during a field trip made in connection with the RAF/87/099 Project.

2. Lakes George/Edward

The waters of Lake Edward are shared between Uganda and Zaire but the waters of Lake George and the Kazinga Channel are in Uganda (see Figure 1). The fishing communities of Lake Edward are found within the boundaries of the Queen Elizabeth National Park. There are three government administrative institutions responsible for fisheries and wildlife protection: the Fisheries Department and the Department, the Game Department and the Uganda National Park. For Uganda waters, the number of nets per canoe is legally fixed at 10, with a mesh size of 5 inches (127 mm) stretched. Fish landing time is restricted to day time between sunrise and sunset only. The fisheries of Lake Edward, George and the Kazinga Channel which connects the two lakes are administered from the fisheries field office at Kitchwamba (see Figure 2).

2.1 Katwe

2.1.1 Landing situation

Katwe is the largest and most developed settlement in this area. The Fisheries Department Station at Katwe has a staff of one Assistant Fisheries Development Officer (AFDO) and three Fisheries Assistants (FAs). According to the records, there are about one hundred and twelve (112) licensed canoes at Katwe with a total of forty two (42) which were observed actually operating during the mission. The level of motorization is quite high in comparison with the other fishing villages. There were 24 outboard engines in use. In addition to fishing, the town is known for the production of salt which is used in the processing of dry salted fish. The location of Katwe fishing settlement is shown in Figures 3 and 4.

2.1.2 Fishing techniques

The dominant fishing technique used is gillnetting, with the fishermen going to set their nets around 4 p.m. in the evening. It is illegal for the fishermen to stay on the lake overnight to look after the nets. However, the fishermen prefer to stay to safeguard their nets against theft which is common on the lake. Fishermen use planked canoes manned by 3-4 fishermen with an average of 50 gillnets of 5 inches (127 mm), 90 m length and 4 m deep.

