

INTERNATIONAL CENTER FOR AQUACULTURE
AGRICULTURAL EXPERIMENT STATION AUBURN UNIVERSITY
GALE A. BUCHANAN, DIRECTOR AUBURN UNIVERSITY, ALABAMA
RESEARCH AND DEVELOPMENT SERIES NO. 28 CONTRACT: AID/DSAN-C-0053 NOVEMBER 1980

REVIEW OF AQUACULTURE DEVELOPMENT ACTIVITIES IN CENTRAL AND WEST AFRICA





African women fry fish in palm oil for street vending.

CONTENTS

	<i>Page</i>
LIST OF ABBREVIATIONS	4
LIST OF TABLES	4
INTRODUCTION AND RECOMMENDATIONS	5
Purpose	5
Summary of General Observations	5
Country Synopsis	6
Zaire	6
Cameroon	6
Nigeria	6
Liberia	6
Recommendations	7
COUNTRY OBSERVATIONS	7
Introduction	7
Economic Overview	8
Summary of Economic Considerations	8
Socio-Cultural Overview	9
Cultural Factors Influencing Fish Culture Development	9
Agricultural Skills — Gardening and Animal Care	10
Concepts of Land Ownership	10
Theft and Poaching	11
Social Liabilities for Host Communities	12
Use of Profits from Fish Culture	12
Sex Roles and Fish Culture Development	12
Distribution of Food within the Family	13
Zaire	13
Project Review	13
Technical Evaluation	15
Economic Appraisal	15
Socio-Cultural Factors and Fish Culture Development	16
Cameroon	17
Project Review	17
Technical Evaluation	19
Economic Appraisal	20
Socio-Cultural Factors and Fish Culture Development	21
Nigeria	22
Project Review	22
Technical Evaluation	22
Economic Appraisal	22
Socio-Cultural Factors and Fish Culture Development	23
Liberia	24
Project Review	24
Technical Evaluation	24
Economic Appraisal	25
Socio-Cultural Factors and Fish Culture Development	25
CONSIDERATIONS FOR PROJECT IMPLEMENTATION	26
Socio-Cultural Considerations and Recommendations	26
Program Design and Administration	26
Training	26
Program Implementation	26
Information Efforts	27
Project Evaluation	27
Public Health and Environmental Discussion	27
Shistosomiasis	27
Malaria	28
River Blindness (Onchocerciasis)	28
Sleeping Sickness	28
SELECTED REFERENCES	29
ITINERARY AND PEOPLE	31

PUBLISHED NOVEMBER 1980—1M

COVER PHOTO. Fisheries Station at Fouban, Cameroon.

Information contained herein is available to all without regard to race, color, sex, or national origin.

LIST OF ABBREVIATIONS

AID	U.S. Agency for International Development
FAO	Food and Agriculture Organization of the United Nations
GOC	Government of Cameroon
GOL	Government of Liberia
GON	Government of Nigeria
GOZ	Government of Zaire
OXFAM	Oxford Committee for Famine Relief
PC	U.S. Peace Corps
PCV	U.S. Peace Corps Volunteer
USAID	U.S. Agency for International Development (Country Mission)

LIST OF TABLES

Table 1.	Socio-economic Data for Cameroon, Liberia, Nigeria, and Zaire	8
Table 2.	Revenue and Costs for a One-tenth Hectare Pond by Country in West-Central and West Africa	8
Table 3.	Gross Domestic Product of Cameroon by Sectors 1963-64	20
Table 4.	Crop Areas (in Hectares) in Cameroon by Region	20
Table 5.	Farm Area and Family Size in Cameroon by Province	20
Table 6.	Average Yields of Selected Food Crops in Cameroon	20
Table 7.	Average Yields of Selected Cash Crops in Cameroon	20

Review of Aquaculture Development Activities in Central and West Africa

JOHN H. GROVER, DONALD R. STREET, and PAUL D. STARR*

INTRODUCTION AND RECOMMENDATIONS

Purpose

FOR THE PAST 40 YEARS there has been a general feeling that aquaculture, or fish farming, offered considerable potential in Central and West Africa for the production of nutritious food needed by local populations. As part of development programs in their African possessions during the mid 1940's, for example, the colonial governments promoted extensive fishpond construction and encouraged village farmers to raise fish. In more recent years there have been several multilateral and bilateral assistance projects to promote basic fish farming in the various, now independent, countries in this region. In spite of these external efforts and a variety of national support programs, fish farming presently is not widely practiced and after project support has ended, has not become a part of the way of life in the area.

This study was commissioned by the U.S. Agency for International Development (AID) to determine why fish farming development efforts in the Central and West African region have not had more impact and to suggest what form, if any, new development assistance projects for fish farming might take. The analysis was to include technical, economic, and social evaluations of past and current projects so that the experience gained could be used in assessing new proposals. The team was asked to visit and develop case study profiles in the countries of Zaire, Cameroon, Nigeria, and Liberia.

Significant points from observations made during the study are summarized in the introductory section, followed by a more detailed description of past project activities and an analytical discussion of observations in succeeding sections. Most of the information in this report is of a subjective nature and comes from various reports and interviews with people associated with different projects and country programs, as well as from firsthand observations. At present, however, much of the data and analyses needed for a complete review of such efforts simply does not exist and would be impractical to generate.

Fish farming is but one form of agricultural development which has been attempted in Central and West Africa. To understand the why and how of fish farming development is, in a limited sense, to also comprehend the development needs of diverse and complex societies. The recommendations of this report are obviously not able to do this. Yet, these recommendations may help designers of future fish culture development programs to understand more clearly some of the underlying considerations and enhance the achievement of development objectives.

