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MALAWI FISHERIES : AN ASSESSMENT AND OVERVIEW

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EXECUTIVE SUMMARY

Problem: About seventy percent of Malawi's animal protein is produced by fishes captured in the natural waters of Malawi. Between 4-4½ million Malawian's consume fish. The overall catch has declined since 1976 at an average rate of approximately 4% per annum (40% drop overall in six years). This has led to a decrease in animal protein of approximately 7% per capita each year. If this trend continues a valuable aquatic food rescourse of Malawi may soon be lost or seriously depleted.

Reasons. The reduction in catch could be due to any of three possible causes or combinations thereof : 1) Change in fish distribution and inability of traditional gear to catch fishes due to rising lake level; 2) increased costs due to risinc fuel, net and boat prices which makes fishing unprofitable and hence the resource is being underutilized; 3) the utilization of the resource has pushed the yield past MSY which resulted in a decline in the fisheries.

Constraints: The Malawi Government has established a Fisheries Department within the Ministry of Forestry and Natural Resources to manage these fisheries. The Department has limited financial resources with which to implement their mandate of "feeding the nation". Training of personnel needs to be upgraded and modern data acquisition systems need to be employed so that management decisions can be made in a timely fashion.

Solutions: The Malawi Fisheries Department requires considerable outside assistance. We propose that a 5 year integrative training program covering 13 general subjects including stock assessment, fish ecology, limnology, fish processing and marketing, aquaculture, among others. Teams will be trained over the period so that they will have the skills to analyse and carry out sophisticated management decisions. The Malawi Fisheries Department will therefore, require assistance in purchasing computer systems to help with

data management and systems analysis. Finally an education and extension team will be trained so that the management policies to be implemented will be interfaced and explained to the participants, the rural fisherman.

Evaluation and Determination of Success of Project. During the course of this program the Malawi Fisheries Department should have the capabilities to bring about a halt in the decline of fish harvesting and should with time increase the total fish production within the waters of Malawi. The success or failure of this project will be judged on whether or not the total amount of fish protein produced in the country rebounds to levels found in earlier years.

INTRODUCTION

Importance of Fisheries

About seventy percent of the total animal protein consumed in Malawi is derived from fish. Between 50,000 - 80,000 metric tons of fish are caught annually throughout the country, by both licensed (approx. 25,000) and unlicensed individuals. Added income and foreign exchange are also obtained from the sale of aquarium fish (MK200,000) and overseas tourists who come to Malawi to see these fish. Lake Malawi is the most speciose lake in the world and contains more species (500 +) of fish than are found in the entire Western North Atlantic. These fish have a direct economic impact on 5-10% of Malawi's families (between 1/4 and ½ of a million people) and provide protein for 75% of the population (between 4 and 4½ million people). The loss of this resource would have a dramatic if not catastrophic effect on the socioeconomic structure of the country.

The Malawi Government, recognizing the overriding importance of this renewable resource, created in 1965 a Department of Fisheries, now within the Ministry of Forestry and Natural Resources. This Department is responsible for analyzing and making management decisions that involve a complex network of interrelated activities which include the harvesting, processing, marketing, consumer demand for fish and increasing of production by fish farming. These fisheries operate within certain socioeconomic and political contexts and interact with other sectors of the economy. Certain aspects of these fisheries are controlled by individuals (i.e. a fisherman's decision as to where and for how long to fish). Other aspects of the system (e.g. the size of fleet, fishing gear available in the country, weather, natural fluctuations) are beyond the control of individuals and sometimes beyond the control of all the participants. Collective action is required when individual actions fail to produce desirable results (Stevenson, 1982). Therefore the Malawi Government

acts for society in managing common property fishery resources which have no owners. Without regulation and management, a common resource such as this would be overexploited as individuals try to maximize short-term gains to the detriment of the long-term goals of society, "The Tragedy of the Commons" (Harding 1968).

Resources and Harvesting

As is typical of tropical ecosystems, the Lake Malawi fishery is characterized by a complex network of interspecies relationships. Flow of water and nutrients into Lake Malawi varies seasonally with the rainy season and upwelling caused by the strong southerly winds occuring in the cool dry season. The reproductive cycles of these fishes are correlated with nutrient influx (McKaye1983). The aquatic ecosystems throughout Malawi are susceptible to environmental perturbations such as those caused by contamination brought about by deforestation, dams, industrial and domestic uses of water.

The fishing techniques in Malawi are generally labor intensive. The types of gear used are diverse and relatively inexpensive to operate. (see fishing methods section). Regardless of how efficiently the fishery functions through the use of diverse collecting techniques its potential contribution to society is ultimately limited by the size and productivity of the resources which are harvested. Fishery resources are renewable and produce a biomass which can be harvested (Fig 1). If harvest is excessive, birth and growth processes may not replace the quantity of biomass lost to natural mortality and harvesting. A common objective of fishery management is to maintain a population size which produces the maximum rate of population growth and therefore the maximum sustainable yield to the fishery. (MSY in Fig 1, Stevenson, 1982).

Most small-scale traditional fishery resources are free to be harvested by anyone. This open access nature of the fishery frequently leads to biological overfishing (beyond MEY (Maximum economic yield) Fig 1) to a point

where the total cost of fishing is equal to the total revenue gained from fishing. While MEY may be in rare instances to the right of MSY, the maximum economic benefit to the nation from the fishery is usually achieved to the left of MSY.

Processing and Marketing

The Malawi fisheries have a variety of marketing systems. The simplest being fishermen who sell fish directly to individuals where the fish are landed. However, sophisticated marketing networks involving processing, middlemen, and the transportation of fish to distant markets such as Blantyre and Lilongwe also exist. Fish are purchased and sold at each stage in the process, thus adding to the eventual price paid by the consumer. These fisheries are characterized by fluctuations in supply on both a temporal and spatial scale and prices on the free market can vary considerably.

Processing maintains, and can increase, the value of fish in that it allows fish to be shipped farther, and stored longer. The types of processing used in Malawi are relative simple - drying, smoking and icing.

Malawi Government intervention in marketing and processing is stimulated by the desire to improve operating efficiency, thereby increasing the quantity and quality of fish. It also protects public health by setting handling and processing standards.

Relation to Agricultural Sector

In Malawi, most fishing families also raise crops (predominately maize), and livestock (typically chickens and goats). The agricultural sector plays the dominant rôle in determing the location of roads and the basic marketing network throughout the country. The means available for expanding the distribution and marketing of fish is dependent on the basic infrastructure necessary to move agricultural and industrial products. The agricultural section poses a threat to the survival of fish due to the use of pesticides and herbicides as well as increasing water run-off due to deforestation

However, fishing and agriculture can also compliment each other. The introduction of ponds onto agricultural plots for example, makes efficient use of both plant and animal waste in the production of additional protein for the land holder. The varied relationships between agriculture and fishing suggest that changes in one area should not be considered without taking into account the potential effects on the other (Stevenson, 1982).

Relationship to Entire Country

The fisheries system must operate within the economic, physical, sociocultural, legal, institutional, and political constraints of the Nation. These basic constraints will determine what is "allowable, acceptable and desirable" (Stevenson, 1982).

"Attempts to intervene at some point in the system without adequate consideration of the possible effects of the entire system and its various contexts incur considerable risk of failure. Changes which are unacceptable in the economic, sociocultural, institutional or political contexts can result in failure as certain as changes which are, for example, technical failures. It is clear that the fishery administrator is responsible for generating information which will ensure that the fishery is properly evaluated in the process of establishing National priorities", (Stevenson, 1982).

The Malawi Fisheries Department, therefore, must take a multidisciplinary integrative approach to determining the needs of the nation. Figures 2 & 3 demonstrate how decisions are reached in a fisheries such as Malawi where :

1) there is a need to increase the supply of animal protein,
2) the fishery appears to present one of the best alternatives for increasing this supply, and
3) that there is not sufficient fresh fish available to meet projected demand. (Stevenson, 1982).

The crucial items necessary for making decisions aimed at government interventions to increase the supply of fresh fish required 1) a strong and

accurate data base; 2) trained personnel to gather, analyze, and interpret these data; 3) data acquisition systems capable of handling vast amounts of fisheries statistics and marketing information; 4) senior officials capable of communicating this information and articulating fisheries policy; 5) extension training development services.

OVERVIEW OF MALAWI FISHERIES

1. Fish Production

Production figures from 1971-1981 are presented in Table 1 for the entire country. During this time period the harvest has varied from a peak of 84.1 metric tons in 1972 to a low of 51.3 metric tons in 1981. This decline may be due 1) to the increased lake level or general flooding which may not allow fish to be as efficiently harvested as before; 2) reduction in fishing effort because it is uneconomical due to increased costs for fuel, nets and boats; or 3) utilization which pushes the yield curve past MSY. Detailed research is required to determine which factor(s) is operating. If this trend is not reversed, the amount of protein available within the country will continue to diminish; thus animal protein will have to be imported or other sources found within the country to make up the loss. The situation is even more acute when one considers that the number of Malawians is steadily increasing. To maintain the same per capita amount of protein the fisheries must expand at a rate of 3-4% a year. It is, however, contracting at a rate of approximately 3% a year, which results in a per capita reduction in protein of approximately 6 percent per annum.

2. Main Fishing Areas in Order of Importance

See also Table 1 Fig. (color plate).

a) Lake Malawi, Lake Malombe and the upper Shire River.

i) Fishing is concentrated in the shallower waters of Southern Lake

Malawi, Lake Malombe and the Upper Shire River.

b) Lake Chilwa and Lake Chiuta.

c) Lower Shire River

3. Fishing Methods

a) Gill nets

b) Chirimila nets

c) Seine nets including mosquite nets

d) Long lines

e) Trawl nets

f) Fish traps

g) Hand lines

h) Scoop nets

i) Cast nets

j) Fences

k) Open water seines

4. Species Groups Caught in Order of Importance

Few individuals can identify a significant number of Malawi species, therefore their importance can only be listed in terms of species groups.

a) Tilapia Oreochromis

b) "Haplochromis" (Cyrtocara) species (primarily utaka)

c) Barbus species

d) Clarias species

e) Lethrinops species

f) Bagrus meriodinalis

g) Engralicypris sardella

h) Labeo mesops

5. Commercial Fisheries

In 1980 there were fifteen commercial organisations, including Maldeco, using trawlers which were owned and operated by individual businessmen. The

Malawi Government assists by providing them with marketing facilities, advice concerning fishing, fishing gear and boats and training for their crew. The commercial fishermen sell their catch to middlemen through a centralized landing market. Depending on the type of fish and market they are either sold fresh or processed primarily by smoking or drying.

6. Traditional Fisheries

The traditional fisherman usually sells his catch to a fish trader who either takes the fresh fish directly to a market, or processes the fish before selling it. In some cases, either the fisherman himself or the middleman processes the fish to sell to another who retails it. Occasionally the fisherman catches, processes and retails the fish himself.

The dugout canoe is the most commonly used fishing craft and accounts for 74% of the traditional fisheries. The other 26% consists of boats of which half have engines. All the boats use assistant fishermen, who get paid with a proportion of the catch. Some hand line and trap fishermen fish from shore.

7. Form in which fish are sold

Fresh fish are primarily consumed along the lake shore. The majority of fish are either dried or smoked before they reach the final consumer. Problems of transporting fresh fish and the lack of cold storage facilities in the interior are responsible for the lack of fresh fish in this area.

8. Fish Farming

At present fish farming of tilapia in Malawi accounts for 10 tons of fish per annum. The value of these fish is between 10,000 - 15,000 dollars. Trout are also cultured on the Zomba Plateau and sold to local hotels.

Attempts to develop aquaculture in the country have been made by the Government for the past two decades. Since 1975 there have been experiments in rearing fish in ponds, dams and reservoirs. This is particularly true in the Southern Region where up to now the Extension Team of the Fisheries Department has concentrated all its efforts. Two experimental fish farming

stations are located at Domasi and Kasinthula. Unfortunately, efforts to intensify aquaculture activities, especially in the Central and Northern Region, have been hampered by insufficient numbers of trained personnel, particularly extension workers, lack of transport and funds for operation and maintenance of vehicles and equipment, and lack of fingerlings to stock the private fish ponds and reservoirs. The main species now cultured in Malawi is Oreochromis shirana. According to the results of several trials carried out by the Fisheries Department and results of harvests of private ponds, its growth never exceeds 0.5g/day. Trials, both in mono- and polyculture of different species, will allow the choice of the most suitable species for fish farming in Malawi.

To improve aquaculture production and to increase the actual production of ponds and reservoirs (about 80), adequate farming techniques have to be demonstrated to the farmers. Such fish farming techniques have been successfully implemented in other African countries, but they have yet to be tested under the conditions prevailing in Malawi. Results of these tests and of applied research will allow the development of viable intensive fish farming management techniques to be demonstrated to the fish farmers by extension workers. This basic applied research is now lacking in Malawi.

Suitable land and water are available in almost all districts for fish farming, and several dams and reservoirs have been constructed in the country, especially in the Central Region. Some of these have been stocked and are now fished at a subsistence level by villagers living adjacent to them. Other reservoirs have never been stocked and are now unproductive. These reservoirs, if properly stocked, could produce about 50kg fish/ha./year. Although aquaculture can increase protein production in a significant fashion it will never be able to match the amount of fish coming from Malawi's natural waters (presently 10 tons vs. 60,000 tons, respectively).

GOALS OF MALAWI FISHERIES DEPARTMENT

As definied by the Fisheries Act of 1973, the goals of the Fisheries Department are :

1. To so manage the fisheries of the natural water of Malawi that the optimum sustainable yield is obtained;
2. to foster the establishment of a stable and economically viable fishing industry through the development of the activities of the present fishing community;
3. to assist the efficient landing, processing and distribution of all fish caught, and to ensure the achievement of maximum landing is not hampered by lack of marketing facilities;
4. to encourage, where appropriate, fish culture as a means of supplementing supplies of fish from natural waters;
5. to protect Lake Malawi's and other waters' endemic fish fauna as a scientific and educational asset.

