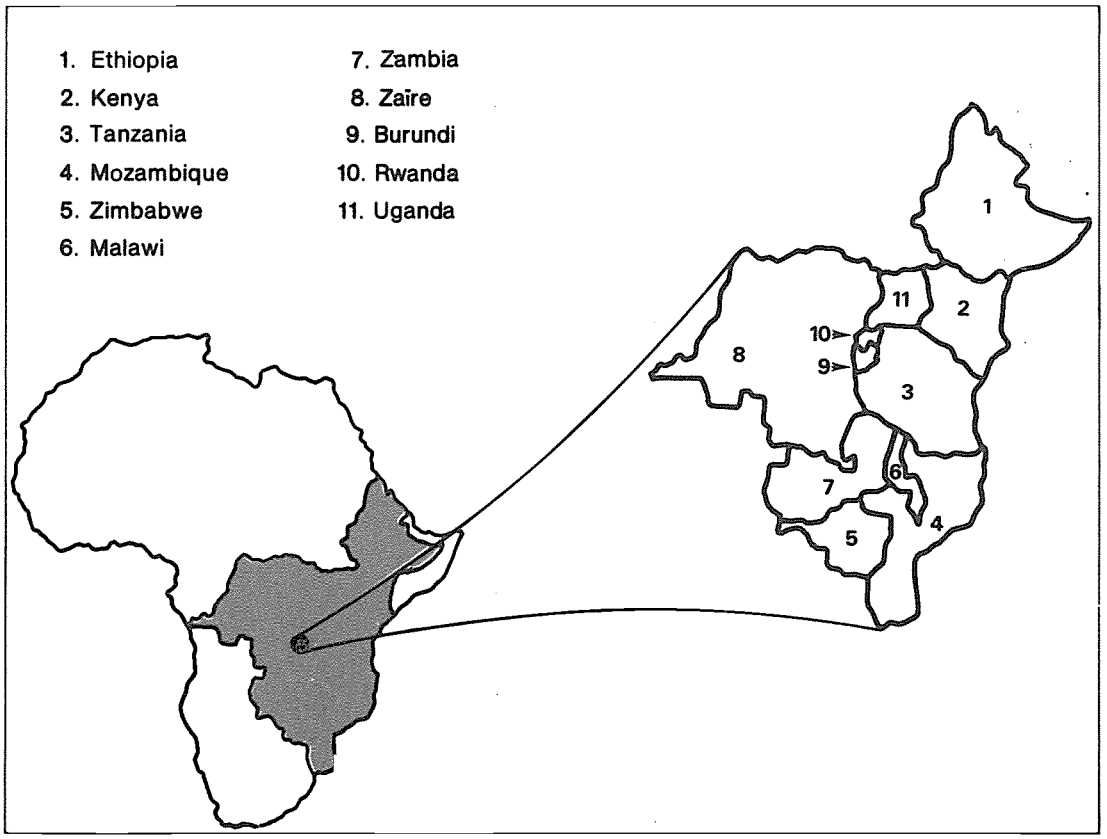
REGIONAL PROJECT FOR INLAND FISHERIES PLANNING, DEVELOPMENT AND MANAGEMENT IN EASTERN/CENTRAL/SOUTHERN AFRICA (I.F.I.P.)

IFIP PROJECT

RAF/87/099-TD/27/91 (EN) December 1991

Report of a National Seminar on the Development and Management of the Kenyan Fisheries of Lake Victoria - Kisumu, Kenya, 22 - 24 July 1991



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

RAF/87/099-TD/27/91 (EN)

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Report of a National Seminar on the Development and Management of the Kenyan Fisheries of Lake Victoria - Kisumu, Kenya, 22 - 24 July 1991

Edited
by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
UNITED NATIONS DEVELOPMENT PROGRAMME
Bujumbura, December 1991

The conclusions and recommendations given in this and other reports in the IFIP project series are those considered appropriate at the time of preparation. They may be modified in the light of further knowledge gained at subsequent stages of the Project. The designations employed and the presentation of material in this publication do not imply the expression of any opinion on the part of FAO or UNDP concerning the legal status of any country, territory, city or area, or concerning the determination of its frontiers or boundaries.

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

This report includes the final report and recommendations of a National Seminar on Development and Management of the Fisheries of the Kenya sector of Lake Victoria as well as the 8 working papers presented at the meeting. National Seminars on Lake Victoria fisheries, for the Riparian States, were recommended at the Fifth Session of the FAO Sub-Committee for the Development and Management of the Fisheries of Lake Victoria, held from 12 to 14 September 1989. The purpose of the national seminars was to discuss fishery development and management issues, options and strategies at national levels, and also to formulate Management Plans for the national sectors. The three national plans for the Riparian States will subsequently be incorporated into a unified regional plan for the entire lake. This work is being sponsored by the IFIP Project.

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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 (27), the year of publication (91) and the language in which the document is issued: English (En) or French (Fr).

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SUMMARY OF MAIN CONCLUSIONS AND RECOMMENDATIONS

FISHERIES STATISTICS

Considering the inadequate data on fishing boats, engines, gear and fishermen, the National Seminar recommended the following:

- Review of the system of data collection and methodology for estimating total landing; and
- Collaboration, harmonization and close supervision of data collection by the Fisheries Department and KMFRI.

STATUS OF STOCKS

Considering that the magnitudes of standing stocks of exploited species are unknown, it was recommended that a vigorous stock assessment survey programme be mounted to establish the biomass of Nile perch, dagaa/Omena, Nile tilapia and other species including the shrimp Caridina niloticus.

REGULATING FISHING ACTIVITIES

Gillnets :

It was recommended that the mesh size restriction of 88.9 - 127 mm gillnets targeted to tilapias be enforced. It was also recommended that for the Nile perch fishery, gillnets must have a mesh size greater than 127 mm.

Beach Seines :

Recognising the destructive effect of beach seines to spawning stocks, juveniles and breeding grounds (leading to poor recruitment), a total ban on beach seining was strongly recommended.

'Omena' Seines :

The National Seminar recommended that 10 mm mesh size nets be used provided that these nets are targeted at R. argentea and that they are operated at not less than two hundred meters from the nearest shoreline.

Trawling

Considering the incompatibility of trawling with gillnet fisheries, a total ban on trawling in kenyan waters of Lake Victoria was recommended.

Traps :

The participants recommended a total ban on the use of traps in rivers and rivers mouths.

ENVISAGED NEW FISHERIES

The National Seminar recommended the introduction of a new selective fishing method for exploiting the pelagic Rastrineobola (Omena) with lift-net by catamaran in offshore waters.

FISHERIES LEGISLATION/RESTRICTIONS

Noting that the present Fisheries Legislation and Restrictions are adequate, it was agreed that these provisions be implemented, enforced and regularly reviewed.

Closed Areas :

It was noted that the principle of closed area is applicable in some areas of Lake Victoria. It was therefore recommended that these areas be identified, specified and gazetted.

Closed Season :

The Working Group noted that good legal provisions exist for protecting the principle of closed season for catadromous fish species. It was, therefore, recommended that these provisions be strictly enforced.

MECHANISMS AND CHANNELS OF COMMUNICATIONS

In full agreement that there is no institutional interaction among researchers, fishermen and policy makers, it was strongly recommended that the institutions concerned (Fisheries Department, KMFRI, LBDA and Universities) take immediate initiatives to collaborate and ensure continuous and effective interaction among them.

INFRASTRUCTURE AND SERVICES

Village Fishing Facilities :

In view of inadequate infrastructure and facilities in fishing villages, it was strongly recommended that the required social amenities be provided to fishing communities.

Fishermen Cooperatives :

Noting that the organization and management of fishermen cooperatives are inadequate, the participants recommended urgent restructuring and strengthening of cooperatives with a view making them more efficient in dispensing services.

ENVIRONMENTAL PROTECTION

Pollution :

In view of pollution potential around Lake Victoria, it was recommended that KMFRI continue monitoring pollution levels in the lake and inflowing rivers as well as presence of pollutants in fish. This should be done in collaboration with other environmental protections agencies.

For the purposes of effective monitoring of pollutants, it was also recommended that an inventory of pollution sources be compiled and that the established safe levels of water quality be adhered to. In effect, there should be a strong public education in environmental protection.

Mbita Causeway :

In view of the general concern about the ecological effect of the Mbita Causeway on the ecosystem of the Gulf, the National Seminar recommended the collection of ecological data to assess and determine its effects to the ecosystem, which might necessitate its demolition and the subsequent construction of an appropriate bridge.

BUDGETARY PROVISIONS

Noting that the annual budgetary allocation to KMFRI, the Fisheries Department and LBDA are inadequate, the Working Group recommended that the Government makes significant financial increases to these institutions mainly involved with the day-to-day management of the productive fishery sector.

INTRODUCTION

The fisheries of Lake Victoria have undergone very substantial changes in recent years owing, in particular, to the proliferation of Nile perch since the late 1970's. While there has been some controversy over the impact of this species, the fisheries of Lake Victoria have become the main source of fish supply for the three Riparian States bordering the lake, and an important source of employment and revenue in the lake region.

The Fifth Session of the FAO CIFA Sub-Committee for the Development and Management of the Fisheries of Lake Victoria, held from 12 to 14 September 1989 at Mwanza, noted tremendous changes in Lake Victoria fisheries. It was, therefore, recommended that national seminars be organized to discuss management issues, options and strategies for the Riparian States.

Accordingly the UNDP/FAO Regional Fisheries Planning Project (IFIP) based at Bujumbura (Burundi) organized a national seminar for Kenya from 22 to 24 July 1991 at Kisumu. A national seminar for Uganda was held at Jinja from 6 to 8 August 1991; and a national seminar for Tanzania was organized at Mwanza from 15 to 17 October 1991. The three reports on these national seminars are to appear in separate IFIP technical document issues.

Regarding fish production, the total annual fish catch in the Kenyan sector of Lake Victoria was put at about 135000 t in 1989 and currently accounts for over 90% of the total national fish production. Fishing is mostly an artisanal activity involving about 30000 fishermen using about 7,000 planked canoes. The primary and secondary employment in the fisheries sector is estimated at about 120000 persons.

For the purpose of drawing up conclusions and recommendations, the National Seminar formed two working groups : (a) the Working Group for Development; and (b) the Working Group for Management. It should be noted that for a number of fishery issues, the recommendations of both Working Groups were similar.

This document includes the final report and all the recommendations of the National Seminar on Development and Management of the Fisheries of the Kenya sector of Lake Victoria as well as the eight working papers presented at the meeting.

REPORT OF A NATIONAL SEMINAR ON THE DEVELOPMENT AND MANAGEMENT OF THE KENYAN FISHERIES OF LAKE VICTORIA, HELD AT SUNSET HOTEL, KISUMU (KENYA) FROM 22 TO 24 JULY 1991

A. OPENING OF THE NATIONAL SEMINAR

1. A National Seminar on the Development and Management of the Fisheries of the Kenya sector of Lake Victoria was held from 22 - 24 July, 1991, at Sunset Hotel, Kisumu - Kenya.

2. The Seminar was attended by participants from the Fisheries Department, KMFRI (Kenya Marine Fisheries Research Institute), LBDA (Lake Basin Development Authority), National Universities and the Fishing Industry. A list of participants and observers is given in Appendix 1.

3. The Director of Fisheries welcomed participants to the National Seminar and thanked the UNDP/FAO Regional Fisheries Planning Project (IFIP) for assisting in sponsoring the Seminar.

4. On behalf of the Coordinator of the IFIP Project, Mr. Ssentongo stressed the importance of the seminar as a first step to the formulation of a management plan for the entire lake.

5. The Seminar on the Development and Management of Lake Victoria fisheries was opened by the Hon. Mr. Onyango Midika, Minister for Regional Development. The Hon. Minister welcomed the participants and emphasised the importance of the fisheries of the lake to Kenya. The Minister stressed that the principle objective of the Government for the fishing industry is to increase fish production and utilization on a sustainable basis. The Lake Victoria fishing industry plays a significant role to the national economy in the provision of food and employment. He added that it was mandatory to ensure that both exploitation and management practises maintain a balance between harvesting and conservation of renewable resources.

B. ADMINISTRATIVE ARRANGEMENTS

6. Mr. N. Odero, Director of Fisheries, chaired the National Seminar; Mr. G. Ssentongo served as Technical Secretary; Mr. Abuga Moire (Fisheries Department), Mr. Peter Ochumba (KMFRI), Mr. James Ogari (KMFRI), B. Wangila (Moi University), served as rapporteurs; and E. Mwakilenge (Fisheries Department), Mrs. N. Gitonga (Fisheries Dept.) and Mr. P. Mannini (IFIP Project) constituted the Secretariat. Dr. E. Okemwa (KMFRI) and Dr. K.M. Mavuti (University of Nairobi) were chairmen of the Working Groups on Development and Management respectively.

C. ADOPTION OF AGENDA AND ARRANGEMENT FOR THE SEMINAR

7. The annotated agenda and timetable shown in Appendix 2 was adopted.

D. SUMMARY OF PAPERS PRESENTED

8. The National Seminar considered and discussed the fisheries resources of the Lake Victoria on the basis of the paper presented (see Appendix 3.3). The paper highlighted the remarkable change from multi-species fishery prior to mid 1970s to three target species: Lates niloticus (Nile perch), Rastrineobola argentea (Dagaa) and Oreochromis niloticus (Nile tilapia). The Seminar noted that there was no reliable information on the magnitude and dynamics of the three target species.

9. An overview paper on the Development and Management issues for the Kenya Sector of the Lake, was given (see Appendix 3.2). Inspite of the importance of fisheries to Kenya, fisheries is still down-played in the national planning. It is therefore, necessary to make government aware of its actual contribution. Rational management should possibly involve fishermen to facilitate the implementation measures.

10. An examination of trends in fisheries development prospects and limitations was made (see Appendix 3.5). The paper highlighted the following limitations:

- inability to exploit open deep-water resources;
- absence of cold storage facilities at many landing sites;
- poor feeder roads particularly during the rainy seasons;
- lack of basic biological parameters on the three targeted and most abundant fish species; and
- the destructive effects of non-selective fishing gears such as the beach and mosquito seines.

11. The paper on linkages between research, fishing industry, policy making and implementation was considered (see Appendix 3.7). It was noted that interaction among researchers, fishermen, policy makers and planners was still inadequate.

12. A paper on management issues, options and strategies for Lake Victoria fisheries was presented (see Appendix 3.4). This paper highlighted the importance of adequate interactions among researchers, policy makers and the fishermen with a view to educating and convincing them on the value of rational resource management. The paper further stressed the importance of protecting breeding areas, cage culture and continuous monitoring of biological and socio-economic aspects of target species.

13. An overview of Lake Victoria fisheries was presented (see Appendix 3.1). It emphasized the potential pollution threats around the Lake particularly to the Nzoia River (by paper and sugar factories). The paper called for environmental research and continuous monitoring by KMFRI and other researchers.

14. Some socio-economic aspects of the Lake Victoria artisanal fisheries resources were considered (see Appendix 3.6). The paper analyzed among other things, the marketing system and the role of the middlemen in the fish distribution chain.

15. A paper on Kenya's Fisheries Legislation was presented (see Appendix 3.8). The paper reviewed the development of Fisheries Legislation from early independent Kenya to the present time. It focused on the present legislation instruments currently used in the development and management of fisheries.

16. Considering the diversity of fishery development and management aspects, the National Seminar was split into the following working groups:

    (a) fisheries development; and

    (b) fisheries management.

E. CONCLUSIONS AND RECOMMENDATIONS

E.1 FISHERIES DEVELOPMENT

17. After careful consideration of development issues, the Working Group on Fisheries Development made the following conclusions and recommendations.

Fishery Information Needed for Development

18. Recognising that the fisheries information base needed for development and management of fisheries is still inadequate, the working group recommended that all the national institutions concerned make concerted effort to resolve this problem.

i) Fisheries Statistics:

19. It was recommended that the collection, compilation and analysis of fisheries statistics be streamlined following the recommendations as indicated in the FAO/IFIP Report of the first workshop on Fisheries Statistics and Information Systems for Lake Victoria (RAF/87/099-TD/14/90).

ii) Biological Data:

20. The Working Group stressed the immediate need for assigning a team of scientists to the three major commercial species to facilitate the understanding of biotic and abiotic factors affecting these species.

iii) Socio-economic Data:

21. The need to collect information on fishing inputs for the fishermen and output from fishermen as well as socio-economic factors including distribution and marketing channels on a continuous basis was underscored.

Status of Stocks

22. Taking note of the fact that the current status of exploited stocks is relatively unknown, it was strongly recommended that stock assessment surveys be carried out periodically on the commercial target species.

Types of Fishing

i) Gillnets:

23. Noting that the current mesh size of gillnets are appropriate but aware of the changing nature of the fisheries, it was recommended that there must be periodic monitoring of the effect of various gillnets on the stocks through experimental fishing.

ii) Beach Seines:

24. Recognising the destructive effect of beach seines to spawning stocks, juveniles and breeding grounds (leading to poor recruitment), a total ban on beach seining was strongly recommended.

iii) 'Omena' Seines:

25. The working group recommended that 10mm mesh size nets be used provided that these nets are targeted at R. argentea and that they are operated at not less than two hundred meters from the nearest shoreline.

iv) Trawling

26. Considering the incompatibility of trawling with gillnet fisheries, a total ban on trawling in Kenyan waters of Lake Victoria was recommended.

Mechanisms and Channels of Communications

27. In full agreement that there is no institutional interaction among researchers, fishermen and policy makers, it was strongly recommended that the institutions concerned (Fisheries Department, KMFRI, LBDA and Universities) take immediate initiatives to collaborate and ensure continuous and effective interaction among them.

Village Fishing Facilities:

28. In view of inadequate infrastructure and facilities in fishing villages, it was strongly recommended that the required social amenities be provided to fishing communities.

Fishermen Cooperatives:

29. Noting that the organization and management of fishermen cooperatives are inadequate, the working group recommended urgent restructuring and strengthening of cooperatives with a view of making them more efficient in dispensing services.

Environmental Protection:

30. Considering pollution threats emanating from increasing urbanization, industrialization and agricultural practices around the lake, an urgent

need for integrated environmental impact assessment on pre- and post-development undertakings within the Lake Basin was strongly called for.

E.2. FISHERIES MANAGEMENT

31. The Working Group on fisheries management considered the management issues, strategies and options and made the following conclusions and recommendations.

Fishery Information Needed for Management

i) Fisheries Statistics

32. Considering the inadequate data on fishing boats, engines, gear, fishermen and their dependants, people involved in boat building and also information on net production, the Working Group recommended the following:

- Review of the system of data collection and methodology for estimating total landing; and
- Collaboration, harmonization and close supervision of data collection by the Fisheries Department and KMFRI.

ii) Biological Data

33. Noting the inadequacy of available biological data, the group recommended urgent improvement of the state of knowledge and more use of taxonomic guidelines by extension workers.

iii) Socio-economic Data:

34. In view of the inadequate socio-economic data, it was recommended that the collection of this information should be a continuous process and must cover new fishermen settlements and social amenities.

Status of Stocks:

35. Considering that the standing stocks of exploited species are unknown, it was recommended that a vigorous stock assessment survey programme be mounted to establish the biomass of Nile perch, dagaa/Omena, Nile tilapia and other species including the shrimp Caridina niloticus. This would require a seaworthy research vessel.

Types of Fishing

i) Gillnets:

36. The working group recommended the continued use of gillnets of mesh size 88.9 - 127mm for "tilapia" fishery; gillnets of mesh size greater than 127mm for the Nile perch fishery.

ii) Long Lines :

37. In view of the high selectivity of long lines, it was recommended that their use be enhanced.

iii) Beach Seines:

38. Aware of the destructive effects of beach seines, the Working Group recommended their total ban in the Kenya waters of Lake Victoria.

iv) 'Omena' Seines:

39. As stipulated in the provisions for the Fisheries Act, 1989, seining for 'Omena' should not be done within 200 meters of the shoreline. It was recommended that this provision should be strictly implemented.

v) Trawling:

40. The Working Group recommended a ban on the use of trawls in the Kenyan waters of Lake Victoria.

vi) Traps:

41. The working group recommended a total ban on the use of traps in rivers and river mouths.

Envisaged New Fisheries

42. The working group recommended the introduction of a new selective fishing method for exploiting the pelagic Rastrineobola (Omena) with lift-net by catamaran in offshore waters.

43. Mechanisms and Channels of Communication

Recognising the fact that the mechanisms and channels of communication between various fisheries institutions, researchers at national and regional levels are ineffective, it was strongly recommended that immediate collaboration and coordination be established to bridge the gap.

44. It was also recommended that a coordinating body 'Fisheries Annual Review Committee' composed of Fisheries Department, KMFRI, LBDA, MOCD and local universities be formed under the chairman of the Director of Fisheries to review and evaluate research findings, and management policies.

45. The working group stressed the need to circulate research publications widely.

Fishing and Fish Marketing Strategies

46. Considering the lack of adequate infrastructure and social services in fishing settlements, the Working Group recommended the provision and improvement of infrastructural facilities which includes; access roads, cold storage, power and clean water supply in major landing beaches.

47. It was also recommended that credit facilities to the fishing industry be established.

Fisheries Legislation/Restrictions

48. Noting that the present Fisheries Legislation and restrictions are adequate, it was agreed that these provisions be implemented and enforced and regularly reviewed.

Closed Areas:

49. It was noted that the principle of closed area is applicable in some areas of Lake Victoria. It was therefore recommended that these areas be identified, specified and gazetted.

Closed Season:

50. The working group noted that good legal provisions exist for protecting of the principle of closed season for catadromous fish species. It was recommended that these provisions be strictly enforced.

Mesh Size Restriction:

51. It was recommended that the mesh size restriction of 88.9 - 127mm gillnets targeted to tilapias be enforced. It was also recommended that for the Nile perch fishery, gillnets must have a mesh size greater than 127mm.

52. The Working Group noted that surveillance and enforcement capabilities of the Fisheries Department were inadequate and recommended the enhancement of these measures.

Environmental Protection

53. In view of pollution potential around Lake Victoria, it was recommended that KMFRI continue monitoring pollution levels in the lake and inflowing rivers as well as presence of pollutants in fish. This should be done in collaboration with other 'Environmental Protection' Agencies.

54. For the purposes of effective monitoring of pollutants, it was also recommended that an inventory of pollution sources be compiled and that the established safe levels of water quality be adhered to. In effect, there should be a strong public education in environmental protection.

Mbita Causeway

55. In view of the general concern about the ecological effect of the Mbita Causeway on the ecosystem of the Gulf, the working group recommended the collection of ecological data to assess and determine its effects to the ecosystem, which might necessitate its demolition and the subsequent construction of an appropriate bridge.

Women in Fisheries Development

56. Considering the role of women in rural development, the Working Group recommended that women participation in the fisheries sector be encouraged and enhanced.

Training Needs

57. Recognising the fact that effective fisheries management cannot be realised without a strong extension service, it was recommended that short-term and in service training be accorded to extension officers and fishermen around the lake.

Budgetary Provisions

58. Noting that the annual budgetary allocations to KMFRI and the Fisheries Department and LBDA are inadequate, the Working Group recommended that the Government makes significant financial increases to these institutions mainly involved with the day-to-day management of the very productive fishery sector.

59. This report with all its recommendations was adopted by the participants of the National Seminar on the 24th July, 1991 at Kisumu (Kenya).

APPENDIX 1 : LIST OF PARTICIPANTS

Name of Participant	Organization/Institution	Address
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APPENDIX 2 : AGENDA AND TIMETABLE FOR THE SEMINAR

FORMAL ANNOUNCEMENT OF NATIONAL SEMINAR ON DEVELOPMENT AND MANAGEMENT OF THE FISHERIES OF THE KENYAN SECTOR OF LAKE VICTORIA AT KISUMU 22-24 JULY 1991

National seminars on Lake Victoria fisheries, for the Riparian States, were recommended at the Fifth Session of the FAO CIFA Sub-Committee for the Development and Management of the Fisheries of Lake Victoria, held from 12 to 14 September 1989.

The purpose of the national seminars is to discuss fishery development and management issues, options and strategies at national levels; and to formulate Management Plans for the national sectors. The three national plans for the Riparian States will subsequently be incorporated into a unified regional plan for the entire lake.

Accordingly, the UNDP/FAO Regional Fisheries Project based at Bujumbura (Burundi) plans to organize the national seminar for Kenya from 22-24 July 1991.

