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**FISHCULTURE SURVEY REPORT
FOR WEST CENTRAL AFRICA**

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Project: AID/csd-1581

**Title: Increasing Fish Production
by Improved Fishcultures**

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PREFACE AND ACKNOWLEDGEMENTS

AID Washington initiated this survey of West Central Africa which developed into a joint effort between AID Washington and the Food and Agriculture Organization of the United Nations. Mr. Paul De Kimpe, Project Manager, Regional Fishculture Training and Research Project sponsored by FAO, accompanied the Auburn Team in the Central African Republic and Cameroon; Mr. W. H. L. Allsopp, FAO Regional Fisheries Officer for Africa, traveled with the Team in Togo and Ivory Coast. The assistance rendered by these two gentlemen both in serving as interpreters and in contributing toward the survey in other ways is acknowledged gratefully. Also acknowledged is the fine cooperation received from FAO Fisheries personnel in Rome. Members of the Auburn Team consisted of two fisheries biologists and an economist and marketing specialist (Professor Danner).

TABLE OF CONTENTS

	PAGE
I. INTRODUCTION.....	1
1. Summary of Present Economic Status.....	2
2. Summary of Present Fisheries Status.....	4
a. Marine Fisheries.....	4
b. Freshwater Fisheries.....	5
c. Fishculture.....	6
3. Fish Marketing and Processing.....	7
a. Limitations in Marketing Fresh Fish.....	7
b. Marketing Smoked Fish.....	8
1. Hot smoking.....	10
2. Dry smoking.....	10
3. Cold smoking.....	10
c. The "Mammie" System of Marketing and Distributing Fish.....	11
4. Summary of Nutritional Status and Fish Consumption.....	12
II. SENEGAL.....	14
1. Economic Status.....	16
2. Marine Fisheries.....	16
a. UNDP/SF Pelagic Fish Resources Project.....	18
b. ORSTOM.....	18
c. Peace Corps Fishery Cooperative.....	18
3. Freshwater Fisheries.....	19
4. Assessment of Fishculture.....	20
5. Conferences and References.....	21
III. CENTRAL AFRICAN REPUBLIC.....	22
1. Economic Status.....	24
2. Freshwater Fisheries.....	26
a. Bouroungon Fishing Village.....	26
b. Regional Fish Culture Training and Research Project....	26
c. Regional Fisheries Center at La Landjia.....	29
1. Experimental ponds.....	30
2. Buildings and other facilities.....	30
3. Staff.....	30
4. Training program.....	32
5. Research program.....	33
d. Bengue Fisheries Station.....	36
e. Bossembele Fisheries Station.....	40
3. Assessment of Fishculture.....	40
4. Conferences and References.....	43

	PAGE
IV. CAMEROON.....	44
1. Economic Status.....	46
2. Marine Fisheries.....	48
a. Traditional Fisheries.....	48
b. Industrial Fishery.....	49
c. Shrimp Fishery.....	50
1. Imports of fish and shellfish.....	50
3. Freshwater Fisheries.....	50
a. Melen Fisheries Station.....	51
b. Fouban Fisheries Station.....	51
1. Buildings and other facilities.....	52
2. Program of work.....	53
c. Other Stations.....	54
d. Fisheries of West Cameroon.....	54
e. Bambui Fisheries Station.....	54
f. New Government Fisheries Station.....	55
g. Peace Corps Project.....	58
4. Assessment of Fishculture.....	59
5. Conferences and References.....	62
V. NIGERIA.....	63
1. Economic Status.....	65
2. Marine Fisheries.....	66
3. Freshwater Fisheries.....	67
a. Lake Chad Fishery.....	67
b. Reservoir Fisheries.....	68
4. Federal Fisheries Service.....	69
5. State Fisheries Departments.....	69
a. Ogunpa Fisheries Station (Ibadan)	70
b. Panyam Fish Farm.....	72
6. Assessment of Fishculture.....	76
7. Conferences and References.....	78
VI. TOGO.....	80
1. Economic Status.....	82
2. Marine Fisheries.....	82
3. Freshwater Fisheries.....	83
a. Du Nɛ Fisheries Station (Sokode).....	84
b. Kpewa Fisheries Station.....	84
4. Assessment of Fishculture.....	87
5. Conferences and References.....	89
VII. GHANA.....	91
1. Economic Status.....	93
2. Marine Fisheries.....	95
3. Freshwater Fisheries.....	96
a. Lake Volta.....	96
4. Assessment of Fishculture.....	98
5. Conferences and References.....	99

	PAGE
VIII. IVORY COAST.....	101
1. Economic Status.....	103
2. Marine Fisheries.....	104
a. UNDP/SF Pelagic Fish Resources Project.....	105
3. Freshwater Fisheries.....	105
a. Bandama Lake Project.....	105
b. Bouake Fishculture Research and Training Center.....	106
4. Assessment of Fishculture.....	109
5. Conferences and References.....	110
IX. SUMMARY AND RECOMMENDATIONS.....	112

LIST OF FIGURES

	PAGE
1. Sun drying fish at Joal, Senegal.....	9
2. Smoking of fish by "fish mammies" in Ghana.....	9
3. Capture fisheries in Oubangui River, Central African Republic.....	27
4. Fouban Fisheries Station, Cameroon.....	27
5. Principal fish species being evaluated in Africa.....	37
6. Volta Lake Dam, Ghana.....	107
7. Fishculture Research Station at Bouake, Ivory Coast.....	107

LIST OF MAPS AND ILLUSTRATIONS

1. Map of Senegal.....	15
2. Map of Central African Republic.....	23
3. Illustration of Regional Fish Culture Training and Research Center, Bangui, Central African Republic.....	31
4. Map of Cameroon.....	45
5. Map of Nigeria.....	63
6. Illustration of Panyam Fish Farm.....	73
7. Map of Togo.....	81
8. Illustration of Kpewa Fish Culture Station.....	86
9. Map of Ghana.....	92
10. Map of Ivory Coast.....	102

**Itinerary of Auburn University Fisheries Team During Survey
of Central and West Africa
March 30-May 28, 1969**

March 30-31	Washington, D. C.
April 1-4 May 24-27	ROME FAO Fisheries Department
April 5-11	SENEGAL Peace Corps Fish Cooperative at Joal Artisanal Fishing Village at Kayar
April 12-19	CENTRAL AFRICAN REPUBLIC Landja Fisheries Station (Bangui) Bossebele Fisheries Station Bengue Fisheries Station (Bambari)
April 20-26	CAMEROON Melen Fisheries Station (Yaounde) Mbalmayo Fisheries Station Bamoungoum Fisheries Station (Bafoussam) Foumban Fisheries Station Bamenda Fisheries Station
April 27-May 3	NIGERIA Ijora Fisheries Terminal Ogunpa Fisheries Station (Ibadan) Panyam Fish Farm (Jos)
May 4-9	TOGO Sokode Fisheries Station Kpewa Fisheries Station
May 10-17	GHANA Ashaman Fisheries Station Tema Fishing Harbour and Dock Complex Volta Lake Project and Akosombo Dam Ampem Fishing Village
May 18-23	IVORY COAST Bouake Fisheries Station Bandama Lake Project

FISHCULTURE SURVEY OF WEST CENTRAL AFRICA¹

USAID-Auburn University Project AID/csd-1581
Increasing Fish Production by Improved Fishcultures

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INTRODUCTION

This fishculture survey was carried out from March 30 to May 27, 1969, with visits of approximately one week to each of seven countries in West Central Africa. The countries, in the order surveyed were: Senegal, Central African Republic, Cameroon, Nigeria, Togo, Ghana and the Ivory Coast. Brief visits also were made to Rome for the purpose of conferring with personnel of the Fisheries Department of the Food and Agriculture Organization of the United Nations.

Principal objectives of the survey were: to determine the status of fisheries development, including marketing and economic aspects, in the countries visited; to evaluate existing programs being carried out in inland fisheries, with particular emphasis on fishculture projects; to determine need for establishment of fishculture research facilities under conditions prevailing in the various countries; to assess the interest of host country governments and AID/Missions in supporting fishculture programs. The pattern generally followed in conducting the surveys was: 1) upon arrival, report to AID/Mission for general discussions and formalize itinerary within country, 2) confer with officials of host government and the United Nations, 3)

1. This report is based on a survey made from March 30 to May 27, 1969.

make field trips to fisheries stations and other facilities, 4) prior to departure, discuss with appropriate personnel of the AID/Mission impressions gained during field travel and through conferences. The one-week period allotted to survey each country and the state of roads in rural areas did not permit extensive in-country travel. For fishery projects and facilities described, but not actually visited, the authors relied upon publications, reports and information obtained through conferences. A list of officials with whom conferences were held and pertinent reference materials are included in the individual country reports.

Summary of Present Economic Status

All countries surveyed border on the Atlantic Ocean, with the exception of the Central African Republic which is landlocked. Major cities generally are located on coastlines and are seaports that serve as principal centers for light industry and import and export of materials to and from foreign ports. The status of foreign trade for the year 1967 can be seen in the following table:¹

Total foreign trade 1967 (millions U. S. \$)	<u>Senegal</u>	Central African <u>Republic</u>	<u>Cameroon</u>	<u>Nigeria</u>	<u>Togo</u>	<u>Ghana</u>	Ivory <u>Coast</u>
Exports	137	29	188	680	32	302	325
Imports	<u>-164</u>	<u>-44</u>	<u>-152</u>	<u>-626</u>	<u>-45</u>	<u>-319</u>	<u>-263</u>
Balance	-27	-15	-36	54	-13	-17	62

Nigeria and the Ivory Coast showed a positive trade balance while the remaining countries exhibited deficit trade balances, with the Central African Republic and Togo having the largest deficits in proportion to total exports.

1. Agency for International Development. Africa: Economic Growth Trends. Statistics and Reports Division, Agency for International Development, Washington, D. C. January, 1969.

Land area and population for the various countries and other relevant statistics are presented in the following table:¹

<u>Item</u>	<u>Senegal</u>	<u>Central African Republic</u>	<u>Cameroon</u>	<u>Nigeria</u>	<u>Togo</u>	<u>Ghana</u>	<u>Ivory Coast</u>
Area (1,000 sq. miles)	76	241	184	357	22	92	125
Agriculture land (per cent of area)	28	10	35	24	44	11	6
Population (millions) 1968	3.8	1.5	5.6	55.5	1.8	8.4	4.1
Population growth rate (per cent)	2.6	2.4	2.2	2.1	2.6	2.6	2.3
GNP per capita (U. S. dollars)*	200	130	135	125	113	219	260
Electricity per capita (KWH per year)	65	20	181	24	8	192	78

* Data unadjusted for inequalities in purchasing power among countries.

Nigeria is the largest country visited with 357 thousand square miles and a population of 55.5 million. An area in the U. S. approximately equal to that of Nigeria would include the states of Florida, Georgia, South Carolina, North Carolina, Tennessee, Mississippi and Alabama. This southeastern region of the U. S. contains approximately one-half of the total population of Nigeria. Togo is the smallest country of those visited, with a land area about one-half that of Alabama and a population of 1.8 million. The Central African Republic is the second largest, but the least populated of all countries surveyed.

1. Agency for International Development. Africa: Economic Growth Trends. Statistics and Reports Division, Agency for International Development, Washington, D. C. January, 1969.

With an annual population growth rate estimated from 2.1 per cent in Nigeria to 2.6 per cent for Togo, Ghana and Senegal, population of the countries will double within 30 years. Gross national product per capita is lowest in Togo at \$113 and highest in the Ivory Coast at \$260. Another index relating to level of development is production of electricity. In Togo and the Central African Republic, per capita production was 8 and 20 KWH per year, respectively, while in Ghana and Cameroon it was 192 and 181 KWH per year.

Summary of Present Fisheries Status

Marine Fisheries

In recent years harvest of fish, consisting primarily of marine species, has increased substantially as indicated in the following table:¹

<u>Catch</u> (thousand metric tons)	<u>Senegal</u>	<u>Central African Republic</u>	<u>Cameroon</u>	<u>Nigeria</u>	<u>Togo</u>	<u>Ghana</u>	<u>Ivory Coast</u>
1957	77.5	-----	53.6	-----	4.0	28.4	30.0
1967	173.7	-----	58.5*	64.2**	7.0***	110.1	66.9

* Latest available data are for 1965.

** Latest available data are for 1964.

*** Latest available data are for 1966.

The marine fishery industry of the region is expanding at a rapid rate principally as a result of increases both in African and foreign vessels utilizing sophisticated gear and modern techniques in locating pelagic and demersal fish stocks. However, the

1. Data are from 1967 Yearbook of Fishery Statistics. Food and Agriculture Organization of the United Nations, Rome, 1968.

traditional canoe fisheries operating primarily within sight of land remains quite important in most of the countries. Improved port facilities including freezing and storage facilities, increased ice supplies, expanded processing, boat repair and reconditioning services all have contributed toward expansion of the industry. The extent to which total marine catches in the West Central African region can be further increased is unknown at present, but it is thought that catch of valuable food species inhabiting waters of the continental shelf is nearing the level of maximum sustained yield.

Freshwater Fisheries

Major areas of production of freshwater fish in West Central Africa are Lake Chad and flood plains and swamps of the Niger River, principally in Mali. It is estimated that annual production from Lake Chad proper is 80,000 metric tons with an additional 30,000 metric tons caught annually from rivers of the lake basin. A portion of this catch is salt-dried and exported to Central African Republic, Cameroon and Nigeria. In 1965 freshwater catch for Mali was reported at 90,000 metric tons of which a considerable proportion was exported to the Ivory Coast, Upper Volta and northern Ghana.

With few exceptions, the freshwaters of countries surveyed principally support a subsistence type fisheries in which catch statistics generally are not reported. However, these freshwater fish are utilized locally and hence the fishery is providing an important source of animal protein for people of the area. A specific example is the Volta Lake fishery in Ghana where it has been ascertained that the annual catch of approximately 24,000 metric tons is consumed by 1 million inhabitants living within a 25-mile radius of the lake. There is little question that catch in freshwater rivers

and lakes in the region can be improved by motorization of canoes and utilization of improved fishing gear.

Fishculture

Fishculture was first undertaken in Central Africa by the Belgians in the early 1950's. Shortly thereafter the French initiated a program of pond construction for fishculture in the Central African Republic and Cameroon. By 1958 over 12,000 ponds had been constructed in the Central African Republic and by 1964 it is estimated that 25,000 ponds had been constructed, but only 500 managed for fish production. In Cameroon 5,000 ponds were constructed in the area of Fouban in one year, but in 1964, there were only approximately 3,200 ponds in production in the entire country. A similar pattern of fish pond development occurred in Togo and the Ivory Coast and apparently to a lesser extent in Ghana and Nigeria. Because of its arid climate, little effort was made toward development of fishculture in Senegal.

The initial effort on fishculture development in West Central Africa was notably unsuccessful, principally due to two factors. One was the extremely small size of the ponds - many were no larger than 30 square feet in surface area. The other very important factor was that no "tried and proven" method of culture had been developed prior to the crash program on pond construction. The small ponds simply were stocked with a few dozen fish of whatever species happened to be available - normally Tilapia - and some months later, it was expected that hundreds of pounds of fish would be available to take to market. It is no wonder that such a program failed!

In recent years interest in fishculture as a means of providing an economical source of high quality protein, especially for people living inland or in landlocked countries, has been rekindled. Emphasis now, however, is on construction of ponds

of larger size and some limited amount of testing of fish species best adapted for culture is being carried out in several of the countries surveyed. A more detailed discussion follows under each country.

Fish Marketing and Processing

Changes in the methods of marketing fish in West Central Africa will be slow to develop. The continued improvement of port facilities and fishing fleets in many of the coastal cities will force certain changes, but for the major portion of the African population the pattern of distribution and consumption of fish is likely to experience little change within the next decade. The limiting factors in fresh fish distribution are described in the following section.

Limitations in Marketing Fresh Fish

Except for major ports, there are no facilities generally for holding, icing, or for the rapid transport of fresh fish. The lack of facilities is no less serious in most coastal or near coastal areas than in inland areas. Fish are several hours old when brought in and usually no ice is used to maintain their freshness. During further delays that result from dividing the catch and while portions of the catch are being sold, fish generally are left unprotected from sun or soil. The local demand for fish at landing sites is limited, frequently necessitating long hauls to reach adequate markets. Depending upon problems encountered in hauling, fish may be smoked where caught or transported inland for smoking. At many of the ports, Douala (Cameroon), Tema (Ghana), and Abidjan (Ivory Coast), blocks of frozen marine fish are sold that can be kept for 24 to 48 hours before a decision to smoke must be made. The lack of facilities also prevails in the markets where fish are sent for sale so that fresh fish

can be held for a very short time only. Ice is not available except by individual traders who procure their own supply.

The supply of fresh fish is largely dependent upon the daily catch. Thus, the production and marketing of fish is haphazard. Supplies at the end of the day must be cleared by a severe price reduction; as a result, returns are highly variable.

The opportunities for improving distribution of fish are much greater in developed coastal areas. Provisions for icing, freezing, storing, and handling can be made. The problems, however, are much more serious in inland areas. The public or village market is the center for almost all African buying, including highly perishable fish and other food products. There is an absolute lack of handling facilities for fresh fish in practically all village markets. Except for towns connected by roads or rail systems that permit refrigerated transportation, most villages are almost inaccessible, and receive only smoked, dried, or preserved fish transported by trucks. Fish drying and smoking operations are shown in Figures 1 and 2.

To provide the proper facilities, including transport services for handling fresh fish, at inland markets would likely result in a price considerably out of reach of all but a few of the consumers.

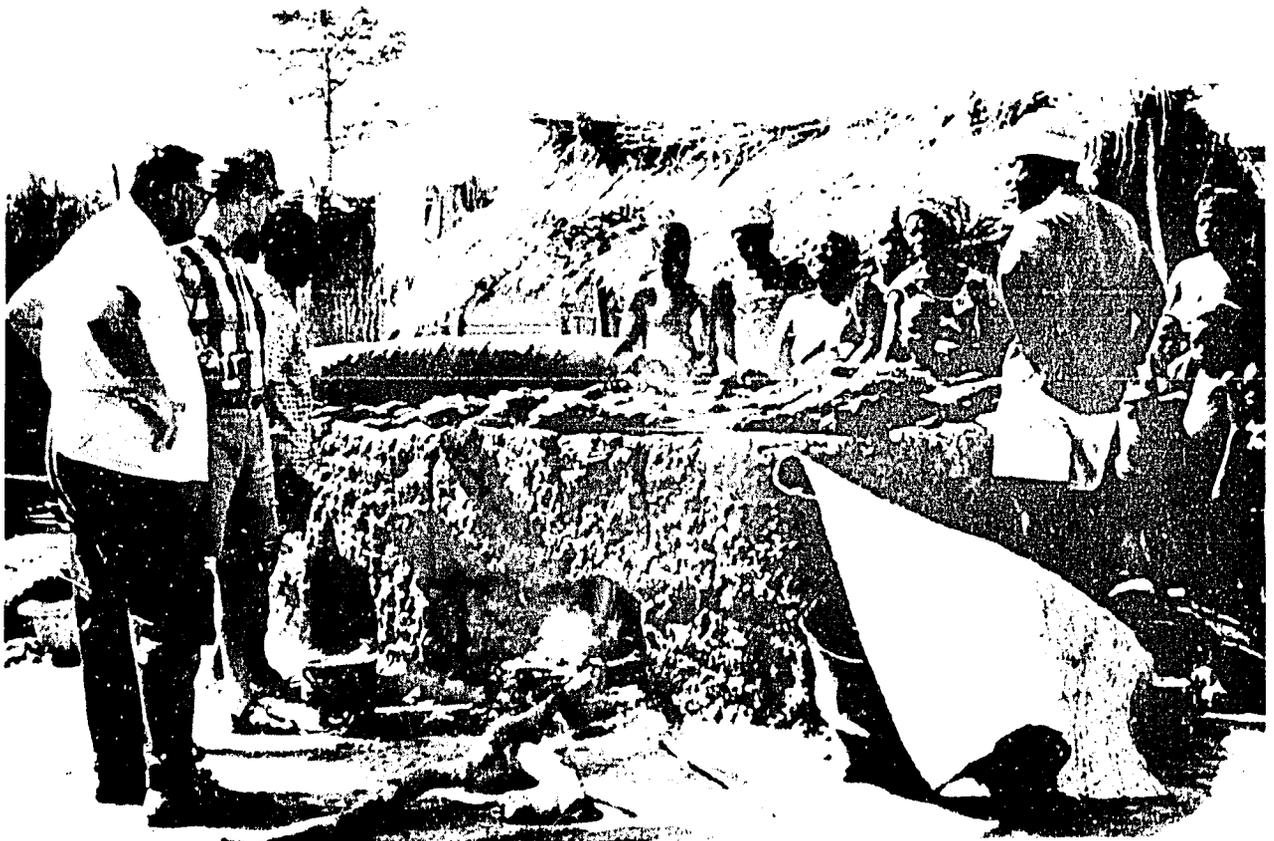
Marketing Smoked Fish

Because of the limitations outlined above, throughout West Central Africa smoked fish is the usual fish product sold. Smoked fish are highly acceptable since most are used in stews for which a strong flavor is desired. Fish are also dried, particularly in Senegal and Lake Chad area because of the climate, and a few are salted but preferences are strongest for fish that have been smoked. Smoking appears to be the most suitable way of preserving fish since storage and transporting



Fig. 1. Sun drying of fish is an important means of preservation in arid areas of Africa. Photo of fishing village at Joal, Senegal.

Fig. 2. Smoking of fish by "fish mamas" is commonly practiced in West African countries. Smoking for several days preserves fish up to three months. Photo at Ampem fishing village on Volta Lake.



problems are minimized. Preferences for fresh fish are probably pronounced but there was no practical reason for assessing consumer preferences since fresh fish is generally unavailable in village markets. There was no consistent price relationship between smoked and fresh fish. Quite often the smoked fish sold for the same price as fresh fish. A fully smoked fish is reduced one-fourth to one-fifth of its original weight. However, since smoked fish are sold by numbers or by the piece, weight loss is not a major consideration. There are three different degrees or methods of smoking.