Summary of General Observations

First attempts at fish culture in West Africa involved little more than seeding shallow ponds with native fishes and gleaning the resulting production after a period of time. Much of what is done in the name of fish culture is still practiced at this same rudimentary level, which is consistent with other animal production practices. Harvests are small, but costs and effort are negligible so operators get something for almost nothing. Efforts of the UN Food and Agriculture Organization (FAO) and Peace Corps (PC) have focused on enriching ponds with manures or composts and supplemental feeding, along with the stocking of more productive, lower trophic level species such as *Tilapia nilotica*. These more recently introduced techniques do give significantly better results, but they generally require a degree of management discipline, government extension, and hatchery support that has seldom been forthcoming. Common carp have been introduced in a few places, particularly where altitude and cooler temperatures suppress tilapia growth and reproduction. Common carp, however, will not reach high standing crops without substantial inputs of feed that are usually beyond the economic capacity of small farmers to provide.

Profit seemed to be the prime stimulant for fish production. Communal fish farming schemes, however, evidenced little history of success and were not regarded with enthusiasm by those interviewed in any of the countries visited.

Once harvested from ponds, fish generally go into the family soup pot. Unfortunately, pregnant and lactating women and newly weaned children, the prime targets for protein and nutrition programs, typically receive only meager amounts of fish. Fish produced in excess of family consumption is readily sold.

Fish were well accepted as food by the vast majority of the population in each country visited. There was uniform agreement that a considerable quantity of fresh fish could be marketed in almost any area where they could be produced, and that marketing, distribution, or preservation did not constitute a constraint to production. In coastal areas where there were significant landings of marine fish, cultured fish are not highly competitive.

In general, large fish of 200 grams or more were preferred. Smaller fish, although readily saleable, frequently were substantially discounted. Prices of fish were good but usually below that of a comparable quantity of beef, chicken, or other meat.

Fish farming was generally considered a cash crop enterprise and within the domain of the male in village society (possible exceptions existed in Liberia). This condition may be one reason why fish farming has not become well established. Typically, livestock have not been well tended in African villages and men give priority to other cash crops, such as palm fruits, coffee, or cocoa, over fish production. Changing attitudes about fish production or any other modernization of agriculture must be

*Respectively, Associate Professor, Department of Fisheries and Allied Aquacultures; Associate Professor, Department of Economics; and Associate Professor, Department of Sociology.

regarded as a long-term process which cannot usually be accomplished within the life of a brief foreign aid project.

Health and environmental problems did not appear to be a significant factor in fishpond development, with the possible exception of the disease schistosomiasis. Specific information about this disease for most localities seems to be unreliable. A monitoring component should be included to document pre- and post-project incidence of schistosomiasis and a public education and sanitation effort should be a component of any pond development project.

Every country visited had at least some land area with suitable conditions for fishpond development. Many of the resources adaptable for fish culture had virtually a zero opportunity cost and should be put into production alternatives. Higher-placed officials in the government ministries were also generally receptive and sincere in their desires to support fish culture development. In turn, little was seen to inspire confidence or give encouragement at government fish hatcheries or demonstration farms. Economically feasible, field level operations on the part of government organizations were not apparent. Most hatchery or farm managers are not technically qualified nor sufficiently analytical for their applied functions. None of the fish culture development efforts studied has really had the financial support and stable economic-political environment required to facilitate complete success. There is an unlimited and all too familiar litany of frustrations associated with almost all the projects. Clearly, future projects should seek ways to insulate programs from political change and at the same time stress the public accountability of each program.

In spite of the interest expressed in West Africa, the study team found little good production data involving local conditions upon which reasonable development programs could be based. As an example, the feeding of cassava leaves to tilapia is generally considered useful, but no one knows how many kilograms are needed to produce a kilogram of the different species of fish, or the most effective nutrient and species combinations. Similarly, information is lacking on the use of crushed agricultural limestone to correct acid water conditions.

Country Synopsis

Zaire

The continuing AID-assisted Peace Corps (PC) effort in Zaire is impressive in several features. Farmer demonstrations have given good fish yields, some exceeding 2,000 kilograms per hectare per year in selected small ponds stocked with *Tilapia nilotica* and using composts or manures with cassava leaf, rice bran, or other feeds. Peace Corps volunteers have operated at the village level and have been extremely dedicated in their efforts. Small fish are readily accepted by the rural population and the profitability of pond culture is obvious under the current harsh economic conditions. Fish culture is a relatively flexible production system that appears more adaptable to the rural way of life than other animal improvement schemes that have been attempted or contemplated. There is some indication that the experience gained by improved fish culture techniques may open the way for the adoption of other improvements in agriculture.

Counterpart government participation with the Peace Corps fish culture program has been negligible. Interest among rural people is running high, however, and social and economic conditions seem favorable for fish culture to expand. Hence, modest USAID support for this program should continue as an experiment to learn whether fish culture will spread without reliance on significant government support.

Government programs in general are mistrusted and it may be advisable not to insist on a governmental presence at the village level. Another few years of investment would seem a modest cost considering the few available alternatives for increased food production.

Cameroon

The Peace Corps in Cameroon also has been the main force behind fish culture development efforts. Production demonstrations have been less dramatic than in Zaire, possibly because of a slightly cooler climate. Economic conditions are different in Cameroon and the strong grass-roots interest in fish culture that was noticed in Zaire was not apparent. The dedication and commitment of Peace Corps fisheries volunteers was obvious and impressive. As in Zaire, their impact to date and their sphere of influence on actual production is small. A modest input by USAID could be justified to determine if such efforts can eventually lead to meaningful production or nutritional impact on a large scale.

Nigeria

The agricultural sector in Nigeria has generally fallen behind in the economic swirl associated with the petroleum boom. Large quantities of food are now being imported to feed Nigeria's population, which is estimated to be about 80 million. Government strategists recognize the need to strengthen domestic food production, but support efforts to date have not been substantial.

There is a semblance of a fish culture extension and fingerling distribution system in Oyo State and possibly elsewhere, but the impact of these programs did not appear to be significant. Indications of a well-planned development effort involving fish culture were almost completely lacking.

The Bendel State has supported a large land clearing and fish farm development scheme managed by expatriates employed by the United States-based Tiffany Farms. To date, 320 hectares of delta land have been cleared and 40 hectares of ponds have been started in common carp production. An effort of this scale, particularly when projected with an annual 30 percent return on investment, has generated considerable interest among other states and large-scale investors that may signal further similar development schemes.

