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9. ABSTRACT <p>Analyses of the grain marketing system and the fisheries problems and future prospects in Chad. This study reviews the states of Chadian fishery production with reference to the effects of the 1971-73 drought on the abundance of fish. It describes and evaluates the marketing, conservation and preservation methods currently in use. It discusses the fishing methods used in Lake Chad and the Chari and Logone Rivers, and assesses the fisheries potential. It evaluates the present structure of the Chadian National Fisheries Service, the major infrastructural problems hindering the development of the fishery. It recommends specific A.I.D. responses. It concludes that the major objective of any fisheries development plan should be increasing the geographical range and distribution of fish within Chad. It recommends that A.I.D. undertake a five part program which includes education and training, expatriate intervention, development of a National Fisheries Service, organization of fishermen through cooperatives, and development of a new fishing canoe construction method. Appendix D is a translation of a paper on the effects of the drought on the fish stock in Lake Chad and the Chari Delta. Appendix G is a translation of a paper on fishing techniques practiced in the Lake Chad Region and the Bas Chari.</p>		
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ANALYSIS OF
FISHERIES DEVELOPMENT
POTENTIAL IN CHAD

by my door

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Multinational Agribusiness Systems Inc.
1725 K Street, N.W.
Washington, D.C. 20006
202-872-8782

Fishery Specialist: *BAW* Hill
Home Office Administrator: C. J. Metzger



Multinational Agribusiness Systems Incorporated

1725 K Street N.W., Washington, D. C. 20006 • (202) 872-8782

August 5, 1976

AFR/DR/SFWAP
Office of Development Resources
Bureau for Africa
Agency for International Development
Department of State
Washington, D.C. 20523

Attention: Mr. James M. Kelly

SUBJECT: Transmittal of Grain Marketing and Fishery Reports, Chad
(Work Order #6, Contract #AID/afr - C - 1149)

Dear Mr. Kelly:

Although our work order, signed in June, 1976 named Mr. John Pielemeier as Project Officer, we understand that you are now responsible for this project. Therefore, we are pleased to submit twenty-five copies each in English of our reports which analyze the grain marketing system and fishery in Chad. The field work for these reports was conducted in June/July, 1976.

Dr. Richard Maxon and Mr. Barry Hill served as MASI's Grain Marketing and Fishery Specialists respectively. Some of the translation into English of appendices in French plus editing and typing were done by MASI's staff in Washington. Please note that these reports elaborate upon material already submitted by our Specialists prior to their departure from Chad. The previously submitted material was in the form of a Project Identification Document (PID) or Accelerated Project Identification Document (A-PID).

We appreciate this opportunity to serve the Agency and your Office and look forward to doing so again in the near future.

Very truly yours,

Carl J. Metzger
President

CJM:jm

Enc.

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I. INTRODUCTION

A. Background of Work Order

AID issued Work Order No. 6 to Multinational Agribusiness Systems Incorporated (MASI) under contract No. AID/AFR-C-1149. The objective of the work was to assist the Government of Chad and the CDO/N'Djamena in analyzing the grain marketing sub-section and the fisheries industry in Chad, and to determine if there are any appropriate AID programs in these areas. This report is an analysis of the fisheries problems and future prospects (Field study performed during June.)

B. Scope of Work

The scope of the work undertaken was as follows :

1. Review the present status of Chadian fishery production with reference to the effects of the 1971-1973 draught on the abundance of fish.
2. Describe marketing, conservation and preservation methods currently in use and evaluate them.
3. Describe fishing methods utilized in Lake Chad and the Chari and Logone rivers.
4. Assess the fisheries potential in Lake Chad and the Chari and Logone rivers.
5. Evaluate the present structure of the Chadian National Fisheries Service in reference to skill level of personnel, ability to respond to problems in the fishery, capability in fisheries extension work, and future growth potential.
6. Evaluate the major infrastructural problems hindering the development of the fishery.
7. Recommend specific AID responses to overcome problems identified and to improve the distribution system to make fishery products more available throughout a wider geographical area in Chad.

C. Background of Project

Although the Chadian fishery is the third largest contributory sector to the Chadian economy (4% of GNP) and provides 50,000 to 110,000 metric tons 1/ of highly valuable and essential protein to the country, one of Africa's poorest, it has been largely neglected.

Several thousands of Chadian nationals are engaged full-time in the fishery and approximately 175,000 fish part-time or on a casual basis.

The recent draught seriously affected species abundance. There is evidence, however, that the fishery is recovering. Improper drying and smoking of fish and consumption by insects leads to large losses of fish between the fishermen and the market. The lack of all-weather roads and communication systems impedes the development of a fisheries marketing system to distribute a relatively perishable commodity to the interior areas of Chad. Illegal exportation of fish caught in Chadian waters to Nigeria, the Cameroons and the Central African Republic has been plaguing the Government of Chad for 15 years.

II. MAJOR FACTORS AFFECTING THE DEVELOPMENT OF THE CHADIAN FISHERY

The Development Assistance Plan (DAP) for Chad has pointed out several problems facing the development of the Chadian fishery, e.g., poor preservation techniques which result in a 40 to 70% loss of flesh between the harvesting and marketing sectors; the fact that the major portion of the commercial catch is exported to the Cameroons and Nigeria; the lack of large trees required for making "pirogues" (hollowed-out canoes); and the lack of an organized fisheries marketing system. The following consists of a list of observations concerning these problems and others uncovered during this visit by the Agricultural Design Team, in the order of their priority.

A. Lack of Infrastructure

Insufficient all-weather roads and an almost total lack of communication facilities make organized fish marketing, even on a minor scale, nearly impossible. Most villages along the rivers and the lakes become, in reality, islands as the waters flood during the rainy season. Even in the months preceding and following the rainy season, roads to the interior of Chad are impassable. 2/

1/ Best range of estimate available.

2/ See picture 1, Appendix C.

B. Lack of a Functional National Fisheries Service

The present "Service nationale de pêches" consists solely of a Chief (3 years training in fisheries), a Deputy (2 years training), a Secretary and a Supervisory Field Agent (1 year on-the-job training). There will be a total of 40 "moniteurs" (low level field agents) available by September 1976, but their primary duties will be in forestry, not fishery. There are definite indications that the "Direction des eaux, forêts, pêches et chasses", which operates under the Ministry of Agriculture 1/ has relegated low priority to the development of the fisheries service. There are almost no funds available, even for basic tasks.

C. Three Other Countries - Cameroons, Nigeria and Niger - Share the Fishery with Chad

Lake Chad is partitioned among four countries, each having different and often conflicting fishing methods, customs, laws, and conservation/production techniques. Fish caught in the Chari and Logone rivers (which mark the Chadian border with the Cameroons) freely flow to either country depending upon where demand/prices are highest. Because of international conflict, 2/ the Lake Chad Basin Commission has ceased all fisheries research and development activities on the Lake for the present.

D. Conservation Programs and Techniques for Preserving Harvested Fish are Lacking

The 1971-1973 drought seriously affected the abundance of several species, especially the "capitaine" (Lates niloticus) which has almost disappeared from the Lake (but not from the rivers). Low oxygen levels were the probable cause. Other species were not so seriously affected, such as the "carpe" (Tilapia galilea) which remains abundant. Heavily depleted at the time of the drought, but rapidly recovering,

1/ This situation may have changed. On June, 1976, the structure of several ministries was rearranged and ministers transferred or fired by the Government. Rumor has it that fisheries will be placed within a new Ministry of Natural Resources.

2/ During the week of June 1 to 7, 4 Nigerian soldiers were killed by Chadian fishermen on Lake Chad. The fishermen were angered after the soldiers had been using force to search their island villages for weapons.

are the "salanga" (Alestes baremoze) and "sardine" (Alestes nurse). The fisheries service, able to draw only upon part-time extension agents, lacks the funds, resources and talent to institute or enforce conservation methods to ameliorate these problems.

Lack of proper preservation techniques leads to heavy losses of fish between the fishermen and the market, principally due to insect damage. Poor drying in the sun, the lack of salt (which is very expensive in Chad) for enhanced preservation, the lack of packaging material impervious to moisture and frequently very long transportation time to market contribute to a poor quality product.

E. Lack of Sufficient and Up-to-date Catch and Effort Data, Socio-Economic Statistics on Fishermen and Marketing Structure and Costs Information

ORSTOM, the French research organization, has accomplished much basic research on the Chadian fishery and the hydro-geologic nature of the Lake Chad Basin. Although very useful and fairly complete for scientific purposes, this work lacks both the depth and intensity of coverage necessary for solving the practical problems of the Chadian fishery. Had the fisheries service sufficient and trained personnel to gather and provide the required data to ORSTOM, there is little doubt that the organization could and would respond with immediately useful and important recommendations based on the data vital to the development of the fisheries and the implementation of marketing strategy. ^{1/} Other organizations, e.g., UNDP, CARE and the Lake Chad Basin Commission, could also expeditiously respond as the data was transmitted to them for response.

F. Lack of Fishermen's Organizations

The first major effort in forming fishing cooperatives with provision for revolving credit was made by CTFT ^{2/} in the middle 1960's. The movement met with some limited degree of success at first, but eventually collapsed in 1971 when the project ended with the departure of the French nationals. The reasons are several :

1. The drought led to reduced catch levels, forcing the fishermen to range far from their homes in search of fish.
2. The fishermen are individualists who resist attempts at organization.

^{1/} ORSTOM personnel have indicated their willingness to help with these needs.

^{2/} French National Center of Tropical Forestry.

3. Much of the fish was illegally exported because of higher prices in Nigeria and the Cameroons and the ease with which Chadian customs agents are avoided.
4. Transport to market was frequently impossible due to flooded roads, causing loss of income to the fishermen.
5. The credit system was badly administered and loans were not dispensed on an equitable basis.
6. Opposition of Hausa businessmen to the cooperatives.

G. The Major Problem

It must be pointed out that the main problem of the Chadian fishery is not quantity (abundance of fish) but quality (conservation/preservation/marketing). The Chadian fisherman is not suffering from loss of income due to insufficient catch. Fisherman's income ranges from 25,000 to 40,000 FCFA per annum (\$106 to \$170), 1/ well above the per capita income in Chad (\$80).

Therefore it is imperative that the problems related to quality be tackled first and solved before attempting projects related to quantity, e.g., improving boats and fishing techniques for increasing catch. In several markets visited, 2/ abundant quantities of dried and fresh fish were observed. The exception was in Massakory, in the North, far from the Lake. As the team was not allowed to visit areas in the far southern, eastern and northern areas of the country 3/ no definite statements can be made about quantity of fish available in these locations. It can, however, be surmised that fish are not abundant there because of the problem of transportation.

An official in the Chad Ministry of Planning 4/ stated that there is a large demand for fish in the interior of Chad and that the market for fish throughout the country is definitely unsaturated.

1/ Personal communication of Mr. R. Dine, Technical Advisor to the Ministry of Planning.

2/ Markets were surveyed for fish in Kim, Bongor, Lai, Gounou-Gaya, Djimtilo and N'Djamena.

3/ Due to security problems.

4/ Mr. Dine's personal communication. There is no hard data available to back up these statements, however.

H. Another Major Problem

Chad is a country which is, at present, in deep, although subtle, political turmoil. This factor leads to (a) difficulties in erecting long-term solutions to complex developmental problems, one of which is the fishery and (b) the lack of internal government funds for development programs since a major portion of GNP is spent on defense. Any AID programs recommended for Chad therefore must have built in flexibility/cut-off mechanisms as well as provision for full support of programs from external funding sources for lengthy periods into the future.

III. THE FISHERY

A. Present Status of Chadian Fishery Production

Estimates of the harvest of all species of fish taken by Chadian fishermen range from 50,000 to 110,000 metric tons annually. About 30,000 tons of this amount enter the commercial market. 16% (4,800 tons) is purportedly exported to Nigeria and the Cameroons. 1/ Statistics reveal that the value of exports of fish from Chad has been declining in recent years, most notably due to the drought, but has been increasing in 1975-1976. 2/ Present major production centers around the southern portion of Lake Chad and from the confluence of the Chari and Logone rivers North to the capital city of N'Djamena.

Fisheries production zones and market destinations are :

1. Chari Delta, Lake Chad - Essentially all production is exported to Nigeria.
2. Mid-course of the Chari and Logone rivers and the lower basin of the Pende - Fish marketed in Sahr, N'Djamena, Nigeria. Also for local consumption.

1/ Statistics supplied by M. Lassou-Kaurdina, Chief of the National Fisheries Service. A plethora of differing estimates of fish production in Chad were received. The conclusion that must be reached is that there are no accurate data available.

