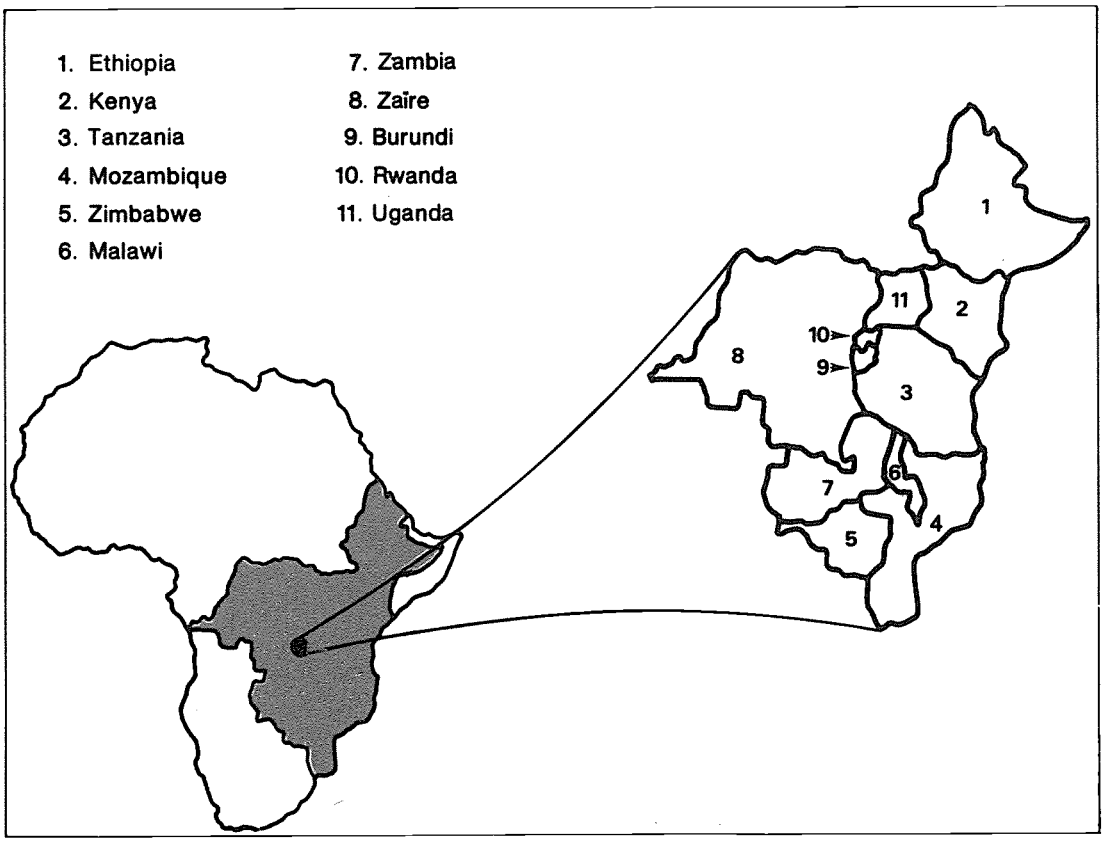
REGIONAL PROJECT FOR INLAND FISHERIES PLANNING, DEVELOPMENT AND MANAGEMENT IN EASTERN/CENTRAL/SOUTHERN AFRICA (I.F.I.P.)

IFIP PROJECT

RAF/87/099-TD/33/92 (En) March 1992

Report of the Technical Consultation between Malawi and Mozambique on the Development and Management of the Fisheries of Lakes Malawi, Chilwa and Chiuta



UNITED NATIONS DEVELOPMENT PROGRAMME

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

RAF/87/099-TD/33/92 (En) March 1992

Report of the Technical Consultation between Malawi and Mozambique on the Development and Management of the Fisheries of Lakes Malawi, Chilwa and Chiuta

edited by

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
UNITED NATIONS DEVELOPMENT PROGRAMME
Bujumbura, March 1992

PREFACE

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

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

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

PREPARATION OF THIS DOCUMENT

This report includes the final report and recommendations of the Technical Consultation between Malawi and Mozambique on the fisheries of their shared lakes as well as six (6) working papers presented at the meeting. The First Technical Consultation was held from 24 to 26 September 1991 at Mangochi, Malawi. This meeting was sponsored by the Regional Project for Inland Fisheries Planning, Development and Management in Eastern/Central/Southern Africa (IFIP). The FAO/UNDP Project MLW/86/013 (Chambo Project) collaborated with IFIP and participated in the meeting.

The IFIP Project organised this Technical Consultation at the request of the Malawi/Mozambique Permanent Joint Commission of Cooperation for technical consultation on fisheries development and management issues.

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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 (33), the year of publication (92) and the language in which the document is issued: English (En) or French (Fr).

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REPORT OF THE TECHNICAL CONSULTATION BETWEEN MALAWI AND MOZAMBIQUE ON THE DEVELOPMENT AND MANAGEMENT OF THE FISHERIES OF LAKES MALAWI, CHILWA AND CHIUTA

I. Opening of the First Technical Consultation

1. The Technical Consultation on Development and Management of the fisheries of Lakes Malawi, Chilwa and Chiuta was held from 24 to 26 September 1991 at Mangochi, Malawi.

2. The Technical Consultation was attended by participants from the Fisheries Department and Fisheries Projects of Malawi and the delegates from the Republic of Mozambique. The list of participants is given in Appendix 1.

3. The Chief Fisheries Officer Mr. B. Mkoko welcomed the delegates and participants to the First Technical Consultation and thanked the UNDP/FAO Regional Fisheries Project based at Bujumbura and the UNDP/FAO Fisheries Project MLW/86/013 based at Monkey Bay/Mangochi for technical and financial support.

4. On behalf of the UNDP/FAO Regional Fisheries Project (IFIP), Mr. G.W. Ssentongo stressed the importance of this meeting as a first step to the formulation of management for all the lakes. The need for collaboration at national and regional levels in the rational development and management for the fisheries of Lakes Malawi, Chilwa and Chiuta was underscored.

5. The FAO Programme Officer Ms A. Schückler represented the FAO Representative in Malawi, Mr. G.K. Mburathi at the opening ceremony and delivered an address on behalf of the FAO Representative. The nutritional and economic value of fish was stressed. The FAO Representative observed that despite the importance of fisheries to Malawi and Mozambique, its role in the agricultural and animal industry production sector is still down-played. The FAO Representative requested the delegates and all participants to give serious consideration to the following development and management needs for Malawi and Mozambique:

- adequate financial resources and well-trained manpower;
- well ranked applied research priorities and adequate consultation between researchers, policy makers/administrators and the fishermen;
- problem of the relatively poor artisanal fishermen;
- socio-economic factors affecting the fishing industry;
- more equitable supply of fish products to rural, urban and foreign markets;
- proper research and extension services liaison as well as giving research results to the fishermen;

- continuous exchange of information between various fishery institutions involved in fisheries; and

- fisheries education and training at various levels including that of various fishermen.

6. The Technical Consultation was officially opened by Mr. E.T. Kafuwa, the Under Secretary, Ministry of Forestry and Natural Resources. He re-affirmed the importance attached by Malawi and Mozambique Governments to the work of the permanent Joint Commission of Cooperation between the two Governments.

7. The Guest of honour thanked the IFIP project for working tirelessly to ensure the success of this First Technical Consultation. He also appreciated various programmes of FAO and UNDP which are designed for the following purposes:

(a) boosting the social, economic and nutritional roles of fisheries;

(b) enhancing the well being of artisanal fisherfolk;

(c) acquiring greater self-sufficiency in dealing with the unique characteristics of the fisheries sector; and

(d) seeking effective means of conserving, managing and utilising the fishery resources.

8. The Under Secretary, Ministry of Forestry and Natural Resources appreciated the agenda for the meeting, which included topics related to the sustainability of fisheries and the environment. These are areas that need to be approached with a sense of joint responsibility because population growth is exerting pressure for intensified fishing to the extent that some stocks could be fished at their maximum sustainable levels. If management plans are not devised jointly, we would expect reduced per caput consumption of fish. He wished the Technical Consultation success in formulating and implementing appropriate management plans that would maintain fishing intensities at sustainable levels which are economically viable, ecologically sound and socially acceptable.

II. Administrative Arrangements:

9. Mr. B. Mkoko, Chief Fisheries Officer of Malawi and Mr. R. Massinga, were the Chairman and Vice-Chairman respectively for the First Technical Consultation; Mr. G.W. Ssentongo, Fisheries Biologist, IFIP Project was the Technical Secretary; whereas Mr. E. Ng'ombe and S.A. Mapila served as rapporteurs.

III. The Agenda and Arrangements for the Seminar:

10. The annotated agenda and timetable shown in Appendix 2 were used at the technical consultation meeting.

IV Summary on Key Issues Pinpointed in the Papers Presented:

Fishery Resources Base

11. The paper on the fishery resources of the shared lakes (see Appendix 3.1) was presented and discussed. Lake Malawi fisheries are diverse and involve the exploitation of many stocks in a variety of ways. This diversity means that management and development policies are necessary; and many factors need to be considered before recommendations are made. These include the interactions of different types of fishing effort on the same stocks, the co-existence of different stocks with different management requirements, the balancing of widespread demands for fish against the long-term need for preservation of stocks.

12. The demersal trawl fishery is targeted at Lethrinops spp. (Chisawasawa), Copadochromis (Utaka), Bagridae (Kampango), Clarias (Mlamba), etc. The paper also covered the Chambo (Oreochromis) ringnet fishery which is fairly selective for chambo but has a by-catch of some catfish (Clarias and Bagrus).

13. The pelagic fishery mainly exploits Engraulicypris sardella (Usipa). It was stated that Usipa has the highest known potential in the open water of Lake Malawi. It was noted that the pelagic fishery is semi-industrial and commercial.

14. As regards Lake Malawi, the artisanal fisheries exploit both the inshore and offshore stocks and contribute about 90% of the total landed catch on the Malawi Sector of Lake Malawi/Niassa.

15. Finally the paper on fishery resources considered the prevailing situation of Lakes Chilwa and Chiuta which border on Malawi and Mozambique. The two lakes are characterized by closed systems without outlets. Their fish production potentials are high but very variable owing to climatic factors.

16. In view of these factors, the paper recommended applied research, and fishing trend monitoring which are the basis for rational development and management of the available stocks.

Fisheries Statistics and Socio-economic information in Malawi

17. The Technical Consultation also considered statistics and socio-economic information ideally desirable for rational management. Some socio-economic data has been collected by the Chambo project for the southern end of Lake Malawi. It was noted that the present catch Assessment Survey (CAS) and Frame (Census) Survey (FS) could be used to collect the data on regular basis. However, there is still a need to develop the competence to analyse and interpret this data.

The Fisheries Statistics of Lake Malawi/Niassa

18. The third paper (Appendix 3.2) considered fisheries statistics of Lake Malawi/Niassa. This paper dealt with methodology of data collection systems for commercial and artisanal fisheries including CAS, FS, as well as problems of catch and effort data for the Malawi sector of these lakes.

19. Finally, the paper pointed out common issues which could be addressed and harmonized by all the countries bordering on Lakes Malawi, Chilwa and Chiuta, particularly cooperative research, standardization and harmonization of statistical systems.

The Malawi Fishing Industry with Actual and Pipeline Programmes

20. The fourth paper (given in Appendix 3.3) gave an assessment of the Malawi fishing industry covering actual and pipeline programmes, that is fisheries policy and planning. Malawi Government has well defined development/management policies and strategies. These cover the following aspects:

(i) monitoring of resource trends;

(ii) research programmes for under-utilized fishery resources;

(iii) development of appropriate shore-based infrastructures for more efficient commercial fisheries;

(iv) institutional building which is still constrained by inadequate manpower as well as local and external financing;

(v) more focussed and appropriate research;

(vi) increased and sustained fish production;

(vii) involvement of women in rural fisheries development;

(viii) control of water weed (Eichornia crassipes) and pollution abatement;

(ix) better fishing innovations using light to exploit the more abundant pelagic fish species;

(x) implementation measures for fishery management, harmonization of legislations as well as mechanisms for surveillance and enforcement; and

(xi) finally, but not least, the establishment of meaningful and viable data system base which is a prerequisite for rational management of renewable but depletable resources.

Cooperation in Research and Development

21. The paper on Cooperation in Research and Development outlined the areas of research done in Malawi waters from pre-colonial time to-date (see Appendix 3.4).

22. It was noted that the present fisheries policy and strategies in Malawi provide a framework for cooperative effort in research and development towards better management of shared stocks. The SADCC Lake Malawi/Niassa pelagic resources assessment is an example of cooperation where Mozambique, Tanzania and Malawi are jointly examining the fish

potential of the pelagic zone and to ultimately develop techniques to exploit such resources which are still underexploited.

23. Six possible areas of cooperation were suggested including joint research programme on shared stocks accessing of statistics on catch and effort data by partner countries, accessing of publications from research studies, establishment of common legislation for management of shared stocks, joint monitoring of catchment basin of the shared water bodies against unauthorized introduction of exotic fish species which may escape into the lake systems and the inclusion of Tanzania in future technical consultations on Lake Malawi/Niassa.

Short Expose by the Mozambique Delegates

24. A brief national paper, shown in Appendix 3.5, concerning the mechanisms, infrastructure and means available for fisheries administration, development and management was presented by the Mozambique delegation. It was stated that owing to the prevailing civil conditions in Mozambique, the fisheries managers were still unable to control, monitor and analyse fishing trends of Lakes Malawi, Chilwa and Chiuta.

25. During the subsequent discussions, Mozambique delegates generally agreed that fishery programmes and strategies described by Malawi would be somewhat applicable on the Mozambique sectors of these shared lakes in normal circumstances.

26. The Mozambique delegates informed the FAO/IFIP Secretariat that a proper version in Portuguese of the report including summaries on papers presented and the recommendations should be submitted to the Goverment of the Republic of Mozambique as well as to the Malawi/Mozambique Permanent Joint Commission of Cooperation. The FAO/IFIP Project Secretariat responded positively that the translation of the main report in Portuguese of this consultation would be made available to the Government of the Republic of Mozambique.

An Overview of the Development and Management of the Fisheries of Shared Lakes Malawi, Chilwa and Chiuta

27. The paper presented by the Secretariat (see Appendix 3.6) covered geographical, hydrographical and limnological aspects of Lakes Malawi, Chilwa and Chiuta as well as the complicated issues of managing the shared multiple fish species located in stable and fluctuating lakes.

28. The paper highlighted fisheries aspects that are vital to management, particularly the following:

(a) magnitude and behavioral characteristics of a given species, stock biomass including intermingled multi-species;

(b) the way in which the stocks vary in response to natural forces and to alternative levels of exploitation;

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

(d) the optimal catch rates and levels; hence size, density and biomass;

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

(f) possible trade-offs among total catches, catch rates and catch stability; and maximum yield catch from a biomass that is sustainable over time (MSY).

29. Consideration was also given to fishing regulations concerning fish season, mesh size limits, catch limits where applicable, closed or restricted areas, restrictions on gear and boats as well as quantitative control on fishing boats and fishermen.

30. Finally emphasis was placed on the following management measures and options:

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

(b) In formulating fisheries policies and management plans the Governments 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) To ensure effective fisheries management in widely scattered small-scale fisheries where direct enforcement is difficult or impracticable, governments should possibly 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.

(d) It must be emphasized that technical and financial aid to fishery sectors can be effective only in a participatory way. There is a fundamental lack of understanding on the part of managers the nature of participants of inland fisheries. It is hardly possible to manage for societal long-term needs when so little is known about the innate behaviour of the local fishermen. 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 policy makers, the scientists and the fishermen.

Area of Cooperation Between Malawi and Mozambique

31. The following were identified as good areas of cooperation:

(i) Exchange of information on fish stocks between the two countries;

(ii) The Mozambicans would like officials from the Niasa Province to train in fishing techniques. Officials from Mozambique will send to Malawi particulars of the kind of training required and their CVs and the training;

(iii) Malawian delegation requested to send officials to Mozambique to train in Deep-water fishing;

(iv) Malawi wishes to learn the extension and development system which uses the Combinados;

(v) Malawi wanted to send officials to Mozambique to learn surveillance and enforcement of fisheries regulations.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

Status of Exploitable Stocks

32. The Technical Consultation recognized the various research and stock assessment programmes around Lake Malawi but also noted that there were still some gaps on information concerning the magnitudes, (biomass) and lake-wide distribution of exploitable stocks. It was therefore recommended that the on-going stock assessment work be strengthened.

Engraulicypris sardella (Usipa)

33. It was noted that the Usipa (Engraulicypris) has high potential but its biomass around the lake is not yet determined. Hence, it was recommended that the necessary measures be taken to establish its biomass and yield potential by existing fishery projects.

Oreochromis Species Complex (Chambo)

34. The Technical Consultation noted that Chambo in the southern end of Lake Malawi and Lake Malombe were over-exploited. There was a need for stricter control of fishing effort to avoid the depletion of Chambo. It was also observed that the stocks of Oreochromis in the Northern sector of Lake Malawi were unknown. It was strongly expressed that the assessment of Chambo stocks be extended to the north of Lake Malawi.

Small Inshore Haplochromines (Kambuzi)

35. It was recognized that the inshore Kambuzi are an important source of protein for the southern sector of Lake Malawi and that this species group interacts with Oreochromis species. However information on its abundance is lacking. It was recommended that the stocks of Kambuzi be assessed as soon as possible.

Semi-pelagic Haplochromines (Utaka)

36. Noting that no information is available on the semi-pelagic haplochromines, it was recommended that a research programme for Utaka be designed and implemented henceforth.

Fishery Statistics and Socio-economic data

37. During the deliberations of the Technical Consultation, the delegates noted the very important role fishery statistics plays in development and management of lake fisheries.