1. Host Institution : Fisheries Department, Ministry of Regional Development

2. Location : Sunset Hotel, Kisumu

3. Duration : 22-24 July 1991

4. Working Language : English

5. Provisional Agenda

Date	Time	Programme
Monday 22 July	09.30 - 10.00 hrs	Opening Ceremony
	10.00 - 10.30 hrs	Tea Break
	10.30 - 11.00 hrs	Administrative Arrangements
	11.00 - 12.30 hrs	Presentation and discussion of a paper on fishery resources of the lake
	12.30 - 14.00 hrs	Lunch Break
	14.00 - 15.00 hrs	Presentation and discussion of a paper on fisheries development and management issues for the kenyan sector of Lake Victoria

	15.00 - 16.00 hrs	Presentation and discussion of a paper on trends in development prospects and limitations
	16.00 - 16.30	Tea Break
	16.30 - 17.30 hrs	Presentation and discussion of a paper on Linkages between the fishing industry, Research, Policy making and Implementation
Tuesday 23 July	8.30 - 9.30 hrs	Presentation and discussion of the paper on Management Issues, Options and Strategies
	9.30 - 10.30 hrs	Presentation and discussion of a paper on existing fishery legislation and mechanism for control and surveillance
	10.30 - 11.00 hrs	Tea Break
Tuesday 23 July	11.00 - 12.30 hrs	Two working groups discussions and the framing of recommendations for the following fishery aspects:

(a) The working group on Management will consider resource management issues options and strategies, focusing attention on Nile perch and 'tilapias'. The group will particularly:

(i) examine carefully qualitative control of effort through mesh size, restrictions on types of boats and gear as well as closed areas and seasons

(ii) examine quantitative control of effort on number of fishermen, canals and different gears

(iii) propose concerted actions on harmonization of management measures, enforcement and surveillance

(b) The working group on Development will consider fishery development strategies for different fisheries. The group will specifically:

		(i) examine the possibility of switching the fishing effort to dagaa (Rastrineobola);
		(ii) discuss fishery products valorisation for both artisanal and semi-industrial fisheries as well as reduction of post-harvest loss; and
		(iii) propose options for revenue and income distribution
	14.00 - 16.00 hrs	Continuation of working group Discussions and drafting of resolutions and recommendations
	16.00 - 16.30 hrs	Afternoon tea break
	16.30 - 18.00 hrs	Presentations of resolutions and recommendations on management issues and subsequent discussions
Wednesday 24 July	8.30 - 10.00 hrs	Presentation of resolutions and recommendations on development issues and subsequent discussions
	10.00 - 10.30 hrs	Tea Break
	10.30 - 12.30 hrs	Drafting Committee and FAO Secretariat prepare summaries on papers, working groups and summary of major conclusions, resolutions and recommendations
	12.30 - 14.00 hrs	Lunch Break
	14.00 - 15.30 hrs	Drafting Committee and FAO Secretariat finalize report of summaries, resolutions and recommendations
	15.30 - 16.30 hrs	Adopting resolutions and recommendations on development and management strategies
	16.30 hrs	Closing ceremony

APPENDIX 3: WORKING PAPERS PRESENTED AT THE SEMINAR

Appendix 3.1: AN OVERVIEW OF LAKE VICTORIA FISHERIES - KENYA SECTOR

by
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INTRODUCTION

In this short paper we have attempted to review the fisheries of Lake Victoria in general, it is in no way intended to be a detailed and exhaustive paper on the industry in this area. However, it is expected that the views expressed herein will supplement those that will be provided by scientists from the department and other institutions participating in this Seminar namely the Lake Basin Development Authority and the KMFRI. It is also hoped that the views held in this paper will generate discussions and criticism from the audience which represent a good proportion of those involved in the fishing industry in this country.

Kenya portion of Lake Victoria which is generally referred to as the Nyanza (Winam) Gulf forms only 6% (4,100 Sq. Km) of the entire lake. It is a shallow bay that lies at an altitude of 1134 metres above sea level. The equatorial location of the Gulf enables it to experience a relatively constant climate regime throughout the year. The gulf is endowed with wide range of freshwater fish species, and according to records and information which have already been documented, it is evident that there are 13 families and 29 genera of fishes in Lake Victoria (Rabuor, 1990). The demersal biomass is dominated by Lates niloticus which belongs to the family Centropomidae whereas the pelagic biomass is dominated by Rastrineobola argentea.

The lake provides the main fish resources of a densely populated area where the four districts bordering the lake namely, Busia, Siaya, Kisumu and South Nyanza depend on it for provision of fish. The immediate hinterland fall within lakeshore savannah, characterised by low and unreliable rainfall and limited arable land. This environment hinders farming activities within this zone which is mainly at subsistence level, therefore dependence of the populace on fishing as a primary industry can easily be understood in this context.

Fishing is a very important occupation along the lake shore given that the immediate vicinity is not very productive especially when there is no adequate rainfall.

THE FISHERY

To subsidize the lake resources, fish farming in the unutilized marginal land and swampy areas is continuing to gain prominence. It is now a government policy to place emphasis in this sector of the development of the industry.

The present trend in Kenya waters indicate that the three species Oreochromis niloticus, Rastrineobola argentea and Lates niloticus, still dominate the fishing industry. According to the results of the catch and effort assessment survey conducted at 22 beaches (Rabuor, 1988), the fish landings were dominated by Lates niloticus 59.3%, R. argentea 36.52% and Oreochromis niloticus 2.43% and the rest of the species constituting 1.75% (i.e. 82.019 metric tons, 50.512 mt., and 3361 mt. and 2420 mt. respectively).
Although the three taxa dominate the catches presently, other species are showing an increase in catches in some landing beaches in the Nyanza Gulf. Their reappearance in Nyanza Gulf has been confirmed by bottom trawl survey carried out in 1988/89 (Ogari and Asila, 1990). Trawl catches indicate notable recoveries of fish species including Bagrus docmac Mormyrus kannume, Protopterus aethiopicus and some haplochromines. Lates has established itself in the lake. However, R. argentea and O. niloticus seem to co-exist or even flourish in the presence of lates (Arunga, 1981). Lates has shown a very sharp increase (from 1,599 metric tons in 1972 to 82,019 metric tons in 1988; Rastrineobola increased from negligible quantities in 1972 to 50512 metric tons in 1988. Except for Oreochromis niloticus, other species including Haplochromis have shown a decline (Rabuor, 1988). Reasons advanced for the decline in Haplochromis and other species include increased use of smaller mesh nets and predation of other species by Lates niloticus.

Apart from the reasons advanced for the decline in number and diversity of species, pollution must also be included as possible cause for the same. With increased industrialization and modern farming techniques where various chemicals are used as pesticides and for decease control, there is a high likelihood for our water systems to be polluted. The effluent from industries, together with these chemicals contain organic and inorganic compounds which may be lethal to fish.

A water system faced with threat of pollution is that of Nzoia River; it passes through agricultural areas whereas farm chemicals are in use. During the rains, some of these farm inputs are washed down by rain water and get access into the river. Industries along the river may also be a source of pollution, e.g. Webuye Paper Factory and the Mumias Sugar Factory both of whose effluent find their way into the river.

It is possible that the effluent not only alter river composition but, also fish behaviour. Effluent from Webuye Paper Factory may be altering the chemical and physical conditions of the water, thus causing biological pollution. Polluted waters resulting from effluent load are characterised by high temperatures, low pH, high turbidity, high BOD-, conditions which are all not suitable for fish survival.

Apart from Nzoia River, all rivers that feed the lake need also to be monitored with a view to correcting any anomalies that may create problems to the fishing industry. Once again, it is hoped that research in this important yet hidden field will yield results that will go along way in enhancing our knowledge on this very important yet relatively unknown area.

The ecological changes, in the gulf, as caused by construction of the Mbita causeway is already being felt and physical observations of the Mbita area and the habitat along the causeway tend to confirm the long-held belief by the majority of fishermen and people around the Lake region that the construction of Mbita causeway affected the ecology of the gulf adversely.

There has been a decline, and in some cases an almost total disappearance of many of the endemic fish species of Lake Victoria. The Nile perch, Lates niloticus, is thought to have caused the reduction in the stocks of several species. But overfishing and competition between different species also appear to have contributed to this decline. Lates niloticus has also been associated with the decline in population of haplochromine cichlids which was abundant in the Lake before the Nile perch became established. Even without predation by Nile perch, it is common observation that the haplochromine cichlids could not have withstood heavy commercial exploitation if a trawl fishery had been established throughout the lake. The Nile perch fishery however, has become a very lucrative business which has attracted investors, this is exemplified in the springing up of fish processing industries based mainly on Nile perch throughout the country and mainly in urban centres. Additional fish markets around the interland are dominated by Lates niloticus, R. argentea and to a lesser extent Oreochromis niloticus. Lates niloticus undoubtedly, therefore provides a flourishing fishery in the Lake Victoria. In terms of foreign exchange generation, its contribution to the economy cannot be over-emphasized. The fishing industry in this area is now well known as an important economic entity and it is rapidly influencing economic development in this region.

There has been improvement in the management of Lake Victoria fisheries with introduction of new legislations. Such legislation would go a long way to achieve rational management and conservation measures if there could be regional harmonization. Same would facilitate the management of the lake as a unit. It is long overdue for our regional leaders to address themselves to this important issue that affects our resource.

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Appendix 3.2 : AN OVERVIEW ON FISHERIES DEVELOPMENT AND MANAGEMENT ISSUES FOR THE KENYA SECTOR OF LAKE VICTORIA

by

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1. Introduction

Fish production in the Kenyan sector of Lake Victoria (146,000 t) currently accounts for over 90% of the total national fish production. Fishing is mostly an artisanal activity involving about 30,000 fishermen using about 7,000 planked canoes. The use of outboard engines is limited. Most of the catch is marketed outside the lake area where the catch fetches high prices.

At present 30-40% of the total fish catch is consumed fresh. This is far less than the percentage observed in the 1970's due to increasing long-distance marketing of fresh Nile perch from Lake Victoria. The production of frozen fish is rapidly increasing for marketing in distant urban centres and for export.

Per caput consumption is about 7.5 kg/year. All the fishery resources are fully exploited and probably overexploited in the case of Lake Victoria. Therefore, there is now a need to introduce and apply effective management measures to prevent the eminent depletion of the fishery resources and to ensure that the rural fishermen continue to fish and earn money.

2. The Actual Fishery Situation in the Kenyan Sector of Lake Victoria

The indigenous Haplochromis (Furu/Nkeje), Bagrus, Clarias, Protopterus, anadromous fish species and endemic tilapias have declined in abundance and have been replaced by the introduced Nile perch, exotic Oreochromis niloticus and the indigenous pelagic Rastrineobola (Dagaa/Mukene).

Kenyan artisanal fisheries expanded rapidly in the late 1970's and early 1980's. The total annual catch rose from about 19,300 t in 1977 to about 60,900 t in 1982 and finally to about 146,000 t in 1989.

For the purpose of analyzing fishery trends and changes in abundance and species composition, three fishing areas are distinguished in Kenyan waters:

- Nyanza Gulf with a depth of 4 to 10 m which extends from Uyoma to Kisumu, Kendu and Homa Bays and Kasagunga. This area is almost depleted of Haplochromis. Commercial catches mainly consist of Lates, Oreochromis niloticus and Rastrineobola (Dagaa).

- The area extending from the Uganda/Kenya border to the mouth of the gulf around Rusinga and Mfangano islands within depths of 5 to 40 m.

This area has still some species like Bagrus and Clarias which are rarely seen inside the Nyanza Gulf. Additionally, experimental fishing in this area sometimes locates some haplochromines in small quantity (Ogari of KMFRI, per. comm).

- The third fishing area is the exposed southern sector of Kenya, from Mfangano to Karungu and Mohuru Bay. This small sector still has a number of the original species groups that inhabit deep waters (more than 40 m).

Exploratory fishing in the 1960's and 1970's revealed a high biomass of 700,000 - 800,000 t mainly consisting Haplochromis species. Thus the mean standing stock was then about 10.2 t/km^2 (or 102 kg/ha) and this would correspond to maximum sustainable yield (MSY of 3.6 t/km^2 or 36 kg/ha).

This mean annual catch from Lake Victoria for the period 1974 to 1986 was about 45,600 t corresponding to a commercial catch of 110 kg /ha. In 1986 Kenya reported a total catch of 103,160 t from its territorial waters and this is equivalent to about 250 kg/ha. If we discard the catch of the pelagic Rastrineobola (Dagaa), the annual catch estimate becomes 166 kg/ha. Is this type of productivity biologically feasible?

With the 1989 annual catch of 146,000 t and an estimated total number of canoes of 7,000 the cpue is about 20.9 t/canoe/year equivalent to 83 kg/canoe/day. But interviews with fishermen indicate the present catch rates to be almost a third of this magnitude. There is also evidence of overexploitation, illustrated by the decline in the average size of the Nile perch landed in the past three years. Research information also shows that most of the Nile perch landed are between 5 and 15 kg corresponding to between 60 and 90 cm (a size range at which Lates first matures).

All this information suggests that the Kenyan fisheries of Lake Victoria are either fully exploited or overexploited and that rational management is urgently needed to maintain at least the existing fleet and to preserve existing infrastructures used in processing, distribution and marketing.

3. Management Problems

There are some doubts regarding the sustainability of present fish catches and maintaining the income of artisanal and semi-industrial fishermen. This national seminar should give serious consideration to the following management needs:

(i) sufficient financial and manpower resources;

(ii) well ranked research priorities and adequate consultation between researchers and policy makers;

(iii) problems of disadvantaged artisanal fishermen ;

(iv) socio-economic factors affecting the fisheries;

(v) more equitable supply of fish products for export and local markets;

(vi) proper research-extension liaison and communicating research results to fishermen;

(vii) exchange of information between various fishery institutions; and

(viii) means for motivating scientists working in various fishery disciplines;

3.1 Understanding the fisheries environment of Lake Victoria

Knowledge of qualitative factors that have a bearing on fisheries management and development is essential. A good data base will be of little use to the planner and policy maker as long as he is not sufficiently familiar with the fisheries environment to be able to correctly interpret the data he has assembled.

Starting with the resource base, the planner must acquire at least a basic knowledge of elements that influence on cost and earnings. In this connection, he should gain a general acquaintance with determinants of stock abundance, climatic factors and migratory patterns affecting fish availability and fishing effort, distances from port facilities, density of fish schools, physical and chemical characteristics of the resources such as age, size, colour, appearance, taste, fat content, quality of flesh, boniness, feeding patterns (including dependence for food on other species of commercial significance, predation and instances of cannibalism).

For fisheries management purposes, the following aspects will require special attention:

(a) magnitude and behavioral characteristics (i.e. seasonal concentration, migratory patterns, of a given species stock biomass including intermingled multi-species);

(b) the way in which the stocks vary in response to natural (environmental) forces and to alternative levels of exploitation intensity, i.e fishing pressure;

(c) manner in which the exploitation of a particular stock interact with that of others in the same ecosystem;

(d) optimal catch rates size and density of biomass;

(e) effect of alternative allocations of access to a particular stock among competing user groups, on the total quantity harvested, the catch rate and the unit size (age of individuals of the species caught);

(f) possible trade-offs among total catches, catch rates, and catch stability;

(g) maximum yield (catch) from a biomass, i.e. for a stock in an ecosystem that is sustainable over time (MSY).

3.2 Types of Data Needed

The data to be collected and compiled could be classified according to whether, these data pertain to fishing input factors or fishing output factors:

(i) evaluating fishing input factors requires knowledge on: potential and actual catches as well as actual landings by species, geographical area, season and gear. Concerning material input , data is needed on size of fishing fleets, fishing gear and fishing ports; as well as processing and marketing facilities.

(ii) On the output side, the planner and policy maker must assemble data on quantities and sales prices, at the primary and at subsequent levels of distribution by species and product, and - where appropriate - quality characteristics. These data should be obtained separately for products for domestic and for export markets. Where possible, price information should refer to principal market destinations. To round out this part of the data-gathering exercise, the planner has to collect also information on the distribution and market infrastructures.

3.3 Linkage of Fisheries With Other Sectors of the National Economy

Two considerations the fisheries planner should never lose sight of are that: (a) development resources are scarce; and (b) both in factor and product markets, fisheries are in competition with other industries.

There can be rivalry in the exploitation of Nile perch, Rastrineobola, tilapiines, sport fisheries and pleasure boat sports. Development in other sectors of the national economy, may be beneficial to or damage fishing activities. The destruction of swamps, pollution of effluent rivers, and irrigation schemes might result in the interruption of nutrients in the lake, resulting in lower productivity and decreasing fish yields.

On the market side, fish is in direct competition with other animal protein foods such as poultry products. More indirectly in many countries, but most certainly in the least developed countries with very limited economic resources, fish will compete with other food items.

Problems likely to arise because of competition between fisheries and other sectors of the economy in input and/or output markets should be taken into account as risk factors in fisheries planning. At the same time, thought should be given to possible measures for strengthening the position of fisheries in competitive situations.

3.4 The legal framework for Controlling the fisheries

Planning is governed by a policy framework that comprises the following:

(i) all the laws, institutional arrangements, regulations and procedures governing the management and use of fishing resources; and

(ii) governmental activities that affect fisheries indirectly, e.g. those relating to taxation, industrial and fish trade development.

3.4.1 Fishing Regulations

Rational management of the fisheries of the Kenya sector of Lake Victoria should include restrictions on the following:

- fishing season;
- mesh size limits;
- periodic (daily, weekly, seasonal, annual) catch limits;
- closed or restricted areas; and
- restrictions on types of gear and vessels used; and
- restriction/limitation on entry (number of fishing canoes and gears).

3.4.2 Control on the alteration of physical features of the environment

Serious consideration should be given to the following measures:

- regulation of the flow (inlets and outlets);
- control of water levels;
- control of erosion and silting;
- barrier removal or erection or both
- fish screens;
- improvement of spawning grounds;
- construction of fish shelters; and
- improvement of habitat in the inlets or outlets.

3.4.3 Control on the alteration of the chemical features of the environment

The chemical nature of Lake Victoria waters should be maintained by control measures on pollution, salinity and fertilizers from agriculture areas.

3.4.4 Control against the alteration of the biological features of Lake Victoria

Conservation of the fishery resources of Lake Victoria can be attained by focusing attention on the following:

- control of aquatic plants and weeds;

- introduction of foods (plant and invertebrate);

- introduction of forage fish;

- control of disease and parasites;

- control of predation and competition; and

- population manipulation.

3.5 Effects of Overfishing the Stocks

Excessive effort may have several important economic consequences of which the most evident is the misallocation of resources generated by the use of excessive and unnecessary fishing effort to harvest a given amount of fish. The other important consequences are:

- forgone revenue from alternative uses of fishery resources

- over-capitalization when the fishery resources are limited;

- higher risk of fluctuations and vulnerability of exploited species particularly Nile perch and Dagaa;

- social and economic conflicts between various types of fisheries; and

- re-allocation of fishing effort and high costs for management.

3.6 The Need for a Reliable Fishery Data System

The Fisheries Department, KMFRI and LBDA should collaborate in establishing a reliable fishery data base for using in making management decisions.

In addition to obtaining information from KMFRI, LBDA and the statistics unit of the Fisheries Department, one can obtain data on the state of fisheries from the following sources:

(i) universities and other scientific institutions dealing with fishery problems directly or indirectly;

(ii) individual fishermen and fishing settlements chiefs;

(iii) fishermen's groups or organizations;

(iv) extension agents for fishery and associated industries;

(v) data from fishing licences of artisanal and semi-industrial vessels;

(vi) marketing organisations for local and export fish supply;

(vii) fish-processing plants and associated enterprises.

4. Management Measures and Options

In this view of the dynamic nature of the Lake Victoria fisheries, serious consideration should be given to the following measures:

(a) For effective fisheries management and enforcement it is very essential that there should be a strong political commitment on the part of the government to implement fisheries management measures and that this commitment is supported by appropriate legislation and adequate technical and financial resources.

(b) In formulating fisheries policies and management plans the Government should pay special attention to ensure that the related management measures are enforceable in practice, reasonable to the fishermen and cost-effective in implementation. The latter could in some instances be facilitated by measures, such as checking of fishing gear and catches on land or in port, which avoid costly enforcement on the lake.

(c) It is also essential that fishermen as well as other individuals who are directly or indirectly associated with the implementation of fisheries management measures (such as politicians at the national or local level, enforcement personnel, fisheries extension staff and the community at large) are made aware of the management rationale and the potential social and economic benefits to the country or riparian countries jointly exploiting the resource.

(d) To ensure effective fisheries management in widely scattered small-scale fisheries where direct enforcement is difficult or impracticable, governments should promote self-management by fishermen through education and extension, through the recognition and preservation of traditional management practices and by supporting the creation and functioning of fishermen's organizations.

(e) In cases where non-fisheries agencies such as defence and other law enforcement agencies are entrusted with fisheries management functions, the Government should ensure that the overall responsibility for fisheries law enforcement remains vested with the fisheries authorities, who are charged with administration of fisheries legislation and management programmes. Steps should also be taken to formalize arrangements for fishermen to take a role in ensuring compliance with the rules that are intended to protect and conserve exploited stocks.

(f) Information, knowledge and sound judgement used in decision-making must be based on available fishery data. However, data are no more than orderly representation of facts and unless processed, interpreted and communicated effectively, they do not represent information on which to base decision for effective management.

(g) Management entails a wide variety of activities depending on beneficiaries or users. It is essential that planning proceeds in a hierarchical way, describing information needs to meet the criteria of scope, relevance, timeliness, accuracy and precision. The development of fisheries from assessing stocks, catching, processing, distributing and marketing must be coordinated or there can be negative consequences, possibly irreversible ones, for the fish, fishermen and for the key national objectives of protein supply and employment for the rural poor.

(h) It must be emphasized that technical and financial aid to fishery sectors can be effective only in participatory mode. There is a fundamental lack of understanding, on part of managers, the nature and behaviour of Kenyan fishermen. It is hardly possible to manage for societal long-term needs when so little is known about the innate behaviour of the local fishermen. Understanding is a basis for effective communication. There is still a poor record of success in convincing fishermen of the value of management measures. Knowing more of the behaviour, perceptions, and desires of the fishermen could lead, or substantially contribute, to the elimination of this major gap in communication between the policy makers, the scientists and the fishermen as well as fish processors.

APPENDIX 3.3 : FISHERY RESOURCE BASE FOR THE KENYAN SECTOR OF LAKE VICTORIA

by

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1. INTRODUCTION

Fish yield in Lake Victoria has been rising over the past two decades, more so, steeply over the last decade with the target species shifting from Oreochromis esculentus towards Haplochromines, Bagrus docmac, Protopterus aethiopicus and Clarias gariepinus towards the most recent Lates niloticus, Oreochromis niloticus, Rastrineobola argentea and haplochromines.

Changes in the species composition have been influenced by an array of factors, namely: establishment of two out of the six introduced species (Nile perch and Nile tilapia), changing exploitation patterns of the fishery necessitated by the increase in population, disappearance and re-appearance of some fish species, political and socio-economic development of the riparian states, introduction of more complex fishing gear into the lake, interspecies competition and insatiable external market (export).

Prudent policies in management would assist in maintaining the high yields given the multispecies and multiple gear nature of Lake Victoria fisheries in order to maintain the high yields which appear to be declining.

2. BACKGROUND OF THE FISHERIES OF LAKE VICTORIA

Adoption of fishing gear in the lake has been rather fast and haphazard although in pace with the development of the fishing gear technology elsewhere. Most of the introductions have not been accompanied by adequate research to evaluate their suitability and viability.

During the second decade of this century, traditional methods of fishing were in practice (Graham, 1929). Majority of the nets used were made of papyrus leaves interwoven by the split stems of papyrus. With the advent of civilization, these were improved to flax gillnets which have been replaced by synthetic fibres in the recent past. Baskets and traps, though outmoded and less efficient are still in widespread use in shallower parts of the lake. Excellent catches have been obtained using these gear with very little effort (Kudhongania et al, 1988). Their catch, despite not being assessed are significant to the areas where they are effectively in use. Improvisation taking place are in line with the introductions and skills of the modern fishing gear. Ligtvoet (1988) reported construction of gillnets from loose

strings stripped out of old vehicle tyres. Sophisticated adaptations of the current technology which in turn generates excessive effort, together with malpractices by fishermen aimed at specified species and better catch have been some of the factors behind the declining trends of the traditionally cherished species of the lake.

Instability in the fishery observed from the beginning of this century has been blamed on the absence or inadequacy of management (Graham 1929; Garrod 1961; Welcomme 1969; McConnel 1975; Marten 1979 a, b; Benda 1979, 1980; Ssentongo 1975). Presence of Nile perch as a topmost piscivore aggravated the already existing problem culminating into fisheries scientists making veracious predictions based on transient trends. Endemic tilapiines declined because of overfishing from fishermen who lacked adequate facilities to exploit offshore fishing grounds. Preferred grounds happened to be the habitat and spawning grounds for Oreochromis esculentus and Oreochromis variabilis as well as the routes to spawning grounds for the potamodromous species (Labeo victorianus, Schilbe mystus, Barbus altianalis, Synodontis sp.) which are often fished at their critical stages.

Thriving haplochromines evaluated by the stock assessment groups (Kudhongania 1971,1974) were a direct result of the inability of the fishermen to move offshore where those trophic groups were colonizing (Witte and Oijen, 1990). Establishment of the Nile perch was a direct result of the abundant prey (haplochromines). It is not surprising that Rastrineobola argentea showed prominence after the decimation of their competitors (Zooplanktivorous haplochromines).

After the decline of the endemic tilapiines, fishing pressure was diverted to the potamodromous species because of their proximity to the fishermen using unmechanized boats. Adjustment of mesh sizes commensurate with the fishery of Nile perch (Ligtvoet, 1988) relaxed the fishing pressure on the potamodromous stocks and shallow water species, hence conserving the stocks. The shift resulted in continuous rise in Nile perch landings from 41319 metric tons in 1987 to 61210 metric tons in 1988 (Table 1). Landings of Nile perch have decreased to 56810 metric tonnes in 1989. Decreasing yield have been observed to correlate with the rarity of larger specimens of over 110 cm TL from trawl surveys (Table 7).

Gillnet and longline boats on realizing a decreasing yield of Nile perch moved to beaches outside the Nyanza Gulf in search of better catch. In the recent past, stimulation of labour for the beach seine and mosquito seine have been motivating entrepreneur fishermen to adopt seine fishery within the Gulf resulting into increase in the number of seine nets and a consequent increase in the seine net catches (Asila et al, 1990).

With fluctuations in the ecosystem and human activities around the lake, it is paramount that practicable and flexible pragmatic management strategies be adopted in conjunction with the other countries.

3. SOME ECOLOGICAL OBSERVATIONS ON FISH STOCKS

3.1 Lates niloticus

Nile perch has a lakewide distribution (Ogari, 1984) with highest concentration of more than 160 kg h^{-1} (6.58 tonnes km^{-2} in depth zones of 10m to 50m in the Nyanza Gulf. Some specimens have been collected from the adjoining rivers and pools of water in the floodplain (Ochumba and Manyala, 1989). Lates occurs demersally as well as in the pelagic zone. It is believed that its distribution is restricted to well oxygenated strata (more than 3 mg/L). Deep waters which have low oxygen show limited abundance from bottom trawling.