Liberia

Little, if any, fish culture is taking place at the village level in Liberia, nor is there any significant infrastructure, such as functioning hatcheries or extension biologists, to support a development effort. Earlier efforts to gain support for fish culture have largely failed because the marine fishing, fish importing, and distribution systems within the country have been controlled by a single influential company. This company has recently developed a large integrated farm with livestock and poultry operations that includes 140 hectares of fishponds and the services of a Chinese fish production manager. Such a large-scale production unit has considerable potential to supply significant quantities of fish. The integrated operation system, once demonstrated to be practical, might possibly be scaled down to smaller farm units to meet local market demands.

The current USAID proposal to strengthen the Central Agricultural Experiment Station at Suakoko seems worthwhile, and fish culture should be one of the farm activities studied within the Experiment Station program.

Recommendations

1. To the question, "Is aquaculture development an appropriate AID activity in Central and West Africa?", the answer is yes. Aquaculture has the potential to more fully utilize available land and water resources and subsequently provide both food and income for rural village dwellers. Aquaculture generally has no conflict with other agricultural practices and can be integrated with animal and plant production efforts. AID support should not focus on large-scale or highly intensive fish production systems, but rather on small-scale efforts that can be maintained at low cost with a minimum of dependence on outside support.

2. This region of Africa does not have a tradition of aquaculture and few local people are trained in practical fish production methods. Development efforts should recognize the need for more trained people at the hands-on level and for the generation of more practical result-demonstration experience. It is upon such efforts that careful economic feasibility studies and extension programs should be based.

3. Fish culture development efforts should start with a careful country-by-country inventory of land, water, climate, and other resources to assess each area's suitability and availability for fish culture. If resources are adequate and a firm commitment is apparent on the part of the host government, then small demonstration centers should be developed where techniques can be tested and out of which extension programs can start. These centers should be located where prospects for success are best and may involve rehabilitation of existing facilities. Each center could have 30-100 small ponds where adaptive yield demonstrations could be conducted. There should be modest but functional laboratory and training facilities associated with each center. All experimental endeavors should be directed toward economic accountability at both the micro and macro levels. The macro level recognizes social opportunity costs in the recipient countries. Support for the centers needs to be long term, but with adequate review procedures to ensure practical application of the work program. It is more important to have a small, properly funded and operational center than to have a thinly spread but less effective national program. Preferably, a fish culture development center would be integrated with other rural development projects or agricultural experiment station activities.

4. AID is in a good position to add complementary support to existing programs receiving help from FAO, Peace Corps, and other donors. Continued cooperative participation with other

agencies is to be encouraged for aquaculture support. AID can provide training funds, skilled technical assistance, equipment, or even capital for infrastructure development that might not be available from host-country resources or other donor programs.

5. Aquaculture development efforts should be integrated with appropriate health education programs that will emphasize the role of fish in family nutrition and the need for appropriate sanitary practices to control schistosomiasis.

COUNTRY OBSERVATIONS

Introduction

In the following country-by-country observations of the four nations visited, the Zaire section is most complete because this country was visited first. Observations have not been repeated in detail for other countries where conditions were similar. Overall, a remarkable similarity existed in the structure of village life in the countries visited.

Traditional life styles and family patterns, food production systems, cash crops, marketing methods, and experiences with new agricultural technologies had many characteristics in common. Peasant farmers generally cling to traditional lands and use time-proven methods to raise unimproved crop varieties with little use of chemical fertilizers, pesticides, heavy mechanization, cooperative planning, or other technological aids. Women are generally responsible for family food production, and diets are based on cassava or other tubers, rice, maize, or bananas. Wildlife food resources have become depleted and lands for rotational cultivation are being more frequently and intensively cropped. Plantation crops, such as oil palm, rubber, and coffee, are subject to wide price fluctuations and government manipulation of marketing and distribution. All of the countries studied are experiencing the rapid growth of cities and difficulty in building domestic agricultural productivity, either of crops for domestic use or export. Educational and economic aspirations were being keenly felt, and traditional religions and tribalism were in conflict with forces of modernization. Nowhere is there an abundance of trained agricultural technicians or a fully effective agricultural extension program. With the exception of Cameroon, each of the countries had undergone some relatively recent disruptive economic or political events.

Cooked bananas and powdered cassava root are staple but low protein foods in West Africa.



Economic Overview

It is a well-known fact that incomes in Africa are low by accepted standards. Although all of the countries in the survey have had per capita incomes in the \$100 to \$300 per year category during recent years, changes can take place rapidly. Such was the case in Nigeria as the petroleum export market developed recently. Similarly, recent sporadic conflict in southern Zaire affected the country adversely as production was interrupted. Dependence on one or two export items in world markets can also change the direction of an economy in a short time. Zaire's dependence on copper gave the economy a jolt toward the mid 1970's as world prices plummeted. Data reported in table 1 illustrate income positions of the four countries in 1974. Such data are of questionable reliability because of rapid changes caused by political events or natural causes, and should be used with caution. Revolutionary instability, market changes, governmental realignments, weather changes, and other catastrophes have been fairly common in Africa in the immediate past. Unstable monetary conditions could be added to the above list, along with other poor planning which has led to varying degrees of inflation in the different countries in question. *International Financial Statistics* of the International Monetary Fund show consumer Price Index numbers for Cameroon, Liberia, Nigeria, and Zaire as 145, 124, 179, and 768, respectively, on a 1975 base of 100 for late 1978 and early 1979 for the four countries in question. An inflation of 668 percent in 3 plus years, as occurred in Zaire, can have disruptive effects on an economy and on incentives to lend money for investment purposes.