Hot smoking. This method of smoking is characterized by the relatively high temperatures used (from 80 to 100^oC) and by the short period of time (no more than 24 hours) needed to complete the process. The keeping time of hot smoked fish is much shorter so that the market is limited to immediate distribution. The price ordinarily was somewhat higher than for the heavily smoked product.

Dry smoking. Smoking by this method requires a much longer time (from 4 to 14 days) and a lower temperature (not above 50^oC) than that of the hot smoking method. Fish must be redistributed periodically on the rack for even smoking and drying. Dry smoked fish can be kept indefinitely with periodic cold smoking if insect and rat infestations are not permitted. The practical storage period is from 3 to 4 months.

Cold smoking. This is the process used for "freshening" dry smoked fish. The frequency will depend upon the amount of moisture present since the purpose is to remove excess moisture. Ordinarily once a month is sufficient.

There are, of course, many ways that the above smoking procedures are conducted. Different kinds of ovens are used and fish are prepared for smoking in

different ways. Smoking is highly adaptable. Large fish can be cut into pieces and small fish can be grouped into bundles. Thus, the amount can be adjusted for the lowest wage earners or income groups. Smoked fish can be hauled by various transport methods, can be widely distributed, and can be made available at the regularly spaced market days of the inland towns or villages. Spoilage is not a major factor and the irregularity of the transport method is of less consequence.

The acceptance of smoked fish is well established. Moreover, the African household has no means of keeping a perishable product so it is not likely that the marketing of smoked fish will diminish in importance.

The "Mammie" System of Marketing and Distributing Fish¹

Until recent years, the dugout canoes were the only boats used by native fishermen. The canoe crews worked on a share basis and divided the catch. Each man was responsible for selling his own share, and since fishing was a full-time job, fishermen handed the fish to their wives or female family members to sell.

This method of marketing forms the background of the "mammie" system, which operates with many variations at the present time. The majority of these mammies are small operators who are not in a position to handle commercial or large quantities of fish. The women are also the processors, and carry out the cleaning, smoking or drying of the fish, often working through the night when catches are heavy. Many of the coastal women have connections in the inland market towns where fish is sent regularly, or sometimes a group of women will hire transport

1. This section draws heavily on the work of John L. Dibbs, as presented in Reports 1300 and 1446, both entitled Report to the Government of Ghana - Fish Marketing in Ghana. Food and Agriculture Organization of the United Nations, Rome.

and visit the coastal villages, collect a load of either fresh or smoked fish and return to the inland markets.

Fishermen are completely dependent upon the fish mammies for selling their fish. In actual practice many of the fishermen are not paid in cash at all, but are provided with food and other necessities, and have no financial independence. It is not surprising to find that the majority of canoe fishermen are bound financially to the women, being in debt for food supplied when catches are poor, or for gear replacement. Eventually the women become the owners and the fishermen are merely fishing for their own subsistence.

In many cases it is the women who provide funds for the purchase of a boat which immediately obligates the boat owners to their respective mammies. The women themselves work closely with a traditional chief. It is difficult for outside buyers to enter the market and similarly the women make it difficult for the boat owners to have other contacts under direct threat of not buying any more of their fish. The improvement of port facilities and transportation of iced or frozen fish seems not to have interfered with the mummie system. Most of these fish are paid for and transported back to their own villages for smoking and distribution.

Summary of Nutritional Status and Fish Consumption¹

From the standpoint of quantity, calorie levels of the region generally are satisfactory, ranging from 1,850 to 2,500 calories per person per day. Total daily

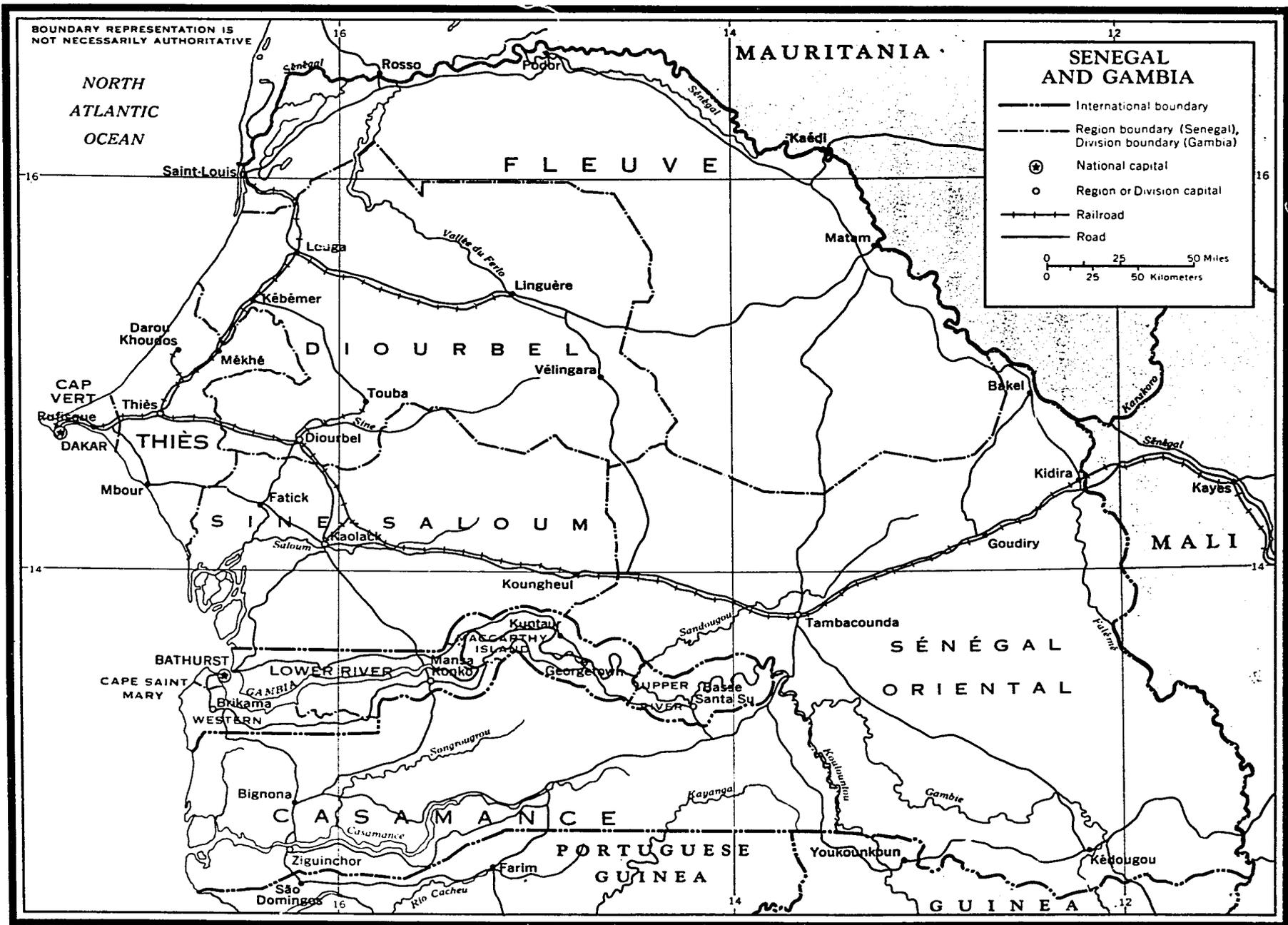
1. This section draws heavily upon a report entitled Report of the Possibilities of African Rural Development in Relation to Economic and Social Growth. Food and Agriculture Organization of the United Nations, Rome, 1962.

protein consumption, however, is low, ranging from 45 to 70 grams per person; animal protein consumption is much too low, ranging from 4 to 17 grams. Poor quality of the diet also is indicated by the fact that 71 to 91 per cent of the total calories are derived from starchy foods and cereals, whereas the recommended maximum from such sources is two-thirds of total calorie requirements.

Factors which tend to aggravate nutrition problems in West Central Africa are: 1) preharvest shortages are sometimes acute and in years when crops fail as a result of drought or insect and bird damage, famine develops; 2) inadequate food intake among children is prevalent resulting in stunted growth and lack of resistance to infections; 3) enormous losses occur due to improper methods of processing and inadequate facilities for storage and transport.

Consumption of fish in West Central Africa varies greatly from country to country and from one region to another within a particular country. Greatest consumption, estimated annually at 40 kg fish per person, occurs in areas immediately adjacent to the coastline. Fish consumption in inland areas, 100 miles or so from the coast, is low -- probably less than 5 kg per year per person for the countries surveyed. Where fish is available, it is generally greatly appreciated either in fresh, smoked, or dried state by most Africans. Although it is presently expensive relative to the income of the typical African consumer, fish probably offers the best opportunity for increased production of animal protein supplies in the near future.

SENEGAL



SENEGAL

Economic Status

The economy of Senegal is dominated by agriculture with almost 80 per cent of the active Senegalese population engaged in the agricultural sector. Three-fourths of the monetary earnings from agriculture result from peanuts.¹ Farms are largely village type, and except for peanuts, exist for subsistence purposes. Peanuts and peanut products make up practically all export trade in agricultural commodities and constitute the major portion of total exports. The economy of Senegal is closely allied with France, which receives most of her exports, and is the major source of goods imported.

Senegal is one of the smaller West Central African countries and has a population of 3.8 million persons. The gross national product on a per capita basis was estimated at \$200 in 1966.

Marine Fisheries

Fish production is primarily from marine sources. Senegal has a longer history of marine fishing than other West Central African countries, and the marine catch is greater than any of these countries, except for Ghana. In 1967 marine fisheries were estimated at about 133,000 metric tons primarily from native fishermen in pirogues or canoes. The catch from inland sources was considered

1. Economic Research Service, *Agricultural Policies in Africa and West Asia*. Foreign Agricultural Economic Report 49. USDA, Washington, D. C.

of much less importance. In contrast, also with other West Central African countries surveyed, a larger proportion of the catch apparently was sold fresh. Disposition of the 1967 marine catch was: fresh - 50 per cent; dried - 32 per cent; exported - 10 per cent; canned - 7 per cent; and other - 1 per cent.¹

The canning of tuna for export to France is important and is being expanded. With new processing facilities, planned capacity will far exceed the current catch of tuna. Also being expanded is the shrimp fishery industry.

Because of the proportion of the marine catch that is distributed fresh, very little marine fish reaches inland areas. Roads are poor and keeping facilities are non-existent. Apparently the catch does provide ample supplies of marine fish for coastal and near coastal areas where fish consumption has been estimated at 40 kg per person annually. In inland areas, however, consumption is only 0.5 kg per person annually.

During the three different fishing seasons along the Senegalese coast, it is estimated that 25,000 fishermen with 5,000 pirogues move up or down the coastline of Senegal following the fish. In the spring, Kayar, located 25 miles north of Dakar, is the central area for the majority of the artisanal fishermen. Fishermen go to sea before dawn and return between 4:00 and 5:30 in the afternoon. Their catch is sold to fish mummies or wholesalers who then truck the fish into the various towns for sale to the population.

1. Bureau of Commercial Fisheries. The Marine Fishing Industry of Senegal, 1967. Foreign Fisheries Leaflet 78. USDI, Washington, D. C.

Native pirogues are constructed of a single log hollowed by hand. The sides are then built up with planks to a height of approximately 3 feet. Overall length varies between 15 and 30 feet. Many of the pirogues are now equipped with 18 to 20 hp outboard motors which are mounted inside the boat in a "well" built in the stern. In addition, all pirogues are equipped with paddles and small triangular sails. Pirogues cost the fishermen approximately \$245. The motors cost \$470. This cost, however, is about one-half the actual cost on the open market because the government helps outfit the fishermen and these costs are comparable to wholesale prices.

UNDP/SF Pelagic Fish Resources Project

FAO has a project titled Survey and Development of Pelagic Fish Resources whose purpose is the biological evaluation of pelagic fish stocks, especially Sardinella, and exploratory and experimental fishing. This is a 5-year program operational since 1968 with a total contribution of \$2,352,102. In addition to the project manager, Mr. J. Elwertowski, there is a technical staff of five. The project has a 75-foot and a 125-foot trawler.

ORSTOM

Oyster culture has been established at two oyster culture cooperatives located at Joal and Thies. These cooperatives have produced 1,146 tons valued at \$28,000 during the period December, 1965 to April, 1966. A laboratory and regional office for fisheries is located at Joal. The project has been operational for several years with assistance from ORSTOM (Office de la Recherche Scientifique et Technique Outre Mer).

Peace Corps Fishery Cooperative

The Peace Corps has been in Senegal since 1963 and has 129 volunteers. There is a

cooperative fisheries project with a Peace Corps volunteer supervisor located at Joal. This operation is an effort to industrialize and improve the drying, salting, and smoking processing methods without changing the nature of the product. Fresh fish from the cooperative is sold in Dakar. Sharks are also caught, the fins sold for soup and the meat smoked and subsequently sold at local markets.

Freshwater Fisheries

Inland or freshwater fisheries is limited to the two major rivers of Senegal, the Casamance River in the South, and the Senegal River in the North. There is also one natural lake (Lac De Guiers) that has a limited fishery. Total catch from the freshwater fisheries is estimated at 20,000 metric tons per year. Fishing is with hand lines, cast nets, gill nets, and long lines with no bait. The primary species caught ranked in order of importance are: Lates niloticus, Citharinus citharus, Mormyrus macrophthalmus, Hemichromis fasciatus, Gymnarchus niloticus, Tilapia sp., Hydrocyon sp., and Clarias anguillaris.

CTFT Freshwater Research Project

The Centre Technique Forestier Tropical (CTFT), in cooperation with the Government Department of Waters and Forests has a division of fisheries research at Richard Toll. The primary objective of this French assistance project is analysis of data necessary for the management of the fisheries of the lower valley and of the river delta of the Senegal River. Present studies include:

1. Periodic measurements of temperature, pH, conductivity and concentrations of chloride, sulfate, carbonate, bicarbonate, sodium, potassium, calcium and magnesium at eleven stations, four on Lake Guiers, two on

Tawey Channel and five on the Senegal River.

2. Biology of the following economically important species: Citharinus citharus, Lates niloticus, Clarias senegalensis, Synodontis sp., and Heterotis niloticus.
3. Studies of the distribution of fish in delta basins of North Boundoum.
4. Studies of the movement of fishes in the Tawey Channel during the period Richard Toll Dam was open. This is being done using a combination of banks of nets and baskets.
5. Interpretation of results of experimental fisheries carried out in Lake Guiers from 1961 to 1966.

Assessment of Fishculture

With extensive development of marine fisheries along the approximately 300 miles of coastline, there is no immediate need for fishcultures except in inland areas. Presently, however, there is little emphasis in fishculture even in inland areas apparently because of limited rainfall, 10 inches annually, and the predominantly sandy soils. Best location for fishculture operations would likely be in the area of Lac de Guiers, near Richard Toll in north Senegal, if soils in the area are suitable for ponds and water to supply the ponds can be obtained from the lake.

Some consideration apparently has been given to a combination culture of rice and fish in an intensive rice culture project sponsored by the Chinese. Since intensive culture of rice, however, requires periodic applications of insecticide for control of the rice stem borer and other damaging insects, growing of fish in paddy fields will not be practical.

CONFERENCES

U. S. GOVERNMENT

Mr. Alfred Hurt, Director, USAID Regional Office - Dakar
Mr. Stanly Baronson, Assistant Director, USAID Regional Office
Mr. James Reese, Program Officer, USAID
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SENEGALESE GOVERNMENT

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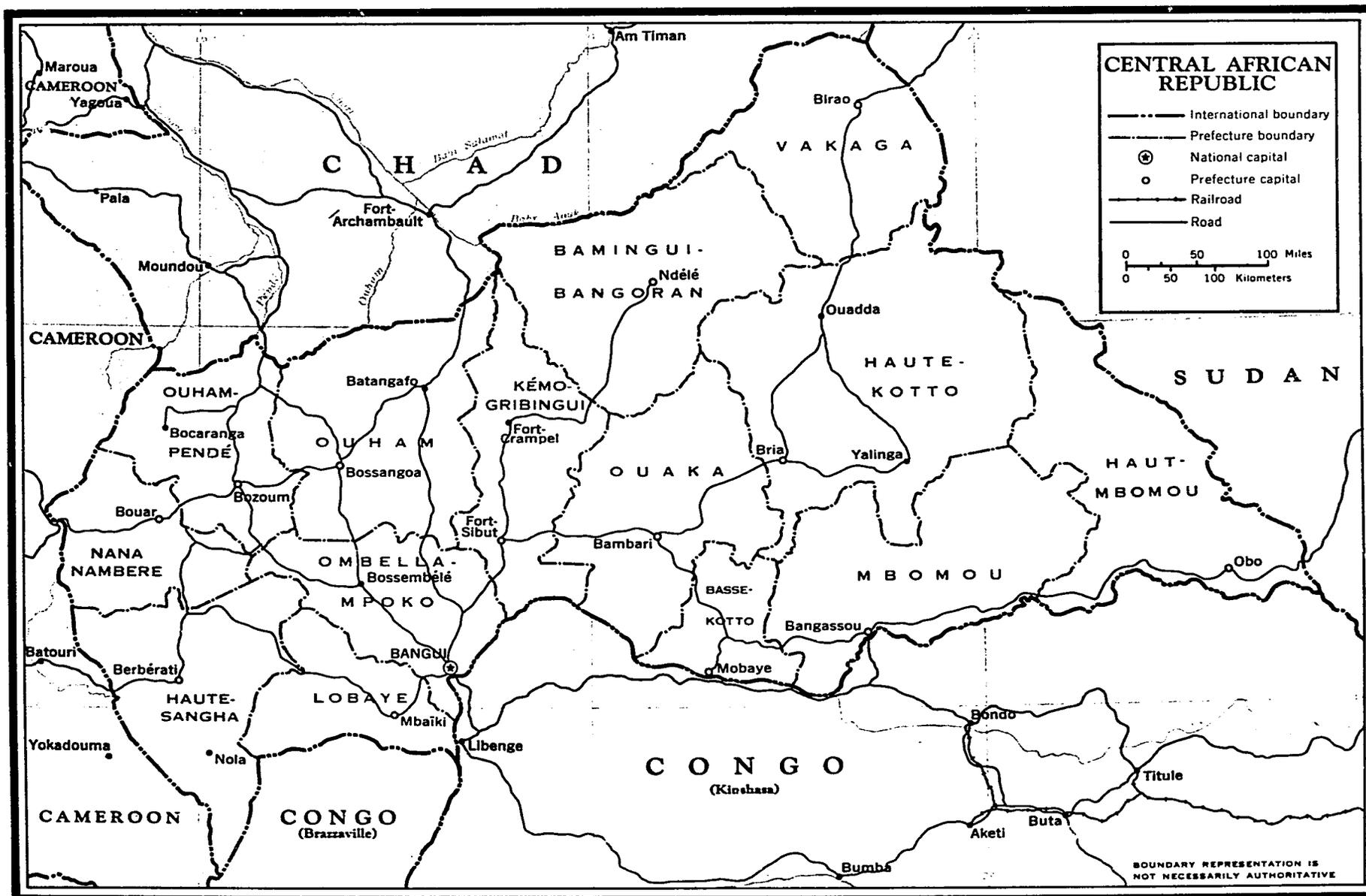
UNITED NATIONS

Mr. J. Elwertowski, Project Manager, Survey and Development of Pelagic
Fish Resources Project

REFERENCES

- Allsopp, W. H. L. 1967. Report on travel to Senegal and Mali. FAO Fisheries
Travel Report No. 4. AFRO. 6 p.
- Bjuke, C. R. 1963. Rapport Au Government De La Republique Du Senegal Sur
Les Ports De Peche. Organisation De Nations Unies Por L'Alimentation Et
L'Agriculture Rapport No. 1600. 10 p.
- Bureau of Commercial Fisheries. 1968. Shrimp industry in Senegal. 1967. USDI,
Foreign Fisheries Leaflet 139. 5 p.
- Di Palma, Salvatore. 1967. FAO Technical Conference on the Fisheries of West
African Countries, Daka, July 31-August 4, 1967. USDI, Bureau of Commer-
cial Fisheries, Foreign Fisheries Leaflet 128. 10 p.
- Di Palma, Salvatore. 1968. The marine fishing industry of Senegal, 1967.
USDI, Bureau of Commercial Fisheries, Foreign Fisheries Leaflet 78. 5 p.

CENTRAL AFRICAN REPUBLIC



CENTRAL AFRICAN REPUBLIC

Economic Status

The Central African Republic was the only landlocked country of the seven West Central African countries visited. The economy is largely agricultural and subsistence farming dominates agricultural production. There is little industry and the export of diamonds, the extraction of which has importantly increased in recent years, accounted for more than one-half of the country's total export value in 1966.¹ Cotton and coffee are the principal money crops and are the most important export crops.

The gross domestic product was estimated at \$166,000,000 in 1964, the last year for which such figures are available. Estimates of the population of the CAR, a country about the size of Texas, vary from 1.2 million to 1.5 million. Annual per capita income roughly approximates \$130. A 40-hour work week based on current minimum hourly wage rates, provides \$1.50 and \$4.00 weekly for agricultural workers in rural areas and non agricultural workers in the capital city of Bangui, respectively.

The road system in the CAR is poor. Bangui is connected with other cities by roads, but few are paved and maintenance is highly inadequate. Main roads are frequently closed to traffic, particularly during the rainy season. The Oubangui

1. International Monetary Fund. Surveys of African Economies. Volume 1. International Monetary Fund. Washington, D. C., 1968.

River, below Bangui, is navigable by barges and shallow-draft vessels. However, distance to the Atlantic Ocean via the Oubangui and Congo Rivers is nearly 1,000 miles. Transportation difficulties severely handicap the economic development of the Central African Republic.