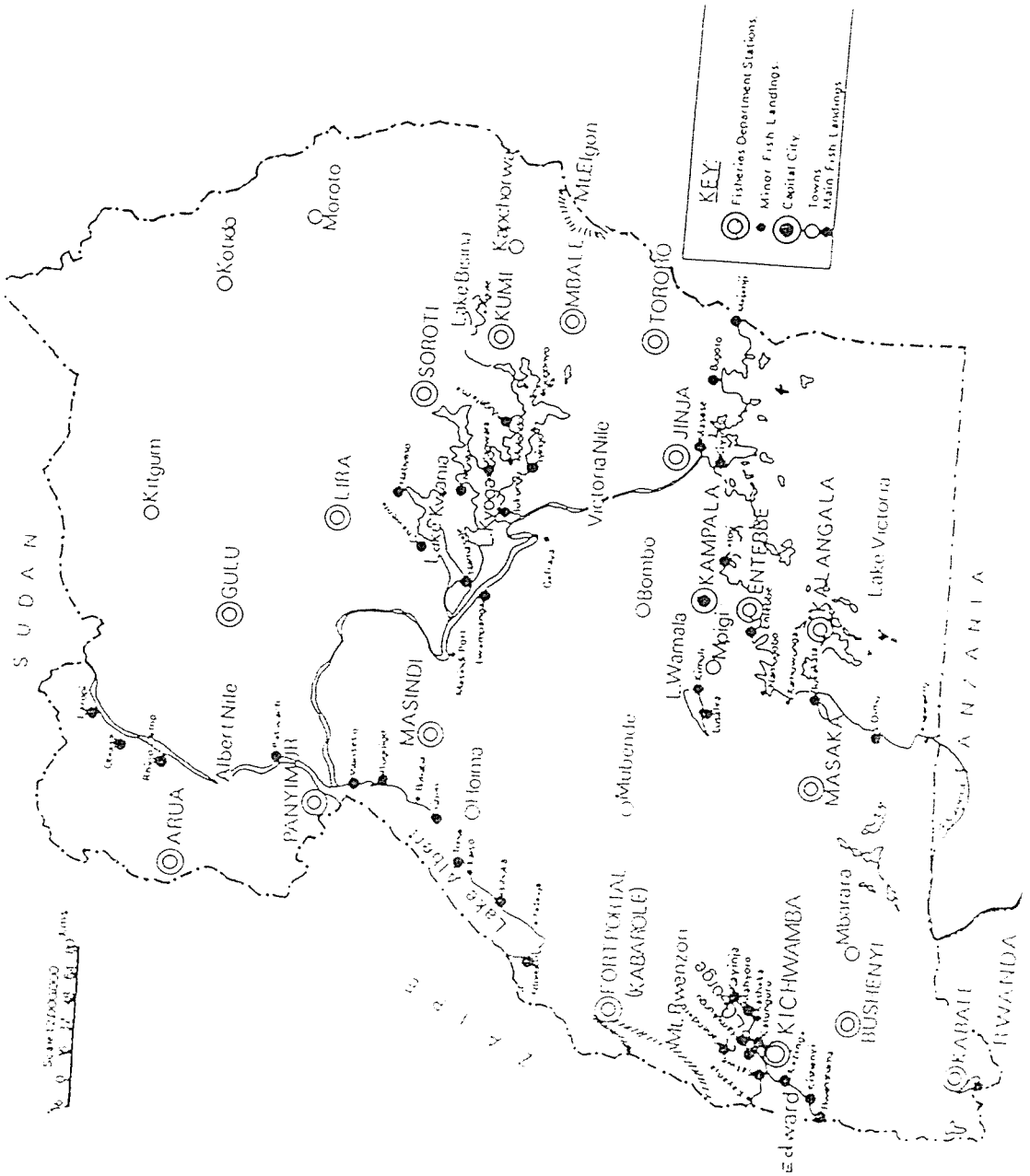
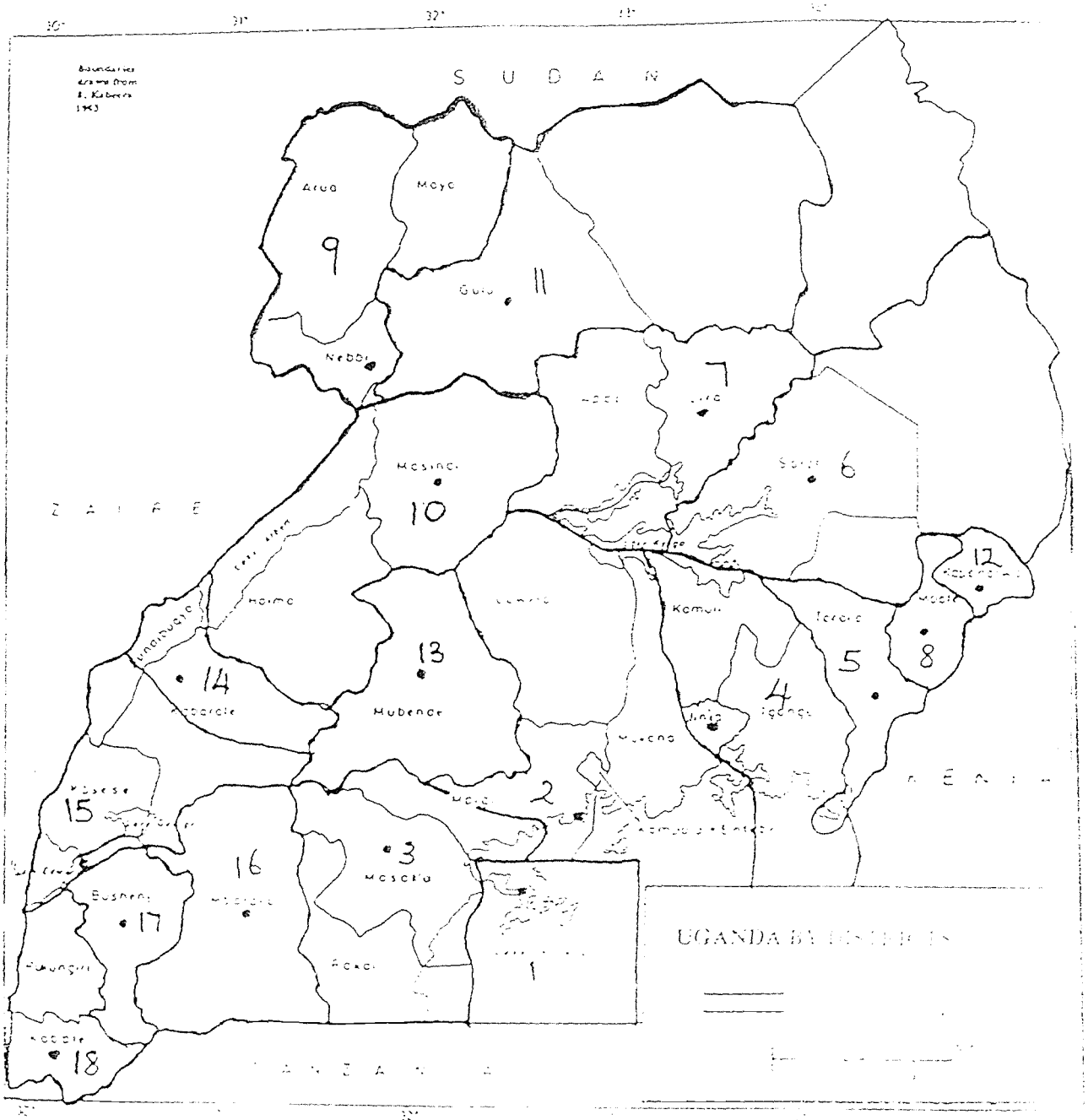


Figure 1 : General Map of Uganda



1. Kalangala
2. Lake Victoria East
3. Masaka
4. Jinja
5. Tororo
6. Soroti
7. Lira
8. Mbale
9. Moyo
10. Masindi
11. Gulu
12. Kapchorwa
13. Mityana
14. Port Portal
15. Kisoro
16. Mbarara
17. Bushenyi
18. Kabale