TABLE 1. SOCIO-ECONOMIC DATA FOR CAMEROON, LIBERIA, NIGERIA, AND ZAIRE, 1974

Country	Per capita GNP	Area in		Population	Population density per	
		km ²	mi ²		km ²	mi ²
	<i>Dol.</i>	<i>Thou.</i>	<i>Thou.</i>	<i>Thou.</i>	<i>No.</i>	<i>No.</i>
Cameroon	268	458	183	6,282	13.0	34.3
Liberia	256	108	43	1,669	15.5	38.8
Nigeria	201	893	357	61,270	68.6	171.6
Zaire	143	2,263	905	24,222	10.7	26.7

Source: *Political Handbook of the World 1977*. pp. 585-587

Various post-colonial slumps, price controlling mechanisms, a lack of government accountability, and general poor planning have held many countries back during the past 20 or so years. Nationalization programs in some cases have also driven out expatriate expertise, thereby damaging real output in certain countries. Bureaucratic redtape within some countries is a further deterrent to economic progress because of the

discouraging problems to foreign companies willing to make investments.

Aside from the low per capita income discussed above, it is also true that a severe maldistribution of income exists in these countries. Overwhelming proportions of the populace live in rural areas — often on severely limited incomes at the subsistence level. There is a strong attraction for rural dwellers to move into cities, further worsening social problems that are practically unmanageable.

Summary of Economic Considerations

The economic summary for the four countries, with simulated cost-returns data on fish culture, was calculated by methods detailed in the Zaire discussion of the main report.

In general, fisheries at the farm level are so infinitesimal as a fraction of the total economy that they can be ignored from a tradeoff standpoint on resource use, employment of labor, and on competitiveness with other enterprises of an agricultural nature. High rates of unemployment, ranging to 50 percent in urban-type industries and services, also illustrate a lack of conflicts of employment in fish culture with other non-agricultural enterprises.

The market for fish is generally good in the areas of Africa surveyed, but larger size fish are preferred in some of the areas covered. Part of the fish are sold and part are consumed by the family. An educational effort is needed to accompany production development to assure meeting nutritional needs of children, lactating mothers, and others with the severest deficiency problems. The use of cash income received by the operator was not known in general, but in some instances farmers indicated that the extra money would be used to pay for education of their children or to buy small tools used on the farm.

Fresh fish in the economy had the advantage of being salable locally without the use of elaborate transport and cooling infrastructure. No new marketing and processing facilities are involved, and the community has an opportunity to improve its economic welfare through the fish culture option.

Simulated cost and returns data for a 0.1-hectare pond are given in table 2 for the four countries, based on local prices for fish and labor, and on production data in the area or in a similar area. Nutrients were plant scraps, cassava leaves, and locally available manures. The economics of intensive feeding operations were not studied in detail, but indications were that a heavy feeding operation entails importation of feeds. Productivity is generally proportional to the intensity of nutrient input; however, only by-product manures and nutrients from animal by-products and residues are available, with high quality feedstuffs being generally unavailable.

TABLE 2. REVENUE AND COSTS FOR A ONE-TENTH HECTARE POND BY COUNTRY IN WEST-CENTRAL AND WEST AFRICA

Variable	Country							
	Zaire		Cameroon		Nigeria		Liberia	
	1st 2 years	Later years						
Costs*								
Water system ÷ 2	\$ 20.00	---	\$ 43.20	---	\$ 82.40	---	\$ 37.00	---
Pond construction ÷ 2	\$ 25.00	---	\$ 54.00	---	\$103.00	---	\$ 46.25	---
Operating labor	\$ 16.00	\$ 16.00	\$ 34.56	\$ 34.56	\$ 65.92	\$ 65.92	\$ 29.60	\$ 29.60
Fingerlings	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00	\$ 20.00
Total	\$ 81.00	\$ 36.00	\$151.76	\$ 54.76	\$271.32	\$ 85.92	\$132.50	\$ 49.60
Total revenue	\$305.00	\$305.00	\$139.58	\$139.58	\$245.70	\$245.70	\$113.75	\$113.75
Residual	\$224.00	\$269.00	(\$12.18)	\$ 85.20	(\$25.62)	\$159.78	(\$19.10)	\$ 64.15
Price of fish	\$3.35/kg		\$1.92/kg		\$2.70/kg		\$1.25/kg	
Productivity of fish	910 kg/ha/yr		727 kg/ha/yr		910 kg/ha/yr		910 kg/ha/yr	
Prices of labor	\$1.00/day		\$2.16/day		\$4.12/day		\$1.85/day	

*Labor assumed was 40 days for construction of the water system, 50 days for the pond construction, and 16 days for operation.



Examination of peanut oil cake that may have local fish feed potential.

A serious impediment to project planning and economic analysis in the four countries is the lack of a body of production data to which economic data can be attached for policy purposes. This lack of data could be solved by a systematic approach to experimental work in government facilities as well as by gathering experimental data from cooperating farmers in extension programs. The data base is so thin and unreliable in most instances that this important link must be strengthened before any massive new approach to pond fish culture is established. Peace Corps volunteers have not been trained to be sensitive to the economic implications at all levels of the program. Opportunity cost appraisal seems hazardous at best and must be given more consideration in the future. Benefit-cost analyses at the macro level are completely lacking, and social opportunity cost of the country's resources seems not to have been considered. In short, the three countries where the Peace Corps operates do not appear to have an adequate base on which to build appropriate development policies.

Socio-Cultural Overview

Cultural Factors Influencing Fish Culture Development

There are few specific cultural constraints which impede fish culture development in West Africa. Fish is a highly sought after food throughout the region, and fresh fish is generally preferred over smoked or salted varieties. Those who do not eat fish are people who cannot afford it or who live in areas where it is not available. Fish is commonly perceived as a delicacy that only a minority can enjoy with any regularity.

Three cultural constraints were found to specifically concern the consumption or cultivation of fish. In some parts of West Africa, a few small religious groups have norms preventing the consumption of certain types of fish, usually catfish. Other small minorities believe that one should not eat fish under certain conditions, such as while undergoing treatment for particular afflictions. The precise nature of these beliefs varies according to tribe or area, but the belief appears not to be widespread and should not be regarded as a serious barrier to fish culture development.

The third specific constraint concerns the attitudes of farmers who had old ponds that were built some years ago by their ancestors. Some farmers refused to destroy or make significant changes in their ancestors' ponds even if it prevented the creation of a much improved facility. Their refusal was due to the belief that such ponds had a special, almost sacred character because they were built by their forebears. This belief is fully congruent with the forms of animistic religion found throughout West Africa, involving different types of ancestor worship often in combination with either Christian or Moslem practices. Many of the indigenous religions regard different natural objects, such as trees, ponds, and other water sources, as being a haven for spirits.