2/ Stauch, A. and Oji-Alala, O.K., "Evolution of the Fisheries in the Lake Chad Basin During the Past Five Years", UN/FAO Report FI/FPSZ/74/5, November, 1974.

3. Bahr Salamat, Bahr Azoum, Lake Iro - Mostly for local consumption.
4. Toubouri Ponds, Lake Treney, Lake Lere, the Benoue tributaries - Mostly for local consumption. Some exported to the Cameroons.
5. Lake Fitri - Dried up in 1973. No production since that time.

Fishing seasons and techniques are :

1. Subsidence campaign (November to February). Smaller fish are caught and sold in the dried state. Wicker traps and hand nets are used. Fishermen sometimes dam the rivers to entrap fish.
2. Low water campaign (March to July). Larger fish and salanga are caught. Fixed and drifting gill nets and lines with multiple hooks are used.
3. Flood campaign (July to August). Larger fish are caught. Drifting gill nets and multiple hook lines are used.

No current information is available concerning the fisheries harvest in Chad on a species-by-species basis, but inspection in the markets reveals that "carpe" (Tilapia galilea), "salanga" (Alestes baremoze), "sardine" (Alestes nurse) and "capitaine" (Lates niloticus) are the principal species harvested both because of their abundance and/or for high demand. 1/

There are little current statistical data available on where the fish are harvested either in the lakes or the rivers, catch per unit effort, recruitment, or species abundance. It has, however, been estimated that the 1969-1973 drought reduced the catch by two-thirds. 2/ This was mitigated by the fact that catch per unit of effort increased as the lake and rivers shrank in size, creating pockets where the fish became concentrated. Also, the monetary volume remained the same as prices rose in reaction to reduced supply and an increasing demand for fish by the burgeoning populations in the nations in and around the Basin.

B. Prices and Marketing of Fish

Most of the fish sold commercially is split in half, gutted and dried in the sun on wires or on racks made from palm leaves. A somewhat smaller percentage of the fish is smoked in lieu of sun drying and is either split in half or chopped into 2" x 2" morsels; the latter form (called "banda") is preferred by Nigerians and brings the highest prices there.

1/ See picture 2 and 3, Appendix C.

2/ Stauch, op. cit., p. 6.

The "banda" is sold in large sacks (called "mats"), made from palm fronds. Each sack weighs approximately 40 kg and is sold for 3,200 to 3,600 FCFA (\$13.62 to \$ 15.32). 1/ The "salanga" (large sardines) are also marketed in the same type of "mats" which are larger in size, weighing 70 kg and containing about 1,000 dried or smoked fish. They sell for between 4,000 and 7,000 FCFA (\$17.02 to \$29.78) depending upon costs of transportation and season of the year. Prices of the "capitaine" and the "carpe" vary widely in the markets, from 150 to 3,000 FCFA (\$0.64 to \$ 1.28) per kg for the former to 75 to 150 FCFA (\$0.32 to \$ 0.64) per kg for the latter. 2/

A severe problem in the marketing of the sun-dried fish occurs. A combination of high humidity, too high levels of moisture in the fish due to improper drying and consumption by flies and maggots leads to a 40% to 70% loss of flesh between the fishermen and the market. This problem was repeatedly presented as the most critical restriction on the development of the fishing sector by all authorities interviewed vis-a-vis maintaining the potential movement of a high protein food into the interior of Chad and returning maximum income to the fishermen and middlemen. 3/

It has been suggested that solar drying be substituted for open air drying of fish. Solar drying, according to the Chief of the Chadian Fisheries Service, can cut the drying time by 75% (from 48 to 12 hours). 4/ Solar drying ovens have, however, been proven to be prohibitively expensive in Chad.

Salt, as a preservative, enhances not only the quality of dried fish but also its resistance to insect damage. Salt, at 125 FCFA (\$0.53) per kg, however, is prohibitively expensive. In this connection, the possibility of using a derivative from natron (taken from lime/salt deposits in northern Chad) needs to be investigated. 5/

The single greatest factor impeding proper marketing of fish beyond the immediate area of the catch is the lack of all-weather roads. For four months of the year (from July to October) many roads in Chad, South of Bongor, are impassable; for two months, both preceding and following that period, some roads may be completely closed to traffic due to frequent rain. Also, many of the towns and villages become, virtually, islands where the only available transportation is

1/ US\$ 1 = 235 FCFA.

2/ See picture 4, Appendix C.

3/ See picture 5, Appendix C.

4/ M. Lassou-Daurdina, Chief, "Service Nationale de Pêches".

5/ See picture 6, Appendix C.

by "pirogues" (small, hollowed-out canoes). Clearly, the development of any - regional or national - marketing system will depend upon the construction of all-season roads.

Telephone communications are limited to the capital of N'Djamena and one or two other large cities. There are telegraphic links between the Préfectures and Sous-préfectures, but communication via this means is limited to official government business and emergencies and even for these purposes is unreliable.

Efficient regional or national marketing requires immediate and expeditious communication links with potential markets and, until such is obtained, little can be done to develop a regional or national fish marketing system, even on a minor scale.

Several marketing cooperatives in Sahr, Kim, Logone-Ghana and N'Djamena were initiated in 1966 under the auspices of the French development organization CTFT. Although several hundred fishermen did join this cooperative movement, the twin factors of the drought, which commenced in 1968, and poor administration caused their collapse in the early 1970's.

Although there is some movement toward the re-establishment of cooperatives (especially in Sahr, Moundou and N'Djamena), the infrastructural problems of lack of proper roads and communication will very likely hinder their further development. Many fishermen interviewed cited their greatest need as credit, not cooperation, in order to preclude the necessity to deal with the local money-lenders who tend to keep them in perpetual poverty. Another factor inhibiting the development of cooperatives is the itinerant nature of the fisherman. He frequently moves from place to place on river or lake, following the fish and landing them where he can. Being therefore away from his home for perhaps months at a time, precludes his active participation in a cooperative.

Exports of fish harvested in Chad waters to other countries in the Lake Chad Basin occur both legally and illegally. There are no data available on the extent of illegal exports, although one authority has estimated that over four-fifths of the fish harvested in Lake Chad is destined for Nigerian markets, 1/ and is handled by Nigerian middlemen. 2/

1/ Stauch, op. cit., p. 6. (This figure may be overstated).

2/ During a trip to the Bol area by the team, it was found that a "mat" of "banda", priced two years ago at 2,500 FCFA (\$10.63), is now being sold to the Nigerian middlemen for 15,000 FCFA (\$63.80) - a price increase reflective of decreased abundance due to current strife between Nigerian and Chadian fishermen which has reduced fishing effort, the still-existing effects of the drought and increasing demand in Nigerian markets.

TABLE 1

Chadian Fish Exports

(in millions of FCFA)

<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
95	108	84	28	32

Source : "Development Potential and Constraints in The Republic of Chad", World Bank, 1974.

Commercial marketing destinations vary with the species and location of harvest. The highly desirable "salanga" (sardine) generally moves towards markets in southern Chad. Fish taken in the Sahr region for export purposes move into the Central African Republic, while in the Lere region in southwestern Chad they are marketed in the Cameroons. Reportedly, little fish moves to markets in the Sudan or Libya.

C. Fishing Methods

Chadian fishermen employ handnets, gill nets, fish traps and long-lines with multiple hooks in the rivers (see Appendix for translation of an ORSTOM report on Chadian fishing methods). Observations reveal that all four methods are highly efficient means of obtaining large quantities of fish. Seine nets are the primary fishing tool in Lake Chad. ^{1/}

"Pirogues" are used on both the lake and the rivers. They average about 16' to 21' in length, with about 2½' beam. Certain villages, such as Ba-Illi, 50 kilometers Northeast of Bongor, specialize in the construction of "pirogues" due to the nearby availability of large trees. Generally, "pirogues" are less expensive South of N'Djamena, 15,000 to 30,000 FCFA (\$64 to \$128) and more expensive North of N'Djamena, 70,000 to 90,000 FCFA (\$298 to \$383). Relative to the income of the fishermen, his "pirogue" is the largest item of capital expense he incurs. The dwindling number of trees of sufficient size in Chad for the

^{1/} See picture 7, Appendix C.

construction of "pirogues" will very likely inhibit the long-run development of the fishery as well as contribute to the ecological degradation of the terrain, as more and more trees are removed.

Due to the lack of trees in the North, many fishermen on Lake Chad construct and use reed boats, which reportedly last for 2 to 3 months. Some new methods of boat construction have been tried (most recently fiberglass) by the National Fisheries Service, but have resulted in failure due to the exorbitant cost of material.

Nets are very expensive due to the high cost of nylon filament which must be imported from Nigeria at a cost of 15,000 FCFA (\$64) per 100 meter roll. The fishermen have become adept at net construction and repair. Local fibrous roots are used as floats. Lead serves as sinkers for gillnets. Very few hand-nets observed utilized local materials for construction, as nylon provides superior handling and durability. Long lines with hundreds of hooks are also used extensively throughout the country.

Only men participate directly in the fishing process. The drying/smoking and packaging of the catch for transport are left to the women.

The future development of the fisheries harvest to maximum sustainable yield will undoubtedly require the provision of assistance to the fishermen to obtain fishing boats and nets more inexpensively and in greater abundance. For the present time, however, efforts in this direction should proceed slowly and cautiously until fisheries conservation measures are introduced and enforced to allow those species which are depleted to recover.

D. Fisheries Potential

Although the recent drought drastically reduced the volume of catch in the Lake Chad Basin by approximately two-thirds, there is recent evidence that the fishery is recovering. 1/ (See translation of ORSTOM report in Appendix on the effects of the 1971-1973 drought on Chadian fisheries stocks). One expert predicts that the sustained fisheries harvest from the Lake Chad Basin could approach 200,000 metric tons annually. 2/

Chadian fisheries exports have been increasing slowly but steadily since 1973, the peak year of the drought.

1/ Personal communication, Mr. B. Panache, ORSTOM, N'Djamena.

2/ Stauch, op. cit., p. 6.

The lake and the rivers evidently experience frequent turn-over cycles due to rapid heating by the sun, which brings rich organic matter from the bottom to the surface. The hydro-bio-geologic nature of the Lake Chad Basin is under continuing study by the Lake Chad Basin Commission, the Club des Amis du Sahel, SODELAC and ORSTOM in cooperation with international funding agencies. This research will continue to contribute to knowledge about the ecology of the basin in general and to the role this unique environment plays in relation to the fishery in particular. Much more intensive applied research remains to be done, however, to develop full-knowledge about the fisheries potential in Lake Chad and the Rivers. Obtaining landing statistics on a species-by-species basis, developing catch/unit effort data, and conducting experimental fishing voyages are vital activities which must be conducted to achieve knowledge of and to preserve and enhance the Chadian fishery in the future.

IV. CONCLUSIONS

A. Need for Increasing Geographical Distribution of Fish

Increasing the geographical range distribution of fish within Chad should be the major objective of any fisheries development plan. This is hindered by the lack of all-weather roads, the absence of communication systems, the resistance of fishermen to efforts at organization and the very poor fish preservation methods currently in use.

B. Need for Fisheries Conservation

Fisheries conservation methods need to be instituted to protect depleted species, especially in Lake Chad. This is almost impossible to implement because of the lack of trained field agents to collect the data required to decide what must be done. The lack of trained high-level personnel in the Chad National Fisheries Service required to interpret the data is also a serious problem.

C. Harvest Levels and Fishermen's Incomes

Fishermen in Chad have higher than average incomes and catch sufficient fish at present to saturate narrowly-defined markets. Any efforts to increase harvesting efficiency (e.g., improved boats and nets) should be done cautiously and prudently, in order to allow depleted species to recover.

D. Illegal Exportation of Fish a Serious Problem

The problem of illegal exportation of fish caught in Chadian waters results in loss of income to the Chad Government and a loss of a vital protein source to the Chadian people. This can only be overcome by the creation of an expanded and effective fish distribution/marketing system which may tend to raise price levels as demand for fish rises.

V. RECOMMENDATIONS

A. Introduction

It is recommended that AID undertake a program to assist the Government of Chad to develop a functional and efficient National Fisheries Service and an organized fish distribution system. The program consists of five components, as follows :

1. Education and training.
2. Expatriate intervention.
3. Development of a national fisheries service.
4. Organization of fishermen through cooperatives.
5. Development of a new fishing canoe construction method.

Each component will be addressed separately below. The project time line (Table 3) indicates the recommended phasing in and out of the components. The objectives of this project cannot be met within a 5-year period, therefore the time-line covers 10 years. The budget attached is, however, for the 5-year period 1978-1983.