Fig. 2 : Map showing Uganda Districts

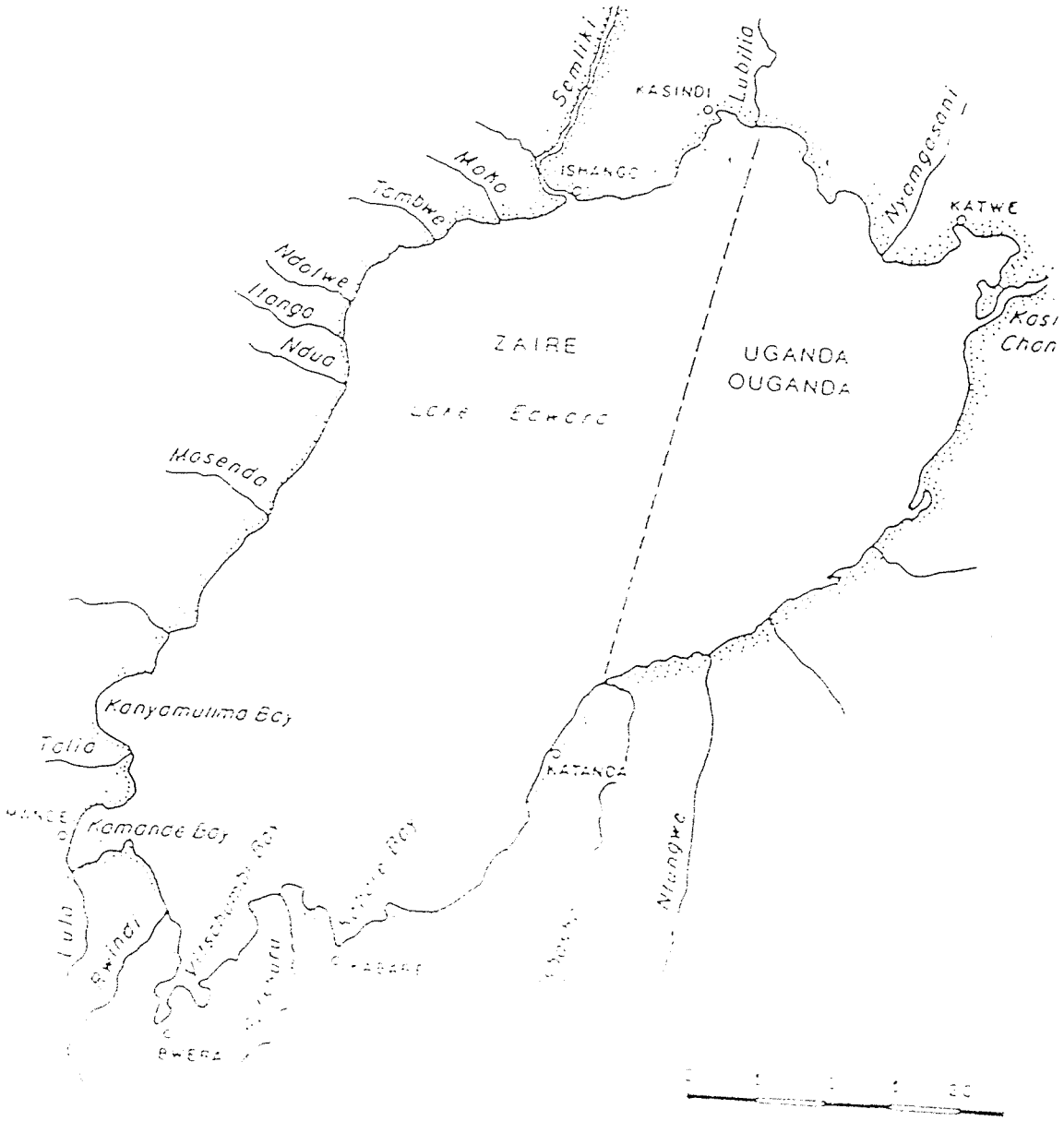


Fig. 3 : Map of Lake Edward

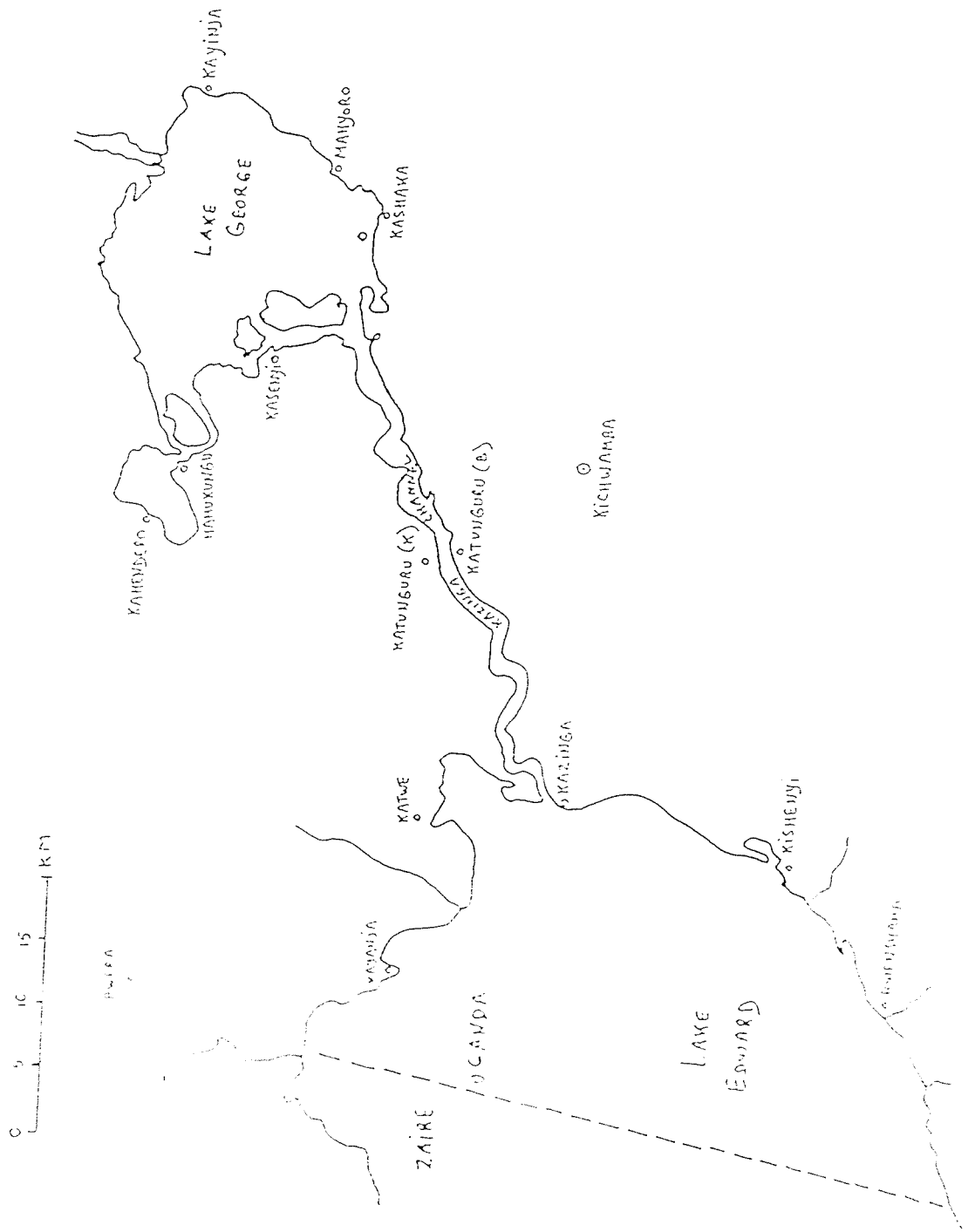


Fig. 4 : Map of Lakes Edward and George

The fishermen also use longlines with hooks of mainly size N°7, targeted towards Clarias, Protopterus and Bagrus with Haplochromis as baits. 2/3 of the money from the fish sold per day goes to the boatowner and the remaining 1/3 is divided between the 3 or 4 fishermen manning the boat.

2.1.3 Handling and processing

The fish is landed around 9-10 a.m. and the fishermen sort out the catch by size and species. The daily catch is recorded by the Fisheries Assistant stationed at the landing site prior to the sale of fish by the fishermen to the traders. The Fisheries Assistant records the number and type of gear, boat serial number, the different species and their weight. The weighing is done with a scale of 100 kg. The recorded data is sent to the Statistical Unit of the Fisheries Department (Entebbe). After the recording of the catches by the Fisheries Assistant, the fishermen sell their catch to the fish traders, the majority of whom are women. Almost all fish landed are sold fresh and transported mainly to markets in Bwera, Kasese and to Zaire on pick-ups and bicycles.

2.1.4 Catch

TABLE 1: Catch for Katwe landing in 1988, 1989 (in tons)
(note of the project FAO/UNDP/UGA/87/007)

Year	Oreochromis	Bagrus	Clarias	Protopterus	Total
1988	428.51	250.50	47.00	63.30	806.70
1989	428.66	328.37	21.33	56.88	837.24

According to the table above, the average catch/boat (42 active) per species for the year 1989 was as follows:

- Oreochromis: 10.21 tons
- Bagrus: 7.82 tons
- Clarias: 0.51 tons
- Protopterus: 1.35 tons

According to the above records, it is calculated that the catch for the year 1989 consisted of Oreochromis (51.2 %), Bagrus (39.2 %), Protopterus (6.8 %) and Clarias (2.5 %) (see Annex 2); and the approximate catch per boat per year was about 19.9 tons (or 1.6 tons per month).

2.1.5 Financial assistance

The fishermen benefited from loans from the Uganda Commercial Bank under the "Rural Farmers Loan Scheme". This loan attracts an interest of 40 percent and is repayable in 6 months. The penalty for defaulters is the confiscation of their materials: engines, nets, etc ... by the Bank.

2.1.6 Beach prices

The cost price of fish caught in gillnet of 5 inches (127 mm) was as follows:

- Oreochromis:shs 120 (25 cm) or about shs 360/- per kg;
- Bagrus: shs 2,000 (10 kg) or about shs 200/- per kg;
- Clarias: shs 250 /- per kg;
- Protopterus: shs 300 /- per kilogram.

Expected investment cost of a fishing unit in Uganda shillings:

- 1 boat of 28 feet (8.54 m)	200,000
- 1 engine of 6 hp	300,000
- 1 engine of 15 hp	650,000
- 1 net on the local market (with life-span: 4 months)	3,000

TABLE 2: Estimated monthly income per boat in 1989:

Species	Kilogram	Price Ushs.
Oreochromis	850	306,000
Bagrus	651	130,200
Clarias	42	10,500
Protopterus	112	33,600
	1655	480,300

Note: This is 99.7% of the total catch where the total catch earns Ushs. 481,750/= per boat.

As seen from the table above, the total monthly income for the year 1989 on average is 481,750 Uganda shillings per boat, 2/3 of this income is for the boatowner (321,000 Uganda shillings/month or shs 3,854,000 per year). The remaining three fishermen have to share 160,500 Uga. shillings from the total income of the fishing unit per month. This means that each fisherman gets approximately 53,530 Uga. shillings per month or shs 642,300 per year.

Estimated costs of fishing equipment, gear, etc.. in Uganda shillings:

Total sales from fish catch	5,781,000
less fixed costs/year	
- boat (8.54 m), depreciation 4 years	50,000

- engine of 6 hp., depreciation 3 years	100,000	
- licence	500	
- income tax	40,000	
		-190,500
less operating costs		
. 50 nets*3 (life-span of 4 months)	450,000	
. Petrol (7 litres/day @ Ushs. 250/litre	638,750	
. Miscellaneous (repairs ...)	40,000	
		-1,128,750
less crew shares		-1,927,000
NET REVENUE		2,534,750

In conclusion, to get a fishing unit, the boatowner has to save at least 1,319,250 Uganda. shillings per year or 109,940 Uganda. shillings per month. It should be noted that **40 %** interest was added for the items received on loan from the bank. On this basis a boatowner can save 2,534,750 per year or 211,300 Uganda. shillings per month.

2.3 Katunguru (B) fish landing

2.3.1 Landing situation (see Figure 4)

Katunguru (B) is situated between Lake George and Lake Edward on Bushenyi District side. There are 30 non-motorized canoes at this landing site and the fishermen have formed themselves into a cooperative. The fishing canoes are either owned individually or in partnership: 23 canoes are individually owned, 7 canoes are shared.