38. It was also noted that the present available data on the fisheries of Malawi and Mozambique are still inadequate, and sometimes inconsistent and inaccurate. All these factors reduce the utility of this data for decision making and planning.

39. There is therefore an urgent need for the two countries to set up strategic programmes and systems for the collection, compilation and analysis of fishing statistical data and for the exchange of results to enable effective monitoring and management of the fisheries of Lake Malawi, Chilwa and Chiuta.

40. Noting that there is a need for comparability and harmonization, it was recommended that Malawi and Mozambique focus attention on the following:

(a) periodical data acquisition from frame (census) surveys;

(b) annual data acquisition from Catch Assessment Survey (CAS); and

(c) periodical data acquisition of socio-economic factors.

41. It was recommended that each country undertakes a frame (census) survey at least once every three years on the basis of complete enumeration of landing sites, fishermen/fisherfolk, fishing vessel by type and fishing gear by type.

42. It was further recommended that increased financial and manpower support be given by both donor agencies and the national Governments to the respective fisheries institutions and statistics units to develop and sustain viable catch assessment surveys to enable continuous monitoring of trends in the fisheries.

43. Concerning socio-economic data, it was recommended that both countries establish a system of collecting and analysing data on fishing units, species marketed, types of fish products, quantity and prices, source of fish supply and market destination.

Fish Processing and Marketing

44. The Technical Consultation meeting noted that processed fish products were sometimes of poor quality and that post-harvest losses were often high. It was therefore recommended consequently that the use of smoking kilns which use less fuel be encouraged in the two countries.

Deep-water Fish Species

45. It was recommended that an assessment of the biomass of the deep-water stocks in 50-200 m depth be undertaken except for southern arm of the lake which is lightly fished.

46. The Technical Consultation also recommended that investigation of the offshore Usipa stocks as started by SADCC/ODA Project be continued in order to develop commercial fisheries of the pelagic stocks.

On-shore Infrastructures and Access Roads

47. Noting that the infrastructures ideal for rational development and management were still inadequate it was recommended that the necessary measures be taken to improve access roads around the lakes and to construct appropriate on-shore infrastructure.

Women in Fisheries Development

48. Considering the importance of the role of women in fish processing and marketing, it was recommended that encouragement should be given to women groups for income generating purposes and for the overall development of rural fishing communities.

Abatement of Aquatic Weeds

49. Recognising that the water weed Eichonia crespissa was expanding in the Shire River system, it was recommended that strong measures be devised to prevent the invasion of the water hyacinth into Lakes Chiuta, Chilwa and Malawi.

Fishing Legislations

50. Aware of the fact that appropriate fishing regulations and their harmonization for shared waters is a basis for rational management, it was strongly recommended that an examination of legislations covering closed season, mesh sizes, restrictions on gears, boats and species introduction be undertaken with a view to subsequent harmonization.

51. Recognizing that one of the major lakes in East Africa has had species introductions which are possibly being cultured in some areas within the Lake Malawi/Niassa catchment basin, much fear was expressed that these species may accidentally escape into Lakes Malawi, Chilwa and Chiuta. It was strongly recommended that at the next Technical Consultation, before 30 June 1993, all Riparian States (including Tanzania) should be invited to attend, to discuss species introductions as well as conservation and exploitation of the indigenous species of Lake Malawi.

52. This report, and all its recommendations, was adopted by the delegates of Mozambique and Malawi on the 26 September 1991 at Mangochi, Malawi.

APPENDIX 1: LIST OF PARTICIPANTS

Name	Title	Address
MOZAMBIQUE DELEGATION		
1. Manuel Luis Gonçalves	Director of I.D.P.P.E	P.O. Box 2473, Maputo
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APPENDIX 2: ANNOTATED AGENDA AND TIMETABLE

TECHNICAL CONSULTATION BETWEEN MALAWI AND MOZAMBIQUE ON THE DEVELOPMENT AND MANAGEMENT OF THE FISHERIES OF SHARED LAKES MALAWI, CHILWA AND CHIUTA AT NKOPOLA LODGE, MANGOCHI (MALAWI) 24 - 26 SEPTEMBER 1991.

The Fisheries Authorities of the Governments of the Republics of Malawi and Mozambique have for a long time expressed the need for technical consultation on shared lakes. There has also been a strong request by the Malawi/Mozambique Permanent Joint Commission of Cooperation, for technical consultation on fisheries development and management issues and strategies.

Accordingly, the UNDP/FAO Regional Fisheries Project based at Bujumbura (Burundi), in collaboration with the UNDP/FAO Fisheries Project MLW/86/013 organised the Technical Consultation between Malawi and Mozambique on the fisheries of the lakes shared by the two countries.

1. Host Institution : Fisheries Department

2. Location : Nkopola Lodge, Mangochi, Lake Malawi

3. Duration : 24 - 26 September 1991

4. Working Language : English

5. Provisional Agenda: As indicated below

Date	Time	Programme
Tuesday 24 September	10.00 - 10.30 hrs	Opening Ceremony
	10.30 - 11.00 hrs	Tea Break
	11.00 - 11.30 hrs	Administrative Arrangements
	11.30 - 12.30 hrs	Presentation and discussion of the paper on fishery resources of the lakes.
	12.30 - 14.00 hrs	Lunch Break
	14.00 - 15.00 hrs	Presentation and discussion of the paper on fishery statistics and socio-economic information
	15.00 - 16.00 hrs	Presentation and discussion of the paper on an assessment of the fishing industry indicating the actual and pipeline programmes.
	16.00 - 16.30 hrs	Tea Break

	16.30 - 17.30 hrs	Presentation and discussion of national paper(s) by the Mozambique delegation.
Wednesday 25 September	08.30 - 09.30 hrs	Presentation and discussion of the paper on an overview on the development and management of the fisheries of Lakes Malawi, Chilwa and Chiuta.
	09.30 - 10.30 hrs	Presentation and discussion of the paper on Cooperation in research and development.
	10.30 - 11.00 hrs	Tea Break
	11.00 - 12.30 hrs	Discussions and the framing of recommendations for management particularly for targeted fish species Engraulicypris; "Mbuna" and "Chambo" (= Oreochromis and Tilapia Clarias; Bagrus; Labeo; etc.
	12.30 - 14.00 hrs	Lunch Break
	14.00 - 15.30 hrs	Discussion and framing of recommendations on fishery development for the three lakes, particularly fish products, valorisation and reduction of post-harvest loss. Also propose options for more equitable distribution of income for the relatively poor fishermen.
	15.30 - 16.00 hrs	Tea Break
	16.00 - 17.00 hrs	Discuss harmonization of fishery research, statistical systems and fishing regulations.
	17.00 -------	Drafting Committee and the FAO Secretariat prepare summary of discussions and summary of major conclusions, resolutions and recommendations.

Thursday 26 September	08.00 - 11.00 hrs	Drafting Committee and the FAO Secretariat finalize report.
	11.00 - 12.00 hrs	Adopting Meeting Report; resolutions and recommendations.
	12.00	Closing Ceremony.

APPENDIX 3 : WORKING PAPERS PRESENTED AT THE MEETING

Appendix 3.1: Fisheries Resources of Lakes Malawi, Chilwa and Chiuta and their Management

by

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Abstract

The fisheries resources of the shared lakes in Malawi are described in detail including their rational exploitation and management issues pertaining to conservation of fish stocks. Both artisanal and commercial fisheries are covered, fishing methods are described and where possible standing stock biomass, maximum sustainable yield and effort estimates are determined.

An attempt has also been made to give current statistical figures for both the artisanal and commercial fisheries in terms of the number of fishermen involved, the number of dug-out canoes, plankboats, ringnets and trawlers deployed; and the amount of fish landed.

Resource management is in the form of licensing, mesh size limitation on gill-nets, ringnets, seine nets, bottom and mid-water trawls, effort quotas for trawlers, closed season for ringnets and seine nets and minimum fishable size for other species.

INTRODUCTION

Dominating Malawi's inland waters is Lake Malawi (Fig. 1). It is 580 km long, 20-80 km wide and covers an area of 30,800 km^2. The mean depth is 426 m and, its maximum, 758 m (Welcomme, 1972). The lake is oligotrophic and meromictic. The water below 250 m is anoxic and complete vertical mixing of the lake has never been observed (Eccles, 1974).

The lake supports a wide variety of fish, yielding about 34,000 metric tonnes of fish annually from waters controlled by Malawi. Approximately 28% of this is caught by the commercial sector.

Lake Chilwa is an endorheic, shallow and turbid lake with a mean depth of 2 m. It dries out almost completely in some years, but may extend over 2590 km^2 at highest water when it is surrounded by 1,000 km^2 of marshland. Its mean area is about 750 km^2 (Welcomme, 1972). The most important commercial fish species are Barbus paludinosus, Clarias gariepinus and Oreochromis shiranus. Annual fish yield is estimated at 16,600 metric tonnes.

Lake Chiuta is clear and heavily weeded with a mean depth of 5 m. It has a varied fish fauna which supports a small but active artisanal fishery. The lake covers an area of 200 km^2 when full, and fish production is estimated at 1,500 metric tonnes per year. Approximately 29,200 artisanal fishermen operate 7,773 dugout canoes and 2,450 plank boats on lakes Malawi, Chilwa and Chiuta

landing about 42,800 metric tonnes of fish per year; using traditional gears such as gillnets, longlines, fish traps, shore seines, chilimira etc. The commercial fisheries in the southern portion of Lake Malawi employ less than 1,000 fishermen operating fourteen pair trawlers of 22 to 30 engine horse power per boat, two ringnetters, one mid-water and three bottom water stern trawlers of less than 250 engine horse power, landing some 9,400 metric tonnes of fish per year.

Fish stocks and dependent fisheries

Lake Malawi's fisheries are diverse and involve the exploitation of many stocks in a variety of ways. This diversity means that management and development policies are necessary; and many factors need to be considered before recommendations are made. These include the interactions of different types of fishing effort on the same stocks, the co-existence of different stocks with different management requirements, the balancing of widespread demands for fish against the long-term need for preservation of stocks (Lewis, 1985).

Both commercial and artisanal fisheries operate, the latter being more important in terms of amount of fish landed and number of people involved. The commercial fisheries are restricted to the southern portion of the lake and involve the use of demersal trawls, mid-water trawls and ringnets. The artisanal fisheries consist of open water "Chilimira" seines, various shore seines, gill-nets, longlines etc (Magasa, 1985).

Demersal trawl fishery

Trawling in the southern portion of Lake Malawi started in 1968. An exploratory trawling programme was started by the Malawi Fisheries Department in 1969 to monitor changes in the fish population brought about by the commercial fishing, and to assess the potential yield of fish stocks in the other parts of the lake (Tarbit, 1972). Over 160 species are caught, most of which are small cichlids. Of the 160 species, 80 species belong to the genus Copadochromis, 30 species to the genus Lethrinops, 12 to the family Siluroidae of which Bagrus meridionalis is the most common. Thirty eight are undescribed (Turner, 1977).

Six surveys were made from 1971 to 1973 to determine fish biomass following the methods outlined by Alverson and Pereyra (1969) using mean catch rates, average towing speed and gape of trawl net (swept area method). The results suggest that the mean biomass of the southeast Arm is almost equal to the total of the southwest Arm and Domira Bay (Fig. 2). The mean of the six estimates for the total biomass of the three areas was estimated to be 29,500 metric tonnes and fish potential yield was estimated at 13,000 metric tonnes with an optimum effort of 8,000 boat-days (FAO), 1976). Based on these results, the southern portion of the lake was divided into eight (8) management areas (Fig. 2). Effort quotas for the areas were calculated using Gullland's (1961) modification of Schaefer's (1954) surplus yield model; and where insufficient data was available, extrapolations were made from exploratory surveys.

The on-going Demersal Fisheries Re-Assessment project which started in May 1989 and will end in January 1992 is aimed at re-assessing fish biomass, potential yield and species composition in Areas A to H (Fig. 2); using the same method followed by FAO, 1976 for comparison of results. Tentative fish

biomass is estimated at 27,000 metric tonnes and fish potential yield at 12,000 metric tonnes based on 45% of fish standing stock biomass. Fish potential yield Area by Area is also determined (Fig. 2). Currently, the demersal trawl fishery is producing 7,000 metric tonnes of fish per year.

The current management policy is that all commercial operators are licensed and a condition of issue is that any or all vessels can be withdrawn if returns show that the total allowable effort is exceeded in any area. Trawling is prohibited within 1.6 km from the shore and in waters less than 20 meters deep. Cod-end mesh size for demersal trawls is restricted to 38 mm, and fishing is only allowed from 07 hours in the morning to 17 hours in the evening to allow artisanal fishermen to set their gill-nets and longlines after 17 hours on the same fishing grounds and leave them overnight to be hauled the following morning before 07 hours. Gill-nets on Lake Malawi have mesh size limitation of 94 mm.

Chambo ringnet fishery

The Chambo ringnet fishery was started in 1943 and has been reviewed by several authors (Lowe, 1952; Williamson, 1966; Fryer and Iles, 1972; FAO, 1976; Tweddle and Magasa, 1989). The major nets in current use are 102 mm stretched mesh, 593 m long and 57 m deep.

The introduction of 38 mm and 108 mm stretched mesh mid-water trawls in 1973, utaka ringnet (38 mm stretched mesh) in 1975; which between them land large proportions of chambo, made it necessary to assess the additional effect of trawl by standardizing unit of effort to cater for differences in gear efficiency between trawls and ringnets. Each fishing unit is measured in tonnes per pull for all ringnets, and in tonnes per day for all trawlers. The combined chambo catch data from utaka mid-water trawl, the chambo mid-water trawl and the demersal trawl were converted to ringnet equivalents for each year, the total effort being calculated using the formula: Total effort = total catch (all gears) divided by ringnet catch and multiplied by ringnet effort (Tweddle and Magasa, 1989).

A plot of catch against effort data from 1951 to 1990 for the ringnet and associated fisheries gives an MSY of 2,200 metric tonnes at an effort of 11,000 ringnet pulls (Fig. 3). Similar results of MSY of 2190 metric tonnes and effort of 11,360 ringnet pulls were obtained with data series running from 1951 to 1985 (Tweddle and Magasa, 1989).

Ringnets are closed to fishing from November to December to reduce fishing effort and protect nesting chambo for at least part of their breeding season. In addition to the regulations governing closed season, minimum mesh size and types of permissible gear, there are laws which prohibit the capture or sale of juvenile chambo. Thus the possession of chambo below 15 cm is an offence which can lead to legal action being taken.

Pelagic fishery

The fish biomass of the pelagic zone of Lake Malawi has been estimated by acoustic methods in October 1979 and April 1980 to be 90 kg/ha/yr (Rufli and Vitullo, 1982). Turner (1982a) obtained an independent estimate of 75 kg/ha on the basis of purse-seine catches. The potential yield was estimated to be 45 kg/ha/yr. The total estimated biomass in the studied area (Fig. 4)

in October 1979 and April 1980, was 150,000 metric tonnes and 140,000 metric tonnes respectively (Rufli and Vitullo, 1982).

In the October 1979 survey, the biomass in the studied area from Karonga to Nkhata Bay and Nkhata Bay south to Domira Bay was estimated to be 58,000 metric tonnes for each, and from Domira Bay to the southern arms was estimated to be 35,000 metric tonnes. In April 1980 the fish biomass was estimated at 42,000 metric tonnes from Karonga to Nkhata Bay, 47,000 metric tonnes from Nkhata Bay south to Domira Bay and 49,000 metric tonnes from Domira Bay to the southern arms (Rufli and Vitullo, 1982).

A Regional SADCC project to be implemented jointly by Malawi, Mozambique and Tanzania to be based in Senga Bay, Salima is about to start. Its primary aims are the assessment of Lake Malawi's pelagic resources by the use of acoustic methods and the development of means whereby resources may be economically exploited.

Current pelagic fish landings mainly usipa (Engraulicypris sardella) are estimated at an average of about 6,000 metric tonnes per year. This is considered to be an under estimation due to the fact that night catches are not recorded. A study conducted by Lewis and Tweddle (1986) in the Nankumba Peninsula area revealed that total usipa catches for the whole lake can be in excess of 50,000 metric tonnes per year if environmental factors are favourable. Presently, no management system exists for pelagic resources.

Artisanal fisheries

The artisanal fisheries of Lake Malawi produce on average about 25,000 metric tonnes of fish per year (Table 1). The main fishing gears are chilimira seines, shore seines, gill-nets and longlines which among them land approximately 70% of the annual total catch. Other gears such as handlines, fish traps and scoop nets are also used but on a smaller scale (Alimoso, Magasa and van Zalinge, 1989).

The chilimira (open water seine net) is the most refined of the indigenous fishing methods on Lake Malawi (Howard, 1964). It is used in clear water and fishes for Copadichromis species. Shore seines fish for both Oreochromis species and Copadichromis species, catfish and Labeo species.

Available data indicates that 22,000 artisanal fishermen operate on Lake Malawi and are distributed at about 600 fishing sites along the lake using approximately 10,000 fishing craft, 80% of which are dug-out canoes, the rest being manually propelled (Alimoso, Magasa and van Zalinge, 1989).

An Artisanal Fisheries Re-Assessment Project started on Lake Malawi in April 1986 and ended in March this year. The project was aimed at providing a full detailed description of the present artisanal fisheries, with an analysis of data collected since 1976, to act as a baseline information from which management alternatives can be assessed, future trends determined and the present recording system can be examined and modified if considered necessary. The principal investigator of the project is in the process of preparing the project's final report which will shed light on the present trends (status) of the artisanal fisheries by gear which in turn may be used as a basis for revising management guidelines for the artisanal fisheries which are administered under the Fisheries Act (Cap. 66:05), Fisheries Regulations.