More significant are the more general cultural factors which can prevent or impede an interest in improving oneself economically through fish farming or other endeavors. These factors commonly involve the status one occupies in a larger social order that is of fundamental importance to the person. Conventional village roles provide the individual with important, mutually binding rewards for "appropriate" conduct and punishment for behavior which deviates from that which is expected and valued. These clusters of norms and expectations can vary considerably from village to village according to ethnic-tribal group, but share many common features.

The basic character of the society remains strongly influenced by traditions developed over centuries of hunting, gathering, and the cultivation of simple foods in what were often harsh environments. The activity and status of men centered around the hunting of wild game, while those of women emphasized the securing of food through gathering and cultivation. The fact that wild game stocks have been drastically depleted within the last few decades has posed several serious problems to traditional ways of life. Many West Africans are still coping with fundamental changes and have yet to successfully resolve them. Some argue that the loss of game has had its greatest impact on the role of men in rural West Africa, creating a vacuum in their social life which has yet to be adequately filled and is at the root of many community social problems.

Typically, men work with cash crops, such as coffee, oil palm nut clusters, or maize, while women are responsible for the production of food for household consumption. In most communities, women have a substantially greater responsibility for the well-being of their children than do men. This is particularly true in polygamous families (units in which one husband has two or more wives), a common form of marriage in West Africa. With two or more females securing food for their children and common spouse, the husband has less need and incentive to engage in productive labor. Instabilities and uncertainties influencing the value of cash crops over the last few years have further decreased the incentive of many men to cultivate them, allowing the potential cultivators to devote a considerable amount of additional time to other pastimes, including the socializing with village peers and enjoying locally-made palm wine. In many cases, a great proportion of the typical village male's week traditionally has come to be devoted to drinking palm wine while socializing with kin and village associates, but interviews suggest that the time invested has increased in proportion to the time released from the production of cash crops.

Informal socializing and related activities play a central role in the community life of males that should not be underestimated or prematurely condemned as non-rational conduct. Rituals centering around the tapping and use of palm wine, for example, serve as mechanisms to promote communication among village men, providing an arena for the cultivation of economic exchange, matchmaking, and social control through gossip and

jesting. Group processes can serve to reconcile differences and resolve disputes. The custom also serves to unify the participants and give them a common identity that is expressed in their conversation about non-participants in the area or "outsiders" from other extended family groups or villages. In some communities, those who work in another's field are paid in palm wine and some men collect wine for cash sale in a local market. There is usually at least one family in every sizable village which earns whatever cash it may have through the collection and sale of palm wine.

An individual male who wishes to devote his time and energy to economically productive activity in a village which has norms resisting such activity may have to pay a "price." The price in this instance refers to the penalties the individual pays for breaking out of an important system of social relationship that may be, after the secret societies, the most important male institution in the village. In some cases, the farmer who wishes to take fish culture or any other innovation seriously will be regarded as a kind of "deviant" who is violating the largely implicit norms about what it means to be a "good fellow" among the men in the community. He may be gossiped about or joked about in his presence. In some instances his tools or possessions may be misplaced and his ponds vandalized, or, more rarely, even poisoned. "If you succeed, beware from whose glass you drink" goes a traditional proverb.

The good things in life are not commonly seen as a zero sum game in which there is only a limited amount of good that is received by some at the expense of others, but those who do engage in "too much" productive activity may often do so at the expense of good social relationships with other village males. Given the pressure to conform to what is (in relative terms) a largely unproductive routine, it is clear that innovative and serious fish farmers would, in many villages, be unusual and highly independently motivated individuals.

Clearly, the best targets for extension work would be those who are interested in fish culture and who have already demonstrated their independence and managerial skill. This includes individuals with some degree of aptitude and experience outside the confines of the community, such as those who are or have been teachers, government workers, policemen, soldiers, or who have been employed in urban or industrial enterprises.

Norms can also be developed and promoted to encourage productive activity in fish culture and other agricultural pursuits. This is one of the most difficult goals of any village level development project. Incorporating an improved method of production into the routine way of life of a community and bringing about the institutional supports that will give the new method some momentum is a great challenge. It is a goal which is seldom accomplished during the experience of any Peace Corps volunteer (PCV) or change agent, and by its very nature a goal which requires a considerable investment of time.

In the case of fish culture, promoting such norms requires the creation of a critical mass of farmers who are well motivated to practice good management, who learn from one another, and, most importantly, who provide one another continuing social support and positive reinforcement. In its most obvious form, such relationships are formalized through local voluntary associations of farmers which have leaders and a regular meeting schedule. Ideally, these associations provide a forum for the exchange of ideas and experience, involve mutual assistance among members, and serve as a way by which farmers can acquire and share tools and other materials. Efforts to create such organizations are typically premature and usually fail, however, because there is no informal structure of

communication and reciprocal relationships upon which to build a more formalized organization. High priority should always be given to the cultivation of informal norms and social patterns at the village level rather than to the more formalized or bureaucratic modes of organization, most of which have been ineffective in Zaire and other places in West Africa. To put things in an overly simplistic way, it is the long-term task of any village level fish culture development effort to get villagers to evaluate one another and themselves in terms of their productivity as fish farmers rather than in their role as hunters of (now depleted) wild game and providers of wine.