Nile perch is an opportunistic carnivore, feeding on the most abundant prey in the environment (Anon, 1988). Dominant prey items vary from one location of fishing to another but the major prey are Rastrineobola argentea, Caridina nilotica, Nile perch juveniles and Haplochromis sp. Ligtvoet and Mkumbo (1990) report that juvenile Lates (up to 4 cm TL) feeds on cyclopoid and calanoid copepods with diet changing to small Caridina for 3-10 cm TL onto insect larvae mainly chaoborus, chironomids and Odonata nymphs onto Caridina and small fish for specimens 40-70 cm TL. Ogari (1991) noted that the maximum prey Nile perch can eat up should be 30% of its body length. Fish of 133 cm TL was observed to have eaten two specimens of Oreochromis niloticus of 43 cm TL and 30 cm TL at one go around Kisumu Bay. In general, preference is given to smaller sizes of prey. Cannibalism amongst Lates predation accounts for about 19 per cent of all fish with food items (Asila and Ogari, 1988). Ligtvoet and Mkumbo (op cit) gives a simplified food web for Lates niloticus in Lake Victoria. Through cannibalism Nile perch exercises self restraint on her own population.

Mature fish are found through out the year in specific areas within the Nyanza Gulf (stations 38, 36, 6 and 34). (Fig. 1). The smallest mature Nile perch observed were a male of 37.4 cm TL and a female of 59.4cm TL in December 1990 and January 1991. Maturity ogives for Lates niloticus is given (fig. 3) for the most recent data (cf: Asila and Ogari, op. cit.; Ligtvoet and Mkumbo, op cit). Sex ratios of Lates are also reported (Table 7). The young of Nile perch are normally found intermingled with the adult, although at shallower depths (3-10m) the ratio of smaller fish to the adult is considerably higher than in deeper water (> 10m). Gonadosamatic index has not been calculated for Nile perch in Lake Victoria. Diseases of Nile perch have not been documented in Lake Victoria. Since the fry of Lates feed on zooplankton and on smaller fish of its progeny and other species, it competes favourably with Schilbe mystus, Clarias gariepinus, Bagrus docmac and Protopterus aethiopicus which were established piscivores in the lake, so it could be partially responsible for the low catches of these species in commercial landings through competing over the same food source. Currently Nile perch is the top predator amongst the fish species.

Growth parameters have been estimated for Lates (Asila and Ogari, op cit; Acere, 1985). Estimates for Nyanza Gulf were L_{00} = 205 cm and K = 0.19 per year. Length-weight was relatinship L_{00} is as follows:

$$W = 0.0000078\ L^{3.12}$$

Where W is in kg and L is in cm

3.2 Rastrineobola argentea

The small cyprinid endemic in Lake Victoria was regrouped by Wanink, (1989). It is pelagic and migrates within the water column regulated by the light intensity. Their vertical migration is associated with the presence of zooplankton which are photosensitive and traverse the water column. Greenwood (1966) suggested that Rastrineobola lives near the surface in inshore and coastal waters, although the growth of its fishery to cover open waters tend to contradict the hypothesis. Bottom trawl hauls within the Nyanza Gulf were observed to have highest catch rates between 10 am and 1 pm. Main fishing grounds are spread within and outside the Nyanza Gulf. Wanink (op. cit) suggested that the distribution of Rastrineobola is influenced by the dissolved oxygen in the water column, light penetration, food abundance, interspecific and intraspecific competition, predation by Nile perch and parasitization. The study also proposes that the distribution of juveniles of Rastrineobola opposes the distribution of the adult fish.

Food of Rastrineobola has been reported to comprise mostly of copepods (more of cyclopoid) and cladocerans to a lesser degree. Rotifera and diatoms (Graham, 1929; Corbet, 1961; Greenwood, 1966). Further Chaoborus might be taken when they emerge in large numbers. Amount of food consumed by Rastrineobola has not been calculated nor has the amount of food available to it.

Rastrineobola forms the main food of Nile perch in the Nyanza Gulf around Kisumu Bay, and at stations 30, 31, 36 and 38 (Fig. 1). Spawning period has not been reported for Kenya waters of Lake Victoria, though as for other pelagic species is assumed to be continuous. Highest number of ripe and running individuals were recorded between June and October. Wandera (1990) observed the length of 50% maturity between 44 mm SL and 47 mm SL two breeding peaks were identified for the northern waters of Lake Victoria, one early in the year and the second one between August and September. Graham (1929) cited by Greenwood (1966) suggested that Rastrineobola spawns in the lake and produces floating eggs.

Growth rates have been derived by Wanink and Wandera (1989). Some works have also been carried out in the Nyanza Gulf (unpublished), Wanink (op. cit.) reported that Rastrineobola reaches 36mm SL in about two years. It has been reported that the length-weight relationship for Rastrineobola is Log W = 0.031 log TL - 1.67. The maximum length observed in the Nyanza Gulf is 70mm (Manyala, pers. comm).

3.3 Oreochromis niloticus

Greenwood (1966) reported that their distribution is restricted to inshore waters particularly sheltered bays and is absent in deep waters. Bottom trawl surveys in the Nyanza Gulf reveal restrictions to depths less than 4m depth.

Balirwa (1990) reported presence of large quantities of zooplankton (up to 90% by volume) in the Oreochromis niloticus as opposed to the popular view of the fish being herbivore. Its feeding could be characterized as being adaptable in times of scarcity just as Nile perch. The young of Oreochromis niloticus are omnivorous feeding on copepods, hydracarines and various insects (aquatic and terrestrial) falling on water. Bulk of the food eaten by Oreochromis in Egypt comprised blue-green algae, diatoms and parts of

macrophytes. Insects and crustaceans are eaten and digested. Trewavas (1983) reported that from around 5cm TL, the fish is dominantly herbivorous, though contradicted by Balirwa (op. cit.) who suggests that even in adult stage there tends to be a switch from herbivorous diet to zooplankivorous diet. Getabu (1988) remarked that O. niloticus is omnivorous. Balirwa (1990) observed that the Nile tilapia in Lake Victoria has an omnivorous diet and a wider ecological tolerance. It was also observed that the trophic characteristics of Oreochromis niloticus at present may be a reflection of the ecological changes that have occurred in the Lake. The abundance of O. niloticus is attributed to the decline in the trophic groups of haplochromines. Predation of Nile tilapia by Nile perch has been observed. Asila and Ogari (op. cit.) reported that 3.2% of the stomach contents of Lates consists of "tilapia".

Oreochromis niloticus spawns through out the whole year mainly over hard bottom composed of gravel or sand between depths 0.6-m and 3.5-10m (Welcomme, 1967; Witte et al, 1989). Nursery grounds have been identified in the submerged regions adjoining the lake where temperatures are slightly higher. It is possible that the fry move into such areas to shield themselves off from predation. Maturity ogive for O. niloticus in Lake Victoria is given (Fig. 4). The smallest mature fish observed in the Nyanza Gulf was 22.3cm TL. 50% maturity for males was observed at 27.5cm while for females is 31.5cm TL. Before spawning nests are prepared by males. Fecundity has been observed at 340 (17cm TL) and 3706 (57cm TL). The maximum length observed in the lake is 65cm TL caught in fishermen gillnets. Their distribution is concentrated up to 10m depth zones.

3.4 Other tilapiines

The other tilapine species currently available in the lake are Oroechromis variabilis, Orecchromis leucosticus and Tilapia zillii. Tilapia melanopleura introduced in the lake by accident is thought not to have established itself (Ogutu-Ohwayo and Hecky 1990). However, Wambayi (1981) citing Welcomme (1966) remarked that it might have formed hybrids with Tilapia zillii because they are similar in appearance. Some studies have been initiated on the ecology of the other tilapines whose preliminary results were not available.

3.5 Haplochromines

The genera was widely studied by the Haplochromis Ecology Survey Team (HEST). A summary of taxonomy, ecology and fishery of the trophic groups of lake Victoria is given in Witte and Van Oijen (1990). They proposed that shallow water haplochromine cichlids were unaffected by the Nile perch predation. Haplochromines occupied nearly all habitat of the lake feeding on all food sources. Each species is believed to have a specific habitat and diet. The trophic group composition of the haplochromines communities differed between habitats. All species are female mouth-brooders, have different fecundity, spawning areas, spawning periods and nursery grounds. There were nine trophic groups identified for the haplochromine cichlids.

3.6 Potamodromous Species

These are Alestes sadleri, A. jacksoni, Labeo victorianus, Barbus sp. Synodontis sp., Schilbe mystus, Clarias gariepinus and small mormyrids. Other potamodromous are Labeo victorianus, Schilbe mystus and Gnathonemus longibarbis. Their ecology has not been exhaustively documented. Their spawning is believed to be triggered by the onset of the rains inducing them to move up the rivers in their gravid conditions.

3.7 Other Fish Species

Other species scantily available but cherished by the fishermen are Protopterus aethiopicus, Bagrus docmac, Afromastacembelus, Xenoclarias and Clarias. The ecology of some of the species have been studied for Lake Victoria (Okach and Dadzie, 1988; Mkumbo, 1988). Adult Bagrus docmac feeds on fish mainly Haplochromis sp. and Rastrineobola argentea, while juveniles prefer aquatic benthic invertebrates (Phyllogomphus, Phanostoma, Chironomids, Caridina, Chaoborus). Selectivity of food for Bagrus docmac is dependent on the occurrence of the prey items in the environment.

4. DISTRIBUTION PATTERNS

4.1 Stock densities

Fish species available from the most recent trawl survey data are Lates niloticus, Rastrineobola argentea, Oreochromis niloticus, Haplochromis spp. Schilbe mystus (occasionally), Barbus spp. and Clarias spp. Lates forms 90% by weight of the bottom trawl catch followed by Oreochromis niloticus Rastrineobola argentea, and Haplochromis spp. (Table 5). Lates was found at most of the stations sampled. Haplochromis spp. were most frequent in five stations (31, 36, 6, 34 and 8). Oreochromis niloticus was more frequent in two stations 17 and 31, but present in five other stations characterized by their shallow depth. Rastrineobola argentea was most frequent in one station.

Nile perch in general is less abundant in shallow depths and their catch rate increases towards deeper waters in areas which are not oxygen deficient. Least density of Haplochromis was observed to relate to highest density of Nile perch. Compared to 1983/84 stock density data, there is an increase in mean catch rates of Lates niloticus (Table 6).
Species diversity in the bottom trawl survey is also reducing and there has been a decrease in the ichthyomass within the Nyanza Gulf.

4.2 Characteristics of the Fisheries of Kenya Waters

Longline and larger meshed gillnets are frequently used in offshore waters where they target on Nile perch and other midwater species. Inshore shallow waters are often fished by mosquito net seines, beach seines (with ropes of length 3000m each side) and small meshed gillnets. Though occasionally, fishermen restrict themselves to minimum mesh size (4" = 101mm), it has become a practice that they use them as seine nets in order to catch tilapines which might otherwise escape the hanging method. In some instances, it has been observed that the nets are set 10-20m away from the shoreline and the fishermen move to the papyrus and submerged weeds to scare the fish out of their hiding so that they get caught in the gillnet.

Practically all parts of the Nyanza Gulf are heavily fished by small meshed gillnets and seine nets with heaviest pressure from Kusa Bay, Kisumu Bay, Nyakach Bay, Asembo Bay, and Mirunda Bay. There is over representation of mosquito net seines in these beaches. Within the Gulf, mosquito seines are not used with light attraction, so they are not intended for catching Rastrineobola argentea at all. More often than not seines are used in shallow waters where the width of the net covers the whole water column, so catches effectively all sizes of fish in the water column.

Mean catch per boat day (MCPB) has decreased between 1989 to 1990 (Table 3) for gillnets, longline and mosquito net seine. There has been a decrease in the MCPB for all types of gear put together from the sampled beaches. Mosquito seine has been the most popular gear accounting for over 50% of the catch by weight in the Nyanza Gulf, followed by gillnets, longline and beach seine outside the Gulf. Mosquito net seine accounts for 39% of the catch by weight followed by gillnet, beach seine and longline.

Other types of gear in use are traps and fences operated in shallow water and river estuaries. Liftnets have been introduced in some areas although their impact is not known in Kenya waters. Yield of Lates has been decreasing as compared to that of Rastrineobola argentea which has been increasing (Table 1). Lately another method was introduced for shallow waters believed to have been introduced from the northern sector where it is popularly used for Oreochromis niloticus. While holding one end of the gill net, whose bottom line is a wire rope the net is hauled from the shoreline so that is spreads out, effectively trapping all the fish under the net. The net is thereafter inspected to find out its catch. Meshes are normally small, it is more common around the Nyandiwa and its environs in Gwasi.

Currently most of the fishery is concentrated outside the Nyanza Gulf where all types of gear are in use. In shallow waters, beach seine, mosquito net seine and small meshed gillnets are in use. In deep waters large sized gillnets and longline are in widespread use with the largest conglomeration around Mfangano, Remba, Ringiti, Kiwa, Mageta and Wayasi Islands. Due to heavy pressure on the fishery the sizes of Rastrineobola are smaller now both inside and outside the Gulf. Nile perch fry are caught along with Rastrineobola in the mosquito net seine fishery forming 5% by weight. In some beaches, mosquito net seines only register young Nile perch and Haplochromis species in their catch.

Synodontis is a preferred bait in the Nile perch longline fishery because of their ability to stay alive long enough under the stress of the hook.

4.3 Problems for Management on the Kenya Waters

It is abundantly evident that the unfaithful methods used by fishermen in the Kenya waters has been responsible for the fluctuations in the catches of the most popular species of fish. Various measures need to be taken in order to rectify the grave situation.

Fisheries Act of 1991 sets the minimum gillnet mesh at 127mm and minimum size of fish to be landed at 25cm SL which is adequate in itself. In most circumstances, the issue has not been in the legislation but on the enforcement of those regulations and manipulations of loopholes in the legislations.

Due to the multispecies character of Lake Victoria fisheries, different species of fish mature at different size ranges. Certain areas of the lake should be declared closed for all types of fisheries for some species of fish to come up. These should be the major river systems and river mouths, shallow embayment where there is heavy fishing going on from small meshed nets (Kisumu Bay, Kusa Bay, Nyakach Bay, Mirunda Bay, Sori Bay and Muhuru Bay, etc). This will assist in conserving the tilapine species, potamodromous and haplochromines species which are threatened with extinction. Licensing of outboard engines negatively inhibits the growth of the fishery into deep waters and ought to be reconsidered.

Alternative sources of both income and food should be sought to ease pressure from the shallow water fishery particularly the seine fishery which affects recruitment into the fishery. Currently there is over capitalization in the fishery resulting from free entry into this sector of the economy under the erroneous belief that the fisheries resource is elastic and inexhaustible. Excellent communication system to beaches in Kenya has made the marketing of fish pose fewer problems. Ita (1973) remarked that the characteristics that lead to overfishing are low basic productivity of a lake, low catch per unit of effort, fishery primarily dependent upon one species, instability of the stock, and questionable recruitment. These, apart from the first factor, are dominantly generated by absence of management enforcement.

Ecological problems generated by the introduced species in the lake are mainly competition for common food resources and hybridization which might result in genetic dilution. Oreochromis niloticus seems to have similar flexibility as Nile perch in their feeding behaviour.

Mechanization of the fishery for deeper waters has been rather slow at the expense of the shallow water fishery which implies that there is intensive fishing in shallow water. It is possible that we have a higher density of fish in the shallower waters which are not assessed. That could be responsible for the disparity between the stock assessment and the catch assessment data.

Management proposals in the past have been executed without research activities and results. It is vital that those proposals get scientific justification.

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TABLE 1: Catch landings of Fish species in Kenya waters of Lake Victoria (metric tonnes)

	Lates	Dagaa	Tila-pias	Furu	Others	Total
1968	-	732	2,419	3,743	9,463	16,357
1969	17	520	4,645	6,427	5,833	17,442
1970	28	524	4,510	5,357	5,981	16,400
1971	46	751	3,142	4,762	6,217	14,918
1972	38	1,255	2,369	4,644	7,683	15,989
1973	147	1,768	1,690	5,571	7,621	16,797
1974	89	3,742	956	6,011	6,375	17,173
1975	51	4,548	642	4,620	6,720	16,581
1976	97	5,652	1,007	6,368	5,556	18,680
1977	203	6,704	1,435	5,378	5,612	19,332
1978	1,066	8,710	2,606	6,621	4,853	23,856
1979	4,286	9,321	2,739	6,599	7,647	30,592
1980	4,310	9,443	5,013	3,636	4,512	26,914
1981	27,259	7,635	3,897	916	5,960	45,667
1982	32,965	10,419	4,475	2,546	10,193	60,958
1983	52,337	16,444	4,282	612	3,652	77,327
1984	41,319	19,437	7,478	41	3,579	71,854
1985	50,029	25,866	9,442	6	4,246	89,589
1986	56,975	34,518	9,164	3	2,503	103,163
1987	58,545	33,145	10,353	183	1,226	113,452
1988	61,210	40,861	16,897	1,338	4,765	125,071
1989	56,810	45,464	17,808	4,759	10,590	135,431
1990	71,514*	46,738*	38,670*	1*	28,178*	185,101*

* Provisional landing for 1990.

TABLE 2 : Percentage composition of catch landings from sampled beaches

SPECIES	1986	1987	1988	1989	1990
Lates	62.8	69.6	59.5	54.3	56.7
Rastri-neobola	29.3	24.7	36.7	38.5	39.6
O. Niloticus	2.4	2.0	1.7	1.7	1.4
Other Tilapines	1.7	0.3	0.3	1.1	0.7
Other Species	3.8	3.4	1.8	4.4	1.5

TABLE 3 : Mean catch per boat-day (MCPBD) from the sampled beaches (kg)

	Gillnets	Beach seine	Longline	Mosquito seine	TOTAL
1989	145.2	387.8	64.7	256.6	179.7
1990	92.2	449.8	63.7	240.8	152.1

TABLE 4 : Percentage catches by weight from sampled beaches

	Gulf Beaches	Open water beaches
1986	33.5	66.5
1987	27.1	72.9
1988	21.9	78.1
1989	20.9	79.1
1990	15.1	84.9

TABLE 5 : Mean catch rates by trawl stations within the Kenya waters of Lake Victoria (kg ha^{-1})

	17	30	31	36	6	34	8	7		Mean catch rates
Lates	8.87	14.87	19.68	55.85	56.78	54.31	21.96	29.36		32.71
Haplo-chromis			.43	.19	.06	.18	.22			.22
Rastri-neobola			.85							.85
O. nil-oticus		3.10	.52	.44				4.14		1.73
Clarias		.77								.77
Schilbe				.15						.15
TOTAL	9.33	18.74	20.48	23.63	56.84	54.49	22.18	33.5		36.43

TABLE 6 : Comparison between stock densities from different Trawl Surveys (kg ha^{-1})

	1969-70	1975	1977	1982-83	1990-91
Bagrus	11.7	12.5	1.8	0.9	-
Clarias	3.3	2.6	0.7	0.9	0.8
Haplochromis	35.8	32.7	28.7	-	0.22
Labeo	0.1	0.1	0.1	0.1	-
Lates	0	0.8	2.8	29.0	32.7
Protopterus	3.7	10.7	0.3	0	-
Schilbe	0.03	0.20	0.01	0	0.20
O. Variabilis	0.03	0.11	0.30	-	-
O. niloticus	0.01	0.20	0.70	1.40	1.70
	54.67	59.91	35.41	32.30	35.62

TABLE 7 : Sex ration (males:females) of Lates niloticus in Lake Victoria

Length group (cm)	Sex Ratio	TOTAL
10-20	10:7	17
20-30	19:20	39
30-40	37:21	58
40-50	61:13	74
50-60	22:7	58
60-70	3:1	24
70-80	13:2	15
80-90	4:1	5
90-100	2:3	5
100-110	4:0	4
110-140	0:0	0
140-150	0:1	1
150-160	0:1	1
160-170	0:1	1
170-180	0:1	1

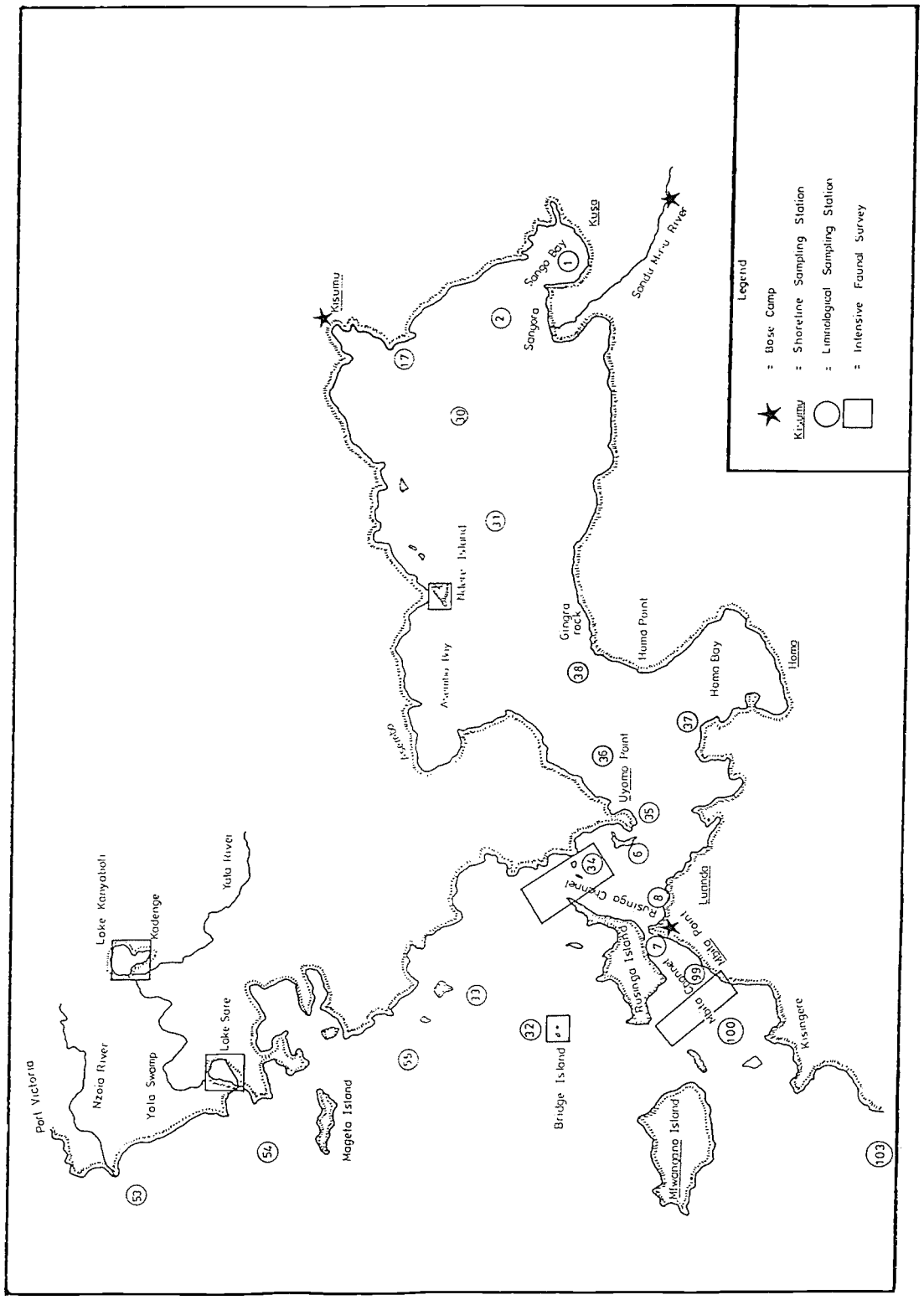

Fig. 1 : Distribution of Nile Perch in Kenyan Waters of Lake Victoria

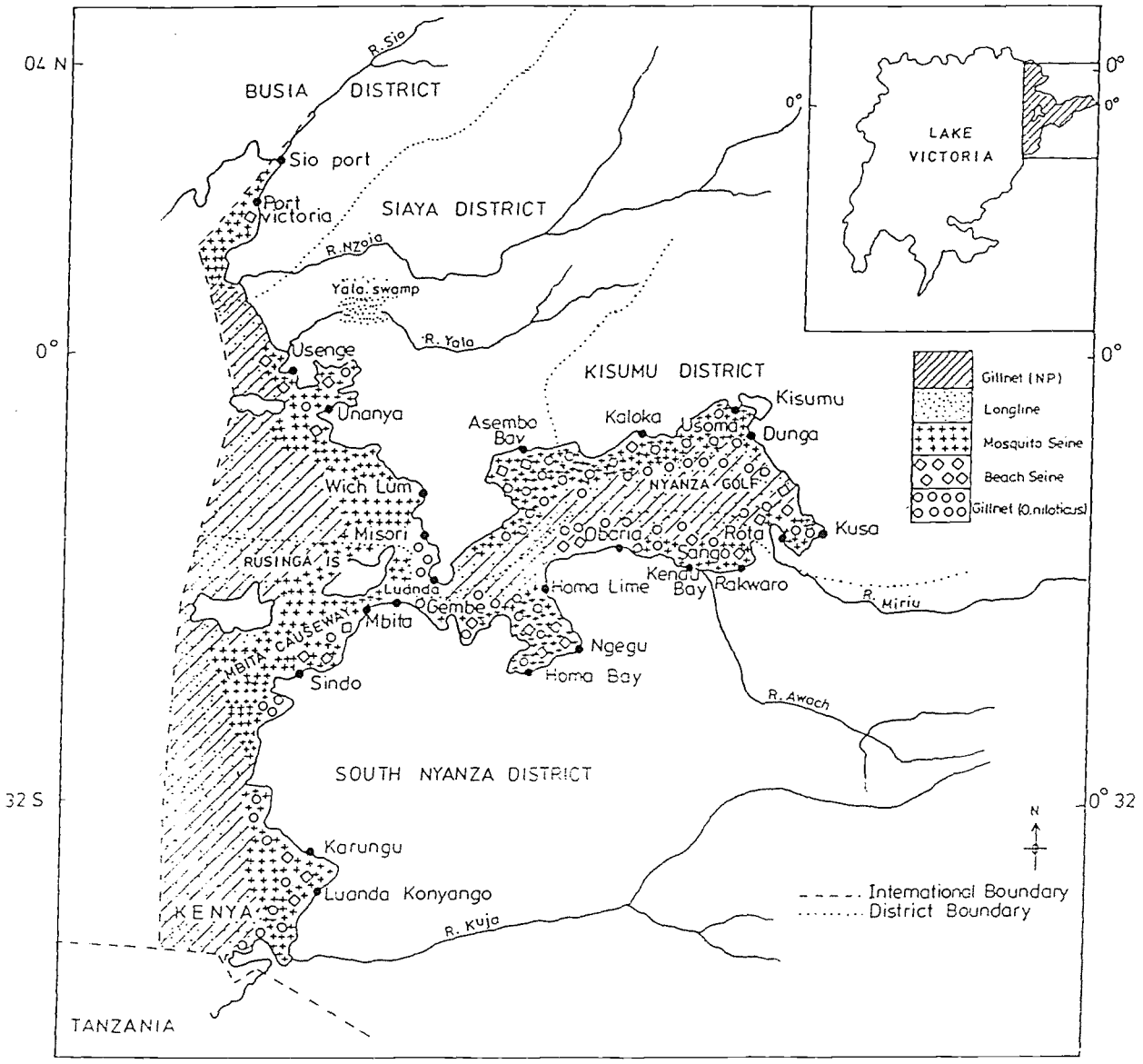

Fig 2 Characteristics of the fisheries by gear type for the Kenya waters of Lake Victoria.