The management of Lake Malawi's artisanal fisheries is a more complex matter. The diversity of the fisheries in terms of fish habitats, fish stocks and fishing methods mean that no simple universal policy can be adopted. The lake is divided into zones which in turn are split into minor strata. Fishing settlements are selected randomly and beach recorders are allocated to these sites to record and categorise all fish landings. Returns are then co-ordinated and analysed by the statistical division of the department, which is thus able to define trends within the fisheries (Lewis, 1985).

Direct control of effort within the artisanal fisheries is not feasible in most areas as a high proportion of settlements rely on fishing for subsistence. However, effort is controlled in the seine net fisheries for both Oreochromis and mixed haplochromines by the imposition of closed season (Lewis, 1985). There are no closed season for the rest of the artisanal gears though there are laws in force prohibiting the use of gill-nets below a minimum mesh size. Besides mesh size limitation, gears such as chilimira seine nets, shore seine nets and gill-nets are licensed to reduce fishing effort.

Lake Chiuta fish resources

The Lake Chiuta fishery produces on average 1,500 metric tonnes of fish per year (Table 1). The lake has about 36 species and the most important commercial species are Oreochromis shiranus, Clarias gariepinus, Barbus paludinosus and Tilapia rendalli. Fish production has generally been stable from 1976 to 1989 with the exception of 1980, 1981 and 1986 (Table 1). The main fishing gears are gill-nets, fish traps, longlines and seine nets. Fish caught are sold fresh to traders who in turn smoke and sell them to major towns in the southern and central regions.

Gill-nets are the most important gear especially in the open water of the northern area of the lake, with fish traps assuming more importance in the weedy central area of the lake. The entire southern area of the lake is covered with emergent vegetation interspersed with channels permitting passage of canoes only, and in this area static gears such as gill-nets long lines and fish traps are the only suitable methods compared to the use of other gears such as seine nets (Tweddle, 1983).

A frame survey conducted in August 1990 revealed that there are 1,443 fishermen on Lake Chiuta distributed at 35 beaches. Of the 1,443 fishermen 343 are full time fishermen, 125 part time fishermen and 975 as employed assistants using 282 dug-out canoes and 68 plankboats without engines.

The use of engines on Lake Chiuta is not feasible, because the entire lake is covered with aquatic plants. Hence, the fishery cannot be developed to a large commercial scale. No management system presently exists for the fishery.

Lake Chilwa fish resources

Lake Chilwa is one of the most productive of the Central African lakes in terms of fish caught per unit area (Mzumara, 1967). A frame survey conducted in 1990 revealed that there are 3,949 fishermen and assistants on Lake Chilwa, using 1801 dug-out canoes, 229 plankboats without engines and 4 plankboats with engines landing on average 16,600 metric tonnes of fish per year (Table 1).

There are three main distribution out-lets for fish leaving the lake; Mposa in the north, Swang'oma in the south and Kachulu on the western shore. A 27 km stretch of hard gravel road connecting with the Zomba-Liwonde is the only all-weather route to the lake and this facilitates the transport of fish in lorries from Kachulu jetty to Zomba, Limbe and Blantyre markets.

Several methods of fishing are employed on Lake Chilwa, depending on the season and place where fishing activities are being carried out. The most commonly used fishing methods are gill-netting, seine-netting, fish traps, long-lining and spearing. Most of the methods appear primitive, but are adopted to the nature of the lake and its marshes. The constantly changing level of the lake is a big problem for the fishing industry, and a long-term development strategy is considered not feasible.

The management policy for the seine-net and the gill-net fisheries on Lake Chilwa is that seine-nets are limited to a maximum length of 300 metres and a maximum depth of 5 metres, whilst gill-nets are restricted to 70 mm stretched mesh size and 3 metres maximum depth. There is no closed season for all fishing gears on Lake Chilwa.

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Table 1 : Fish Production by Area for the Period 1976 - 1989 (in '000 tons)

	L. MALAWI		L. CHILWA	L. CHIUTA	TOTAL
	T	C			
1976	29.0	9.5	21.2	1.8	61.5
1977	27.2	8.3	20.8	1.5	57.8
1978	26.4	9.1	17.8	1.7	55.0
1979	15.3	8.5	25.8	1.6	51.2
1980	23.0	9.6	19.4	0.8	52.8
1981	17.7	9.7	8.6	0.9	36.9
1982	17.8	8.6	15.5	1.4	43.3
1983	23.4	10.5	16.8	1.1	51.8
1984	25.0	10.2	14.6	2.0	51.8
1985	21.0	11.2	15.2	1.7	49.1
1986	29.2	9.4	13.8	0.7	53.1
1987	31.1	10.5	15.7	3.2	60.5
1988	26.9	8.9	13.2	1.7	50.7
1989	33.1	7.6	13.7	1.1	55.5
$\bar{X}$	24.7	9.4	16.6	1.5	52.1

Notes : T = Traditional Catch

C = Commercial Catch

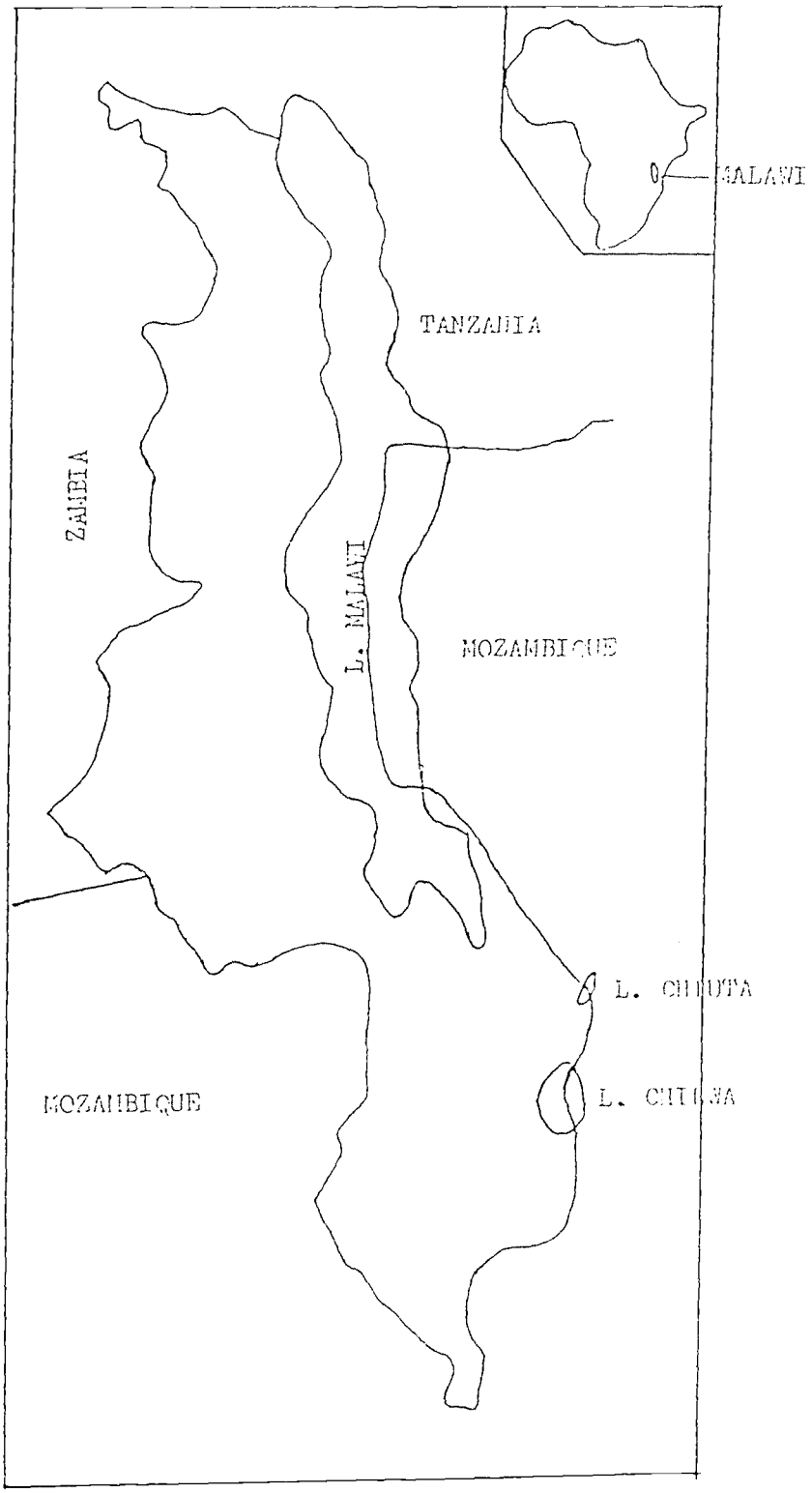

Fig. 1 : Map of Malawi showing Lakes Malawi, Chilwa and Chiuta

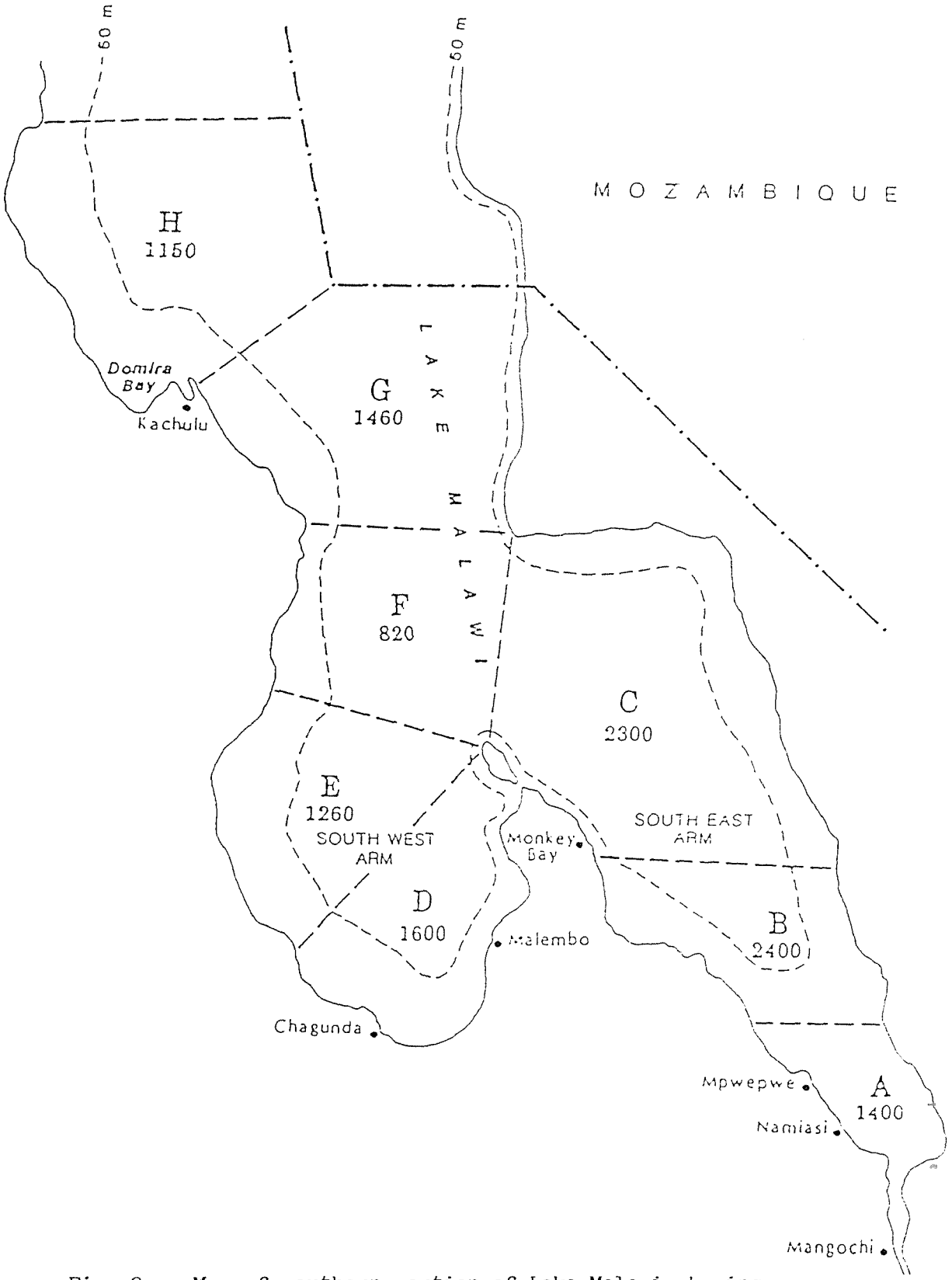

Fig. 2 : Map of southern portion of Lake Malawi showing Management areas. Numbers on figure below the letters A, B, C, D, E, F, G and H designate tentative fish potential yield for the demersal trawl fishery.

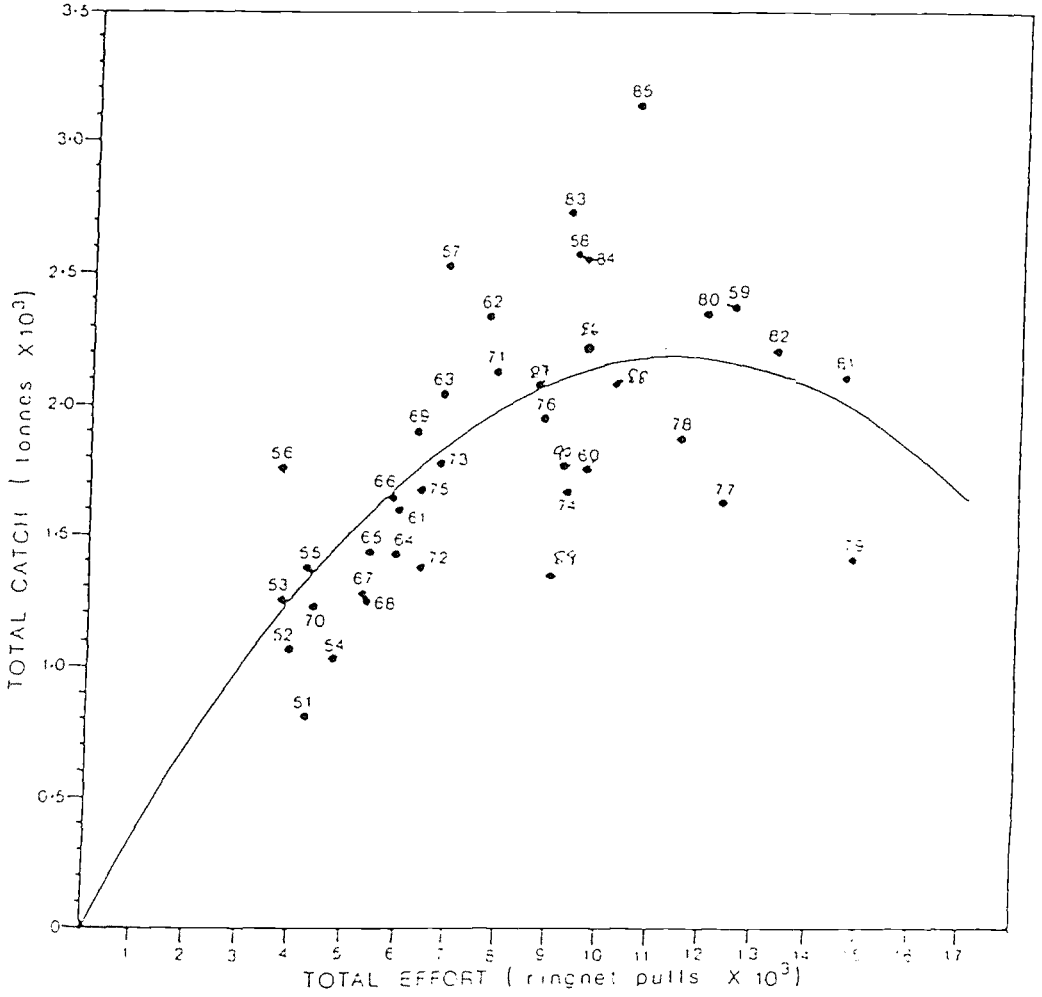

Fig. 3 : Updated analysis of catch/effort data for the chambo ringnet and associated fisheries. Numbers on figure designate years (from Tweddle and Magasa, 1989).