Agricultural Skills — Gardening and Animal Care

Although communities and tribal groups differ considerably with regard to their success in agriculture, the greatest source of variance encountered concerned the relative incentives that were present. Communities in which reasonable profits could be made growing and selling things had many individuals who were engaged in such activities. In areas where the economic rewards were scarce or essentially absent, few people were active farmers. With some important exceptions, however, the rural communities visited were lacking in effective farm management. Some tribal-ethnic groups successfully specialize in raising cattle, but most rural communities had few large animals. A few pigs, goats, chickens, and even a rare rabbit were seen, but it was apparent that few people effectively "raised" animals; the vast majority of animal owners just "kept" them. Goats and chickens were expected to fend for themselves and would be consumed or sold for cash for a holiday, special event, or emergency. Varieties kept were traditional types selected for their hardiness rather than growth efficiency. Clearly, the routine care of animals for effective production is not consistently a part of most West African cultures. The same is true with regard to horticulture, with the exception of systematic cassava and yam production in some villages. It is not surprising that those with the best management skills in other forms of agricultural production tend to be the most successful fish farmers. The lack of such skills and the appropriate attitudes that accompany them will remain a barrier to progress for some time to come. The team believes, however, that fish culture is one of the more effective ways of demonstrating the rewards of systematic care, planning, and management in general agriculture.

Concepts of Land Ownership

The prevailing unit of both production and ownership of property throughout West Africa is generally the individual. Brothers, children, and kin may assist with production, but the individual continues to be the possessor. The individual owns the things he has created, such as his house, the lands he has cleared, or the ponds he has made for his fish. The land used for such activities, however, may belong to the extended family or kin group at large or possibly to the whole community or village. If the land is the property of his larger group and is not being used, the potential user gains access to it by informing other family members, primarily as a matter of courtesy, that he intends to use it. In the rare case that the land is presently being used for other purposes, he must seek the consent of the senior members of the family. An individual can also use land owned by others as long as it is not being used and he secures the permission of the head of the household that does own it. The approval of the owning family is generally granted unless the use entails a long time period, such as for the building of a



Private fishponds developed in narrow valley in Zaire.

permanent house or the planting of coffee or palm trees. The longer the proposed use, the greater the potential deprivation of the owners or their descendants. Less permanent activities, such as fish farming and growing vegetables, corn, or cassava, are generally approved with little difficulty because the owners can easily retrieve their lot in the future. It is also possible for a newly arrived person to gain the use of unused lands, but such requests are unusual.

Generally, there has been little competition for access to lands suitable for fishponds. The land has little alternative use, except perhaps for some rice growing, and is usually located at the bottom of a valley away from preferred living areas. It is not common for a person to request use of land owned by another family for fish culture, but it has been done. Reportedly, the construction of such ponds on another's land is not seen as a permanent change, but only an alteration of property that is not in current use and will continue to be the property of the owners. In situations where the land is owned by the village, the prospective user should secure the chief's approval.

No evidence indicated that communally organized fish culture projects have succeeded in West Africa. Some have failed over disputes concerning the rights of various contributors to the harvest. Usually little management input can be sustained in communal fishponds because of a lack of incentive.

Although under current law each government retains title to all unsurveyed land, the realities of tradition prevail and there is considerable consensus on the village level about who owns what land. Only a small proportion of the land in West Africa has been surveyed and registered, and the governments in the area have confined their claims to urban and mining areas or to road or public service projects.

Theft and Poaching

The stealing of fish from ponds occurred with varying frequency in the areas visited. Estimates of the fish removed without permission from ponds range from virtually none to as high as 40 percent.

Generally, only four measures could be taken to prevent theft:

1. A fence could be constructed around the pond area. This was rarely done, however, as it is expensive and could easily be crossed.

2. The farmer could move his house close to his ponds. Although a few have done this, most ponds are located at valley bottoms, some distance from the residential clusters of the village. As most families enjoy living next to their neighbors and kin and such proximity entails several social and economic benefits, the idea of moving closer to ponds is not popular. Two instances were encountered in which wives returned to their original house and refused to live in new houses built by their husbands near the ponds.

3. The area could be guarded, either frequently or near harvest time. One way of doing this has been to hire a guard. For small farmers, the cost of hiring a guard would be greater than their entire profit from a sale.

4. Another method involves placing "magic" devices around the pond to ward off thieves. Its effectiveness is not known, but the method does have the confidence of many.

The more valuable fish are in a community and the greater the need for food, the greater is the probability of theft. Regardless of theft frequency, however, it has rarely deterred a farmer from continuing to practice fish culture.

In addition to the praedial larceny that takes place among village communities, there is a certain amount of "official" loss

of fish. For example, stories were heard about soldiers stationed near a village marauding ponds and taking fish, or of local officials accepting "gifts" of fish when ponds were harvested. This latter example is more typical of government-owned production units or hatchery ponds where facilities are frequently operated for the private gain of those who supervise the operation of the ponds. A government official who is profiting from the sale of fish produced in a hatchery pond is not easily persuaded to use the pond to produce fish fingerlings that are to be given to deserving farmers.

Social Liabilities for Host Communities

Although information was sought concerning the problems brought about by fish culture at the community or higher levels, no serious liabilities or threats of future problems were found. No instances were encountered in which fish farming interfered with other forms of activity that are generally considered to be productive or beneficial. Successful fish culturists, as is generally the case with other good farmers, spend much less time socializing than nonfarmers or those with little productivity. A village in which a number of men started serious fish farming could expect an overall increase in the amount of time used in productive activity.

A few villages have become known for the production of baskets and pottery for cash sale. The income produced, however, is modest and barely makes the effort worthwhile economically. Should fish farming become a more profitable pastime, those traditional forms of production would hypothetically decline. In short, no social dislocations of any negative sort have occurred in any village where fish culture was being practiced.

Use of Profits from Fish Culture

There was substantial agreement among interviewees, including farmers, Peace Corps volunteers, and government specialists, about the uses of money earned in fish culture. Most of the money was said to go for school fees and/or medical expenses. Some was used to pay required bride prices, buy salt, and meet unanticipated emergency expenses. Actual behavior seemed to confirm this with one exception. Although some harvests were accomplished just before the start of the school year to enable the farmer to earn money to pay his children's school fees, other harvests were made before a major religious holiday, Christmas for Christians and the end of Ramadan for Moslems. This pre-holiday harvest indicates that at least some of the profits were used for feasting and other social obligations associated with religious holidays. Some fish farmers regard their ponds as they do chickens and other forms of livestock, as a modest form of insurance or "money in the bank" to be tapped in an emergency or for a special occasion. This attitude is one reason why some farmers will put off draining their ponds for some months even if the fish have already achieved their maximum growth. Meat prices in local markets are commonly higher during festival days, but the farmers would make more money by harvesting more often.