It must be emphasized that the appropriate development of the components will require frequent and detailed evaluation/re-evaluation. The organization of fishermen through cooperatives (and construction of fish storage facilities), for instance, will require the construction of all-weather roads and the installation of a communications system. Should these infrastructural requirements not be met, this component will fail in its implementation entirely, and all the other components will likewise not reach stated objectives.

B. Education and Training

1. The Problem

Important as the fisheries sector is, as a large source of protein, the Government of Chad has neglected its development.

The chief impediment to the proper development of the fisheries is the lack of infrastructure - all-weather roads and communications. Secondly, but also of great concern, is the lack of a recognized, organized and effective national fisheries service. This component and the others which follow are concerned directly or indirectly with the long-term gradual development of such a fisheries service and, thereafter, the implementation of a fish distribution system for Chad. The Government of Chad lacks the funds necessary for these purposes.

To underscore and highlight the problem, it must be pointed out that all field agents ("moniteurs") formerly involved in fisheries extension activities during the mid to late 1960's have now been assigned to forestry duties. The Chief of the Fisheries Service will have, by September 1976, 40 "moniteurs" on whom he can call for specific fisheries tasks, but their primary duties will remain in forestry.

First in importance is the need for training and retraining present personnel in the National Fisheries Service at all levels. There are at present four high level staff - the Chief of the Fisheries Service, his Deputy, a Secretary and an Administrative Aide. The Chief has had only three years of training in fisheries in the Ivory Coast and Mali; his Deputy, two years in Mali. The Secretary and his Aide have had only on-the-job training. Just four of the field agents have had formal training in fisheries (by CTFT in the mid-1960's).

2. Purpose of Project

The purpose of this project is to train seven high-level personnel to the baccalaureate degree level in fisheries management, 11 mid-level personnel in practical fisheries management and 65 low-level personnel as field agents ("moniteurs") during the five year period 1978-1982. Provision for beginning training of one Chadian at the high level in 1977 has been included in the Program Plan (PP) for Chad Agriculture and Manpower Training currently being developed. This step has been taken because it is considered essential to the development of the entire fisheries program to begin training now so that trained Chadians will be able to return to service as soon as possible.

3. Implementation

The personnel to receive training should be phased as follows :

TABLE 2

<u>Level</u>	<u>1978-79</u>	<u>1979-80</u>	<u>1980-81</u>	<u>1981-82</u>	<u>1982-83</u>	<u>Location of Training</u>
High-level	2	1	1	1		Canada/Belgium
Medium-level	2	3	3	3	1	Ivory Coast or Mali or Cameroon or Nigeria
Low-level	10	15	15	15	10	in Chad (ORSTOM) and on-the-job

It is proposed that high level training be conducted in either Canada or Belgium in francophone institutions. Medium level training could be accomplished at schools in the Ivory Coast, Mali, the Cameroons or Nigeria, whichever location is deemed to be superior, taking into account the Chadian fisheries environment. ORSTOM in N'Djamena has the facilities and personnel to conduct short courses for the field agents. Agents would also receive on-the-job training under the supervision of Peace Corps Volunteers who will temporarily intervene as mid-level field personnel until their Chadian counterparts have finished schooling (see component entitled "Expatriate Intervention") and have returned to Chad.

4. Further Requirements/Constraints

- a. Infrastructural development (roads and communications) will develop apace of the growing technical capacity of the Fisheries Service to provide extension services to fishermen throughout the country. 1/
- b. The Chadian Government desires to elevate the stature, structure and responsibilities of the present embryonic National Fisheries Service.

1/ This point cannot be overemphasized.

- c. The Chadian Government will make available sufficient funds to provide salaries for personnel returning from training, or salaries can be provided by AID or other international organizations. 1/
- d. The appropriate Ministry overseeing the Fisheries Service will direct that the field agents selected for training be released from their present responsibilities in forestry-related activities.

5. Possible Complementary Activities

CTFT trained over 40 Chadians in fisheries from 1957 to 1973 in conjunction with the development of fisheries cooperatives. CTFT has since ceased all activities and the field agents have either been released from government service or redirected into forestry. A list of these people is available. It may be possible to contact them and bring them back into the service.

This project may complement, or be complemented, by a project reported on in the DAP for strengthening of the National Fisheries Service. This is a four year project proposed to FAC - 115 million FCFA (\$500,000), GOC, 41 million FCFA. The present status of the proposal should be verified and, if appropriate, coordinated with this effort and other projects proposed in this and other components on fishing development located elsewhere.

6. Anticipated Results

Trained fisheries personnel will be qualified to carry out the applied research, data gathering and extension activities required to develop the full potential of the Chadian fishery, and to implement an organized and functional fish marketing system in the country. This work will eventually serve to provide increased levels of high quality protein throughout Chad, and contribute to the development of the economy. The design and enforcement of fishery conservation measures, which will result from the work of these trained Chadians, will have beneficial effects on the hydro-bio-geological ecosystem of the entire Lake Chad basin, as well as promoting beneficial effects on the economies of the countries sharing its water resources.

As a first step in the development of a Fisheries Service responsive to the need to develop a very important section of the Chadian economy, this project should

1/ In the component entitled "Development of a National Fisheries Service" it is proposed that AID provide partial salary support for low-level fisheries personnel throughout the 5-year budget period 1978-1983.

have significant long term effects on the major problems facing the fisheries in Chad by training personnel who will assist in (a) organization of fishermen, (b) fish preservation and conservation within the context of an improved marketing system, (c) the elevation of fishermen's income, thereby increasing the revenues to the Government, and (d) most importantly, increasing the volume and availability of an excellent source of protein to a wider segment of the Chadian population.

C. Expatriate Assistance

1. The Problem

As high and medium level Chadian personnel leave their in-country posts for training abroad, large gaps will appear in the fisheries service roster. This will hinder the timely and expeditious development of the Chadian fishery and thus delay the provision of a much needed source of essential protein to the Chadian people.

2. Purpose of Project

To overcome this problem, it is proposed that an experienced practical fisheries management specialist be added as an advisor to the fisheries section of the Ministry of Agriculture in 1978-1979. This person's overall short run duties will be to survey the fisheries problems identified in the DAP and this present effort, and to further clarify them. He will contact and work with all pertinent Chadian and expatriate personnel engaged either directly or indirectly with fisheries in the Chadian Government ministries, the Lake Chad Basin Commission, SODELAC, ORSTOM, UNDP and other international agencies. He will be assigned specifically to the Chadian National Fisheries Service. The Chadian Ministry, in which the fisheries service is located, should officially recognize him as an advisor/counterpart to the Chief of the Fisheries Service or his temporary replacement as he is undergoing training abroad. The AID fisheries specialist should travel extensively throughout the country to thoroughly acquaint himself with the perceived needs and problems of the fishermen related to fishery production and marketing. By the end of his first year of service, he should produce a detailed and long run plan for solution of the problems he has identified.

It is also proposed that Peace Corps Volunteers Fisheries Agents be assigned to the Chad National Fisheries Service beginning in 1979.

The AID fisheries expert will serve as technical backstop and informal supervisor for the volunteers. The volunteers' duties will include gathering data on fish production and marketing, investigating improved methods of fish preservation and conservation, development of methods for organizing the fishermen and assisting the fishermen in small boat construction and net making, among other duties.

Each volunteer will be assigned a counterpart who should have had attained a minimum level (at least two years) training in fisheries, either in formal courses or on-the-job. Preferably median level Chadian fishery extension agents would be available to serve as counterparts.

3. Implementation

A pragmatically oriented French speaking individual with experience in inland fisheries development will be assigned to the Ministry of Agriculture in N'Djamena as early as possible in 1978. Such a person could possibly be recruited from a cadre of ex-Peace Corps Fisheries Volunteers who have gained significant experience in fisheries development in the Ivory Coast, Cameroon or Zaire (countries where very successful Peace Corps Fisheries programs have been or are now operating). The Associate Director of Peace Corps/N'Djamena reports that several such ex-volunteers may be currently available, or soon will be available, for employment.

The Fisheries Expert will travel extensively throughout Chad to gather critically needed data on fisheries problems vis-a-vis production, conservation/preservation and marketing. He will establish working relationships with the appropriate Chadian Ministry(ies) concerned with fisheries, with the Lake Chad Basin Commission, with UNDP, with ORSTOM, with CARE and with other international organizations/potential donor-participants interested in Chadian Fisheries Development. He will develop an organized plan for fisheries development in Chad, based upon this initial plan, the DAP and other inputs as appropriate. His other responsibilities will include close liaison with the Peace Corps Director in Chad regarding the placement and description of the duties of the Peace Corps Volunteers scheduled to arrive in country in 1979, as well as serving as technical advisor to these volunteers during their terms of service.

It is recommended that the phasing in/out of the Peace Corps Volunteers be as follows :

1979 - 5 volunteers will be placed in locations within the Mayo-Kebbe, Tandjili, Logone Occidental Prefectures, and at Bol. More specific assignment areas will be identified as the planning for this project continues through the development of the PRP and PP.

1980 - 2 additional volunteers arrive, to be placed in locations as appropriate to the development of the program, or to serve as replacements for those volunteers who have resigned from service.

1981 - 8 additional volunteers will be assigned to locations as appropriate.

1983 - Proposed date for phase-out of Peace Corps, unless further volunteer effort is deemed desirable.

4. Selection and Training of the Volunteers

Volunteer candidates need not be experts in fisheries, rather they should be selected on their past practical experience in mechanics, wood-working, fishing or other similar skills. Each should have attained the bachelor's degree level or equivalent. It is essential that they have high levels of motivation, a desire to work with "grass-roots" people, and be sufficiently flexible and organized to accomplish work in a complex and constantly evolving developmental situation which may require swift changes in direction from time to time.

Vital to the success of the program is proper training of the volunteers. They should receive training in specific aspects of inland fisheries development in a concentrated and intensive program at a US University. Auburn University or the University of Rhode Island are recommended because of (1) the experience of their personnel in LDC inland fisheries development and (2) the sound working relationship these Universities have developed with AID.

The US based training program should be no longer than 6 to 8 weeks, and must include components specific to the needs of the Chadian fisheries development program. To insure the latter, the AID in-country fisheries expert should be sent to the training site beforehand to develop the training syllabus. He should also serve as co-coordinator of the program with the University appointed staff member nominated for this purpose.

5. Duties of the Volunteers

The following constitute the primary and secondary recommended responsibilities and duties of the volunteers and their counterparts :

a. Primary

- i) Become intimately familiar with the technical capacity and socio-economic structure of the fishermen and their families and through frequent reports provide this information to the AID fisheries expert in N'Djamena.
- ii) Survey and report on, in as much detail as possible, the procedures and costs of fishing methods, drying/smoking/salting preservation techniques, catch per unit of effort, volume of production by species, and other data requirements to be developed in the future.
- iii) Develop and experiment with innovative boat building and net construction techniques, utilizing locally available materials as much as possible.

b. Secondary

- i) Assess the potential for the development of fisheries cooperatives/credit unions in their areas of responsibility.
- ii) Introduce where and as appropriate improved fish conservation/preservation techniques, including, possibly, solar drying.
- iii) Other duties as may from time to time be assigned by the AID fisheries expert.

It is envisaged that the work of the volunteers will proceed gradually from primarily information-gathering at first to more visible, concrete projects as infrastructural needs - roads and communications - are met and the program develops.

6. Equipping the Volunteers

AID will supply to each volunteer :

- a. 4-wheel drive Land Rover pickup;
- b. small outboard motor boat for transportation during the rainy season;
- c. wood-working tools, nylon nonfilament line, experimental materials for improving fish preservation techniques, mechanic's tool kit for outboard motor repair, and other equipment as necessary.

7. Further Requirements/Constraints

- a. Sufficiently trained, pragmatically oriented volunteers are available and willing/able to live under harsh up-country situations.
- b. The Chadian Government will formally request the Peace Corps Volunteers through channels as soon as possible.

8. Possible Complementary Activities

The Peace Corps has been working in Chad since 1967. Chadian Government response to the Peace Corps has been excellent. The Peace Corps Director in Chad has been informed of this potential project and has endorsed it in principle.

This project may complement a proposal reported on in the DAP to "create an Office de pêche" for Chad. The proposal has been submitted to the Chado-Libyan Society, according to the DAP, requesting 70 million FCFA (\$330,000).

The purpose of this project is to provide boats and extension services in improved fish preservation and credit and create storage units at N'Djamena, Djimtilo, Dougia, Mailao and Logone-Ghana. The status of this proposal should be checked with the appropriate Chadian officials before completion of the PRP and PP.