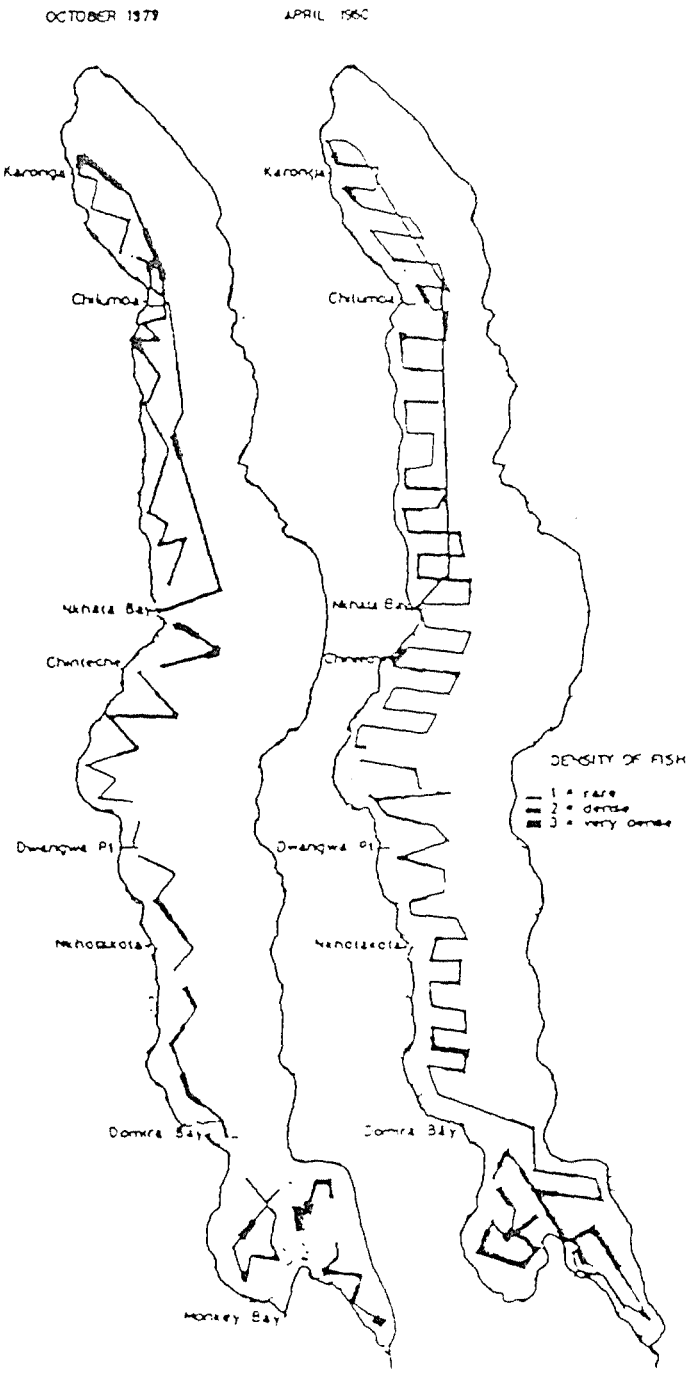

Fig. 4 : Fish distribution and abundance along the track of the vessel during the October 1979 and April 1980 (from Rufli and Vitullo, 1982)

Appendix 3.2: The Fisheries Statistics of Lake Malawi/Niassa

by

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Abstract

The estimated potential annual fish production for Lake Malawi/Niassa varies between 150,000 and 200,000 t. To date, production on the Malawian side has stabilised at 60,000 t., which is almost half of the lake potential.

The methods used to derive the fish production estimates in Malawi are in two stages. Data is collected on two fisheries in the Malawi Artisanal and Commercial fisheries. Two surveys are used for collection of artisanal fisheries data: the Frame Survey (FS) and the Catch Assessment Survey (CAS). The FS is annual, the CAS monthly. These are conducted for each minor strata.

Remarkable progress has been made in summarising artisanal fisheries data in Malawi, monthly summaries are being plotted over time, by species, and sophisticated fisheries modelling is taking place using this data.

Not much has been done on the Mozambican side in terms of statistical collections. There is scope for cooperation and the learning of some very important lessons from these virgin fisheries.

INTRODUCTION

Lake Malawi/Niassa is the third largest lake in Africa with a surface area about 30,800 km^2 (24,400 km^2 in Malawi, and 6,400 km^2 in Mozambique). It is shared by Malawi, Mozambique and the lake also borders on Tanzania.

Fish production from the whole lake has been variably estimated to range from 150,000 to 200,000 t. Production from Malawian waters has stabilised at about 70,000 t. Production from Mozambican waters has at most been very sketchy and last known figures were at 4,300 t.

With the growth of the economies in our two countries, the problem of planning and economic coordination has become increasingly complex. Consequently, demands on statistical systems which have to provide empirical data for analysis and policy formulation have also greatly increased. Efforts to effectively plan economies entail an improvement in statistical systems in general and fisheries statistical systems in particular.

The planning and management of the fisheries sector requires adequate, accurate and relevant statistical information on stock levels, fish harvesting, processing, marketing, socio-economic factors and institutional settings.

An effective, bi-lateral fisheries statistical program, improving present capacities in data collection and management, is essential to achieving the short and long-term goals of planning and management of the lake fishery.

In this paper, I present the current methods used to collect, analyze and report the results of the fisheries statistics of the lake. I also discuss the shortcomings of the methods and suggest improvements that could lead to more reliable data collection, and hence estimates of the various fisheries parameters.

THE SOURCES OF FISHERIES STATISTICAL DATA IN LAKE MALAWI/NIASSA

Various authors have given estimates of dates as to when fisheries statistical data were first collected on the Malawian portion of Lake Malawi. One record indicates that statistical data had been collected on the fisheries of the southern portion of Lake Malawi and Lake Malombe since 1946.

However, it was not until with the creation of the Fisheries Department as a ditinct body in 1965, that the introduction of regular statistical monitoring of the fisheries started.

Commercial demersal fisheries statistics have been collected since the fishery started in 1968. The collection of data on the chambo ringnet fishery can be dated as far back as the early 1950's. The artisanal fisheries data collection system started in 1976, while pond records started in 1977.

To date, it has been ascertained that little fishery resource investigation has taken place in Mozambican waters, apart from short descriptive reports in the 1950's and 1960's. During the Portuguese colonial period a "Nyasa Hydrobiological station" operated from Lisbon was located at Meponda. The results of these investigations do not seem to be readily available. Recent studies conducted in the 80's have shed some light on the extent and magnitude of the fishery in Mozambican waters. Attempts to institute statistical systems in the area have been unsuccessful.

DATA COLLECTION SYSTEMS IN MALAWI

Data is collected on two fisheries in Malawi: the Artisanal fisheries and commercial fisheries. The artisanal fisheries is sampled by means of annual frame surveys and sample based on monthly catch and effort assessment surveys; whereas, catch and effort data are collected on a complete enumeration basis to cover operations of boats owned by registered fishing companies. Both systems are implemented with the purpose of assisting the Fisheries Administration with information on the magnitude of fishing effort exerted and the size of resulting captures of commercial species.

COMMERCIAL FISHERIES

Commercial fishing takes place in eight fishing areas confined to the southern part of Lake Malawi. Areas are allocated to fishing units through licensing under the Laws of Malawi Fisheries Act. The Enforcement Unit of the department ensures that each unit fishes in its respective area (Fig.1).

All commercial fisheries operators complete and submit catch and effort standard forms at the end of each month as a condition of their licence.

The statistical approach is that of census in space and time, by means of which catches are recorded by each fishing unit on a daily basis giving the date when fishing was conducted, the fishing area, the number of hours trawled (or the number of hauls in the case of ring-nets), and the quantities of fish

caught by major categories (Table 1). Fishing effort is expressed as number and duration of fishing operations for each fishing day.

To facilitate the collection of fisheries data, the department has in some instances established centralised fish landing units. With the expansion of the commercial fleet, more and more commercial units are now landing at their own private landing sites.

ARTISANAL FISHERIES

Collection of data on traditional fisheries consists of annual census-based frame surveys and monthly catch and effort assessment surveys; the latter based on stratified random sampling approaches.

Traditional fisheries in Malawi are characterized by a wide area of operations and a large variety of gear and fishing methods used. To this end, the national waters of Malawi have been divided into major and minor strata; stratification combines both methodological and operational/administrative criteria with the two fold purpose of increasing statistical effectiveness and facilitate recorders in their task of collecting information.

Both the frame survey (FS) and the catch assessment survey (CAS) are conducted in each minor strata.

The FS involves examination of the whole coastline by field staff either on foot or bicycle. All fishing sites and beaches are visited and precise details of the populations of fishing units at each fishing site are recorded. The details on the forms include the name of the fisherman, number and type of fishing gear and craft owned, how many people assist him in fishing and other socio-economic data. This survey is only conducted once a year in the dry season. (See Tables 2, 3 and 4 for form details).

The CAS involves sampling catches from fishing units in order to estimate total catches and fishing effort in each minor stratum. The number of craft operating in any one area, based on information collected during the FS, an area will be classified to be either "large" or "small" for the sake of sampling.

CATCH ASSESSMENT SURVEY (CAS)

In the CAS, four fishing sites are selected from each minor stratum, two from each size division. A survey round, a period in which a complete cycle of CAS activities are to take place, is defined by taking into account the seasonality of the fisheries and the administrative arrangements at the time. In this case, a survey round lasts for one month.

Within every survey round each of the four selected fishing sites is visited on four consecutive days, the order of visits being selected on a random basis.

At each sampled site, the recorders spend the first day gathering basic information on fishing activities. Fishermen, usually the village headmen, are interviewed and the information recorded on PSI Survey Form 1 (Table 5).

The information recorded on PSI Form 1 includes:

(i) Name of crew in order of status;

(ii) Status crew member: is he a craft owner, cooperatively owns the craft, a crew leader or an assistant;

(iii) Type of craft owned and number of the crafts;

(iv) Number and type of gear owned by each crew member;

(v) Duration lived in the village; and

(vi) Last place he used to fish: name of village or area.

On each of the next three days, sample data is first collected on out-going fishing crafts on PS2 Survey Form 1 (Table 6) in the order they are leaving the beach. On their return, craft are chosen on a random basis using a prescribed selection schedule (Table 8) from which data are recorded on PS2 Survey Form 2 (Table 7).

The information recorded on PS2 Survey Form 2 includes:

(i) Serial number: according to the frequency of fishermen landing;

(ii) Type of craft used;

(iii) Name of owner or crew leader;

(iv) Gear inspected and size: type (code number); number of hauls; number of gear or length if gillnet;

(v) Catch of fresh fish in kg. : chambo, makumba, etc.; and

(vi) Remarks: stating whether fish has been caught at night in the case of seine nets; or no. of pulls per day if the catch has not been totally recorded.

CATCH EFFORT DATA (CATCH ASSESSMENT SURVEY)

For each selected fishing unit to be sampled, the landed catch is sorted into major categories and species. One or two sub-samples from each sorted group are weighed. The number of individuals in the sub-sample noted. Individual fish from each sorted category are then counted and their weight calculated from the sub-sample data.

Individual large fish such as Oreochromis spp. and catfishes are weighed singly or using a standard weight of 25 kg. per box.

Landings with large quantities of small fish (eg. haplochromines and Engraulicypris sardella) the number of tins caught is noted and converted into weight. In the case when the catch is poor, sub-samples are not taken, rather the whole catch is weighed.

Fishing effort is recorded depending on the type of gear used. Nets are manufactured to 91 m. (100 yards) specification by Malawi Netting Company regardless of mesh size. Long lines are defined as comprising 100 hooks and effort is expressed in terms of numbers of long lines. Fishing traps are

characterised in terms of individual gear fished. Chilimira data is got directly from fishermen in terms of number of hauls per night.

ESTIMATION OF THE TOTAL CATCH AND RAISING FACTORS USED

Using a manual calculator, the weights of the sample catches collected from each selected fishing site from the second to the fourth day of sampling are summed up to total weight (W). The total number of fishing craft (S) from which the samples were collected over the three days of sampling and the total number of fishing craft (L) which where observed landing their catch on the fishing site during the period are determined.

The total estimated catch (c) landed on the fishing site during the three days is therefore the product of W and (L/S). To find the total catch (C) landed in a month c is multiplied by the number of three day periods in the month. Since the number of existing craft (N) on the fishing site is known from the census taken on the first day of the CAS, this is assumed to be the population which produced C during the month. As the total number of fishing craft for the whole fishing area or minor stratum (Z) is also known from the annual FS, the total estimated catch (Y) for the minor stratum is determined by multiplying the quotient resulting from the division of Z by N, by C. Finally the mean of Y values obtained from the data from each of the four selected fishing sites is determined. This is taken to be the estimate of the yield from the fishing area for the month.

Fishing effort is calculated using the same procedure and raising factors.

Market statistics are collected in a few selected markets in urban areas such as Blantyre, Lilongwe and Mzuzu. The two market survey are:

(i) Fish entering the market survey; and

(ii) Market price survey

The former survey is conducted daily by a fish recorder who is based permanently at the market entrance. He weighs all fish entering the market by species and origin. The latter survey is conducted by visiting individual traders at their selling points in the market. The recorder thus collects statistics pertaining to species being sold and at what price including the duration a trader has had his fish.

This data is collected with a view of obtaining information on fish marketing channels and consumer prices. Information on movement of fish from the source to the consumer centers is also monitored.

The above information is very important in Malawi where there is usually an outcry from urban dwellers about the shortage of fish. Shortage of fish in this instance actually means shortage of the high value fresh Oreochromis spp. rather than the sun-dried or smoked haplochromines or bagrus species.

DATA PROCESSING

The introduction of the systems described above have resulted in a continually increasing volume of incoming data forms which are first edited,

then manually processed for the preparation of summaries and finally stored for use.

A statistical collection system is a vital part of any fisheries department. The role of the system is to provide information on fish stocks and on the fishing industry in general, in order to effectively manage each country's resources. The diversity of the fishery on Lake Malawi/Niassa requires appropriately designed systems which are compatible to each other.

Statistical compilation, tabulation, analysis and storage can be done far more accurately, easily and cheaply with computers. Long term trends in catches can be uncovered and studied. Given our countries current restraints, recording such voluminous data manually has become increasingly difficult and analysis exceedingly slow.

Introduction of effective data management techniques at the level of primary information, obtained from source documents will drastically reduce gross errors caused by manually performed data. Furthermore, fisheries management has become increasingly demanding for more accurate and timely information and statistical services which, in turn, necessitate flexible means of handling information and data, a well balanced degree of detail in reporting and, higher standards in the presentation of the final output.

When the two sources of fisheries data (CAS and FS) collected on the Malawi portion of Lake Malawi are considered from the point of view of computerisation, it is noted that the commercial fisheries data is relatively simple, while the artisanal fisheries data is relatively complex. However, it is found that not much emphasis is going into the computerisation of commercial fisheries data whereas tremendous progress in the analysis of the artisanal fisheries has been made to date. The artisanal data is now being used in sophisticated fisheries models.

GENERAL STEPS OF STATISTICAL PROCESSING

There is a definite set of steps which apply to most research and data processing exercises, including the fisheries production statistics of Malawi. Typically data is collected in the field through measurements or by completing a questionnaire. The raw data is then brought in from the field to be processed.

Once in the office, clerks or statisticians are called upon to summarise the data in such a way that it can be interpreted. Traditionally this work is done by hand. Adding machines and hand-held calculators have been great improvements.

There is no doubt, however, that the most effective way to handle large amounts of data is with a computer. Therefore, the next set of research activities involves computerisation of the information collected in the field.

Problems are envisaged in an area lacking electricity and trained manpower. Also the general steps involved in the statistical processing of data requires people on the ground and constant monitoring, without which the quality of the data produced cannot be relied upon.

SOME IMPORTANT LESSONS TO BE LEARNED

It is absolutely essential to establish at the earliest possible time an effective fishery statistics network on the Mozambican sector of Lake Niassa.

Observations on the Malawian portion of the lake have shown that certain fish species have heightened sensitivity to fishing pressure and have suffered declining biomasses in Malawian waters (Labeo mesops, Bagrus meridionalis and clariids). It is desirable to avoid similar declines in Mozambican waters once the fishery becomes highly developed.

Malawi would also benefit from preliminary studies on the Mozambican fishery, as this is more or less a virgin fishery. To date, the reasons for the decline of some of the most important fishery on the Malawian side are not known nor documented. Important lessons could be learned by our compatriots on how not to adversely damage their fishery.

COOPERATIVE RESEARCH WITH MOZAMBIQUE AND TANZANIA

It is heartening to know that cooperative research between the three riparian states has now started, at least as far as pelagic species are concerned. It is hoped that demersal stocks will also be studied collaboratively in the future. Due to its efficiency and economy, bottom trawling has become an important technique for harvesting fish in Malawi, though with dire consequences to some stocks. It is hoped that a thorough knowledge on the Niassa part is garnered before full scale operation is sanctioned.

The precision of the estimates of maximum potential yields to be derived from a fisheries resource, and of the estimates of catch, need to be high during early stages in the development, but must be made progressively more precise as development and management progresses.

Assistance is needed to frame these surveys and process existing data. Comparisons with similar programmes on other lakes would be valuable. Harmonization of legislation is needed in order to make statistical comparisons in the two areas equal and comparable.

Fig. 1 : Fishing Areas and Trawling Potential (Southern Lake Malawi)

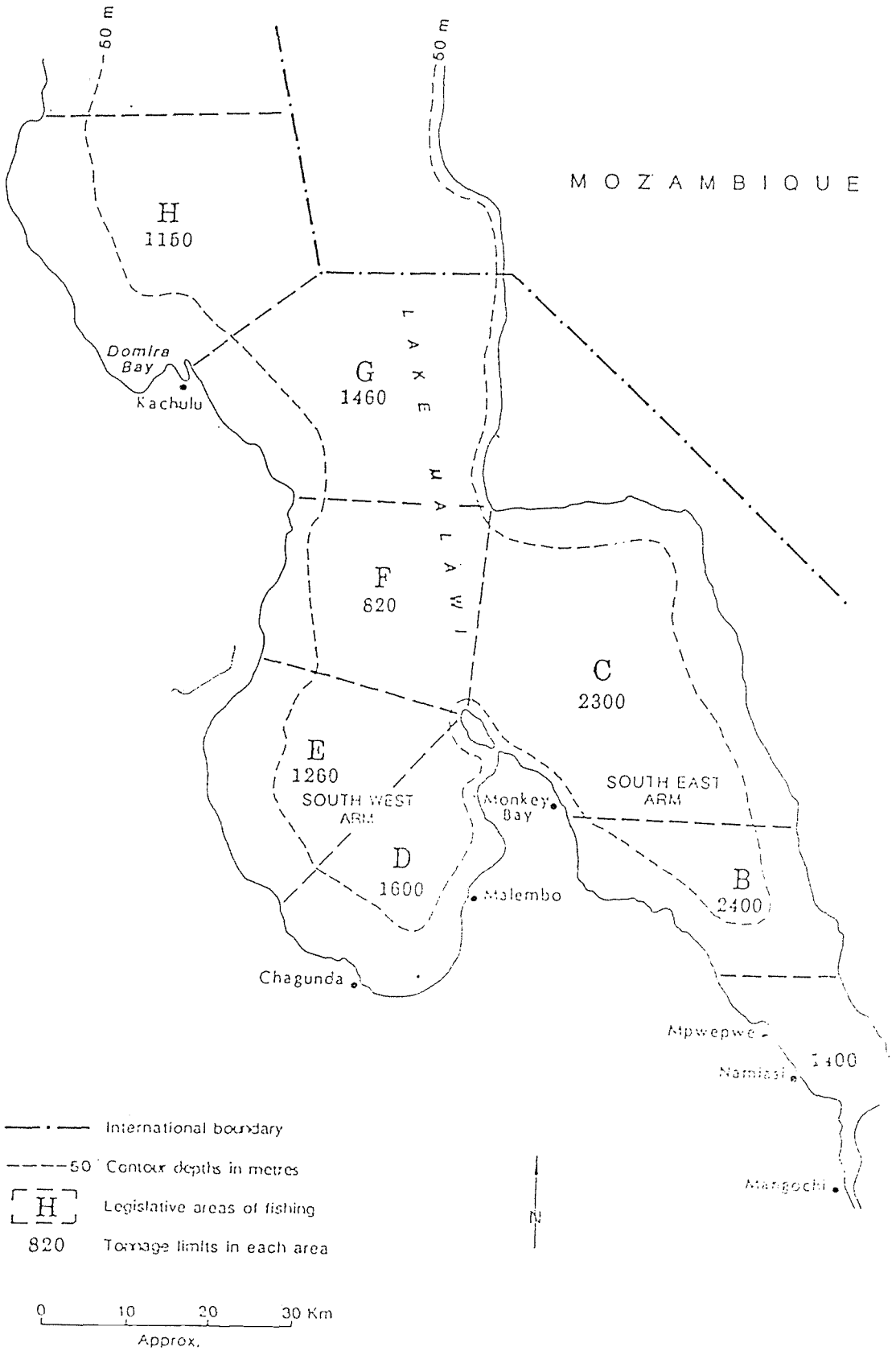

Table 1 : Fisheries Statistical Form

USE ONLY BY FISHERIES DEPT.