IMPLEMENTATION OF FISHERIES GOALS

1. Data on fish landings and corresponding fishing effort is collected in order to assess fish stocks. Regulations are introduced and enforced to reduce fishing pressure on any stocks which are in danger of being overfished. Experimental fishing with new techniques, or with traditional methods in new areas, is undertaken to test the extent of untapped stocks, and discover economical methods of exploiting them.
2. The use of new or improved fishing methods, gear and craft is demonstrated to fishermen, and credit facilities for the purchase are made available where appropriate. A training centre has been established where fishermen, fish processors and boat builders can learn new techniques.
3. Experiments are carried out with different fish processing techniques to find suitable methods for adoption at village level. These techniques are

demonstrated to the villagers. The efficient distribution of fish is assisted by the development of landing facilities and feeder roads. The organization of the national marketing system is constantly reviewed and techniques to reduce insect infestation have been implemented.

4. Experimental fish farms have been established in the country and demonstration programs have been initiated which will lead to more intensive and varied fish culture in the future.

5. Lake Malawi National Park has been created for the purpose of better understanding and appreciation of the fish of Lake Malawi. Working in close co-operation with the Parks Department and with the help of international research teams from South Africa and the United States, considerable scientific data on the basic biology of these fish have been collected. Educational materials and a guide book to the fishes of the National Parks are being prepared by the Department.

GENERAL CONSTRAINTS TO FULFILLING POLICY

The Department is large, with over 1000 employees. Although the support staff is available, the department seriously lacks a sufficient number of senior officers to implement fisheries policy. There are only 16 senior officers in the entire Department who are Malawian. The British Government presently provides six senior officers and will be increasing this number to nine. Vacant posts in the Department must be filled and additional ones created. Existing senior officers need further training as only one of them has a degree above the bachelor's level. Because of the shortage of manpower at the senior level, the most qualified individuals are often moved out of the research area for which they were trained and into administrative posts. Training of senior officers in their respective fields must receive top priority.

Although the Department has over 100 technical assistants and technical

officers to assist in the research program, their training needs upgrading. Very few have received advanced training in stock assessment, liminology, fish farming, fish biology, marketing, etc. Although well motivated and very enthusiastic as students, the training they receive in this country leaves much to be desired. Instruction needs upgrading. One of the most obvious deficiencies is the fact that most of the personnel in the department cannot identify more than a few fish species. Such deficiencies bring into question the validity of the data base upon which management decisions must be made. Immediate upgrading in the training of intermediate level and lower level assistants must be initiated so that they have a better understanding of basic fish biology and stock assessment techniques.

Even if the data base was not questionable, it would still be difficult if not impossible for the Department to analyse information quickly and in a timely fashion so that fish stocks could be properly managed. Once the staff has been trained and the quality and quantity of data increased, it will be imperative that a modern data acquisition system be available for their use. While fisheries personnel are being upgraded in their abilities to collect accurate data, they must also begin to learn how to analyse these data. Instruction in computer systems will allow them to analyse data quickly, write and publish their results in time to make useful and accurate management decisions.

DONOR SUPPORTED DEVELOPMENT PROGRAMS

The Fisheries Department has presently three ongoing donor supported projects.

1. The British Overseas Development Agency presently supports six expatriate personnel. Next year ODA will support three additional expatriates to help with research and administration.

2. THE CENTRAL LAKESHORE FISHERIES DEVELOPMENT PROJECT is supported by the European Development Fund. The goals of this project are two-fold. The

first is to develop a commercial fishing unit capable of exploring and exploiting stocks of fish in the deeper water of the project area. For the most part, these stocks cannot be exploited by artisan fishermen. The second object is to improve the living conditions of traditional fishermen within the project area. This goal is being attained by the development of thirteen centralized fish landings at selected beaches throughout the project area. Upgrading of present access roads, provision of fish markets, smoking kilns and shallow wells are being implemented. The Salima boatyard is being improved and a boat repair yard is being established at Nkhotakota.

3. THE CAPE MACLEAR FISHERIES PROGRAM is supported in part of the United States National Science Foundation. The project's primary goal is to gather basic limnological, fisheries, and biological data on the commercially important species which occur over sand. This includes fish known commonly as the chisawasawa (Lethrinops spp.) and the zooplankton feeding fishes (the utaka). Over 20 scientific publications have resulted from this ongoing project, and two Malawian technicians working with the project are presently receiving advanced training for a Diploma in Fisheries Biology at Duke University.

PROJECTS UNDERGOING FEASIBILITY STUDIES

The European Development Fund is presently examining a proposal entitled CENTRAL AND NORTHERN REGION FISHFARMING DEVELOPMENT, TRAINING AND RESEARCH. The basic object of this proposal is to conduct applied research on aquaculture production and involves in-service and overseas training for personnel in these fields. If approved, five fish farms in the Central and Northern Regions would be established as centres for demonstration of integrated fish farming for applied research, for extension and for fingerling production to supply the requirements of an expanded aquaculture development program.

The second project under review is the LAKE CHILWA AND LAKE CHIUTA RESEARCH AND DEVELOPMENT PROJECT. A German technical team is examining this project which has as its goals 1) to increase fish production from Lakes Chilwa and Chiuta, 2) to minimise wastage of fish due to insect infestation and lack of good processing and preserving techniques, and 3) to check and monitor any possible pollution effects on the fishery resulting from fertilizers and pesticides used in the agricultural schemes of Chilwa and Phalombe basins.

The EDF is also examining a third proposal, NORTHERN REGION FISHERIES DEVELOPMENT PROJECT. The objectives of this proposal are to explore and assess the fish stocks in the Northern waters of Lake Malawi to determine the optimum sustainable yield through a comprehensive exploratory fishing program and intensive biological studies. Fishing gears best suited to the Northern Region will be identified and developed. Fish caught by the exploratory fishing units will be processed and marketed through landings, processing facilities and wholesale outlets which would be established by the project.

PROPOSED PROJECTS REQUIRING DONORS

The Fisheries Department presently has three projects for which they seek support.

1. THE CHAMBO RESEARCH PROJECT has as its objectives 1) to determine the effects of the fishery and fishing techniques on fish of the genus Oreochromis/ tilapia, commonly known as Chambo in the South East arm of Lake Malawi, Lake Malombe and the interconnecting Upper Shire River; 2) to carry out biological research on Chambo so as to determine its life history in the project area; 3) to carry out stock assessment research and analysis on Chambo to determine productivity, and any natural or fishing influences which affect its population dynamics 4) on the basis of the findings review the present management of the artisanal Chambo fishery in the project area.

2. THE DEVELOPMENT OF FISHERIES ECONOMIC CENTRES proposal has as its goals the development of eight Fisheries Economic Centres along the shores of Lakes Malawi and Malombe in the Mangochi District. These economic centres will provide fishmen and fish processors and traders with centralized fish landings, markets and processing facilities which will facilitate better fish handling and preservation leading to higher quality products and reduction in losses through spoilage.

3. THE CYPRINID AQUACULTURE RESEARCH PROJECT

1 Objectives of the project are :

1.1 to develop and perfect methods of rearing Malawi's large cyprinid fishes as a means of supplementing production from natural waters.

1.2 to restock selected areas of Lake Malawi with large numbers of fingerlings in an attempt to re-establish fisheries which have declined.

1.3 to build a Cyprinid Research Centre incorporating laboratories, offices, a hatchery, nursery and rearing ponds, race-ways, a workshop and store.

4. The World Wildlife Fund and the International Union for the Conservation of Nations are considering a project entitled THE CONSERVATION OF THE FISHES IN THE LAKE MALAWI NATIONAL PARK. The objectives of the project are threefold : 1) to prepare a guide to the fish of the Lake Malawi National Park with notes on their habits and behaviour; 2) to study the interactions between the endemic fish community of West Thumbi Island (the focal point of the park) and fish from other parts of the lake which have been released around West Thumbi Island during the past decade; 3) to study aspects of the basic ecology of the endemic fish of the National Park in an effort to obtain information upon which management policies can be based. This project will probably begin in early 1984.

PAST DONOR SUPPORTED PROGRAMMS

1. Project title : PROMOTION OF THE INTERGRATED FISHERIES DEVELOPMENT PROJECT (FAO/UNDP)

1. Objectives of the project :

1.1 To determine the fish stock for trawling operations mainly in the Southern Lake Malawi.

1.2 To establish a boat building yard and assea its economic viability.

1.3 To study the marketing conditions prevailing in the country and recommend improvements in the processing, storage, distribution, landing and marketing facilities.

1.4 Offer training facilities both to the fisherman and Fisheries Department staff.

1.5 Study and make improvements on the data collection system.

2. Project life : 1972 - 1977

2. Project Title : SHIRE VALLEY AGRICULTURAL DEVELOPMENT PROJECT (UNDP/FAO)

1. Objectives of the project :

1.1 To study the fishery of the Lower Shire; its biology and species composition.

1.2 Establish a planked canoe building yard.

1.3 Establish landing points and also cutting channels for ease of landing.

1.4 Build and demonstrate the use of the Ivory Coast type of smoking kiln.

2. Project life : Data not received

3. Project title : FISHERIES EXPANSION PROJECT, PHASE III (UNDP/FAO)

1. Objectives of the project :

1.1 Monitor the effects of effluent from the Chinteche Pulp Mill.

1.2 Study the biology and behaviour of the Northern fisheries.

1.3 Assess the economics of different fishing gears for the region.

1.4 Design and experiment with different gears with a view to finding the most economical and effective gear.

1.5 Study, explore and recommend the most suitable and economical way of bringing fresh fish to the Northern area.

2. Project life : 1977 - 1982

4. Project title : FRESH WATER PRAWN CULTURE (Japanese Techn. Asst.)

1. Objective of the Project :

1.1 To set up a hatchery to produce fresh water prawn for stocking.

2. Project life : 1974 - 1977

5. Project title : UNICEF PROJECT FISH FARMING

1. Objectives of Project :

1.1 To establish a small demonstration/extension fish farming station.

1.2 To train local farmers in fish farming

1.3 To assist in the construction and running of local fish ponds using techniques well established by the Fisheries Department.

1.4 To expand the coverage of the Fisheries Department in aiding the increase in the production of fish in areas remote from natural fisheries.

2. Project life : Data not received

6. Project title : ORNAMENTAL FISH RESEARCH PROJECT : South African Government 1978 - 1981

7. Project title : MAKANJIRA RURAL DEVELOPMENT PROJECT (German Aid)

1. Objective of project :

1.1 Supply facilities to the Fisheries Department, but without direct involvement by the Department. Housing, drying racks, smoking kilns, fish store, fumigation chamber.

8. Project title : MPASA RESEARCH PROJECT (IFS)

1. Objective of project :

1.1 To study Mpasa (Opsaridium microlipis) and Nchila (Labeo mesops) as subjects for aquaculture in Malawi.

2. Project life : 1981 -

9. Project title : KARONGA FERROCEMENT BOATBUILDING PROJECT (Appropriate Technology International (ATI))

1. Objective of project :

1.1 To build and introduce ferrocement boats to the Northern area.

1.2 Train fishermen in the use of sail.

2. Project life : 1981 -

10. Project title : FISH PROCESSING PROJECT (Tropical Products Institute)

1. Objectives of project :

1.1 Devise methods to combat infestation during drying period.

1.2 Develop new fishery products.

1.3 Demonstrate the proper use of chemicals.

1.4 Experiment with different chemicals in order to find the most effective and easily adaptable.

1.5 Train local staff to carry on with the work started.

2. Project life : 1974/5 - 1983

ORGANIZATION OF MALAWI DEPARTMENT OF FISHERIES

The Malawi Department of Fisheries is currently organized into six main branches and a common work pool (Table 2). The Administration Branch is located in Lilongwe and is responsible for the central administration of the Department. Its principal components are the Chief Fisheries Officer, Assistant Chief Fisheries Officer, and Principal Fisheries Officer.

The Research Branch is responsible for basic and applied research as indicated by the Administration branch. The position of Senior Fisheries Research Officer for this branch, which is based at Monkey Bay, is currently vacant. There are five Fishery Research Officers all of whom have a B.Sc. plus some post-graduate training. In addition to conducting research, this branch has also some responsibility for commercial fleet operations, and thus is partly responsible for generating revenue.

The Fish Farming Branch consists of a Senior Fishery Research Officer, Mr. Msiska based at Domasi Fish Farm, and a Fishery Research Officer, Mr. Rashidi. Mr. Msiska holds a BSc and MSc from Chancellor College, and a Diploma from

Auburn University, USA. Mr. Rashidi holds a BSc from Bunda College, a Diploma in Agriculture, and a Diploma in Aquaculture.

The Fish Marketing Branch consists of a Fish Marketing Officer, Mr. Chiumia at Lilongwe, and an Assistant Fish Marketing Officer, Mr. Mkandawire. In addition to the administration of this branch, Mr. Chiumia aids in the central administration of the department in the absence of a headquarter Fisheries Officer. This Branch has primary responsibility for the compilation and analysis of data provided by Beach Recorders and Fish Scouts whose functions will be discussed in a later section. The Training Branch is responsible for both instructional and on-the-job training of the lower level staff of the Department. The Principal, Mr. Ng'ombe, holds a BSc from Chancellor College and a Diploma in Fisheries Management from Grimsby College, Great Britain. Presently based at Mpwepwe, Mr. Ng'omba will move to the N.R.C. which is scheduled to open in October 1983. The Fishery Officer, Mr. Mtambo, holds a BSc from Chancellor College and will also be based at the N.R.C. This Branch currently is also responsible for the boat yards.

The Extension and Advisory Branch consists of two Senior Fishery Research Officers and four Fishery Officers, all of whom have a BSc and a Diploma of Fisheries Management. The primary function of this section is to administer the various fishery stations located throughout the country. Currently, this section also is responsible for the inspection of the commercial catches.

In addition to the above branches, there exists a common work pool of Assistant Fisheries Officers, Senior Fisheries Assistants, Clerical Officer, Fish Scouts and Beach Recorders. Senior Assistant Fisheries Officers and Assistant Fisheries Officers hold the grade of STO and TO respectively. These officers have completed a training course at Mpwepwe Training School and usually hold a Diploma in some aspect of fisheries biology obtained from training abroad. The Senior Fisheries Assistants and Fishery Assistants

have also completed the course at Mpwepwe Training School and have had some on-th-job- training.