9. Anticipated Result

The long term goals of upgrading the National Fisheries Service and the organization of fishermen will be enhanced through this suggested pattern of expatriate intervention by filling gaps in the current roster of Chadian personnel positions, which may not as yet be filled or may be temporarily unfilled due to the training abroad of Chadian personnel.

In order to maintain momentum in the development of a Chadian Fisheries Service, a way must be found to replace mid-level Chadians while they undergo training in fisheries abroad, or, in the first instance, fill positions which as yet do not exist. This project, if carefully planned and executed, will significantly decrease the time required to develop a National Fisheries Service and to organize the fishermen through cooperatives to enhance fish preservation techniques and marketing procedures.

D. Development of a National Fisheries Service

1. The Problem

The present understaffed, embryonic Chad National Fisheries Service faces several serious obstacles to development :

- lack of trained staff at all levels;
- lack of a development plan for fisheries;
- lack of funds for personnel and project support;
- lack of recognition by the Chadian Government.

2. Purpose of Project

The purpose of this project is to provide the assistance of a fisheries management/administration expert to aid in the design and development of a National Fisheries Service and Fisheries Development Plan; provide salary support for low level extension agents; and in future periods assist with the construction of regional fisheries offices and provision of vehicles and outboard motor boats for field agent transportation. 1/

3. Implementation

In 1976-1979, AID will begin to provide half the salaries of the lower level 'Moniteurs' (grass-roots level extension agents). The Government currently lacks the funds to support full-time fisheries agents.

In 1979-1980, AID will contract with FAO to supply a fisheries management/administration expert to advise the GOC on the design and structure of a National Fisheries Service. This person should be in residence in Chad for at least 6 months and on call thereafter for as long as five years as needed. He will also advise in the development of a long range Fisheries Plan.

After 1983, the construction of small regional fisheries offices will begin at locations to be determined as the program proceeds. CARE will assist in the construction of the offices through the donation of materials and provision of food to the workers in return for their labor. Vehicles and outboard-motor boats required by mid-level extension agents will be supplied by AID beginning in 1984. ORSTOM, in N'Djamena, will serve as the research arm of this project to evaluate data and provide recommendations necessary for furthering an understanding of the fisheries potential of the Lake Chad Basin as well as contributing to fisheries conservation efforts.

4. Further Requirements/Constraints

- a. All-weather roads and communication facilities are developed in parallel with the project.

1/ This activity will take place during the second 5-year budgeting period, after 1982, should other component activities be positively evaluated and the required infrastructural needs (roads and communications) be met.

- b. The Government of Chad pays increasing attention to the need for developing a National Fisheries Service and concurrently provides increasing funding for salaries.
- c. Other potential participants/donors, CARE, UNDP, ICBC, ORSTOM, express willingness to cooperate.

5. Possible Complementary Activities

This project has potential overlap with two proposals submitted by the Government of Chad :

- Strengthening the National Fisheries Service. Proposed to FAC 115 million FCFA, GOC 41 million FCFA.
- Establishment of an "Office de pêches". Submitted to the Chado Libyan Society, 70 million FCFA (\$330,000).

These proposals should be identified as part of the PRP process and combined with this present effort if they are still viable.

6. Anticipated Results

The development of a strong National Fisheries Service is the basis on which an integrated and coordinated fisheries management and marketing effort must be based to ensure the longevity of development in the fishing sector. This shall provide for the national management and enhancement of Chadian Fisheries resources to maximum sustainable yield. Government will directly benefit from the much increased tax revenues.

A cadre of field extension agents in fisheries will be created.

The effects of this project will flow into and build upon the momentum, although admittedly slight, now existing in the present embryonic National Fisheries Service. ORSTOM, FAO and other agencies will benefit from the socio-economic and biological data acquired and transmitted by the field extension agents. Experience gained through the development of this project will very likely be useful to AID in the development of fisheries programs in other countries worldwide.

E. Organization of Fishermen Through Cooperatives

1. The Problem

Distribution of fish throughout Chad during the rainy season (ca. July-December) is limited by impassable roads. 1/ The lack of proper fish preservation methods results in losses of fish flesh of 40% to 70% between the fishermen and final market destination. As mentioned above, cooperative movements have been attempted in several locations in Chad, but have failed.

2. Purpose of Project

The purpose of this project is to provide expert assistance to the Chad Government to assess in full detail the reasons for past failures in the cooperative movement. Based on this experience, an evaluation of the potential for restarting cooperatives will be made. AID will supply a revolving credit fund for fishermen beginning in 1982. In later periods after 1982 (during the next budget cycle) construction of fish storage warehouses and provision of trucks for transport of fish may proceed if appropriate. 2/

3. Implementation

An FAO fisheries marketing expert will be sent to Chad under AID contract in 1979/1980 to begin assessment of potential sites for centering cooperative action. He will take into account the developing road and communication network in the decision process. He will also lead short courses for mid-level fisheries agents in cooperative marketing management techniques. He will assess the previous projects in fishing cooperatives and determine the reasons for their failure.

This effort will continue throughout 1980/1981 as groundwork is being laid for the construction of fish storage warehouses, perhaps at Sahr, Moundou, Logone-Ghana, Djimtilo and Bol, or other locations to be determined as appropriate. This work would not commence until after 1982.

After 1981/1982, the actual construction of the warehouses may take place if appropriate to program development, in a CARE-AID combined effort. Trucks will be provided to transport fish.

1/ Again, an always recurrent problem.

2/ Dependent again, of course, on the state of development of all-weather roads and communication facilities.

4. Further Requirements/Constraints

- a. Road construction and installation of communication facilities must proceed - essential factors for even a limited marketing effort.
- b. Chadian Government takes action to reduce taxes on fish to discourage illegal export of fish.
- c. FAO and CARE cooperation is assured.

5. Possible Complementary Activities

The Development Assistance Plan (DAP) mentions a proposal by the Government of Chad to re-establish conservation and marketing cooperatives. The potential donor is not named. Funds required are cited as donor - 76 million FCFA (\$300,000) and GOC 15 million FCFA.

The CTFT experience in cooperatives from 1966 to 1971 should be investigated in detail. Much could be learned, i.e. reasons for success or failure, which would be of a direct benefit to this project.

6. Anticipated Results

This project will be of direct benefit not only to the fishermen but also to the Chadian people by creating a network to move better quality fish in larger and more consistent quantities over a wider area in the country.

The fishermen will benefit from stable prices and consistent markets for their catches. Illegal exportation of fish may be lessened.

Chadian tax revenues will increase. A portion of these funds could be transferred back into further development of this project and other fisheries-related activities. This project will encourage the transfer of vital fish protein from areas where it is abundant (near the lake and rivers) to where it is scarce and most needed (the interior of Chad). Sound marketing technologies and cooperative development techniques derived through the project could likely be transferred to other areas in the food production sector of Chad. Other Sahel countries may be able to adopt the methods and techniques developed.

F. Development of a New Canoe Construction Method 1/

1. The Problem

Fishermen in southern Chad utilize traditional, hollowed-out canoes, called "pirogues" for fishing purposes. They are well adapted and durable - they last up to ten years - but their cost to the fisherman is prohibitive and is increasing with time, due to the scarcity of large trees required for construction. Costs in southern Chad vary between 15,000 to 30,000 FCFA depending upon length and transportation costs from the construction site.

The cutting of what few large trees that remain also exacerbates problems which ongoing and planned projects in reforestation are attempting to solve.

Obtaining and constructing suitable fishing canoes in the Bol area of Lake Chad is made much more difficult by the total absence of trees. Reports are that log pirogues cost in excess of 100,000 FCFA in this area (for the average fisherman this equals over three to four years' income). For this reason many fishermen construct boats from papyrus. These boats last no longer than two to three months. They become rapidly waterlogged and are therefore unable to carry any more than a limited weight of catch.

2. Purpose of Project

It is proposed that AID fund a project to determine whether a unique method of construction utilizing sprayed-on plastic over a matting/fiber framework, developed by AID/CARE in Bangladesh, could be successfully adapted for boat construction in Chad.

According to reports from CARE/Bangladesh and in a cabled reply to an inquiry made on June 25, 1976 from CARE/Chad, the method is definitely feasible for boats. CARE/Bangladesh personnel report that they are ready to proceed to construct a prototype of a Chadian reed canoe using this technique upon receipt of specifications and photos. Actual cost of production data could be obtained for the prototype, and if figures could be obtained for actual demand for the boats in Chad, long-run production costs/unit could be projected.

1/ This project has been submitted to the CDO/N'Djamena as an A-PID.

3. Implementation

This project would begin in early Fall, 1976, with the construction of the prototype boat in Bangladesh, which is estimated to take three months. The construction and cost data would then be evaluated. If a positive evaluation takes place, the CARE/Bangladesh technician would be sent to Chad by February 1977 for a 6 to 8 week period. He would train a local Chad CARE representative in the process who will in turn train local Chadians. Funds for equipment and supplies would continue to be supplied by AID until September 1979, when, hopefully, the project will have become self-perpetuating.

4. Further Requirements/Constraints

Major assumptions pertinent to project success are the following :

- a. This new method of construction has proven to be feasible in Bangladesh for low-cost housing and school construction, and will be applicable to the construction of small canoe-like boats.
- b. There is sufficient demand for such boats in Chad to enable them to be cost competitive.
- c. The boats are similar in handling characteristics to the local log canoes and reed boats and will be adopted by the fishermen.
- d. CARE will be able to supply housing, maintenance and salary support for the CARE/Bangladesh technician for a 6 to 8 week period.
- e. The boats, if successful, are not released for sale until fishery conservation measures are introduced. The fishery must have recovered sufficiently before increased fishing effort is encouraged.

5. Possible Complementary Activities

The "Direction des eaux, forêts et chasses" in Chad has experimented with the construction of fiberglass boats and has found the method to be exorbitantly expensive. The major portion of the project has been shelved; they are still experimenting with the construction of larger fiberglass boats for the transporting of fish to market and for use by Fisheries Service personnel in their work. These efforts should be surveyed and evaluated by AID before the final decision is made to proceed with this project.

6. Anticipated Results

Some methods must be found to construct boats of other types of material than wood. The cutting of large trees in Chad certainly contributes to the degradation of the environment. Reed boats used in the Lake Chad area, especially around Bol, are inefficient. This situation is not in keeping with the purposes of this program to develop an efficient fishing technology and fish marketing strategy for Chad. If this project is not attempted these factors will continue to remain as long term inhibiting characteristics for the development of the fishery.

It is envisioned that if the process proved to be feasible, a small cottage industry could be developed in Chad to produce boats for local fishermen, especially on the Lake. Eventually, the boats could be supplied throughout the country. ^{1/} Deforestation, which now occurs widely due to the cutting of large trees for boats, would very likely be diminished.

^{1/} There is some indication that several species of fish have become seriously depleted since the 1971-1973 drought. Therefore the rapid dissemination of low-cost boats might worsen this situation and cause long-run damage to the fishery by increasing fishing effort. This possible cause/effect relationship must be carefully evaluated before a large number of these boats are allowed to come onto the market, if they prove to be successful.

TABLE 3

Overall Project TimelineDevelopment of a National Fisheries Service and fisheries marketing system for Chad (10 year period 1977-1986)

<u>PROJECT COMPONENTS</u>	<u>1976-1977</u>	<u>1977-1978</u>	<u>1978-1979</u>	<u>1979-1980</u>	<u>1980-1981</u>	<u>1981-1982</u>	<u>1982-1983</u>	<u>1983-1984</u>	<u>1984-1985</u>	<u>1985-1986</u>
<u>Road and Communication Infrastructure Develop.</u>	ESSENTIAL FOR PROGRAM SUCCESS									
<u>Training and Education</u>										
High level		2 persons	1 persons	1 person	1 person					
Median level		2 persons	3 persons	3 persons	3 persons	1 person	1 person	1 person	1 person	1 person
Low level		10 persons	15 persons	15 persons	15 persons	10 persons	10 persons	10 persons	10 persons	10 persons
<u>Expatriate Intervention</u>		Practical AID fisheries mgmt. specialist to National Service, N'Djamena	5 Peace C. Vol. (PCV) assigned to fisheries service	2 PCVs assigned to fisheries service	8 PCVs assigned to fisheries service		Phase-out of PCVs 1/	Phase-out of AID specialist		
<u>Development of a National Fisheries Service</u>		Funds provided for ½ year support of salaries of "moniteurs" (low level agents)	FAO fisheries mgmt. expert assigned to N'Djamena to advise in develop. of fisheries service	ORSTOM + LCBC provide research back-up to FAO expert		Construction of regional fisheries offices begins. CARE cooperating 2/	Construction of additional offices continues subject to infrastructure develop.	Vehicles, boats and outboard motors provided to National Fisheries Service		
<u>Organization of Fishermen Through Cooperatives - Development of a Fisheries Marketing System</u>				FAO fisheries marketing expert assigned to N'Djamena to begin cooperative development. Training of mid-level agents in cooperative mgmt. begins 3/	Cooperative mgmt. training for mid-level extension agents continues - organization of fishermen begins	Construction of warehouse storage facilities for preserved fish begins. CARE cooperating 2/	Provision of vehicles for transport of fish to the market. Warehouse construction continues subject to infrastructural development			

1/ Unless further volunteer intervention is deemed advisable at the time. 2/ These construction activities should take place only if roads and communication facilities are available.