Sex Roles and Fish Culture Development

The division of labor on the basis of sex tends to vary by ethnic group and local community. In general, however, women are primarily responsible for the production of food to be consumed by the family, while males are concerned with cash crops. Conventionally, this has meant that the bulk of routine agricultural work has been the wife's domain. She usually

accomplishes this by cultivating cassava and other tubers. In some communities, the husband will aid with the initial planting and later harvesting. In areas where cash crops have been less important or in decline, the daily agricultural work of the male has been correspondingly less. Even when such cash crops as coffee beans, tobacco, and cocoa are actively cultivated, the male's routine tends to be more seasonal than his spouse's work. This division of labor has been influenced by the hunting tradition. When wild game was abundant in the past, men devoted a good part of their energy and skill to hunting. Women remained at home working at routine tasks, either cultivating or collecting edibles, while taking care of children. Again, although there has been a rapid drop in wild animal populations and hunting cannot produce much food, a way of life which evolved over several centuries continues to influence contemporary practices.

These roles are instilled in young people from their earliest years. A mother usually has a son help with some of the family food production or preparation, such as grinding cassava flour. Upon early adolescence, however, he will be replaced by a younger brother or a sister. Girls are commonly responsible for taking care of their younger sisters or brothers and routine household tasks, often up to their marriage. Among the least involved in productive activity in the village are adolescent males. Many attend elementary school, but many spend most of their time in less productive pastimes. Most aspire to leave the village and live in a city.

Given these social patterns, fish culture in West Africa has been and promises to remain a male domain. Although a good part of the fish is eaten by the farmer and his family, it is regarded as a cash crop. Almost all family ponds are dug by the individual farmer, sometimes assisted by kin. It is not often that anyone is hired for the job. The filling, stocking, feeding, and harvesting are carried out by the male. In unusual instances where fish are sold at a marketplace, a wife may do the selling. A few fish farmers are women, usually prosperous widows who use resources inherited from their husbands, but these are unusual exceptions. Like most differences between the sexes, the roles are cultural and social. There is no fundamental reason for women not to become active in fish culture, but there is little doubt that the current sex role differences in West Africa will persist for some time.

Distribution of Food within the Family

In polygamous households, each woman has been basically responsible for the feeding of her children and for providing dishes for her husband. Wives may borrow from one another and sometimes share foods, but the general pattern is for each to prepare an individual dish for the husband's main meal that is usually taken in the evening, or for each of the wives to be responsible for feeding him on certain days. Typically, the husband or his guest has first choice of the food, followed by the wife and then the children. Generally, the more and higher quality of food available to the family, the better the nutritional status of the children. The team encountered no instances where parents routinely deprived their children of food, but it has been demonstrated in other research that young children and expectant women are among those who bear the brunt of food shortages in West Africa. Even when food is plentiful, however, it is apparent that a large proportion of the rural population does not understand the basic elements of sound nutrition. Although there is a general lack of information about health and foods, only one specific cultural practice was encountered that was directly concerned with food distribution: the belief that children should not be given eggs because it would tend to

spoil them and bring disappointment when they grow up. In a few areas, such later deprivation was thought to lead the frustrated one into a "life of crime." No survey has been conducted on how widespread these views are, but they persist in local folklore.

Zaire

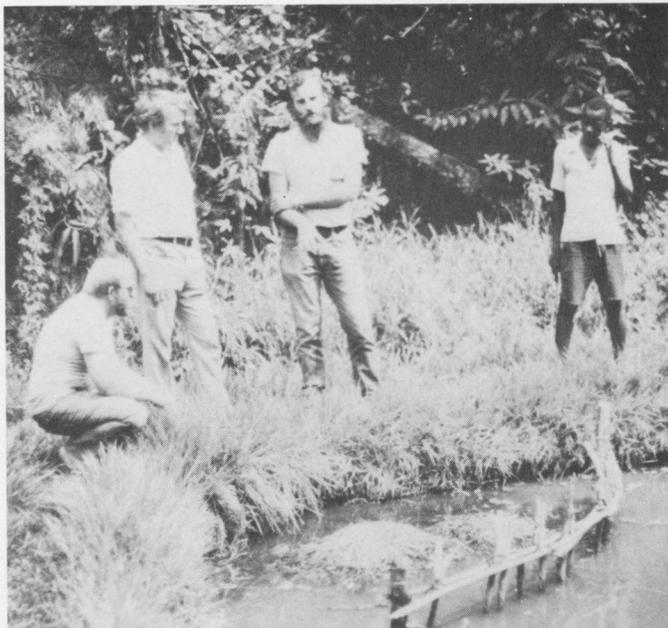
Project Review

THE BELGIAN EXPERIENCE. During World War II, Belgium sought to secure the strategic resources coming from the Zaire Region, particularly copper and uranium, for use by the Allies. The people in the area felt the impact of the war, particularly as meat supplies and other foodstuffs traditionally imported from southern Africa were diverted for troop use. As a result, the Belgians attempted to increase local agricultural productivity, including the construction of fishponds, to help provide for the people. This effort continued throughout the remainder of the Belgian colonial period.

The Belgian Congo was divided into six states, each of which had a director of fisheries and two or three fish fingerling production stations. Within each state there was a group of Belgian fishery officers who supervised fisheries development and trained local monitors or extension agents. Farmers were encouraged, in some cases even coerced, to build small ponds in tandem fashion along the bottoms of small valleys typical of the agricultural countryside and to stock these ponds with fish from government hatcheries. In this manner, several thousand ponds were constructed. A 1957 estimate claimed 93,766 ponds with a combined area of almost 3,975 hectares. Fish distributed to the ponds were generally *Tilapia macrochir* and *Tilapia rendalli* (earlier called *T. melanopleura*). The two species are herbivores, and culture practices generally involved recommendations to grow vegetables beside ponds, chop up the leafy matter, and feed it to the fish. Yields using this system were seldom more than a few hundred kilograms per hectare, and the required feeding effort was considerable. Extension services, even with locally trained agents, were more of a directive nature than a cooperative exchange.