The Administration Branch has recently requested a reorganization of the Department (Figure 5). The major change will be the creation of a Fishery Industry Branch in which all revenue generating operations will be concentrated. These responsibilities include operation of the boat yards, licensing and enforcement of fish quality, and inspection of commercial catch,and fleet operations. In addition, a special subsection of the Fish Marketing Branch will be created which will be responsible for data storage, retrieval and analyses. Although located in Fish Marketing, this section will interact with all other branches of the department.

TRAINING

In Country Training Centers

As indicated the majority of fishery personnel at and above the rank of Fishery Officer have received a BSc plus some form of advanced training. The majority of BSc degrees have been from the University of Malawi at either Chancellor or Bunda colleges. Chancellor College offers a four year general degree program in biology and a 5 year honors program. Students are taught general biology during the first year and genetics and evolution in the second. Nine units of specialised courses are offered in years three and four. The content of these units varies and is dependent upon the availability of teachers; however, it has included ecology and aquatic ecology in the past. The honors program has been reviewed and approved by an external examiner. We did not have the opportunity to visit Bunda College. However, based on talking to various fisheries personnel, it is concluded that the programme at Bunda College centers more on agricultural training. Therefore it may be useful to recruit Bunda graduates for the Fish Farming Section of the Department.

Fishery personnel above the level of Fish Scout and below Fishery Officer have received training at the Mpwepwe Training School. A curriculum in fishing technology, seamanship and navigation is presented. In addition, students received preliminary training in data collection and statistics. As of 1 October 1983 these personnel will be trained through the Natural Resources School. This school will consolidate the training of all technical assistants from the following Departments : Agriculture, Veterinary, Fisheries, Water Resources, Parks and Wildlife, Surveys and Farm Home Economics. Certain science, math, and communication courses will form the core of the program. The proposed fisheries curriculum is attached in Appendix II. The consolidation of the natural resources and technical assistants training programs will hopefully develop student appreciation for all of the various disciplines. A total of 720 students are anticipated to be enrolled in the program, of which 30 will be from Fisheries (see Table 3). Fisheries students will spend the first year at the Natural Resources College and the second at Mpwepwe.

Below the level of technical assistants are the Fish Scouts and Beach Recorders. Duties of both these positions are identical, however the Fish Scout is an established position within the Fisheries Department. Beach Recorders are employed on a month-to-month basis, although some have been employed for several years. These persons receive only on-the-job training.

Foreign Training Opportunities

Opportunities for foreign training have existed at many levels within the Fisheries Department. Advanced training above the BSc in Fishery Management has occurred for the most part at Grimsby College in Great Britain, while advanced training in Limnology has occurred in Vienna, Austria. Scholarships and training courses which were available to the Malawi Department of Fisheries during 1982-1983 are listed in Table 4. In many cases it was difficult to determine which of these opportunities were utilized. As indicated, hwoever, certain programs were not attended because of insufficient

funds, in country workload commitments, or lack of suitable candidates.

For the most part, promotion above the level of Technical Assistant requires an additional diploma in some facet of fishery science or related field. Such training may occur either within the country or at a foreign faculty. Foreign training for Technical Assistants to date had been essentially limited to a training course in Fishery Science at Duke University.

EVALUATION OF THE DEPARTMENT'S ABILITY TO REALIZE 5 YEAR STATED GOALS

In order to properly assess the current level of training and facilities one must define the needs of the Department. The Malawi Fisheries Department has identified three priorities upon which they will focus for the next five years. This effort has resulted in the establishment of high priority, medium priority and low priority objectives (Table 5). These objectives are designed to facilitate the implementation of departmental policies :

1. "To so manage the fisheries of the natural water of Malawi that the optimum sustainable yield is obtained".
2. "To encourage where appropriate fish farming as a means of supplementing supplies of fish from natural waters of Malawi".
3. "To develop new fish handling and processing techniques to minimize wastage and to reduce seasonal fluctuation in supply".

Clearly the top priority of the Department requires the ability to 1) estimate the population size of a particular species within a given time frame; 2) predict how many individuals of what size can be harvested in any given fishing period; and 3) determine how to regulate the fishery so that the desired goals are realized. These tasks can be grouped under the general heading of stock assessment and management.

The two basic models available for the assessment of fishery stocks are the Schaefer production model and the Beverton and Holt recruitment model (Munro 1979). Other models, such as that formulated by Pope (1979) are based

on one of these two approaches. Although both the Schaefer and Beverton-Holt models are developed for temperate single species fisheries, other authors have been able to modify them for tropical multiple species fisheries (see Munro 1979). Inherent within any of these models is the estimation of certain essential parameters. These include such statistics as : 1) fecundity, 2) mortality rate, 3) survival rate, 4) instantaneous growth rate, 5) theoretical maximum size, 6) size at any particular time, 7) theoretical time at which growth begins, 8) stock identification, 9) breeding ecology, 10) trophic level analyses and 11) biological interactions. Therefore the proper management of any fisheries clearly requires the following elements : 1) basic biological, economic and catch data of the fisheries, 2) trained personnel to gather and analyze such data, 3) equipment and facilities to make such data collection possible, and 4) computer facilities to allow for storage, retrieval and use of data in modelling and analyzing the relevant aquatic ecosystems.

The Malawi Department of Fisheries is faced with some of the following problems which are typical of tropical artisanal fisheries (Pauly 1979) :

1. "The fishery under investigation catches and lands a large number of species, and relatively few specimens of one single species.
2. There are no reliable catch, landing and effort data available to assess the fishery, and especially no time series of such data.
3. There exists no suitable theoretical model into which these data could be plugged, even if primary data are available.
4. There are no funds, no scientists, no time available even to apply standard methods and to use standard models of stock assessment".

It is our opinion that with a comprehensive integrated training program and the installation of high speed computational equipment, the aforementioned problems can be solved for the fisheries of Malawi. Certainly the infrastructure of the Department of Fisheries has the manpower requirements to collect the needed information (Table 2).

TRAINING NEEDS

Stock Assessment

The concept of optimal sustainable yield (OSY) implies some preconceived goals of the fishery in question. These goals may be to maximize the production of biomass (i.e. maximum sustainable yields, MSY) or to produce the maximum number of fish of a certain size or age class. The concept of OSY is also important when dealing with a multi-species fishery. For example several authors (i.e. see Hongskul 1979) have shown that when two or more species interact the sustainable yield is lower than the sum of the MSY of each individual species. However, the calculation of MSY for individual stocks is an important first step to the management of a fishery for OSY.

The first step in the calculation of MSY is the calculation of standing crop. Standing crop may be calculated by multiplying the average individual weight times the number of individuals present at any given time. This concept is expressed in the Beverton and Holt yield model (Everhart and Youngs 1981) :

$$Y = \int_t F(t)\, W(t)\, N(t)\, dt$$

where Y is equal to yield F(t) is a time function of fishing mortality, W (t) is a time function for weight, and N (t) is a time function for the number of fish in the population. Other yield models are comprised of these components, but use different estimators for the various parameters. Since the stated goal of the Malawi Department of Fisheries is to estimate stock sizes of the various fisheries, we will show what training is needed to gather the appropriate information.

The most efficient educational program will be to provide training and technical support for a team of Malawians who can then collect and interpret data for each of the following disciplines. Any given team will consist of Fish Scouts, Technical Assistants, Technical Officers, Fisheries Officers and Senior Fishery Officers.

Stock Identification

Current assessment techniques of multiple species fisheries depends upon the proper identification of target populations. Lake Malawi has the most speciose ichthyofauna of any freshwater lake in the world; thus, the problem of correct identification is intensified. Nevertheless it is essential that a team of biologists be trained to : 1) correctly identify the important commercial species; 2) recognise different species when they enter the fishery, and 3) teach Fish Scouts and Beach Recorders to identify those species which comprise the bulk of the local commercial catches. Without the accurate identifications of the stock it is not possible to assess and manage the fisheries effectively.

Population Dynamics

In order to manage any given fisheries an estimate of the number of fish present at any given time is required. Various techniques used to estimate population size include : 1) direct enumeration, 2) area-density, 3) mark and recapture, 4) survey removal, and 5) catch per effort.

Direct enumeration techniques are particularly useful for those species which make spawning runs into rivers. Several of the cyprinids in Lake Malawi are of this spawning type. Aerial photography may also be used to count certain pelagic fishes.

Area-density methods are implemented by counting the number of fishes in a series of sample strips or plots which are distributed either randomly or systematically. Essentially population size is estimated by the following formula (Everhart and Youngs 1981).

$$N = \frac{A}{a} \sum_{i=1}^{a} Ni$$

where N is the estimate of the population size, A is the number of equal units occupied by the entire population, a is the number of units sampled, and Ni is the number counted in the ith sample area. This technique would be extremely useful to estimate population sizes of sand dwelling

fishes in the shallow litteral zones of Southern Lake Malawi.

Mark and recapture techniques represent one of the simplest methods to census fish populations. A first sample of fish is captured, marked and released. A second sample is then taken and the total number of marked and unmarked fish are enumerated. The following formula is used to estimate population size with a single census :

$$\hat{N} = M\,C/R$$

where $\hat{N}$ is the estimate of the population size, M is the number of fish marked and released, C is the total number of fish which are captured in a second sample and R is the number of marked fish (i.e. recaptures) which are captured in the second sample. Various other formulas are used to expand this technique when multiple samples are used. However, all methods are based on the assumption that the proportion of marked fish recovered is to the total catch of the second sample as the total number of marked fish released is to the total population. There are several assumptions and precautions which must be taken when applying these techniques.

Survey removal and catch per effort can also be used to estimate population size. The two most common methods which are appropriate for variable effort are the Leslie and Delury techniques (see Everhart and Youngs 1981). These types of data are available for many of the species for Lake Malawi and can be obtained by the Beach Recorders and Rish Scouts. If these people are properly trained they can enumerate the catch by species at the beaches. Effort can be expressed as number of canoes/km^2, number of nets/km^2, number of fishermen/time unit, etc.

Once it is possible to estimate population size at any given time it is possible to estimate survival and thus mortality rates. Mortality can be divided into mortality due to natural causes (u) and that due to exploitation or fishing (v). These two components are related in the following manner :

$$m = u + v - (u*v)$$

where m is equal to total mortality and (u*v) is equal to the interaction of natural mortality (u) and exploitation (v). Thus, it is possible to increase the exploitation of a population within certain limits without increasing overall mortality. Such information is essential to predict the time function of fishing mortality.

Biology of Commercially Important Species

The various time functions of the generalised stock assessment model can be estimated by gathering basic biological information on the target species. Therefore it is essential to have a team trained in general fishery biology which is capable of determining : 1) age structure of the population, 2) growth rates, 3) fecundity, 4) breeding ecology, and 5) trophic level analysis.

Techniques for aging fish include length frequency distribution, release and recovery of marked fish of known age, and interpreting annual layers in bony parts. The interpretation of annual layers is usually considered the most reliable technique; however, because of the evenness of growth throughout the year in most tropical fisheries, this technique may not be applicable to Lake Malawi fishes. A detailed examination of hard structures must be completed to determine if there is seasonal growth variation. Certainly it may be possible to use the microstructure of otoliths in which the lamellae are formed with daily periodicity to age the fish (Brothers, 1979).

Once accurate age determinations are made it is possible to determine growth rates for the various species. Growth rates are needed to determine the theoretical maximum weight which a particular individual can obtain. This parameter can be calculated from the von Bertalanffy growth equation.

The number of eggs which can be produced per female and the breeding ecology of the commercially important fishes must be determined. These data are needed to assess the potential of a fishery to recover if over-fished, set size limits so fish are not harvested before the reproductive age, set seasonal limits to protect reproducing fish, and to designate protected nursery areas.

Trophic level analysis is needed to determine at which positions in a food web a species interacts. Fishes which feed on primary producers (i.e. algae and green plants) theoretically have more energy available to them than species which feed on secondary producers (i.e. zooplankton, macroinvertebrates, and fish). Such information is used to estimate the biomass potential of the population.

Pollution assessment

With the increased utilization of Lake Malawi it is reasonable to expect certain environmental perturbations. Therefore it will be necessary to have personnel trained in the assessment and production of both realized and potential impacts. Areas to be covered will include water quality parameters, species assemblages, diversity indices, biotic indices, and indicator species which are indicative of a healthy and productive ecosystem. Methods to evaluate and interpret these indicators will be examined. Moreover, parameters which affect species richness and recovery of damaged ecosystems will be discussed. Such information is needed to determine if population fluctuations are due to over-or under-fishing versus habitat deterioration or improvement.

Marine Engineering

All of the above facets of the program are dependent upon certain equipment needs. Moreover, certain studies and applications of known techniques require the design of new equipment and/or the alteration of existing resources. Therefore, it is necessary to have a nucleus of people which is trained to maintain, operate, design and modify the needed equipment. These people will have the responsibility for the operation and maintenance of the boat fleet. Without this support the effectiveness of the other teams will be diminished.

Data Processing and Statistics

Persons trained under this section will be responsible for the collection,

storage, retrieval and manipulation of catch data collected by the Beach Recorders and Fish Scouts. Additionally they will work closely with the other teams and will act as a service branch. Persons will be trained in the use of digital computers, biostatistics, and stock assessment models.

In order for this section to function it will be necessary to install some form of computational capability. The system must be capable of the 1) storage, retrieval and manipulation of large data sets, 2) communication among various components of the system, 3) compatibility with intelligent terminals operable with a 12 volt power supply, 4) graphic capabilities, 5) automated data entry, 6) and word processing. The manufacturer must be able to supply service contracts and software consultants. Three system alternatives are discussed.