2.3.2 Fishing techniques

The fishermen use gillnets of mesh sizes 5" (127 mm), 90 m long and 26 mesh sizes deep. Others use 4.5" (114 mm) mesh size. They carry an average of 30-40 nets per canoe. They also use longliners (averaging 400 hooks of No.8 per line) for species like Protopterus and Clarias with Haplochromis and small Oreochromis as baits. They fish only in the Channel as the Channel banks are part of the National Parks and fishermen are forbidden to land there.

2.3.3 Handling and processing

The fishermen fish all night and they return around eleven o'clock in the morning. The enumerator counts the number of fish per species because at this landing site there is no weighing scale. Traders,(both men and women) come to buy the fish after recording is completed. There is no constraint in marketing the catches because of the high demand for fish. All the catches are sold fresh. Much of the fish bought by the traders is transported fresh to markets at Katunguru and Kasese.

2.2.4 Catch

TABLE 3 : Catch for Katunguru (B) in 1988, 1989 (in tons)
(based on project FAO/UNDP/UGA/87/007)

Year	Oreochromis	Bagrus	Clarias	Protopterus	Total
1988	57.70	42.20	30.10	61.10	198.30
1989	88.14	18.57	15.63	22.54	147.02

For the year 1989, the catch magnitudes have been in the order of: Oreochromis (59.9 %), Protopterus (15.3 %), Bagrus (12.6 %), and Clarias (10.6 %) (see Table 3). Usually, the best fishing period is from March to June and October to December. During the mission, the average catch per day per canoe (30) was: 30 Oreochromis, 10 Protopterus, 20 Bagrus and 10 Clarias. The average weight was 2.0 kg for the Bagrus, 3.5 kg for the Protopterus, 3.0 kg for the Clarias and 0.4 kg for the Oreochromis. The estimated average catch per canoe per year is 4.9 tons or 410 kg per month and the average catch/canoe for the year 1989 per species was as follows:

- Oreochromis: 2.95 tons;
- Bagrus: 0.62 tons;
- Clarias: 0.53 tons;
- Protopterus: 0.76 tons.

2.2.5 Financial assistance

The cooperative at Katunguru constructs boats which can be sold to its members on a hire purchase basis. The boats can be sold to a fisherman on hire purchase by the cooperative. Ushs. 20 000 is paid in instalments for 5 months. The cooperative also guarantees its members at the Uganda Commercial Bank for loans obtained through Rural Farmers Loan Scheme. The cooperative pays the balance of money defaulted by its members at the Bank. All members of the cooperative have to pay Ushs. 2= (two) in fish value.

2.2.6 Beach prices

At the moment, the price of fish is as follows:

- Oreochromis: 4 inches (101 mm) shs 100 per fish;
- Oreochromis: 5 inches (127 mm) shs 150 per fish;
- Bagrus: 5 inches (127 mm) shs 100 per kg;
- Protopterus: 5 inches (127 mm) shs 100 per kg;
- Clarias: 5 inches (127 mm) shs 100 per kg.

Expected costs of a fishing unit in Uganda shilling:

- 1 net (from the Bank): 6,500
- 1 canoe: 100,000

TABLE 4: Estimated monthly income per boat in 1989 based on the project UNDP/FAO UGA/87/007

Species	kilogram	number of fish	Price Ushs.
Oreochromis	247.0	618	77,250
Bagrus	51.6	26	51,600
Clarias	43.5	15	43,500
Protopterus	62.6	18	18,600
Total	677 for 190,950/= (98.4% of the total catch) or 94,000 for the total catch i.e. 100 %		

According to the above table, the monthly income per boat (30) is on average Ushs.194,000/= which is shared. Of this, the boatowner takes 2/3: i.e. Ushs.129,300/=. or Ushs. 1,552,000/= per year (1989). Each of the two other fishermen receive Ushs. 32,300/= per month or the equivalent of Ushs. 387,600/= per year.

Estimated costs of fishing equipment, gear, etc... in Uganda shillings:

Total sales from fish catch		2,328,000
less fixed costs (per year)		
- canoe (depreciation: 2 years)	50,000	
- licence	1,000	
- income tax	40,000	
		-91,000
less operating costs		
. 30 nets (life-span of 6 months)	390,000	
. Cooperative (Ushs.2/=/fish)	16,250	
. miscellaneous (repairs ...)	4,000	
		-410,250
less crew shares		-776,000
NET REVENUE		1,040,750

The above calculation is for the cost of an owner's fishing unit. However fishermen who get a loan from the Bank have to be given the equivalent of Ushs.461,250/= per year or Ushs.38,417/= per month plus 40% of the interest on the loan. As already shown at this landing, an owner of a canoe saved 1,040,750 or Ushs.86,700/= per month (1989).

2.3 Katunguru (K) Fish Landing (see Figure 4)

It is exactly the same as Katunguru (B), the only difference is that there are 14 fishing canoes and 2 motorized boats for water transport. As the two landings are just opposite on the Channel the prices of fish are the same for both landing B and K.

2.4 Kasenyi Fish Landing (Lake George)

2.4.1 Landing situation (see Figure 4)

Kasenyi is located on the south-western side of Lake George. There are 36 registered canoes, 10 of which belonged to the old company "Tufmac" (The Uganda Fish Marketing Company).

2.4.2 Fishing techniques

There are 26 fishing boats with an average of two crew. Each boat, on average operates 20 nets of 5" (127 mm) mesh, 90 m length and 26 meshes deep. The fishermen set their nets in the lake in the evening and leave them overnight. However some of the fishermen stay over night to guard their nets against theft. The nets are lifted early in the morning and fish is landed around 10 a.m.