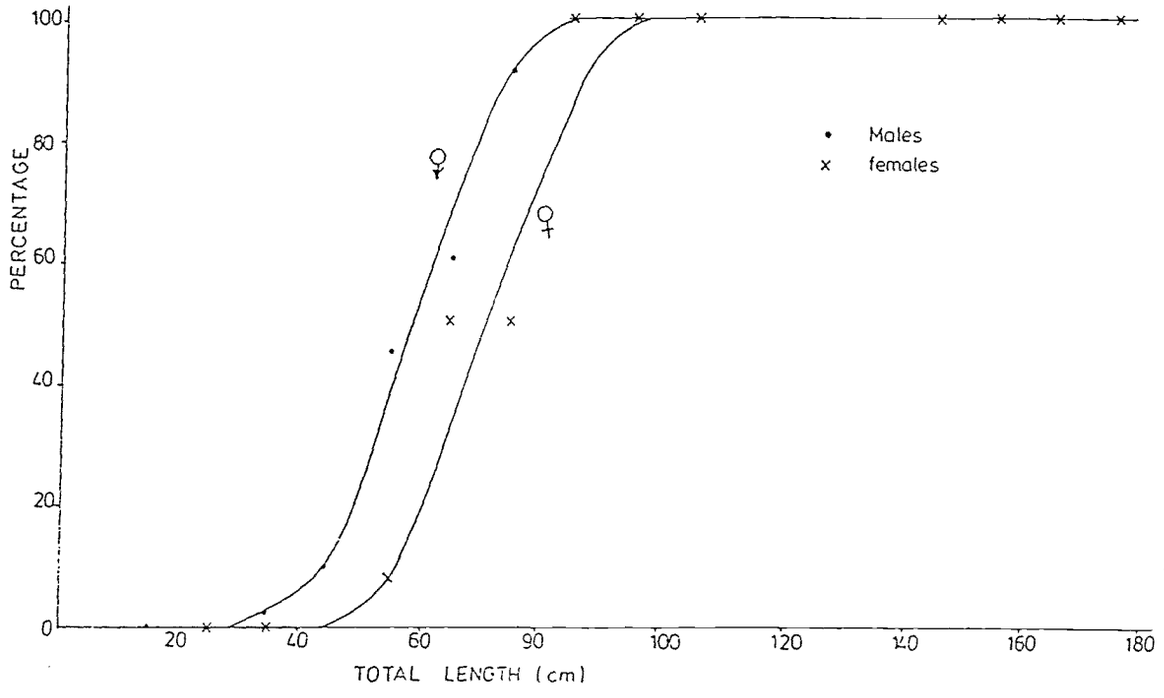

Fig. 3 : Maturity ogive for Lates niloticus

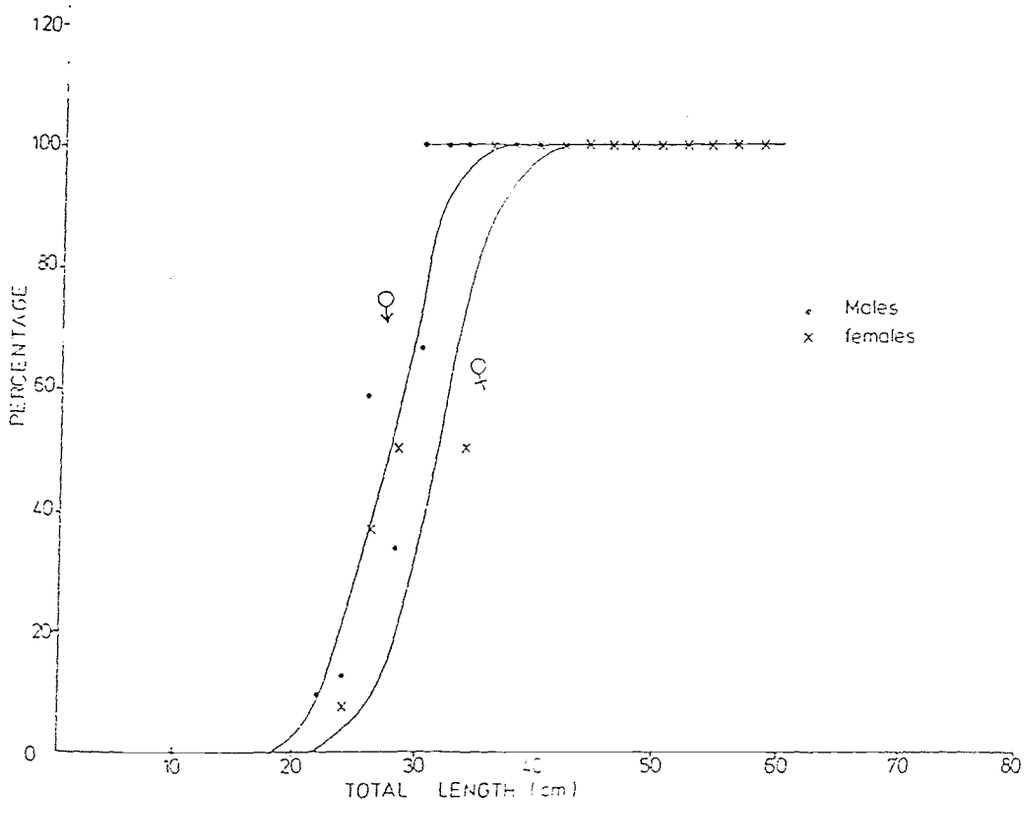

Fig. 4 : Maturity ogive for Oreochromis niloticus

APPENDIX 3.4 : MANAGEMENT ISSUES, OPTIONS AND STRATEGIES FOR LAKE VICTORIA FISHERIES

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I. LAKE VICTORIA: PHYSICAL GEOGRAPHY AND BACKGROUND INFORMATION

With an area of 30,300,410 km^2 Africa is the second largest continent in the world exceeded only by Asia. Amongst its noteworthy features Africa contains several Great Lakes amongst which are Lakes Victoria, Malawi, and Tanganyika, the three richest lacustrine fish faunas of the world. Lake Victoria is the largest lake in Africa and the world's second largest freshwater lake. In area, Lake Victoria covers 68,800 km^2 and has a maximum depth of 79 m and mean depth of 40 m and is shared by the three riparian states of Kenya, Uganda and Tanzania. It lies between the two East African rift valleys across the Equator at 0° 21'N to 3° 0'S and 31° 40' to 34° 53'E. The shoreline is extremely irregular and totals some 3,440 km in length and is deeply indented with shallow and protected bays, sandy exposed beaches, and occasionally rocky cliffs or broken rocky exposures. In the northern half there are a number of large islands whose shorelines are as varied as those of the mainland. The lake is inhabited by at least 200 species of fish many of which are lacustrine while some undertake spawning migrations to the rivers and streams. The fish are caught by fishermen using various methods and techniques which exploit knowledge of fish habitat and behaviour. The Lake Victoria water resources have always been of great economic and social importance to the three riparian states. Apart from providing food from the naturally rich diverse fish fauna, the people of the region benefit from the water resources through water supplies for domestic, industrial and agricultural purposes and transportation between riparian states.

But now the lake faces imminent problems due to various factors. These include widespread deforestation and the consequent soil erosion in the lake watersheds; pollution from agricultural pesticides in the run-off, and eutrophication from fertilizers and industrial effluent. For the three riparian states of Kenya, Uganda and Tanzania, Lake Victoria represents a most valuable source of the much needed animal protein in the form of fish.

For Kenya, the Lake Victoria region is the most densely populated regions with a high growth rate of about 4% per annum. The fisheries in the region constitute not only a potential source of animal protein in the form of fish, but also an alternative means of livelihood and earning income to many people. The fisheries in the lake region currently support about 30,000 full time fishermen operating about 7,000 fishing vessels. The ratio of fishermen to fish traders in the region is about 1:3. The fishing industry therefore, supports 30,000 fishermen plus 90,000 fish traders, a total of 120,000 on full time basis.

With a dependency ratio of 7:1, the number of people whose livelihood is dependent on fisheries on the Kenya side is approximately 840,000 in addition to others who are working in auxiliary services such as boat building, trade in fishing gear and other equipment.

The origin and past history of Lake Victoria is still the subject of some controversy and as yet no fully comprehensive and convincing theory exists although it is now thought that it was formed by tectonic (earth movements) during the Mid-Pleistocene, about 750,000 B.P. (Greenwood, 1981).

There is good evidence of an earlier lake named 'Lake Karunga' in the region now occupied by the present Lake Victoria (Beadle, 1981). Lake Karunga dried out or was drained westward by faulting during the Mid-Pleistocene. Its fish fauna was exterminated but the fossil remains of the fishes have been found to include two genera 'Lates' and 'Polypterus' found on the Rusinga mainland near the present day Winam (Nyanza) Gulf, (Fryer and Iles, 1972). Although these genera are found elsewhere in Africa today, they are not indigenous to Lake Victoria.

Of particular interest is Lates niloticus (Linnaeus) which belongs to the family Centropomidae (Order Perciformes) and is commonly referred to as the Nile perch. Although it may have existed in Lake Karunga, L. niloticus was absent from Lake Victoria until May 1960 when it was discovered in fish catches in the northern part of the Lake near Jinja. A few years earlier (1955) L. niloticus had been introduced in Lake Kioga which has connection with Lake Victoria through Victoria Nile, but the fish could not have entered Lake Victoria from this source because hydroelectric turbines at the Owen Falls Dam constitute an effective barrier.

It has been suggested that Nile perch may have entered the lake accidentally from a fish pond in Uganda. This is most unlikely because around that time there was only one known fish pond in Uganda which had a few Nile perch. However, nobody has claimed responsibility for introducing Nile perch in the lake and therefore, the mode of entry of Nile perch into Lake Victoria prior to its discovery in the lake in 1960 remains a mystery.

II. OFFICIAL INTRODUCTION

The Nile perch was officially introduced into Lake Victoria when 35 fish from Lake Albert were stocked into the Lake off Entebbe pier, in May 1962, by the Uganda Fisheries Department amid unsettled controversy for and against. In September 1963, the lake was again stocked with Nile perch when a further 339 fish from Lake Turkana were put into the Lake, near Kisumu on the Kenya side, by the Kenya Fisheries Department (Achieng', 1990). Earlier on in 1953/55, several tilapiine species among them Oreochromis niloticus were introduced into the lake.

III. THE FISHERIES: PAST AND PRESENT

The species composition of the catches from Lake Victoria has changed drastically from that which prevailed at the beginning of this century when fisheries development started. The earliest survey of the lake in 1929 showed that the two tilapiine species Oreochromis esculentus and Oreochromis variabilis were then the most important commercial species. Other important species included Protopterus aethiopicus, Bagrus docmac, Clarias mossambicus,

Barbus species, Schilbe mystus and mormyrids. Labeo victorianus formed the most important commercial species in the affluent rivers of the lake. Haplochromines and Rastrineobola argentea were abundant but because of their small size, they were not exploited originally on a large scale.

The earliest fishing was at subsistence level using basket traps, hooks and seine nets of papyrus with low efficiency carried out in swamps and river mouths. This type of fishing has now largely disappeared. At the beginning of the century gillnets of cotton were introduced. Increases in population, rapid urbanization and improved means of communication increased the demand for fish and led to the rapid expansion of the fishing industry and to an increased fishing intensity. This development was specifically concentrated at Winam Gulf, the northern coast and to Ssesse Island, near to Kampala and Jinja. There was uncontrolled entry into the fisheries and this soon resulted in the decline in CPUE of accessible stocks (Ssentongo and Welcomme 1985).

The catches of tilapiines per net dropped from 30 fish in 1921 to six in 1928 in Winam Gulf. Information on this development led to Graham's expedition of 1927-1929 (Graham 1929) which collected very valuable information during six months and confirmed the concentrated overfishing of the tilapiines species. In 1933 the recommendation on mesh sizes came into force. From 1929 when Graham presented his proposals and up to the 1950s the catch of tilapiines per gill net had continued falling to 1.6 fish per net (in Winam Gulf) because of increased fishing intensity and use of smaller meshed nets.

In 1952 synthetic fibre gill nets were introduced. These had a higher catching efficiency and a longer life span. Further, in 1953, outboard engines were introduced of which the expected effect was a spreading of fishing activity. Beauchamp estimated in 1953 an increase in the fishing effort of 100% but only an increase in the yield of 10%.

The fisheries of Lake Victoria are mainly exploited by traditional and artisanal fishermen. The fishermen have also engaged a destructive fishing method - beating of the water with paddles which drive the fish into the net. Others have used the same fishing area all through. The overall effect has been a decline in catches, in sizes and probably in biomass.

Some research work has been carried out on the fisheries of the lake. The results of exploratory bottom trawling in the lake indicated that water depth is an important variable affecting spatial distribution and catch rates. The catches of the endemic Tilapia (Oreochromis esculentus) and other tilapiine cichlids decline with increasing depth. The catch rates of the predator catfish, Bagrus docmac, follow a pattern similar to those of haplochromine species on which it preys.

The present fishing patterns in the lake can be divided into a number of individual but overlapping species oriented fisheries (Ssentongo, Welcomme 1985). Although experimental bottom trawling between the mid-1960s and mid-1970s had revealed a substantial quantity of Haplochromines, which could form a basis of a trawl fishery, there followed drastic declines in catches and stocks of the species in the 1980s (Witte 1981, 1983; Hoogerhound et al. 1982).

These changes were attributed to several factors: (a) an intensive artisanal fishery in the inshore water of less than 25 m depth around the lake, (b) introduction of exotic tilapiine cichlids since the 1950s and (c) the introduction of voracious Nile perch.

IV. THE IMPACT OF THE INTRODUCTION OF NILE PERCH, Lates niloticus ON THE FISHERIES OF LAKE VICTORIA

It is now 30 years since L. niloticus was introduced into Lake Victoria. Since then it has transformed the fishing industry and the species composition of the fish fauna more than any other phenomenon in this century. The multi-species fishery was originally comprised mostly of cichlids (tilapias, haplochromines), cyprinids (Barbus, Labeo, Rastrineobola), and siluroids (Bagrus, Clarias, Synodontis, Schilbe). Currently the fisheries are based on the introduced Nile perch, the native cyprinid, Rastrineobola argentea (Pellegrin), and the introduced Nile tilapia, Oreochromis niloticus (Linnaeus). In the Kenyan waters of the lake, the Nile perch is the most widespread species, contributing 68,000 tonnes or 60% of the total annual fish catch of 113,000 tonnes in 1987. The Rastrineobola fishery is second to that of the Nile perch, contributing 33,000 tonnes or 29%, while the tilapias contributed 10,000 tonnes or 9% of the total fish catch. All the other fish species are no longer significant in the catches and contributed only 2% of the total fish catch in 1987 (Table 1). Unfortunately, little information is currently available on the three new fisheries mentioned above with regard to their interrelated population dynamics, and there is an urgent need for biological and stock assessment investigation.

Within 25 years of its introduction the Nile perch became ubiquitous in the lake and now occurs in virtually every habitat with the exception of swamps, and affluent rivers. It has preyed on all other species and has made a profound impact, especially on the haplochromines (Table 1 and 2). These originally comprised 80% of the total fish biomass in Lake Victoria but have now decreased to less than 1% in the fish catches in the Kenyan waters of the lake. The exponential increase in Nile perch population has had quantitative inverse relationship with most of the other species (Arunga, 1981).

The Nile perch is a highly fecund species, each female producing 3-17 million eggs per spawning (Asila & Ogari, 1987). It matures at an age of about 2 years. Its longevity is not known but evidence suggests that it lives for up to 20 years (Ligtvoet, 1989). It grows to a very large size. The largest Nile perch recorded recently in Kenyan waters of Lake Victoria weighed 179 kg (J. Ogari, pers. comm.). Weights of 35-50 kg are common, but the best quality fillets are made from fish of about 10 kg (pers obs.). The growth of the population in Lake Victoria has been very rapid. Having been introduced in Ugandan waters in 1962 and Kenyan waters in 1963, in relatively small numbers, it is remarkable that it has conquered the whole lake within 25 years. Initially at least, juveniles must have had a very high survival rate.

In contrast, members of the 'Haplochromis species-flock are very small (5-25 cm S.L. for adults and average weight of around 25 g). They produce very few eggs, with an average of only about 20 eggs per clutch (Witte & van Oijen, 1989). The rapid depletion of the haplochromine stocks indicates that they are very sensitive to cropping and, even in the absence of Nile perch, the haplochromines might have been depleted by the trawl fishery which was being planned for Lake Victoria.

As haplochromines are no longer plentiful, the Nile perch now feeds on Rastrineobola and the crustacean Caridina nilotica (Roux), which are increasingly appearing in the gut contents of the predator.

When Nile perch of large size started to appear plentifully in local catches of fish, the socio-economic impact on rural communities, especially in Kenya, was tremendous. It was the kind of impact akin to that experienced by American science when the first sputnik was launched. Not only were there exaggerated stories about the ability of the Nile perch to feed on other fishes, but it was also alleged that parts of human bodies had been found in its stomach. This added to the fact that it was very difficult to cook by traditional methods, gave Nile perch a bad reputation around the lake and its value per unit weight remained very low compared with other fish species. Many fishermen considered it was a menace to their fishing nets, which were destroyed by large specimens. To some scientists it was considered an ecological disaster, while to another group it was thought to be an experimental success. To the local scientists of the region it was considered a challenge.

The Nile perch has been condemned because after its establishment in the lake, population of other fish species, some of which were considered a delicacy, declined rapidly and some even virtually disappeared from the fishery. Prior to the introduction of Nile perch, the lake fishery produced many species. Fishermen and fish consumers enjoyed this variety and had a wide choice. As the Nile perch spread, the variety of fish decreased until some people were left with nothing to eat except Nile perch.

While not denying that most fish species, especially the haplochromines, have virtually disappeared from the lake due to predation by Nile perch it is necessary to point out that about 40% of the fish species in Lake Victoria are, at least partly piscivorous. These include Bagrus, Clarias, Schilbe, Synodontis, Protopterus and some haplochromines. These, together with the human fishing pressure, when added to Nile perch predation, may also have contributed to the disappearance of many fish species. At the same time there has been a definite increase in commercial fish production, mainly due to the increase of Nile perch. The original unfavourable attitude towards this fish, for food, was founded on the traditional methods of cooking. However, with new improved methods of cooking, interest has of necessity shifted from the other species and Nile perch has found wider acceptance by local consumers. As a result the value per unit weight of Nile perch is rising. Processing by smoking, frying it in its own oil, or filleting, has also gained it a wider market.

With the population explosion of the Nile perch and a sharp decline in the catch of more desirable fish species, the fishermen, and the fish traders most of whom are women, faced a serious crisis. As the problem became more acute following the dramatic upsurge in the Nile perch population, the future of the fishing industry seemed to be in jeorpardy. Forced by these circumstances to find a use for the fish, the fishermen reacted quickly by adopting large mesh-size fishing nets to catch the Nile perch, while the women fish traders learnt how to fry and hot-smoke it for the local markets. At the same time, big industrial traders moved in with large insulated cold-storage trucks to transport Nile perch to filleting centres, from which fillets are exported to several overseas markets. Some fillets are also distributed to large hotels and supermarkets for the increasing domestic consumption. In the final analysis, Nile perch has become the most important commercial fish

species, supporting a major and thriving industry on a scale not anticipated either by those who introduced it into Lake Victoria or by those who opposed its introduction into the lake.

Recent reports from the Kenyan and Tanzanian Fisheries Departments have remarked on the persistence of haplochromines in certain shallow-waters habitats. In other areas where Nile perch densities have fallen, populations of haplochromines have reappeared. The British Museum (Natural History) recently (1986) sent a small collecting expedition to Lake Victoria and the author had the opportunity to meet some members of the expedition and hold discussions. The expedition collected more than 4000 specimens representing many different haplochromine species from several localities and a variety of habitats. Field observations from this material and from other collections obtained from different parts of the lake by a member of staff of Havard University confirmed that there has been a marked decline in the overall number of haplochromine cichlids, and in some habitats certain species are no longer caught. A report by the British Museum (Natural History) on the specimens indicate that there seems to have been little change in species composition despite the very obvious presence of Nile perch. In yet other habitats the situation is seemingly as it was before the Nile perch invaded the area. The situation in Lake Victoria is by no means a simple one and the final consequences of Nile perch introduction in this lake are difficult to predict at the present time. From Table 1, it is obvious that the tilapiine species are also beginning to increase in the fishermen's catches.

5. MANAGEMENT ISSUES, OPTIONS AND STRATEGY FOR THE KENYA SECTOR OF LAKE VICTORIA

1. Development objectives

The overall objectives for fisheries development are:

- to increase fish production to the maximum sustainable level consistent with sound economic management and conservation of the natural environment;
- to improve nutritional standards, especially of the small fishermen;
- to improve rural income especially of the small fishermen;
- to increase value added of fish products through reductions in post-harvest losses and better marketing methods; and
- to generate foreign exchange earnings by promoting exports.

2. Legislation:

The Kenya Fisheries Act of 1989 makes provision for the protection of certain areas of the lake as breeding places. The shoreline of the Kenya portion of Lake Victoria is made up of indented and protected bays which are most suitable breeding places for tilapiine species. The protection of these areas could enhance the return of tilapiine species which are already on the increase. Compare the percentage of Tilapiine species for 1988 in Table 1 with previous years.

3. Floating Cage Culture:

Increase in fish production in the Kenya Sector of Lake Victoria especially the tilapias could be achieved by the application of cage culture. The application of cage culture as a viable method of fish production is already becoming an important industry in South Eastern Asian countries where it has been shown that a ten-fold increase in fish production is possible through the application of known technologies in fish culture using floating cages. It is reported that in the Philippines there were 200 hectares of lake water in Luguna Bay covered with Tilapia (Oreochromis) niloticus floating cages. The Kenya Sector of Lake Victoria is very suitable for cage culture because of the numerous indented and protected bays.

4. Monitoring of the Fisheries:

The Nile perch, Tilapia and Rastrineobola (dagaa) fisheries of Lake Victoria are the livelihood of many people. As such it is essential that the lake fisheries be monitored and managed. Moreover some scientists believe that the Nile perch fishery, in particular, could be threatened. The predatory species underwent a dramatic fluctuation in population, as in the case of the rise and collapse of the Lake Kyoga Nile perch fishery.

Whether such a collapse could happen in Lake Victoria as a result of excess fishing pressure or changes in Lake water level is not known with certainty, but the clear evidence of reduced production in Nyanza Gulf and less clear but more general signs of reduced abundance from elsewhere on the lake suggest that extremely close monitoring of the fisheries of the lake is needed. Furthermore, the situation counsels a prudent strategy of sustaining the high level of productivity achieved during the past decade and of improving the value of output, rather than one of increasing output.

5. Improved Fisheries Management with Special Emphasis on Control of Effort:

In order to implement the above policy, the system of data collection should be revised and revalidated. Additional manpower resources should be deployed to ensure a rigorous monitoring of production and of fishing effort in all portions of the Lake under Kenya jurisdiction. Close liaison should be maintained with other riparian states on Lake Victoria and the Department of Fisheries should cooperate fully with the European Community's regional Lake Victoria Fisheries Research Project.

A locality of special concern from the point of view of the environment in general, as well as from that of fisheries, is the Nyanza Gulf. An integrated ecological study of the Gulf and associated River systems should be undertaken. The study should determine levels of pollution, the current status of riverine fisheries as well as the effects of recent construction (such as the new causeway) on hydrographic conditions. Means of rehabilitating the anadromous fishery should be studied.

Socio-economic studies should be undertaken to identify the effects of changing economic circumstances on local communities. Among the questions to be addressed there will be the extent of diminution of fish supplies for local consumption and/or relative price increases as a result of the growth of the Nile perch processing and exporting industry, and the socio-economic impact of the fishery on people living in the Nyanza region.

6. Assistance to Small-scale Fishing Communities by Strengthening Security of Incomes:

In order to strengthen the position in the market of small-scale fishermen, steps should be taken to provide additional shore facilities, subject to their being shown in feasibility studies to be financially viable. These will delay quality deterioration, permit storage of fish during the absence of buyer's vehicles and enable a greater degree of price stability.

7. Making of Access Roads into all Weather Roads:

Access roads, one on the north side of Nyanza Gulf and one on the south side, should be constructed so as to serve better the fishing communities and the fish-landing sites associated with the commerce in Nile perch and tilapia. These roads will improve quality, reduce post-harvest losses, as well as enable fish to be collected by the processors, trucks during all weathers. It is currently estimated that 60 to 90 fish-production days are lost each year through poor quality access roads. It is expected that the roads will also bring additional benefits to local agriculture and trade.

It is intended that the improved access roads will bring benefits from increased efficiency of production through waste reduction and better continuity of fishing activities. However, they could also result in increased pressure on the fish stocks. This danger underlines the importance of the tighter regime of fisheries management on the lake, referred to above, which will be introduced by the Department of Fisheries.

8. Encouragement in Locating the Fisheries-related Industry in Nyanza Province:

The establishment of modern fish-processing plants in the vicinity of Nyanza Gulf will be encouraged by giving the processors priority in the allocation of sites. The emphasis should be on relocation of existing national processing capacity and greater efficiency rather than increasing the capacity which would exacerbate the problems created by the existing heavy pressures on the resource.