Alternative I - Main Frame with Connecting Terminals

The primary advantage of a main frame is the existence of a completely integrated system. A main frame would have as a minimum 1 megabyte of memory with 300-400 megabytes of fixed disk storage. All the information is stored in one unit and users have the potential to access any stored data sets. Additionally numerous languages (i.e. BASIC, COBOL, FORTRAN, PASCAL, ASSEMBLER, etc.) plus various canned programs (e.g. SPSS, SAS) are usually available with a main frame. However there are several disadvantages to the use of such a system. First, the initial cost of the main unit will be approximately $150,000. Additionally there will be an annual charge of $3,500 for software maintenance, and service charges could be as high as $1,000/month. These figures do not include remote terminals. Moreover, leased lines in Malawi would run about K6,000/year, and in many places lines would not be available; thus the full capability of the system could not be realised. Finally a main frame would require an operation staff of three to four people. Therefore, such a system would have substantial recurrent costs which the Malawi government would have to assume at the end of the USAID project.

Alternative II - Mini or Business Micro Interfaced with Personal Computers

It is proposed that one unit be installed at Lilongwe and one at Zomba. Each of these units would have about 600K byte memory, 60 megabytes of fixed disk storage, floppy disks capability, graphics unit, and high speed line printer. These two units would have the ability to communicate with each other. Peripheral personal computers would be placed at the various fisheries research stations. They would have stand-alone computational capability plus they could communicate with the mini's by posting floppy disks. Initial costs of the two mini's would be about $45,000 each. However, service charges would be expected to be less than half the costs of a main frame. Furthermore compilers for BASIC, PASCAL, FORTRAN, COBOL and ASSEMBLER would represent a one time cost of about $3,000 rather than an annual fee. While the stations would not have interactive capability with the mini's, they would communicate through the use of floppy disks. Because there are two complete units the probability of loss data and down time would be reduced. Finally, a trained operations staff would not be necessary. The main disadvantage of this configuration is that certain canned programs available with larger main frames may not be available, depending upon the manufacture.

Alternative III - Series of Personal Computers

The primary advantages of this configuration are low initial costs and reduced service charges. However, such a system would not be an integrated system. Primary communication would be by posting floppy disks. Furthermore it would be difficult to manipulate large files because of reduced memory and fixed byte disk space. Finally the number of programming languages would be limited.

Management and Fisheries Administration

This team would differ in that it would consist of those persons at the rank of Senior Fisheries Officers and above. These people would be involved in seminars in which various management options are discussed. It is these persons who will utilise the stock assessment models to aid them in implementing

stated goals. They will have to determine which regulatory processes will be used to manage the fisheries (i.e. season limits, net size regulations, number of licensed fishermen, etc.). They will in effect determine and implement the goals, direction and policy of the department.

Enforcement Team

This team will be trained in fisheries law enforcement. Their primary duty will be to enforce the regulations implemented by the Chief Fisheries Officer. They would attend workshops on law enforcement and public relations. If this team cannot enforce the policies of the department then the effective management of the stocks cannot be realised.

Education and Extension

The primary function of this group will be to work with the local fishermen. They will be responsible for gaining the cooperation of the chiefs and local fishermen. They must be able to convince the fishermen that the Fisheries Department is trying to improve the catches. In addition to explaining departmental decisions they will help fishermen to improve their techniques. Furthermore they can inform fishermen which species are expected to have strong year classes and where species can be caught. They will be responsible to secure the participation of the fishermen in the overall program and will serve as an interface for the exchange of information. Without the cooperation of the local fishermen this program cannot work. It is important that this team is not involved in law enforcement. It is suggested that several mobile vans with video capability be purchased for this team. These vans would be used to help educate fishermen in remote areas.

Verification Team

This team will be trained in stock assessment as well as general fisheries biology. Their primary function will be to determine the effect of the management decisions of the department. Beach Recorders working with this

team will do independent checks on the catch data. After a certain policy is implemented, they will design sampling programs which will determine the effect of the policy. Are the predictions of the stock assessment models and the goals of the administration realised? If the stock does not respond as predicted, then they will determine the cause of the discrepancy. Such discrepancies may result because of lack of enforcement and cooperation of the fishermen, a mistake in one of the parameters of the model, or some biological interaction not incorporated into the model, etc.

Overview of Stock Assessment Teams

It is our opinion that if the above teams are formed and provided with proper training that the primary goal of increasing in situ fish production can be realised. Each of the research teams would provide the information needed to the stock assessment team, which in turn would provide the administration with various alternatives. The administration would select a strategy which would fulfill a preconceived goal and state various regulatory processes. The Enforcement Team and Education and Extension Team would be responsible for the implementation of these regulations. Finally the Verification Team will determine the effect of the strategies and report the causes of any discrepancies back to central administration. It is realised that the level of sophistication needed to effectively manage the stocks will be realised in a short time period. Table 6 lists the level of progression and expectations of the proposed models.

FISH FARMING

Fish farms can be used to supplement the in situ production of fishes throughout Malawi (see Fish Farming P 7). Therefore, it is proposed to train several teams to assist the fisheries agriculture sector.

Agriculture Team

These people would receive some training in biochemistry, nutrition, water

quality, microbiology, and disease control. They would conduct experiments on single or multiple species production.

Extension and Education

This team would be trained to interface between the Agriculture Team and the private fish farmers. Farmers would be able to use this team to aid them in disease control, water quality control, and nutrition problems. It will be the primary function of this unit to increase production in the private sector.

PROCESSING AND MARKETING

Production from both commercial operations and fish farming must be processed and marketed throughout the country. It is therefore proposed that a single team be trained to aid the private sector. This team would conduct research on various processing techniques including drying, solar drying, smoking, salting, freezing and freeze drying.

IMPLEMENTATION OF TRAINING PROGRAM

As stated previously, each team will consist of Beach Recorders, Technical Assistants, Technical Officers, Fishery Officers and Senior Fishery Officers. Beach Recorders and Technical Assistants will receive in country training by selected foreign experts, who will conduct 8-12 week courses. A particular course will be attended by 15-20 persons. Two of these programs will be held each year. The top three students from each program will be sent overseas for a six month intensive training course. Technical Officers will be selected by the Department for a four year BSc program at either Chancellor or Bunda Colleges. Finally two students will be selected per year for a MSc program. This degree program will be conducted in selected USA universities, depending upon the discipline. The student will spend 12-18 months completing course work and residency requirements. He will

then return to Malawi, conduct research, and write a thesis on a problem of interest to the Malawi Department of Fisheries. It is essential, however, that these students be relieved from all Departmental responsibilities while working on the MSc.

The overall training program will be administered by a team leader selected by USAID and the Malawi Department of Fisheries. This person will spend ten months per year in Malawi administering the program. Two other persons will be assigned to the program administration half-time to track training programs in the US. Finally, a full-time administrative assistant will be employed to assist the team leader.

In country training workshops will be conducted by US experts. These experts will be selected by the team leader and his assistants and forwarded for approval by USAID and the Malawi Department of Fisheries. The top three students in these workshops will then accompany the expert to his home base for a six month training program.

Universities for training at the MSc level will be selected by the administrative team, USAID, and the Malawi Department of Fisheries. As many USA universities will be involved as possible so that the program can take advantage of areas of speciality.

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Table 1

FISH PRODUCTION, BEACH PRICE, EXPORTS AND IMPORTS, 1971 - 1981

	Total Malawi Waters			Production by Source (1000 Tonnes									
Year	Production ('000 Tonnes	Value (K'000)	Beach Price t/kg	Lake Malawi	(1) Lake Malombe	(1) Lake Chilwa	(2) Lake Chiuta	Middle Lower Shire (2)	Total Value (1000)	Aquaria Value (K'000)	Other Fish Qty ('000 Tonnes)	Other Fish Value (K'000)	Other Fish Qty ('000 Tonnes)	Other Fish Value (K'000)
1971	73.2	5166.0	7.1	54.0	5.0	3.6	0.9	9.7	350.7	42.2	1.5	308.5	0.3	182.0
1972	84.1	7044.0	8.4	57.0	3.1	5.3	1.4	17.3	467.9	82.9	1.0	385.0	0.4	210.5
1973	69.4	6114.0	8.8	54.8	2.1	1.9	0.8	9.8	538.6	107.2	1.0	431.4	0.2	156.6
1974	70.1	6198.0	8.8	52.2	4.2	3.1	0.9	9.7	654.1	216.9	1.4	437.2	0.5	462.6
1975	70.9	7940.8	11.2	47.2	8.1	2.8	0.7	12.1	1357.0	296.9	3.5	1060.1	0.2	260.0
1976	74.9	7490.0	10.0	36.5	6.1	21.2	1.8	9.3	698.6	247.4	1.9	451.2	0.4	336.2
1977	68.2	6820.0	10.0	33.9	6.4	20.8	1.5	5.6	1046.0	243.9	1.1	802.1	0.1	217.6
1978	67.8+	8798.0+	13.0+	33.6	6.1	17.8	1.7	8.6+	765.8	253.5	5.8	512.3	0.3	466.3
1979	59.8	8372.0	14.0	22.4	3.6	25.8	1.6	6.4	839.1	168.1	1.0	671.0	0.2	250.0
1980	65.8	10521.1	16.0	30.2	6.5	19.4	0.8	3.9	1720.0	211.5	2.0	1508.5	0.2	288.0
1981	51.3	8220.6	16.0	25.3	8.5	8.6	0.9	4.0	1590.5	202.5	1.5	1388.0	0.5	384.8

1) Including Upper Shire (between Lakes Malawi and Malombe)

2) While as previously Landing from Lake Chiuta, Middle and Lower Shire were recorded under "OTHER WATERS" they have now been separated beginning from 1969 to show their separate water of origin by quantity.

3) Imports : For the first three quarters of the years.

SOURCE: Department of Fisheries

Table 2

CURRENT ORGANIZATION OF THE MALAWI DEPARTMENT OF FISHERIES

Fisheries Department

I Administration

Chief Fisheries Officer
B.S. Mkoko BSc (Chancellor College)
Diploma in Fisheries Management, Grimsby College, G.B.
Certificate in Limnology, Vienna, Austria

Assistant Chief Fisheries Officer
G.M. Nongwa BSc Chancellor College
Diploma in Fisheries Management, Grimsby College, G.B.

Principal Fisheries Officer
T. Jones *

Support Staff

Senior Executive Officer

Senior Assistant Accountant

Executive Officer

Shorthand Typist-Stenographer

Senior Clerical Officers (4)

Senior Accounts Assistants (3)

Senior Copy Typist

Clerical Officers (12)

Clerk/Storekeeper (3)

Library Assistant

Copy Typist (7)

PBT Operators (4)

Messengers (11)

Security Guards (15)

II Research Branch

Senior Fisheries Research Officer
Vacant

Fisheries Research Officers

Dr. C. Lewis *

D. Tweddle *

Mr. S.A. Mpilas
BSc University of Utah
Post-graduate training in Limnology, Vienna, Austria

Mr. S.A. Alimoso
BSc Chancellor College
Training in Computer Science, G.B.

Mr. J. Magassa
BSc University of Massachusetts
Diploma in Laboratory Techniques, University of Malawi
Post-graduate training in Limnology, Vienna, Austria

Support Staff

Senior Assistant Fisheries Research Officer (ST))

Assistant Fisheries Research Officers (TO - 5)

Senior Fisheries Assistant (STA)

Clerk/Storekeeper

Fishing Master (TA)

Laboratory Attendants (2)

III Fish Farming Branch

Senior Fishery Officer
Mr. O. Msiska, BSc Chancellor College
MS Chancellor College
Diploma, Auburn University

Fisheries Research Officer
B.B. Rashidi, BSc Bunda College
Diploma in Agriculture
Diploma in Aquaculture

Fish Culturist

Mr. O. Msiska

IV Training Branch

Principal

Mr. Ng'ombe BSc Chancellor College

Diploma in Fisheries Management, Grimsby College, G.B.

Fisheries Officer

Mr. Mtambo, BSc Chancellor College

Support Staff

Chief Fisheries Instructor

Chief Boatbuilding Instructor

Senior Fisheries Instructor

Fisheries Instructors (3)

Boatbuilding Instructor

Stores Supervisor

Mechanical Supervisor

Matron

Bursar

Assistant Boatbuilding Instructor (2)

Launch Mechanical Foreman

Senior Accounts Assistant

Senior Fisheries Assistant (4)

Fisheries Assistant (3)

Clerk/Storekeeper (3)

Copy Typist (3)

Head Security Guard

Messenger (2)

Security Guard (5)

V Extension and Advisory Section

Senior Fishery Officers

J.M. Wilson *

A.G. Seymour *

Fishery Officers

M.L. Mills *

Mr. Nyirenda BSc Chancellor College
Diploma in Fishery Science, Grimsby College, G.B.

Mr. Bandula BSc Chancellor College
Diploma in Fishery Science, Grimsby College, G.B.

Mr. Hara BSc Chancellor College
Diploma in Fishery Science, Grimsby College, G.B.

Mr. Mkandawire, BSc Chancellor College

VI Fish Marketing Section

Fish Marketing Officer
M.B. Chiumia

Assistant Fish Marketing Officer
D.G. Mkandawire

Support Staff

Senior Fish Marketing Assistant (SFA)

Fish Marketing Assistants (TA - 6)

Head Fish Scouts (5)

Assistant Head Fish Scout (10)

VII Common Work Pool

Assistant Fisheries Officers (16)

Senior Fisheries Assistant (15)

Fisheries Assistant (121)

Clerical Officers (3)

Fish Scouts (35)

Beach Recorders - part time (135)

* British ODA assistance

Table 3

ENROLLMENT AT MPWEPWE SCHOOL FROM 1979 THROUGH 1983

YEAR	ENROLLED	DROPOUTS	SUCCESSFUL	FAILURES
1979/80	22	12	10	-
1980/81	?	-	14	-
1981/82	?	-	14	-
1982/83	?	-	-	-

Table 4

FOREIGN TRAINING OPPORTUNITIES AVAILABLE TO MALAWI FISHERIES DEPARTMENT DURING 1982 - 1983

A Scholarships and Funding Sources

1. Fulbright Awards
2. Cambridge Livingstone Trust Scholarships
3. Commonwealth Fund for Technical Cooperation
4. U.S. National Science Foundation
5. African Wildlife Leadership Foundation
6. British Council Scholarships
7. George G. Martin Memorial Scholarship (nematology)
8. Southern African Nature Foundation - Wildlife Fund
9. UNESCO/COSTED/IFAS Scholarships

B Training Courses and Programs

1. Training Course in Fishery Science, Duke University, USA
2. Humberside College of Higher Education, G.B.
   i) Diploma in Fisheries (Master Fisherman)
   ii) Diploma in Fisheries (Fishing Skipper)
3. Project Planning Centre for Developing Countries, University of Bradford, GB
4. British Government Technical Cooperation Training - Fish Processing.
5. Fisheries Mechanical Course, Japan
6. Training Course in Agriculture, Bombay, India
7. Training Course on the Management of Small Scale Fisheries in the Inland Waters of Africa, University of Toronto (Funded through FAO).
8. Regional Training Courses (i.e. African Limnology Nairobi) Man and Biosphere Program - UNESCO/FAO.
9. Land Use Planning Project Study Tours Training Programme, Lesotho.