No extensive hunger was observed in the CAR but malnutrition exists because of the scarcity of protein foods. Except in the urban centers protein foods from animal sources are in short supply. Other than marine imports, fresh fish were available only from river sources that apparently produce limited supplies. Very few fresh fish were observed on the native market at Bangui. No estimates were available on the composition of fish consumed but it was apparent that consumption of fresh fish in the villages was unimportant relative to the consumption of smoked and dried fish. The bulk of supplies of smoked and dried fish came from northern sections of the CAR and from the Lake Chad basin. Imports of marine fish from the Cameroon amounted to 33,000 pounds valued at about \$17,000 in 1968. There were no exports of fish reported from the CAR. In any case, the CAR is far from being self-sufficient in fish production and likely could sustain a very great increase in production without an appreciable effect on price. On the native markets smoked or dried fish is commonly sold by the piece or in bundles of pieces, red meats is sold by weight or piece irrespective of cuts, and poultry, when available, is sold live. In Bangui, dried and smoked fish from Lake Chad sold for approximately \$0.73 per pound while fresh fish was approximately \$0.75 per pound. In all probability, competition from other animal protein sources, either from price or preference, is not likely to greatly influence the production or consumption of fish, either as fresh, smoked, or in other forms.

Freshwater Fisheries

The Oubangui River with its tributaries in the extreme south and the Aouk River with its tributaries in the extreme north provide the majority of fish produced from freshwaters in the CAR. Although estimates are not available on total catch of freshwater fish, production from rivers is low - apparently due, in part, to low natural fertility of watershed areas.

Bouroungon Fishing Village

Several small fishing villages are located on the Oubangui River near Bangui. In Bouroungon, a village with 50 to 60 total population, there were 18 fishermen with 6 canoes. Principal fishing gear is the gill net, which is fished at night (Figure 3). Nets, generally made of nylon twine, are from 300 to 500 feet in length and approximately 12 feet in depth. Three fishermen in a canoe, with a drifting gill net fishing near the bottom of the river, may catch 50 pounds of fish per night. Catches are collected in early morning by fish mammies who pay fishermen \$0.30 to \$0.60 per pound according to species. A list of the fish species common to the area and their relative importance in the market at Bangui is presented in Table 1.

Regional Fish Culture Training and Research Project

This regional fish culture project is sponsored by a Special Fund of the United Nations Development Program (UNDP/SF). The Fisheries Department of the Food and Agriculture Organization of the United Nations administers the project, but with actual training and research contracted to the Centre Technique Forestier Tropical (CTFT), Paris. This French organization has long rendered assistance in forestry and fisheries to various French-speaking countries in Africa.



Fig. 3. Capture fisheries in Oubangui River, Central African Republic. Three fishermen in pirogue using drifting gill net may catch from 50 to 100 pounds fish per night.

Fig. 4. Fouban Fisheries Station, Cameroon, has 37 ponds with total surface area of 0.83 acres. Village women bring fish food (brewery wastes) in exchange for firewood they collect from Station area.

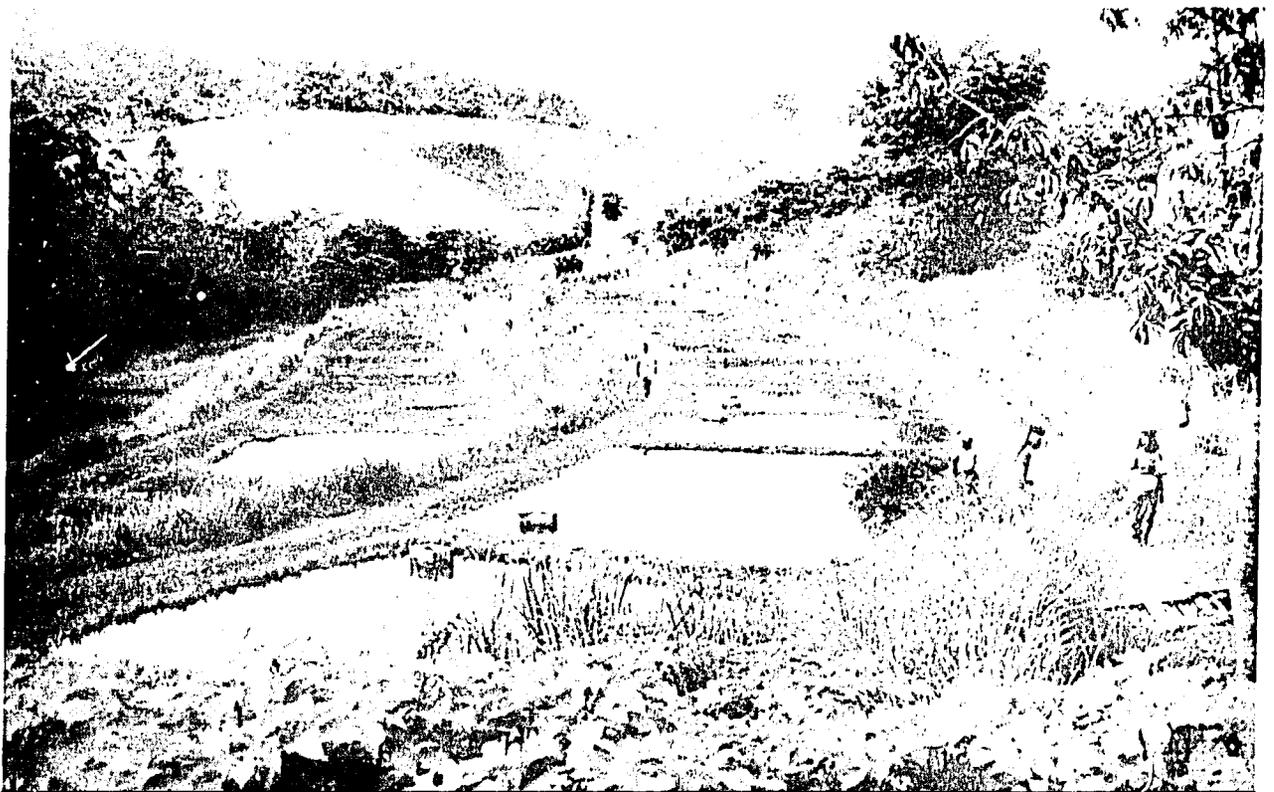


Table 1. Important Fish Species in Markets at Bangui, Central African Republic*

Scientific name	Local name	Average weight (pounds)
<u>Clarias anguillaris</u> <u>Clarias submarginatus</u>	Ngoro	2-4
<u>Alestes nurse</u> <u>Alestes macrolepidotus</u>	Pete	1
<u>Hydrocyon lineatus</u> <u>Hydrocyon vittatus</u>	Binga	3-5
<u>Labeo brachypoma</u> <u>Labeo senegalensis</u>	Soukourou	4-6
<u>Distichodus rostratus</u>	Mbamba	5
<u>Lates niloticus</u>	Nzambi	20-50
<u>Chrysichthys auratus</u>	Kamba	8-10
<u>Eutropius niloticus</u>	Mokele	4-6
<u>Auchenoglanis occidentalis</u>	Nzouim	8-10
<u>Gymnarchus niloticus</u>	Mbondi	10-20
<u>Gnathonemus tamandua</u>	Kpete	4
<u>Synodnotis ocellifer</u> <u>Synodnotis schall</u> <u>Synodnotis violaceus</u>	Wougnein Nebanga Ngbanga	0.5 0.5 0.5
<u>Schilbe mystus</u>	Nzanzara	0.3
<u>Malepterus electricus</u>	Nini	10
<u>Marcusenius isidori</u>	Lutu	0.1
<u>Hemichromis fasciatus</u>	Touya	0.3
<u>Tilapia galilaea</u>	Nzara	1

* Listed in decreasing order of importance on market.

The purpose is to provide assistance in expanding and developing fishculture through training and research in the Central African countries of Cameroon, the Central African Republic, Congo (Brazzaville) and Gabon. The project became operational in December 1967 and is funded for a period of five years. Total funds obligated amount of \$1,409,182 of which \$676,700 is from UNDP/SF while \$732,482 is contributed by the participating countries.

The Regional Center for the Fish Culture Training and Research Project is located at Bangui, Central African Republic with National Centers at Foumban, Cameroon; Djoumouna, Congo (Brazzaville); Oyem, Gabon. The project manager and an instructor are presently on post at the Regional Center, but instructors for each of the National Centers are still under recruitment.

The Auburn Team visited both the Regional Fish Culture Center at La Landjia in the Central African Republic and the National Center for Cameroon at Foumban. A description of the program and facilities at the Regional Center follows while information relative to the National Center at Foumban is included in the Cameroon report.

Regional Fisheries Center at La Landjia

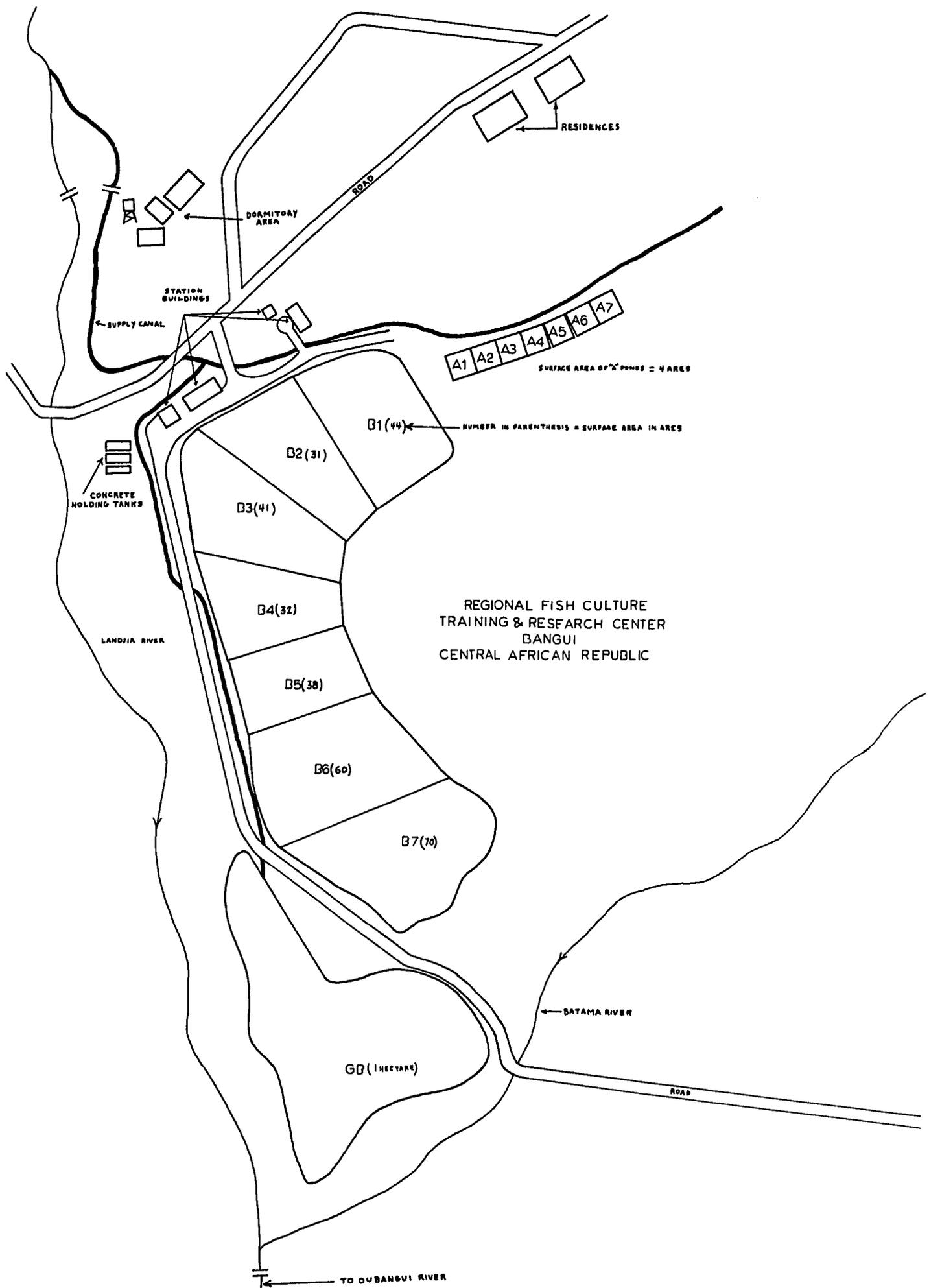
The original ponds at La Landjia Fish Cultural Station, located six miles from Bangui, were constructed by hand labor under supervision of the French during 1955-1956. However, the station essentially was abandoned in 1960 after the country gained its independence. Upon implementation of the Regional Fish Culture Training and Research Project, many of the ponds were renovated and additional facilities added.

Experimental ponds. At present there are 8 larger ponds and 5 smaller ponds with a total surface area of 10.7 acres. A plan of the ponds and area are shown on the following page. The largest pond (GB-Pond) has very limited usefulness since flood waters of the Oubangui River occasionally overtop the dam. Also, excessive seepage in Pond B-7 precludes its use for research. In addition to those listed above, 2 ponds (A-6 and A-7), each with a surface area of 0.1 acre, were under construction. There are 22 small concrete ponds (3 x 3 x 2.5 feet) and 1 larger concrete pond for holding fish for short periods.

Water supply to the station is diverted by gravity from a small stream, the Landjia River, through a concrete-lined canal. Water flow, estimated at 400 gallons per minute is adequate to maintain water levels of all but pond B-7, which loses water rapidly through seepage. Water temperature in the canal was 25^oC and apparently does not fluctuate appreciably during the year.

Buildings and other facilities. Construction was completed on a single laboratory and office building with a total area of approximately 1,500 square feet. The laboratory has about 700 square feet of floor space while 3 offices occupy the remaining space in the building. One new residence, recently constructed, is now occupied by an instructor and another residence is under construction. Also under construction is a dormitory which will house 12 trainees. There is also a watchman's house, a supply building and a shed for a 20 KWH diesel generator, which provides the only electricity on the station.

Staff. Mr. Paul De Kimpe, originally from Belgium but with considerable experience in fisheries in Africa, is Project Manager of the Regional Fish Culture Training and Research Project. He coordinates research and training programs



carried out at National Centers located in Cameroon, Congo (Brazzaville) and Gabon and supervises similar activities at the Regional Center in the Central African Republic. Mr. Croizeau is from France and has been associated with CTFT fisheries programs in Gabon and the Ivory Coast. He serves as the Project Instructor for CAR and will have primary responsibility in the training program. Mr. Jaques Bard, CTFT, Paris, is retained on a consultation basis. Additional staff include 2 technical assistants, Mr. David Yangué, who received one and one-half years experience and training working on a fish farm in Israel, and Mr. Makasso. There are 15 laborers employed at the station.

Training program. This Center conducts training programs at 2 levels. Since it serves as the National Center for Fish Culture Training for the CAR, participants from CAR will be trained at the Moniteur level to serve principally as fisheries extension agents. These trainees undergo a 3-month training program with emphasis on proper location, size and construction of fish ponds, proper stocking methods, methods of feeding and formulation of artificial feeds, and suitable draining and harvesting procedures. The level of formal education required for moniteur trainees is Certificat d' Etudes Primaires, roughly equivalent to fifth grade in the U. S.

The second level of training provided is for Technical Agents. The educational level required is Brevet d' Etudes du Premier Cycle, equivalent to ninth grade in the U. S. After employees of the Water and Forests Services of Cameroon, CAR, Congo (Brazzaville) and Gabon complete the 10-month training program, they return to their respective countries to direct activities relating to fishculture development. Various areas of work emphasized in this particular program include:

1) location and proper construction methods, 2) fish nutrition and feeding, 3) pond fertilization, 4) fish breeding, 5) aquatic weed control, 6) predator control, 7) fish parasite and disease control, 8) handling and transporting fingerlings, 9) species selection, 10) economics of fishculture, 11) administration of fishculture programs, and 12) supervision and training of Moniteurs for extension services.

The initial program of training at the Regional Center, carried out June, July and August, 1969, will be at the Moniteur level for ten participants of the Waters and Forests Service in the Central African Republic. The second training session, scheduled for October, 1969, will involve a total of 12 trainees at the Technical Agent level.

During the five-year period that the Fish Culture Training Program is scheduled to operate, it is anticipated that a total of 100 Moniteurs will be trained at the Bangui Center for work in the CAR while Moniteurs trained at National Centers in Cameroon, Congo (Brazzaville) and Gabon, will number 80, 50, and 40 respectively. During the same five-year period, a total of 24 Technical Agents, 6 from each participating country will be trained at the Landjia Regional Center during two 10-month training sessions. A number of one-year fellowships are provided so that some of the Technical Agents may obtain further fish culture training abroad.

Research program. During 1968, the first year of research at the Regional Center at Bangui, work was primarily on fish production with supplemental feeding. Fish species tested were Tilapia nilotica and Heterotis niloticus. The former species has long been utilized as a pond fish in Africa. It is well accepted by peoples in most countries in the area and large crops can be produced in relative short periods. Its major limitation so far as pond culture is concerned is its

exceptionally high reproductive potential. This fish becomes sexually mature within a few months after hatching and subsequently produces several broods of young fish each year. This results in large crops of fish but with a significant amount of total production in the form of fish too small for general consumption. The latter species, H. niloticus, grows to a large size in a short period (one specimen attained a weight of 7 pounds in one year). However, the quality of the flesh is inferior and it is easily injured and difficult to keep alive during stocking and draining operations.

Six ponds were stocked in 1968 with T. nilotica at the rate of 1.5 fish per square meter of surface area of water. These fingerlings averaged 10 to 25 grams. Several of the ponds also received H. niloticus, approximately 40 fingerlings per pond. Dried brewery wastes were utilized as food since this could be obtained locally at no charge; costs for transporting this material 12 miles in 2-ton lots amounted to less than one-half cent per pound. Fish were fed once per week at the rate of 30 percent their initial body weight.

Production results and other relevant data for 3 ponds, drained early in 1969, are summarized as follows:

Pond B-6 (1.48 acres) was stocked June 21, 1968, with 416 pounds Tilapia nilotica per acre and contained a standing crop of 853 pounds when drained approximately 6 months later. Net production was 437 pounds (874 pounds per acre per year, assuming two crops per year). Total feed per acre was 4,459 pounds of brewery wastes with an "S" conversion of 10.2. ("S" conversion equals the total pounds fed divided by the net pounds of fish produced.)

Pond B-3 (1 acre) was stocked May 31, 1968, with 231 pounds fingerling Tilapia nilotica plus 33 pounds adult and 8.8 pounds fingerling H. niloticus per acre. The total standing crop at the end of 8 months was 1,698 pounds, with a net production of 1,426 pounds per acre per year. A total of 13,200 pounds brewery wastes were fed during the 8-month period, with an "S" conversion of 9.3.

Pond B-2 (0.77 acres) was stocked May 31, 1968, with 228 pounds fingerling T. nilotica and 8.6 pounds fingerling H. niloticus per acre. After 10 months, the standing crop was 2,619 pounds per acre, while net production was 2,393 pounds per acre per year. A total of 24,285 pounds brewery wastes were utilized per acre as fish food during the 10-month period, with an "S" conversion of 10.2.

Food conversion ratios (pounds of feed required to produce one pound of fish) are quite high, indicating poor quality of feed and/or need to feed fish on a daily basis. Fish normally are more efficient and exhibit improved rates of growth if feed is given daily rather than on a weekly basis. At Auburn University, maximum per acre production attained in a 10-month period with tilapia, feeding daily with a balanced ration at 3 per cent of body weight per day, amounted to approximately 8,000 pounds, with a conversion ratio of 1:1.

As indicated previously, one of the problems involved in tilapia culture is the relative large weight of small fish produced. In the experiments described above, from 18 to 21 per cent of the total standing crops upon draining consisted of fish too small to be easily disposed of at local markets. Mono-sex culture, in which sexually mature male and female of different Tilapia species hybridize to produce principally male progeny, provides an effective method of eliminating excessive numbers of very small tilapia resulting from uncontrolled reproduction. However,

mono-sex culture necessarily requires elaborate facilities in terms of numbers and location of hatchery ponds in order to maintain broodstock of appropriate Tilapia species in the pure state.

The program of research at the Bangui Regional Fish Culture Station is being expanded as experimental facilities permit. Future research will include: 1) stocking T. nilotica in combination with a carnivore, Hemichromis fasciatus, as a means of reducing numbers of small Tilapia; 2) testing Astatoreochromis alluaudi, a fish imported from Lake Victoria feeding principally on mollusks, for biological control of snails that serve as vectors of bilharziasis; and 3) determining fish production in fish-duck combination ponds. These fish species are shown in Figure 5.

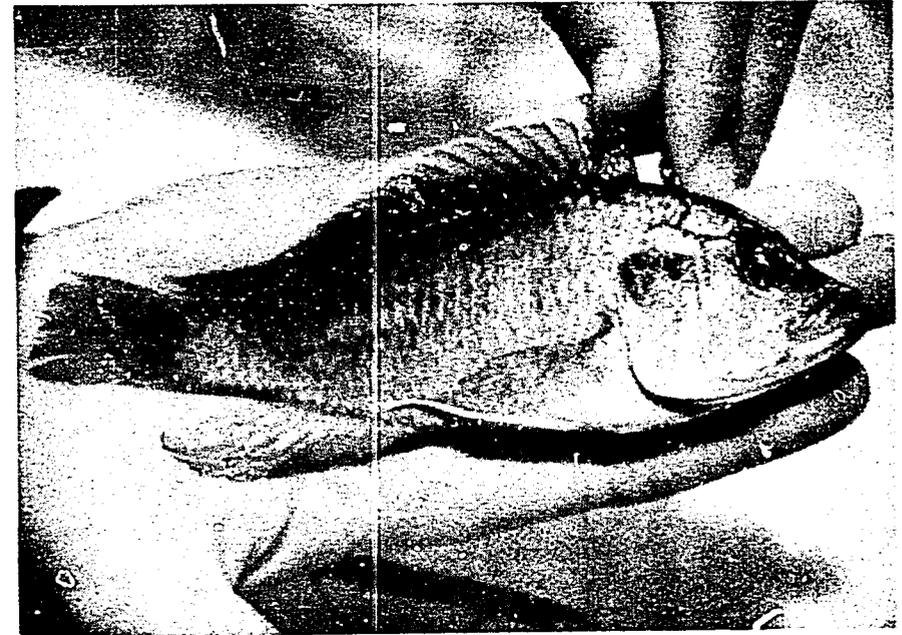
Bengue Fisheries Station at Bambari

Initially constructed by the French in 1952, this station, with 23 ponds and a total area of 2.9 hectares or 7.06 acres, is operated by the Waters and Forests Service. It is located 6 miles from Bambari, the second largest city in the CAR, with a population of approximately 35,000. Ponds on the station were constructed so that each can be filled and drained individually. Moreover, ponds are sufficiently large to be utilized in tests for commercial fish production. Size and number of ponds are presented on page 38.