Table 1 : The percentage contribution of the different fish species to the total weight in metric tons of fish landed from Kenya waters of Lake Victoria over a period of 20 years from 1968 to 1987

Species	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Lates		0.1	0.2	0.3	0.2	0.9	0.5	0.13	0.5	1.1	4.5	14.0	16.0	59.8	54.4	67.7	57.5	56.5	55	60
Haplochromis	22.8	36.8	32.7	32.0	29.0	33.2	35.0	27.9	34.0	32.4	27.8	21.6	13.5	2.4	4.2	0.8	0	0	0	0.1
Mastrinecobola	4.5	3.9	3.2	5.1	7.8	10.5	21.8	27.4	30.3	34.7	36.5	30.5	35.1	20.0	17.1	21.3	27.1	29.3	34	29
Tilapine	14.8	26.6	27.5	21.1	14.8	10.1	5.6	3.9	5.4	7.4	10.9	9.0	18.6	10.2	7.3	5.5	10.4	10.7	8	9
Clarias	10.6	7.6	9.7	12.5	17.0	15.7	12.9	15.6	13.0	9.1	7.2	10.0	4.5	2.6	3.4	2.7	1.1	0.6	0.7	0.3
Bagrus	7.0	5.5	6.7	7.1	5.4	8.6	6.4	8.4	5.5	6.0	5.9	5.8	2.4	1.1	4.2	3.1	0.1	0.1	0.2	0.1
Protopterus	17.2	9.3	11.0	12.8	12.7	13.0	8.6	1.1	5.0	4.0	2.6	1.5	1.4	0.5	0.4	0.3	0.1	0.2	0.2	0.1
Schilbe	2.4	1.4	0.4	0.4	0.4	0.9	0.2	0.3	0.3	0.7	0.5	1.0	0.4	0.1	0.1	0	0	0	0.0	0.0
Alestes	2.2	0.3	0.1	0.1	0.01	0.02	0.01	0.08	-	-	-	-	-	0	-	0	0	0	0.0	0.0
Bargus	3.1	1.1	1.3	1.6	1.7	1.1	0.7	1.7	1.0	1.0	0.8	1.4	1.6	0.8	1.1	0.1	0.1	0.1	0.1	0.1
Labeo	3.6	2.7	1.8	1.5	2.0	0.8	0.3	0.7	0.7	0.3	0.6	1.5	1.8	0.3	1.5	0.1	0.1	-	0.0	0.0
Mormyrus	0.3	0.4	0.5	0.5	0.5	1.1	0.8	0.3	0.5	0.5	0.6	1.2	1.2	0.5	4.4	0.3	0.1	0	0.1	0.1
Synodontis	1.1	1.5	1.1	0.7	1.3	1.3	1.1	0.8	1.0	1.6	0.6	1.6	1.4	1.3	0.4	0.1	0.1	-	0.0	0.0
Small mixed	10.4	3.6	5.0	5.2	7.9	3.8	1.9	3.8	-	-	-	-	-	-	-	-	3.3	2.6	1.0	0.1
Total (m.t.)	16357	17442	16400	14918	15989	16797	17135	16581	18680	19332	23856	30592	26914	45667	60958	77327	71854	39589	103000	113000

Table 2. Catch rate (kgh^{-1})* of demersal fish species in the Nyanza Gulf, Kenya

Genus	1969	1979	1981	1982	1983
Lates	1.12	46.3	169.0	169.0	273.0
Haplochromis	440.0	59.2	0	0.10	8.5
Mormyrus	0.34	0.01	-	-	0.5
Synodontis	2.31	0.16	0.20	0.01	0
Schilbe	0.54	0.01	-	0	0.03
Barbus	0.25	0.59	-	-	0.03
Bagrus	33.45	10.8	0.30	0.45	0.22
Clarias	23.23	2.5	0.10	0.48	0.14
Labeo	0.17	0.01	0.02	0.01	0
Oreochromis niloticus	0.58	3.45	15.60	13.3	7.6

*Source: Fisheries Abstracts 1984, 1985, except for Barbus.

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APPENDIX 3.5 : TRENDS IN FISHERIES DEVELOPMENT, PROSPECTS AND LIMITATIONS

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1. INTRODUCTION

1.1 General

Lake Victoria is situated across the equator at an altitude of 1240m and has an area of 6800 km^2. The lake is shared by the three riparian states namely Kenya, Uganda and Tanzania. The Kenya portion of the lake is the smallest and covers an area of about 4,100 km^2 with a shoreline of about 769 km.

Population distribution is generally influenced by rainfall distribution being relatively sparse along the lake shores where rainfall is low and erratic. Lake shore savanna climate covers much of Kisumu, Siaya, South Nyanza and Busia Districts. The most disappointing experience is abundance of unused water during the wet season and lack of it for most part of the year when no rainfall is received. Due to the above factors, the area along the lake shore experienced scarcity of agricultural land and shortage in employment opportunities in the area. The lake therefore remains the most dependable resource in the area.

There is no documentation stating when fishing actually started in the Kenya waters of Lake Victoria. However, it is known that at the initial stages fishing was at subsistence level using baskets, traps, spears, long-line, rod and line, "Ngogo" made of papyrus stalks considered as a moving fence used as a seine, clasp-net (Graham, 1929). The areas fished were mainly swamps and river mouths. The fishermen fished without or with simple crafts. The main fish species was Oreochromis esculentus, followed by the anadromous species including Labeo, Barbus, Mormyrus species.

1.2 Past Trends in Fisheries Development

In addition to the indigenous fishing gears came the flax gillnets in 1905. The simple crafts were increasingly augmented by paddle or sail propelled canoes. Increase in population, rapid urbanization and improved means of communication increased the demand for fish. This led to the rapid expansion of the fishing industry, and with the introduction of beach seine nets in early twenties there was an increased fishing intensity. The increased fishing effort caused a decline in the catch per net which in Nyanza Gulf reduced from 25 fish per net to 7 fish per net in 1920. The decline in catches led to a survey of the resources by Graham in 1927-28 (Graham, 1929), who confirmed overfishing of the tilapiine species.

Between 1925 and 1930 there was a gap in the development of the industry which actually picked up between 1930 and 1940. With the expansion of the industry during this period there was a corresponding decline in catches from 7 per net in 1933 to 2 per net in 1940. This led to the use of gillnets whose mesh sizes were below 5".

After the 2nd World War there was rapid development of urban centres, industries and plantation farming. These were coupled with the development of roads, rail facilities which actually enable the fishermen to exploit the new markets. Improvement in demand and transport means created an incentive to the fishermen who in turn intensified their fishing activities. Between 1949 and 1953 the only technological advancement achieved by the fishermen were the introduction of outboard engines in 1953 (Mann 1969), followed by the replacement of dugouts by planked canoes. Before 1953, fishing activity had been restricted to the inshore grounds which had led to overfishing, resulting into a decline in catch per net falling below 2 per net. For the anadromous species heavy attack was made on the gravid fish resulting in their virtual disappearance from the commercial catch. At River Nzoia, for example, the average catch per net declined from 10.0 in 1952 to 1.2 in 1962 and has never recovered. The fish were caught by a new fishing technique, of steaming gillnets behind canoes in river estuaries during spawning migration of gravid fish. This method caused the abandonment of traditional fishing methods, by barriers across rivers (Cadwalladr, 1965). The introduction of motor boat engines was therefore expected to spread the fishing activities offshore.

The nylon gillnets had greater efficiency and durability than flax nets. Together with the outboard engines, the fishermen extended their range as they began to invest their earlier profits and to make use of credit facilities that were becoming available. Some fishermen begun to operate from temporary camps on distant islands where they could fish for ten days before returning to market their sun-dried or smoked fish (Garrod, 1960). There was a shift from traditional fishing techniques such as traps and weirs used to catch the anadromous sp. towards beach seines, mosquito seines, scoop and ringnets used for Haplochromines and Rastrineobola fisheries.

Due to the decline in the catches in the inshore areas the following tilapiine species were introduced in L. Victoria between 1951 and 1957, to enhance the stocks of endemic tilapiines: Oreochromis leucostictus, Tilapia zillii, Tilapia rendalli and Oreochromis niloticus. Reduction in mesh size between 1953 - 1956 led to increased number of fishermen which ultimately led to increase in catch. By 1957 the catch per net was again declining towards two per net. As the totally yield dropped between 1957 and 1960 within the Nyanza Gulf, landings outside the Gulf indicated a general increase in fishing effort with increasing yields (Garrod 1960). This signalled migration of fishermen away from the Gulf where profits had declined. In the Kenya part of L. Victoria fish landings had declined from 20,000 metric tons in 1948 to 4200 metric tons in 1961 (Table 1). Attempts by the government to revive economic catch rates by restricting mesh-sizes, search for new fishing grounds and methods of introducing the exotic fish species including nile perch in 1960s, did not arrest the declining catch rates throughout.

This was mainly due to high demand for fish in the markets and also due to the introduction of various materials of gillnet which led to an increase CPUE for a short period.

With no proper guidance in the distribution of effort the gradual expansion of the industry offshore led to economic overfishing on several target species e.g. O. esculentus, O. variabilis, Clarias, Synodontis, Protopterus, Labeo , Schilbe and Barbus. Intense fishing pressure was also leading to the disappearance of some haplochromine species within the Nyanza Gulf (Wanjala and Marten 1974).

Though several species were threatened by overfishing, large stocks of Haplochromines were believed to abound in the lake. Due to lack of information on relative abundance and distribution pattern of various fish species an exploratory survey was carried out by UNDP/LVFRP and EAFFRO between 1969/70 to determine the magnitude and relative abundance of the available stocks and to indicate the best method for exploitation.

The results of the EAFFRO, UNDP/LVFRP reported in 1974 indicated that the relative abundance of the major taxa in the lake was in the following order of decreasing significance (by weight): Haplochromines (80 %), Bagrus docmac, Clarias mossambicus, Protopterus aethiopicus, O. esculentus, O. niloticus, Synodontis victorianus, O. variabilis and Lates niloticus (Kudhongania and Cordone 1974), (Table 2).

The haplochromines were estimated to have a biomass of 600,000 metric tons with a potential yield of about 200,000 metric tons in the whole lake (Kudhongania 1972). This information revealed new information needed for the planning of development programmes. Thus with the high potential yield for haplochromines, there was need to ensure effective utilization. Kenya planned to set up a fish meal using the haplochromines as raw material.

TABLE 1 : CATCHES PER NET (5"/4" GILLNET) IN THE NYANZA GULF FOR THE PERIOD 1905 - 1968*

Year	Catch per net No. of fish tilapiines	Catch per net No. of fish all species	Source of information
	5"/4" Gillnet		
1905	50 - 100	-	Worthington & Worthington (1933)
1921	30	-	EAFFRO Annual Rep. 1954/55
1928	6	-	EAFFRO Annual Rep. 1954/55
1933	7	-	Review of Kenya Fisheries 1946/47
1937	3.08	-	Review of Kenya Fisheries 1946/47
1939/49	-	2.2	LVFS Ann. Rep. 1952
1942	2.52	-	Rev. of Kenya Fish. 1946/47
1947	2.12	-	Rev. of Kenya Fish. 1946/47
1952	1.9	2.0	LVFS Ann. Rep. 1952
1954	1.6	-	EAFFRO Ann. Rep. 1954/55
	4" Gillnet		
1962	1.38	1.56	Kenya Fisheries Rep. 1962
1965	0.51	0.54	Kenya Fisheries Rep. 1965
1968	0.35	0.45	Whiting (1969)

* Source: Based on Jackson (1971)

TABLE 2 : ESTIMATES OF STANDING STOCK (M. TON) FOR THE KENYA WATERS OF LAKE ViCTORIA*

Species	M. tons	%
Haplochromines	36,694	84.11
Tilapia esculentus	636	1.46
Tilapia variabilis	12	0.03
Tilapia niloticus	48	0.11
Tilapia zillii	-	-
Bagrus docmac	2,788	6.39
Clarias mossambicus	1,936	4.44
Xenoclarias spp.	65	0.15
Protopterus aethiopicus	896	2.05
Lates niloticus	93	0.21
Synodontis victoriae	309	0.71
Synodontis spp.	42	0.10
Barbus altianalis	21	0.05
Labeo victorianus	14	0.03
Mormyrus kannume	28	0.06
Schilbe mystus	45	0.01
Total	43,627	100.00

* Source: Adopted from Kudhongania and Cordone, 1974

1.3 Employment

By 1927 the number of fishermen in Kenya was 4,000 - 6,000 with about 2,000 canoes (Graham, 1929). In 1973 EAFFRO/FAO sociology team of the LVFRP reported that the Kenya part of the lake had some 4,100 canoes and about 10,700 fishermen belonging to households estimated to contain 80,000 individuals. During this period it was estimated that 2,000 boats were operating outside Kenya waters (Wanjala & Marten 1974). In 1979 Fisheries Department sources estimated that there were about 4,600 canoes and 18,000 fisherfolk supporting households totalling about 120,000 individuals. By 1985 the figures had risen to 21,500 operators and 5,500 canoes (Reynolds & Gréboval 1988).

Currently it is estimated that there are 30,000 artisanal fishermen operating on L. Victoria. With a dependency ratio of about 7,000 fishing canoes: this gives a figure of 210,000 persons dependent upon fish harvesting for their livelihood. There are also industrial fishermen who include those involved in distribution and processing and these in turn, support a further 630,000 people in addition to these in the ancillary activities such as boat building and other equipment.

1.4 Fish Resources of the Lake

The species which were significantly contributing to the landings in the 1970s such as Haplochromines, O. niloticus, Clarias, Protopterus, Bagrus, Synodontis and Schilbe, started showing signs of decline in the 1980s, (Table 3).

With the collapse of fishing based on the demersal endemic species by early 1980s, there emerged a growing dominance based on two exotic species and one pelagic endemic species namely L. niloticus, O. niloticus and Rastrineobola argentea respectively. Catches of Lates became significant from 1977, and with the establishment of Lates in Lake Victoria, the total fish yield from early nineteen eighties to date increased significantly.

It is to be noted that this evolution implied higher investment and operational costs per fishing unit with increasing gross benefits throughout most of 1980s. Due to the presence of nile perch the yield from Lake Victoria accounted for 90% of all fish production in Kenya in 1989.

1.5 Fish Handling and Preservation

The native methods used for preserving fish were sun-drying and smoking. Fresh fish were iced and railed from Kisumu to Nairobi. The fishery had very little value and remained a food of last resort all round the lake.

From 1980s when nile perch became dominant in the catches, processors of nile perch fillets opened up factories in Kisumu, Nairobi and Mombasa.

2. EXISTING FISHING PROSPECTS AS WELL AS RESOURCES AND TECHNOLOGICAL LIMITATIONS FOR THE KENYA SECTOR OF THE LAKE

2.1 Fishing Prospects as well as Fish Resources

After the 1969-1970 UNDP/FAO and EAFFRO exploratory survey of Lake Victoria, there is need for a similar survey in our waters. The current fishing industry is based on three commercial species and any further development will need to be guided increasingly by information provided by fisheries scientists. The scientists need to learn as much as possible about all the natural factors that affect the abundance or otherwise of the fish species. Furthermore the survey ought to evaluate the resources and to determine the potential yields and stock abundance of the fish species available. Fishing for R. argentea is currently restricted within the inshore areas. There appears to be untapped zone of this resource offshore which could be made available. Research is also needed in order to derive the maximum value from the fish landed. Apart from methods used for preservation today, some new methods remain to be discovered, but the discoveries are only likely to be made by laboratories specialised on this subject. This would ensure international quality standards for our processing and handling.

2.2 Facilities Available

(a) Fishing Crafts

The choice of the type of canoe to be acquired depends on the financial resources of the individual fisherman and the area the craft is intended to be used in. Only a few canoes have outboard engines or diesel inboard engines. Almost all canoe use sail and paddle for propulsion. The canoes are small and they are difficult to manoeuvre in heavy waves. Due to these problems most of the fishing has been confined to within the inshore areas. Boats which would withstand off the wind sailing properties combined with on the wind motoring capabilities should be introduced so as to be able to fish in offshore waters.

(b) Gears

Fishermen have always used an assortment of gear (Graham, 1929; Kongere, 1979). Gear choice is determined by the target species and the investment capability of the fisherman, and may also vary in accordance with the changing technology and stocks of target species.

The fishing gears used in Lake Victoria and its affluent rivers are both traditional and modern. However, majority of the fishermen use modern gears such as hooks and lines, gillnets, mosquito and beach seines and long lines.

(i) Gillnets

Gillnet fishery is by far the most important fishing gear in Kenya waters. Before the establishment of Nile perch in Kenya waters, gillnet fishing was based on mesh sizes varying between 1 1/2" to 6". With the establishment of Nile perch and decline in haplochromines and tilapiines, there was a switch from the use of a small mesh gillnets to large meshes of 4" - 12" in early 1980's. By about 1986 the mesh sizes had been reduced to 3" - 10". Today the mesh sizes used for catching both O. niloticus and L. niloticus have narrowed down to 3" - 5" and 5" - 7 1/2" meshes respectively.

(ii) Longline

This is the main gear used for Nile perch within the Gulf, where catch levels have dropped drastically. The gear is also used in the open waters though with a different type of bait.

(iii) Beach Seines and Mosquito Seines

These gears are used for 8 months in a year except 1st April to 31st July. Mosquito seines are used to catch R. argentea, whereas beach seines are non-selective and are used to catch fish of all types and sizes.

(c) Processing

The traditional ways and means for preserving various species of fish caught in the lake included sun-drying, hot smoking and icing. The business was previously primarily in the hands of women.

The presence of Lates has drastically changed the nature of fishing operations; it has produced far reaching effects in the post-harvest sector of the fisheries. There are now 20 companies involved in the nile perch fillet business. Refrigerated vans collect fish from various landing sites along the shoreline. Shipments are delivered to company plants in Kisumu, Nairobi and Mombasa, where fish are filleted and packaged for distribution locally and abroad. The women processors preserve Nile perch through smoking and frying. Recently a significant development of fish meal production from R. argentea is operated.

(d) Marketing

Nile tilapia, haplochromines and R. argentea were the mainstay of small-scale fish traders before the advent of Nile perch . The other fish included Protopterus aethiopicus, Clarias mossambicus, Labeo victorianus and Barbus altianalis. These fish species were sold in fresh, smoked or sun-dried state. The trade has mainly been carried out by women. The fish are carried on the headload, on bicycles, by bus and matatus. The fish are transported to markets away from the lake shore areas.

The upsurge of nile perch has fundamentally altered the character of the fish trade. In the local markets the small-scale fish traders, sell the fish fresh, smoked, fried and for the juveniles in sun-dried state. Due to demand for nile perch fillet in both domestic urban markets and overseas, a number of companies are involved in the trade. Frozen Nile perch fillets are shipped in special ocean freight containers and reach outlets in Israel, Europe, Australia, Japan and elsewhere.

2.3 Technological Limitations

Despite the work already done,the scientists have not yet arrived at a satisfactory means of exploiting the three major commercial species on a sustained basis. We do not know enough about the species being exploited to be able to manage the lake properly, and this remains one of the biggest problems to be solved. The models used like the Beverton-Holt are meant for single species and would not be applicable in our situation where complications due to species interactions such as competition and predation are the order of the day (Marten 1979). The survey required to evaluate the resources and to determine the potential yields would call for a regional approach.

It can be argued that our fishermen would be able to reach most of our waters of the lake if only they slightly improved their present types of fishing equipment. There is need to introduce boats which can easily manoeuvre in heavy waves and using either outboard or inboard engines. These boats are supposed to withstand the presence of waves at any time of the day. The need to switch fishing operations to offshore will have a significant socio-economic impact, especially in terms of operating and investment costs.

Theft of gear has been a problem in the lake for several years and it is a retrogressive tendency bound to affect any development proposals for the lake fisheries. Due to gillnet theft a significant number of fishermen have switched to beach seining. Furthermore many fishermen are making their own nets using less expensive material rather than purchasing factory made nets. Mosquito seine nets are operated in the inshore areas causing overfishing of pelagic R. argentea. Possibilities for increasing yields would be achieved if our fishermen would switch to the use of catamaran/lift nets. This change would enable fishing to be extended to the untapped offshore resources, thus reducing mounting pressure on shoreline fishing for R. argentea.

On processing the main limiting factor is the infrastructure required for the preservation of fish at the landing sites. There is need for these sites to have sorting sheds, insulated containers, drying racks and smoke houses with the necessary ancillaries such as ice boxes. These infrastructure facilities would play a vital role in stabilising the economy of fishing industry due to proper handling and preservation of the fish for better realization of market price for the fish. Research capabilities would also be needed to assist the industry to improve the quality hence the value of the product.

2.4 Marketing

The limiting factor in marketing are access roads between the landing beaches and the outside markets to facilitate fast distribution of the fresh commodity. Currently most of the feeder roads to the landing beaches, become inaccessible during the rains, thus affecting the fish trade in such areas.

3. WAYS AND MEANS FOR ACHIEVING AND MAINTAINING APPROPRIATE FISHING AND FISH TECHNOLOGIES THAT WILL NOT LEAD TO OVER CAPITALIZATION AND OVERFISHING

3.1 Management of Resources

This would call for improved management of existing stocks and a reduction of post harvest losses. Up to independence period the Fisheries Department dealt primarily with the sport fishery but after 1964 this had to shift towards commercial fisheries. The major constraints which hindered fish conservation and management before 1963 were lack of qualified personnel, limited fish related facilities which included, fish technologies and lack of fisheries co-operatives to gainfully exploit fish resources.

The main objective under this would be to ensure that the fish stocks under exploitation are maintained as resources on a lasting basis. Experience has shown that a persistent pursuit of attainment of the maximum sustainable yield involve risks of over-capitalization in the fishery and damage to the resource base.

It is now accepted that a wise management policy must be based on a more careful and conservation approach. This primary objective of maintaining the fish stocks as resources on an indefinite basis must be interpreted in the relevant biological terms of the fish and its production systems.

The two specific biological objectives of fishery management are:

(a) to secure adequate reproduction and recruitment; and

(b) to make proper use of the growth potential of the exploited fish by harvesting the adults.

This therefore requires management to control the rate of mortality which the fishing exerts on both juveniles and the adults. Since the rate of mortality is directly proportional to the amount of fishing effort, therefore, in order to control the total fishing mortality the fishing effort needs to be controlled. Effective biological management also involves the need to protect juvenile fish, avoid the catching of immature fish and there may be need to avoid or reduce fishing of adult fish during spawning period.

The only means of avoiding catching juveniles and brood stock is by regulation on gear, closed areas and seasons of the year. The closed areas would include beaches which act as breeding sanctuaries for lacustine species and river mouths at the period when upstream migration starts for the anadromous species.

3.1.1 Gear

The selectivity of gear will depend on the gear type and mesh size in case of nets or hook size in case of lines. In Lake Victoria where the fishery is dependent on three commercial species, gear regulation stipulating minimum size of fish to be landed and accepted to be marketed would be a better control measure. Already there are small mesh seine and gillnets being used to crop R. argentea, O. niloticus and Lates niloticus. These have attributed to the small sizes of these species being landed.

There are several beach seines that are operating along the open beaches of our waters. Such areas are inhabited by the juveniles of various fish species including the tilapiines and Lates. The beach seines are detrimental to the tilapiine fishery, since the net drags over and flattens out nests, interferes with pre-breeding courtship behaviour and takes brooding females with eggs and fry in the mouth. There is need to put a total ban on the use of beach seines no matter the mesh size.

3.1.2 Fishing Craft

With slight improvement on the present types of boats used, the fishermen will be able to reach most of the Kenya waters of the lake. Introducing trawlers in the lake would increase the mortality rates of juveniles as well as interference with the spawning and brooding stocks of various species. The introduction of the trawlers may also create physical interference and direct conflict with the artisanal fishermen. It is recommended that in order to avoid over-capitalization trawling should be banned in Kenya waters. This is aggravated by the fact that the offshore waters are also restricted in area and may not possibly be able to accommodate six trawlers if they have to operate economically.

3.1.3 Fish Handling and Preservation

It is only by availing adequate infrastructure facilities on shore that the fishing industry would be successful and viable. There would be need to use mechanized boats for transportation of fish and ice between fishing points and landing beaches. The ice for the preservation of fish would have to be produced in Kisumu and Homabay because of availability of power. There should be insulated and open trucks operating for conveyance of fish for processing as well as marketing. To avoid over-capitalization it would be necessary not to involve in ambitious projects in processing like the one planned by LBDA and to be funded by the Italian Government at a cost of more than Ksh. 100 million loan. The project is supposed to set up a filleting plant in Kisumu capable of handling 75 tons of fish per day. In addition to producing fillets, the plant would also manufacture oil and meal.

3.1.4 Fish Marketing

The sale of fish should be by weight rather than by numbers so that the fishermen can accrue the true value of their catches. As far as demand is concerned, one notes that the price of 'table' fish does not decrease with decreasing fish size. As often noted, a better price can be derived from fish size corresponding to an individual serving. This is one of the factors which induces the progressive use of smaller mesh size in the fishery. It is therefore noted that the creation of price differential between large and small fish would discourage the use of undersized gillnets.

4. RECOMMENDATION OF SUITABLE DEVELOPMENT APPROACHES CONSIDERING THE PREVAILING SOCIO-ECONOMIC FACTORS AND GOVERNMENT POLICY ON INDUSTRIAL AND ARTISANAL FISHERIES OF LAKE VICTORIA

4.1 Government Policy

The Kenya Government is concerned with both export trade and population migration from rural to urban centres in the country. To reduce this movement, the Government is determined to initiate developments in rural areas so as to:

(a) Promote vigorous growth of secondary towns and small urban settlements;

(b) Bring renewed economic growth to all regions so that even the least developed regions can share in the general growth of the economy.

To achieve the above within the fishing industry in the lake region, the main objectives would be:

(i) To ensure that the income from the utilization of the fish resources benefit the local population and the economy in the region.

(ii) To increase local employment.

(iii) Utilize the fish resources to improve the nutritional condition of the community around the lake.

(iv) To promote export trade where possible.