10. Multi-purpose Training - Mission of Malawi - World Food Programme
11. Senior Management in Agriculture, Mananga Agricultural Management Center Swaziland.
12. African Regional Agriculture Centre, Port Harcourt, Rivers State, Nigeria.
13. Masters in Fishery Science, University of Idaho, USA (no funds).
14. Masters in Fisheries Biology and Management, Bangor University of Wales (no suitable candidate).
15. Fishculture and Inland Fisheries, Wageningen, Netherlands. (Multi were selected but could not attend due to workload commitments).
16. ADCP inter-Regional Training Course in Inland Agriculture Engineering (no suitable candidate).
17. Fish farming at Aquatic Hybrid Fish Farms, Scotsdale, Arizona, USA.
18. Postgraduate Course on Environmental Studies, French Commission for UNESCO.
19 Postgraduate Diploma, Fishery Science, Rhodes University, Grahamstown, South Africa.
20. Dutch/Israele Research Project - (sent training officer to Malawi)
21. General Fisheries Council for the Mediterranean (FAO)
22. Regional Postgraduate Course in Limnology, Zimbabwe
23. Technical Cooperation by Italian Government
    i) Marine Electricians
    ii) International Course in Hydrology
24. Technical Trainee Programme for Marine Engineers in Japan, Japan Overseas Cooperation Volunteers
25. International Ocean Institute Training Programme
26. Training Courses on the Control of Environmental Contamination, FAO Computer Programming Course, UK (Alimosa)

Table 5

FIVE YEAR GOALS AND PRIORITIES OF THE MALAWI FISHERIES RESEARCH DEPARTMENT

I High Priority Goals

A) Analysis of the traditional catch data to obtain stock sizes and the current states of the major commercial fisheries in various natural waters of Malawi.

B) Stock assessment of existing and new commercial fisheries in Lakes Malawi and Chilwa.

C) Review the current states of chambo stocks in areas of importance.

D) Obtaining biological information on life history, breeding, seasonality and other related studies on the important species in the various water bodies.

E) Obtain information on economic benefits derived from fishing activities in Malawi.

F) Develop an effective method of fish handling and processing to minimise wastage particularly in the wet season.

II Medium Priority Goals

A) Key to commercially important fish.

B) Pollution studies.

C) Studies on artificial reefs as a means of increasing fish population density.

D) Research into effects of introducing clupeids.

E) Gear development studies for deep waters, marsh areas and near "Chirundus".

F) Studies of Mpasa and other cyprinids.

G) Investigations into the possible use of sails in fishing.

III Low Priority Goals

A) Review of the system on collection of statistics.

B) Studies on crocodile populations.

C) Studies on the role of current in chirimila fishery.

D) Research into socio-economic aspects of modern fishing.

E) Fish behaviour studies.

F) Development of crab and molluscs fishery.

Table 6

THE DEVELOPMENT OF MULTISPECIES MODELS AND THEIR EXPECTATIONS AT EACH PROGRESSIVE LEVEL (Hungskul 1979)

	Level Progression	Date required	Expectation
1.	Exploratory	Standing crops Primary production	Virgin biomass Potential yield Fish communities
2.	Production models	Catch/effort Fishing strategies	Overall MSY Optimum effort
3.	Biomass models	Mortality rates Catchability coefficient Biological parameters	Species life tables Mesh regulations Effort regulations
4.	Interactive models	Food web analysis Plankton analysis Life history	Management options Effort control
5.	Ecological models	All-level productivity Ecological coefficients Energy transfer	Overall production Conservation

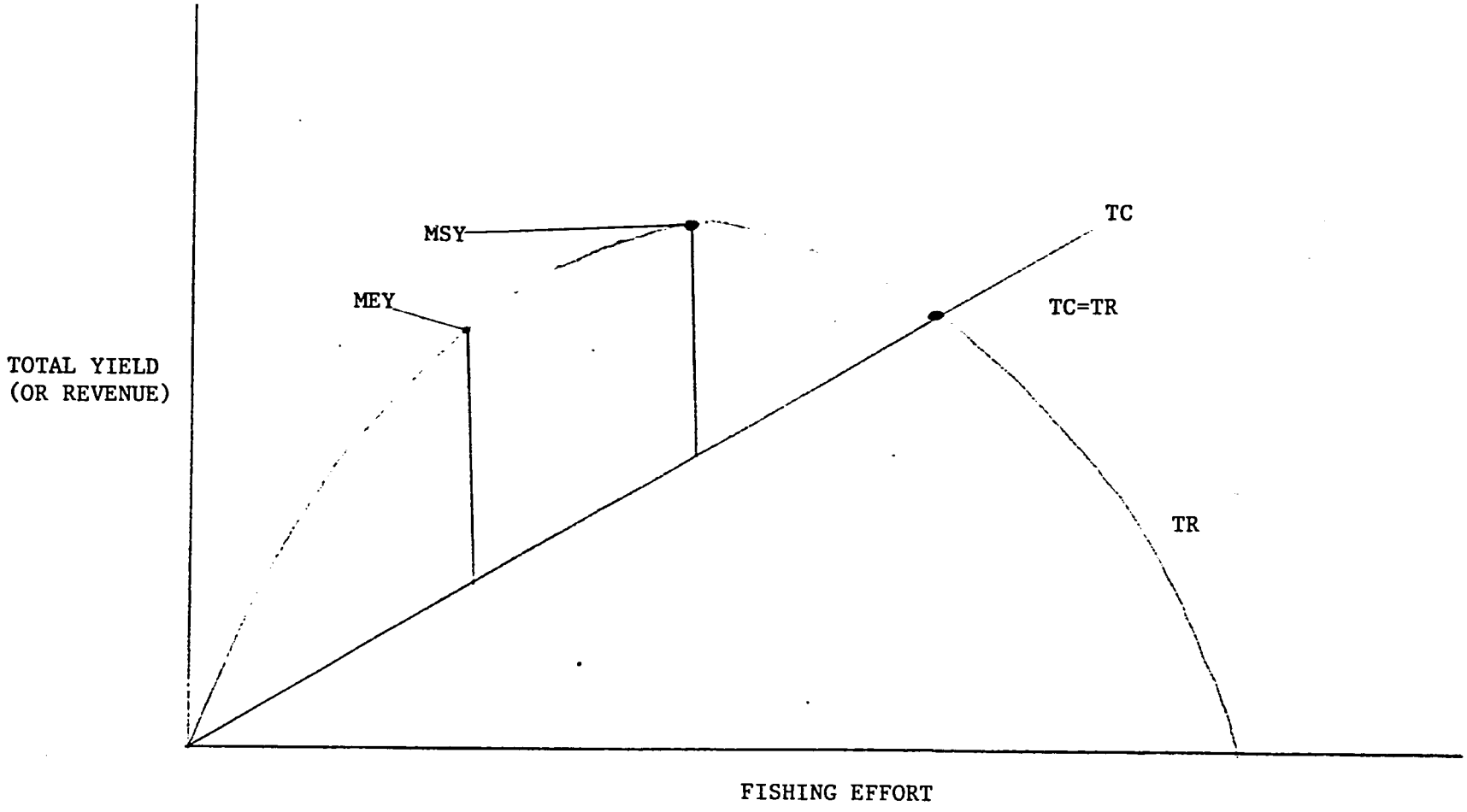


Figure 1. Yield-effort curve for an exploited fishery resource showing how equilibrium yield changes as fishing effort increases (and population size decreases).

This model is based on the premise that equilibrium yield is equivalent to the rate of increase in population size and that maximum sustainable yield (MSY) is reached at one-half the maximum amount of effort (and half the maximum population size). If yield is multiplied times price, the curve becomes a total revenue (TR) curve. Furthermore, if total costs(TC) of effort increase proportionately with effort, a point is reached where TC=TR. Maximum economic yield (MEY) is achieved when total revenue exceeds total cost by the maximum amount.

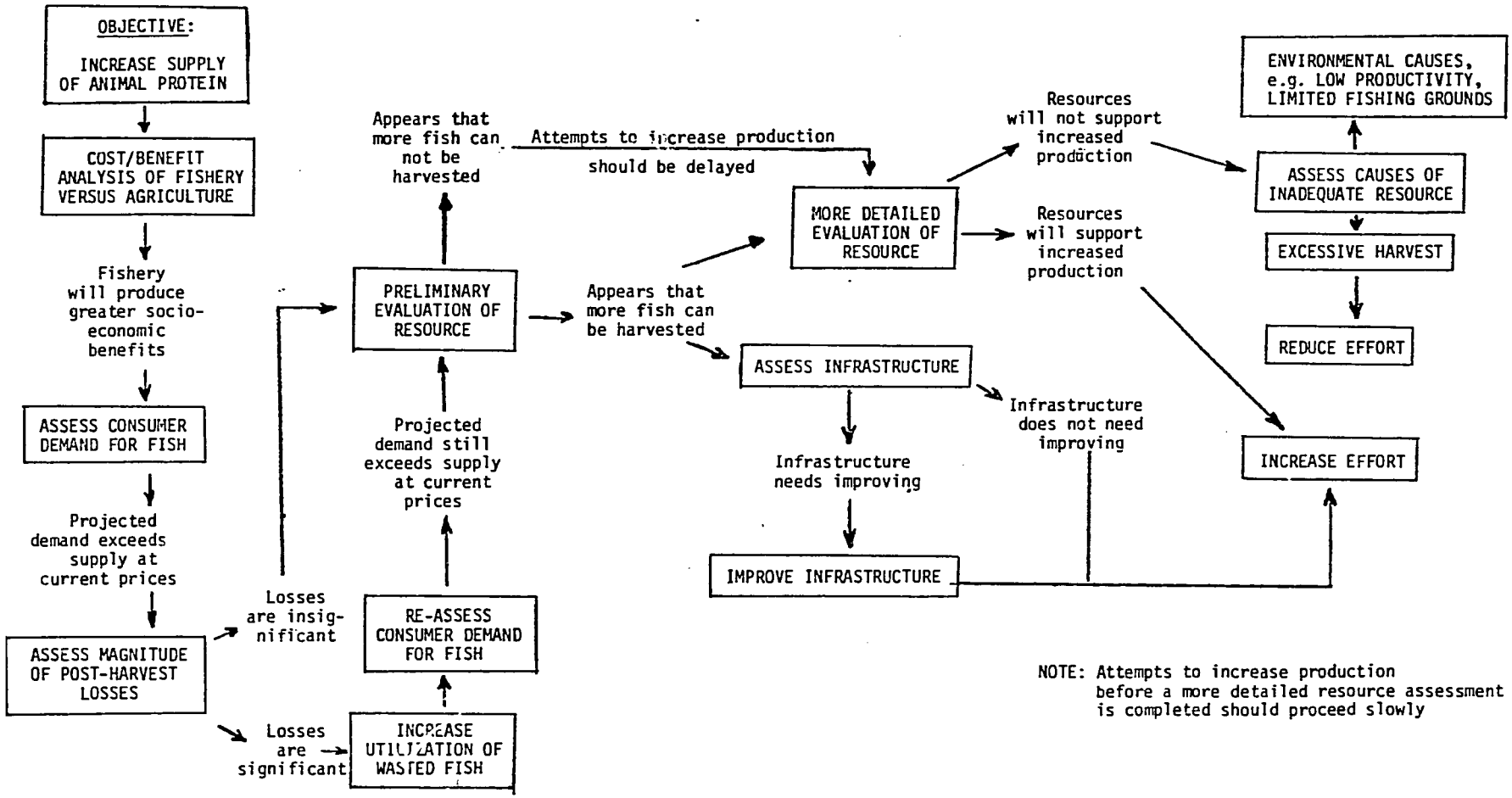


Figure 2. A hypothetical series of actions and decisions which must be considered when attempting to expand the fishery's role in increasing protein supply. (From Stevenson et. at 1982).