TYPE	UNIT	YEAR	MONTH

LICENSEE SP _____
MONTH/YEAR _____
BOAT/GEAR _____
DAY/NIGHT _____

DAY	AREA	PULLS or HOURS	CHAMBO	CHISA'WA	'UTAKA'	CATFISH	USIPA	OTHERS	DEPTH
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
TOTALS									

Remarks _____

Original : To The Chief Fisheries Officer, P. O. Box 593, Lilongwe.
Duplicate: To The Fisheries Officer, of your District.
Triplicate : To The Senior Fisheries Research Officer, P. O. Box 27, Monkey Bay.
Quadruplicate: for your records.

Table 2 : Frame Survey II Traditional Form

Name of Recorders .....

Name of Beach.....

FRAME SURVEY OF THE TRADITIONAL FORM 2 LAKES MALAWI/MALOMBE

Minor Stratum .....

Month .....

Fisherman Number	Home of fisherman	Craft Owned	Main Occupation	Other Occupation	Fish Month	Disposal of Catch				Remarks
						Home Consu-mption	Sell fresh to traders	Dry for sale to traders market	Exchange with Goods	

Table 3 : Frame Survey Traditional Form

FRAME SURVEY FORM II COST OF INPUTS - TRADITIONAL FISHERIES

NAMES OF RECORDERS.....

MINOR STRATUM.....

BEACH.....

NO. OF FRAME	FULL TIME OR PART TIME	NO. AND SIZE OF CRAFT	VALUE OF CRAFT	EXPECTED LIFE TIME	NO. AND TYPE OF GEAR	EXPECTED LIFE TIME	NO. OF ASSISTANTS EMPLOYED	VALUE PER ASSISTANT	FUEL AND OIL USED	OTHERS	REMARKS

Table 4 : Frame Survey Summary Form

FRAME SURVEY (FM) TRADITIONAL FISHERIES

LAKE MALAWI AND MALOMBE

FORM : .....

ZONE : .....

STRATUM : .....

MONTH : .....

YEAR : .....

ORDER: .....

FISHING SITE		NUMBER OF OPERATING CRAFT				NUMBER OF CRAFT WITH					NO OF FISHERMEN WITH ONE GEAR ONLY				REMARKS	OFFICE USE
AGE	NAME OF ASSOCIATED BEACHES	BOATS WITH ENGINES	PLANKED CANOES & BOATS WITHOUT ENGINES	DUGOUT CANOES & OTHER	DISUSED	GILLNETS	CHILIMILA	BEACH SEINES	LONG AND HAND LINES	OTHER	GILLNETS	CHILIMILA	B. SEINES	OTHERS		

CATCH ASSESSMENT SURVEY (S) - LAKES CHILWA AND CHIUTA

FISHERIES DEPARTMENT, MALAWI
PS1 SURVEY FORM 1

FISHING VILLAGE .....
NAME (S) OF BEACH 1.....
2.....
3.....
4.....

RECORDER (S) ..... DATE ..... SAMPLE CODE NO.
.....

SURVEY ROUND

LIST OF EXISTING FISHING ECONOMIC UNITS (FLUE) OPERATING AT VILLAGE (ALL BEACHES)

	Name of crew member (in order of status)	Status crew member (B- craft owned) (cooper, or crew leader A Assistant)	Type of craft owned enter no. of each			Number type of gear owned by each crew member					How long has he lived in the village ? tick appropriate				Last place he used to fish (name of village or areas	Remarks
			Boat with eng. BB	Boat with eng. B	Dug cr other (D)	GN NO, size	LL	B	FF	Other species	Over 1 yr	6 month to 1 yr	1 to 5 month	less than 1 month		

Table 6 : Catch Assessment Survey (C.A.S.) - Lakes Chilwa and Chiuta

PS 2 SURVEY FORM 1

FISHING VILLAGE .... DATE ....

NAME OF BEACH(S) 1 .... RECORDERS SAMPLE CODE NO. [| | |]

2 .... 1 .... SURVEY ROUND [|]

3 .... 2 ....

4 .... 3 .... SURVEY DAY [ ]

LIST OF ALL OUTGOING FISHING CRAFT

TOTAL NUMBER OF CRAFT GOING OUT FISHING (Use this number in table of samples)	
TOTAL NUMBER OUT FOR OTHER PURPOSES	

ORDER OF OUTGOING CRAFT	NAME OF CRAFT OWNER OF CREW LEADER	PURPOSE OF JOURNEY (TICK APPROPRIATE)		TYPE OF GEAR TO BE INSPECTED (TICK APPROPRIATE)					REMARKS
		FISHING	OTHER	GILL NET	LONG LINE	BEACH SEINES	FISH TRAPS	OTHERS	

FISHERIES DEPARTMENT, MALAWI

Table 7 : Catch Assessment Survey (CAS) - Lakes Chilwa and Chiuta

PS2 SURVEY FORM 2

Fishing Villages ..... Recorder(s) ..... Date .....

Name of Beache(s) 1. .....

2. .....

3. .....

4. .....

Sample Code No

Survey Round

Survey Day

Sampled Catches of Fresh Fish: By Gear and Species (Main Beach Only)

Serial No.	Type of craft	Name of owner or crew leader	Gear inspected and size			Catch of fesh fish (kg)					Remarks (eg. state whether night fish in case of seine nets, No. pulls per day if you have not totally recorded catch)
			Type (code no.)	No. of hauls	No of gear (or length) if gillnet	Makumba	Matemba	Mlamba	Others (spec)	Total	

Total number of craft observed landing their catch at all beaches.....

Total Number of craft sampled.....

Table 8 : Order of Selected Fishermen

NUMBER OF FISHERMEN							
1	2	3	4	5	6	7	8
All listed fishermen to be ← Selected →					1st	1st	1st
					3rd	3rd	3rd
					5th	5th	5th
					6th	7th	7th

NUMBER OF FISHERMEN							
9	10	11	12	13	14	15	16
1st	1st	1st	3rd	2nd	1st	2nd	2nd
3rd	3rd	3rd	5th	5th	3rd	5th	5th
5th	5th	5th	8th	7th	8th	8th	8th
7th	7th	7th	10th	11th	10th	11th	11th
9th	9th	9th	12th	13th	12th	14th	14th

NUMBER OF FISHERMEN							
17	18	19	20	21	22	23	24
1st	4th	6th	3rd	4th	5th	6th	4th
4th	7th	9th	7th	8th	9th	10th	8th
7th	10th	12th	11th	12th	13th	14th	12th
10th	13th	15th	15th	16th	17th	18th	16th
13th	16th	18th	19th	20th	21st	22nd	20th

NUMBER OF FISHERMEN							
25	26	27	29	30	31	32	33
2nd	3rd	8th	4th	5th	9th	1st	8th
6th	7th	12th	8th	9th	13th	5th	12th
10th	11th	16th	12th	12th	17th	9th	16th
14th	15th	20th	16th	16th	21st	13th	20th
18th	19th	24th	20th	23rd	25th	17th	24th

APPENDIX 3.3 : The Fishing Industry With Actual And Pipeline Programmes

by

Mr. B. Mkoko
Fisheries Department, Lilongwe

1. INTRODUCTION

Fish Resources are of importance to the people of Malawi. Total fish production fluctuates at about 70,000 tons a year and provides about 75% of total animal protein supply to the diet of the nation. Fisheries activities are a source of employment for about 35,000 fishermen and fish traders and there are 2,000,000 people whose livelihood stems from fisheries related activities such as fish processing, marketing, boatbuilding, engine repairs, government employment and fishing gear supply.

From early sixties, fish production has exhibited two main characteristics. Production increased progressively from mid sixties and peaked in 1975 at 75000 tons. From 1975 total catch has fluctuated around 70,000 tons a year however peaking in 1988 at 85,000 tons.

2. CHARACTERISTICS OF THE FISHERY

2.1 The capture fishery industry in Malawi is broadly divided into two, the commercial and artisanal sectors. The commercial sector's fishing methods include pair trawling, ring netting, single-boat bottom trawling and mid-water trawling. In recent years commercial fishing has contributed between 10% to 15% of the total catch landed. The remaining 85% to 90% of fish landed is produced by a diverse artisanal fishery which is very widely and uniformly spread throughout the shores of Malawi's lakes and rivers. Artisanal fishing methods include gill nets, open water seine, chirimila nets, longlines, mosquito nets and traps.

Malawi has five main waterbodies which are sources of fish production. These are:

(i) Lake Malawi
(ii) Lake Malombe
(iii) Lake Chilwa
(iv) Lake Chiuta
(v) Shire River

Lake Malawi is the second largest and deepest of the Rift Valley lakes. It is about 620 km in length, 87 km at its widest and has a total area of 30,800 km^2. The mean depth is 426m and its maximum, 758m. The waters below 250m are permanently stratified and are devoid of oxygen and do not support fish life. The upper layers, however, experience annual cycles of stratification and vertical mixing and are a source of relatively high production within the shallow area of the southern part of the lake.

The productivity of Lake Malawi is limited by the availability of nutrients in its surface waters. During the warm months, October to March when wind-induced mixing of the water column is least, nutrients become locally

depleted by phytoplankton populations. In the cold season the southeasterly trade winds promote vertical mixing and also tend to transport nutrient-poor surface water in a northerly direction. This, in turn, induces an upwelling of nutrient-rich deep water in the southern parts of the lake. Total fish production from Lake Malawi fluctuates between 40,000 to 55,000 tons a year.

Lake Malombe in comparison to Lake Malawi is relatively very small, 390 sq km, and has a maximum length and width of 29 km and 17 km respectively. The lake is shallow, with a mean depth of 4 m and its deepest only 6m. Lake Malombe lies immediately south of Lake Malawi's only outflow, the Shire River. The types of gear used are mostly gill nets, chambo seines, and kambuzi seines which account for 99% of fish landings. Total fish landing is about 10,000 tons a year.

Lake Chilwa is situated on the border between Malawi and Mozambique. The area of the lake varies greatly depending on the magnitudes effect of rainfall and the lake dries up sometimes. The total area including the lake floodplain and its associated marshes is about 1,800 km^2. Lake Chilwa is shallow (2-3m) , has no outflow and is extremely productive. Landings in good years have averaged 15,000 tons per year.

Lake Chiuta is on the border of Malawi/Mozambique, north of Lake Chilwa. The area of the lake fluctuates depending on rainfall, ranging from 25 sq km in bad years and 130 sq km in good years. Lake Chiuta is shallow, the southern half of which is covered with emergent vegetation penetrable by canoes but not larger watercraft. Annual production averages 2,000 tons.

Shire River is the only outlet of Lake Malawi and is divided into Upper, Middle and Lower Shire. Upper Shire is between lakes Malombe and Malawi, Middle Shire is between lake Malombe and Kaphichila falls. Lower Shire is below Kapichila falls and includes the elemphant and Ndinde marshes.

Fish production of the river, particularly the Lower Shire is dependent on the annual flooding of the marshes and is high in a year when water levels have the widest variation between high and low. Estimated production has ranged between 8,000 to 12,500 tons. However, of recent years, production has fallen probably due to the invasion of water hycinth.

2.2 Aquaculture

Aquaculture in Malawi is still in its early stages of development. Though fish farming was first introduced into the country in the early fifties, the effort was shortlived. Most of the farms were abandoned by farmers at the end of sixties because of poor yields mainly due to lack of suitable species, feed and extension services.

The Fisheries Department has revived its interest in small-scale fish farming. It has established research centres at Domasi, Kasinthula and Mzuzu in addition to small extension centres at Kunenekude, Chisitu, and Namwera in the south and Limphasa, Nchenachena and Bolero in the north. New stations will be established in Dowa and Ntichisi to cater for the central.

Arising from this new impetus about 600 ponds have been constructed by small-holder farmers throughout the country. Production levels are still low averaging about 1.5 tons per hectare per year. Commercial fish farming has not

yet taken off. A few estate farms have fish ponds, primarily to provide fish meals to their workers.

3. STATUS OF THE FISHERY

Fish production from Malawian waters has been generally stable fluctuating at a mean of 70,000 tons a year (see table below):

Table 1 : Fish production 1976-1990 (x 1000 tons)

Year	1976	1977	1978	1979	1980	1981	1982
Production	75	68	68	60	66	52	58

Year	1983	1984	1985	1986	1987	1988	1989	1990
Prod.	65	65	62	73	88	78	71	74

Most of this catch comes from the shallow areas of the lakes. The above trend could suggest that the shallow areas have reached sustainable yield levels. Increased pressure in these areas could lead to over exploitation.

However, there is at present limited knowledge of the abundance and distribution of fish in the open waters of Lake Malawi. There are possibilities that reasonable amounts of Engraulicypris sardella (usipa) together with those larger species which feed upon it could exist.

Two hydroacoastic surveys carried out by Rufli and Vitullo in 1981 put the total biomass of the pelagic zone at 140,000 tons. Currently it is hoped that under the auspices of SADCC the whole of the pelagic zone will be assessed by the Joint Survey of Pelagic Fishes Project of Lake Malawi.

4. ECONOMIC ROLE OF THE INDUSTRY

The fish resources of Malawi are estimated to contribute about 4% of the country's GDP. However, the sector's significance lies in the fact that fish is an important and cheap source of food, employment and income for the country's rural population.

As a source of food in 1990, on a national basis, the fish supply per person was 9.00kg, which is relatively high by international standards. At this level, fish is estimated to supply about 70% of animal protein. However, these are average national figures and there are local disparities from the lakeshores to the inland areas.

4.2 As a source of employment

The Malawian fisheries are also a source of employment. The artisanal fisheries provide a livelihood for a great number of self-employed or wage earning fish workers e.g. men, women and children working in the production, processing and marketing phases of the industry. According to the 1990 Frame Surveys of Traditional Fisheries, there were 37,000 fishermen engaged in fishing and over 180,000 part-time workers.

4.3 As a source of income for women

Although not participating in actual fishing operations, Malawian women, similarly to those in other countries in Africa engage in fisheries related activities.

Fish processing and marketing are some of the major areas where women play a major role. Customarily from the time the fish is landed it belongs to the fisherman's wife or sister or close female relation. Once the fish is landed, fish handling, processing and trading is dominated by women.

5. DEVELOPMENT POLICIES AND STRATEGIES

The current Government Fisheries Policy was revised in 1987 and is contained in the statement of development policies 1987-96. The development strategy has defined objectives and strategies with a list of priority areas. In pursuit of these objectives, the government will take action which involves the following:

(i) Monitor and where appropriate, control the exploitation of fish fauna from all national waters on a continuing basis, directing and regulating production within safe sustainable yields for each individual fishery, and using the land to safeguard the resources from any other threat.

(ii) Promote aquaculture development as a means of raising rural farm incomes and increasing the supply of fresh fish in rural areas.

(iii) Undertake a programme of research to identify and quantify underutilised fish resources, particularly those in the offshore areas.

(iv) Encourage the appropriate exploitation of such underutilised resources once they are identified.

(v) Promote interterritorial cooperation in fisheries matters on all shared waters to minimize resource depletion and avoid risk of over exploitation.

(vi) Disseminate to those concerned the results of research and development into improved fishing, fish handling and processing techniques.

(vii) Identify and construct as a priority viable infrastructure requirements needed to help improve the effeciency of the commercial fishery.

(viii) Maximise the returns from exports of aquarium fish and other fish and crocodile products.

(ix) Prohibit the introduction into Malawi of live exotic fish species unless and until scientific evidence justifies otherwise.

(x) Develop the institutional capacity of the Fisheries Department.

The paramount responsibility of the Department is therefore the protection of the existing fish resources by means of appropriate research, extension and vigorous application of the various regulations. There is concern over the validity of some of the catch data collected which requires a review of the methodology and practices.