Those involved in the fishing industry have not been able to absorb the benefits of development effectively and successfully and have therefore not economically grown with the development.

4.1.1 Fishermen's Body

For the above development to be achieved there has to be a body to handle the affairs of the fishing industry. The body currently handling similar affairs is the Fishermen's Co-operative Society. There are about 35 registered Co-operative Societies with membership estimated at 8,500 fishermen. The co-operatives have not been successful and most are inactive as well as unprogressive. Currently the cooperatives' main aim has been collection of commission from fishermen who actually sell their fish directly to dealers. Their problem include inadequate or dishonest management and resentment by fishermen about paying the co-operative dues, which are based on a percentage of the catch value.

The body to be formed would be charged with the responsibility of improving socio-economic conditions of the members, initiating them into modern methods of fishing, processing and storage, marketing of fish and providing the necessary inputs. The most important policy to deal with is the degree of technological advancement and sophistication which should be applied in the fisheries sector in the lake. For instance, introduction of trawlers would create imbalance and conflicts among the fishermen. There is need to adopt a careful policy involving a limited technological advancement beyond the present level. The body would also be expected to set up other industrial activities which are associated with fish. The body would be required to provide a medium for the convenient provision of credit facilities and services including provision of equipment to fishermen on easy and convenient terms. In case the government seeks to change policies, such a body would serve available purpose as channels of communication with those involved in the fishing industry.

It is most probable that by the formation of a body like Fisheries Development Corporation as an autonomous body to handle development of the fishing industry, those activities geared towards renewed economic growth among the fishermen in the region would be achieved. Some of the specific problems that would require the body to deal with include:

(a) Marketing

Successful organizations have more freedom of manoeuvre in pricing agreement under marketing policies. Currently the fisherman has no control over the prices, since the traders have the greatest influence on the prices agreed. The fisherman does not always sell his fish directly and is not able to control his distribution facilities. This makes it difficult for both wholesale and retail prices to rise in proportion to the cost of living and the cost of fishing. As it is at present any increase in the number of fishermen would result in decline in individual catches, subsequently would make his profit level get beyond his control, and consequently force him to reduce the mesh size, if possible, of fish as well.

(b) Developing the Region

There is reported malnutrition in the lake shore area affecting mainly the young children. There is also reported low standard of living of hired labour in the harvesting sector.

Theft of gillnets may be due to poverty, which may be stopped if the fishermen are assured of income beyond the poverty line. Recently there was an allegation that the fish dealers provide fishermen with boats to go fishing and are paid Ksh.200/=. Later the dealer sells his catch for Ksh. 10,000/= (Daily Nation, 3rd April 1991). This happens because the merchants approach the fishermen directly other than through the co-operatives.

Many full-time fishermen are compelled to go on migration trips when fish becomes scarce in their home area. Such fishermen should be assisted to derive maximum sustainable returns from the occupation, so as to avoid migration which is a consequence of economic dependence on fish. One way would be to provide credit facilities to enable these fishermen invest more on equipment required for effective fishing. The other probable way would be to suggest that recruitment into the fishing occupation be regularized and based on clearly set criteria. For instance, it should be made difficult for people engaged in other occupation such as farming to join the fish harvesting occupation.

Some of the objectives are obviously in conflict with each other. Maximizing employment in the region would be difficult to achieve simultaneously with maximizing economic benefits from the fishery. Likewise it would also be found rather difficult to supply adequate fish protein to those in the lake shore area, at the same time have enough supply for export markets. Highest profitability of the fish would be ensured by the production and export of high priced products at the lowest possible local costs. This would exclude the aim of making the fish available as food to the population around the lake shore. The other imminent problem will be how to maintain small-scale fish traders in business at the same time meet the demand of other large scale traders especially those owning fleets of trucks and vans. There is thus a need to carefully balance potentially conflicting goals. This can only be possible through liaison between the Corporation and other Ministries with similar problems.

4.1.2 Role of the Government

The role expected from the Government in order to promote development in fisheries of the lake include among others:

(i) Improving infrastructures such as access roads, rural electrification and water to landing points as well as communication infrastructure with the major markets including those at the rural level.

(ii) The future of Lake Victoria fisheries will depend on collaboration among fishermen. This calls for measures aimed at strengthening the organization by developing fisherman's interest in the most appropriate education programmes. This calls for concerted efforts to educate the fishermen on the benefits of forming an organization to look after their interests.

(iii) It is true that most of the fishermen in Kenya waters of Lake Victoria have much knowledge about their fishing occupation. It may only be necessary therefore to mount some little training programmes to adopt the fishermen to any modern and mechanized fishing which may be introduced in the region.

(iv) Enforcement of management measures requires consultation between all parties. Fisheries regulations are unpopular among fishermen

because they restrict the individual fisherman's catch under circumstances where it is difficult to get a satisfactory catch even without restriction. It is vital that fishermen through the Corporation are made to know and understand the regulations and also be progressively associated in their elaboration and implementation.

(v) Taxation levied on the fishing inputs including import duties should be removed or reduced as in the way the agricultural sector inputs have been handled. It has been noticed that there is a decrease in net production, which may be due to high price of the nets. Due to the same taxation levied on outboard engines the fishermen are unable to acquire them.

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APPENDIX 3.6 : SOME SOCIO-ECONOMIC ASPECTS OF LAKE VICTORIA ARTISANAL FISHERIES RESOURCES (KENYA)

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1. INTRODUCTION

Lake Victoria is still the most important fishery in Kenya accounting for about 90% of the total national catch. In the last two decades, there has been progressive increase in catches from about 16,000 metric tons in 1968 to about 146,403 metric tons in 1989 valued at kshs 819 millions.

Lake Victoria was for a long time a multispecies fishery comprising mainly the cichlids, cyprinids, siluroids, mormyrids and some significant quantities of protopterus. The main cichlid species were Haplochromis spp. group, Oreochromis esculentus and Oreochromis variabilis. The commercially important cyprinids included Labeo victorianus, Rastrineobola argentea, Barbus altianalis. Of the siluroids Clarias mossambica, Bargrus docmac and Synodontis victoriae were abundant. Mormyrus kannume was the most important lake mormyrid followed by smaller quantities of Marcusenius and Gnathonemus, Protopterus aethiopicus, a Lepidosirenid formed a small but important fishery.

Due to socio-economic activities of man, Lake Victoria has changed from a multispecies fishery to essentially three species fishery of Lates niloticus, Rastrineobola argentea and Oreochromis niloticus. Out of the 146,403 m tons of fish landed in 1989, the three dominant species accounted for 115,375 m tons valued at Ksh. 547,340,000 to the fishermen.

The possible factors which have led to the changes in Lake Victoria fishery could be summarised as follows:

(a) The preference given to Oreochromis esculentus and Oreochromis variabilis by the British during their rule in Kenya as suitable freshwater table fishes. By 1984, the Oreochromis esculentus answered the preference call by disappearing from our records.

(b) The use of destructive nylon nets which were introduced into the country from Japan in 1950 onwards. These nets were set in a crisscross fashion in seasonal river estuaries and mouths thereby dealing a crushing blow to the anadromes, heralding their possible extermination or reducing their numbers well below the suitable yield. Some of the more easy to catch anadromes like Alestes jacksonni disappeared first and consequently none was recorded from Kenya Waters of Lake Victoria in 1987. It is worth pointing out here that the traditional methods like weirs and traps could not exterminate the anadromous fish because setting up traps across a river was taboo among certain ethnic groups.

(c) The improved sese canoes enabled fishermen to exploit the more open waters of the Lake.

(d) With Oreochromis esculentus established as a prefer table fish, the fishermen took their own initiative and learned the ecology of the fish thoroughly and consequently perfected their fishing methods at the detriment of Oreochromis esculentus and other related species.

(e) The development of more internal and external markets without alternative ways of replenishing the stocks have contributed significantly in overfishing the popular species.

(f) The heavy rain of 1961-4 were unprecedented in the then living memory. Due to excessive rains and floods fish colonized more territories thereby revamping their population. The effect of heavy rain was the great increase in Oreochromis esculentus population in 1965-66 period. These tilapias which were popularly called "Ong'ogo" locally were quickly exterminated before any Lates niloticus nile perch was caught in the Kenya commercial fishery of Lake Victoria.

(g) After independence the Kenya waters of the Lake Victoria have experienced a most intensive fishing compared to other areas. This has been due to the fact that cash crop development side-stepped the immediate hinterland of the Kenya side whereas Uganda side had tea, coffee and other valuable food crops up to the shores of Lake Victoria and Tanzania had well developed cotton and rice farming in Southern and Eastern shows, while coffee and banana growing flourished in the north western shores, bordering the Kagera Region.

Other factors which might have contributed to the present state of fisheries in the Kenya waters of Lake Victoria are summarized below:

(i) It appears that the two exotic species of Nile perch and Oreochromis niloticus are partly filling the niche formerly held by the predatory catfish Bagrus and the herbivorous Oreochromis esculentus. Furthermore, to some extent Nile perch may be occupying part of the niches of Clarias and Protopterus though the fecundity of the latter is much less. However both Clarias and Protopterus can survive in relatively deoxygenated environment unlike the Nile perch. The Nile perch landings have risen steadily for the last decade though currently there are indications that it may decline. The present rise is maintained by going further a field and using a lot of nets to the extent that an ordinary fisherman would not cope with the cost of equipment.

(ii) Commercial fishing for Rastrineobola started in the early sixties whereas the use of attraction lamps was started in early seventies. Thus the chances are that it will naturally decline. It is already difficult for some of those resident around the lake to purchase Rastrineobola due to scarcity.

(iii) Papyrus swamps were recognised to be the main breeding areas of Protopterus. The heavy rains of 1961-4 undermined the rooting systems of the papyrus anchorage breaking large chunks resulting

in the floating islands of the 1960s. The cutting of large quantities of papyrus for mats and other cottage industries worsened the Protopterus ecology threatening the survival of this ancient species.

(iv) The anadromous mormyrids like Marcusenius and Petrocephalus succumbed to over-fishing the river mouths and estuaries in flood plains. At present only Mormyrus kannume which apparently evolved beyond returning to the rivers for breeding survives in small numbers, though it should be noted mormyrids were not dorminant in Lake Victoria during 1940's and 1950's.

(v) There seems to be correlation between the rise of Nile perch and the decline of Haplochromis. But it is not easy to make definite conclusions as to whether the Nile perch is responsible since large quantities of Haplochromis were already being harvested with seines and small gillnets.

2. SOCIO-ECONOMIC CONDITION OF ARTISANAL FISH TRADERS

Formerly artisanal fish traders dealt exclusively in dry fish. There were no open air markets we see today. The trader could take dry fish to a relative or friend living far from the lake. The fact that a fish monger is around would spread and interested local residents would come and exchange fish with food grains, cassava, sweet potatoes or livestock in a barter system.

The development of open air markets facilitated trade in fresh fish. Small scale traders carry fish on their heads to markets close to the beaches. This trade is popular with women.

The advent of bicycles led to the fresh fish trade to be extended to markets situated to a maximum of about 30 km from the landing beaches.

The situation has improved further due to a number of beaches becoming accessible to buses and the artisanal fish traders are able to market their fish in urban areas. With cold storage facilities in urban areas fresh and preserved fish finds its way to more urban areas thereby improving fish distribution.

Rastrineobola argentea is transported exclusively in the sun dried form and finds its way to all parts of the country. Its small body makes it handy for sun drying and the fact that it is utilized whole makes it particularly nutritive.

Presently women dominate the artisanal fish trade. They have even strengthened their hands further by buying fishing gear for some fishermen. This practice gives the trader the facility of regular supply.

For a long time artisanal fish traders have been the backbone of fish trade in Lake Victoria. But now they are slowly being replaced by powerful middlemen who are able to pay higher prices and also assure the fishermen of a regular customer, who can more or less take the whole catch and essentially eliminate the burden of post harvest losses from their shoulders.

Marketing systems and the role of Middlemen

The marketing systems relate to that period when the catch is hauled into the fishing vessel to the time when the consumer will purchase the fish or fish product for final consumption.

The fish market systems include the following :

(a) Fish landing markets where fish is bought by final consumers right at the beach.

(b) Local open air markets where fish is taken by the very small artisanal fish traders - mainly members of "Eve Stock" in the nearby markets which are within walking distance from the landing beach. Fish presented in these markets are half smoked if they happen to be juvenile nile perch or fried in own fat if adult Nile perch cut into convenient pieces. Oreochromis is presented fresh in these markets, and any unsold by the end of the day can be brought back home and processed in the late evening.

(c) More inland markets say 20 or so kilometres are mainly supplied by cyclists who are normally men and fish is presented fresh. Any fish remaining unsold at the end of the day is taken home for processing and can be sold to women who could take to the market the next day or alternatively taken to nearby markets by the trader's wives while the men cyclists go to beaches to buy more.

(d) Then we have the interior markets which are too far for unpreserved fish because the risk of spoilage is enhanced by the long time taken in transit, hence fish to these markets are more or less invariably preserved in one way or the other. In case of Nile perch the fish is deep fried in its own oil (frying in vegetable oil would be too expensive and neutralise the profit) or smoked chunks or whole for smaller specimens. Most of these are Municipality or County Council or Town Council markets where fish is sold on racks built in open air. The fish is transported in buses or pick-ups.

(e) The other marketing system comprises essentially an additional middleman, normally resident in an urban area and has some cold storage facilities like one or two deep freezers. An artisanal fish trader collects fish from the beach and transports to the urban area where the second middleman buys his fish. The second middleman sells his fish to the local residents or he may have customers in other urban areas where he may decide to take surplus fish.

(f) Then we have the large scale fish dealer who owns refrigerated vehicles and cold storage facilities in an urban area. The trader sends refrigerated vehicles to various landing beaches around the lake to buy and collect fish. The iced fish is taken to the factory in the urban area where it is processed for immediate sale to residents or for export trade. The export markets earns Kenya much needed foreign exchange.

It is worth noting that before the rise of the Nile perch most species caught were popular with the local population and surpluses were consumed in the main urban areas.

Thus there was no marketing problem because the whole catch could be easily disposed of or processed. The indigenous species had less fat content and could be split, gutted, washed and sun-dried and could take months without going bad. Hence, any unsold fish could be split and sun-dried. The split sun dried Oreochromis esculentus, O.variabilis, Labeo victorianus and Protopterus aethiopicus were delicacies among certain groups. Labeo Victorianus had the added advantage of being a choice dish when hot smoked - a process which made it boneless and was referred to as "dunya".

However, the Nile perch introduced into the Lake Victoria seems to have found the new environment very favourable and therefore it grows very fat and big. Due to high fat content among other characteristics the Lake Victoria Nile perch cannot be sun-dried unless under very special circumstances, hence it must be either sold immediately when landed or be preserved in one way or the other without delay otherwise the post harvest losses could be very high in no time. The largest nile perch ever recorded in Lake Victoria Kenya Waters was a female weighing 189 kg. and 2.2 meters long caught by beach seine at Madundu in Uyoma, Siaya, in 1978.It was about 65% fat.

The rise of the wealthy fish traders was facilitated by the inability of the local artisanal fish traders to cope with large quantities of Nile perch landed by the artisanal fishermen. The inability of the fishermen co-operatives to organize fish marketing on co-operative basis also played a part in encouraging these fish dealers to venture into Lake Victoria fish trade.

3. THE ROLE OF THE MIDDLEMAN:

The role of the middleman is complex and involves several disciplines like salesmanship, marketing, accounting, storage, transport and law to mention only a few. Middleman-ship in a moderate scale fish trade calls for considerable funds to establish transport and storage facilities.

After landing, the fish is taken over by the middleman who now takes the risk of possible post harvest losses, fish being such a highly perishable commodity. The middleman facilitates the movement of fish in areas where the fisherman could be a total stranger let alone the loss of fishing time if the fisherman was to involve himself in fish trade. Due to the presence of the middleman, the primary producer has more time to his trade.

After spending several hours in the lake, the fisherman has no energy left to handle the complexities of fish trade. This is the case with the artisanal fishermen on Kenya side at Lake Victoria.

4. THE PROBLEM AFFECTING FISHERIES AND FISH TRADE IN LAKE VICTORIA KENYA WATERS:

The problems facing the fishing industry in the Lake Victoria Kenya waters are summarized as follows :

(i) Lake Victoria being a limited inland lake, there is possibility of depletion of stocks of fish. This problem is very real and calls for genuine cooperation among the three riparian States of

Kenya, Uganda and Tanzania. The fields of cooperation should include research, legislation and utilization of the resources in the lake. Other areas of cooperation for mutual benefit could also be worked out. States could facilitate fish farming to reduce pressure on lake fishery.

(ii) Lack of access roads to some important landing beaches enhances post-harvest losses and depresses the fishery activity. This problem is particularly serious during the rainy seasons when the beaches become inaccessible.

(iii) Lack of cold storage facilities at the landing beaches is another problem.

(iv) The fishermen need constant education to enable them manage their businesses more fruitfully and for the individual fishermen to invest intelligently in view of the fact that some of them have passed the subsistence level mark. In 1989 primary proceeds from fish sales stood at Ksh. 747,063,000. This figure divided by the 30,000 or so fishermen, gives a capital income of approximately K£ 1078 excluding fish taken for the daily meals. The time appears to have come when it is not strictly accurate to grade all artisanal fishermen as subsistence people. This is particularly so when their other occupations like farming and other forms of businesses are considered.

(v) Pollution and environmental degradation from factory effluent and denudation enhanced by over-exploiting forests and bushes encourage silting and other dangers to the aquatic environment.

(vi) High custom duty on fishing gear makes them expensive.

(vii) Insecurity of fishing gears resulting from thefts is common. A carefully organized fisheries anti-poaching unit could help.

5. ADDENDUM:

5.1 For the last few years, there has been some significant increases in the landings of anadromous fishes in the Kenya Waters of Lake Victoria. The species have included Labeo, Schilbe, Clarias. Even Synodontis which did not quite disappear at the height of Nile perch dominance appear to have increased. The non anadromous fish Haplochromis catches have also gone up to some extent. Appreciable quantities of fresh Protopterus is now a common sight in local markets.

It would be interesting to work on the relationship between the rate of recovery of the above species and the heavy rate of harvesting of the predator Lates niloticus.

5.2 PROJECTED LAKE VICTORIA (KENYA SECTOR) PRODUCTIONS

year	metric tons
1990	133,848
1991	139,242
1992	144,770
1993	149,133

The projections should be watched and compared to what transpires at each stage to help in improving future project techniques.

5.3 The development of Nile perch in Lake Victoria has made Kenya a net exporter of fish and fish products for the first time in the history of the lake.

5.4 Justification for intensifying fish farming in Kenya to save Lake Victoria artisanal Fisheries

As the productivity limits of the Kenyan sector of Lake Victoria approach, alternative methods of maintaining or increasing fish production have to be developed through aquaculture. More specifically fish production can be increased by the following techniques:

(a) improving fishing methods;

(b) increasing or expanding areas of fishing operations;

(c) fish breeding and protection of nursery grounds; and

(d) fish farming practices.

Fish farming where possible is the best method of increasing fish production because in method (a), the fishing gear technology has developed to over efficiency thus further improvement in killing fish from natural waters would herald fish extermination.

Method (c) of fish breeding and nursery grounds would mean raising fingerlings and stocking the lake and then protecting the nursery grounds. To be useful would mean imposing unacceptable restrictions on the local fishermen operating in an essentially international lake with free aquatic fish movement since fish is oblivious to immigration rules.

Method (d) of introducing more exotic productive species like "mbuta" might be counter productive due to unforeseen circumstances in a new environment.

The brief analysis above leaves technique(s) of fish farming the most attractive and relatively harmless method of increasing fish production. Furthermore, the urgency of investing more in fish farming in this area is abundantly justified by the indications that Lake Victoria fishermen have passed or are about to pass maximum sustainable yield of Kenya side of the lake. Fish is a depletable and renewable natural resource. Hence to encourage and financially support fish farming hardly needs any emphasis.

It is impossible for us to depend on natural fish populations alone like our prehistoric ancestors who depended entirely on wild animals and fruits. This was only possible because of their low population and lack of advanced technology. Finally, it should be noted that the first recorded justification for fish farming was done by the ancient hieroglyphic scribbling subjects of the Pharaohs, 4500 years ago in Africa!

TABLE 1: LAKE VICTORIA LANDINGS : KENYA WATERS

YEAR	PRODUCTION IN METRIC TONS	VALUE IN KSHS.
1968	16100	1,416,710
1969	17442	16,047,000
1970	16400	15,482,000
1971	14918	15,333,000
1972	15989	16,825,000
1973	16797	18,127,000
1974	17175	21,007,000
1975	16581	21,308,000
1976	18680	24,050,000
1977	19332	25,681,000
1978	23856	36,980,000
1979	30592	57,095,000
1980	26914	58,805,000
1981	38179	85,346,000
1982	111263	60,791,600
1983	77327	120,300,000
1984	71854	133,310,000
1985	88589	190,560,000
1986	103163	237,300,000
1987	113452	317,113,062

Table 2 : Fish production and value by species for the Kenyan waters of Lake Victoria

	1968		1969	
	M.Tons	KShs	M.Tons	KShs
Alestes	346	320,177	56	45,000
Bargrus	1129	726,772	966	514,000
Barbus	494	634,686	443	242,000
Clarias	1710	1,256,622	1354	950,000
Rastrineobola	720	595,018	520	581,000
Haplochromis	3684	2,609,581	6427	4,652,000
Labeo	586	627,603	467	406,000
Mormyrus	52	41,085	73	45,000
Nile Perch	-	-	-	-
Protopterus	2764	2,075,481	1626	1,351,000
Schilbe	388	222,423	248	141,000
Synodontis	177	144,504	256	138,000
O. esculenta	2107	3,303,769	3951	5,868,000

Table 2 : Continued

	1970		1971		1972	
	t	Shs	t	Shs	t	Shs
Alestes	11	7,000	19	10,000	2	2,000
Bagrus	1091	667,000	1056	660,000	856	3,540,000
Barbus	494	300,000	230	287,000	268	320,000
Clarias	1617	1,270,000	1862	1,851,000	2725	2,974,000
Rastrineobola	524	53,000	759	534,000	1255	1,018,000
Haplochromis	5357	3,673,000	4762	3,641,000	4644	3,441,000
Labeo	296	283,000	228	266,000	310	375,000
Mormyrus	82	52,000	73	53,000	77	75,000
Nile Perch	-	-	-	-	38	73,000
Protopterus	1629	1,380,000	1798	1,547,000	1915	2,052,000
Schilbe	69	42,000	56	49,000	70	111,000
Synodontis	181	105,000	110	99,000	202	227,000
O esculenta	3686	5,970,000	2407	4,739,000	1480	2,939,000
O other	2366	1,958,000	735	1,040,000	889	1,446,000

Table 2 : Continued

	1973		1974		1975	
	t	Shs	t	Shs	t	Shs
Alestes	3	2,000	1	1,000	10	4,000
Bagrus	1446	1,058,000	1103	1,123,000	1371	1,523,000
Barbus	183	240,000	127	272,000	214	534,000
Clarias	2628	3,296,000	2211	3,241,000	2417	3,368,000
Rastrineobola	1768	1,693,000	3742	3,698,000	4704	4,540,000
Haplochromis	5569	3,982,000	6013	5,430,000	4484	5,106,000
Labeo	141	176,000	59	103,000	94	189,000
Mormyrius	182	162,000	136	163,000	57	76,000
Nile Perch	146	154,000	81	131,000	52	81,000
Protopterus	2024	2,735,000	2179	3,748,000	1501	2,900,000
Schilbe	159	171,000	31	48,000	32	44,000
Synodontis	219	212,000	196	220,000	134	173,000
O. esculenta	304	806,000	57	149,000	25	60,000
O nilotica	488	1,018,000	411	1,082,000	197	524,000

Table 2 : Continued

	1976 t	1976 Shs	1977 t	1977 Shs	1978 t	1978 Shs
Alestes	3	3,000				
Bagrus	1025	1,113,000	1141	1,277,000	183	2,036,000
Barbus	182	470,000	183	508,000	207	522,000
Clarias	2507	3,995,000	1755	3,202,000	2047	4,189
Rastrineobola	5652	5,211,000	6704	6,891,000	8710	9,928,000
Haplochromis	6368	7,342,000	6255	5,536,000	6621	7,264,000
Labeo	123	175,000	62	1,024,000	148	262,000
Nile Perch	97	150,000	203	382,000	1066	1,873,000
Moryrus	89	140,000	102	173,000	132	247,000
Protopterus	935	1,823,000	773	1,627,000	653	1,513,000
Schilbe	51	109,000	129	268,000	120	252,000
Synodontis	191	285,000	310	399,000	155	243,000
O esculenta	49	157,000	42	103,000	1549	3,678,000
O nilotica			465	1,398,000	972	3,640,000
O others	274	337,177			1815	1,728,000

Table 2 : Continued

	1980	
	t	Shs
Alestes		
Bagrus	462	1,293,000
Barbus	421	2,258,000
Clarias	1223	3,012,000
Rastrineobola	943	17,306,000
Haplochromis	3636	4,328,000
Labeo	482	1,430,000
Mormyrus	333	514,000
Nile Perch	4310	7,434,000
Protopterus	370	1,060,000
Schilbe	117	266,000
Synodontis	388	910,000
O esculenta	90	388,000
O nilotica	1184	4,927,000
O others	3739	12,376,000

Table 2 : Continued

	1981		1982		1983	
Alestes	4	11,000	2	8,000	4	12,000
Bagrus	430	964,000	2532	5,060,000	1243	2,483,000
Barbus	292	1,598,000	682	1,822,000	100	359,000
Clarias	1003	2,728,000	2062	5,599,000	845	1,980,000
Rastrineobola	7635	13,284,000	10419	14,121,000	16444	17,853,000
Haplochromis	916	1,599,000	2546	3,394,000	621	754,000
Labeo	112	339,000	918	1,889,000	81	153,000
Mormyrus	208	454,000	33134	60,381,000	218	417,000
Nile Perch	22834	45,817,000	26780	3,510,000	52377	72,905,000
Protopterus	189	485,000	239	912,000	108	340,000
Schilbe	49	138,000	78	273,000	22	111,000
Synodontis	127	320,000	232	907,000	47	274,000
O esculenta	139	548,000	399	2,107,000	108	511,000
O nilotica	1858	8,523,000	2581	14,406,000	1516	14,061,000
O others	1900	7,437,000	1495	7,338,000	1658	6,559,000

Table 2 : Continued

	1984		1985		1986	
Alestes	1	14,000				
Bagrus	88	226,000	16	220,000	62	182,000
Barbus	53	241,000	113	701,000	248	2,147,000
Clarias	780	1,765,000	547	1,814,000	762	2,508,000
Rastrineobola	19437	24,259,000	25866	35,806,000	24518	47,746,000
Haplochromis	41	73,000	6	22,000	3	8,000
Labeo	58	119,000	-	-	161	328,000
Lates	41319	65,914,000	50029	89,308,000	56975	114,648,000
Mormyrus	89	211,000	49	128,000	51	135,000
Schilbe	3	24,000	5	23,000	25	158,000
O nilotica	6136	29,857,000	7573	48,152,000	7853	59,036,000

Table 2 : Continued

	1987	
Alestes		
Bagrus	40	162,000
Barbus	125	1,021,000
Clarias	345	1,375,000
Rastrineobola	33145	48,598,000
Haplochromis	183	296,000
Labeo	477	1,322,000
Lates	68545	181,877,000
Mormyrus	11	43,000
Portopterus	58	315,000
Schilbe	-	-
O esculenta	-	-
O nilotica	5025	71,304,000

Table 3 : HAPLOCHROMIS AND LATES LANDINGS

YEAR	HAPLOCHROMIS SPP.	LATES NILOTICUS
1968	3684	-
1969	6427	-
1970	5357	-
1971	4762	-
1972	4644	38
1973	5569	146
1974	6013	81
1975	4484	52
1976	6368	97
1977	6255	203
1978	6621	1066
1979	-	-
1980	3636	4310
1981	916	22834
1982	2546	26780
1983	621	52377
1984	41	41319
1985	6	50029
1986	3	56975
1987	183	68545

TABLE 4 : LAKE VICTORIA LANDINGS: KENYA WATERS

YEAR	PRODUCTION IN METRIC TONS	VALUE IN KSHS.
1988	125,071	493,021,000
1989	135,431	647,063,000
1990	185,101	354,973,000

TABLE 5 : LAKE VICTORIA PRODUCTION BY SPECIES 1989

SPECIES	M. TONS	VALUE 000 SHS
Alestes	-	-
Bagrus	18	112
Barbus	213	1384
Clarias	405	3027
Rastrineobola	45464	140476
Haplochromis	4759	6411
Labeo	49	412
Lates	56810	261415
Mormyrus	403	4166
Schilbe	15	111
Protopterus	24	237
Synodontis	*	4
O. nilotica	13101	139449
Oreochromis	4707	45687
Unspecified	9363	44172
TOTALS	135431	647063

*: Less than 1 (one) ton.