2.4.3 Handling and processing

After landing, the fish is transported to the processing shed provided, to be gutted, cleaned and subsequently smoked. About 70 percent of the daily fish landed in Kasenyi is smoked. This is because the village is isolated and there is only one pick-up per week which calls at Kasenyi with traders to buy the smoked fish. The remaining 30% is consumed by the community. The salted fish is mainly destined for Zaire via the border market at Bwera.

2.4.4 Catch

TABLE 5: Catch for Kasenyi landing in 1988, 1989 (tons)
(based on the project FAO/UNDP/UGA/87/007)

Year	Oreochromis	Bagrus	Clarias	Protopterus	Total
1988	59.35	142.47	6.33	111.60	320.6
1989	198.35	81.58	7.32	43.67	330.9

For for the year 1989, the catches were as follows: Oreochromis (59.9 %), Bagrus (24.6 %), Protopterus (13.2 %) and a small number of Clarias (2.2 %). There has been a decrease in catches for the past 20 years. In 1970, one net cost Ushs.11/= against Ushs.8,000/= in 1990 and the fish was sold at 30-50 cents which today sells at about 100-150 shillings. At present they need 64 fish to repay one net whilst in the past they needed only 22 fish to repay one net i.e. the price of a net has almost tripled. The fishermen's catches further declined with the lifting of the ban on protected fishing at Kayinga reproduction site by the government. In 1989, the catch per each of the 26 canoes per year was approximately 12.7 tons or 1 ton per month. According to the table above, the average catch per boat for 1989 per species was as follows:

- Oreochromis: 7.63 tons;
- Bagrus: 3.14 tons;
- Clarias: 0.28 tons;
- Protopterus: 1.68 tons.

2.4.5 Financial assistance

The fishermen also benefit from loans provided by the Uganda Commercial Bank at Kasese under the Rural Farmers Loan Scheme.

3. LAKE ALBERT - KABALORE/BUNDIBUGYO (FORT PORTAL) REGION

3.1 Introduction

The appearance of the water of Lake Albert signifies that the lake is rich in phytoplankton because of its green colour in the area of Semliki River. This also reflects that this lake is somewhat productive as indicated by the catches of fishermen.

3.2 Landing situation (see Figure 5)

There are 9 fish landing sites in Fort Portal Region which are administered by the Regional Fisheries Officer. These are Ntoroko-Kanara, Katolingo, Mulango, Rukwanzi, Kamuga, Rwangara, Songa-Kiyanga, Kamoga and Katanga (see map). Ntoroko village is isolated: it takes more than 3 hours to reach the landing from Fort Portal by car when conditions are good. Ntoroko is one of the largest villages along the southern sector of the lake with a population of about 3,000 people. There is a lot of fishing and processing activities going on in the village. There is no record of the actual number of boats operating at the landing, but during the mission, it was reported that there are about 100 boats, 23 of which are used for transport, and only 3 of them are motorized.

3.3 Fishing techniques

The fishing craft is a rudimentary planked boat with a flat-bottom which is very heavy, slow and difficult to operate. However, the boat has the advantage of being cheap and easy to construct. Because of the high cost of petrol and of spare parts which are not easily available in the area the boats on the southern sector of the lake are not motorized. The fishermen use nets of only 2" for Alestes, Synodontis, Hydrocynus and 4" (101 mm), 4.5" (127 mm) mesh for Oreochromis, Lates, Barbus or for Clarias and Auchenoglanis.

Since 1988, the beach seines have been confiscated. At this landing there is no practice of long line fishing, except for Lates, but this is rare. There are 20 (twenty) boat owners who usually employ fishermen to operate their boats. A boat owner can own an average of 4 (four) boats, each operated by 3-4 fishermen. They fish mainly during the night and land their catches in the morning. The average number of nets per boat depends on the fishing techniques used. They can use 30-70 nets per boat which are set overnight or they can use only 2-3 nets per boat which are set for active fishing and are retrieved during the night.

3.4 Handling and processing

In Ntoroko handling and transportation to the processing sites are well organised. The fish are gutted, cleaned and then sun-dried or hot-smoked; about 600 (six hundred) Oreochromis are smoked each week. The storage period of a smoked fish is about 3 to 4 days. The fish traders, mostly men, come to Ntoroko from Kasese to buy fish at least once a week. About half of the traders buy fresh fish from the beach and process it themselves or they can buy processed fish at the landing site. The transport cost from Ntoroko to Bwera are Ushs.1250/= per bundle of 20 fish.

3.5 Catch

TABLE 6: Catch for Ntoroko landing in 1988, 1989 (in tons)
(based on the project FAO/UNDP/UGA/87/007)

Year	Oreochromis	Hydrocynus	Synodontis	Clarias	Total	Total catch
1988	65.23	111.23	68.12	37.55	282.13	677.87
1989	602.30	245.20	99.70	44.80	992.0	1,082.70

Fish production at Ntoroko 1989 of catch in percentage was as follows:

- Oreochromis: 55.6 %;
- Hydrocynus: 22.6 %;
- Synodontis: 9.2 %;
- Clarias: 4.1 %;
- Bagrus: 3.3 %;
- Lates: 3.1%;
- Labeo, Alestes, Protopterus and Polypterus: 2.1 %.

According to the above records, it can be seen that the average catch per each of the 77 active boats for the year 1989 was 14.1 tons or the equivalent of 1.2 tons per month. The estimated average catch per species per boat, for the year 1989 was as follows:

- Oreochromis: 7.82 tons;
- Hydrocynus: 3.18 tons;
- Synodontis: 1.29 tons;
- Clarias: 0.58 tons;
- Bagrus: 0.47 tons;
- Lates: 0.44 tons.

Note that 80% of the catch consists of Oreochromis. The majority of the total catch was exported to Zaire according to reports.