3/ To be delayed if road construction projects are not proceeding.

TABLE 3 (Cont'd)

Submitted as an APID to the CDO/N'Djamena

PROJECT COMPONENTS	<u>1976-1977</u>	<u>1977-1978</u>	<u>1978-1979</u>
<u>Development of a New Fishing Canoe Construction Method</u>	Prototype canoe constructed in Bangladesh. If positively evaluated, CARE/Bangladesh technician will be sent to Chad for 6 to 8 weeks to train local CARE counterpart	Canoe construction continues. Chadian personnel are trained if fishery conservation measures enforced.	AID phases out of project. Construction continues by Chadians <u>4/</u>

4/ Dependent on the state of the fisheries at the time.

TABLE 4

Preliminary Estimate Project Costs *

	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
<u>Technical Assistance 1/</u>						
FAO Fisheries Management/						
Administrative Expert			70	70	70	70
FAO Fisheries Marketing Expert				50	5	5
AID Practical Fisheries Mgmt. Specialist		70	70	70	70	70
CARE Technician	6 8/	—	—	—	—	—
Sub Total		70	140	190	145	145
<u>Participant Training</u>						
High Level 2/		40	40	20	20	
Medium Level 3/		20	20	30	30	10
Low Level 4/		12	12	18	18	12
Sub Total		72	72	68	68	72
<u>Commodities</u>						
Four-wheel Drive Vehicles 5/		20	100	60	160	
Equipment and Supplies for Canoe						
Construction	75	50				
Equipment for Peace Corps Volunteers		—	25	35	50	50
Sub Total		70	125	95	210	50
<u>Other</u>						
Revolving Credit Fund for Fishermen						
½ Salary Assistance for "Moniteurs"						
(field agents) 6/		20	36	51	66	76
Sub Total	75	20	36	51	66	76
Grand Sub Total	75	232	373	404	489	343
Inflation Factor 7/	—	—	37	85	161	158
Total	75 9/	232	410	489	650	501
	==	==	==	==	==	==

GRAND TOTAL : \$2,282 10/

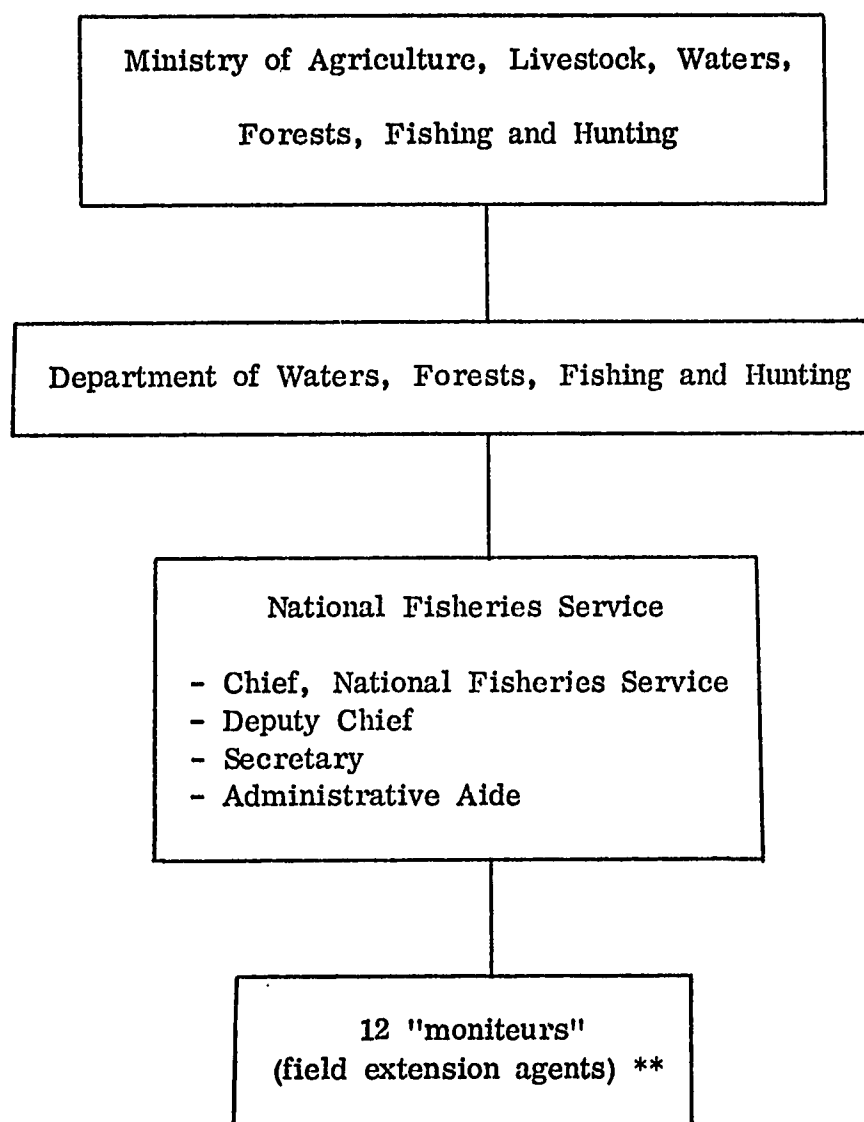
* Not to be used for final budgeting purposes
 Figures in thousands of dollars

(See footnotes on following page)

TABLE 4 (Cont'd)

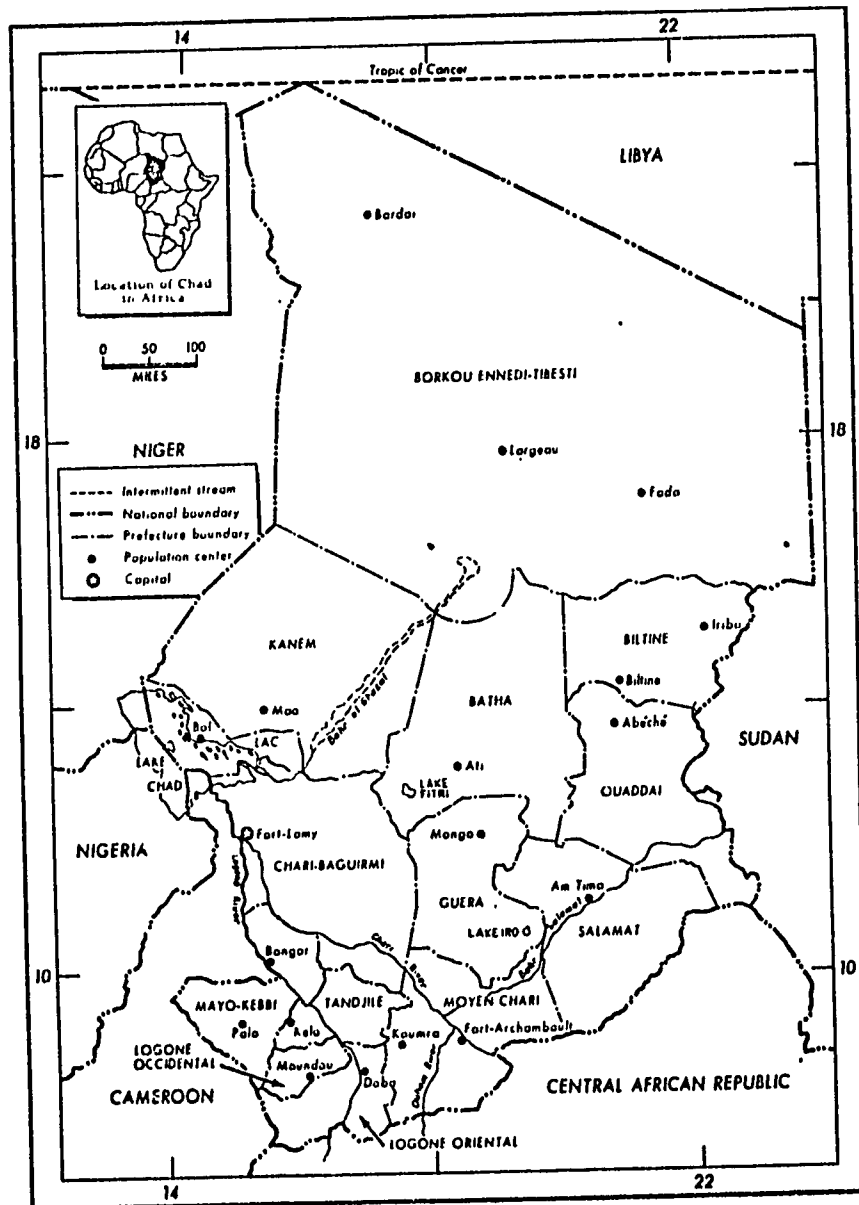
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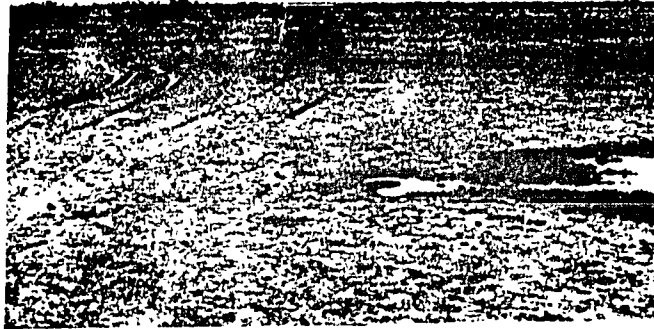
- 1/ Figures include salary, housing and maintenance.
- 2/ Training costs abroad estimated at \$20,000/year/person inclusive of transportation, tuition, books and maintenance.
- 3/ Training costs at African schools estimated at \$10,000/year/person, all inclusive.
- 4/ For training at local level, estimate is \$200/person/month. Each person would likely receive a total of 6-months' training, interspersed with periods of on-the-job experience. Total, then, equals \$1,200 per person.
- 5/ Costs inclusive of gas, oil, maintenance and spare parts.
- 6/ Figured on the basis of 40,000 FCFA/worker/year.
- 7/ Estimated at 10% (1979), 21% (1980), 33% (1981), and 46% (1982).
- 8/ To be provided by CARE. (AID cannot fund expatriate technical assistance under A-PIDs.)
- 9/ Not included in Grand Total. (A-PID funding is separate from conventional AID funding channels.)
- 10/ Technical assistance costs are based upon direct hire of personnel by AID. Costs will be significantly higher if personnel are obtained through private companies or universities.

ORGANIZATION OF CHADIAN NATIONAL FISHERIES SERVICE *

* Up to June 24, 1976. On June 25 a re-organization of several Chadian ministries took place. It is not known at this time which ministry the Fisheries Service will be placed under.

** To be increased by 30 persons in September, 1976.

MAP OF CHAD SHOWING THE 14 PREFECTURES



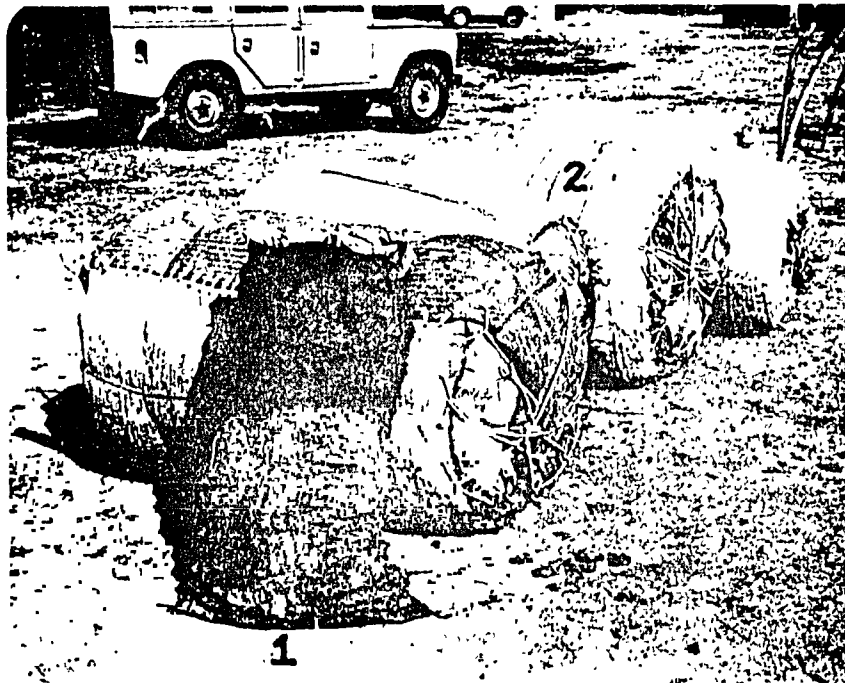
Picture 1 - On the major route to Massakory, 144 kilometers Northeast of N'Djamena. The "road" (seen here during the dry season after a rain) is little more than a track.