Water to supply the ponds is obtained from a small stream and diverted by gravity to the ponds, a distance of 0.84 miles. Shortage of water presents a problem during the months of December, January and February in years of extreme drought. No records of the rainfall could be obtained for Bambari, but data obtained for Grimari, a small town located 50 miles west of Bambari, are presented on page 38.



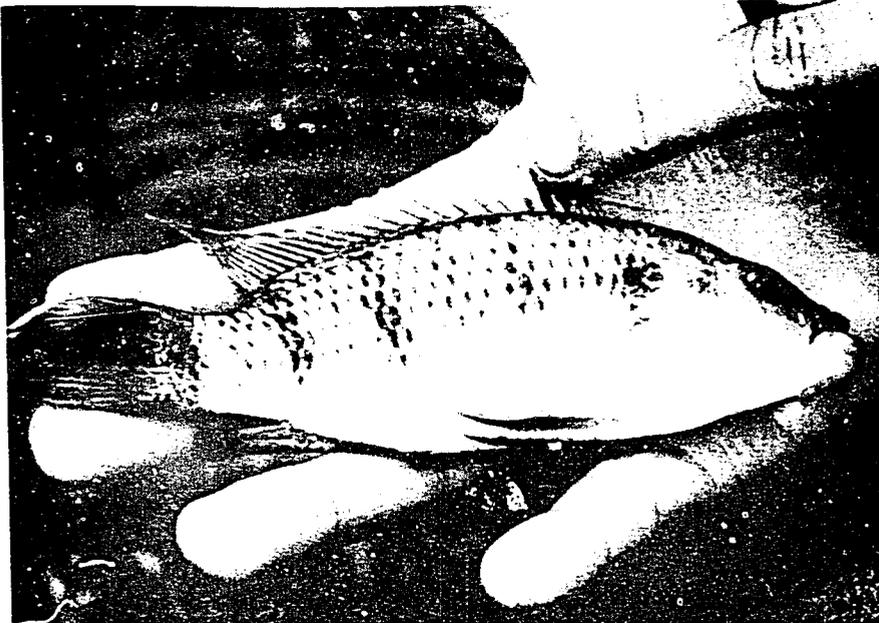
a. Heterotis niloticus



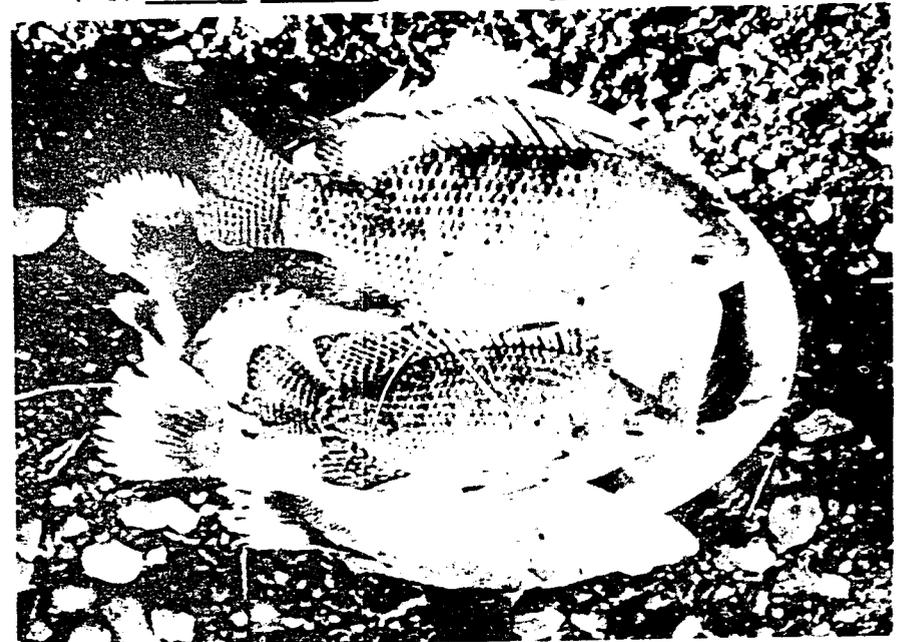
b. Astatoreochromis alluaudi

Fig. 5. Principle fish species being evaluated at various fisheries stations in Africa

c. Hemichromis fasciatus



d. (top) Tilapia nilotica (bottom) Lates niloticus



Number and Size of Ponds, Bengue Fisheries Station, CAR

<u>Number of ponds</u>	<u>Size (acres)</u>	<u>Total acres</u>
F-Series		
5 ponds	0.01 each	0.05
2 ponds	0.02 each	0.04
A-Series		
6 ponds	0.05 each	.3
S-Series		
3 ponds	0.07 each	.22
P-Series		
1 pond	.67	.67
1 pond	.76	.76
1 pond	.89	.89
1 pond	.94	.94
1 pond	.99	.99
1 pond	1.04	1.04
<u>1 pond</u>	1.18	<u>1.18</u>
23 ponds		7.08 acres

Temperature and Rainfall at Grimari Agricultural College

<u>Month</u>	<u>Temperature (°C)</u>	<u>Rainfall (inches)</u>
January	24	.39
February	26	1.17
March	26	3.51
April	26	4.48
May	26	6.63
June	25	6.63
July	24	7.61
August	24	8.97
September	24	8.58
October	24	8.19
November	25	3.12
December	24	<u>1.17</u>
		60.45 inches

This station produces fingerlings for stocking 66 private ponds around Bambari and 835 ponds in the district. Although T. nilotica, T. galilaea, T. macrochir and Heterotis niloticus are cultured, the greatest demand is for T. nilotica which grows to a larger size. Per acre stocking rates range from 90 pounds fingerlings for very small ponds (0.1 acre) to 350 pounds fingerlings for larger ponds (0.5 acre and larger). Cost of fingerlings to pond operators is roughly 18 cents per pound. Larger fish are sold fresh at the local market for 27 cents per pound.

In 1968, approximately 14,500 pounds of fingerlings and larger fish were sold. In one production pond, 27 ares in size, 861 kg fish were produced in 1968 and 692 kg in 1969, equivalent to 2,826 and 2,283 pounds per acre, respectively during a 6-month culture period. Rate of feeding was 90 pounds per acre per day, with an average "S" conversion of 6:1 for the two crops.

In station ponds, fish were fed daily, except Sunday, with a mixture of whole cottonseed, peanut meal and pressed sesame seed. Cottonseed is available in quantity in the area at no charge, while peanut meal and sesame each cost approximately two cents per pound. Income from the sale of fish at the station is forwarded to the regional development office, which, in turn, provides money for salaries of station personnel. In addition to the head of the station, there is a superintendent, an extension agent, 2 guards and 20 laborers. An annual budget of about \$3,600 is provided from the central government plus a smaller amount from the regional government to operate the station. Total annual production of 14,500 pounds fish at \$0.20 per pound would result in revenue of \$2,900 per year, which is \$700 less than funds presently being expended for salaries and supplies - with no depreciation considered.

Bossemebele Fisheries Station

This is a small government station with 8 ponds, each with a surface area ranging between 0.1 to 0.2 acres. The ponds, which were constructed in 1959, are supplied with water from a small stream. Water flow is by gravity through an earthen canal.

Tilapia nilotica was being cultured in two ponds while a combination of T. melanopleura and T. zillii, with T. zillii being most abundant, were stocked in the six remaining ponds. Ponds were stocked at the rate of 220 pounds fingerlings per acre and total standing crop after 8 months ranged from 650 to 850 pounds per acre. Fish are sold locally, either as fingerlings for stocking some 90 ponds or larger fish for market, for approximately 18 cents per pound. Leaves of manioc and whole cottonseed were used as fish feeds, with three applications being made per week. However, no records were kept of the amount of the food materials added to the various ponds.

Assessment of Fishculture

Pond fishculture is not a new concept in the Central African Republic. Before the country gained its independence, the CTFT constructed several fisheries stations and encouraged construction of small ponds by local farmers. The fisheries stations provided fingerling tilapia for stocking thousands of these small ponds.

In the early 1960's, the country gained its independence and the fishculture program was practically discontinued. Today, however, the government is extremely interested in pond fishculture and some progress is being made in the area

primarily by the FAO-CTFT project at the La Landjia Station (Bangui) and by the government at the Benue Station (Bambari).

The La Landjia Station and the Benue Station are the principal fisheries stations in the country but both have severe limitations which reduce their effectiveness.

The La Landjia Station has a severe shortage of suitable experimental ponds. At present only 6 of the 13 ponds at the station are in production. Excessive seepage is a problem in one pond (B-7) and a second pond (GB) occasionally floods during the rainy season. Several of the smaller A-series ponds are presently in various stages of construction and renovation.

With such a small number of ponds, many years will be required to develop efficient methods of fishculture. This station needs additional ponds for experimentation, but soil borings in Pond A-7 indicated presence of appreciable amounts of small gravel at 4 to 6 feet. Construction of additional ponds in this particular area based on these soil borings does not seem practical.

Other borings made in the bottom of Pond B-7 indicated good clay to a depth of 6 feet and it is likely that seepage in this pond is occurring under the dam. This general area appears to be favorable for additional pond construction providing periodic flooding can be prevented and adequate clay is present. Construction of a dike between the Oubangui River and the station would prevent flooding of station ponds, and additional soil borings will determine whether adequate clay is present.

Experimentation at this station presently is concerned with feeding combination cultures of Tilapia and Heterotis. This experimentation should be expanded

to include other species of fish, the use of various types and combinations of feeds, and fertilization with available organic and inorganic materials. Research could be conducted not only by the present station staff, but by the trainees in the training program at the station. Both the station and the trainees would benefit by such a program. The station would gain valuable information upon which to base further experiments and recommendations to local pond owners, and the trainees would gain valuable experience in proper research techniques.

The Benue Fisheries Station presently functions primarily as a hatchery to produce fingerlings for stocking local ponds. Many of the station's 23 ponds are adequate for testing commercial culture methods, while the smaller ponds could be utilized for fingerling production. This arrangement, if properly coordinated with the Regional Fish Culture Training and Research Project, would permit more rapid testing of techniques developed at La Landjia and would considerably shorten the time necessary to develop improved methods of fishculture.

CONFERENCES

U. S. GOVERNMENT

Ambassador Lewis, American Embassy, Bangui
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Mr. Komengallot, Chef de Cabinet
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Mr. Damango, Co-Director, Waters and Forests Service

UNITED NATIONS

Mr. Lawrence, Resident Representative of the United Nations
Mr. Le Clair, Regional Agriculture Advisor for FAO

REFERENCES

Centre Technique Forestier Tropical. 1968. Les recherches sur les peches continentales au centre technique forestier tropical - Rapport Annuel 1967. CTFT, Paris. 33 p.

Food and Agriculture Organization. 1967. Plan of operation United Nations Development Programme (Special Fund), Fish Culture Training and Research Project. FAO Rome. Unpublished Report (WS/65135). 55 p.

Ginnelly, G. D. undated. Possible USAID contribution in the development of pond fish culture in Central and West Africa - USAID Washington. Unpublished Report. 33 p.

Poll, Max. 1957. Les Genres des Poissons D'Eau Douce De L'Afrique. Annales Du Musae Royal Du Congo Belge, Tervuren, Belgique. 191 p.

CAMEROON

CAMEROON

Economic Status

The Republic of Cameroon was formed in 1961 from the merger of the British trust territory (now called West Cameroon) with the French-speaking Republic of Cameroon (now called East Cameroon). The economy is predominantly agricultural with 84 per cent of the labor force in agriculture. Most of the agricultural production is for domestic consumption. The industrial segment is quite small but the city of Douala, on the Atlantic Coast, is experiencing a very vigorous industrial expansion. Exports are principally agricultural, the most important of which are coffee, cocoa, cotton, bananas, and peanuts. Coffee and cocoa accounted for half of all exports during the 1965-67 period. While cocoa is cultivated mainly on small farms, coffee, cotton, and bananas grown for export are controlled by foreign companies. The acreage under cultivation devoted to export crops is about 5 per cent of the total, the remainder, except for cocoa, being farmed on a subsistence level.¹

The population of the Cameroon was estimated at 5.6 million in 1968. The gross domestic product per capita approximated \$135 in 1966.² Current minimum wage scales provide a weekly minimum pay for wage earners of \$2.00 and \$6.00 for agricultural and nonagricultural workers, respectively.³

1. International Monetary Fund. *Surveys of African Economies*. Volume 1. International Monetary Fund. Washington, D. C.

2. Agency for International Development. *Africa: Economic Growth Trends*. Statistics and Reports Division. Agency for International Development, Washington, D. C. January, 1969.

3. International Monetary Fund. *op. cit.*

The road system is inadequate. Major cities and towns are connected by roads but only 14 per cent are considered all-weather roads. The railway system connects Douala, the major port city, with Yaounde, a distance of 180 miles and with Nkongsamba, a distance of 100 miles. An expansion of the railway is now underway. The development of a marketing economy in the Cameroon will greatly depend on a further improvement and expansion of the transportation system.

The diet pattern for people in Cameroon is not greatly different from other less-developed West Central African countries. Protein foods are extremely limited. Estimates of production of fish from all sources are included in the Ministry of Plan and Development's Second Five-Year (1966-1971) Plan for the Cameroon. A total of 72,500 metric tons of fish and shellfish were reported for 1967 with 75 per cent estimated from inland or freshwater sources. The remainder was from marine sources. Imports, primarily frozen marine fish and stockfish (dried cod), amounted to about 3,500 tons in 1968. In any case, supplies of fish from all sources provide only a negligible portion of the diet if calculated on a per capita basis (0.03 pounds per year).

The major part of fish consumed by the local Cameroon people is supplied from inland sources. The primary source of these supplies is the Legone-Chari Basin in the extreme northern part of the Cameroon. Because of the distance these fish must be carried, they are smoked or dried, principally smoked. Because of the scarcity of supplies, there is no effective competition on a price basis nor is there any competition between kinds of fish or between fish and other meats. Prices appeared to be high relative to other African countries, a further reflection on supply. Except for imported stockfish, which sold on the Mbalmayo market for 80 cents per pound, prices were consistent for kinds of fish. For example, fresh sea fish were observed

at 30 cents per pound, and local dried fish were 50 cents per pound. There would appear to be a great need for increased supplies of fish protein.

Marine Fisheries

In 1967 the total catch of fish and shellfish was 72,500 metric tons including: freshwater catch - 55,000 metric tons; marine catch (industrial) - 11,558 metric tons; marine catch (traditional) - 6,000 metric tons. The principal species caught are: croakers, sardines, sardine-like fish (Sardinella cameronensis and Ethmalosa fimeriata), sea breams, threadfins, drums, soles, barracudas, rays, shrimp, lobster and crabs.

The bottom fishery may be susceptible to over-fishing if the fishing effort is intensified. Pelagic fishes and shrimp seem to offer major potential for expansion of the fishery.

Traditional Fisheries

The annual landings are between 5,000 and 6,000 metric tons - about one-half of which is sardines. The number of pirogues is estimated at between 1,500 and 3,000. Sails and oars supply the principal motive power although a few have out-board motors.

The larger pirogues are used to fish for sardines and sardine-like fish with ring nets 1,500 to 2,000 feet long and 30 to 40 feet deep. The mesh size varies from 1 to 1.5 inches. Fishing season is from September to mid-January and from mid-February to April. Nylon nets are being used in addition to drift lines, set nets, beach seines, drag nets and cast nets.

Most of the fish are consumed fresh in the coastal area. The remainder is smoked in fishing villages and sold in Douala and inland. Drying of fish is limited by the extremely high humidity.

Industrial Fishery

The industrial fishery is based at Douala where there are 5 active fishing companies. The 1967 landings totaled 11,558 metric tons. Most of the catch was bottom fish. At present there are 20 side trawlers 33 to 92 feet long and two larger fishing vessels 165 and 198 feet long. Eight modern shrimp vessels are expected in 1969.

The Douala harbor has 545 feet of dock frontage for the fishing industry which is not sufficient for needs of the expanding fishery. Space in the one large building is divided among the following companies: Societe a la peche Cotieres a la Baleine (Sopecoba), Cotonnec et Cie, Les Pecheries Camerounaise, and La Societe Africaine de Peche Industrielle.

Vessels fishing for these companies land iced fish and market them through their own retail outlets or sell to wholesalers. Ice is supplied by the Brasseries Camerounaise. Most of the fish is sold in the Douala and Yaounde area.

The fifth company, Societe Industrielle des Peches au Cameroun (Sipac), became active in 1967. This company has a modern plant with a blast freezer and cold storage depots throughout the country. One depot is already operating in Yaounde and is supplied with frozen fish by three refrigerated trucks.

The Societe Camerounaise de Produits de Mer (SCPM) has a cold storage area in Douala but no vessels. It distributes frozen fish primarily landed from Russian vessels.

Shrimp Fishery

The shrimp fishery is presently limited in Cameroon, but there is increasing interest in this fishery. The La Crevette du Cameroun, the first shrimp processing effort in Cameroon, has a plant with a freezer capacity of 14,124 cubic feet and an ice production of 20 tons per day. Present capacity is 4 metric tons of heads-off shrimp per day.

Imports of fish and shellfish. In 1966 Cameroon imported 1,951 metric tons of fish and shellfish valued at \$1,135,350. In 1967 for the first 9 months, imports were 3,633 metric tons valued at \$1,250,800. Norway was leading supplier in 1966, followed by Morocco, France and Iceland. The principal products were stockfish (603 tons valued at \$542,00) and canned fish, mainly sardines. In 1966 the Soviet Union accounted for 475 tons of primarily frozen fish valued at \$40,970. For the first 9 months of 1967, the figure was 989 tons valued at \$80,923.

Freshwater Fisheries

Inland fisheries, based primarily on natural bodies of water, produce an estimated total production of 55,000 metric tons, with 40,000 metric tons from the Legone-Chari Basin, 3,000 metric tons from Benoue Basin, and 12,000 metric tons from the southern forest region. An additional though limited amount is harvested from an estimated 3,200 fish ponds yielding 200 to 500 pounds per acre annually.

Government fisheries stations were established between 1948 and 1960 at Yaounde, Mbalmayo, Foumban, Mboude, Ngaoundere, and Bartoun for the purpose of supplying fingerlings to stock local ponds and for studying various aspects

of aquatic biology.

Melen Fisheries Station (Yaounde)

This small fisheries station is located in Yaounde and is operated by the Waters and Forests Service. There are 5 large ponds, 1.2, 5.2, 7.4, 3.5, and 6.4 acres. In addition to the large ponds there is one 0.35-acre pond and 3 small ponds of 60 square meters each. There are several small concrete holding tanks and a main building containing a laboratory and several offices. The water supply is by gravity flow in concrete canals from the River Olezoa.

Fishculture began here in 1948 by importing Tilapia melanopleura from the Belgian Congo. Tilapia macrochir was introduced in 1950. In recent years, T. nilotica was substituted as the principal fish cultured because of faster growth and in 1965, Heterotis niloticus was brought to the station from north Cameroon.

One of the major problems in the area is bilharziasis. In 1962, Astatoreochromis alluaudi was imported from Lake Victoria for biological control of snails which are vectors for the disease. When stocked in 100 square meter ponds, 13 fish were found to remove all snails in 3 to 4 months.

Hemichromis fasciatus, a predator found in natural waters of the area, attains a size of 200 grams and is stocked in ponds at a rate of 5 per cent of the total weight of Tilapia stocked. This species cannot eat Tilapia larger than 5 grams because of its relatively small size, but it apparently is effective in controlling Tilapia reproduction.

Foumban Fisheries Station

This station serves as the National Center for the Cameroon under the UNDP/SF Regional Fish Culture Training and Research Project. Unfortunately,

a Project Instructor to direct activities has not been recruited. It is located 1.2 miles from Fouban (Bamoan District), but by road it is 7 miles.

The number and size of ponds are: 15 ponds - 0.01 acres; 9 ponds - 0.02 acres; 5 ponds - 0.03 acres; 1 pond - 0.04 acres; 2 ponds - 0.05 acres; 3 ponds - 0.06 acres; 2 ponds - 0.07 acres. The total area of the 37 experimental ponds is 0.83 acres, with only 13 ponds having areas of 100 or more square meters. For general fishcultural work most of these ponds are too small, but a number of larger ponds could be constructed in the area since there is good clay soil and the water supply is adequate. A photograph of this station is presented in Figure 4.

Water supplying the ponds comes from a stream through an earthen canal a distance of 1.8 miles. The coffer dam consisted of rocks enclosed in wire netting. Some repair work was needed on the dam to increase water flow through the canal to the pond area. Most of the drainage area consists of grassland and forests planted by the French 15 to 20 years ago. Practically the entire watershed is owned by the government and administered by the Waters and Forests Service; so water pollution through uncontrolled erosion or industrial or domestic wastes is not a problem.