6. MAJOR RELATED PROGRAMMES AND PROJECTS

6.1 Past Programmes and Projects

The Fisheries Department in Malawi has benefited from the following expired bilateral and multilateral aid projects:

(a) Lake Malawi Fisheries Development Project UNDP/FAO, 1969-1982. Based at Mpwepwe, Mangochi, it offered training and infrastructure development including the introduction of bottom trawling.

(b) Fisheries Expansion Project, UNDP/FAO, 1977-1982. The purpose of the project was to expand the pelagic stock assessment studies and fishery development activities to the north. It established a research station at Nkhata Bay.

(c) Central Lakes Fisheries Development Project, EEC, 1980-85. Multi-purpose fisheries project on central Lake Malawi. Major success was on combating post harvest losses through the use of actellic for fish preservation.

(d) Fisheries Development Strategy Study 1986. The objective of the study was to review fisheries development and propose orientation of the development strategy until year 2000. The study was funded by EEC.

(e) Development of National Fisheries Training Programme study: The study aimed at identifying national training needs. The study was funded by UNDP.

(f) Traditional Assessment Project. The aim of the project was to make an assessment of the artisanal fisheries of lakes Malawi and Malombe. The project provided estimates of fishing effort with recommendations of sustainable yield levels.

6.2 On-going Programmes and Projects

Malawi has a number of on-going projects and programmes specifically aimed at realising the objectives of the development policy. These are:

(a) Demersal fisheries reassessment project. The aim is to establish the status of the bottom trawl fishery. Bottom trawl fishery was introduced into Malawi in mid-sixties. Regulations and quotas to control the fishery were put into force in mid seventies. The purpose of the project is therefore to test whether the control measures have worked and if possible to fine tune the recommendations.

Preliminary results indicate that the biomass has not changed significantly, there is however need to check the status of the species composition. The project is funded by ODA.

(b) Management of chambo stocks in S.E. Arm of Lake Malawi, Lake Malombe and Upper Shire.

The chambo, (Oreochromis species) is a much sought for fish and as a result it is under heavy fishing pressure. The objective of the project is therefore to assess the present status of the fishery and come up with management plans to regulate the fishery. The project is in its third year, and results indicate that the chambo stocks of Lake Malombe are under heavy pressure and need stricter regulatory measures. The project is funded by FAO/UNDP.

(c) Lake Chilwa/Chiuta Development Project

The objective is to improve fish supply, fish processing and distribution in the Zomba, Machinga and Blantyre areas. The project has developed an improved boat for Lake Chilwa and fuel saving fish processing methods. The project is funded by GTZ and based in Zomba.

(d) Mulanje/Phalombe Fish Farming Project

The project has established an extension centre at Chisitu which is providing fingerlings and extension services to farmers in the Mulanje-Phalimbe area. The project is funded by ODA.

(e) Central and Northern Region Fish Farming Development, Extension, Training and Research Project.

(f) Joint Research of Pelagic Fishery Resources of Lake Malawi/Nyasa.

The aim of the project is to assess the potential of the open waters of Lake Malawi and come up with recommendations on how to exploit the fish stocks. This programme falls under SADDC programme of action and is to be implemented jointly by Mozambique, Tanzania and Malawi funded by ODA.

6.3 Pipeline programme

Programmes which are envisaged to be implemented over the next 10 to 15 years will focus on the following:

(a) Institutional Building

Resource inputs, particularly financial have lagged behind in the Department. As a result, the present Fisheries Department's capacity to effectively implement its programmes is impaired. The Department has overstretched its meagre resources which has led to superficial coverage of some areas. Some important areas such as research, surveillance and extension have not been adequately covered.

In the institutional building programme, the Department intends to streamline its activities, transfer commercial activities to the private sector, review its staffing levels to march with the current Department activities. Emphasis will be given to training in order to develop a sustainable capacity within the Department and reduce dependence on external expertise.

A planning, monitoring and evaluation unit will be established at the Fisheries Headquarters to enhance planning and project implementation capacity of the Department.

(b) Focus on Research

The objective of this programme will be to strengthen the Department's capacity to formulate research plans which focus on issues facing the fishing industry.

Research on demersal stocks will be expanded to include the northern part of Lake Malawi, surveys will be carried out in the pelagic waters in order to refine estimates on the standing stocks. The programme will closely monitor the effects of the bottom trawl and beach seining on the lakes environment.

To achieve these research goals, the facilities at Monkey Bay Research Station will be rehabilitated and supplied with appropriate equipment including a new research vessel.

(c) Increased and Sustained Fish Production

The production sectors of the industry, the artisanal fisheries, semi-commercial fishery and commercial fisheries will be provided with loans to rehabilitate or replace their fishing and fish handling equipment. Hitherto, the artisanal fishermen have faced problems in procuring loans because of lack of "security". Suitable lending conditions will be negotiated with smallholder Agricultural Credit Administration to facilitate loans for the small scale fisherfolk.

Semi-commercial and commercial fishermen will obtain commercial loans from established lending institutions.

(d) Improvement of Infrastructure

Owing to financial constraints most of the existing fish landings and shore-based facilities along the lakeshore are in poor condition. Within this programme funds will be provided to rehabilitate and upgrade the facilities including access roads. At Mpwepwe Boatyard a new slipway, a workshop and staff houses, will be constructed. New solid jetties will be constructed at Monkey Bay and Nkhata Bay with appropriate machinery and equipment. A total of 46 kilometres of access roads to fish landing sites will be upgraded to enable easy transportation of fish.

(e) Women's Programmes

Given the importance of fish as a source of animal protein and the significant role women play in these activities, a programme for women is in the pipeline. The pilot programme, an income generating activity aimed at women, will provide support to those engaged in fish processing and marketing activities in selected districts. The programme will aim at minimizing post harvest losses while increasing the earning power of women participants.

(f) Control of water hyacinth study

Water Hyacinth (Eichornia) has been observed in Lower Shire and is spreading rapidly. A decline in fish catches in the area has been attributed to the spread of the weed which is blocking access channels and choking available fishing areas.

A study has been proposed to investigate the harmful potential and advise on how it can be controlled and used as feed for livestock.

(g) Improvement of the light fishing techniques

It is intended to study the use of light fishing methods which are well established in Lake Kariba and Tanganyika and make some trials on Lake Malawi. If successful it will improve the landings of usipa which are considered as under exploited.

(h) Review and Revision of Data collection and analysis system.

The present statistical system was established with FAO assistance in 1976. There is need to review and if possible institute a simpler but reliable system.

(i) Development of suitable fish farming system by utilising local species. The objective of the project is to research and develop economically viable fish farming systems from native species rather than rely on the use of exotic species.

(j) Improvement on the management of Fisheries Resources in Lower Shire. The aim of the project is to promote and develop the fishery of Lower Shire thereby raising the living standards of

the rural community through increased fish production and reduction in post-harvest losses.

(k) Implementation of Fishery Management, Legislation and Enforcement

The objective is to design fishery management plans supported by appropriate research and legislation that ensure safe sustainable stocks of commercially important species and to develop within the Department the capacity to enforce these regulations.

(l) Establishment of a National Fisheries Data Centre

The project will provide the Department with the means of collecting and analysing data throughout the fisheries sector and be able to respond on a timely basis to biological or social changes while maintaining an uninterrupted service.

7. DISCUSSION AND CONCLUSION

Although the total production from the Malawian waters is estimated at 150,000 tonnes per year, most of the waterbodies except for the pelagic waters of Lake Malawi would be considered to have reached their maximum sustainable levels of production. Increased fishing pressure in these lakes would lead to a collapse of the fish stocks. Developmental activities in such lakes should focus on enforcement of control measures and better utilisation of the landings.

The position for Lake Malawi is somewhat different. Although the maximum sustainable yield for the entire lake has not been scientifically assessed, research efforts have produced sufficient evidence of underutilised pockets of fish stocks in the central and northern parts of the lake. Hydro-acostic surveys carried out in the early eighties strongly suggest the possibility of substantially increasing the production through exploitation of pelagic fish stocks.

In order to increase fish production, there is need to channel credit facilities to fishermen and fish traders. This would enable them to replace their worn out fishing gear, or obtain better fishing craft which would enable them access to the under-utilised fish resources.

Fish production from aquaculture in Malawi is still in its early stages. The majority of fish farmers practice polyculture of native species but fish yields are still very low. Farmers need better packages containing better fish species and appropriate aquaculture technologies intergrated with agricultural management systems.

Despite having the potential to increase fish production, the rational use and protection of fish stocks is of paramount importance. There is urgent need to monitor fishing pressure and carry out continuous stock assessment if overfishing is to be avoided. The present resource allocation in terms of trained staff, finance and equipment is not adequate to perform the basic task of safeguarding fish resources. Efforts to correct the current situation is underway.

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Appendix 3.4 : Cooperation in Research and Development - Malawi Fisheries Research Review

by
E.L. Ng'ombe

ABSTRACT

The paper gives a limnological, climatic and fisheries description of major fishing water bodies shared between Malawi and Mozambique, namely Lakes Malawi, Chilwa and Chiuta. It also describes Lake Malombe.

A brief history of fisheries research in Malawi including a description of major research projects conducted to date is given.

Six points are suggested for discussion as possible areas of co-operation in research and development between the riparian states on the shared Lake Malawi/Niassa, Chilwa and Chiuta.

1. INTRODUCTION

There are four main inland water bodies in Malawi (Fig 1) where fisheries have developed. Lake Malawi, which is 560 km long, 20 - 80 km wide and covering an area of 30,800 km^2 is the largest. It has a mean depth of 426 m and a maximum depth of 750 m (Welcomme, 1972). Apart from the size, the magnitude of its fish yield makes it the most important of the four main water bodies, yielding about 34,000 metric tonnes of different fishes annually from the Malawian side.

Geologically Lake Malawi is younger than Lake Tanganyika but because of its long isolation from other water systems it has evolved a remarkable endemic fauna. Climatically two distinct seasons are observed, a relatively calm season between November and April, followed by six months of heavy winds during which time, air and water temperature are relatively low. This cycle is believed to cause seasonal changes in water circulation in which wind-induced internal waves play an important role. Beadles' (1974) suggestion that these waves cause nutrient to circulate between the anoxic water mass below 200 m and the upper productive layers has been challenged by studies conducted by FAO (1982) which showed the existence of distinct three layer system; the deepest extending from the bottom to a depth of 250 m where the exchange of energy and material between it and the layers above is nominal, and being devoid of oxygen does not support life. The two upper layers however, experience annual cycles of stratification and vertical mixing from June to September, although variation in time and space of this mixing has led some to believe it causes the variability in productivity and standing stocks.

There is something in the order of 7,200 km^2 of water less than 200 m deep within Malawi jurisdiction (GOPA, 1987), accounting for about 22% of the entire water surface. Approximately 1,200 km^2 stretches to a width of about 15 km from the northern tip southwards to Young's Bay, further south of which are precipitous escarpments leading from the mountain ranges flanking the lake, continuing underwater to great depth until Chintheche when the 200 m line appears again extending to 10 km offshore as far as Nkhotakota. From Nkhotakota shallower conditions are experienced for the remainder of the

entire lake. These coastal waters are characterized by long stretches of sand and mud. A few areas comprise rock and stone, restrictive to some fishing operations.

The inflows into Lake Malawi are short water courses from the escarpments and nearby mountains, their volume depending directly on the precipitation in the immediate region. Shire River is the only outflow from the Lake.

LAKE CHILWA

Lake Chilwa is the second largest lake in Malawi, and the eastern shore borders Mozambique. The lake is very shallow with a mean depth of 2 m and a high annual fluctuation of about 1.3 m, as such the lake is vulnerable to occasional drying up. The lake last dried up in 1968 but completely refilled the following rainy season (Ratcliffe, 1971). The lake is characterized by open water with maximum area of 2,500 km^2 and a swampy peripheral area up to 390 km^2. The unstable lake level situation has affected the long-term development strategy of the lake, despite its high productivity and a commercially important fishery.

LAKE MALOMBE

Lake Malombe is relatively small compared to either Lake Malawi or Lake Chilwa. It is 390 km^2 with a maximum length of 29 km and width of 17 km. It has a mean depth of 4 m with the deepest point at 6 m. Its position between Upper Shire and Lower Shire river which is the only outlet from Lake Malawi suggests this to be a flood plain of the Shire River. Lake Malombe supports a very important traditional fishery based on Chambo (Oreochromis spp) and Kambuzi (haplochromine), although due to inadequate policing of the regulations on mesh size for the control of fishing, there is evidence to suggest overfishing of the Chambo stocks, [Alimoso and Tweddle, 1991 (unpublished)].

LAKE CHIUTA

Lake Chiuta is the smallest lake in Malawi. It has an area of 113 km^2 and also borders Mozambique on the eastern bank. It has a mean depth of 5 m.

With such a hydrological and biological variation scientists and enthusiasts have been attracted since the middle of the last century to study the origins of the present fish fauna and its subsequent development. The Government of Malawi, through the Fisheries Department has creditably recognized and developed expertise and the capacity, hitherto inadequate, to investigate such matters as are of immediate importance to the development of fisheries and the conservation of the various resources.

2. FISH PRODUCTION AND FISHING EFFORT

Table 1 shows fish production by water body from 1976 to 1989. On average Lake Malawi's traditional and commercial fisheries produce between 50 and 65% of the total landed catch in Malawi. The second in importance is Lake Chilwa which on average lands between 20 and 30% of the total landings.

It should be noted that from 1976 fish production in Lake Malawi has been stable, generally. This is despite increased effort over the same period (see Table 3).

3. FISHERIES RESEARCH

The historical background to fisheries research pertinent to this review dates back to the 1950's when the Joint Fisheries Research Organization (JFRO) was established and based at Nkhata Bay in the Northern Region of Malawi. Initial studies included hydrological work on Lake Malawi and the affluent rivers; invertebrate studies; development of an annotated check-list of the important fish species; and studies on the ecological zonation. Other studies involved work on the biology of the commercially important fish; and detailed study of the attractive rock-dwelling cichlids (Mbuna) which today form an important ornamental fish export trade. In 1962 the research was transferred to Monkey Bay and carried out by the then Department of Agriculture and Fisheries through a specially established Fisheries Research Unit.

Primary work at Monkey Bay included exploratory and investigatory fishing trials in the southern waters of Lake Malawi which revealed exploitable populations of demersal fish which later became the focus of a commercial trawl fishery. Further studies provided descriptions, distribution and ecological information on a number of important, but up to that point in time, unknown cichlid species eg. "Chisawasawa" (Lethrinops spp), which was particularly abundant in the South East Arm of Lake Malawi. Another commercially important species "Chambo" (Oreochromis spp) was studied in Lake Malombe and the connecting Upper Shire. Chambo presently supports an important traditional gill net and seine net fishery and also a commercial ring net fishery in Lake Malawi. There are indications of possible overfishing of the Chambo particularly in Lake Malombe. A UNDP/FAO assisted research project is presently underway to study further the biological and socio-economic aspects and also review the data collection system of this species with the objective to review the management regime including the legislation that has been applied to date. The discovery of the unexploited demersal populations resulted in rapid development of the fishing industry from 1969 onwards. Fish landings doubled from 1,800 to 41,000 tonnes between 1969 and 1971, reaching a peak of 84,000 tonnes in 1972 (Table 2), although such a dramatic change is generally viewed to reflect more the change in the recording system introduced around 1969 and the apparent inadequacies of the former, rather than the sole effect of the demersal trawl fishery thus developed.

4. PRESENT GOVERNMENT FISHERIES POLICY

The overall aim of the present Department of Fisheries Policy is to maximize the safe sustainable yield from all fish stocks in the national waters; improve the efficiency of exploitation, processing and marketing; promote investment in viable rural fish farming units; and exploit all opportunities to expand existing, and develop new aquatic resources. The policy also embodies recognition of the endemic fish fauna, not only as a scientific and educational asset but also a particularly vulnerable major economic resource requiring protection, (DEVPOL, 1987).

This policy sets the framework for present and future fisheries programmes in the country. It affords the Government the opportunity to

carefully plan development in the industry on the basis of sound scientific evidence.

Among the various strategies to achieve the objective of a safe, sustainable fishing industry are those related directly to research and development and also the international factor, viz:

- monitor, and where appropriate, control the exploitation of fish fauna from all national waters on a continuing basis, directly and regulating production within safe sustainable yields for each individual fishery, and using the law to safeguard the resources from any other threat;

- undertake a programme of research to identify and quantify underutilized fish resources particularly those in the off-shore water of Lake Malawi;

- encourage the appropriate exploitation of such underutilized resources as identified;

- disseminate to those concerned the results of research and development into improved fishing, fish handling and processing techniques;

- promote inter-territorial co-operation in fisheries matters on all shared waters to minimize resource duplication and obviate any risk of over-exploitation. It would be noted from the above policy and strategies that a framework for co-operation between the riparian countries Mozambique, Malawi and also Tanzania in the case of Lake Malawi, exists.

5. THE RESEARCH PROGRAMMES

Research was and still is divided into four general categories, 1

(a) that which is jointly funded by the donor and Government and conducted along with the regular programme of the Fisheries Department, eg, FAO projects;

(b) that which is undertaken by the Department with a degree of external assistance, eg. ODA, but not specifically based with Fisheries Research Unit, Monkey Bay;

(c) that which is within the routine programme of the Fisheries Research Unit and may in some instances receive minimal assistance from donor agencies;

(d) that which is externally funded and is generally academic in nature. Such research is normally conducted by outside researchers but with full knowledge, approval and guidance of the Fisheries Department and the Department of Research and Environment of the Office of the President and Cabinet. In this way the Department has carried out 12 major research projects since 1970, all of which have had direct and important bearing upon the rational development of the individual fisheries, either by geographical location, technique or resource or a combination of more than two of these. Tweddle in his paper "Malawi Fisheries

Research: A Review", has summarized the results of all the research done under these categories since 1970. Included also in the Review are all publications of the research results.