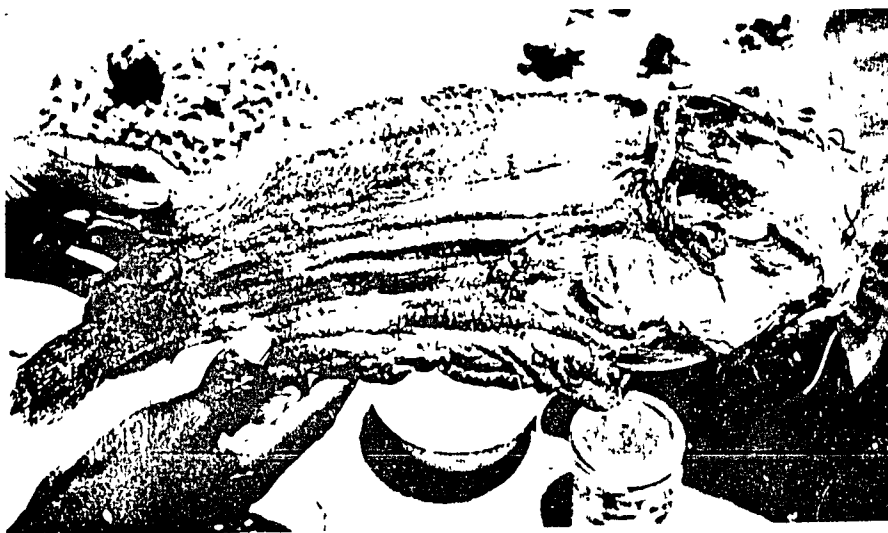
Picture 2 - Lates niloticus, the Nile perch (locally called "capitaine"). This species was heavily depleted in Lake Chad during the drought due to the lowered oxygen levels. This specimen weighs 4 pounds and is 17" long. A "capitaine" weighing over 70 kilograms (154 pounds) has been reported.



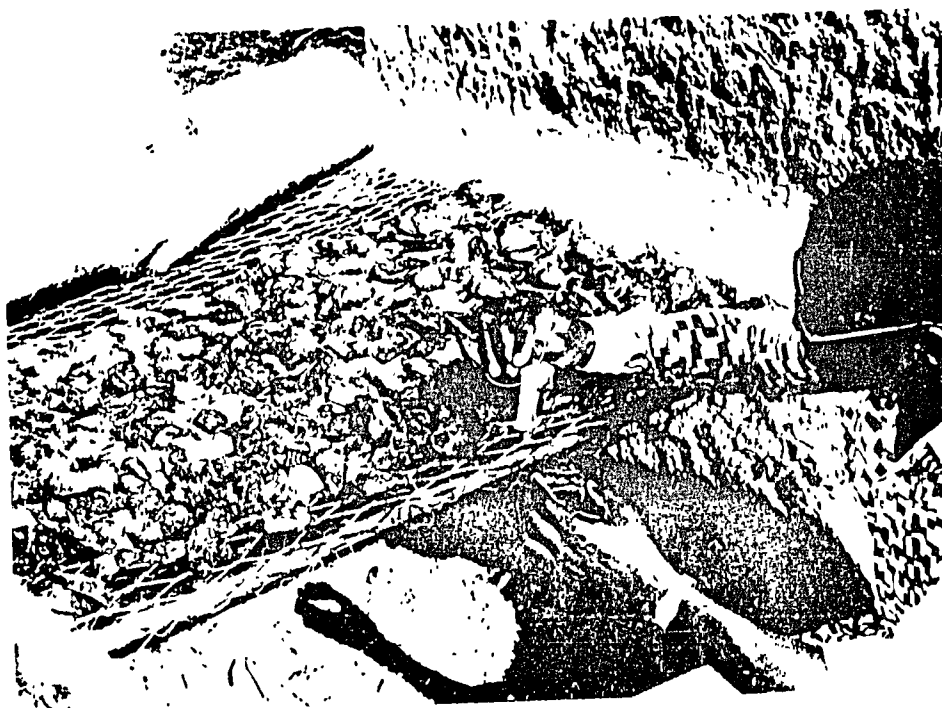
Picture 3 - Tilapia galilea (locally called "carpe"). This is the most abundant species of fish found in Chadian waters. The specimens shown here are about 7" in length and weigh about $\frac{1}{2}$ pound each.



Picture 4 - Sacks (locally called "ma's") containing smoked fish morsels, called "banda". The smaller sack in the foreground ("1") is destined for local markets. The larger sacks ("2") weigh about 70 kg and will probably be marketed in Nigeria.



Picture 5 - Auchenoglanis biscutatus (locally called "garga"). Sundried fish from market in Massakory. This specimen is 13" long and weighs approximately 3 pounds. The fish is cut-up into morsels and used in stews. Hard to see in the photograph are maggots infesting the flesh of the specimen.



Picture 6 - Morsels of smoked fish ("banda") shown here on rack made from expanded metal. The sides of the oven are mud brick. A thickly-woven palm frond cover is rolled into place while the fish are smoking, which takes from 36 to 48 hours. Most of the "banda" is exported to Nigeria.



Picture 7 - Locally made hand-net which is used in the rivers to capture smaller fish. This net is made from local fibers, a rarely seen commodity since the introduction of nylon in the mid-1960's.

APPENDIX D

Effects of the Drought on the Fish Stock

in Lake Chad and the Chari Delta 1/

The drought of 1972-1973 transformed the hydrology of the Lake Chad Basin. Its influence on the fish stock was catastrophic. The price of dried fish rose considerably and cost will remain high for several years until the stock has been reconstituted. This creates a serious problem as fish is a considerable source of animal protein for the population and an important revenue for the Government of Chad which exports the major part of the production. The fish production of the Lake and the Chari Delta was estimated at 140,000 tons in 1972.

Since 1971, the Hydrobiological Laboratory of ORSTOM has made monthly observations on the fish stock in the Archipelago, Southeast of Lake Chad, and in the Chari Delta and the Northern Basin. Local fishing areas in the Delta were studied. They exploit the fluvial-laustral migrations which are responsible, in a normal year, for a large production of "salanga" (8 tons/ha in 1971-1972).

From 1971 to 1973, because of the rapid lowering of the water table in the Lake, transformations in the composition of the ichthyological stock and inhabitational phenomena in the biology of the species occurred. In the Delta, a spectacular down-fall in the production of the fisheries was experienced.

By comparing the hydrology of the milieu in a normal year and its evolution during the drought, it was possible to observe the effects on fishes whose usual biological cycle characteristics are known.

1/ This is a rough translation, done in Chad, of Notes techniques du Centre ORSTOM de N'Djamena, "Effets de la sécheresse sur les peuplements de poissons dans le Lac Tchad et le Delta du Chari"; No. 9; V. Benech, September 1975.

HYDROLOGICAL EVOLUTION

Eighty-five percent (85%) of Lake Chad waters are supplied by the Chari. In the course of a normal rainy year, 40 billion m³ of water are emptied into the Lake causing the water level to rise and compensating for the loss of water due to evaporation and infiltration. The Lake consists of three large different regions - the open water, the island shelves and the archipelagoes. Since 1964, an insufficient rainfall brought about a regular drop in the water level. In 1972, the "swelling" was insufficient and did not even allow for a slight rise in the water table. The progressive drying-up of the Lake caused a parcelling out of three collections of independent water. The Southeastern archipelago, separated from the Southeastern open water in February and March, and at the end of June 1973, the unification of the water in the Southern and Northern basins no longer existed. The surface area of the water in the Southeastern archipelago diminished by 90% during the first semester (6 months) of 1973. An abundant amount of vegetation developed on the banks of the Southern basin and the "Grande Barrière". In 1973, the Chari furnished a limited amount of water for the Southern part of the Lake.

The swelling of 1973 was not much more than that of 1972; nevertheless, the swelling brought water into the Southeastern archipelago, causing the water to rise by 1.50 m from October to December, 1973. The water level started to go down in January, 1974 and the archipelago was again isolated in March of 1974.

The swelling of 1974 reached Bol at the end of September after having crossed a large zone of vegetation (about 15 kilometers). The oxygen content in the water diminished suddenly. This phenomenon can be explained by the presence of a large amount of decomposing vegetation and the rarefaction of micro-organisms which produce oxygen (microscopic algae). This absence of oxygen persisted for several months.

The swelling of 1973 hardly penetrated the Northern basin. The water level of this basin lowered regularly (about 2 m each year) - from July 1973 to July 1974. At the end of 1974 a large part of the Northern archipelago dried up and a great number of small islands appeared in the open waters of the North. In December, 1974 and January, 1975, the swelling arrived in this basin and caused the water level to rise by 0.60 m, which was completely insufficient to avoid a new drying up of the waters during the second semester (last 6 months) of 1975.

The Evolution of the Ichthyological Stocks and their Exploitation

1. Evolution in the Chari Delta

In a normal period two different categories of species can be distinguished - the lacustral and fluvial and those which make fluvial-lacustral migrations. Among these migrating fish, five species are important from a commercial standpoint, and constitute the essential catch in the fisheries of the Delta (81.6% of the total weight during the 1971-1972 season). These five species are - Alestes baremoze, Alestes dentex, Schilbe uranoscopus, Brachysynodontis batensoda and Hemisynodontis membranaceus. In vernacular, these species are referred to as "salanga", "makalele" or "ere-ere" and "gargas".

For instance, the adult Alestes baremoze goes up the Chari during the swelling period. The reproduction cycle takes place in the river and the inundated zones upstream, which are close to N'Djamena. The young profit from the favorable growing conditions in these inundated places, particularly in the Yaere in Northern Cameroon. When the water level drops, these young fishes migrate back to the Lake, via the El Beid and the Chari. The Lake and the archipelago zone, in particular, procure for these young fishes ample food which allows them to grow at a faster rate as compared with other African basins.

Two important fisheries function on the exploitation of these migratory movements which are essential to the reconstitution of the stocks in the Lake - the Delta fisheries exploit the reproducers which go up the river; the fisheries of the dams of the El Beid exploit the young fishes which descend towards the Lake.

The biological habits of these migratory species were evidently perturbed by the hydrological evolution which, in turn, had repercussions on the fisheries in the Chari Delta. The fish production in this zone was studied monthly from July 1971. In this zone, the fishermen use preferably drift nets; fixed nets and unbaited fishing hooks being rarely used.

In order to estimate the production of a fishery, two important factors are taken into consideration - the fishing effort and the catch per unit effort. The fishing effort, with handnets, is expressed by the surface of nets used per day in a given area. The catch per unit effort shows the yield of the catch, in the case of handnets; it is expressed in kg of fishes captured in one night per 100 sq. m of nets. The catch per unit effort is indicative of the fish density. By studying the variations of these two elements, it is possible to follow the collapse of the fisheries in the Delta.

Until October 1972, the fishermen gather towards the Delta and the fishing effort is intensified in order to compensate for the poor catch. At the beginning of February 1973, there was a considerable diminution of the fishing effort which led to an almost complete standstill in May. This was due to the fishermen's disappointment with the very poor results they obtained and their following migration towards the

Northern Basin where the yields are better. In August 1973, there was a certain renewal of fishing in this area, but it was done only by occasional fishermen, mostly farmers for whom fishing is only a secondary activity; hence the poor exploitation results.

The production of the fisheries in the Delta also collapsed during 1973. The production was only 5.5% of the season preceding the drought (August 1971 - July 1972).