Buildings and other facilities. Existing facilities include an unoccupied residence which needs renovating and a large storage shed for equipment and supplies, with an adjoining office. Total floor space of the latter building is approximately 800 square feet. Funds are available under the UNDP/SF Fish Culture Training and Research Project for renovation of the existing residence and construction of a laboratory and a dormitory to house 10 trainees. Construction

will be initiated when the Project Instructor for the National Center is recruited by CTFT, probably late in 1969. Since the station is not supplied with electricity, a diesel generator is needed. There is need to construct an all weather road from the station to Fouban, a distance of 1.2 miles. At present the shortest route to the station from Fouban is 7 miles and requires use of a 4-wheel drive vehicle during the wet season.

Program of work. Major purpose of the station at present is to produce fingerlings, mostly Tilapia nilotica and a few Heterotis niloticus, which are distributed free of charge to pond owners in an attempt to encourage development of more fish ponds in the area. An estimated 5,000 ponds have been constructed in the Fouban area alone, but only 3,200 are presently in operation in East Cameroon. Production of fingerlings during the past year was estimated at 10,000 to 15,000.

Fish feed at the station consists principally of brewery wastes made from corn and millet. These wastes are brought to the station each Thursday by village women. In exchange, the women are permitted to cut and remove firewood from the forest area. The brewery wastes are distributed to the ponds one day each week with an additional feeding of manioc leaves following later in the week. No records were maintained on the amount of feed used.

At this National Center, personnel from the Waters and Forests Service of the Cameroon government will be trained as fisheries extension agents. After completing the 3-month program of training at the Moniteur level, the trainees will assist farmers in fishculture development activities. It is anticipated that

80 moniteurs will be trained during the five-year program. This training program will be initiated following recruitment of a Project Instructor and construction of a dormitory.

Other Stations

Other stations visited included fish hatcheries at Bafoussam and Mbouda. The Bafoussam (Bamoungoun) Hatchery has 31 ponds, each with a surface area of approximately 0.025 acres. The Mbouda Hatchery consisted of several very small ponds. Both stations produce fingerlings which are distributed to ponds in the area. Rate of stocking per acre is 4,000 fingerling Tilapia nilotica plus 1,600 fingerling Heterotis niloticus. Initial stock of fish for newly constructed ponds is provided free; a charge of one cent per fish is made for subsequent fish. No production records were available at either station. Due to the small number and size of existing ponds, both stations have limited usefulness in fingerling production. Expansion would not be justified at either station in view of inadequate water supply and pollution due principally to erosion.

Fisheries of West Cameroon

The state capital of West Cameroon is located at Buea where the Ministry of Agriculture has a fisheries program with emphasis on pond culture.

Bambui Fisheries Station (Bamenda)

Between 1959 and 1965 a small government fisheries station was built at Bambui, 7 miles from Bamenda. There are 8 ponds on the station, all of which have water supplied through a concrete diversion ditch. Each pond has a separate inlet with a sand trap and a separate monk for pond drainage. Four of the ponds

are approximately 0.02 acres and are used as breeding ponds. Twenty pairs of brood Tilapia nilotica are placed in each pond. One 0.25-acre and three 0.1-acre ponds are used as fry rearing ponds.

In a 0.1-acre pond, 2,000 T. nilotica fingerlings per acre were stocked. Production in 8 months was 1,140 pounds per acre excluding fingerlings, using 1,230 pounds per acre of superphosphate and an unknown amount of corn chaff. Survival was 86.5 per cent.

The Bambui Station is located on the grounds of an agricultural college which has use of the land surrounding the station, making expansion improbable.

New Government Fisheries Station (Bamenda)

At present a large government research and fry production station is being constructed on 100 to 150 acres of government land. The station is located in a fertile valley with a good source of water approximately 4 miles from Bamenda. To date, approximately \$1,000 has been made available by the government to begin construction. One pond, 2.47 acres in size, was under construction and a diversion ditch from the stream to the future ponds was being dug. When completed, the station will consist of a number of 0.1- to 0.25-acre experimental ponds and several large production ponds. Laboratory buildings and housing facilities will also be constructed.

Fishculture in West Cameroon is largely concentrated in an area within a 40-mile radius of Bamenda, primarily due to the efforts of the technical fisheries officer for West Cameroon and his small staff of 8 people (4 assistants, 3 trainees, and 1 fisherman). In fiscal year 1969, the budget for fishculture activities has been raised from \$2,742 in fiscal year 1968 to \$4,325.

Estimates of the total number of ponds in the Bamenda area vary from 3,000 to 5,000. The ponds range in size from 0.15 to 4 acres in size. Most of the ponds are privately owned and are very small. The family pond owners are being organized into a Federation of Fish Farmers. This organization presently has a membership of over 5,000. Interest in pond culture, however, has extended beyond the family pond owner to the various councils in the Bamenda area. The council ponds are considerably larger than the family ponds and are better constructed and managed. The council is a part of the State or Federal Administration, and a continuation, although modified, of traditional forms of government. The council collects taxes levied, remitting a portion to the state and retaining a portion which is used effectively to involve the community in self-help projects. By raising money and providing labor, the council has proven to be one of the most effective means of development within local communities in West Cameroon. Gardens, poultry houses, and fish ponds are a few of the revenue raising projects in which councils are engaged. They have an annual budget for fishculture of between \$208 and \$625, and a policy that states that profits from the sale of fish are to be reinstated in the program. The council, by far, has the strongest fisheries program in the country.

The fisheries officer and his staff, in addition to supervision of management and pond construction in the Bamenda area, carry out an active public relations program. At the local agricultural shows, aquaria are displayed containing the various species of live Tilapia used for culture. Also exhibited are preserved specimens of fish and fish predators, types of fish food, scale models of monks showing pond draining and water level regulation features, photographs of

fish harvesting methods, and a series of drawings of pond construction methods.

Production of fresh fish from the ponds in the Bamenda area at present is fairly low, estimated at 300 pounds per acre per year. With proper stocking and management through fertilization and feeding, annual production could be significantly increased.

The following list provides information on the costs of various feeds and fertilizer materials which are available throughout the year for use by pond owners in the Bamenda area:

<u>Feeds</u>	<u>Cost</u>
Maize	3 cents/lb. (27 cents/gallon)
Blood (cow)	free
Corn chaff	free
Peanuts	3 cents/lb.
Beans	
Koki	15 cents/lb.
Black	3 cents/lb. (32 cents/gallon)
White	3 cents/lb. (32 cents/gallon)
Red	12 cents/lb.
Soy	-----
<u>Fertilizer materials</u>	<u>Cost</u>
Azote chemical nitrogen	\$62.50/ton
Compost	-----
Cow dung	-----
Pig droppings	-----
Fowl droppings	-----
Lime	20 cents/100 lbs.
Slacked lime	30 cents/100 lbs.
Superphosphate	\$3.50/100 lbs.

The demand for fish in the grasslands area far exceeds the supply. Many people in the area prefer fish to meat as a source of protein. An indication of the demand for fish in the area is a venture by a Douala-based firm that ships

frozen, whole fish into the area. Few figures were available but it was estimated that 8,800 pounds of frozen fish, selling at between 33 cents for coarser varieties to 54 cents for better types is marketed in the region each month.

Dr. Foncha, Vice-President of Cameroon, has a 1.5-acre private pond in the Bamenda area which cost \$1,250 to build. He netted \$46.00 from a 1967 harvest of 158 pounds of Tilapia and \$233 in a recent yield of 840 pounds. This pond was managed by the Fisheries Service and used to demonstrate production obtained with proper stocking, feeding and fertilization.

Peace Corps Project

The Peace Corps is planning a fisheries project in West Cameroon. This is a pilot effort on the part of the Peace Corps and the Secretariat of State for Natural Resources in West Cameroon to increase fish production in the already existing fish ponds. Ten volunteers will be working from August, 1969, to December, 1971, for the Agricultural Department in the Extension Fisheries Service.

Peace Corps involvement will be to: 1) work with council and private ponds to demonstrate the advantages of intensive fishcultural methods; 2) train counterparts to carry on the work; 3) increase the number of fingerlings produced at the Bambui Fisheries Station; and, 4) keep accurate records with which to evaluate the success of their efforts. This project is directed toward increasing available fish protein and increasing the per capita income of rural farmers.

Assessment of Fishculture

Seventy-five per cent of the total fisheries catch in Cameroon is obtained from freshwater sources, which indicates the importance of inland fisheries in Cameroon. During the period of French control, several fisheries stations were built by CTFT. The government operated the stations after Cameroon gained its independence and has since maintained the existing stations with little emphasis placed on expansion and development of intensive fishculture methods.

The government fisheries station at Melen was constructed in 1948 and served as the principal research and fish production center for Cameroon. At present the city of Yaounde has encircled the station making efficient operation difficult. The water supply to the station is not adequate for present needs due both to increased domestic consumption and to pollution. The Waters and Forests Service clearly realizes the dilemma and is gradually curailing activities at the station. At the present time, there are no fishculture stations suitable for development of intensive fishcultural methods in the Yaounde area. Apparently this problem will not be rectified in the near future because the Director of the Waters and Forests Service indicated greater interest in expansion of the capture fisheries in natural waters than in development of intensive fishcultures. This is unfortunate because maximum per acre production in natural waters generally is no more than 100 pounds while in ponds with intensive feeding, per acre production of 4 tons and 20 tons has been attained with Tilapia and Clarias, respectively.

The Fouban Fisheries Station possesses the largest number of ponds of any station visited in Cameroon. This station serves as the National Center for Cameroon under the UNDP/SF Regional Fish Culture Training and Research Project. Several problems exist at the present time on the station. Most of the ponds are too small for general fishcultural work. This problem could be alleviated, however, because there is good clay soil in the area, there is sufficient room for expansion, and there is an adequate water supply. The project director for the station has not been recruited and until this is done no progress in training and research can be made.

Pond fishculture began in West Cameroon in 1959. Presently there are an estimated 3 to 5 thousand ponds in the Bamenda area. As in other countries surveyed, most ponds were privately owned but far too small for fishcultural purposes. In the Bamenda area a tremendous amount of interest in pond fishculture has been generated by the technical fisheries officer and his staff. Although handicapped by a very small annual budget and a small staff, an impressive amount of progress is being made. Large ponds suitable for commercial fish production are being constructed by various town councils, with construction and subsequent management supervised by the technical fisheries officer. A fertilization and feeding program (based on locally available foodstuffs) has been initiated and accurate records are maintained on these council ponds.

The small government fisheries station at Bambui is inadequate for production of Tilapia fingerlings or for research on various methods of intensive fishculture. There is no room for expansion of the station. A large government

research and fry production station presently is being constructed in an adjacent area. When completed, this station will provide an additional source of Tilapia fingerlings and experimental ponds will be available for development of improved fishculture methods.

A fish farmers federation has been established in the Bamenda area. This federation and the public relations program of the fisheries officer serve to disseminate present methods of fishculture to all interested persons.

The proposed Peace Corps project, when initiated, will provide a total of 10 volunteers to aid the technical fisheries officer in development of intensive methods of fishculture and will also provide a full-time trained fisheries biologist to advise and direct general operation of the project.

Pond fishculture in the Bamenda area of West Cameroon is a relatively new program (10 years old). Since there is an abundant water supply throughout the year from numerous streams and small rivers and topography and soil quality is ideal, fish pond development in this area should greatly expand in the future, providing economical methods of fishculture are developed.

CONFERENCES

U. S. GOVERNMENT

Ambassador Payton, U. S. Embassy, Yaounde
Mr. Salason, General Service Officer, U. S. Embassy
Mr. James Bishop, Economic Section, U. S. Embassy
Mr. J. C. McLaughlin, AID Affairs Officer, Yaounde
Mr. Murray Stuart, Director, Peace Corps, Yaounde
Mr. Craig Kinzelman, Associate Director, Peace Corps
Mr. Garry Laidig, Peace Corps Volunteer, Bamenda

CAMEROON GOVERNMENT

Dr. Foncha, Vice-President, Republic of Cameroon, Yaounde
Mr. Eko Ebongue, Director, Waters and Forests Service, Yaounde
Mr. Ole, Assistant Director, Waters and Forests Service
Mr. Isaac Nzoungo, District Commissioner, Fouban
Mr. Gustave Mbeng, Director, Waters and Forests School, Mbalmayo
Mr. Elombo Kouho, Director, Waters and Forests Service, Bamileke Region
Mr. Mvogo, Head of Melen Fisheries Station
Mr. Samuel Tondo, Principle Fisheries Officer, Bamenda
Mr. S. M. Ndam, Principle Agricultural Officer, Bamenda

CENTRE TECHNIQUE FORESTIER TROPICAL

Mr. Jaques Bard, Director, Regional Fish Culture Project, Central Africa (Paris)

REFERENCES

- Allsopp, W. H. L. 1968. Report on travel to Republic of the Cameroons. FAO Fisheries Travel Report, AFRO FI 1/68.
- Clemens, H. P. 1967. A study on the feasibility of the Peace Corps establishing a fish culture program in West Cameroon. Peace Corps, Washington, D. C.
- Di Palma, Salvatore. 1968. The fisheries of Cameroon, 1967. USDI, Bureau of Commercial Fisheries, Foreign Fisheries Leaflet 169.
- Ginnelly, G. D. . Possible USAID contribution in the development of pond fish culture in Central and West Africa. USAID Washington, Unpublished Report. 33 p.
- Peace Corps Cameroon Project Description; West Cameroon Agricultural Extension, Inland Fisheries - Draft.

NIGERIA



NIGERIA

Economic Status

Agriculture is by far the most important economic activity in Nigeria. It directly supports around four-fifths of the country's estimated 56 million population and generates around 55 per cent of the gross national product. Almost 70 per cent of total merchandise exports, valued at 680 million dollars in 1967, were agricultural commodities. Important agricultural exports were peanuts, cocoa, and palm oil. The largest single export commodity, however, was petroleum, indicating the diversity of Nigeria's economy. Compared with other African countries, its agricultural and industrial resources are highly diversified and probably much more capable of rapid development. Nevertheless, the bulk of Nigeria's agricultural output is produced by farmers working on tiny plots of land, primarily at a subsistence level and much of its produce, particularly palm oil and rubber, is still obtained from uncultivated sources.

The gross national product for 1967-68 was estimated at 4.7 billion dollars, exceeded in Africa only by the Republic of South Africa.¹ Because Nigeria is the most populous country in Africa, its per capita GNP is necessarily low at about \$125.

Nigeria is the largest market for fish in West Africa, estimated in 1964 as the equivalent of about 350,000 tons of fresh fish. Approximately 15 per cent of the

1. Food and Agriculture Organization. Agricultural Development in Nigeria, 1965-1980. Food and Agriculture Organization of the United Nations, Rome.

consumption was supplied from domestic production. Most of the imported fish comes from Norway as stockfish (dried cod). Nigerian fish production is about equally divided between marine and freshwater sources. Lake Chad, in extreme northeastern Nigeria, is the largest single freshwater source and provides at least one-half of total inland production. The output from Lake Chad must be carried long distances to find a market, limiting the amount that can be transported fresh. Except for Lake Chad, most of the domestic catch is sold locally. These come from local trawlers and from direct landings of frozen fish by foreign vessels, primarily at Lagos. These are generally sold directly to market mammals who may sell them locally as fresh fish, smoking unsold fish for later distribution.

The need for increased supplies of fish, as well as other foods of animal origin, is evident. FAO estimates indicate that only 2.5 to 4.0 per cent of total calories in the Nigerian diets are received from animal foods, including fish. To maintain a supply of fish protein for a country with the population of Nigeria will require a much greater production effort than is now indicated.

Marine Fisheries

The industrial trawl fishery amounts to 3,000 metric tons or 10 per cent of total marine production. The traditional canoe fishery is limited to the coastal zone and is estimated at 26,000 metric tons, two-thirds of the total catch. The marine catch principally consists of Ethmalosa, Sardinella and Ilisha which are taken mainly by beach seines and gill nets. Nigeria is one of the largest importers of fish in Africa, importing 33.9, 31.2 and 20.3 thousand metric tons in 1965, 1966 and 1967, respectively.

Freshwater Fisheries

The freshwater and brackishwater fishery, exploited by means of cast nets, gill nets, lines and traps, produces an estimated 60 per cent of total fisheries production. The lagoon zones produce in addition to fish, some 1,000 tons of shrimp annually.

Lake Chad Fishery

Lake Chad has about 180 miles of shoreline in northeastern Nigeria. It is estimated that 4,000 full-time fishermen and 500 seasonal migratory fishermen operate from the Nigerian region of the lake, harvesting between 10,000 and 15,000 tons of fish per year. Fishermen establish camps in the papyrus islands of the lake and fish from canoe-shaped rafts of papyrus. About 80 per cent of the fishermen use traps and long lines of unbaited hooks. The remaining fishermen use gill nets made of local fiber or cotton, or nylon nets, which were first introduced by the Ministry of Agriculture in 1962.

Most of the catch is smoked by fishermen and their families. A small part of the catch is sun-dried whole, and some is consumed fresh. The smoked fish is conveyed to local agents who transport the fish to Maiduguri. From Maiduguri, after repacking, the fish is transported to other southeastern towns. Loss during the journey, because of rough handling and fly and beetle infestation is high and may be as much as 40 per cent.

The catch is composed of Lates niloticus, Heterotis niloticus, Tilapia sp., Citharinus sp., Distichodus sp., Clarias sp., Gymnarchus sp. and Alestes sp.

No assessment of the lake's maximum sustained yield has yet been made, although it is generally believed that a greater catch may be attained.

Two main obstacles have prevented increased consumption of fish from Lake Chad: 1) the primitive fishing, processing, and lack of mechanization; and, 2) the lack of an all-weather road from the lakeside to major market areas.

The first obstacle is gradually being overcome by the introduction of nylon nets, proper instruction in fishing with gill nets, improved processing techniques and motorized boats to replace papyrus rafts. Construction of an all-weather road from Maiduguri to Mongonu, Kukawa and the lake shore Baga began in 1965. This project was financed by a loan from the International Bank for Reconstruction and Development.

Reservoir Fisheries

Two main dams were planned for the Niger River. One is the Kainji Dam, completed in 1968, and downstream construction on the Jebba Dam will begin in 1978.

The Kainji Dam has created a reservoir of approximately 320,000 acres. The fisheries potential has been estimated at between 6,000 and 12,000 tons per year, with a market value of between 1.9 and 3.6 million dollars. The lakeside value would be approximately one-third of the market value, and if the upper production estimate were realized, this fishery would support 2,500 full-time fishermen and their dependents. It will probably take about 10 years before the full potential of the reservoir is realized.

A UNDP/SF Lake Research Program entitled Lake Kainji Research has been established to investigate resettlement and other problems including research into

the biology and hydrology of the lake. Total contribution to the project is \$2,084,100.

Specifically, the purpose of the project will be to assist in the establishment and initial operation of a Kainji Lake Research Center. Investigations in the fields of limnology and fisheries, sociology and economics of resettlement, public health and diseases, conservation and tourism will be carried out. The duration of the project is 6 years. It was approved January, 1966, and became operational August 12, 1968. Presently, the project manager, a sociologist, two fishery biologists, and an epidemiologist are on duty and a limnologist and a boat builder will be added in 1969.

Federal Fisheries Service

The Federal Fisheries Service has the responsibility for research into the biology of commercially valuable species of fish in Nigeria. There are three main stations in Nigeria. One is located in Lagos where research is being conducted on life history aspects of selected marine species. The second station is located at Malamfatori on Lake Chad. The Malamfatori research program currently includes studies on fish populations, fishing gear, life history and limnology. A third station is presently being established on Kainji Lake.

State Fisheries Departments

Each State has a Fisheries Department under the Ministry of Agriculture and Natural Resources. The State Fisheries Department at Lagos conducts research on fishing methods and gear, while the Federal Fisheries Service conducts research on the biological aspects of fisheries. The Lagos State Fisheries Department has

its office at the Ijora Terminal where there are facilities for cold storage, dry docking and repair of small vessels. The Ijora project provides assistance to local fishermen. Mechanization of the boats has been one of their more successful projects, increasing the catch approximately 500 per cent.

Fishculture in the Western State (Ibadan) began in the 1950's. Emphasis is on building and stocking ponds in the area with species of Tilapia.

Ogunpa Fisheries Station (Ibadan)

There are nine research ponds on this station consisting of the following:

<u>Number</u>	<u>Size (acres)</u>
3	0.04
4	0.02
1	0.5
1	1.0

In addition there is an 8-acre fish storage pond. All ponds are supplied individually with spring water by gravity and all have separate drains. There are laboratories and offices located in one building, a separate building for seines and other equipment and a cold storage facility where frozen marine fish transported from the coast are stored prior to sale. Approximately 1,200 pounds of frozen marine fish are sold daily primarily to wholesalers in the Ibadan area.

The School of Agriculture at Moor Plantation sends students to this station annually to carry out specific fisheries projects and to gain practical experience in pond management procedures. In addition to a training program, the station conducts research on fish production and produces fingerlings for distribution to local ponds.

In 1954, the mirror strain of Israeli carp (Cyprinus carpio) was imported. In 1965-66 the carp were successfully spawned for the first time in special breeding

ponds at the Ogunpa Station. In production ponds stocked at 1,500 carp per acre, growth rate was 0.5 pound per fish per month with heavy supplemental feeding.

Station staff provide assistance to local farmers in site location, surveying, cost estimates, construction of dams, and stocking. At present, there are 150 ponds in the Western State. The actual cost inputs as given by the Western State Fisheries Division for construction of a 10-acre pond in the area are summarized as follows:

<u>Item</u>	<u>Cost (\$)</u>
Surveys (visual and detailed)	Free
Acquisition of land	420
Clearing land	700
Cost of dam (3,000 cubic yards)	2,100
Cost of labor	280
Cost of screen and spillway	280
Contingency	<u>140</u>
Total	3,920 or 392 per acre.