APPENDIX 3.7 : LINKAGES BETWEEN THE FISHING INDUSTRY, RESEARCH, POLICY MAKING AND IMPLEMENTATION FOR LAKE VICTORIA

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1. INTRODUCTION

Lake Victoria plays a critical role in the economic and social development of the riparian countries of East Africa namely Kenya, Uganda and Tanzania. Its highly productive ecosystems supporting a wide range of economic activities such as fisheries, transportation and tourism. Increasing population and economic and social development in the Lake Victoria basin placed heavy demands on the lake's fishery and water resources and often have resulted in natural resource depletion, environmental degradation and conflicts over the use of valuable resources.

There were over 54,000 fishermen using over 11,000 boats in the whole of Lake Victoria by 1974. Of these, Kenya waters had the highest concentration of fishermen, over 25,000 followed by Tanzania waters over 20,000 and lastly by the Uganda waters, over 8,000 fishermen (CIFA, 1983). There have been agricultural and industrial developments in the form of the use of chemical fertilizers and pesticides in the tea, coffee, paper and sugar processing industries in the lakes catchment area whose effluent drain into the lake.

The resources problems which stem largely from overexploitation are due mainly to poor planning allocation and management. The harvesting of the natural resources in the lake must therefore be effectively managed if present and future opportunities for socio-economic development are to be assured.

Certainly in the last 10 - 20 years the disappearance of Oreochromis esculentus and appearance of Lates niloticus in the lake and the blame of L. niloticus that has eaten all tilapias and small fishes have been the subject of public debate.

It is argued that Nile perch has resulted in an increase in the annual fish production from about 300,000 to 400,000 metric tonnes, employment, financial returns to the fishing industry and reduced consumer price (Grèboval, 1989). On the other hand, Nile perch has been in the lake only for about one decade and already is showing signs of decline. Are these benefits therefore long term in the light of the transient nature of the Lake Victoria fisheries. This reflects on the one hand the requirements of the society for proper fisheries research to support national objectives on fishery sector for proper management.

The overall problems of Lake Victoria fisheries are:

i) The decline in catch per unit effort of the fishery of endemic species and the subsequent growth of the fishery of non-endemic species.

ii) The decline in number of fish species that were endemic to Lake Victoria.

iii) Lake Victoria is fully exploited and there is need to establish what capacities of fishing efforts can be supported and the appropriate fishing gears used in order to avoid depletion or disappearance of certain stocks. Almost 60% of the total annual fish catch in Kenya come from the Kenya waters of Lake Victoria.

Today, the most important issue which the three East African countries (Kenya, Tanzania and Uganda) face is the urgent need to bring the fisheries and any other aquatic resources of Lake Victoria under proper management in order to avoid overfishing and the loss of huge benefits brought about by new fisheries regime (Gréboval, 1989).

The overall objective is to evaluate the rationale of the existing regulations in order to improve on their weaknesses and formulate new regulations which are realistic. Further more efforts should be made to institute public awareness of these regulations to the fishermen through mass media and public fora so that their enforcement is more effective.

2. FISHERY DEVELOPMENT

Fishing has always been an important occupation of the people around Lake Victoria. Before the introduction of the cotton gillnets in 1905, hooks and lines, harpoons, lances, fences and basket traps were the main fishing gear used. The fishing pressure was determined by the subsistence needs of the people living around the shores. The main fish species caught included tilapias (Oreochromis esculentus and O. variabilis), mormyrids, catfish, anadromous cyprinids (Labeo victorianus and Barbus spp.) and Lungfish.

Higher catch rates were brought about by the introduction of cotton gillnets in 1905 and flax gillnets during 1916. This created a fishery based primarily on O. esculentus. This demand for fish was very high when the Mombasa - Kisumu railway was completed in the early 1900s. This led to the increase of number of gillnets used in the Lake. This uncontrolled entry into the fisheries confined to the shallow inshore waters soon resulted in the decline in catches per unit effort, particularly in the Kenya part of Lake Victoria. Graham (1929) reported decline of the fishery of the tilapias. The average catch of O. esculentus per standard 45 m net per day was about 100 fish in 1905, 30 in 1921 and 7.8 in 1928 (Acere 1988).

Certain measures were instituted. Firstly, in 1933 the gillnet had a mandatory stretched mesh size of no less than 127mm to avoid catching immature O. esculentus. Beach seines were retained. Secondly, the collection of catch statistics was started. Thirdly, in 1947 the Lake Victoria Fisheries Service was created, with authority for complete control of fishing power. In the same year the East African Fresh Water Fisheries Research Organization EAFFRO was formed.

Several other developments happened within the fishing industry in the 1950s. In 1952 terylene and nylon gillnets were introduced in the lake. These nets had high initial cost but with higher catching efficiency and a longer working life than flax gillnets. Outboard engines began to be used from 1953. The initial increases were short lived. The average catch per net fell from 2.7 to 1.6 fish in 1954 (Acere 1988).

The enforcement of the 127mm mesh size regulation was very difficult and the Government of Kenya replaced it in 1961.

Since 1952 medium gillnets (52 - 65mm) have been used at river mouths and have removed ripe fish from the population at the beginning of the spawning migration. Labeo victorianus was overfished by that method. In Late 1950s gillnets below 127mm were used to capture non cichlids species, i.e., Bagrus, Clarias, Barbus and Protopterus.

In the early 1960s, gillnets below 90mm mesh came into use for the tilapias although some non-cichlids had disappeared from the catches because of the previous use of small mesh nets and traps at the mouths of rivers. Smaller mesh gillnets between 46 to 38mm were in use by late 1960s to harvest smaller fish species such as the haplochromine cichlids and Synodontis spp. which previously had been unexploited. The beach seines, have also been introduced in the lake to harvest haplochromines and large numbers of brooding juvenile tilapias and juvenile Nile perch. The mosquito seine (13mm mesh), which also captures juvenile haplochromines is being used in some parts of the lake. O. esculentus and O. variabilis have disappeared from some parts of the lake. By 1981 the haplochromines had disappeared from Kenya waters, while Schilbe mystus, Alestes nurse, Synodontis spp, Clarias mossambicus, Bagrus docmac and Protopterus aethiopicus were rare.

Finally, even the present booming fisheries of Lates niloticus and O. niloticus are doomed if the use of small mesh gears including trawling and beach seining continues unabated (Acere, 1988).

There should be interactive linkages between the fishing industry, research, policy making and implementation for proper management of the Lake Victoria fisheries.

3. INTERACTION BETWEEN THE FISHING INDUSTRY, RESEARCH INSTITUTES AND FISHERIES DEPARTMENT POLICY MAKERS

In capture fishery sub-sectors, resource considerations are fundamental as the availability of stocks in sufficient quantities forms the basis of exploitation. The fisherman must need accessible technology for harnessing the catch. The fish and fish products must reach consumers either internally or through the export markets.

A researcher looks at the preservative and conservative level, while the developer sees it at managerial level. For example, the availability of fish stocks affects the fisheries sector and, in turn, the manner in which the stocks are exploited affects the biological environment. The environment on the other hand determines the amount of fish naturally produced by virtue of its inherent productive capacity.

For proper fisheries management the researcher has to research on the fish stocks and the environment in order to give the results to the fisheries manager. In turn, the manager educates the fisherman on how to exploit the resource on a sustainable basis (Fig.1).

Both the manager and the researcher evaluate whether the enforcement of the fishery regulations is effective. There should be a report between the developer, the fishermen, the researcher and the industrialist.

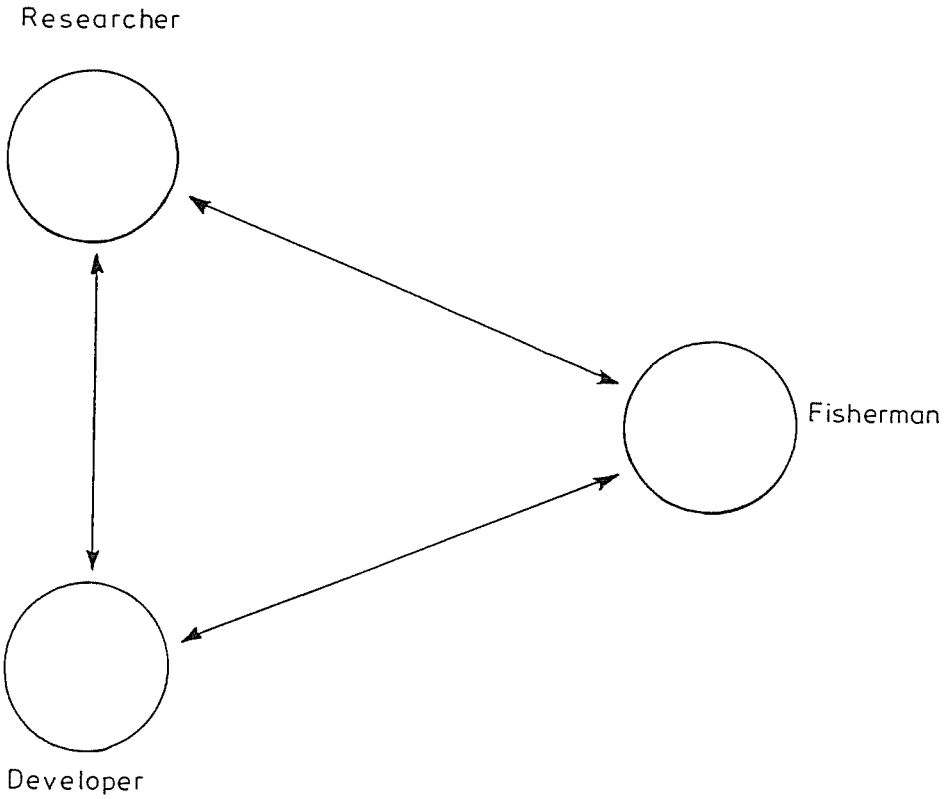

Figure 1.: Interaction amongst researcher, Developer and Fisherman.

3.1 Fishery Institutions:

Two institutions have been established to implement the government's policy on fisheries. These are the Department of Fisheries within the Ministry of Regional Development and the Kenya Marine and Fisheries Research Institute in the Ministry of Research, Science and Technology. The first is concerned with the implementation of fisheries policies and the latter with fisheries research.

3.2 Department of Fisheries:

The fresh water station charged with the fisheries of the Kenya waters of Lake Victoria is based in the Nyanza Province, with its headquarters at Kisumu. It is headed by an Assistant Director of Fisheries. In addition, there are five stations, in the five Districts each headed by a District Fisheries Officer.

3.2.1 The Role of Fisheries Department

The functions of the Department (Nyanza and Western Province) include market surveys, fish quality control, licensing (although the decisions regarding who are to receive licenses are made at the headquarters in Nairobi), the collection and analysis of fishery statistics, supporting the fishermen's cooperatives, fishery extension and the enforcement of management regulations. The enforcement has been carried out for a long time but needs to be intensified and also the results evaluated to test their effectiveness. The Department has no fishery research function.

3.3 Kenya Marine and Fisheries Research Institute

The Institute conducts research on marine and inland fisheries, aquaculture, basic and applied research on the aquatic environment, fish biology, fish technology and marketing economics. KMFRI gathers and disseminates information on fisheries science and management. Its headquarters based in Mombasa houses the centre for marine research. The station charged with research on the fisheries of Lake Victoria is situated at Kisumu. It conducts research on limnology, freshwater fisheries, marketing, economics and aquaculture. Its sub-station at Sangoro also conducts research on endangered fish species, limnology, fish biology, aquaculture, fish technology, marketing and stock assessment and riverine fisheries. The Institute has a large staff of 124 scientists.

3.3.1 Role of the Researcher in the Fishing Industry:

According to the Ministry of Research, Science and Technology Research Development strategies: 1990 - 2010, the research activities of KMFRI have to be targeted on fisheries and other related aquatic resources. The highlighted research roles for KMFRI are:

(a) Appropriate technology for fishing in lakes;

(b) Efficient system of transportation, processing, storage, preservation and marketing of fishery products to make them acceptable to local and export markets;

(c) Utilization of fish by-products;

(d) Identification of species for fish culture adaptable to local conditions including disease control methods and integration of fish farming with other farming systems;

(e) Fish stock assessment in inland waters of Kenya;

(f) The biology and ecology of major fish species and other aquatic organisms of commercial importance; and

(g) Fish marketing and socio-economics of fishing communities.

Proper industrial exploitation of fishery resources requires the knowledge of the amounts that can be economically harvested without depleting the resource. It is also important to know whether the resource is available all the year round or seasonally. Thus research on stock assessment is essential and can provide key information/outputs for the development of the fishery. Unfortunately, inadequate attention is often paid to determining research priorities. The result may be that too much attention is paid to theoretical research (academic bias in fisheries/fish culture research institutions) or to minor aspects (i.e. research on species which are of no economic importance). Furthermore, key aspects such as sociology, economics, marketing are often neglected. Finally, research should be regularly assessed and programmes which have not or are unlikely to produce tangible and relevant results should be terminated.

3.4 Role of the Fisherman

A fisherman is a very important person in the fishing industry as he is the one who fishes. He can destroy the fishery or protect it. His aim is to hunt fish and catch more. It is therefore important to educate the fisherman on the importance of fisheries management regulations, mesh-size regulations, and the damaging role played by illegal and destructive gear and toxic substances in the fishery.

3.5 Role of Private Entrepreneurs on Research Activities:

A private Fisheries entrepreneur is interested in the exploitation of a fisheries resource. He may employ people to fish for him, fish himself, process the catch and market it. He interacts very much with the fisherman, the fisheries manager and the researcher. He may fund research to locate and assess a fishery resource to find out whether it can be profitable for investing.

Shortage of money for research at all levels inevitably results in researchers looking for private organization to fund their research activities. Discussions are carried out and where research fits the aims of the respective organization, money is provided and a contract be signed.

4. FISHERIES DEVELOPMENT PLANNING

The objective of fisheries development planning can be defined as the benefits that the owners who is the Government of a fishery resource wish to obtain from its exploitation. Objectives are generally based mainly upon political considerations. Objectives are, therefore, broad national aims that have to be translated into physical and quantitative terms (Fig. 2).

The current National Development Plan (1989 - 1993) identifies the policy objectives of job creation, food self-sufficiency and security,

increased rural household income, and foreign exchange earnings which in turn would contribute towards national economic growth.

There are three conditions that must be met if the fishery resources of riparian countries are to yield and derive economic and social benefits (Fig. 3) which are:

(a) the states must have clear objectives which they wish to achieve from the exploitation of the fishery;

(b) the administration must have the necessary knowledge and information about the resource and the authority and capacity to establish, enforce and evaluate the conditions of its exploitation; and

(c) the administration must be able to translate government objectives into achievable goals.

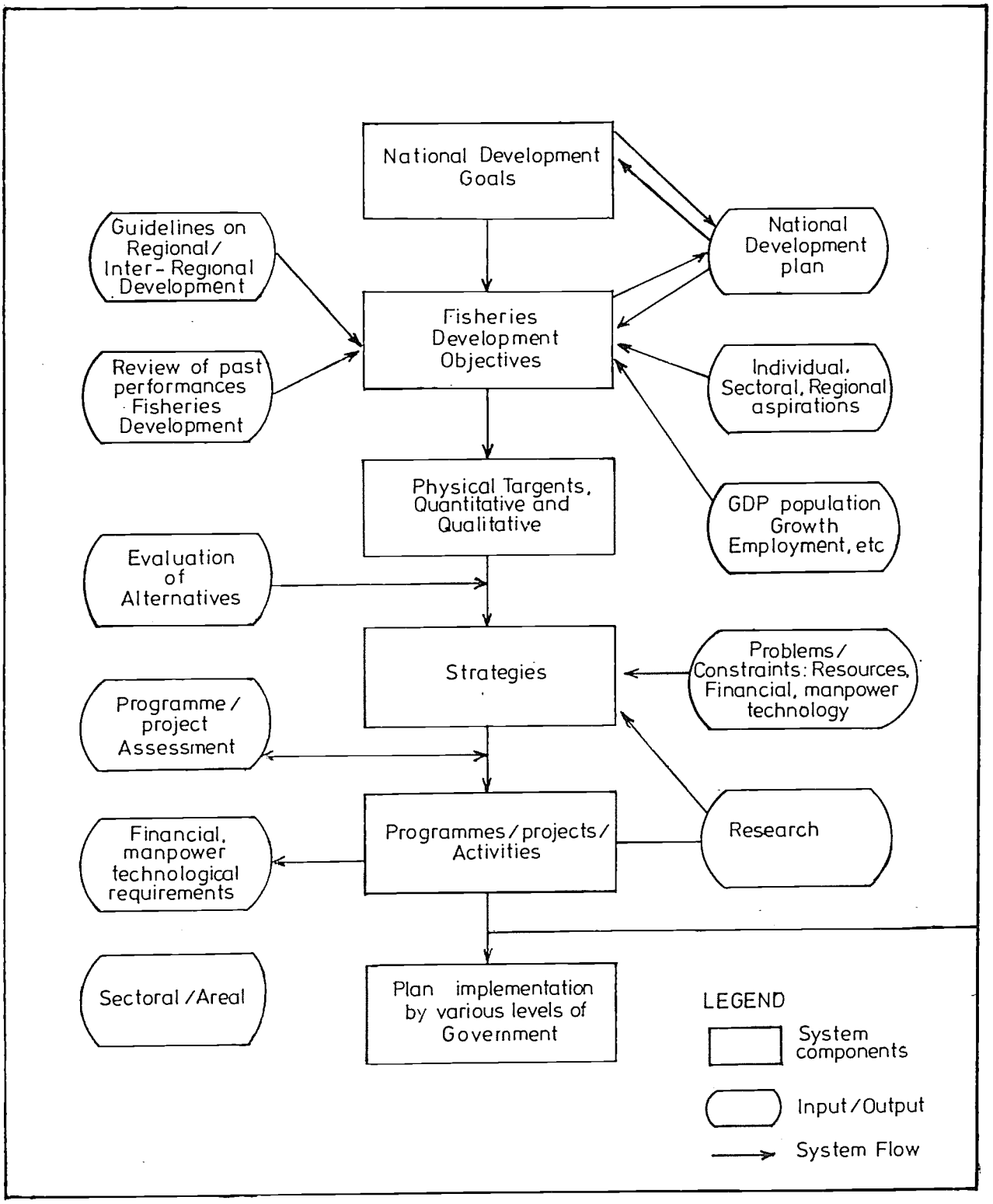

Fig 2. The Fisheries Development Planning System.

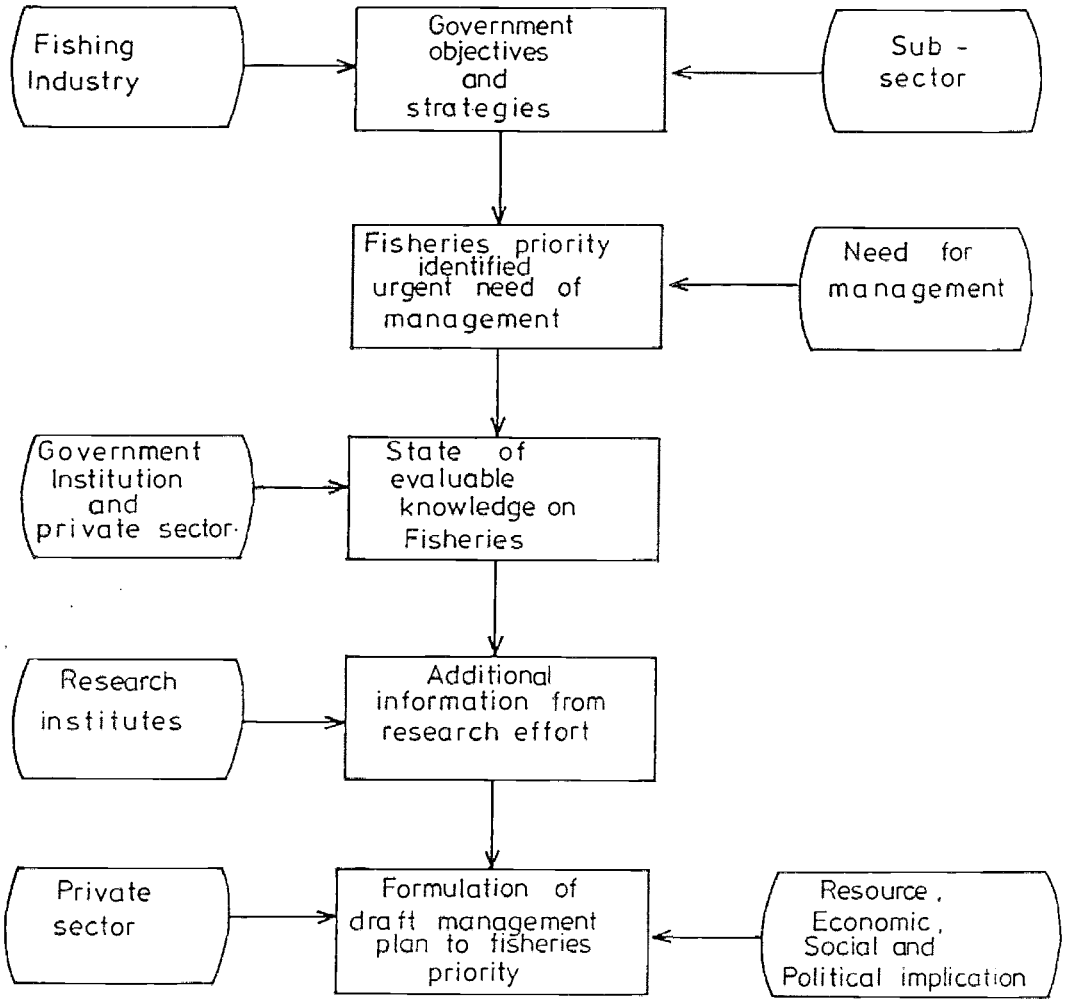

Figure 3 Management of Fisheries

An individual fisherman's skills and his knowledge of the fishing grounds and fish movements, where to go and, where not to go, often account for at least as much as advanced technology. That knowledge often built up by father to son over several generations is jealously guarded and explains the wide disparity between catch rates of identical fishing crafts.

Even when planners exercise caution, mistakes can be made. Very often in the past, planners have assumed that the performance of one of the better fishermen in an improved boat or with improved gear will be replicated through the fleet. It usually cannot.

At the preparation stage, therefore, planners need not only information over a fairly long period of fish catches and size distribution but also a clear indication of the relative performance of the different boats in the fishing fleet.

The government has generally sought to disinvest from direct involvement in fishing and associated activities. Instead it anticipates that the private sector continues to take the lead role in fisheries development.

The government (through the Central Bank) exercise the right to convert export earnings into local currency and to retain 100 percent of the foreign currency for its own use. This, coupled with the administrative difficulties in obtaining permission to purchase foreign currency from the Central Bank for use in importing the means of production for example boats, engines, spare parts and gears, acts as a disincentive to private sector investment.

The government's decision to permit the establishment of "export processing zones" will allow designated processing establishments to buy and sell in foreign currency, and to retain all their profits in foreign currency. Such establishments will be permitted to purchase and produce fish from outside the country, and to process and export it from Kenya. These initiatives are expected to provide further encouragement to private sector investment.

4.1 Linkage Between Research and Development Activities

There has been very little interaction between the fishing industry, Research Institutes and the Fisheries Department policy makers. Results from research on fisheries management may be used for the formulation of the national plans.