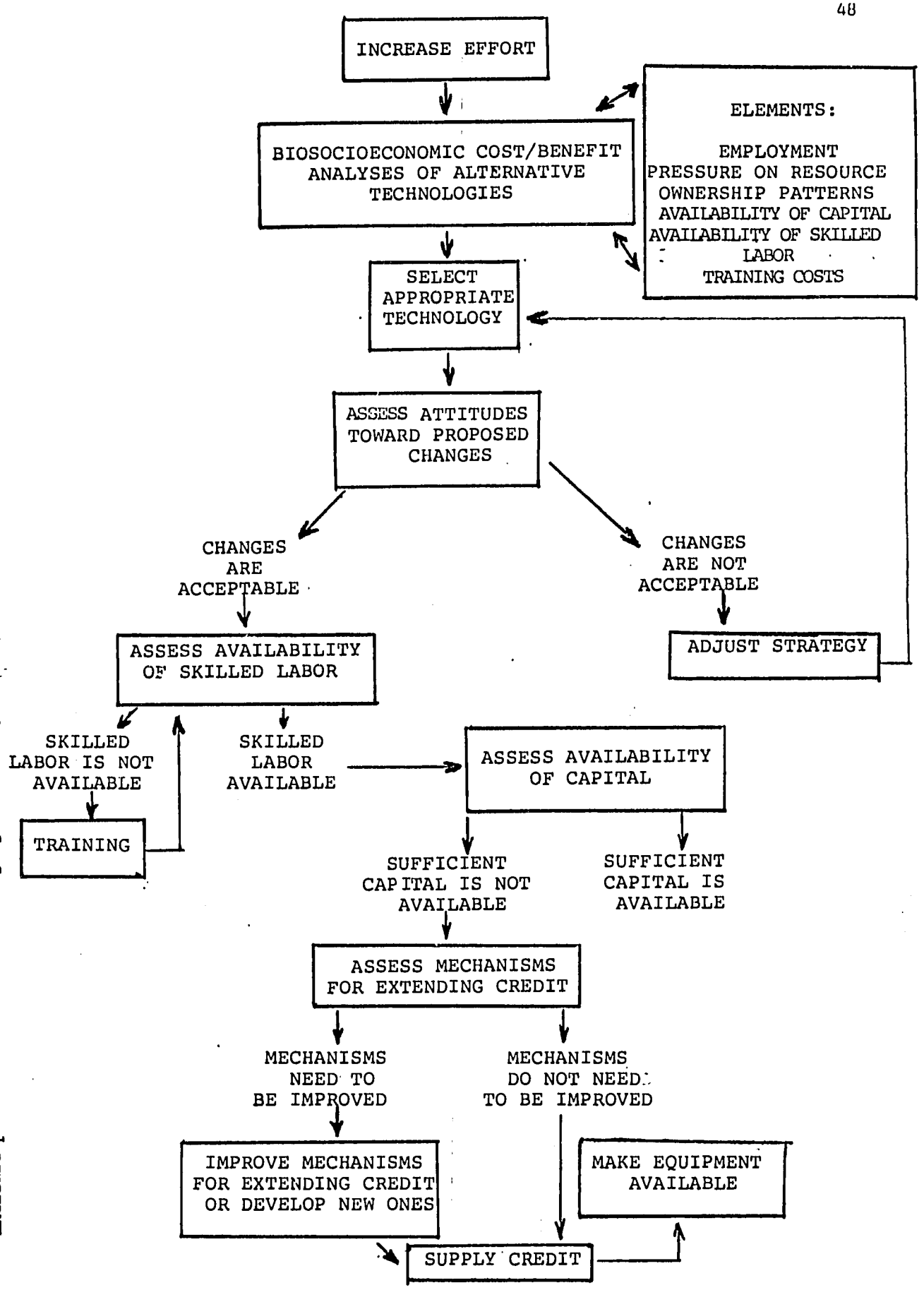
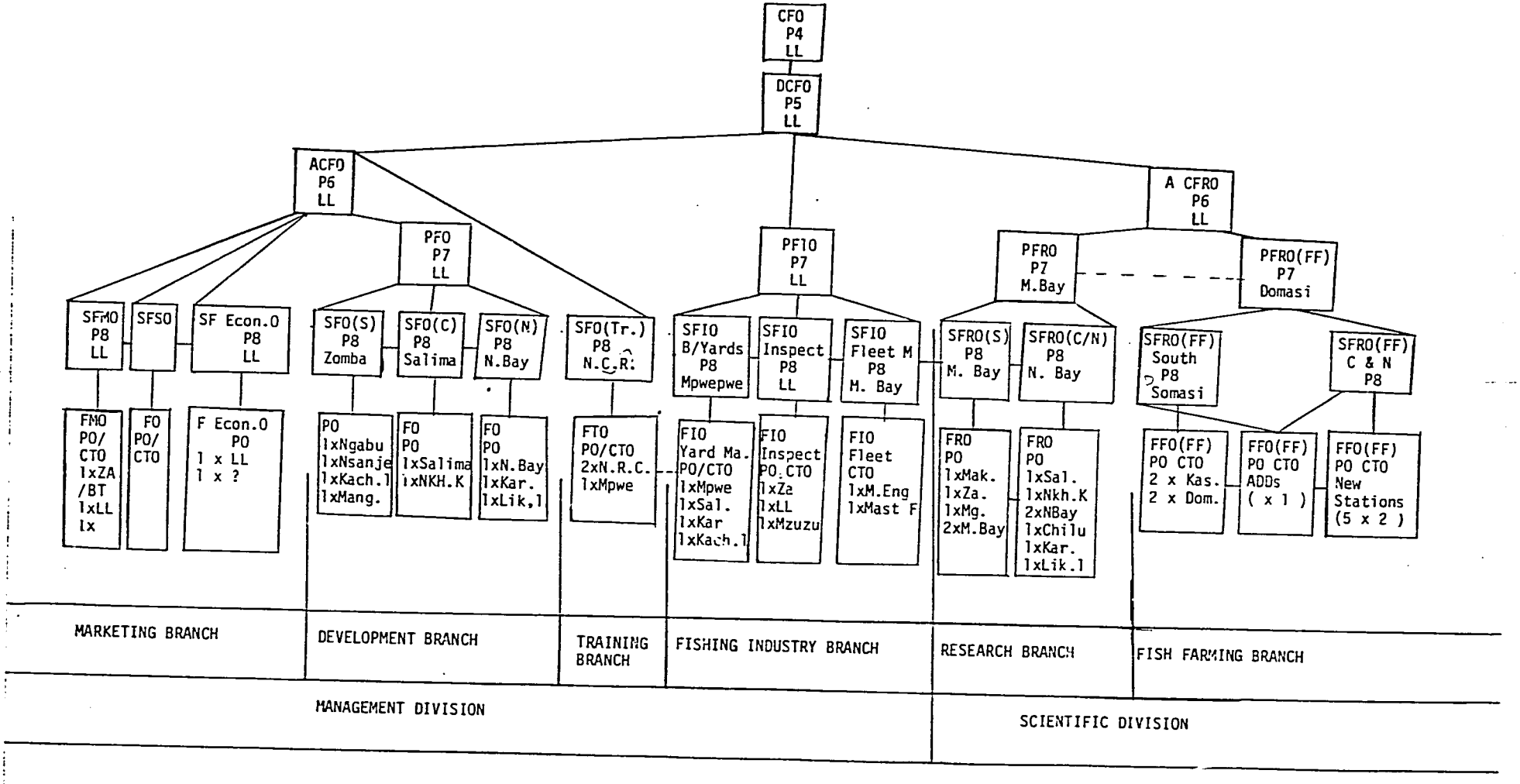


Figure 7. A hypothetical series of actions and decisions generated by an attempt to increase production from the fishery by increasing fishing effort. (From Stevenson ex at 1982).

Figure 4. PROPOSED FISHERIES DEPT. ORGANIZATION



APPENDIX II

PROPOSED SYLLABUS FOR FISHERIES ASSISTANT (T.A.) TRAINEES

1ST YEAR — FISHING METHODS — 15 HOURS

The introduction of Fishing Methods prevalent in Malawi and those of other countries, so that if there is need for improvement of the local methods, improvements can be tried; best ways of introducing new methods.

1. Introduction of fishing methods

The fish species :- The Fish's nature, size and barbs; Habits - swimming depth, shoaling, regular movement, feeding, reaction to wind, movement of water, breeding and reaction to surroundings.

2. Fishing Area

Depth of the water, distance to fishing grounds and kinds of bottoms.

3. Possibility of operation

Normal state of the sea affects the size of boat and gear. Obstructions such as rocks, stumps and wrecks.

4. Elements of catching fish

The principle used in capturing fish by surprise, enticement, imponding, filtering, entanglement, enclosure and dragging.

5. Efficiency of methods

Comparing static and dynamic fishing methods and their catching powers.

6. Hydrology

The physical - chemical properties of water comparing to fishing methods and grounds. Descriptions of instruments used to measure the properties of water.

7. Practicals

Fishing and Handling of Fishing Gear by setting and hauling of beach seine; handling, setting and hauling of gill net.

1ST YEAR — FISHERIES SCIENCE DEPT. — 90 HOURS

a) Duration 2 years
b) Total teaching time 90 hours

Basic secondary school biology is assumed and therefore emphasis is mainly laid on the biology of fish and such studies of population and environments that have a direct relationship to fish. At the end of the course, students are expected to have become well knowledgeable in all aspects of fisheries biology and so can, among other things, easily perform a wide range of technical tasks in fisheries research establishments and carry out fishing operations with a full understanding and respect for conservation policies in force.

	Course	Outline
a)	Year one	60 hours

A. FISH BIOLOGY

1. Introduction to fish as a living organism and a natural resource. Its relation to other vertebrates. Definition of fish.

2. Identification and classification of the fishes in the Malawian area. Classification should cover family and genus as it is impossible under normal class periods to cover all the species, but the most common species should be used in classification and species names may be mentioned.

3. Ecological zonation of Malawian area and some of families and general found in them.

4. Fish Anatomy

   a) External anatomy

      i) Body shapes and adaptation
      ii) Types of scales
      iii) Appendages; fins and their functions
      iv) Body openings and their functions
      v) Eyes

   b) Internal anatomy

      i) Head bones, vertebral column, ribs and intermuscular bones, alimentary canal.

5. Physiology

   a) Digestive system

      Type of food, feeding habits, brief discussion of chemical digestion; differences of herbivores and carnivores in regard to alimentary canal. Assimilation.

   b) Circulatory system

      Heart (2 chambers), comparative difference with other vertebrate hearts (e.g. man 4 chambers), blood circulation.

   c) Respiratory system

      Basic structures of gill in bony fishes, nose/or mouth trachea and lungs. Diffusion of gases and fish blood as a carrier of gases. Adaptations for air breathing among some fishes (give example) Functions to gas bladder, and how to determine if a fish will survive return to water having been taken from greater depth.

   d) Excretory system and osmotic regulation

      Kidney structure and function. Function of gills in excretion and osmoregulation. Function of oral membrane in absorption.

   e) Nervous and endocrine system

      Brief outline of brain as a centre of stimuli receiving and integration. Function of lateral line.
      Brief outline of interaction of some of endocrine glands of fishes and their function.

f) Reproductive system

Structure of gonads and condition.
Types of reproduction
Breeding behaviour.
Fecundity in relation to care, give typical examples.

B. FISH POPULATION

1. Define population
2. Direct method
3. Indirect methods
   a) Mark and recapture
   b) Delury method
   c) Catch per effort as a measure of denisty of fish.

C. POPULATION DYNAMICS

1. Aging fish
   a) Anatomical structures used to age fish
   b) Methods of ageing fish
   c) Reasons for ageing fish
2. Growth
   a) In weight
   b) In length
   c) Relationship of length to weight
   d) Condition and its implication
3. Mortality
   a) Natural mortality and some of the causes
   b) Determination of natural mortality
   c) Fishing mortality
   d) Determination of fishing mortality
   e) Overfishing
4. Survival
5. Recruitment

1ST YEAR FISH CULTURE COURSE 45 HOURS

a) Duration 2 years
b) Total teaching time 45 hours

The course aims at providing essential background knowledge of general principles of fish farming. Students, being potential extension assistants, should after leaving the school, be able to advise and assist prospective as well as established fish farmers on the proper and rational management of fish ponds.

COURSE OUTLINE

a) Year one — 30 hours

1. Pond justification

   Potential markets, fish prices, transport.

2. Pond Planning

   Site, topography, soil chemistry/physics, water availability/chemistry/cost. Area, convenience, layout.

3. Mathmatics of pond construction

   Geometry, volumetric measurement, flow rates (cusecs), areas, topographical charts, plans.

4. Construction and layout

   Labour/machinery - availability, costs, quality of job (compaction, etc.). Wall building, pegging, earth moving, keying, drainage, filling ducts, filling with water.

5. Fertilization

   Phosphate fertilizers - action, types and quantities, potassium fertilizers - action, types and quantities; micronutrients; organic manure.

5. Biology

   Hydrobiology - food chain; nutrient cycle, pond as a bione, actions always to upset and redress the balance; ichthyology.

7. Fish Culture Systems

   Extensive, semi-intensive, intensive; techniques : monoculture, polyculture, hybridization, monosex culture.

8. Stocking

   Choice of species, rate of stocking, density of stocking, carrying capacity.

9. Feeding

   Principles of nutrition - adequacy - limiting factors in feed wastage, food conversation ratios, principle foods used in fish culture - foods of vegetable origin, foods of animal origin, dry concentrated foods.

10. Growth of fish in Ponds

    Growth rates - hereditary factors, maintenance need, food (quantity and quality). Impediments to growth curve - temperature, food space, disease.

1ST YEAR — ENGLISH — 34 HOURS

Although English grammar is taught in this programme, it is so done as a remedial approach. But the intention is that through proper use of English the student will be oriented in the technical use of English in fisheries work.

Grammar

The word formation, phrase, clause and sentence. The parts of speech and their function in normal English usage. Elements of a sentence.

Usage

Proper use of pronouns, modifiers, prepositions and connectives in continuous writing. Words easily confused.

Writing

Mechanics in writing, i.e. capitalization, punctuation, syllabication and paragraphic.

Composition and essay writing. Summary and precis made from technical reports; paraphrase of notes made from a visit, talk, lecture and other audio aids.

Comprehension from extracts of general fisheries work - written or oral.

1ST YEAR — FISHERIES STATISTICS — 30 HOURS

1. a) Course definitions

   Procedures and consumers of statistical data.

   b) The role of statistics in research planning and Development

   e.g. manufacture, marketing, government, etc.

   c) Classification of statistical data

2. a) Methods of collecting statistical data

   Complete enumeration
   Sampling systems

   b) Updating various statistical data

3. Procedures in collecting statistical data

   a) Setting survey objectives
   b) Designing questionnaires
   c) Methods of dispensing questionnaires; advantages and disadvantages of each method.

4. Processing survey results

   a) Estimating versus complete enumeration
   b) Practical use of various types of adding machines and calculators.
   c) Weight and measure; the metric system

5. Basic statistical notation

   Variables
   Constants
   Superscripts and subscripts
   Summation

   With exercises.

6. Simple Algebraic Expressions

   Monomials and polynomials
   Addition, subtraction, division and multiplication
   Evaluation by substitution

Geometric presentation of real numbers
Simple equations, literal equations and simultaneous equations

With erercises

7. Measures of Central tendancy

Arithmetic of simple mean
Weighted mean
Median
Mode

With exercises

8. Measures of spread

Range
Mean deviation
Variance

1ST YEAR — FISHERIES LEGISLATION — 28½ HOURS

Introduction

Legislation will be taught to students so that they are made aware of the need for proper management of Fishery resources and other aquatic living things.