Tilapia production from 10 acres averages 7,000 pounds per year. The total annual expenditure for Tilapia is \$616 and the fish will sell for \$980, with a profit of \$364 per year. Approximately \$36 per acre per year is realized from production of Tilapia. Carp production from 10 acres averages 15,000 pounds per year. The total annual expenditure for carp is \$1,434 and the fish will sell for \$2,624, with a profit of \$1,190 per year. Approximately \$119 per acre per year is realized from production of carp.

Construction is scheduled to begin soon on a pilot demonstration fish farm at Ijebu-Ode, under the supervision of the Western State. This farm will have various types of fish ponds (nursery, rearing and production) for producing large quantities of fish fry and fish for market. It will also serve as a training ground

for prospective fish farmers in the state. There will be approximately 350 acres of water on 400 acres of government land. At present, the state government has budgeted \$112,000 for construction.

Panyam Fish Farm

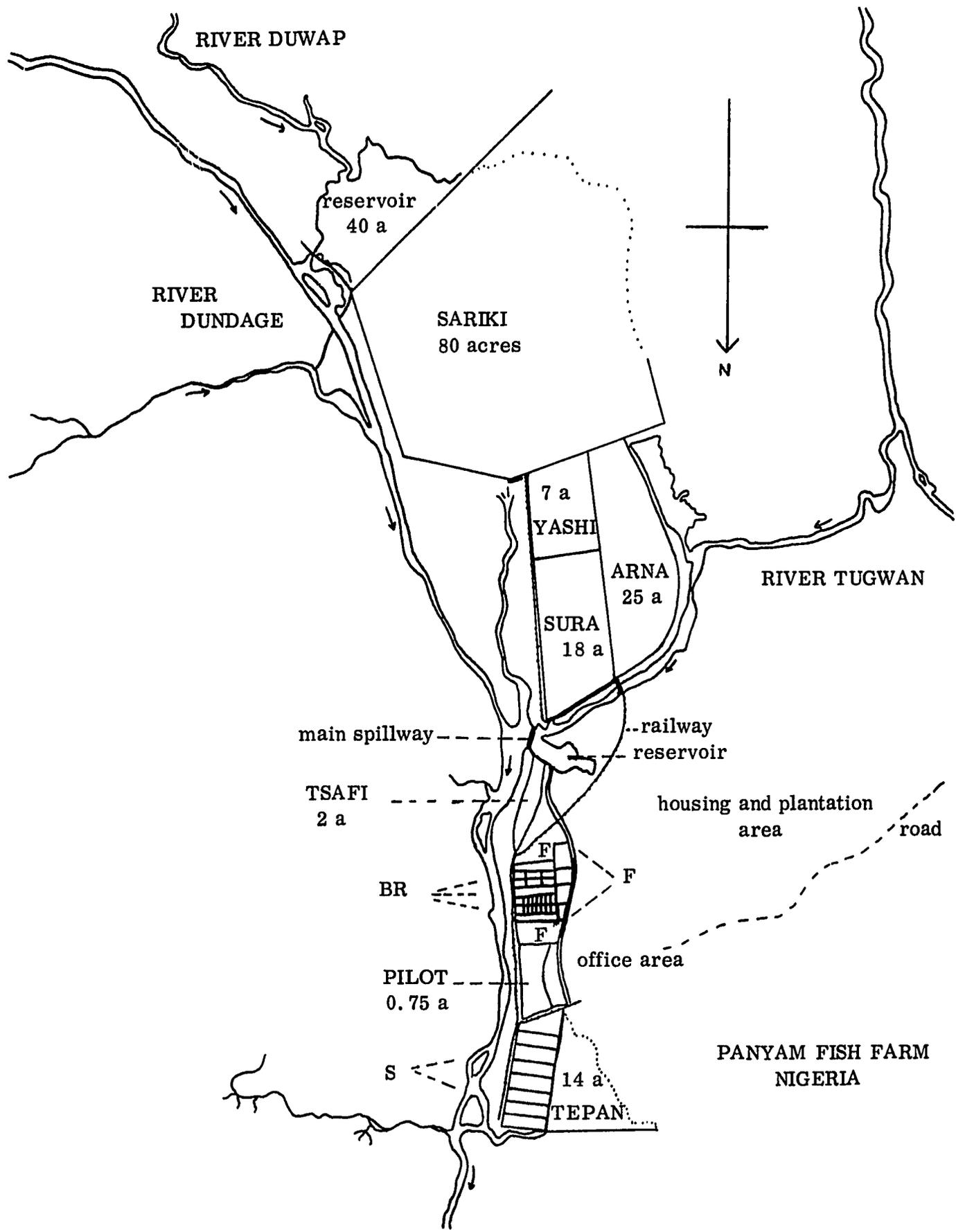
Panyam Fish Farm is presently operated by the Ministry of Agriculture and Natural Resources in northern Nigeria, Benue-Plateau State. The farm is located 57 miles by road to the south of Jos at an elevation of 3,543 feet. It is situated in a shallow valley some 3,900 feet wide at the confluence of three small rivers, the Tugwan, the Duwap and the Dundage.

This 250-acre fish farm was built by the Northern Government in 1951-1954 as the first commercial fish farm operation in Nigeria. Using local labor and hand tools, approximately 19,420,500 cubic feet of earth were moved in the construction of dams and spillways. A railway track system was laid around the ponds a distance of 1.9 miles for transport of fish and materials.

Ponds were constructed for fish breeding, fry storage, segregation of brood-stock, production and storage. A drawing of the pond system is included on the following page.

Facilities at the station include one building containing a two-room chemical laboratory, one net storage and repair building with an adjoining feed storage and feed grinding mill, one electric generator building, and residences for the director, 8 laborers, and 4 watchmen. There are also two additional feed storage buildings on the station.

The water supplying the farm is derived from two rivers, the Duwap and Tugwan, and a spring. Water supply from the two rivers is seasonal. The spring is



500 m

PANYAM FISH FARM
NIGERIA

perennial, but supplies adequate water only to storage and fry ponds. Approximately one-third to one-half of the total area in ponds cannot be utilized during the dry season. Rainfall in the area is indicated in the following table:

Total Rainfall at Panyam for the Period 1953-1960

<u>Year</u>	<u>Inches</u>	<u>Year</u>	<u>Inches</u>
1953	49.2	1957	54.6
1954	55.4	1958	39.7
1955	47.5	1959	31.4
1956	38.5	1960	40.4

Mean annual rainfall for the 8-year period was 44 inches.

A survey of fish of the small streams before the farm was built showed only four species: Barbus nigeriensis, Barbus trispilus, Labeo coubie, and Barilius sp. In the early period of fish farming, four species of Tilapia were introduced: T. zillii, T. nilotica, T. melanopleura and T. galilaea. These were collected in the Shendam area, off the Plateau, and are now firmly established in all ponds and water channels of the farm.

A few other species have been introduced, also from the Shendam area:

Barbus occidentalis, Heterotis niloticus, Gymnarchus niloticus, Lates niloticus, and Citharinus sp.

Scale and mirror carp were introduced from Europe in 1954. Production at the Panyam Farm consists of approximately 75 per cent carp and 25 per cent tilapia. Some Lates niloticus also are being produced. Two-year-old carp, 1.5 to 2.0 pounds in weight are sold at 28 cents per pound in Jos. Tilapia sell at 14 cents per pound. Fish are transported to market alive, but only 300 to 400 pounds of fish can be transported per trip with present equipment.

The fish at Panyam are fed deteriorated peanuts, cottonseed, and other materials that can be obtained locally. Fish are fed not at a certain percentage of body weight, but on a percentage of the total feed available for the year. In 1968, 25 tons of fish were produced in approximately 100 acres of water using 80 tons of deteriorated peanuts as feed. Per acre, 500 pounds of fish were produced.

Several ponds are open to sport fishing. Anglers are permitted to catch fish from selected ponds, but they pay for fish caught at the rate of 10 cents per pound for tilapia, 21 cents per pound for carp and 42 cents per pound for nile perch (Lates). Revenue from total sales of fish at Panyam in past years were given as follows:
1963 - \$128; 1964 - \$170; 1965 - \$641; 1966 - \$1,685; 1967 - \$2,895; 1968 - \$4,200;
1969 - \$5,600 (estimated).

Assessment of Fishculture

Fisheries in Nigeria is divided among the Federal Fisheries Service and the various State Fisheries Departments. The Federal Fisheries Service is primarily interested in marine and lake fisheries while the State Fisheries Departments are concerned mostly with pond fishculture.

Two state operated fishculture stations were visited in Nigeria, Ogunpa Fisheries Station (Western State) and Panyam Fish Farm (Benue-Plateau State)

The Ogunpa Fisheries Station in Ibadan is not a large station, but the 8 ponds are well constructed and provide limited facilities for production of Tilapia and carp fingerlings and for research on intensive fishculture methods. In addition there is an active training program for teaching fundamentals of pond fishcultures.

A pilot demonstration fish farm is scheduled for construction at Ijebu-Ode. When completed, the fish farm will be used both for experimental research in fishculture, and for teaching proper construction and management techniques to prospective fish farmers. It is doubtful, however, that the Western State can finance a facility such as planned without assistance from the Federal Government or other agencies.

The fisheries program in both Western State and Lagos State have received substantial assistance through USAID in the form of technical services and commodities.

The Panyam Fish Farm is the largest pond fishcultural operation in West and Central Africa. The farm is relatively old and was originally constructed as a commercial venture to produce common carp for sale in an area that traditionally had very little fish protein.

The station is far too large for the existing water supply and for the present staff to maintain without mechanized equipment such as tractors, mowers and earth-moving equipment. Almost one-half the pond area cannot be utilized for fish production during the dry season (a period of 5 months). Flash floods occurring during the wet season have heavily damaged roads and completely washed away some of the dams. The existing staff is not adequate to repair breaks in the dams or to even keep the grass cut around the ponds. The miniature railway system constructed around the pond dams to transport feed and fish is in need of repair.

Production of fish at Panyam is low and there is little hope for increased production at the station for the following reasons: 1) limited availability of feed materials and high cost required to transport feed materials to the station; 2) the farm is located 57 miles from the nearest large town and adequate transport equipment is not available to market present fish production economically. The Panyam Fish Farm presently is not a profitable operation as evidenced by the desire of Ministry of Agriculture and Natural Resources of Benue-Plateau State to turn the farm over to the Federal Fisheries Service.

A large number of permanent ponds and lakes are present in the Benue-Plateau area as a result of extensive tin mining. The majority of these reservoirs contain few fish. A proper stocking and management program appears feasible in this area providing suitable methods for harvesting can be found. These reservoirs potentially offer a tremendous increase in supply of fish protein with little input.

CONFERENCES

U. S. GOVERNMENT

Mr. William Johnson, Food and Agriculture Officer, USAID, Lagos
Mr. W. A. Goodbarry, Deputy Food and Agriculture Officer, Lagos
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Mr. E. I. Asa, Principal Agriculture Officer, Benue - Plateau State, Jos
Mr. S. Danielewski, Principal Fisheries Officer, Panyam Fish Farm

REFERENCES

FAO

- Allsopp, W. H. L. 1967. Travel Report to Niger, Lake Chad, December 1967, Unpublished. 9 p. (typed).
- Collart, A. 1967. Fisheries of Nigeria and their development prospects. FAO Fisheries Circular No. 116. 23 p.
- FAO. 1967. Fisheries development in Nigeria. FAO Fisheries Circular No. 106. p. 247-266.
- Lagler, Karl F. 1969. Man-made lakes - planning and development. UNDP, FAO/UN, Rome. 71 p.
- Piatek, Mieczyslaw. 1963. Report to the government of Nigeria on improvements in the bulk smoking of bonga in western Nigeria. FAO Fisheries Report No. 1756. 67 p.
- Pillay, T. V. R. 1965. Investigations of the possibility of brackishwater fish culture in the Niger delta. FAO Fisheries Report No. 1973. 52 p.

NIGERIAN PUBLICATIONS

Fisheries Division. 1968. The economics of small scale fish farm in Western State, Ministry of Agriculture and Natural Resources, Ibadan, Nigeria. 10 p.

Federal Fisheries Services. 1968. Annual Report, 1966-1967, Lake Chad Research Station, Malamfatori, Nigeria. 83 p.

Federal Fisheries Services. 1963. Carp farming on the Jos Plateau, Bulletin di L'I. F. A. N. , T. xxv. Series A, No. 1, Lagos, Nigeria. p. 285-298.

Hopson, A. J. 1968. The gill net fisheries of Lake Chad. Federal Fisheries Occasional Paper No. 11, Maiduguri, Nigeria. 63 p.

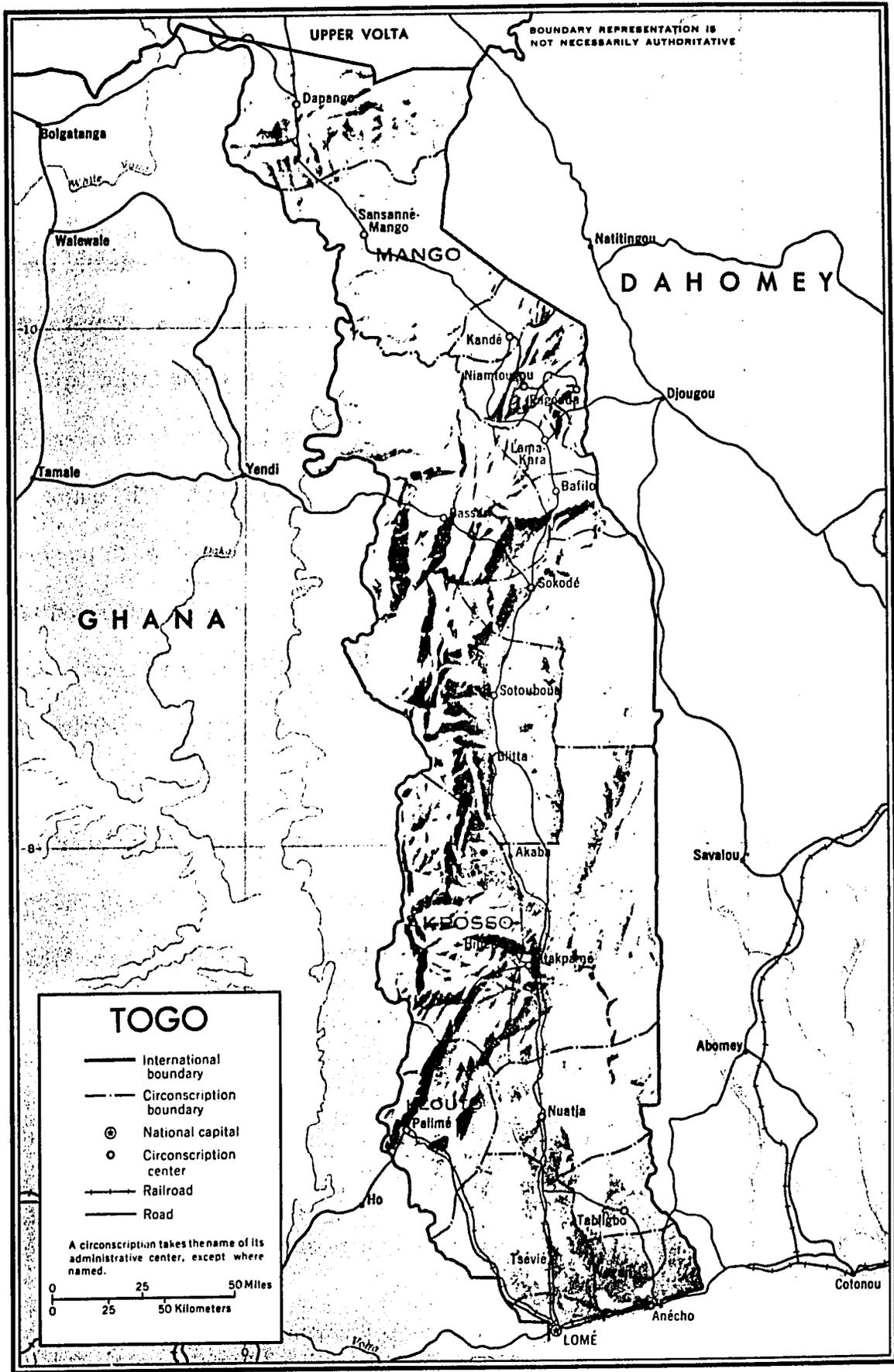
Reed, W. , J. Burcherd, A. J. Hopson, J. Tenners, and I. Yaro. 1967. Fish and fisheries of northern Nigeria, Ministry of Agriculture, Northern Nigeria. 227 p.

Sivalingam, S. 1968. Present status and possible development of eastern Nigeria fisheries 1966, Federal Ministry of Information, Lagos, Nigeria. 57 p.

MISCELLANEOUS

Bureau of Commercial Fisheries. 1967. Fisheries of northern Nigeria. USDI, Bureau of Commercial Fisheries, Foreign Fisheries Leaflet 79. 11 p.

TOGO



TOGO

Economic Status

The economy of Togo is principally allied with agriculture. Practically the entire agricultural output comes from small, village-type crop farms. Major crops from which money income is received are cocoa and coffee, also the major agricultural products exported. In 1967 cocoa and coffee made up 70 per cent of agricultural exports. Palm oil is also an important agricultural export. The major export commodity, however, is phosphate minerals which accounted for 38 per cent of total exports of 32 million dollars in 1967.¹ Only 3 per cent of the cultivated land area is devoted to export crops, the remainder is devoted to food crops grown for domestic consumption. The agricultural economy contributes the major portion of the gross national product.

Estimates of the gross national product are difficult to make but one source indicates a per capita GNP of \$113.² Total GNP probably is in the range of 160 to 200 million dollars. The population of Togo, one of the smallest countries in West Africa, is 1.8 million.

Marine Fisheries

Although located on the coast, the marine fish industry of Togo is relatively undeveloped. A deep water port was only recently completed and efforts begun,

1. Agency for International Development. Africa-Economic-Growth Trends. Statistics and Reports Division. Agency for International Development. U.S. Department of State Washington, D. C.

2. op. cit.

with German aid, to modernize the fishing fleet. Togo has been a net importer of food fish and in 1967 imported approximately 6,800 metric tons of marine fish, primarily from Russian trawlers that fish off the Togolese coast. Marine fish are trucked from Lome to the Sokode area as whole, frozen fish weekly during the fishing season. The wholesale price of such fish is approximately 60 cents per pound. Relatively small amounts are sold fresh, however, as most are smoked for later sale. Smoked and dried fish also are brought from Ghana.

The marine fisheries of Togo is administered by the Service des Peches located in Lome. The traditional fishermen include 4,600 full-time and 1,300 part-time fishermen. There are only 20 industrial fishermen. The fishing fleet consists of 400 traditional canoes, 30 of which are motorized with the help of an FAO mechanization scheme. Production from the traditional fishery is estimated at 6,000 tons per annum and includes primarily the following species: sardines, mackerels, bream, snapper, sharks, skates, barracuda, sole, weakfish and tunas. Approximately 30 per cent of the catch is consumed fresh while 70 per cent is processed as smoked, dried or salted.

Freshwater Fisheries

Inland fishermen number 5,300 for Togo Lake and Mono River and 600 in other rivers and small impoundments. There are approximately 2,000 canoes in inland areas of Togo and a few planked boats on Togo Lake. Cast nets are primarily used to catch approximately 150 tons of freshwater fish per year. Most of the inland fish are smoked in villages and sold locally by mammies. Insect infestation of smoked fish is a major problem.

Du Na Fisheries Station (Sokode)

There are six fisheries stations in Togo, the largest of which is Du Na located 2.5 miles west of Sokode. There are 20 ponds on the station, with 5.2 acres of water. The primary responsibility of the station is production of fingerlings for stocking reservoirs and ponds in the area. In 1968, 10,000 tilapia were distributed. The fish ranged in size from 2 to 6 inches total length and were stocked at a rate of 450 to 600 pounds per acre. Also produced in 1968 were 5,000 pounds of fish sold locally for consumption at 18 cents per pound.

In addition to raising fingerlings, some experimental work is conducted at the station, including testing of different stocking rates of tilapia, Israeli carp and various riverine species including Chrysichthys, Labeo, and Gnathonemus to evaluate their suitability as pond fishes.

Feeding is utilized on the station to increase production in ponds. Fish are fed daily at 5 per cent of their body weight, and are sampled monthly to adjust feeding rates. Feed consists of 50 per cent beer wastes and 50 per cent cottonseed, kapoc seed, corn, and dried cassava for all species except carp. Small tilapia from previous pond drainings, which have been dried and ground up, are used to supplement food given the Israeli carp. The station has a small feed storage building, a small laboratory, and a residence for watchmen. Station personnel, in addition to the Supervisor, include 4 technical assistants, 11 fisheries monitors, 2 watchmen, 4 laborers and 1 heavy equipment operator.