TABLE 1

Production of the Fisheries in the Hadide Zone in the Chari Delta (J. Quensiere)

<u>Fishing Periods</u>	<u>Sep./Dec. 1971</u>	<u>Sep./Dec. 1972</u>	<u>Sep./Dec. 1973</u>
Large meshed drifting nets	230,000 kg	315,645 kg	1,811 kg
Small meshed drifting nets	686,000 kg	88,091 kg	68,227 kg
Total	916,000 kg	403,736 kg	70,038 kg

At the beginning of 1975, fishing in the Delta was insignificant and the fishermen went to fish in the lake with nets. In the open waters, the majority of the catch consisted of Tilapia. These fish were caught with 50 mm meshed nets. Closer to the river mouth waters, large meshed nets (60 to 150 mm) are used to catch big fish (such as, Lates, Bagrus, Heterotis, Hydrocyon brevis). It is in this region that the specific diversity is the greatest since it is the only area which is in direct communication with the river. Experimental fishing has shown that this region is also the only lacustral milieu containing young "salanga" which represent for the Lake a good potential for repopulation.

2. Evolution in the Northern Basin

The fish production in the Northern Basin has been followed up since the 1969-1970 season according to the statistics on the commercialized fish (banda and salanga) which come from Maiduguri (Nigeria) via the Baga Kawa.

a. Production of "Banda"

The "Banda", which is a piece of smoked fish, represents the almost total production

of the Northern Basin (98 to 99% of the weight). Large meshed nets (90 to 100 mm) were used mostly up to 1971. Because of the disappearance of the large fish, small meshed nets have been more in use since 1971. Following the introduction of nylon meshed nets in 1961-1963, meshed nets of 90 and 100 mm were less used from 1963 to 1967. In spite of the poor yield, an augmentation of the production is noticeable due to the fishing effort and the concentration of fish in the reduced water areas.

It seems as though the effect of concentration was felt until 1973. In 1974, the catch of Lates niloticus ("Capitaine") diminished. The stock of large fish seems to be exhausted. At Kindjeria, in December 1974, the last large fish were the Gymnarchus ("Am Chalando"). These fish grounded themselves in shallow zones where they were fished by means of harpoons. In April 1975 no fish was caught with a 90 and 100 mm meshed fishing net during seven nights of fishing.

The production of Banda rose again in 1973-1974, but the rate of increase sagged and lowered again in 1974-1975.

b. Production of "Salanga"

The "Salanga" constitute a small portion of the production but it doubled in 1973. Thus, this evolution is very different compared to that of the "Banda". The production was stable until 1971-1972, then it rose rapidly in 1972-1973 and more so in 1973-1974.

This rise in production can be explained by a simultaneous increase of the catch per unit of effort due to the concentration of fish and the arrival of the fishermen of "Salanga" from the Chari Delta. At the beginning of 1973, the catch being considerably low in the Chari Delta, the professional fishermen gathered in the Northern Basin where the yield was much higher. According to experimental fishing, the catch by fishing effort unit with meshed nets (30 mm) was maximal from August 1973, to March 1974 (10 kg of fresh fish per 100 m² of net per fishing night). In June and September of 1974, the catch of "Salanga" diminished greatly (5.5 kg per 100 m² per fishing night). In December of the same year the last of the "Salangas" died in the concentrated waters due to a lack of oxygen. In April 1975, not one was caught during seven fishing nights. The "Salanga" production will therefore become nil in 1974-1975.

c. State of the Stock and Fisheries in 1975

While the stocks of large fish were diminishing (such as "Banda", "Alestes baremoze" and "Dentex") new species were proliferating in the milieu which was drying up. Several species of Tilapia appeared and are the main stay of the catch.

Fishermen moved in great number to the Northern archipelago in order to profit from the concentration of fish in the drying up Basin. It was a very good exploitation of

these stocks which would have been naturally destroyed anyway. In spite of this good exploitation there were very great losses during the rainy season. From June to December, fish died of asphyxiation and floated on the surface of the water following heavy wind storms. The most valued species were picked up by the fishermen, but the greatest part, consisting mostly of Tilapia, formed along the banks of the numerous islands a continuous line of 1 meter wide of rotting carcasses. Towards the end of 1974, because the catch was diminishing, qualitatively and quantitatively, and the traveling becoming difficult, the fishermen emigrated towards the Baga Kawa region in the Southern basin where there were more fish.

3. Evolution in the Baga Kawa Region

In 1973, due to the lowering of the water level, the "Grande Barrière" zone was covered with vegetation; this region was then submerged at the time of the swelling in 1974-1975. From the wharf of the Baga Kawa, several kilometers of vegetation had to be crossed in order to attain a small area of open waters which was separated from the open water in the Northern Basin by another zone of vegetation. Gutters were cut across this area allowing canoes to pass from one to the other of these two milieus.

Intensive fishing was carried on in this zone where the most important fishery of the Lake is presently found. The fishermen used nets and unbaited fishing hooks in the weedy areas.

The activity which was taking place around the wharfs, overlaid by drying sheds and smoking installations, was a testimony to the good yield in this region. The yields, obtained by using meshed fishing nets of about 40 mm, was very good but the catch was little diversified - consisting mainly of Clarias and Tilapia and of Heterotis and Gymnarchus.

TABLE 2

Specific/Total Capture by Fishing Effort per Unit
(Weight in grams of fish caught by 100 m² nets during a 24 hour period - Observed in Baga-Kawa on March 13 and 14, 1975).

Milieu	Open Water					Weedy Water		
	35	40	45	65	40	40	45	Line with 1000 hooks
Meshed Nets (in mm)								
Heterotis	----	1112	-----	12190	-----	-----	-----	1145
Gymnarchus	304	1556	453	-----	-----	-----	1260	-----
Clarias	424	-----	-----	1840	2583	30538	12448	722
Tilapia	4776	17354	10309	2194	379	-----	1078	899
Others	163	252	407	305	-----	436	-----	-----
TOTAL	5667	20274	11169	16529	2962	30974	14786	2766

4. Evolution in the Southeastern Archipelago

The evolution of the fish stock in the Southeastern archipelago was followed up by monthly fishing near Bol. Parallel to the lowering of the water level, a transformation of the specific composition of the stock was observed as well as the appearance of the biological phenomenon of the Brachysynodontis batensoda (garga), a species which was particularly studied during this period.

a. Specific Composition of the Stock

During the period of 1971 to 1974, 1973 seemed to be a year of transition with respect to the specific composition of the stock. As a matter of fact, it was during February and March of 1973, that the Southeastern archipelago was isolated from the open water and the surface area of the water was reduced to 90% during the first semester. The dominating species during the high water level disappeared while certain weak species were developed.

At the beginning of 1974, the majority of species which constituted the essential part of the stock in 1971-1972 disappeared or were disappearing. These species were replaced by others which were capable of adapting to or tolerating the milieus which were drying up or found there favorable conditions for their development, thanks to the vegetation.

The arrival of the swelling at Bol in October of 1974, having caused a rapid deoxygenation only the more resistant species, capable of living with a lack of oxygen survived. During this period Protopterus, fish which are better adapted to atmospheric respiration and dryness were caught by meshed nets. It was only in February 1975, that certain old species of this area reappeared, but they were far from reaching their September 1974 peak.

The species caught were the Ileterotis and Clarias but they were not particularly abundant. It would be better to exploit commercially other species like the Brienomyrus niger, which gives good yields by using small meshed nets. However, the utilization of these kinds of nets capture "Salangas" which are too young.

b. Particular Biological Phenomenon

The stock and the biology of the Brachysynodontis batensoda were studied during the drying up period of the Southeastern archipelago. During a normal hydrological year, this type which feeds on zooplankton, migrates during the swelling period to reproduce in the rivers and inundated plains.

Because the milieu was isolated from the river, neither the migration nor the reproduction of this specie, which can only take place in a fluvial system, occurred. Experimental fishing showed a growth of density in this species because of the drying up and high mortality rate. After wind storms there were multitudes of these fish floating on the surface of the water. As a matter of fact, low height of the water table facilitated the suspension of sediments. These particles caused an asphyxiation by sealing up the gills of the fish or by a lack of oxygen.

A stoppage in growth was observed in a portion of the fish which were far from being developed. Research should be made in order to find the cause of this phenomenon, in particular, the diminution in quantity and quality of the food needed for the development of this species.

The adults were impeded from returning to the river in order to reproduce. Reproduction didn't take place even though a certain number of these fish had arrived at sexual maturity. In an inverse manner, no young were able to penetrate into the archipelago.

CONCLUSION

The lowering of the water level in Lake Chad caused in 1973 the formation of three independant bodies of water; namely, the open body of water in the Southeast, which is linked to the fluvial system; the Northern basin and the Southeastern archipelago. The last two regions, which were deprived of flow of water, diminished rapidly in surface area due to evaporation.

This transformation of the milieu upset the living conditions of the fish and caused perturbations in their migration habits, as well as a rapid evolution of the specific composition of the stock. These phenomena had a great influence on the qualitative and quantitative fishing production.

The first fisheries which were damaged were those of the Chari Delta which depend specially on the capture of fluvial-lacustral migrating fish. The "salangas" were grounded in the Northern basin and they were not able to migrate in order to reproduce. Trapped in this reservoir, they were submitted to a severe concentration due to the reduction of the volume of water.

This concentration is the origin of the high yield which attracted fishermen from the Chari Delta to the Northern basin. These two phenomena made the production rise greatly in the Lake region. But, in spite of this active exploitation, a great quantity of fish in the Northern basin died because of a lack of oxygen.

At the end of 1974, the diminution of the stocks and the difficult conditions of traveling in the Northern basin caused the fishermen to emigrate to the Baga Kawa region where important fisheries had been established. The exploitation of the stocks developed in this new milieu after the drying-up period.

Thanks to experimental fishing, it was possible to follow up the changes in the Southeastern archipelago which interfered with the specific composition of the ichthyological stock. The extinction of some of the most common species at the time of the high water level was produced. These particular species were replaced by others which were more tolerant or better adapted to the new biological conditions created by the invasion of vegetation which caused a lack of oxygen in the water. Among the principal species which proliferated in this milieu were the Clarias, the Polypterus senegalus, the Brienomyrus niger, the Tilapia and the Alestes nurse. Some of these species are of economical interest (Clarias and Tilapia), others are not (Polypterus senegalus), or are not exploited due to their small size which allows them to escape from the usual meshed nets (Brienomyrus niger, Alestes nurse).

The geography around the Baga Kawa resembles that of the Southeastern archipelago, and it can be supposed that both areas have the same stock of fish. The fisheries of this region, being very active, have high yields of Clarias and Tilapias. These fish must be the most numerous in the Lake. A similar evolution followed by exploitation, could be established in the Northern basin, where in 1975 the vegetation started to develop. During this period, the number of Clarias increased and the Brienomyrus appeared. These species were introduced in this region during the swelling period of 1974-1975.

During this drought period, fisheries were developed which seemed to have been exploited in these areas in order to assure the continuity of the production. Will this satisfy, quantitatively and qualitatively, the consumers ? It can be hoped that after the exhaustion of the stocks exploited in 1974, the Northern basin will offer, in its Southern part, favorable conditions for development of stock similar to that of the Baga Kawa area. This would allow this fishery to expand in the Northern region and increase its production.

From a qualitative point of view, even in a favorable perspective admitting a rapid rise of the Lake level, the composition of the stocks will take several years to be reconstituted as it was before the drought. On this subject, what was said at the beginning can be recalled, that is : there are two important traditional fisheries depending on the phases of the biological cycle that determine the demography of the fluvial-lacustral migrating stocks on one hand, the reproducers which migrate upstream towards the fisheries of the Delta, on the other hand, the young which migrate downstream toward the fisheries of El Beid.

As for the "salangas", the adults do not presently exist in the Lake area, but many young were seen in the perideltaic zone and in the open water in the Southeast in the beginning of 1974. This shows that the generating stock in the fluvial system represents a sufficient potential reproduction for restocking the Lake without stocking it with fry.

In spite of the drainage of the lacustral stocks of certain species, it appears that none of these species will completely disappear since the Lake contains every species which are present in the fluvial system of which it is the outlet.

APPENDIX E

Fishing Techniques in the Lake Chad Region

and the Bas Chari 1/

Among the practiced traditional techniques of fishing still used in the 1950s, only a few have subsisted, at least in the fluvial network prospected regularly by ORSTOM, Lake Chad being practically unexploited as yet.

The catch due to these techniques was generally poor. In fact, the stock of fish could have been considered practically untouched. The entire Lake Chad and its tributaries constituted one of the most fish-stocked zones.

Constant growing demand, development of transportation and the appearance of synthetic fibers used in the making of meshed nets, accelerated the evolution of these techniques.

The first encroachment of the stock by high-yielding means (meshed nets) caused most of these old fishing methods to disappear. These methods are no longer practiced except as a supplementary activity in which the fish are intended for consumption by the fishermen themselves.