3.6 Financial assistance

The fishermen of Ntoroko can benefit under the same conditions as the other landing sites from loans provided by the Uganda Commercial Bank.

3.7 Beach prices

At present, the price of Oreochromis from 5 inches or 127 mm mesh size nets is Ushs 50-60 each or Ushs 100/= for one kg., 15 shillings for Synodontis, 500 shillings for a Clarias of 40 cm or 200 Uganda shillings per kg., and 80 Uganda shillings for one kg. of Hydrocynus. Polypterus is not sold and is discarded.

On average one Oreochromis from 114 mm or 4.5 inches mesh size nets is sold at:

Ushs.25/=	fresh	at Ntoroko;
Ushs.45/=	smoked	at Fort Portal;

Note: 4 fish weigh 1 kg.

Ushs.150/=	salted/kg.	at Ntoroko;
Ushs.520/=	salted/kg.	at Bwera market (i.e. shs 120 /- per fish).

Considering the vast difference between the processed fish price at the landing and the price at Bwera market it is more profitable for the fisherman to sell his processed fish so that he can generate an extra Ushs.100/= for

every kilo of fish sold. It would be better for the fishermen to have their own organisation to market their products.

There are 5 private boat builders at the landing site which make canoes for both the Ugandan and Zairian market. A fishing boat of 5 m costs Ushs.90,000/= and a transport boat of 8 m costs Ushs.500,000/=

TABLE 7: Estimated monthly income per boat at Ntoroko in 1989:

Species	kilogram	Price (Uganda shillings
Oreochromis	652	65,200
Hydrocynus	265	21,200
Glarias	48	9,600
	96,000 (82,3% of the total catch) or 116,000 for the total catch	

3.8 Estimated value of Fishing Equipment Materials and net Revenue of Proprietor (Uganda Shillings)

The estimated monthly income per boat for the year 1989 is Ushs.116,000/= or Ushs.1,392,000/=annually. Ntoroko a boat owner owns 4 (four) boats and employs 12 fishermen. The estimated income of a fishing unit is therefore Ushs.5,568,000/=. However, there is a difference between the share methods between the boatowner and the fishermen from different beaches: usually the boatowner gets 2/3 of the total catch. On this basis, according to the table above, the boat owner should have received shs 3,712,000 in 1989 and the remaining 12 fishermen should have shared shs 1,856,000 from the yearly total income. This means that each fisherman should have received 154,670 Uganda shillings for the same period or the equivalent of 12,890 Uganda shillings per month.

As shown in the paragraph on Fishing Techniques (3.2.2), the average net per boat depends on the fishing techniques. The first calculation concerns fishermen who use an average of 50 nets which are set overnight; the second one for fishermen using only 2-3 nets per boat but are set and retrieved in the same night. These nets have a shorter life-span because of their frequent use for active fishing.

(a) Analysis for the first fishing technique

	Shs
Total sales from fish catch	1,392,000
less fixed costs/year	
- 1 boat, depreciation of 3 years	30,000
- licence	1,000
- income tax	40,000

		-71,000
less operating costs		
- 50 nets (4,500 shs) *3 (duration 4 months)	675,000	
- Miscellaneous (repairs ...)	6,700	
		-681,700
less crew shares		-464,000
NET VALUE		175,300

(b) Analysis for the second fishing technique

Total sales from fish catch		**1,392,000**
less fixed costs/year		
- 1 boat, depreciation of 3 years	30,000	
- licence	1,000	
- income tax	40,000	
		-71,000
less operating costs		
- 2.5 nets (4,500 shs) *24 (duration 0.5 months)	270,000	
- Miscellaneous (repairs ...)	3,000	
		-273,000
less crew shares		-464,000
NET REVENUE		584,000

The highest investment cost for a fishing unit is the fishing net and it discourages the boatowner from buying more nets. In fact, at Ntoroko landing, people said that the best fishermen are those who use few nets. From the above calculation, it is estimated that, for 1989, a boatowner with 1 boat and good fishermen using 2-3 nets would have saved 584,000 Uganda shillings or Ushs 48,670/= per month, more than a boatowner whose fishermen use the first fishing technique. For the latter, his income would have been: 175,300 Uganda shillings or Ushs 14,610/= per month for the same period. The yearly cost of a fishing unit for the first fishing technique is estimated at about 752,700 Uganda shillings in comparison to 344,000 Uganda shillings for the second technique. However, both types of fishermen get almost the same income.

4. SUMMARY

TABLE: PROFITABILITY OF THE FISHERIES OF LAKES EDWARD AND ALBERT (1989)

Characteristics	Lake Edward		Lake Albert
	Katwe	Katunguru	Ntoroko
Catch (tons)	837.24	147.02	1,082.70
Catch/boat/year (T)	19.90	4.90	14.10
Sales 1989/boat	5,781,000	2,328,000	1,392,000
Fixed cost	190,500	51,000	71,000 (A)* 71,000 (B)*
Operating cost	1,128,750	410,250	681,700 (A) 273,000 (B)
Crew shares	1,927,000	776,000	464,000 (A) 464,000 (B)
NET REVENUE			
Revenue/fisherman	642,300	387,600	154,670 (A) 154,670 (B)
Net revenue boat owner	2,534,750	1,090,750	175,300 (A) 584,000 (B)
Average price Oreochromis (Ug shs per kg.)	360	150	100

(A) Average of 50 nets per boat
(B) Average of 2-3 nets per boat

This table gives a global picture of the profitability of the fisheries of Lakes Edward and Albert in the Uganda sector. However, these figures are estimates and in order to do a full cost benefit analysis, it needs a full economic study of the area concerned.