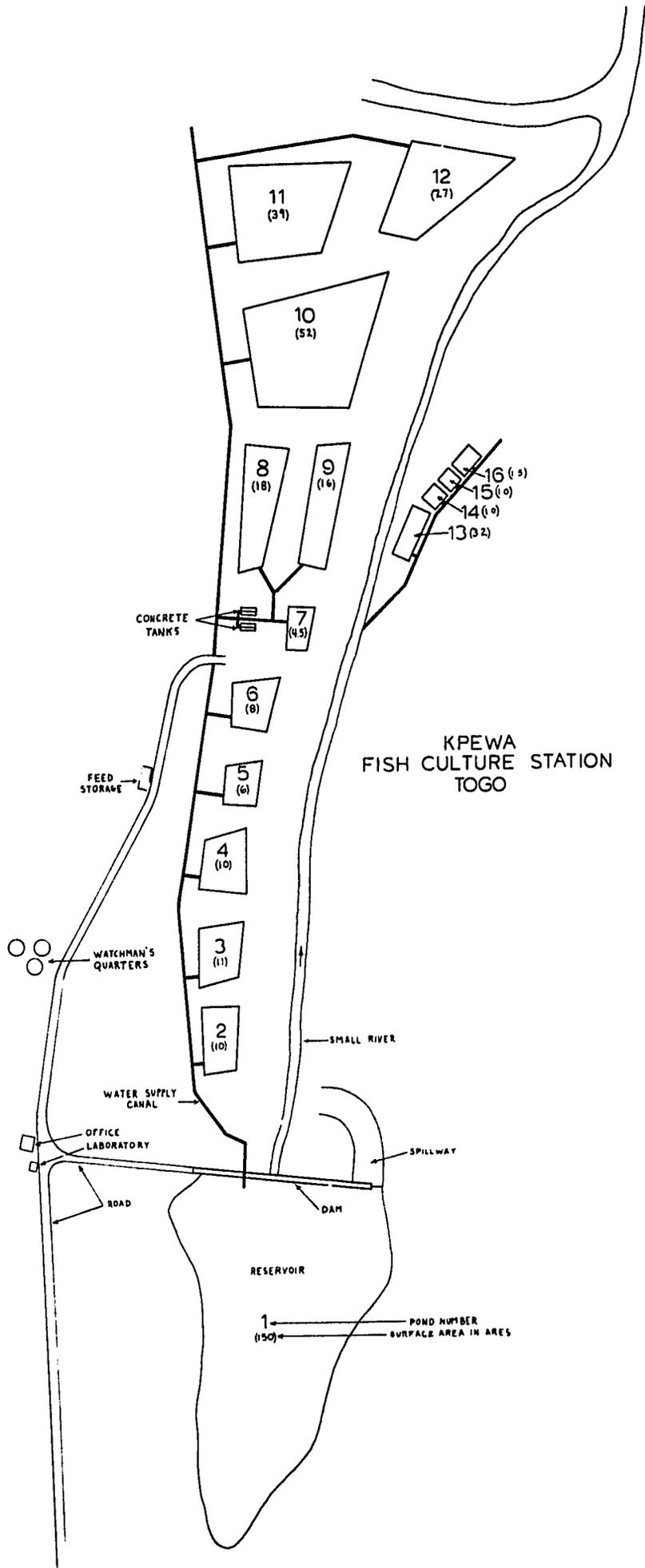
Kpewa Fisheries Station

The Kpewa Fisheries Station, originally consisted of 5 very small ponds, but has been expanded by the Peace Corps. Ponds include one water storage

reservoir of 3.7 acres, and 15 smaller ponds varying in size from .025 to 1.3 acres, with a total of 8.5 surface acres of water. A drawing of the station is included on the following page. Water is supplied from the reservoir to the ponds by gravity, but the supply is limited during the dry season. Other facilities include a feed and net storage building, an office building, a laboratory building, a watchman's quarters and a small shed housing 4 concrete holding tanks.

Average production from the ponds in 1968, the first full year of operation, amounted to 1,746 pounds per acre. Food conversion using primarily ground cottonseed was 5.7:1 or 5.7 pounds of feed required to produce 1 pound of fish. Seventy-three per cent of the fish produced were of harvestable size and sold locally for 18 cents per pound. The principal species cultured was T. nilotica. In addition, efforts are being made to spawn and culture Israeli carp and to test several river species, including Clarias.

Other stations are located at Lama-Kara, Siou Kawa, Tchitchao, and Bafilo. However, these stations are extremely small and not very productive.



KPEWA
FISH CULTURE STATION
TOGO

RESERVOIR

1
(150) ← POND NUMBER
← SURFACE AREA IN ARES

Assessment of Fishculture

There are six fishculture stations built by the French in Togo. Most of these stations are very small, poorly designed, and not very productive. Two of the fisheries stations in Togo are large enough for fish production purposes.

The Du Na Fisheries Station in Sokode contains 20 ponds with 5.2 acres of water. In addition to production of Tilapia fingerlings, a limited amount of experimental work is conducted with various riverine species and with Tilapia and Israeli carp. Research of this nature is essential to develop improved methods of intensive fishculture. Locally available materials, including small Tilapia that have been dried and ground up, are used as fish foods. This technique is valuable both as a means of utilizing the total fish production from the station and as a means of obtaining optimum conversion from waste food products to fish flesh.

This station has several undesirable features. Dams and ponds were designed and constructed without the use of survey equipment. As a result some of the ponds do not receive an adequate flow of water without use of pumps and siphons. Other ponds have dams of insufficient height to adequately utilize the entire pond area.

This station now has a small bulldozer which greatly facilitates pond construction and maintenance. Previously, all ponds were constructed by hand.

The Kpewa Fisheries Station was expanded in 1966 by the Peace Corps. The primary objective of this station is to determine if an economical method of fishculture can be developed in this region. Accurate records are maintained

on amounts and types of fish food used, stocking rates and on fish production.

Major limitations of the Kpewa Station are: 1) inadequate water supply to properly maintain water levels of existing ponds throughout the year; 2) the irregular size of ponds unduly complicates stocking and feeding activities and makes comparison of production results more difficult. The shortage of water probably can be alleviated by construction of an additional water supply reservoir.

The major problem with fishculture in Togo appeared to be lack of interest and financial support on the part of the Togolese government. For example, only after a period of two years has a Togolese counterpart been assigned to the Peace Corps project at Kpewa. Principal interest in fisheries appeared to be in the area of marine fisheries.

CONFERENCES

U. S. GOVERNMENT

Mr. William Buell, Deputy Chief of Mission, U. S. Embassy, Lome
Mr. Robert Wilson, Director, Peace Corps, Lome
Mr. Charles Hamlin, Assistant Director, Peace Corps, Lome
Mr. Paul Guild, Peace Corps Volunteer, Du Na Fisheries Station, Sokode
Mr. Jim Miller, Peace Corps Volunteer, Kpewa Fisheries Station, Bafilo

TOGOLESE GOVERNMENT

Mr. Sylvester Agboton, Deputy Director, Service des Peches, Lome
Mr. Ayivefussani, District Commissioner, Sokode District
Mr. Frederic Lawson, Director, Service des Peches Continental, Sokode

UNITED NATIONS

Mr. Jean Blanch-Soler, Resident Representative of the United Nations, Lome
Mr. Yoes Claret, World Food Program Officer, Lome

REFERENCES

FAO

Allsopp, W. H. L. 1966. Rapport au gouvernement du Togo sur le developpement et L'organisation de L'Industrie des peches, Organisation des Nations Unies Pour L'Alimentation et L'Agriculture, Rome. UNDP Rapport No. 2184. 19 p.
Food and Agriculture Organization. 1967. Status of the fishing industry in western Africa - Togo. AFRO/SFIWA/67. 6 p.

TOGOLESE GOVERNMENT

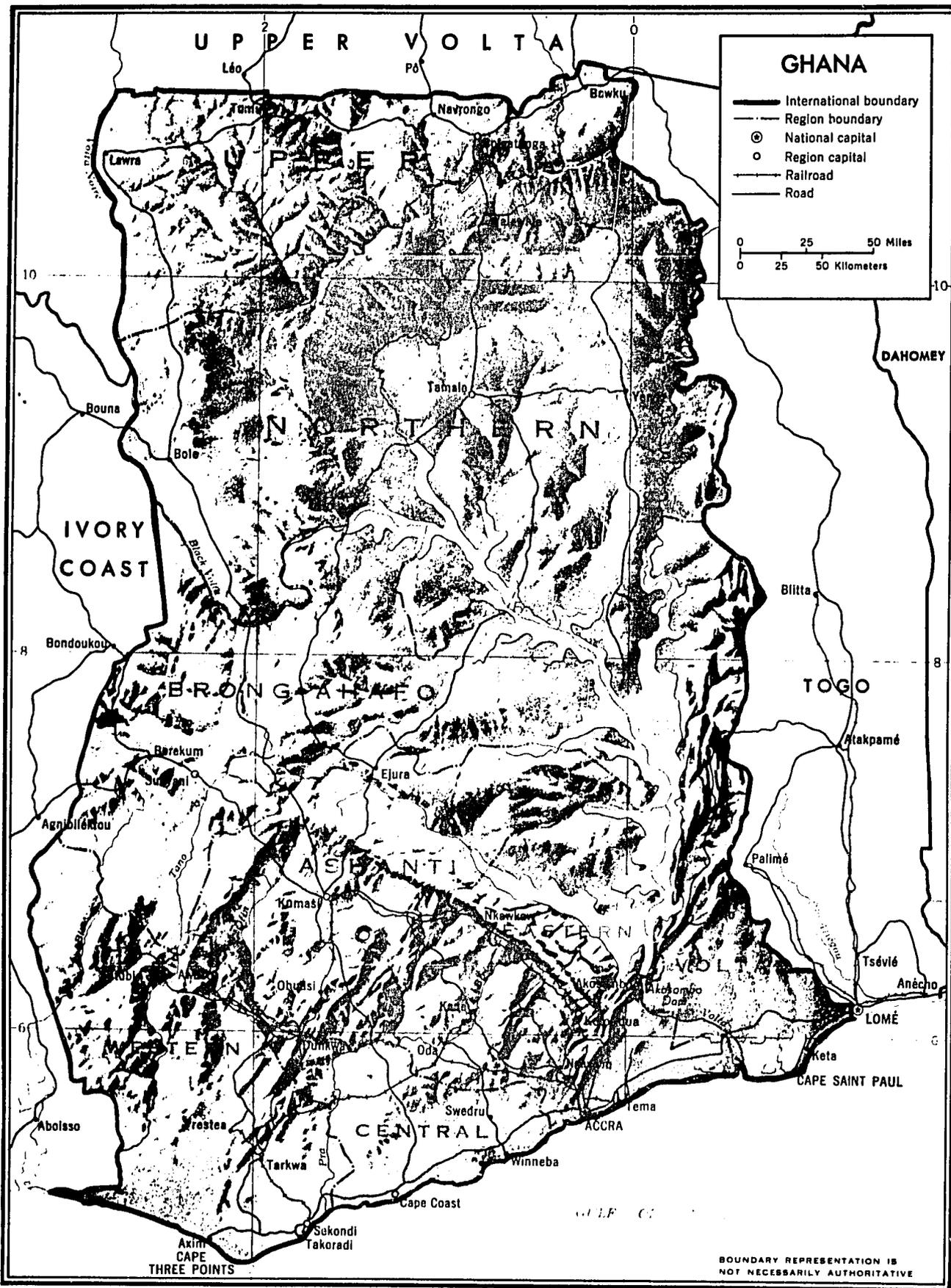
Amegee, P. 1964. Rapport Annuel - 1964, Republique Togolaise, Ministere de L'Economic Rurale, Direccion Du Service Des Peches. 40 p.

PEACE CORPS

Crane, John and Bob Livermore. 1968. Du Na Station Report - Termination of Service. Unpublished Peace Corps Project Report. 12 p. (typed).
Hamlin, Charles. _____. Tilapia culture in French West Africa. Unpublished Peace Corps Project Report. 46 p. (typed).

- Hutchison, Perry B. _____. Report on the Atakpame Fish Culture Station - Termination of Service. Unpublished Peace Corps Project Report. 5 p. (typed).
- Loiselle, Paul V. and Paul D. Guild. 1967. Manuel de Pisciculture. Unpublished Peace Corps Project Report. 136 p. (typed).
- Martin, J. M. 1965. Report for the Peace Corps of a survey of the inland fisheries project in Togo. Unpublished Peace Corps Project Report. 39 p. (typed).
- Miller, Jim. 1969. Fish production at the Kpewa Station - 4 April 1969. Unpublished Peace Corps Project Report. 2 p. (typed).
- Rhoades, Fred. _____. Some comments on the feasibility of private fish culture in West Africa. Unpublished Peace Corps Project Report. 2 p. (typed).
- Rose, Bob. 1968. Termination Report, Dapango, Togo. Unpublished Peace Corps Project Report. 15 p. (typed).
- Webber, Alfred and Paul D. Guild. 1967. Collected architectural reports on existing stations and proposed sites. Unpublished Peace Corps Project Report. 14 p. (typed).

GHANA



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GHANA

Economic Status

Ghana has an area of 92,100 square miles and a population of 8.4 million people, with four-fifths of its population living in rural areas and villages. The agricultural sector is its chief source of national income and accounts for 70 per cent of exports. Nearly all production is carried out on very small holdings by native farmers and their main source of income is cocoa. Ghana produces about 40 per cent of the world's supply of cocoa and in the period 1965-67 this product provided the country with almost three-fifths of its foreign exchange.¹ Other important exports are gold, diamonds, manganese, and timber.

The gross national product of Ghana was estimated at 1.8 billion dollars in 1967; its per capita GNP at 219 dollars is one of the most favorable in Africa. The economic growth of Ghana will be conditioned by a number of favorable factors. The most important is the development of the Volta River Project which was completed in 1965 and is now producing sufficient hydroelectric power to provide for industrial needs.

Another favorable factor is the rapidity with which its industrial development is continuing. A modern port at Tema is now a reality including both expanded food processing industry and a large aluminum smelting facility.

Most of Ghana's resources and most of its people are located in the south-central one-third of the country. The northern two-thirds of the country is hot

1. Agency for International Development. Africa - Economic Growth Trends. Statistics and Reports Division. Agency for International Development. Washington, D. C.

and dry and economically poor, characterized by subsistence farming. Although its economy is predominantly agricultural, Ghana has been a traditional importer of food. For example, in recent years, Ghana has produced about 25 per cent of all the meat and about one-third of all carcass beef it has consumed. While fish production from all sources has quadrupled between 1957 and 1967 to about 110,150 tons,¹ considerable fish and fish products are imported. Net quantities of imported fish of all kinds, in excess of exports, approximated 18,000 tons in 1967. Smoked fish is the principal fish product consumed, estimated at 70 per cent of total sales. Per capita consumption is indicated at about 30 pounds annually.²

Marine Fisheries

In 1967 marine landings totaled 103,251 metric tons. Ghana's marine fisheries may be divided into two categories: canoe fishery and mechanized vessel fishery. The canoe fishery in 1967 landed a total of 39,874 metric tons while the mechanized vessel fishery landed a total of 63,377 metric tons.

Operationally, the fisheries may be divided into three categories: canoe fishery, coastal fishery, and pelagic fishery. The canoe fishery is the traditional fishing method of Ghana and includes use of: the circling gill net, a purse seining operation with the gill net, beach seines, hand lines, set nets and cast nets. The fishing grounds are the near and inshore waters along the coast. The introduction of outboard motors has increased the operational fishing area of the

1. Di Palma, Salvatore. The Fisheries of Ghana. Bureau of Commercial Fisheries Foreign Fisheries Leaflet 77, July, 1968. USDI, Washington, D. C.

2. Ibid.

traditional sail-powered canoe.

The coastal fisheries include the inshore and near-water fisheries excluding the canoe fishery. In addition to the large number of wooden fishing vessels built in Ghanaian yards, a number of foreign-built steel and wooden vessels participate in the coastal fisheries. Purse seining for herring is probably the largest operation. However, purse seining for mackerel is important. Line fishing and drift and set nets are also employed by the smaller wooden vessels.

The pelagic fisheries comprises fishing grounds off the coast of Western Africa from Mauritania to southwest Africa. The fleet includes stern trawlers, side trawlers, seiners and combination vessels as well as several freezer-carriers and one factory ship. The catch consists of various types of pelagic and demersal fishes, including mackerels, sardinellas, sea breams, horse mackerels, groupers, and snappers. Except for a limited amount of canned fish and fish meal and oil produced aboard the factory ship, nearly the entire pelagic catch is landed in Ghana as frozen, whole fish.

The Ghana coast is devoid of natural harbors for large vessels. To overcome this handicap, the government built an excellent port and harbor facility at Tema, 18 miles east of Accra. Dock facilities are provided for large and small fishing vessels as well as canoes. Fuel and water is available at dockside and dry dock and repair facilities are available even for the largest fishing vessels.

The boatyards at Sekondi and Tema provide the fishing industry with a variety of wooden, motorized vessels from 30 to 60 feet in length at a cost of from \$8,000 to \$63,000, respectively. The yards are owned by the State Boat Yard Corporation.

Freshwater Fisheries

Catch from natural inland waters was estimated at approximately 6,900 metric tons for 1967, with the major portion of the catch coming from the Black Volta and White Volta Rivers in central and northern Ghana, and the Volta River in southern Ghana. With the construction of Akosombo Dam on the Volta River and subsequent inundation of 2.1 million acres of fertile river bottom land, the catch of freshwater fish has reportedly quadrupled in 1968. The most important and largest lagoon fishery is located in the southeast portion of Ghana at Keta. Keta Lagoon, with a surface area of 5,300 acres produces catches of Tilapia, mullet and shrimp, but catch statistics were not available for this area.

Lake Volta

Lake Volta was established in 1964 with construction of 2,200-foot Akosombo Dam on the Volta River. A view of Akosombo Dam and Lake Volta is shown in Figure 6. When full, it will inundate an area of 2.1 million acres with an estimated shoreline of 4,500 miles. The lake area is approximately 4 per cent of the total surface area of the country. Construction of the dam raised the water level of the Volta River approximately 250 feet.

The United Nations Development Program (Special Fund) in cooperation with the Volta River Authority has a 3-year project on Volta Lake, with total funding amounting to \$2,954,000. Including the project manager, there are 10 UNDP staff whose specialties include limnology, gear technology, fishing methods, fishery biology, processing and marketing, agronomy, sociology and economics. In particular, the project is assisting in planning, promoting and carrying out the

following:

1. Studies of the abundance, distribution and other biological characteristics of fish species as well as practical methods of exploitation; limnological studies, including the physical, chemical and biological changes taking place in the aquatic environment and their effects on fish fauna.
2. Epidemiological studies and public health problems arising from the major ecological changes resulting from the creation of the lake; studies of the vectors of schistosomiasis, malaria, trypanosomiasis and onchocerciasis.
3. Research on new agricultural systems suitable for farming areas adjacent to the lake; investigations on the incentives and other measures that might be introduced to facilitate resettlement of approximately 80,000 people displaced from the Volta River Basin.

The fishery of Lake Volta has not yet stabilized. Presently, however, 70 per cent of the catch is Tilapia. Research in gear technology has indicated that catches with monofilament gill nets are 2 to 3 times greater than with conventional multifilament nets. Eighty per cent of the fish caught in distant areas of the lake are salt-sun dried. In areas close to markets, much of the fish is smoked. An estimated 24 to 30 thousand metric tons of fish is removed annually from Lake Volta. Practically all of this catch is consumed within a 25-mile radius of the lake by the one million people living in this area.

In addition to the UN-VRA project on Lake Volta, both the government Institute of Aquatic Biology and the University of Ghana in Accra have several active research projects relating to Lake Volta.

Assessment of Fishculture

A fishculture program, under the Fisheries Department in the Ministry of Agriculture, has been in operation for approximately 12 years. Early attempts in this area were largely unsuccessful due to lack of trained personnel and facilities. These deficiencies are gradually being overcome with return of fishery personnel trained abroad. One staff member of the Fisheries Department, presently doing graduate work abroad, will assume responsibility for the fishculture research and development program upon his return from the U. S. A. The government is anxious to initiate an impact program in fishculture particularly in the northern region. At present, there are two very small stations in the area: Kuka Station in the northeast and Turi-Kalsari Station near Lawra in the northwest. Both stations function primarily as hatcheries at the present time, providing fingerling Tilapia for stocking local ponds and reservoirs. In northern Ghana in the Bawku-Bolgatangu-Navrongo area there are 130 reservoirs, while in the Lawra-Wa-Damango-Tamale area there are 90 small reservoirs. Near Accra, a small hatchery located immediately below a 200-acre impoundment was recently constructed. This hatchery (Ashaman Fisheries Station) has five ponds, with a total surface area of approximately 2 acres. Its function is to supply fingerlings for stocking reservoirs located in the southern portion of Ghana.

Primarily because of limited water supplies and the small number of ponds, none of the existing fisheries stations can effectively serve as a research and testing center for pond fishcultures.

CONFERENCES

U. S. GOVERNMENT

Mr. R. M. Cashin, Director, USAID, Ghana
Mr. Gordon Evans, Program Officer, USAID
Mr. H. L. Lasater, Deputy Food and Agriculture Officer, USAID
Mr. Bill Sherman, Agriculture Economist, USAID
Mr. P. C. Pierce, Aquatic Biologist, USAID, Volta Lake Project

GHANIAN GOVERNMENT

Mr. John N. Adjetey, Director of Fisheries, Ministry of Agriculture
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Mr. Frank Denyoh, Principal Fisheries Officer, Volta Lake Project
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Mr. Tony Opoku, Fisheries Officer, Weed Control Project
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UNITED NATIONS

Mr. M. C. Mensah, FAO Regional Representative for Africa
Mr. W. H. L. Allsopp, FAO Regional Fisheries Officer for Africa
Mr. C. N. Coombes, FAO Agricultural Representative in Ghana
Dr. William W. Taylor, Project Manager, Volta Lake Project
Mr. Joe McAlister, Fish Marketing and Processing Specialist, Volta Lake Project
Mr. George Taylor, Fishing Gear Specialist, Volta Lake Project
Mr. Willis Evans, Fishery Biologist, Volta Lake Project

REFERENCES

- Allsopp, W. H. L. 1968. Report on travel to northern Ghana. FAO Fisheries Travel Report. AFRO FI 4/68. 6 p.
- Bureau of Commercial Fisheries. 1963. Fisheries survey of Ghana. Market News Leaflet 77. 18 p.
- Denyoh, F. M. K. 1966. Pond fish culture in Ghana. Proceedings of the FAO World Symposium on Warm-Water Pond Fish Culture. FAO Fisheries Rep. (44), Vol. II, 154-160.
- Di Palma, S. 1968. The fisheries of Ghana. Branch of Foreign Fisheries, Bureau of Commercial Fisheries, Foreign Fisheries Leaflet 77, USDI. 74 p.

Dibbs, John L. 1961. Report to the government of Ghana on fish marketing in Ghana. FAO Fisheries Report No. 1300. 84 p.

Dibbs, John L. 1961. Report to the government of Ghana on fish marketing in Ghana. FAO Fisheries Report No. 1446. 24 p.