Fisheries Department formulates fisheries regulations and passes them over to the Ministry of Regional Development which finally submits them to parliament for ratification to become fisheries laws. Fisheries Department executes the fisheries regulations.

5. BOTTLENECKS FOR VARIOUS INTERACTIONS ON LAKE VICTORIA

Difficulties experienced to date by national and international initiatives to address lake victoria fisheries issues can be attributed to a number of factors, including:

(i) inadequate support from political leadership and the community;

(ii) inadequate knowledge and understanding of the ecological and economic relationships among resource systems;

(iii) inability to quantify economic losses due to environmental degradation or resource depletion;

(iv) lack of resolving multiple resource-use conflicts; and

(v) inadequacy of policies on resources allocation due to lack of consideration of the environmental consequences.

5.1 Current Management Issues

The benefits derived from the fisheries of lake victoria have reached unprecedented levels over the last decade. Without proper management, further potential rent could be dissipated within the next decade as the Nile perch Lates niloticus stock is already believed to be over-exploited. Definite signs of over-exploitation have been noticed in highly fished areas like the Nyanza Gulf (FAO, 1988). These include the reduction in the size caught, the reduction of the mesh size from 8 to 6 inches and temporal local reduction in abundance in shallow waters (CIFA, 1984). Within the next few years, it is likely that Nile Perch catch will start falling and lead to the use of mesh size smaller than the 7 - 9 inch (177 - 228mm) mesh commonly used in the lake. If this occurs it is expected that a certain proportion of effort will be rapidly transferred to the Rastrineobola argentea fishery. This fishery is undergoing very rapid expansion in Kenya and Tanzania, a trend which is likely to persist as the fishery remains largely underexploited. Unlike the past, studies should now be instituted to monitor the changing scenario as Nile perch becomes less dominant in the Nyanza Gulf.

5.2 Fisheries Management Regulations

Scientists who worked earlier on the fisheries of Lake Victoria have noted the destructive methods of fishing such as the continuous use of small meshed gillnets (Kudhongania 1972, Wanjala and Marten, 1974; and CIFA, 1984) harvesting of fish before they reach reproductive age (Muller et al., 1982 and Marten, 1979) and the use of the destructive mosquito and beach seines. Others have suggested corrective measures on the fishery: Marten (1979) suggests that the best strategy for maximizing the yield is to optimally fish the tilapia using large gillnets and hooks at a very high fishing mortality. The hooks capture the predators and thus indirectly increases the yield of the tilapias.

Due to the multispecies nature of the fishery, it is difficult to formulate strategies which can be applied to the exploitation of all species. This is due to the fact that adult size differences of the various species are very large which requires the utilization of a wide range of mesh sizes. For example, the mosquito seines used to harvest Rastrineobola argentea also catch juvenile tilapia, Nile perch and Haplochromis spp. which actually are not the targets. Marten and Polovina (1982) therefore suggest that an optimum mix of gears be used to exploit the Nyanza Gulf fishery taking into account their biological characteristics. CIFA (1984, 1988) has disrecommended the usage of small meshed nets.

It appears highly appropriate that government emphasis be directed towards the formulation of management plans for its important fisheries. This involves the imposition of restraints to fishing effort or production, and hence those to be affected for example the private sector. The latter should be closely involved in jointly deciding the objectives, strategies and subsequent evaluation of management.

Up to 1990 there were few management related regulations controlling fishing effort on Lake Victoria. The few that existed were seldom enforced.

Furthermore, these were not adequate for the management of the lake Victoria fisheries as they did not address all the management options. According to Van Densen (1989) these concern essentially:

- closed areas for trawling and seining in bays in Kenya;
- a closed season from 21/3 to 1/8 for beach seines and mosquito seines in Kenya;
- and minimum mesh size in the tilapia fishery of 10.2 cm in Kenya.

For example, this mesh size was not appropriate as it catches at its maximum Oreochromis niloticus which are in the process of attaining first maturity thus interfering with their recruitment.

Presently, the fisheries management regulations pertaining to the Kenya waters as illustrated in the Kenya Fisheries act 1991 are as follows:

(a) Trawling is a prohibited fishing method:

  (i) within 5 nautical miles from any point on the entire shoreline of the Kenya waters of lake Victoria.

  (ii) within the Nyanza Gulf.

(b) A seining net whose mesh sizes are less than 50mm when diagonally stretched shall be a prohibited fishing gear except for Rastrineobola argentea.

(c) Seining for R. argentea with any net whose mesh sizes are less than 10mm when diagonally stretched is prohibited.

(d) Any gillnet mesh sizes of which measures less than 127mm diagonally when stretched is a prohibited fishing gear in all Kenya waters of lake Victoria.

(e) It is prohibited to:

  (i) land from Lake Victoria fish whose standard length is less than 25 cm.

  (ii) acquire, possess, buy, sell or expose for sale or barter any tilapia fish the landing of which is prohibited.

(f) No person shall fish for anadromous or catadromous fish species in the riverine systems or within three kilometer radius of the

river delta and estuary during the period designated by the director.

(g) No person shall use any explosives, poisonous or noxious substances or electric shock device in order to render fish more easily caught.

(h) No person shall disturb any spawn or spawning fish in a breeding area.

These regulations have been intended to provide sufficient protection to the lake's fisheries so that they can be harvested on a sustained basis. For example, the destructive mosquito and beach seines should be done away with and be substituted with the more efficient and less destructive lift nets now being used in the Tanzania waters. Fishing in the inshore areas where the tilapias breed should be banned (at least 200 m from the shore).

A few of the appropriate guidelines when formulating management are as follows:

i) an attempt should be made to have the Government and industry agree on a broad set of objectives and strategies for the sub-sector;

ii) major fisheries should be identified as those which most urgently need management;

iii) the state of the available knowledge (within the private sector and government institution) concerning these fisheries should be evaluated;

iv) a draft management plan should be formulated in respect to the priority fisheries, clearly indicating the objectives, strategies, expected outcomes, and means of future evaluation;

v) in the formulation process, due consideration should be given to the resource, economic, social and political implications of the plan; and

vi) private sector inputs and an attempt to obtain their endorsement of the draft plan should be an essential component of the exercise.

Effective regulations require monitoring, control and a complementary assessment of expected impact (adequacy of the regulations), enforceability and related cost. A wide number of regulations apply to a wide range of activities, for example labour and corporate laws.

There are a number of alternative regulations related to the management of fisheries, for example:

i) licensing schemes (fees paid on boats and trade permits);

ii) access to the fishery;

iii) collective quotas;

iv) individual quotas;

v) input restrictions (gear, mesh size, etc); and

vi) access restrictions (closed seasons, closed areas).

In practice, few of these regulations are strictly enforced. Notable exceptions are the ban on beach seining in Uganda and to a lesser extent, seine restrictions in Kenya. All these restrictions affect gear use and other qualitative components of effort and not nominal effort per se.

It reflects the generally accepted conclusion that it is the gear used and the fishing practices that have led to severe overexploitation under the previous fisheries regime (Marten 1979). For other socio-economic reasons as well, this also concerns trawling and the expansion of industrial processing.

Imposing an unpopular regulation is politically a difficult task. For example trawlers in the Kenya waters of lake Victoria were prohibited in 1990. It is because there was commitment to enforce such a regulation, because trawling apart from its destructive nature on the breeding grounds of the tilapias, it introduces a competition element in the fishery against the artisanal fishermen.

It is easier to introduce and enforce regulations now in a climate of profitability and prosperity such as in the current fisheries involving Nile perch Lates niloticus, Oreochromis niloticus and Rastrineobola argentea than it would be in a few years after the fisheries become overexploited.

The government own dedication to fisheries management will affect the effectiveness of any regulation of acceptability and enforceability.

5.3 Mesh Size Regulations

Minimum mesh sizes should be introduced for both the Lates niloticus and O. niloticus fisheries. Research needs to be carried out to define these minima. It is recommended that the minimum mesh size of 6 inches (152mm) for Lates and 5 inches (127mm) for O. niloticus be set provisionally. The fisheries department of the Governments of the three East African countries should popularize the regulation and strengthen their enforcement. Restrictions on the sale of gear of illegal mesh sized can only be contemplated if gillnetting for other species is marginal. Some species will recover as the abundance of Nile perch decreases, as has already been noted in the Nyanza Gulf (Siwo, 1988).

5.4 Licensing of Fishing Units

The present system on issuing license should be strengthened. Owners should be required to obtain a license for each fishing unit/boat which they own and for each main fishery. Canoes should carry official markings. Operators gillnetting license should be given for only the Lates niloticus and Oreochromis niloticus fisheries.

5.5 Evaluation of Fisheries Management Regulation

Management regulations should be evaluated in the light of:

(i) pelagic fisheries;

(ii) demersal fisheries; and

(iii) anadromous fisheries.

This requires research priorities to be given to the following:

a) stock assessment: exploratory survey for pelagic stocks, catch sampling and taxonomical studies; and

b) gear innovations and effects: selectivity.

5.6 Fish Resources and Statistics

Knowledge of the resource and the extent to which it can be exploited depends on long term scientific study, on reliable fish catch and fishing effort data. Catch forecasting is difficult. This is because it requires time series and a wide range of both environmental and biological parameters about the fishery which takes a long time to obtain. A number of environmental variables, for example variable, water levels can also influence catch rates, over and above fishing effort.

There is need to harmonise catch effort data collected by the relevant Fisheries Departments and research institutes of the three riparian states. In this respect, there is need for trained manpower, equipment and facilities which are necessary to undertake data collection.

5.7 Future Development of Fisheries

The private sector has the interest and capability to develop new fisheries. Furthermore the investment environment is generally favourable though it is not clear whether this can be sustained bearing in mind the eminent changing scenario on Nile perch dominance. The role of Government in this process should be that of ensuring that the companies are aware of the investment opportunities and also familiar with the Government rules and incentive to invest.

There are arrangements going on to increase cold storage facilities along the Kenya beaches on Lake Victoria. Nile perch skeletons and *R. argentea* are being used as fish meal. The Government should also monitor and document the results from any attempted development.

6. RECOMMENDATIONS FOR SUITABLE APPROACHES FOR COLLABORATION AND INTERACTION BETWEEN THE FISHING INDUSTRY, ADMINISTRATORS, RESEARCHERS AND TRAINING INSTITUTIONS.

There is a growing concern over the environmental consequences of economic and social development within Nyanza Gulf area of Kenya. There is need to form resource management Project for Lake Victoria.

The focus of the program is the proportion of the adoption of integrated lake area management in the riparian countries. It should be conducted by the fishery departments and research institutions in Kenya, Uganda and Tanzania in collaboration with other private and international bodies. The goal is to provide sound socio-economic justification for the conservation of critical habitats and the pursuit of long term and sustainable productivity of lake fisheries, and other forms of environmentally compatible uses of fisheries resources. Opportunities for appropriate public and private sector activities in the Lake Victoria area should be promoted while non sustainable forms of development should be discouraged, through appropriate management strategies.

There are three essential elements in the program: research, training and information dissemination. The objectives of the lake Victoria fisheries management should include the following:

(i) increase awareness among policy makers in East Africa countries of issues related to lake resources depletion, environmental degradation and on the importance of sound fisheries management policies;

(ii) develop an appropriate ecological and socio-economic basis for the formulation of fisheries management policies and strategies;

(iii) improve capabilities for assessment and evaluation of the capacity of the fisheries systems to sustain intensive and multiple use forms of development;

(iv) establish cooperative applied fisheries research on relevant management issues;

(v) strengthen technical and management capabilities of East African nations in fisheries management; and

(vi) disseminate technical and educational information for researchers, educators, lake zone users and the general public with emphasis on the fisheries resource.

The program's outputs will directly benefit national governments of participating countries through strengthening and improvement of the technical and management capabilities of national institutions that deal with Lake Victoria fisheries. This should lead to management of the fisheries resources and, ultimately sustainable improvement in the well being of the lake communities. The program's scope will include research in the following areas:

(i) fisheries resource assessment and inventory;

(ii) analysis of critical relationships between fish population dynamics, fishery resources, the environment and economic systems;

(iii) identification of multiple resource use conflicts and strategies for resolution case studies;

(iv) valuation of fisheries resources;

(v) socio-economic analysis of lake region communities;

(vi) fisheries resources allocation and national accounting with respect to:

- traditional practices and management;
- role of women on fisheries development;
- socio-economic impacts of resource depletion and environment degradation;

(vii) legal and institutional framework.

(viii) management considerations on:

- economic incentives and disincentives;
- common property management;
- environmental management;
- renewable resources management and conservation and
- waste management.

(ix) planning tools and resource assessment methodologies for:

- remote sensing/Geographic Information Systems (GIS) planning and analysis of fisheries and environmental data;
- Environment Impact Assessment (EIA);
- fishery assessment and catch/effort assessment.

(x) habitat enhancement and rehabilitation including methodology development and impact assessment.

6.1 Fisheries Management

It is important to focus international attention on the plight and protection of Lake Victoria fisheries resources. Internal donor agencies have to be requested to support integrated management programs designed to protect fisheries resources. Media representatives have to promote community awareness of these issues by holding a forum in which researchers, fisheries officers, artisanal fishermen and other members of the community involved in the fishery exchange views on fisheries management. Printed material on fisheries management should be distributed out the government objectives and regulations. Other media to be used in educating the public are radio : television and public meetings.

The present on going regional project on Lake Victoria fisheries should be expanded to cover the following area:

(i) analysis, documentation and dissemination of information on how fisheries resources are being development for economic purposes;

(ii) strengthening of existing management capabilities of local and national institutions within the region;

(iii) provision of technical solutions to resolve conflicts arising from competing uses of fisheries resources; and

(iv) assistance to various organizations and agencies in the development of fisheries management plans.

It is recommended to have a policy conference for the riparian countries, donor agencies and other groups and organizations to give emphasis to the protection of fisheries resources by:

(i) endorsing policies that promote and enhance sustainable development of the Lake Victoria fisheries;

(ii) encouraging the development and implementation of integrated, interdisciplinary and comprehensive fisheries management plans;

(iii) further strengthening management capabilities of governmental organizations responsible for the management of fisheries;

(iv) undertaking measures to relieve human population pressures in the Lake region, implementing and vigorously enforcing effective regulations and supporting incentive schemes to promote sustainable uses of fisheries resources;

(v) increasing awareness of Lake region populations regarding their critical dependence on the continued productivity of fisheries resources;

(vi) promoting community-based participation in Lake resource management;

(vii) adopting policies and programs to enable women to participate in and contribute more actively in the effective management of fisheries resources for sustainable development; exploring ways and means by which the public and private sectors can cooperate and thereby benefit from efforts to sustain and develop fisheries resources; and

(viii) promoting current efforts in Lake Victoria fisheries planning and management;

(ix) providing fisheries resources for sustainable development; and

(x) creating community awareness and participation in sustainable development.

Participants should include key policy makers from each of the East African Countries, technical experts from Africa, Europe and Asia representative of the media and international donor agencies. Consequences of failure to address Lake Victoria fisheries management issues are likely to include the following :

(i) disruption of and damage to Lake based ecological systems;

(ii) diminution of goods and services provided by the fisheries resources;

(iii) destabilization of Lake region economies; and

(iv) social dislocations.

In these circumstances, it is imperative to address Lake Victoria fisheries management issues immediately.

6.2 Education, Training and Information

There should be set a program which will offer non degree, short-term training courses in close collaboration with national and international institutions on various aspects of fisheries management and conservation. The program should disseminate information through publications, public awareness activities, mass media workshops and conferences. Training should include the following:

(i) short-term courses in techniques and methodology of fisheries:

- economic evaluation of fisheries resources;
- planning and management of fishery resources;
- ecological socio-economic modelling in fisheries.

(ii) Specialized training in:

- Water quality management;
- Water and fisheries resources management; as well as solid waste management.

(iii) a short annual course for fishermen and other parties involved in fisheries on how to manage and conserve fisheries.

6.3 Future Research Activities

Future research activities should include studies on the eutrophication process and factors in Lake Victoria. Oxygen profiles, nutrient concentrations and pollution levels of various toxic substances in water should be measured. The general goals for managing the fishery should be the following :

(i) conservation of resource thus maintaining the balance of the ecosystem;

(ii) long-lasting stability of the fishery;

(iii) long-lasting economic prospects;

(iv) balanced harvesting; and

(v) protection of the fishery.

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APPENDIX 3.8 : KENYA'S FISHERIES LEGISLATION

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1. Brief History

1.1. Origin of the Legislation

In the early and mid-century the important fishery of the Lake Victoria comprised of Tilapiine fishes. Although very little knowledge existed about the fisheries resources it was felt that fisheries legislation was desirable. To this end, the Lake Victoria Fisheries Service was established in 1948, to look into the development and management of the lake fisheries.

In 1957, mesh regulation was introduced in Kenya but not in Uganda and Tanzania (Tanganyika). This regulation was far from being popular with fishermen around the Nyanza Gulf. This led to tension between fishermen and enforcement personnel resulting in lifting it in 1960. Although the mesh regulation had failed, need still existed to replace it with more acceptable arrangement. It was agreed to involve the fishermen in the management of Lake Victoria fisheries. Through fishermen organisation, fishermen were rallied to a convention at Maseno where Fish Industry and its problems were discussed freely. The convention was successful and plans were put under way to have more. It is evident that attitudes play a major role in the management of any resource.

1.2. Early Kenya's Fishery Legislation

Three Acts formed early independent Kenya's fishery legislation after inheriting them from the colonial government. The Fish Industry Act. Cap 378 which concerned the Fishing Industry, and Government Fisheries Protection Act and the Trout Act. The three Acts constituting the fishery legislation were a reflection of the interest of the Government at the time and which survived into independent Kenya.

1.2.1 The Fish Industry Act Cap. 378

As an Act of Parliament set to provide for reorganisation, development and regulation of the Fish Industry, to make provision for protection of fish and for purpose connected thereof. Though revised about twice in independent Kenya, in 1971 and 1983, the Act still retained serious deficiencies, one of which was failure to approach legislation to cover all the resources within Kenya's borders. This deficiency among others led to numerous fragmental instruments which were geographical in approach.

1.2.2 The Government Fisheries Protection Act Cap. 379

Gave protection to some aspects of marine fish products such as pearl and mother of pearl.

1.2.3 The Trout Act Cap. 380

Trout Act basically protected fish commonly known as trout belonging to the family salmonidea. This fishery was the backbone of the Inland sport fishery of the time attracting tourists into the cool highlands of Kenya. The Act outlines the management, development and practices related to the sport.

1.3 The Deficiencies of the Previous Acts

The later global developments including the Convention on the Law of Sea following which Kenya declared 200 nautical miles Exclusive Economic Zone could not be adequately covered under previous Acts. A new Act was needed to deal with Maritime Zones, EEZ and all the fisheries resources including non-living found in the newly acquired zone which embraced the Kenya's territorial waters.

2. Existing Fishery Legislation

2.1 The Fisheries Act, 1989

This was given Presidential assent on 23rd August, 1989. It is an Act of Parliament which sets out to provide for development, management, exploitation, utilization and conservation of fisheries and for connected purposes. There is also the Maritime Zones Act, which covers the maritime zones and describes the area covered.

The scope of the fisheries Act, 1989 covers the Kenya fishery waters which is defined as comprising "all inland waters and waters of the Maritime Zone described in the Maritime Zones Act, 1989 and for purposes of this Act excludes Government fish ponds and fish farms and any private fish ponds or farms not established for commercial purposes".

The Inland waters covers ponds, lagoons, tanks, estuaries and brackish water, pools, dams, rivers etc. Issues related to management, conservation are comprehensively covered and include the declaration of the Kenya Fishery waters a pollution prevention zone. In addition the Act gives protection to marine mammals and turtles, (Reg. 51). More importantly it provides for foreign participation in fisheries and outlines procedures for entry into Kenya fishery waters.

2.2 Administration

The Director is responsible for the administration of the Fisheries Act, 1989, (sec. 3) with a mandate to delegate in writing the exercise of any of the powers and functions conferred upon him by this Act to such authorised officers as he may think fit.

Regarding management, the Director may impose, if he deems necessary for proper management of any fishery, closed seasons, prohibition of fishing areas, limitations on type and quantity of gear, size and age of fish regulation of handling of fish, control of the introduction into or removal from any Kenya fishery of any aquatic plant.

Also for proper management of fisheries, the Director may require limitations in number of persons or vessels, nets, or areas or other means employed in the fishery, and such means may include:

- refusal to issue or renew licence;

- imposition of special licence and catch fee; and

- preferential licensing in other fisheries.

For any grievance that may result from the actions of the Director, provision is made for appeal to the Minister whose decision shall be final.

3. Licensing

Licensing is central to the development, management, exploitation, utilization and conservation of fisheries resources. The base of the general licensing is found in section 8 which requires without prejudice to any regulations made under the Act, that a licence must be obtained in order to fish in Kenya Waters except for persons fishing for their own consumption. The same section exempts persons employed by a licensee or subject to the Penal Code, to a company which is a licensee.

Section 9 provides for licensing of local fishing vessels and stipulates validity.

Section 11 requires foreign fishing vessels to have valid licences in order to fish in Kenya fishery waters as prescribed in section 12. The validity of the foreign fishing vessel depends on the specification by the Director unlike the local licence, certificate or permit which expires on 31st December or as stated in the permit.

3.1 New Licences

There are 15 different licences, 4 types of permits and registration of vessels and fishing clubs forming the basis for control in the fish industry.

3.1.1 Aquarium Licence

Aquarium fish culturing, and aquarium keepers licences have been introduced in order to keep track of the often harmful species, if such fish were to enter the fishery. Species such as Piranha found in the Amazon could be kept outside this country, (Reg. 24).

3.1.2 Fish Stocking

Limiting fish species to catchment areas so that it now requires a permit to cross fish to catchment areas they did not occur in. (Reg. 25).

3.1.3 Power to Refuse to Issue or Renew Licence

For proper management the Director may refuse to issue or renew a licence or attach conditions on the licence or may suspend it. (Reg. 30, 31, 32, 33).

3.1.4 Prohibitions

Regulation 36 prohibits licence transfer to anybody, but replacement is provided when a licence is lost or defaced, (Reg. 37).

Prohibition includes methods of fishing, (Reg. 43), fish sizes and trawling in certain areas in our large lakes and ocean.

3.1.5 Registers

It is mandatory to keep a register for each licence issued under the Act.

3.1.6 Fish Landing

Fish landing is defined as "displaying or offering of fish for sale by a fisherman". Landing of fish is permitted only at places designated by the Director of fisheries as landing places in Schedule four.

3.1.7 Vessel Inspection

The licensing officer may require vessels to be inspected before registering them, [Reg. 3(4)].

3.1.8 Application for Licences

Regulation 29 requires that any person wishing to get a licence, permit or certificate of registration under these Regulations shall apply in writing to the licensing officer on appropriate form as set out in the First Schedule or on such other form as the Director shall specify. The application forms contain information that would be desired to assist in decision making among other things.

4. Enforcement

The good legal provisions exist which could enable the Director of Fisheries and other authorised officers to control fishing activities.

4.1 Powers

The Act provides broad based powers to authorised officer in exercise of the functions conferred upon them by the Act.

4.2 Obstruction

It is an offence to obstruct any authorised officer in the exercise of the powers conferred upon him by the Act or to fail to comply with any lawful enquiry or requirement made by an authorised officer.

4.3 Powers of Authorized Officers

Section 18 outlines the powers an authorised officer has. Without a warrant he may stop and board any fishing vessel in Kenya fishery waters, and any local vessel outside such waters. Also may inspect such vessel it's cargo, supplies, fishing gear and equipment.

Above all an authorised officer may impound any fish and the Act provides for procedures of seizure of any goods whatsoever, (sec. 18(6).

4.4 Forfeiture

Under Section 19 a court may order forfeiture in addition to any penalty the court imposes.

4.5 Compounding Offences

Section 20 provides for compounding an offence with approval by the Minister. This section is only applicable where the Director is satisfied that a person has committed an offence under the Act and if the person admits in writing and agrees for its being dealt with under this section.

Any sum of money received under this section shall be dealt with as if it were a fine imposed by the court.

4.6 Marine Mammals

Section 22 gives full protection to marine mammals.

5. Regulations Under Section 14 and 23

Legal notice number 34 of 15 February 1991 contains The Fisheries (General) Regulations.

5.1 Interpretation

For better understanding of the regulations it is important to provide additional definitions.

5.2 Surveillance

Control on fishing and surveillance are backed by provisions concerning fish landing, fishing methods and conservation measures.

5.2.1 Landing Fish

Regulation 42 on landing fish at designated places attempts to channel all fishermen to land in places where facilities and personnel are available for inspection and the carrying out of other management measures. This measures would ensure close monitoring of fish handling and hygiene practices.

5.2.2 Prohibited Fishing Methods

Regulation 43 (1) prohibits trawling within 5 nautical miles from point on the entire shore line of Kenya waters of Lake Victoria and the whole of Nyanza gulf. In practical terms this means no fishing trawlers in Kenya waters of the lake. Trawlers found trawling in Lake Victoria were arrested in mid-July, 1991.

Mesh size restriction for seining is limited to not less than 50 mm when diagonally stretched. This could be enforced from any beach as Fisheries staff are spread throughout the entire shoreline. This would be true for gill nets and 10 mm for seine nets seining for Rastrineobola (Omena).

The principal behind seining between 50 mm and 10 mm nets lies in their time and space separation. It is not common to find these two nets operating in the same area at the same time.

Fish size restriction for tilapiine species can only be done at beaches because of the difficulties of identity between lake and fish pond products further away from the beaches.

5.2.3 Conservation

Anadromous and Catadromous fishes have been protected and it should be quite easy to monitor the fishing both at the areas prohibited and in markets where gravid fish may be exposed for sale.

Breeding areas are generally well known to fishermen and it is envisaged that besides keeping an eye on these grounds by ensuring that no fishermen stray the direction of the breeding area, fishermen should assist.

Regulation 53 requires that any licence, certificate of registration or permit holder, issued under this Act, submit at any time as the Director may specify, data or information in respect of his business. It is possible to tie this regulation up with the licence so that it becomes a condition.

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