The Fisheries Act Cap. 66:05

Interpretation of terms licensing of fishing business and commercial licences, application for licences, renewal of registration and licences, general conditions of a commercial fishing licence, revocation of licence, transfer of licence and fees. Catch limits, registration of shore seine nets and gillnets. Minimum takeable size fish and mesh restriction. The close seasons and areas of application. The various schedules to these regulations to be studied in detail.

The Fisheries (Trout) Rules

Citation and interpretation of terms, hour of fishing, methods of fishing, minimum size of trout to be caught and the minimum numbers to be caught, types of licences. Catch returns, the appointment of honourary trout warden, penalties and forfeiture revocation of licence. The various schedules.

The aquarist fishermen and trade in ornamental fish.

1ST YEAR — SEAMANSHIP — 149 HOURS

1. Anchors

Students are going to be taught different patterns of anchors, the advantages and disadvantages so that they know the theory and practice of these.

Stocked and stockless anchors

Care of anchors and cables
Anchoring terms
Duties of the cable man
Anchoring to a single anchor
Amount of cable to use
Duties at anchorage
Dragging anchor
Clearing a foul anchor
Changing anchors

2. Mooring

a) Coming to open moor
b) Fouling hawse
c) Mooring close to a danger
d) Effect of passing a moored boat

3. Beaching and Stranding

a) Difference between beaching and stranding
b) Uses of tugs, lighters, ground tackles, dredges, bigger vessels
c) Correct action on stranding

4. Rules of the Road

To have a thorough knowledge of the International Regulations for Preventing Collision at Sea. Some of these Rules must be learnt by heart because the slightest change of words may change the meaning of the Rule. Students will be expected to have a full knowledge of the content and application so as to prevent collision.

Part A - Preliminary Definitions; Rule I
Part B - Lights and shapes; Rules 1 - 13
Part D - Steering and sailing; Rules 17 - 27
Part E - Sound signals for vessels in sight of one another; Rule 28
Part F - Miscellaneous; Rules 29 - 31

5. Fire Fighting

Sources of fire, types and class of fire, oxidation
Destruction of the fire triangle (heat, fuel and Oxygen).
General action in the event of fire outbreak.
Types of extinguishers.

6. Use of oil for quelling seas.
Man overboard.
Handling a boat in heavy weather.
Preparing the vessel for heavy weather.

7. Towing

Length of towline.
Supplying power to the tow.
Making contact.
Securing the towline.
The towing voyage.

8. The Position

By Latitude and Longitude; which reference to another position by giving the bearing and distance of or from that position.

True course and distance.

9. Reading the magnetic compass

Reading bearing upon distant landmarks, plotting the position on chart; Distance and bearing, intersection of two or more position lines; methods of obtaining a position line, e.g. cross bearing; a transit and a compass bearing; radio bearing.

10. Steering a boat on a given compass course

To find the course to steer to counteract a drift; to find estimated time of arrival.

11. Rope Work

Students will be taught the difference between natural and synthetic fibres when they come to twines for fishing materials; this section will deal with :-

a) The care of ropes both wire and fibre.
b) Bends, hitches and knots, whipping and splices.

1ST YEAR — FISHING GEAR TECHNOLOGY — 106 HOURS

Introduction

Students are introduced to various materials and equipment used in fishing operations. The construction of a fishing gear is also essential.

1. Fishing Materials and Accessories

Floats, shackles, thimbles, wire rope, chains, links, danleno, bobbins, doors of other boards, leadline and buoys - types, formation, sizes and their use to the gear.

2. Ropes and Twines

a) Natural Fibres

Vegetable fibres such as cotton, sisal, manila, tingo, bwazi, coir, ranie, jute, hemp and flax;
Animal fibres such as silk and wool.

b) Synthetic Fibres

Poly Amide, Poly Ester, Poly-Ethylene, Poly Propylene, Poly Vinyl - Alcohol, Poly-vinyl - Chloride and Copolymer with their trade names grouped.

c) Properties and Characteristics of Fibres

Appearance of fibres, staple and continuous; comparison in density, tenacity, water absorption, elasticity, heat resistance, strength, bacterial and fungi resistance.

d) Twist and Lay

The make up of Twines - Filaments yarns, and strands
Twist :- Z-twist and S-twist. Lay:- Hard, median and soft

e) Preserving and Stiffening Agents of Fibres

The purpose of preserving the fibres and the preserving agents such as in tanning and stiffening agents - dying and tarring.

f) Instruction to numbering systems and measurement of rope

Measurement of twines: denier, tex and traditional systems such as runnage, Metric and English count.
Measurement of rope - diameter and circumference.

3. Netting

a) Net Making

Introduction to net making. Hand-made net - materials, methods and knots. Machine made net - single shuttle, multishuttle and knotless.

b) Run of Mesh and mesh measurement

Parts of mesh; run of mesh, with and against the run. Mesh size - length of bar and diagonal measurement.

c) Measuration of netting

Length of netting stretched; mesh in depth; mesh size and thickness of twine.

d) Hanging of netting to frameline

Material and method; purpose of hanging the nettings.

e) Hanging ratio

Mounting by the half; the third, the third plus and the quarter or the three-quarters. The degree of mesh opening and height of netting after being mounted.

f) Net Shaping

Elementary net shaping; bating and creasing by hand braiding. Cutting of machine netting into panels; bating rate and cutting rate, point and bar; then transversal and bar.

g) Net Repair

Ordinary mending - trimming, mending with the run, lacing and cobbling.

4. Fishing Gear and Balancing

Introduction of balancing gear - materials.
Traditional way of doing. Model way of working.
Volume and weight; loss of weight in water of the materials attached.

5 Fish Finder

a) Electronic methods

Echo sounder and Sonar.

b) Traditional methods

Information among fishermen; finding at Chilundu; actual fish swimming in shoal; weather conditions; water current direction; breeding season and birds, e.g. cormorants.

6. Practicals

a) Twine and Rope

Testing fibres in water; by burning and colour. Demonstration of twist and lay; Familiarisation of twines and rope sizes.

b) Netting

Making of braiding needles and putting in twine.
Use of gauge fingers and bar measurement.
Setting up of required meshes. Braiding left to right and right to left, counting rows.
Bating and creasing to give desired tapers to netting section.

c) Shaping

Cutting of webbing to desired shapes by normal and bar or transversal and bar.

d) Net Repair

Trimming of damaged netting, starting and ending; cobbling; patching of small mesh netting.

1ST YEAR — NAVIGATION — 49 HOURS

Introduction

The course of Navigation is intended to feed the students with an aim that at the end of the course they will be able to navigate safely at night using navigational chart and compass in a bigger boat.

1. Terminology

Nautical mile, knots, fathoms, latitudes, longitudes.

2. Types of Navigation

3. Navigational instruments and appliances

Leadline; knotmaster log; the magnetic compass; the degrees of compass variation; deviation; concise rules for correction of courses and bearing; radar and its operation.

4. International Morse Code

Alphabets and numbers only.

5. The Navigational Chart

Scale; graduation of charts; description of charts; standard abbreviations; hints on the correct use of charts.

6. Correction of courses

Simple exercises on correction of the true course from given magnetic bearing and vice-versa.

2ND YEAR — PLOTTING — 90 HOURS

7. Equipment

Chart table; parallel rulers, pair of dividers; soft pencils; soft rubber; logbook; the magnetic compass; hand bearing compass; deviation tables.

1ST YEAR — FIRST AID — 12 HOURS

1. Introduction

There is need for temporal care to casualty before medical assistance is obtained, hence a course in first aid.

2. First Aid equipment

Individual first aid kit (a and b)

3. Outline of First Aid

The scope of first aid; management and care; golden rules of first aid.

4. Dressing and bandages

Types and uses of bandages and dressings.

5. Wounds and Burns

Types of wounds; general rules for treatment of wounds; types of burns and scalds and their treatment.

6. Respiration

Artificial respiration :

a) Oral resuscitation.
b) The Sylvester method.

1ST YEAR — EXTENSION EDUCATION (THEORY) COURSE — 180 HOURS

Since the students are primarily supposed to serve as extension agents after leaving school they are taught the desired extension skills which should help them communicate their technical know-how to fishermen and fish farmers with ease.

1. The meaning of extension

a) The difference between Extension and Advisory services.

b) The purpose of all extension.
c) The basics of extension teaching.

2. The basic principles of extension

a) The recognition of community needs.

b) The five essential stages.

c) The Process of extension.
Five important principles.

3. Social and Cultural factors in extension

a) Terms used :

Culture
Society
Structure (of society)
Tradition
Custom
Belief
Habit

b) Social structure

c) Culture of a society

d) Barriers to change

4. The learning - teaching process

Some contributions of the behavioral science

a) Communication

b) Individual differences

c) Motivation

d) Perception

e) Learning

f) Implication for extension

5. Surveys for extension

a) Initial steps

b) Human factors to be considered

c) Making a survey

d) Recording the observation

6. Programme planning

The extension programme
The plan of work
The calendar of work

7. Evaluation

The reason for evaluation
Evaluation of extension teaching
How to undertake a simple evaluation

8. The teaching of extension

The process of learning
The ladder of learning
The requirements of an extension worker
Incentives
Some principles of extension teaching
Speaking in public.

9. Extension teaching methods

Individual methods
Group methods
Mass methods
Visual aids in teaching

10. Local leaders and fishermen's organisations

Their value in extension work
The selection of local leaders
Their training
Their recognition
Their importance in Rural Development Programme
The value of fishermen's organisations

1ST YEAR — BUSINESS MANAGEMENT — 30 HOURS

The object of this course is to give a Fisheries Assistant some basic ideas leading to simple bookkeeping, accounts and industrial relationships. After completion of this course, Fisheries Assistants are expected to advise and help fishermen and fish traders to do business in fishing and fish trade.

1. Simple Bookkeeping

Types of books a fisherman is required to keep, reasons for keeping business records.

2. Capital

Sources of capital, type of capital, and uses of capital.

3. Revenue

Getting something from the capital invested.

4. Sales

Types of sales, documents, conditions and terms of each type of sale.

5. Types of business operations

Primary producers, manufacturers, distributors, and professionals.

6. Banking

Types of banks, functions and types of accounts kept in a commercial bank.

7. The Ledger and its use

Definition of debit and credit sides of an account. Rules of posting and balancing.

8. Trial balance

Taking a trial balance, trading account, profit and loss account.

9. Balance sheet

An outline of Balance sheet, definition of assets and liability, uses of a balance sheet to an accountant, insurance and its uses.

10. Revenue and Expenditure account

Evaluation of stock and income.

1ST YEAR — FISH MARKETING — 30 HOURS

It is hoped that a course in Fish Marketing would give the students some knowledge of basic economics which could be applied in the fishing industry.

1. Fish Marketing

Definition of fish market, the importance of studying marketing in the Fisheries Department, theories of marketing and economy.

2. Society

The study of a society, human behaviour and culture.

3. Production

Types of production, the object of production, the study of circular flow of funds, goods and services; wants, utilities and choice of goods.

4. Distribution

The link between manufacturer, middle man, retailer and consumer; forms of transport.

5. Trading

The theory of international trade and advantages, foreign exchange.

6. Demand and Supply

The theory of "Demand" and "Supply"; the factors that affect "Demand" and "Supply".

7. Fish Storage

The theory of storage of both dried fish and wet fish, problems associated with storage, quality aspects, types of packaging, control of insect infestation and practices of warehousing.

8. Location of Fish Landings

Site, methods of sales and selling fish, the operation of Namiasi Fish Market (as an example).

9. Fish Trade

The difference between a fish trader, a fisherman and a fish processor.

10. Cooperative Societies

Advantages and disadvantages of a cooperative society, problems and deficiencies in fish marketing in developing countries.

11. Specialisation in an industry

Division of Labour, the theory of market research, advertisement and types of advertisements.

1ST YEAR FISH HANDLING AND PROCESSING 327 HOURS

1 Introduction

Fish as food, nutritional importance of fish, availability of fish and distribution to urban and rural populations.

2. Fish Spoilage

Causes of spoilage of fish, rigor mortis in fish and its effects on quality, assessment of freshness of fish. Control of spoilage of fish.

3. Fish Preservation

The need for the preservation of fish and reasons. Methods of fish preservation, detailed study of fish preservation, e.g. icing and freezing.

4. Fish handling

The handling of fish at sea in a canoe, small boat and trawlers. The need for keeping cool. The importance of storing fish by species and how it affects quality of fish.

How fish is handled by fresh fish merchants on the market and stalls. The handling of fish by the processed fish merchants at the market.

5. VISITS

Visits will be conducted to places of interest to observe the following : how subsistance fishermen handle their fish during fishing and at landing. The handling of fish by industrial fishermen at sea and at landings. How fish traders handle fish at the markets. The freezing and ice plants at Maldeco and Namiasi.

6. Practical work

Stowage of fish at sea, application of ice in fishing craft at sea, handling of fish during transportation and distribution. Construction and repair of fish boxes and baskets. Construction and repair of fish racks and making kilns.

1ST YEAR

MARINE ENGINEERING

270 HOURS

Since the modern fishing industry demands the use of motorised craft, it is necessary for students to learn something about marine engines in order to make the course complete all round.

1. Introduction

Engines, fuels and oils. Types of engines, marine engines, model recognition, general arrangement, cycle of operation.

2. Two Stroke Engines

The study of the following outboard motors : British Seagull, Johnson and Yamaha, in view of lubrications, fuel and cooling systems. The gear box and lower unit, the engine mounting brackets, clutch and the ignition system. The engine overboard instructions, fire protection, the engine remote control and attachments; use and starting instructions, daily checks, minor adjustments, servicing and routine maintenance.

3. The theory of workshop practice

Introduction to metals; ferrous and non-ferrous metals; heat treatment of metals. Tools (files, hammer, marking tools, cutting and measuring tools, drills, lubrication and sharpening, machine tools, spanners, pliers and screw driver). Engineering components, nuts, bolts, screws, washers and locking devices. Screws and threads, welding and soldering, lifting equipment and boatbuilding ashore.