Ghana Academy of Science. 1968. Third Annual Report (1967-1968). Institute of Aquatic Biology, Achimata, Ghana. 37 p.

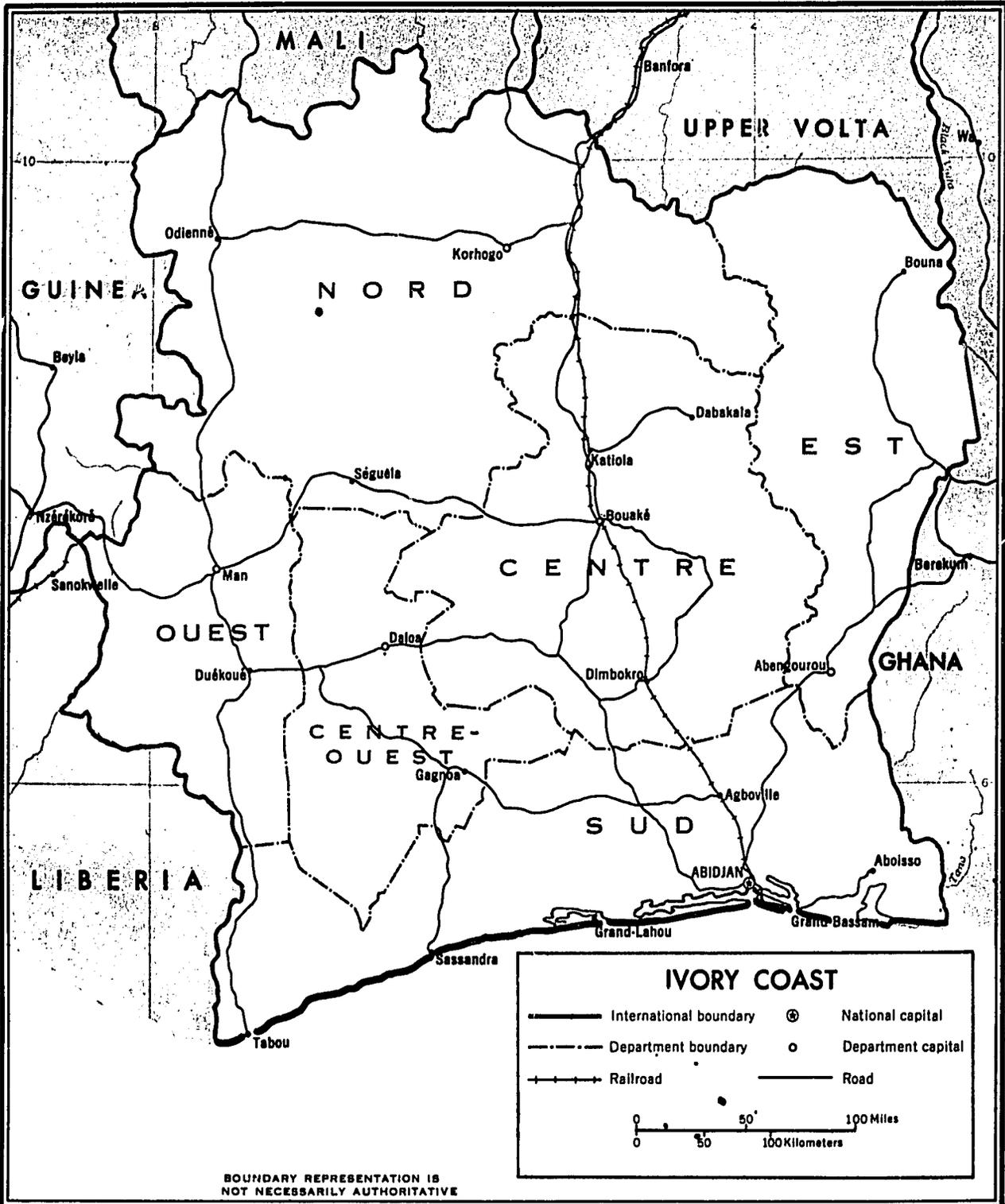
Ministry of Agriculture. 1968. Annual Report of the Irrigation, Reclamation, and Drainage Division, Ghana. 47 p.

Obeng, L. E. 1966. International Symposium on man-made lakes. Ghana Academy of Science. Accra, Ghana. 63 p.

Pillay, T. V. R. 1962. Possibilities of fish culture in lagoons. FAO Fisheries Report No. 1581. 6 p.

Zei, M. 1965. Biological investigation of fisheries resources. FAO Fisheries Report No. 2001. 56 p.

IVORY COAST



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IVORY COAST

Economic Status

The Ivory Coast is 124,503 square miles in area. Since independence in 1960 its annual growth rate has averaged about 8 per cent. The economy, however, is largely agricultural. Almost 90 per cent of the population of 4 million is engaged in agriculture. During 1965-67, the principal agricultural exports of coffee, wood, and cocoa made up 79 per cent of all exports.¹ The largest crops are coffee and cocoa with the Ivory Coast ranking third and fourth, respectively, in world production of these commodities. Nearly 50 per cent of the population derives its main income from coffee which, like cocoa, is grown on small village holdings. Apparently, the effort to diversify the Ivory Coast agriculture is succeeding. Important increases in acreage and production of oil palms, coconuts, bananas, pineapples, rubber, and cotton have been achieved, primarily on industrial plantations. Eventually it is hoped that these industrial plantations can be turned over to village farmers.

The gross national product was estimated at 1.1 billion dollars in 1967, or about \$260 on a per capita basis, one of the highest in West Africa. The foreign

1. Agency for International Development. Africa: Economic Growth Trends. Statistics and Reports Division. Agency for International Development. Washington, D. C. January, 1969.

trade picture is bright. For example, exports in 1968 were 31 per cent higher for the first 8 months than for the same period a year earlier, while imports had increased only 9 per cent.¹ Moreover, the share of the GNP that is accounted for by agriculture continued to decline, from 45 per cent in 1960 to 40 per cent in 1965. Industry's share, on the other hand, increased. A major development project underway that will vitally affect the country's economy is the 95 million hydroelectric project on the Bandama River, expected to be in operation in 1971. The minimum guaranteed wage was raised in 1968 to nearly 20 cents an hour for unskilled labor, also evidence of an expanding economy.

The Ivory Coast probably produces a larger proportion of its food needs than any other West African country. However, its food production is largely limited to crops that are high in starch. Large areas of the country are not suitable for livestock production, consequently four-fifths of its red meat is supplied by neighboring countries. Meat consumption is estimated at 11 pounds per capita per year.

Marine Fisheries

Fish landings rose to a record high of 67,800 metric tons in 1967. In 1966 total catch was 62,000 metric tons and in 1965 total catch was 65,000 metric tons. Landings from the industrial fishing fleet rose to 47,000 metric tons in 1967. There are 31 trawlers and 39 sardine seiners, a total of 70 vessels in the industrial fleet. Six vessels have refrigeration facilities while the rest use ice. They are based at Abidjan.

American Embassy. Semi-annual Report. November, 1968. American Embassy. Abidjan, Ivory Coast.

Landings by traditional fishing methods in 1967 were estimated at 20,000 metric tons of which 10,000 metric tons were marine fishes. The traditional marine fishery is centered in the west, at Sassandra, because of competition from the industrial fleet in Abidjan. Measures to modernize the traditional fishery include motorization of canoes, greater use of synthetic nets, formation of fishery cooperatives and improved processing facilities.

UNDP/SF Pelagic Fish Resources Project

A Special Fund project to survey and develop pelagic fisheries resources is being sponsored by the United Nations. Total contribution to the project is \$2,180,231 over a four-year period. Presently 7 technicians, including the project manager, Dr. Lee, are evaluating pelagic fish stocks, especially sardinnella. There are two research vessels for the project. One is a 125-foot combination stern trawler-longliner, while the other is a 100-foot combination trawler-purse seiner.

Freshwater Fisheries

Total fish catch in 1967 in freshwaters was 4,000 metric tons while the lagoon fishery produced 6,000 metric tons. Major lagoons are found in the southeastern region of the country, with the capital city of Abidjan located nearby. The majority of the freshwater catch is made up of the traditional fishery established on the 3 major rivers of the Ivory Coast: Komoe, Bandama and Sassandra.

Bandama Lake Project

The Koussou Dam located on the Bandama River is in the initial stages of construction. The total cost of this hydroelectric power project is 95 million

dollars of which 36.5 million dollars is a loan from the Export-Import Bank. Kyser Engineering Corporation was responsible for engineering design and planning, while construction is by an Italian firm. The earthen dam, approximately 4,000 feet in length, will impound water for a distance of 75 miles. The CTFT will assist the government by conducting fishery investigations on the reservoir. In addition to pre-impoundment and post-impoundment studies of fish populations, plans are being developed for construction of a hatchery facility below the reservoir to provide fingerling Tilapia for stocking the lake.

Bouake Fishculture Research and Training Center

The Bouake Fishculture Research and Training Center, operated by CTFT, is located approximately 4 miles from Bouake. It is a part of a central forestry research station and was constructed by the French in 1955. The station was expanded in 1964 and presently includes 85 ponds totaling 6.4 acres of water. An aerial view of the station (before expansion) is shown in Figure 7. Water is supplied by gravity from a 250-acre reservoir.

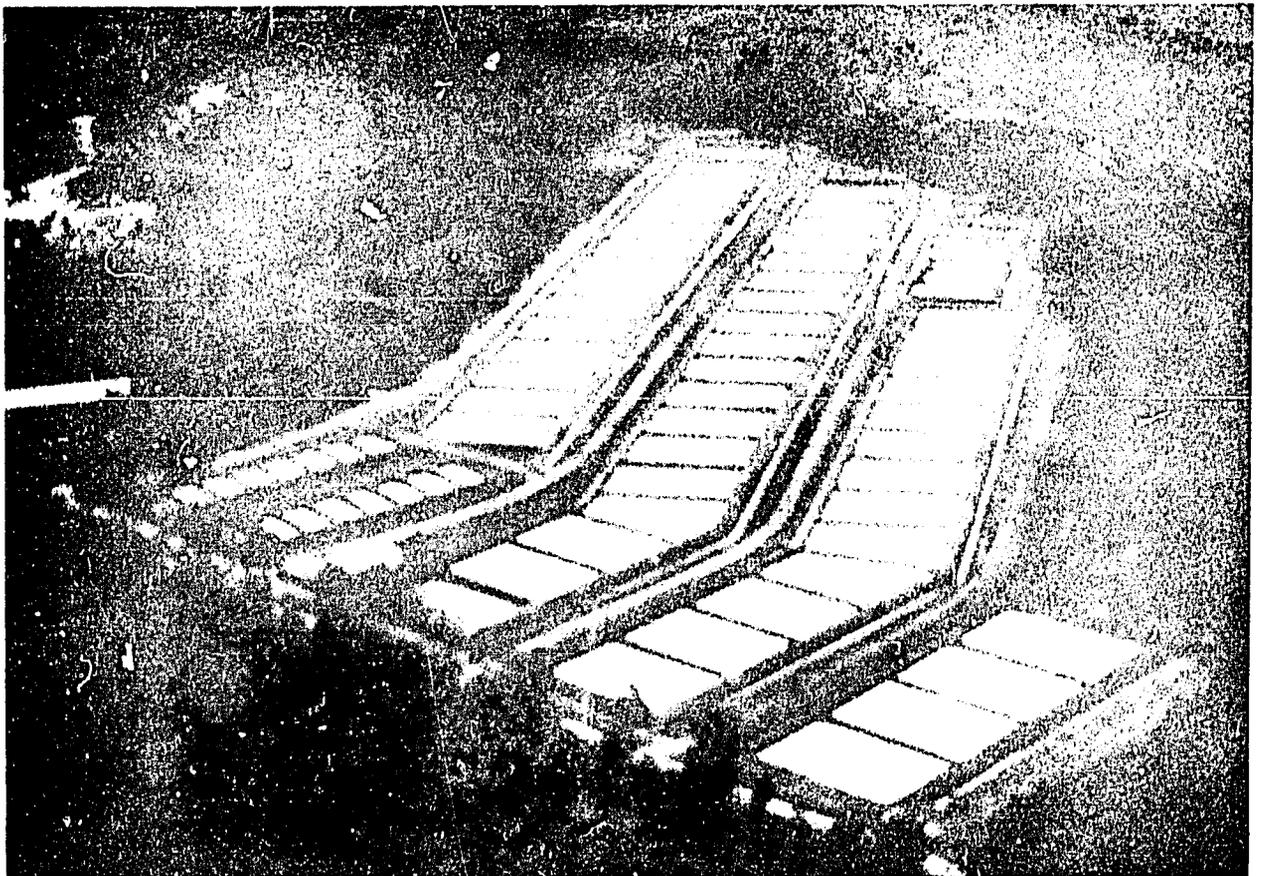
In addition to offices, workshops and maintenance buildings, the center has several laboratories for hydrobiological and fish genetic studies, a large classroom, and dormitory facilities for 10 students. Also located at the center are residences for the director and three senior staff, and a guest house.

The center was originally intended to develop fishculture methods as an economical production system in the savannah type country characterized by limited rainfall. Research is concentrated in the following areas: 1) production of Tilapia and Heterotis; 2) fish genetics; 3) pond fertilization; and, 4) hydrobiological studies of ponds and reservoirs.



Fig. 6. Volta Lake Dam, constructed in Akosombo Gorge, is 2,200 feet in length and impounds approximately 2 million surface acres of water.

Fig. 7. The Fishculture Research Station at Bouake, Ivory Coast, is operated by Centre Technique Forestier Tropical (CTFT). There are 85 experimental ponds with 6.4 surface acres of water.



Current experiments with Tilapia include crosses between male T. hornorum and female T. nilotica, and between T. hornorum and T. mossambica in an attempt to produce mono-sex hybrids for improved pond cultures. Heterotis niloticus is being produced at the station for combination culture with Tilapia in ponds and in reservoirs. One problem with Heterotis in the larger reservoirs is that they are difficult to catch.

Fertilization experiments have indicated that liming ponds is not economical. However, fertilization per acre with 50 pounds superphosphate plus 45 pounds ammonium sulfate increased fish production 100 per cent.

Studies on fish production and limnology are conducted in reservoirs of the region.

Fingerling production at Bouake in 1967 totaled 2,664 pounds, with 2,193 T. nilotica; 145 pounds T. macrochir; 97 pounds hybrid tilapia (T. nilotica x T. macrochir); 229 pounds Heterotis niloticus.

The training program at the Bouake Center was initiated in 1967, with participants from Ivory Coast, Senegal, Togo, and Dahomey. Presently enrolled in the one-year training program are students from Mali, Niger, Chad, Dahomey, Ivory Coast and Senegal. The program, consisting both of formal lectures and field experience, includes:

	<u>Total Hours</u>
Ichthyology	130
Parasites and diseases	10
Fishing gear and methods of fishing	60
Vessels	10
Fisheries products	20
Management of natural waters	70
Types of exploitation of natural waters	10

Management of enclosed waters	135
Administration and regulations	10
Socio-economics of fisheries	80
Mechanics	70
Swimming	<u>25</u>
	630

Field trips are made by staff and students to observe reservoir fisheries in Ghana and Upper Volta, lagoon fisheries in Dahomey, fishculture stations in Togo, and flood-plain fisheries of the Niger River in Mali. Following the completion of the training program, the participants return to their respective countries to assume greater responsibilities in fishery development programs.

Assessment of Fishculture

Fishculture in the Ivory Coast continues to receive French support through the Centre Technique Forestier Tropical (CTFT). An excellent fishcultural and training facility, with 85 experimental ponds and a total of 6.4 acres of water, is located at Bouake. Emphasis at the present time is primarily concerned with investigations on fertilization, growth rates and hybridization and on the training of fisheries personnel from the Ivory Coast and adjacent French-speaking countries.

Work in various aspects of fishculture has been carried out at this station for the past 15 years. However, little impact has been made in the Ivory Coast relative to development and establishment of an economical fishculture operation. The Station Director, with 12 years of service at the Bouake Center, frankly admitted that he was pessimistic about the future for a pond fishculture program in the Ivory Coast and in West Africa. The Director also indicated that river and lake fisheries provided better opportunities for increased fish production in the Ivory Coast.

CONFERENCES

U. S. GOVERNMENT

Mr. M. A. Codi, USAID Operations Officer, Abidjan
Mr. William Miller, Economic Officer, U. S. Embassy
Mr. Salvatore Di Palma, Fisheries Attache, U. S. Embassy
Mr. Richard Rakov, Assistant Director, Peace Corps

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Mr. Jalabert, Fish Geneticist, Bouake Fishculture Research and Training Center

UNITED NATIONS

Dr. J. Y. Lee, Project Manager, Survey and Development of Pelagic Fish Resources
Project

REFERENCES

- Allsopp, W. H. L. 1968. Report on travel to regional fishculture research and training center - Bouake, Ivory Coast. FAO Fisheries Travel Report, AFRO FI 11/68. 6 p.
- Centre Technique Forestier Tropical. 1967. Les recherches sur les peches continentales au centre technique forestier tropical, Rapport Annuel 1967. 32 p.
- Daget, J. and A. Iltis. 1965. Poissons de Cote D'Ivoire. Memoires de L'Institut Francais D'Afrique Noire No. 74. 385 p.
- Di Palma, S. 1968. The fishing industry of the Ivory Coast, 1967, and recent developments. Bureau of Commercial Fisheries, USDI, Foreign Fisheries Leaflet No. 67. 5 p.
- Food and Agriculture Organization. 1967. Rapport sur les peches, Cote D'Ivoire. FAO, Rome. FEe/R52. p. 23-33.

Lessent, P. 1968. Centre de formation piscicole de Bouake CTFT. 3 p.

Lessent, P. 1968. Compte-rendu des travaux effectués durant les années
1966-1967. CTFT, Division des recherches piscicoles. 6 p.

SUMMARY

Intensive fishculture is an effective means of producing protein of high quality. For a successful fishcultural operation, however certain basic inputs are required:

1. A fish species which is both efficient and grows well under pond conditions.
2. A fish which can be induced to spawn for purposes of obtaining adequate numbers of fry for stocking, but one which does not reproduce excessively when placed in production ponds.
3. Availability at low cost of large quantities of waste agricultural products throughout the year to serve as basic ingredients for fish food.
4. Availability of local markets for economical disposal of fish crops.

Although some progress has been made in testing various fish species in West and Central Africa, much work remains to be done. In this region of Africa, over one hundred fish species are present in natural waters of which only a few have been tested for pond culture. Other potentially suitable fish species, based upon present knowledge of food habits, should first be tested individually and subsequently in combination with other species at different rates of stocking and under different regimen of fertilization and feeding. Testing procedures such as these are absolutely necessary to develop improved management methods.

Waste products such as cottonseed, deteriorated peanuts and other materials that can serve as a basis for fish food are available in large quantities in most of

of the countries surveyed. These materials, however, normally are most abundant following harvest, but they may not be available during other periods of the year. This single factor probably is the one which will most limit development of intensive fishculture in the region.

In this survey of fishculture operations, carried out during April and May, 1969, in Senegal, Central African Republic, Cameroon, Nigeria, Togo, Ghana, and Ivory Coast, effort was made to assess fishculture potentials including the availability of required inputs and economic operations.

From the standpoint of economic return to the producer and existing demand for fish, the Central African Republic holds the best possibility for commercial fishculture operations, followed by Cameroon, Ghana and Nigeria.

The Central African Republic and Cameroon, however, already are cooperators in an ambitious program of fishculture research and training sponsored by the United Nations and carried out by Centre Technique Forestier Tropical (CTFT), a French aid agency.

The need for fish is great particularly in the northern regions of the Ivory Coast, Ghana, Togo and Nigeria. Nigeria and Ghana are "impact" countries and both will continue to receive technical assistance through USAID on a bi-lateral basis. At present, however, Nigeria cannot be strongly considered for a fishculture development program because of the following reasons:

1. Although Nigeria is an "impact" country, the AID/Mission felt that it could not support a cooperative program in fishculture in view of existing commitments and obligations to other agriculture programs.

In the past, the AID/Mission has contributed substantially both to marine and inland fisheries projects, especially in Lagos State and the Western State.

2. As long as the present conflict continues, with imposed restrictions on travel and transportation, and preoccupation of government agencies with military priorities, it will be extremely difficult to establish an effective program.

The Ivory Coast has received assistance in fishculture from the French (CTFT) for at least 15 years. Located in Bouake is one of the largest and certainly the best planned and constructed fishculture research facility observed during the survey. A program of research and training at this station is carried out by a staff of 5 Europeans.

Although Togo has need for a fishculture development program in the northern part of the country, there was little indication that the government was interested in supporting a program of this type. Most of the emphasis appeared to be on development and expansion of the marine fishery and assistance in this area was being provided through a German aid project.

RECOMMENDATIONS

Of the countries surveyed, Ghana appeared to provide the best environment for establishment of a cooperative program of fishculture development. This observation is based principally upon the following considerations:

1. Ghana is one of the "impact" countries which is to continue to receive technical assistance through USAID on a bi-lateral basis.

2. The AID/Mission indicated interest in a program of fishculture development for Ghana, if supported by AID/Washington.
3. Government of Ghana through its fisheries department indicated that such a program was badly needed, especially in northern regions, and that it would receive strong support from the government.
4. The fisheries department is staffed with trained biologists who are anxious and eager to be associated with "action" programs. At present, one staff member is studying abroad on a graduate program in fishculture. Upon his return, he will direct the government's fish-cultural program.
5. Ghana at present is not receiving assistance from the United Nations or any other agency for a program in intensive pond fishculture.

If sufficient interest is indicated by AID/Washington and the AID/Mission for a cooperative program of fishcultural development in Ghana, a more detailed and complete survey will be required in order to obtain necessary information and materials necessary to finalize a specific project proposal. Probably a period of 4 to 6 weeks in Ghana would be sufficient to complete this task.