From the above table, it is evident that the annual fish production is greater in Lake Albert but the annual income per fisherman is less in comparison to Lake Edward. The reason is the problem of marketing on Ntoroko which makes prices for the same species (for example Oreochromis) less. However, some fishermen from Ntoroko prefer to process their fish and to sell it at Bwera market (near Katwe) for better prices.

In spite of the differences in income between the fishermen of the two lakes, the fishermen still earn an income which is almost in line with the national PCE per head.

5. CONCLUSION

In general there is a lot of fishing activity being carried out along the lake in the villages visited. However, the following are the major constraints to increase the catches and quantity of fish products:

a) lack of good access roads to some of the landing sites;

b) inadequate processing methods with a high degree of post-harvest losses. However, this is in spite of the Fish Processing Research Project which began its activities in October 1988 for fishing villages included in the Queen Elizabeth National Park and whose objectives are:

- development of a cost-effective fish processing method; and

- diffusion of better processing techniques.

c) lack of fuelwood for smoking;

d) lack of data on the amount of fish exported to Zaïre;

e) lack of data on the actual number of fishermen, boats, gears, etc.; and

f) credits with high interest rate (40%) from the Uganda Commercial Bank.

6. RECOMMENDATIONS

i) The construction of feeder roads to landing sites should be a priority in any future fisheries development project in the area. This will give traders access to markets all the year around;

ii) To improve present traditional processing methods especially smoking with the introduction of the Chorkor type smoker;

iii) To study the present fish marketing and distribution system in the area and make recommendations for possible improvements;

iv) To organise a frame survey which would be useful for any future development actions in the fisheries of this area;

v) To train extension workers whose objectives shall be to educate the communities, plan their activities with them such as in fishing techniques, community organisation, mechanics and family economy;

vi) To provide a consistent, reliable and competent outboard engine repair service to the fishermen in order to maintain and improve levels of trade and communications in the villages.

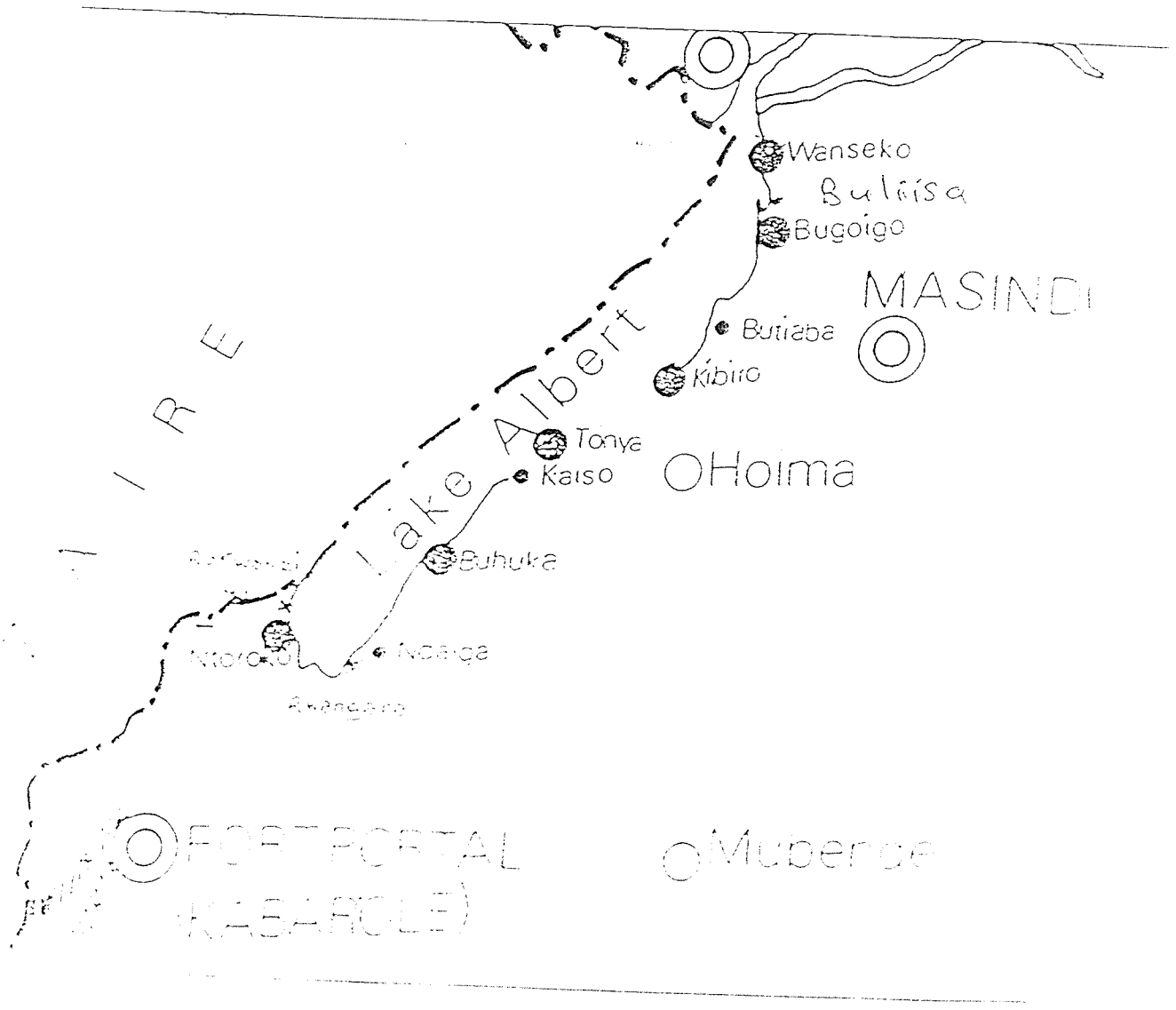


Fig. 5 : Map of Lake Albert

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