4. Practical work

Preparation and starting of outboard engines (one of the following : Yamaha, Johnson or Seagull); fitting arrangements on boat, recognition of systems and components. Fault finding and diagnosis, simple adjustment, servicing and maintenance, removal of components, overhauls and assembly; ordering spare parts from manual books.

Identification of metals, cutting, filing, marking and drilling. Manufacture of simple and test pieces. Sharpening tools and drill, use of spanners and recognition of tools in the tool kit.

1ST YEAR

BOATBUILDING

25½ HOURS

Boatbuilding is intended in this course to introduce to students so that they appreciate the need for well designed and seaworthy fishing craft. Basic principles are discussed as they apply to various fishing craft in this country and elsewhere.

1. Introduction

Comparison between the dugout canoes and boats in view of stability, sea-worthiness, carrying capacity and working space. Economics of boatbuilding, timber and dugout canoe.

2. Boatbuilding tools

Hand saw, jack plane, smoothing plane, spirit level, measuring tape or rule, pencil, caulking iron, oil stone, marking gauge, plumb bob, chisel and clamps.

3. Materials

Timber, glue, paint, nails, screws, oakum, putty and bolts.

4. Timber

Mulanje cedar, mlombwa, M'bawa, Mingongomwa and other suitable types of timber.

5. Boatbuilding Legislation

a) Measurements: Length, width, depth, girth and draught. Tonnage
b) Vessels recommended for night operations.

6. Types of boat construction

Hard chine, flat bottomed, round bilge and clinker construction.

2ND YEAR BOATBUILDING 76½ HOURS

One complete term will be devoted to practical aspects of the course so that the students appreciate the skills required in boatbuilding and maintenance of boats. At the end of the term students will have constructed a small boat of about 10 ft in length.

1. Boat identification

Wooden boats, steel or aluminium boats, G.R.P. boats and ferrocement boats.

2. Plan reading

Lines plan drawing, section drawing and construction drawing.

3. Boatbuilding Procedure

Boat erection; fixing chine piece; timber hole cutting; intermediate frames; side and bottom planking; caulking and marine glue application. Fixing the keel, coverboards, inner stringers, thwarts and the deck.

2ND YEAR MARINE ENGINEERING SYLLABUS FOR TECHNICAL ASSISTANTS 225 HOURS

Gradually, technical assistants build up their interests and choices in the three extensive fields in the Department, i.e. fishing, extension or practice of marine engineering.

Specialisation period gives a mass, bulk and advanced knowledge on a

particular field to a sector number of students (specialists). The period is a six week full time duration 225 hours and fitted in the 3rd term of the 2nd year.

1. Four stroke engines (diesel and petrol engines)

a) Engine operation - turbo- and super-chargers
b) Lubrication
c) Valve arrangements
d) Ignition system
e) fuel system - petrol engine only
f) Cooling system - petrol engine only
g) Governors - Mechanical (i.e. centrifugal)
- Pneumatic
- Hydraulic
h) Fault finding - engine trouble tracing chart

2. Transmission and steering system

a) Marine gearbox - operation
lubrication
adjustment
b) Reduction gearbox - description
lubrication
c) Propeller - fixed and variable pitch
d) Propeller shaft fittings - description
bearing, seals and glands
e) Alignment of engine
f) Steering system - description
names

3. Electrics

a) Introduction to electricity
b) Electrical terms and principles
c) Magnetism and electromagnetism
d) The battery - principles
construction
electrolyte
hydrometer and avometer
charging
e) Charging system - generator principles
regulator current
cut-out
f) Starting system - starter motor principles
solonoids
g) Ancillary electrical components

4. Workshop Practice

a) Joining metal - soldering
brazing, use of oxy-acetylene
rivetting
bolting
b) Screw threads - description, types and relation to spanners
cutting internal threads
cutting external threads

c) Welding - introduction to gas welding
introduction to electrical welding
use of rods, types and gauges
d) Lifting equipment - use of chain blocks, sheers, etc. on engines
e) Boat handling ashore - pulling out
loading lorries
loading trailers
launching

Practicals

1. Four stroke Engines (Diesel and petrol)

a) Servicing, routine maintenance and fault finding
b) Minor repairs - changing injectors/spark plugs
valve adjustment
decompressors

2. Transmission and steering system

a) Marine gearbox - operation
lubrication
adjustment
b) Daily running checks
c) Tightening and reparking glands
d) Alignment
e) Steering system
f) Rudder glands

3. Electrics

a) Battery care and charging
b) Servicing a generator
c) Servicing a starter motor
d) Tracing faults on wiring system

4. Workshop practice

a) Soldering
b) Brazing
c) Rivetting
d) Cutting screw threads
e) Manufacture of simple tools and boatyard components
f) gas welding and electric welding
g) Lifting engines, boat, by using chain blocks
h) Loading boats on trailers - precaution when loading.

2ND YEAR MARINE ENGINEERING 99 HOURS

1. The four stroke engine

The difference between the petrol and the diesel engine. General arrangements and parts. The cycle of operation, the fuel system of diesel engines, cooling system.

2. Practical Work

Specimen : the 4-stroke engines; diesel and petrol engines. Recognition of systems and components, dismantling procedure, reassembly and testing. Preparation and starting of the engine (hand start only). Operation on board and daily running checks.

2ND YEAR — FISH HANDLING AND PROCESSING — 165 HOURS

The detailed study will be approached more through practical instruction than the theoretical aspect in order to enable the students to learn the practical skills in fish handling.

1. Fish Processing

Methods of processing fish, the sun and air as natural agents, use of artificial processes in fish drying. Smoking, the oildrum type and altona kilns. Slats as a mode of fish processing. Varieties in salting fish, dry salting, pickling and brining. The principles of canning.

2. Practical work

Construction of racks, kilns and salting vats. Gutting and filleting fish in preparation to fish processing. Trial of various fuels in fish smoking - palm nuts, firewood, wood shavings and rice husk. Application of ice on fish. Production of fish meal for stock and human food.

3. Visits

To Maldeco to see the Tory kiln.
To Namiasi to see production of fish meal.

2ND YEAR — FISHERIES LEGISLATION — 16½ HOURS

1. Crocodile Act

Cap. 66:06. The chapter will be studied in full.

2. Enforcement Procedures

Procedure in enforcement of the Fisheries Act. Inspection of fishing licences, fishing equipment, fish caught and dried or cured fish. Prosecuting and bringing offenders to court. Confiscation of fishing equipment, fishing craft, fish caught or fish being sold or transported.

3. The inland water shipping act

Survey and registration of vessels, applications for and granting of licences. Conditions, variation, renovation and suspension of licences. Inland water and international arrangements.

2ND YEAR — FISHERIES STATISTICS — 9 HOURS

1. Summary revision of first year work

Organisation of the statistical section of the Fisheries Department and the function of each.

2. Marketing statistics and source of data

3-4 Fish marketing and trade routes in Malawi

Factors affecting each route

5-6 Urban markets - recording
Rural markets - estimating
Beach markets and beach prices
Data from shops and specialised distributors

7 Organised landing markets

Types of statistical data available at organised markets (co-ordinated visit to Namiasi with marketing).

8. Station recording

The statistical set up of Lake Chilwa. Collecting data from Malawi Railways.

9-10 Imports and Exports

Sources of data; acquarium trade and Salima canners (co-ordinated visit to Kambiri and Salima canners with marketing).

11-12 Revision and Testing

a) Processing and presenting data collected from the various sources.
b) Other fishery statistical information. Catch statistics.
c) Definition and uses.
d) Stratification of fishing areas.

13-15 Frame surveys

Collecting and processing frame data (to coincide with annual frame survey)

16-19 Distribution and catch assessment surveys

Definition CAS terms. Uses of field forms (field practices)

20 Revision and Testing

21. Data processing and presentation.

2ND YEAR — BUSINESS MANAGEMENT — 10½ HOURS

1. The Appropriation Account

How the net profit generated in a year is going to be used; i.e. replacing certain assets, repaying a loan, revising salaries and wages, expanding

the business by re-investing, charitable donations and other drawings.

2. People

The human aspect of business; i.e. what people provide, motives for work, types of needs, physical needs, social needs, types and causes of conflicts among employees.

2ND YEAR — FISH MARKETING — 10½ HOURS

1. Taxation

The scope of taxation, the difference between insurance and taxation.

2. Money

Types of money, uses of money and barter system.

3. The role of Government in an economy

The theory of G.N.P. and earnings.

4. Market organisation

Dairy produce marketing organisation, fruit and vegetable market organisation, meat, farm produce and fish.

2ND YEAR — EXTENSION PRACTICE — 225 HOURS

1. Introduction

Specialist training is given to a few selected students to carry out an intensive programme in general extension work for a period of six weeks during the 3rd term of the second year.

2. Extension methods

The fisheries assistant as a teacher and advisor, preparation of demonstrations, preparation and use of visual aids, beach visits, planning the various programmes, meetings organised at the training centre and at fishing places (beaches).

3. Extension techniques

Practical demonstration in the following :

a) Fishing Gear Construction

Gill net mounting, net mending

b) Fish processing and preservation

Fish smoking, salting, icing and sun-drying.

c) Engine maintenance

Oil and petrol mixtures and gear box oil changes, simple repairs.

d) Fishing craft

Care of boats and annual overhauls.

4. General

Group discussions, meetings surveys, fish sampling and beach recording. Fish marketing surveys, maps of the local areas worked. Follow up.

2ND YEAR — FISHING GEAR TECHNOLOGY, SEAMANSHIP AND NAVIGATION — 210 HOURS

Most of the job during this period is done by the specialists on their own and at times they even supervise the T.A. I's. The aim is to make them feel responsible on their special field of fishing. They are given their daily training programme while the instructors assist them to prepare the necessary arrangements.

1. Commercial Trawling

2. Trawl net construction

3. Detailed Fishing

A bigger fishing boat arrives from Monkey Bay for the following :

a) Night navigation where students use :
   i) Fishing light
   ii) Chart, stearing compass and bearing compass to determine the boat's position.

b) Day Fishing, where students use :
   i) Echo sounder for fish finding and fixing ship's position.
   ii) Single trawling where the use of otter boards is observed.

4. More theory on chart work, fishing methods and techniques, entering the logbook.

5. Visits

To Blantyre Netting Co. to see how the machines manufacture twines and nets. Fire fighting at Chileka Airport; different ways of fishing down to Lower Shire. Visits to see ring net fishing with Maldeco; visits to Nkhudzi Bay or Cape Maclear to see or participate in Utaka fishing with Chilimila, net.

2ND YEAR — FISHING GEAR TECHNOLOGY — 80 HOURS

Practical and Theory

1. Gear construction

Braiding of flymeshes and selvedges; take-up and joining panel of netting of different mesh size; lacing together of small mesh netting panels; framing of netting to lines; choice of spacing gill net mounting to grameline at given hanging ratios.

Trawl net framed across the wings; square and belly; beach seine nets and longlines construction.

2. Designs and Netting

Familiarisation of trawl nets and seine nets; making models from the given designs; enlarging scales from small scale; cutting and shaping of webbing to required patterns.

Visit to Blantyre Netting Factory.

2ND YEAR SEAMANSHIP 129 HOURS

1. Theory of ship handling

Up to now students will be able to handle bigger boats.
Approaching a mooring buoy from windward.
Turning the ship with wind ahead.
Securing to two anchors in a very strong wind ahead.
Clearing from two anchors with wind ahead.
Mooring lines.
Coming to a jetty with wind.
Clearing a jetty with wind ahead.
Clearing a jetty with wind astern
Turning a vessel short round, single screw.

2. Emergency

a) Swimming
b) Abandoning ship
c) Preservation of crew and passengers
d) Recovery of survivors
e) Rescuing the crew and passengers of disabled boat.

2ND YEAR FISHING METHODS 100 HOURS

The second year work in fishing methods will be based on practical trials

Fishing and handling of fishing gear

Operation of pair trawl; operation of another trawl; bating; setting and hauling of longlines; operation of Chilimila and ring nets; Demonstration on the operation of Gear net; scoop net, mosquito nets and fish traps.
Visits to Lower Shire, Lake Chilwa, Maldeco, Nkhudzi Bay or Cape Maclear to see various operations.
Visit to Fisheries Research Station to see Hydrological equipment.

2ND YEAR — 30 HOURS

1. Stock Assessment

a) What is there?
b) How much is there?
c) How best can it be used?

2. Elementary Limnology

a) What is limnology?
b) Lentic and lotic environments and their genesis
c) Differences between swamps - marshes - ponds and lakes.
d) Subdivision of a typical lake; littoral, sublittoral, pelagial and profunal zones.
e) Physical conditions in aquatic environment;
   i) Water movement
   ii) Light and suspended solids
   iii) Temperature
   iv) Primary productivity as observed in sea, and possible causes.

3. Ecology

What is ecology? And why do we study it?

a) Common terms mentioned in the study of ecology
   i) Environment
   ii) Habitat
   iii) Niche
   iv) Population
   v) Community
   vi) Biosphere
   vii) Carrying capacity

b) Concept of ecosystem and the two components
   i) Autotrophic component
   ii) Heterotrophic component

c) Four constituents comprising ecosystems
   i) Abiotic substances/Biotic organisms
   ii) Producer organisms
   iii) Consumer organisms
   iv) Decomposer organisms

   Briefly explain where each one of the four will likely be found in aquatic ecosystem and why.

d) Food chain, food web and give an example.

e) Trophic structure and ecological pyramids.
   Mention pyramid of numbers and pyramid of biomass only and explain the differences in their shapes. Give a typical example of Lake Malawi.

2ND YEAR — ENGLISH — 11 HOUR

At this stage English is approached in such a manner that it is a media of technical communication in a Fisheries setting in both written and oral

communication. The students are acquainted with fisheries terms. Study is also directed into the understanding and interpretation of written technical instructions and the writing of reports.

1. Letter writing

Forms of letter, private letters, business letters, official letters. Forms of writing style.

2. Report Writing

Field reports, fishing gear survey reports, monthly reports and accompanying data.

3. General forms of communication

The use of the telephone, telegrammes, recording and filing systems of letters and reports.