TRADITIONAL TECHNIQUES

1. Wicker traps, baskets, other traps

These particular appliances, made from the stocks of gramineous plants (Echinocloa sp) and the bark of trees (Borassus aethiopicus) were placed in the gullies of the slopes along the river banks. They captured the fish which migrated laterally, that is the adult fish going to spawn in the inundation zones and the young rejoining the river beds at low tides. Certain traps, particularly

1/ This is a rough translation, done in Chad, of Notes techniques du Centre ORSTOM de N'Djamena, "Les techniques de pêche pratiquées dans la région du Lac Tchad et du Bas Chari"; No. 10; J. Franc.

on the banks of the Logone, attained impressive yields but for very short span of time only.

2. Barriers

This method was specially used during the period when the water level was lowering. They stopped the fish migrating downstream and channeled them towards the wicker traps and capture chambers which were joined together.

a. The Barrier of the Koulabou at Logone-Gana

Once a year, in December and January, the Koulabou, the axis of the draining zones located between the Chari and the Logone, was entirely obstructed by screens made from the stocks of gramineous plants which were held up by stakes. Upstream from this barrier were several hundreds of wicker traps with their opening facing downstream. Right in the downstream and attached to the barrier, a large number of canoes placed side by side caught the fish as they jumped over the barrier. They caught especially the big Hydrocyon brevis ("Am dounoun"). Several meters downstream from the barriers, double capture chambers were installed. By means of these particular chambers, the species Alestes dentex and Alestes baremoze ("salanga") were caught along with the small Hydrocyon brevis. In 1968, the estimated yield for the first two fishing days was more than 100 tons in a width of about 120 meters.

b. The Barriers of the El Beid

The El Beid river drains the flood waters coming from the Yaere in Northern Cameroon into Tilde to take it to the Lake Chad, especially at Meinari. Along with this descending water, from November to January, comes part of the young fish which have completed their first growth in these flooded plains.

Depending on the year, 150 to 200 barriers made from acacias branches were placed at intervals along the river for 120 km. These barriers were not obstacles for the passage of the fish but asylums around which they could concentrate and where they sheltered during the daytime hours. On the slightly sloped banks, a heap of branches were arranged as a barrier, semi-circular. Huts housed the fishermen and their triangular shaped nets. These nets were put on the bottom of the river, the bindings of the poles were placed between the fishermen's knees and held by their arms. About every five minutes, the nets were raised and the fish were gathered at the bottom of the nets with calabashes.

Fishing at dawn and during the night was more fruitful but the low temperature of the water and the myriads of mosquitoes limited this method of fishing.

During the 1968-1969 season, the average yield per fisherman in 24 hours was 42 kg. The species the most frequently caught were the Tilapia (forfo) the Mormyrides and the "Salangas". Almost all the species found in the rivers were present in this region. The fish, all small ones, were dried in the sun. The particularly low hydrometric degree lent itself to this way of preservation.

3. Sheltered traps for the Tilapia (at N'Gara)

At a low water mark (60 to 100 cm deep), in the calm zones of the rivers, heap of branches are stuck into the sand. These heaps, five to six meters in diameter, constitute a shelter where the Tilapia come to take refuge. The Tilapia prefer occupying these particular zones in the river.

As soon as there are enough fish in the shelter, it is enclosed at night by barriers at the passage-way. At daybreak, the fishermen remove the branches which were placed in the interior in order to reduce the surface area of the enclosure until there is only enough room for one fisherman with his large landing net. The fish are then harvested. The frequency of this method of fishing depends on the density of the stock in the sheltered zone. It varies from one day to the one week. The Tilapia represent more than 90% of the catch. The yields are impressive; they may reach an average of 28 kg of fish per shelter and per day.

It is evident that uncontrolled multiplication of the shelters and too frequent catches would rapidly lessen the yield. Nevertheless, the development of this easy technique of fishing calls for very little work for an high yield and presents a cash income.

Almost all the fish are taken to the large markets by canoe or vehicle where they are sold fresh.

4. Lines with unbaited fish hooks

Leaders are attached on nylon string about 3 mm in diameter at intervals of 15 to 20 cm. To these leaders, about 20 cm long, are tied fishing hooks which vary in size, but more frequently #7 to #11 are used (English measurements). Each line has 500 to 1,000 fishing hooks. These lines are placed across the river and are held down by sinkers (weights) and floats. They are always tied to the river banks.

The fish caught belong to the species which search for their food close to or on the river bottom, such as the Synodontis (garga), the Mormyres, the Silures (balbout, abou'chanap). These are often big fish.

The chart below indicates several daily average yields in kg for 1,000 fishing hooks in the Delta zone.

<u>Aug.</u> <u>1955</u>	<u>Jul.</u> <u>1971</u>	<u>Aug.</u> <u>1971</u>	<u>Sep/Nov</u> <u>1971</u>	<u>Jan.</u> <u>1971</u>	<u>Feb/Mar.</u> <u>1972</u>	<u>Apr.</u> <u>1972</u>	<u>May</u> <u>1972</u>	<u>June</u> <u>1972</u>
100	20	6	Negligible	4.8	Negligible	2	13.8	5.4

5. River bank fish nets (seines)

These nets are made from layers of local fiber. The middle part, serving as a large pocket, is made out of heavy fiber in good condition. The dimensions vary from 100 to 150 m in length and from 2 to 3 m in width. As for the nets, the upper part of the line is buoyed by floats attached to it and the bottom is weighted by round pieces of lead. At the end of each joint of the poles are tied 4 tow-lines.

The fish-net is cast into the water from a canoe and towed simultaneously by a team of 3 or 4 men, each one standing either on a sloped bank or a sand-bank.

These nets which are made out of odds and ends and are often in bad condition, produce varying yields.

With an experimental net the following yield was obtained - from 25 to 180 kg per hectare in the Southern Lake Archipelago; from 9 to 142 kg per hectare in the Chari Delta and from 19 to 223 kg per hectare in the upstream water near N'Djamena.

6. Cast-nets (N'Briki)

The cast nets are coniform nets from 4 to 6 m in diameter and 3 to 4 m in height and their circumference weighted. These nets are thrown from either a canoe or a river bank.

This particular technique has been developed a great deal during the past few years. This technique is used in all seasons either by night or by day.

Depending on the period, the size of the mesh of these cast nets can be adapted to different species, such as Mormyrides, Tilapia, Schilbeides ("ere ere"), Alestes (small or large species), Hydrocyon-Lates ("capitaine"). (A "capitaine" weighing about 100 kg was caught a little upstream from the capital in 1958). No estimate whatsoever of the yield has been made, but it seems to be very

good during the migration period upstream (June-July) and when the water is low (October-November).

7. Exhaustive seasonal fishing

This is practiced in swamps and inundated zones, which are in the process of drying up, by means of small nets, harpoons and baskets. The baskets have an opening which allows the individual to put in his hand in order to seize the imprisoned fish. The fish caught are mostly Clarias ("balbout") and the Protopteres ("amkourou").

It should also be noted that several kinds of poisons using specific toxic vegetation, such as the bark of balanites, tephrosia, etc., are used in the stagnant waters during the low-water mark period.

TRADITIONAL TECHNIQUES SELDOM USED

Their financial benefits are limited and their practice is out-of-date, except upstream from the river system studied. Among these particular techniques, the following can be mentioned :

1. Canoes with rocking triangular nets

A triangular net supported by two poles is attached to the front of a canoe. According to the size of the net, it is handled by hand or by a lever. For this operation, two men are needed - one fisherman and one paddler. This canoe has to be large in order to assure a good balance. The beating action of several canoes working abreast increases the yield but, nevertheless, the yields are always poor from such an operation.

2. Seine with sticks

These seines are made up of several sets of nets, each about 10 m long and 60 to 80 cm wide. These sets, one per fisherman, are stretched out by poles and brought together at the moment of the catch. This kind of fishing is carried on in a part of the river where the water is shallow. While pulling the nets, the fishermen back up towards a sand bank and hold the nets vertically near the bottom of the river. The yields, consisting mostly of "salangas" and Tilapia have been mediocre since 1972.

RECENT TECHNIQUES

1. Hand nets

The outlook on fishing has been changed by the extensive commercial diffusion (promoted by the Technical Center of Tropical Forestry) of strong, rot-proof, easy-to-maintain, and reasonably priced meshed nets of synthetic fibers.

Easy to handle and giving a high yield of fish, these nets have even attracted to fishing many people traditionally destined for other occupations.

The meshed nets can be classed into two categories :

a. Nets for "salanga" in which the dimensions of the mesh are one inch (FM 25,5 mm). These nets are also capable of catching Schilbeides and Hydrocyon for skalii.

b. Big meshed nets (FM 50 to FM 155) are designed to catch big fish like Synodontis membranacens ("garga"), Lates ("capitaine"), Distichodus ("am guech"), Citharinus ("douro").

The fabrication of these nets is done by the fishermen themselves. The width of the net is adapted to the depth of the water. For these two categories of nets two methods of fishing are used :

a. Drifting nets

Drifting nets are uniquely used in rivers especially during the migration period. The nets are placed across the river. They drift in the current during a variable time, depending on the speed of the current and the weight of the catch. A fisherman in a canoe keeps the net in a perpendicular position with the banks bycontrolling one of the ends. According to the clarity of the water, the net are used either to fish on the surface of the water or in depth. This method of fishing can only be used in the areas where the bottom of the river is clean.

b. Fixed nets

This kind of net is rarely used in the rivers, except during the low water mark period. These nets are placed along the river bank or between stagnant bodies of water. Nets for "salangas" and large meshed nets are used. Fishing is carried on in the Lake all year round by using large meshed nets.

The predominant species which are caught are - Bagrus, Labeo ("am dougoula"), Synodontis, Distichodus, Citharinus, Lates.

The average catch by unit of effort is expressed in kg per 100 m² of net and per night of fishing. The catch by unit of effort is variable according to the nets used and the season.

Here is the average catch by unit of effort of the nets used by ORSTOM at Lafia (Southeastern archipelago island in Lake Chad), for a period of one year, from April 1971 to March 1972.

<u>Mesh in mm</u>	25	30	35	40	50	60	70	80	90	100	115	130
<u>Average catch</u> <u>by unit of</u> <u>effort</u>	4,4	4,2	8,0	5,9	6,1	3,4	2,1	2,2	1,3	1,2	0,4	2,0

This average catch by unit of effort is inferior to the one obtained by the nets sold in the local market. This is due to the different size of thread used to make the nets. The finer the thread, the more fish a net can catch, but it is fragile and its life span, especially for "salanga" nets, is very short.

The experimental fishing is done in order to study the young, their growth, as well as the numerous small species which represent an important alimentary element. For this purpose, small meshed nets of 10 to 22 mm are used. Of course, the utilization of these small meshed nets for commercial fishing is not recommended.

2. Flotting lines with large baited fishing hooks

They were introduced in the Southeastern archipelago in 1965, by the Technical Center of Tropical Forest. This kind of line is made from a nylon rope about 100 m long on which 33 floats are attached. Under these floats, leaders with tuna-like fish hooks are suspended. The fishing hooks are baited with Tilapia or "salanga".

The extra work given by the research of the baits, the introduction of the FM 150 used for the capture of Lates, and the drying up of the archipelago, seem to have put an end to this method of fishing. The yield, however, was good and the fish caught of first quality (90% Lates).

In 1965, the average catch was 52 kg per line and per night. This average fell to 8 and 10 kg during 1968 and 1969.

EXPERIMENTAL TECHNIQUES

In order to exploit rationally a stock of fish, the biological mass (weight of the fish by the unit of the area) and its rate of production must be known.

In order to determine these two factors, a quantitative study is necessary.

If the biological content of the river banks and the coast of the islands in the archipelago is known, the biomass of the huge spread of free waters of the Lake remains to be determined.

1. Experimental electric fishing

The electric trawling method being presently experimented in Chad will, in principle, be a means of evaluating the biological mass in the immense zones of the Lake and give a reasonable idea of how to obtain a satisfying exploitation in function of the evolution of the species.

CONCLUSION

The techniques actually in used are in constant evolution. On the whole, the fishermen know how to adapt the methods of fishing according to the fluctuations of the water level and the stocks of fish in the Lake.

The use of small stable boats would permit a rational exploitation of the open waters of the South which are highly populated with Tilapia and would compensate for the production of "salanga" which is almost of no value at this time.

The present rarefaction of the "salanga" is nothing but a transitory phenomenon due to the drought. A very flexible and limited control in the usage of drifting nets could curtail it.

Finally and most important, an improvement of the processing of the fish by presalting would be equivalent to an additional 20,000 T of fresh fish for consumption, and only to the detriment of insects.