Presented here are the research projects of Categories A to C and a summary of the objectives of each project.

UNDER CATEGORY A the following projects have been carried out:

A.1 UNDP/FAO Project for the Promotion of Integrated Fishery Development - Stock Assessment Programme - 1972-1976 (Funding by UNDP/FAO)

Objectives of the project were:

- to determine the optimum sustainable economic yield of the mechanized trawl fishery; to develop a continuing research programme beyond the end of the project and to work closely with the Malawi Government Fisheries staff to obtain the type of biological information needed for stock assessment to assess the status of the traditional fisheries and devise a statistically valid beach recording programme; to conduct investigations into the environmental effects of the proposed Chintheche pulp mill.

A.2 UNDP/FAO Fisheries Expansion Project - 1977-1982 (Funding by UNDP/FAO)

Objectives of this research were:

(a) to establish a reasonable forecast of the pelagic fish stocks and their potential yield in Lake Malawi; and (b) to continue investigations into the environmental effects of the proposed Chintheche pulp mill.

A.3. Traditional Fisheries Assessment Project - 1986-Present (Funding by ODA/Malawi Government)

Objectives of the Project were:

- to provide a full, detailed description of the present traditional fisheries of Lakes Malawi and Malombe and the linking Upper Shire, with an analysis of data collected since 1976, to act as baseline information from which

(a) management alternatives can be assessed;

(b) future trends can be determined by continued monitoring of the fisheries; and

(c) the present recording system can be examined and modified if considered necessary.

An aerial survey and experimental fishing programme were included in the activities to supplement the statistical data and assist in interpretation. The project ended in March 1991. Results indicated need for more rigorous monitoring of fishing effort and intensive enforcement of the restrictions on mesh sizes and close season for the Chambo fishery of Lake Malombe.

A.4 Ornamental Fish Trade Assessment Project - 1975-1983

Objectives of the project were:

- to investigate the fishery for ornamental fish in Lake Malawi, study population densities and dynamics of the fish to determine the effects of exploitation on the stocks; resolve difficulties in the nomenclature (taxonomic, aquarist and vernacular) of the ornamental fish species; study the inter and intraspecific relationships and the balance existing between the different species; assess the distribution and habitats of the different species; study breeding behaviour to determine seasonality, fecundity, territoriality, migration; advise on improvements of catching, holding, packing and shipment to reduce fish mortalities; establish a monitoring system for the future; and assist in the preparation for the establishment of the Lake Malawi National Park.

Some of the results from this project were the establishment of the Lake Malawi National Park, establishment of a legislation for a close season, quota restrictions for certain popular but vulnerable species, prohibition of introduction of species to areas where they do not occur naturally and the phasing out of exploitation in the Lake Malawi National Park waters.

A.5 Conservation of Threatened Fish Communities in Lake Malawi National Park - 1984-1986 (Funding by IUCN/WWE)

Objectives of the project were:

- to determine the current status of populations of fishes introduced into Lake Malawi National Park from other parts of Malawi; to examine the effects of these introductions on the indigenous fishes; to study aspects of the basic ecology of the rock fishes of the National Park in order to obtain information upon which management policies can be based; to promote interest in the conservation of Lake Malawi's aquatic communities by producing an illustrated guidebook to the fishes and aquatic habitats of the park.

A.6 Banqula Lagoon Study - 1975-1976 (Funding by ODA)

Objectives of the project were:

- to investigate the feasibility of undertaking a programme of lagoon management in order to increase the productivity and ease of fish harvesting within tropical swamp fishes; to formulate a biological basis for a programme of rational exploitation and manipulations of the resources with a view to providing optional fish harvesting regimes.

A.7 Feeding Ecology of Cormorants on Lake Malawi - 1978-1981 (Funding by ODA)

Objectives of the project were:

- to study the feeding ecology of the cormorants of the southern part of Lake Malawi, to determine the impact of the cormorant population on fish stocks exploited in the fisheries.

IN CATEGORY B : Fisheries Department Research Programmes Assisted by External Funding, the following research projects have been carried out:

B.1 Lower Shire Fisheries Research Project - 1970-1975 (Funding by Malawi Government/ODA)

Objectives of the project were:

- to study the fish and fisheries of the Lower Shire River and its associated marshes; to determine which fish species are exploited in the fisheries; ascertain the most important commercial species and study their ecology in order to understand the interactions within the marsh and river system; to determine the intensity of the fishing effort and the possibilities for expansion; and to make recommendations on the way in which development of the fisheries should proceed.

B.2 Karonga Baseline Survey - 1978-1981

Objectives of the project were:

- to start fisheries research in the northern part of Lake Malawi; to assess and describe the current status of the fisheries in the area; to carry out experimental fishing programmes in the area to assess potential for development; to study the "Mpasa" (Opsaridium microlepsis) fishery of the North Rukuru River area and the biology of the species; to examine fisheries of other rivers in the area; to provide background information on which development projects can be planned.

B.3 Lake Chilwa Co-ordinated Research Project - 1966-1976

This project was a multidisciplinary project conducted mainly by the University of Malawi researchers. Fisheries was just one component of the whole study.

Objectives of the Fisheries component were:

- to study the fish and the fisheries potential of Lake Chilwa, and to develop improved techniques for exploring the stocks.

UNDER CATEGORY C : Ongoing Internal Research Programmes - the following research has been carried out:

C.1 Commercial Fisheries Studies

Objectives of the studies were:

- to determine breeding seasons of main deep water trawl-caught fishes, to allow close seasons to be imposed, if considered necessary, during the peak breeding season of the fishes; to determine change in species composition as a result of long-term trawling; to determine changes if any, in mean size of the fish from year to year, and to see if there are changes in peak breeding months from year to year; to analyse and continually update data on the commercial fisheries, to ensure that effort quotas are not exceeded and to refine calculations on which present quotas are based.

C.2 Taxonomic Research

Objectives of the work were:

- to prepare descriptions of and to name important commercial and aquarium fishes previously unknown to science so that they can be correctly identified in future, to facilitate biological research on the complex multispecies flocks exploited in the fisheries.

C.3 Usipa (Engraulicypris sardella) Studies

Objectives were:

- to study the ecology of Usipa to discover, if possible, reasons for the dramatic fluctuations in abundance of this species.

C.4 Lake Chiuta Studies

Objectives were:

- to collate all available information on Lake Chiuta and its fisheries; to monitor the development of the fisheries.

C.5 Mpasa (Opsaridium microlepsis) Research Programme

Objectives were:

- to study the Mpasa to determine growth rates breeding biology, fluctuations in abundance from year to year, factors affecting year-class strength, with a view to making recommendations for management of the stocks.

There are a few other research projects that have been carried out which are either minor to the scope of this review or have been purely academic in nature and therefore of less direct consequence to the fishing industry.

6. ON-GOING RESEARCH PROJECTS

Ongoing research projects include the Demersal Fisheries Reassessment Project funded by ODA, which aims at reviewing the status of the commercial trawl fishery to assess the effect of over twenty years of fishing on the stocks in terms of standing stock and species composition through experimental trawling and an in-depth study of the Catch/Effort data from the commercial fishermen; the Management of Chambo Project funded by UNDP/FAO aimed at a thorough study of the biology and ecology of the Chambo and also study the socio-economic aspects of the fishing communities to assess the impact of the management policies and regulations set on the Chambo fishery. The ultimate aim is to review present legislation with the view to improving the management of this important resource. The SADCC Lake Malawi/Niassa Pelagic Resource Assessment Project is yet another project that has just started. This project is being funded by the ODA of the British Government and executed by the three riparian states namely, Mozambique, Tanzania and Malawi.

7. RECOMMENDATIONS ON AREAS OF CO-OPERATION

The review given above and the brief descriptions of the scope of research and development activities conducted and those in progress, illustrate the tremendous potential that exists or can be amassed by collaborative action towards better management of the shared fish resources in the described water bodies. The SADCC Lake Malawi/Niassa Pelagic Resources Study typifies this kind of approach to resource management. Such studies should lead to joint programmes in the management of such shared resources, which should include common legislation where it is established that same resources are being exploited by the partner countries.

Suggested below are specific areas of co-operation:

(a) joint research programmes on shared stocks;

(b) accessing of statistics on catch and effort data to partner countries;

(c) accessing of publications from research studies to partner countries;

(d) establishment of common legislation for management of shared stocks;

(e) joint monitoring of the catchment region to the shared water bodies against unauthorized introduction of exotic fish species which may escape into lake systems, and

(f) the inclusion of Tanzania in future technical consultation on Lake Malawi/Niassa.

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TABLE 1: Fish Production by Area, 1976 - 1986 (X '000 tons)

Year	Malawi		Malombe	Chilwa	Chiuta	Middle and Lower Shire	TOTAL
	T	C					
1976	29.0	7.5	6.1	21.2	1.8	9.3	74.9
1977	27.2	6.7	6.4	20.8	1.5	5.6	68.2
1978	26.4	7.2	6.1	17.8	1.7	6.6	67.8
1979	15.3	7.1	3.6	25.8	1.6	6.4	59.8
1980	23.0	7.2	6.5	19.4	0.8	3.9	65.8
1981	17.7	7.6	8.5	8.6	0.9	4.0	51.3
1982	17.8	6.4	12.1	15.5	1.4	5.2	58.4
1983	23.4	7.8	9.7	16.8	1.1	6.1	64.9
1984	25.0	7.6	11.3	14.6	2.0	4.9	65.4
1985	21.0	8.0	8.6	15.2	1.7	7.6	62.1
1986	29.2	7.2	12.7	13.8	0.7	9.2	72.8

Note : T = Traditional C = Commercial

TABLE 2 : Fish Production 1962 - 1973 (x '000)

Year	Lake Malawi	Lake Malombe & Upper Shire	Lake Chilwa & Chiuta	Middle & Lower Shire	T O T A L
1962	9.3	1.8	0.5	-	11.6
1963	7.4	2.6	-	3.8	13.7
1964	6.2	1.1	-	5.8	13.1
1965	6.5	1.5	-	10.9	18.9
1966	5.8	2.9	-	8.8	17.5
1967	5.4	4.0	-	5.0	14.4
1968	7.8	7.8	-	3.2	18.0
1969	24.2	5.3	3.0	9.2	41.7
1970	43.6	6.4	5.3	11.0	66.3
1971	54.0	5.0	4.5	9.7	73.2
1972	57.0	3.1	6.7	17.3	84.1
1973	53.7	3.3	2.7	9.8	69.4

TABLE 3 : Fishing Effort by Strata 1974 - 1987 (incomplete) Lakes Malawi and Malombe (Number of boats)

Year	1974		1975	1976	1977	1978	1980		1984		1986		1987	
Zone*	A	B	A + B	A + B	A + B	A + B	A	B	A	B	A	B	A	B
1	221	143	470	485	410	362	28	379	14	576	19	791	23	693
2	695	383	1,658	1,432	1,101	1,101	607	562			1,047	883	1,212	896
3	649	111	388	277	697	761	643	147					851	286
4	614	100	306		308	257	165	69	403	153	399	193	461	104
5	924	33	574	544	1,141	1,038	705	101	1,042	160	1,031	166	1,097	78
6	2,086	38	984	650	1,207	1,118	1,343	20	1,312	12	1,426	20	3,499	20
7	1,009	18			623	800	434	3	588	2	587	3	1,756	3

Note : A = Dug out canoes

B = Planked boats

(Data for 1974 and 1987 collected by aerial survey. No data available for 1979, 1981 - 1983 and 1985).

* See Figure 3

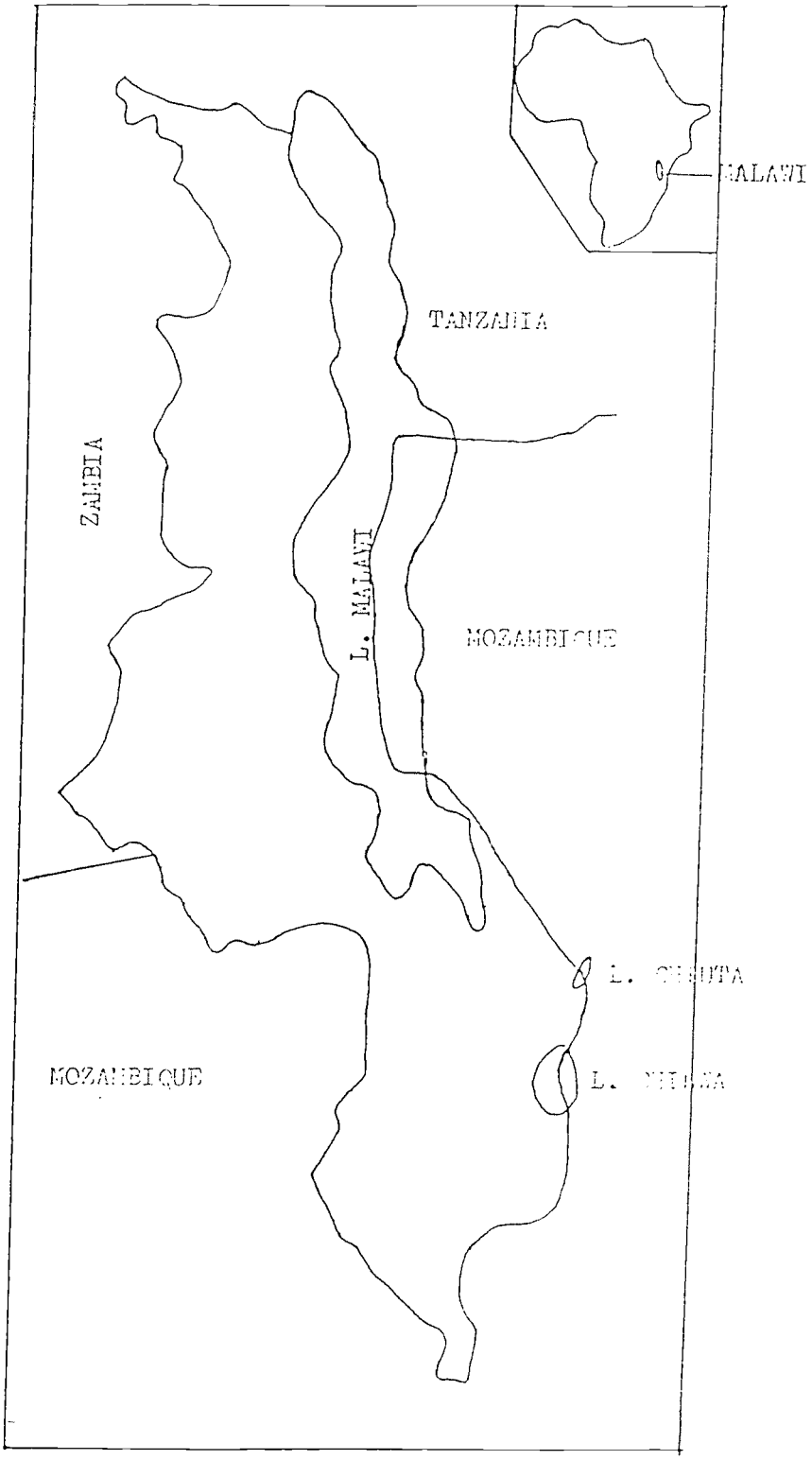
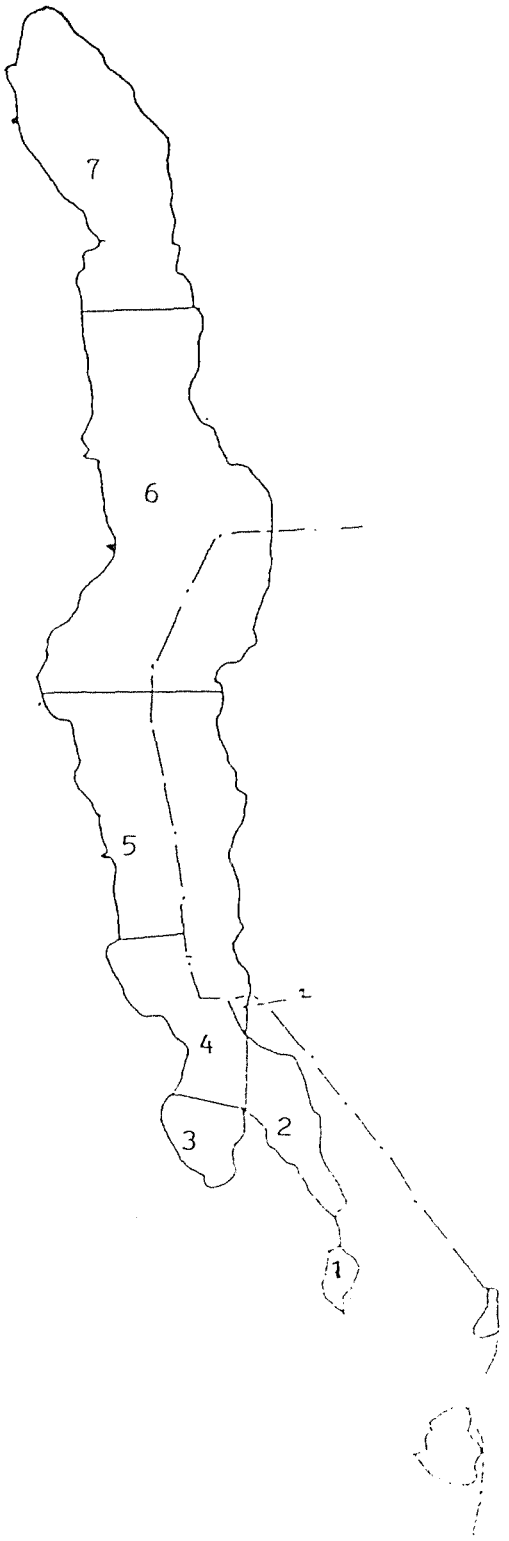


Fig. 1 : Map of Malawi showing Lakes Malawi, Chilwa and Chiuta



Zone :

1 - Upper Shire and Lake Malombe
2 - South East Arm, lake Malawi
3 - South West Arm
4 - Salima to Domira Bay
5 - Nkhota Kota
6 - Nkhata Bay
7 - Karonga

Fig. 2 : Showing zones 1 - 7 of Lakes Malawi and Malombe

Appendix 3.5 : Mozambique Paper For The Mozambique/Malawi Technical Consultation Meeting on Lake Niassa/Malawi

Lake Niassa/Malawi with a surface area of 30,800 km^2 is the third largest lake in Africa. Mozambican territory occupies 6,400 km^2 (20.8%) of this area.

Lake Niassa/Malawi fisheries (Mozambican side only) are artisanal and are carried out by numerous fishing boats using various types of gear and operating from numerous fish landing places scattered along the shoreline. However, few fisheries resource investigations have taken place in the Mozambican side of the lake.

In order to get information on the size and structure of the fisheries of Lake Niassa, a Frame Survey was conducted in 1983. A total number of 3,380 fishermen scattered in 41 fishing villages were identified. The total number of fishing boats were around 1,228 of which only 25 were motorized boats.

In the majority of the fishing villages, gillnets and handlines were used. Also other types of gears were registered such as traps, long-lines, chilimila and beach seines. The total annual catch, estimated from the data obtained during the survey, amounts to approximately 9,000 metric tons.

2. EVOLUTION OF THE FISHERIES SECTOR

2.1 Pre-independence Period

During the colonial period there was no state institution responsible for fisheries development in the country. This fact had a strong negative effect on Lake Niassa/Malawi as it was considered to be a very remote area and out of the development priorities. This explains why the fishing methods and gears are so undeveloped on Lake Niassa/Malawi. Due to these factors fishing activity in the lake is mainly fishing for subsistence by individual fishermen.

2.2 Post-independence period (1975-1980)

With the achievement of independence this situation got worse, particularly due to the breakdown of the Portuguese colonial commercialization network which used to play a very important role in the supply of fishing equipment, materials and consumer goods, and also commercialize the surplus production of the local fishermen.

In 1975 the first state institution for fishery administration, the national directorate for fisheries, was established. During the first five years this institution was forced to fill in the gaps left by the Portuguese through surveys in order to acquire the knowledge about the sector activities.

2.3 1980-1986 Period

In 1980 the Secretariat of State for Fisheries was established. This measure was accompanied by the first big reflection on the sector in order to establish the strategy for the development of the sector. Along these lines several enterprises and institutions for technical assistance were established. The most important enterprises were the ones for technical assistance, equipment supply and distribution of fishing gears and materials as well as the construction and maintenance of fisheries infrastructures.

In the artisanal fisheries, the most important step was the creation of the Small-Scale Fisheries Directorate - UDPEE, which adopted a strategy of creating a network of "Combinados Pesqueiro". Among these, the Combinado Pesqueiros of Metangula was created with the aim of re-establishing the fishing capacity which existed during the past. The following were its main responsibilities:

(a) supply the fishermen with fishing equipment and material;

(b) improve fish processing technologies and trading of surplus production;

(c) provide means of transport for both aquatic and terrestrial resources products;

(d) introduce more developed fishing methods and gears;

(e) give technical assistance in maintenance of equipment; and

(f) carry out research and experimentation.

2.4 Structural Adjustment for the Period 1987 - 1991

With the establishment of the structural adjustment programme, there was a need to restructure the organisational structure of the fisheries sector. In the area of the artisanal fisheries, a company was established with the aim of strengthening the management of the Combinados Pesqueiros. In addition an institute for Small Scale Development - IDPPE was established with the aim of promoting the Development of the Artisanal Fisheries, namely through:

(a) establishment of a network of extension;

(b) promotion of the organization of the artisanal fishermen;

(c) carry out research and experimentation in the areas of fish and fishing technology;

(d) promotion of the construction of strategic infrastructures;

(e) organization of training activities;

(f) stimulation of new enterprises;

(g) carrying out regular surveys on the artisanal fishery and establishment of regular system for statistical data collection; etc.

In order to achieve these objectives, it is planned to establish a network of stations, one of which will be in Metangula, on the shoreline of Lake Niassa/Malawi.

3. PREVAILING SECURITY SITUATION

The security situation does not allow the implementation of the objectives stated above, particularly in Lake Niassa/Malawi where the access roads to fishing villages are blocked and often attacked. Currently, fish production has gone down as a result of the difficulties in supplying the fishermen with fishing gear and equipment and difficulties in commercializing surplus products. Additionally, it is not possible to allocate the necessary field staff nor to attract the cooperating agencies. As such, the development of the fishing activities on Lake Niassa/Malawi depends exclusively on ending the hostilities and the restoration of peace.

4. COOPERATION

With the prevailing present situation, the more realistic approach to take would be to train the future field extension workers of the inland waters, through training courses lasting 1-2 years.

Appendix 3.6: An Overview on the Development and Management of the Fisheries of Lakes Malawi, Chilwa and Chiuta

by

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INTRODUCTION

Malawi has an area of 94 080 km^2, about 20% of which is occupied by Lake Malawi, in the Great Rift Valley. The Great Rift Valley continues from the south end of the lake past the southern borders of the country. East and west of the valley the land rises to form high plateaus, generally between 1 000 and 1 300 m, although the Nyika uplands rise as high as 2 800 m.

Mozambique has an area of 784 090 km^2 comprised by the following sectors:

(a) coastal lowland (44%);
(b) central upland plateaus of 200 - 600 m (17%); and
(c) a higher plateau of 600 - 1000 m (26%).

Mozambique has 6 400 km^2, about 21% of Lake Malawi. Lakes Chilwa and Chiuta also border on Mozambique. Both of these lakes have highly variable areas, due to the fluctuations in rainfall.

HYDROGRAPH OF LAKES MALAWI, CHILWA AND CHIUTA

The three lakes have the following hydrographic features:

(i) Lake Malawi itself covers an area of 30 800 Km^2, over half of which is effectively controlled by Malawi. Lake Malawi is a deep Rift Valley lake with a maximum depth of 758 m, the richer shallow southern areas of the lake both lie within Malawi;

(ii) Lake Chilwa is an endorheic lake showing extreme variations in water level. It dries out almost completely in some years, but may extend over 2 590 km^2 at highest water when it is surrounded by 1 000 km^2 of marshland. Its mean area is about 750 km^2;

(iii) Lake Chiuta is a smaller lake of the same limnological type as Lake Chilwa and covers about 200 km^2 when it attains its maximum water level.

GEOGRAPHICAL AND PHYSICAL/CHEMICAL DATA ON LAKE MALAWI

Lake Malawi geographical data (Welcomme, 1972)

(a) Boundaries Malawi: Mozambique and Tanzania

(b) Altitude : 471 m

(c) Surface area : 30 800 km (24 400 km^2 in Malawi; 6 400 km^2 Mozambique)

(d) Depth: 758 (max); 426 (mean)

(e) Volume: 8 400km^3

(f) Max. length: 603 km

(g) Max. width: 87 km

(h) Shoreline: 1 500km (total lake); 300km in Tanzania

(i) Catchment area: 65 000 km^2

(j) Annual fluctuation in level: 6 m

(k) Major inflowing rivers: Ruhuhu, Songwe

(l) Outflowing river: Shire

PHYSICAL AND CHEMICAL DATA (JACKSON et al, 1963)

- surface temperature : 23-25°C
- conductivity K_{20} : K_{20} 220 µ 0mhs
- alkalinity : 20 - 25.9
- pH : 7.7 - 8.6

Ionic Composition (Talling and Talling, 1965)

	mg/l
Sodium (Na)	21.0
Potassium (K)	6.4
Calcium (Ca)	19.8
Carbonate ($Ca\ Co_3$)	-
Bicarbonate ($HC0_3 + C0_3$)	144.0
Magnesium (Mg)	4.7
Chloride (Cl)	4.3
Suplhate (So_4)	5-5.5
Silcon (Sio_2)	1.1

Lake Chilwa

Geographical data

- Location : Malawi, Mozambique - 15° 15'S; 35° 45'E
- Altitude : 654 m
- Surface area : very variable: 259-2 590 km^2; mean: 7509 km^2 with a surrounding swampy area of 1 000 km^2. Only a minute portion of the lake is situated in Mozambique (29 km^2 max.).
- Depth : 5 m (max); 2 m (mean)
- Max. length : 45 km
- Max. width : 32 km
- Major inflowing rivers: Thondwe, Likangala, Sombani
- Outflowing river: none; internal basin
- Annual fluctuation in level: 1.3 m (the lake sometimes dries up)

Physical and Chemical Data	February	July	December
- Surface temperatures: quite variable	21 - 37°C		
- Depth: (m)	2.05	1.55	1.0
- Conductivity: (µS/cm)	800	1 500	2 500
- pH:	8.2	8.6	8.8
- Total alkalinity: (meq/l)	7.15	8.7	19.0
- Oxygen: (mg/l)	5.6	10.0	6.7
- Transparency: (Secchi) (cm)	7.5	8.5	11.0
- Ionic composition:	mg/l	mg/l	mg/l
Na^+	189	350	780
K^+	14.0	10.5	23.1
Ca^{2+}	10.8	13.4	13.2
Mg^{2+}	6.4	6.3	8.6
Cl	182	277	515

	µg/l	µg/l	µg/l
PO_4-P	1 240	1 214	2 000
NO_3-N	n.d.	n.d.	59

Lake Chiuta

Geographical data

- Location: Malawi and Mozambique - 14° 45'S; 35° 50'E
- Altitude: 620 m
- Surface : total: 200 km^2 (40 km^2 in Mozambique)
- Depth : 5 m
- Max. length: 21 km
- Max. width : 8 km
- Catchment area: 2 000 km^2
- Outflowing river: Lugenda
- Special features: a sand-bar only 25 m higher the floodplain separates Lake Chiuta from Lake Chilwa.

Physical and chemical data (Welcomme, 1972)

- Surface temperature: 21-37°C
- Conductivity: K_{20} 150 µS/cm
- pH: 7.0-8.0
- Dissolved solids: 0.10-0.15 g/l

EXPLOITED FISH SPECIES AND FISHERIES LAKE MALAWI

Lake Malawi has a diverse fish fauna. There are about 245 described fish species of which 193 are cichlids. The main species exploited in the inshore waters are haplochromines whereas Engraulicypris sardella dominates the deeper waters.

The exploitable fish species of Lake Malawi include the following :

Scientific name	Local name
Pseudotropheus and "Haplochromines"	mbuna
Engraulicypris sardella	usipa
Labeo cylindricus	ningwe

Labeo mesops	nchila
Barbus johnstonii	ngumbo
Opsaridium microcephalus	sanjika
Clarias gariepinus	
Clarias mossambicus	mlamba/sapuwa
Bagrus meridionalis	kampango
Synodontis nyassae	
Anguilla nebulosa	
Mastacembelus shiranus	
Mormyrus longirostris	
Mormyrus deliciosus	
Cyrtocara	liyani/binga
Lethrinops	chisawasawa
Rhamphochromis	ncheni
Serranochromis	tsungwa
Hemitalapia	
Chilotilapia rhoadesii	
Aulonocara	
Trematocranus	
Aristochromis christyi	
Docimodus	
Oreochromis squamipinnis	Chambo
Oreochromis saka	Chambo
Oreochromis lidoli	Chambo
Oreochromis karongae	Chambo
Oreochromis shiranus	Chambo
Tilapia spp.	Chambo

Each of the fish species of Lake Malawi has its habitat preference which means that there is a big difference between the fauna of adjacent areas.

The underwater inshore habitats of Lake Malawi can be split into six major divisions, some of which may in turn be subdivided into finer units. The major habitats are: the rocky zone, the sandy zone, the weedy zone, the rock-sand interface, the intermediate zone and the recedbed zone. The rocky coastline zone is about 30% whereas the non-rocky coastline is about 70%.

CATCH TRENDS FOR LAKE MALAWI

In the Malawi sector of Lake Malawi, catches have increased from about 7 900 t in 1962 to about 36 400 t in 1986. There are no reliable data on fishing effort and total catches for the Mozambique sector of Lake Malawi.

Trends in total annual catch for the Malawi Sector of the Lake

year	Total Catch (t)
1962	7 938
1965	6 441
1970	44 000
1971	54 000
1972	57 000
1973	54 800
1974	52 200
1975	47 200
1976	36 500
1977	33 900
1978	33 600
1989	22 400
1980	30 200
1981	25 300
1982	25 200
1986	36 400

The potential annual yield is put at 73 200 - 97 600 t for the Malawi sector of the lake. The overall productivity for the Malawi sector of the lake is 30 - 40 kg/ha/year (FAO, 1982).

EXPLOITED FISH SPECIES AND FISHERIES OF LAKE CHILWA

There 28 fish species cited by Balarin (1987) for Lake Chilwa. The main exploited species are : O. shiranus, Barbus paludinosus and Clarias gariepinus. The fishing intensity and total catch varies with the lake water level and area. The total annual catch for the Malawi sector of the lake has increasad from about 3 500 t in 1962 to about 15 500 t in 1982. The potential annual catch for the Malawi sector (when the lake has its maximum area) is about 20 000 t according to Chaika (1982). There are no reliable data for the Mozambique sector of Lake Malawi. Catch trends for the Malawi sector of Lake Chilwa are as follows:

Year	Total catch (t)	Year	Total catch (t)
1962	3 500	1973	1 903
1963	3 262	1974	3 171
1964	5 255	1975	2 808
1965	8 820	1976	21 200
1966	7 100	1977	20 800
1967	3 139	1978	17 800
1968	97	1979	25 800
1969	3 326	1980	19 400
1970	4 166	1981	8 600
1971	3 595	1981	8 600
1972	5 246	1982	15 500

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 techical consultation 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 poor artisanal fishermen ;

(iv) relevant socio-economic factors affecting the fisheries;

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

(vi) proper research-extension liaison and the transmission of research results to fishermen;

(vii) exchange of information between various fishery institutions;

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

3.1 Understanding the fisheries environment of Lakes Malawi, Chilwa and Chiuta

Knowledge of qualitative factors that have a bearing on fisheries management and development is essntial.

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 impact on cost and earnings. In this connection, he should gain a general acquaintance with determinants of stock abundance, climatic 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 and predation).

Total annual catch for the Malawi Sector of Lake Chiuta

Year	Catch (t)
1965	181
1971	900
1972	1 400
1973	800
1974	900
1975	700
1976	1 800
1977	1 500
1978	1 700
1979	1 600
1980	800
1981	900
1982	1 400

For fisheries management purposes, the following aspects will require special attention from Mozambique and Malawi:

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

(b) the way in which the stock(s) vary in response to natural (environmental) forces and to alternative levels of explotation intensity,

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

(d) the optimal catch rates and levels; hence size and density of biomass, for the fish-harvesting identity;

(e) the effect of alternative allocations of access to a particular stock among competing fishery 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 between total catch and catch rate; and

(g) maximum yield from a biomass 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, "they" pertain to fishing input factors or fishing output factors:

(i) evaluating fishing input factors would require 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 the fishing fleets, fishing gear and fishing aids; port; processing and marketing facilities.

(ii) On the output side, the fisheries 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 concerning 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 Economies

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 crop and animal production industries.

There is often rivalry in the exploitation of haplochromines (Mbuna), Engraulicypris, Clarias and tilapiines, sport fisheries and pleasure boat sports. Development in other sectors of the national economy, may be beneficial for or cause damage to fishing. 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 yields.

On the market side, fish is in direct competition with other animal protein food 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 which are likely to arise because of competition between fisheries and other sectors of the national economy in input and 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 sectors in competitive situations.

3.4 The legal framework for Controlling the fisheries

Planning should be governed by a policy framework that should comprise the following:

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

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

3.4.1 Fishing Regulations

Rational management of the fisheries of Lakes Malawi, Chilwa and Chiuta 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 gear as well as fishermen).

3.4.2 Control on the alteration of physical features of the environment

Serious consideration should be given to the following measures:

- monitoring of the flow of shared river systems;
- control of lake levels;
- control of erosion and silting in lake basins;
- improvement of spawning grounds; and

- improvement of habitat in the inlets or outlets of these lakes

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

The chemical nature of Lake Malawi and others should be maintained by controlling pollution, salinity and fertilizers from agriculture areas.

3.4.4 Control against the alteration of the biological features of Lakes Malawi, Chilwa and Chiuta

Conservation of the fishery resources of the three shared lakes can be attained by focusing attention on the following:

- control of aquatic weeds;
- control on the introduction of exotic plant and invertebrate;
- introduction of forage fish;
- control of disease and parasites;
- control of predation and competition; and
- fish population manipulation.

3.5 Effects of Overfishing the Stocks

Excessive fishing 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. Other important consequences are:

- foregone revenue from alternative uses of resources;
- over-capitalization when the exploitable resources are limited;
- higher risk of fluctuations and vulnerability of exploited species (Mbuna and Usipa);
- social and economic conflicts between various types of fisheries; and
- re-allocation of fishing effort and management costs.

3.6 The Need for a Reliable Fishery Data System

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

In addition to obtaining information from the Fisheries Departments and Research Institutes we can obtain data on the state of fisheries from the following sources:

(i) the universities Malawi and Mozambique and other scientific organizations 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 organisation for local and export fish supply; and

(vii) fishing associated industries

4. Management Measures and Options

In view of the dynamic nature of the shared lakes 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 fisheries management 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 resources.

(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 are or 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 the 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 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 particapatory mode. There is a fundamental lack of understanding on part of managers the nature of participants of most African fisheries. It is hardly possible to manage for societal long-term needs when so little is known about the innate behaviour of the local fishermen. Good understanding is basic to effective communication. There is a need to convince poor record fishermen about 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.

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