With independence and the chaos that followed, most of the European technicians left Zaire and local technicians were lost from service. Without direct encouragement and a supply of fingerlings, most ponds fell into disuse or reverted totally to natural conditions. Nevertheless, the memory of these ponds and earlier production efforts still remains and there is a general positive feeling about fish culture among the rural population.

US PEACE CORPS FISH CULTURE PROGRAM. The Peace Corps/Zaire initially began researching the possibilities of intensive fish culture in the Bulungu region in 1973. Between the time the country gained its independence from Belgium in 1960 and the initial Peace Corps feasibility study, no significant fish culture effort had been made. Sponsored with the cooperation of the Oxford Committee for Famine Relief (OXFAM) and directed by a former PCV from Cameroon, the study indicated that an area in Bulungu with a high density of population and many possible pond sites offered the greatest potential. In September 1973, two PCV's were assigned to the Kikwit area to initiate pilot projects. In 1974, a Peace Corps staff member was sent to Kikwit to provide technical support and encourage Government of Zaire (GOZ) support. Subsequent inquiries reported that the GOZ would be willing to support the project and collaborate with the volunteers by providing resources and counterparts. Throughout the entire later experience of the PC/Zaire Fisheries Program, however, support from the GOZ was virtually nil. The initial hope that the responsibility for the program would eventually be that of GOZ agronomes and that the GOZ would provide needed construction materials to



Compost pile in corner of private fishpond as nutrient source suggested by Peace Corps volunteers in Zaire.

rebuild a local fish station at Nzinda has never been realized. Although the PC project successfully demonstrated the feasibility of fish culture in the Bulungu area, it attracted no GOZ support.

Rather than depend on inefficient feeding of herbivorous fishes as the colonialists had recommended, the Peace Corps helped introduce the plankton filtering *Tilapia nilotica* and encouraged farmers to enrich ponds with composts and manuring to stimulate plankton growth. The results were better yields with less day-to-day attention needed than was required by the earlier herbivorous fish production systems. The system did create an initial need for *Tilapia nilotica* seed stock and, therefore, government hatcheries. Once a farmer had stock, the fish would generally multiply in ponds for the subsequent restocking of further production efforts.

Farmer demonstrations monitored by Peace Corps volunteers have given good returns, frequently with annualized yields in excess of 2,000 kilograms per hectare. This result is particularly true where farmers have been attentive to the directions given by volunteers and where supplemental feeding with proteinaceous cassava leaves has been practiced. Ponds of cooperating farmers where these practices were being followed had good plankton blooms in the water.

Peace Corps volunteers argue that participation by the GOZ at the farm level is not absolutely essential. Volunteers claim that their direct benefit to the farmers is enough to justify their effort, independent of whatever government counterpart system might develop as a result of outside assistance. This reasoning has some merit, particularly in view of current economic and political conditions of the country. The Peace Corps hopes to get enough successful adopters functioning so that the system spreads on its own appeal, including some producers taking on the seed production and farmer educator functions that have been otherwise thought of as government functions.

In 1975, the first group of eight PCV fish culture extension workers was introduced into various sites in the Bulungu area. This number was increased to 13 in 1977, and the project expanded to include three more zones in the Bandundu Region



Company-developed commercial fishponds near Lusanga, Zaire.

(Indiota, Gunger, and Masi Manimba) and two zones of Kasai Occidental Region (Tshikapa and Luiza).

The eight volunteers were provided with modest support in 1975 and nominally attached to a functioning local organization, such as a mission-sponsored agricultural program. OXFAM and AID Self-Help grants later helped provide volunteers with motorcycles that made it possible to transport fingerlings for stocking ponds and for volunteers to travel more in their extension efforts. OXFAM also provided badly needed tool kits to individual volunteers for aid to farmers.

In 1978, USAID/Kinshasa completed a plan that provided for substantial resource support and the expansion of the Peace Corps effort. The project also included funds for increased GOZ participation (PID 660-080). The number of sites for volunteers was expanded in both Bandundu and Kasai Occidental and, for the first time, included sites in Kasai Oriental. There are currently 30 volunteers participating in the program with an additional 20 being programmed for FY 80 and FY 81.

Although the USAID project also included provisions for training Zairian extension agents, 12 fingerling production centers, short formal training courses for farmers, and a substantial increase in GOZ participation, there is little likelihood of these outputs actually being produced. The current status of Zaire's economy and the obvious inefficiency and confused character of government operations makes the attainment of these goals appear overly optimistic. It is also clear that none of these goals could be obtained without the diligent efforts of Peace Corps volunteers and staff.

Given the prevailing economic crises in Zaire, the Peace Corps fish culture effort has been successful in promoting the diffusion of productive fish culture methods among the rural farmers in several areas. The contributions made by the PC program can be attributed to the skills and talent of the individual volunteers, the effectiveness of the PC/Zaire organizational structure, and the larger socio-cultural context in which the program has been operating.

Clearly, the dedication and intelligence of the Peace Corps volunteers working in the fish culture program have contributed to its success. The volunteers tend to learn local languages

rapidly and have been effective in building good relationships with their clientele. The attrition rate of fishery volunteers is low, and the proportion of those continuing for second tours is quite high. These facts reflect the good morale and satisfaction among volunteers who have provided an important service to their host communities and who are generally appreciated for it. They appear to be well in tune culturally with village life and find it both attractive and challenging. A few have married into local families and sought to continue their work with fish culture projects in the rural areas, both within and out of Peace Corps. There are probably few programs in which the several goals and ideals of the Peace Corps have been so well pursued.

The organizational structure of the Zaire program has several features that have contributed to its effectiveness. Like many other Peace Corps efforts, it is both decentralized and flexible to allow considerable discretion on the part of the volunteers, each of whom works in a unique setting. The advantages of the fish culture program have been recognized by both Peace Corps and USAID administrators who have given the program a reasonable priority. Gaining this support has been a long and hard fought battle by proponents, one that has drained much of the human energy available for project implementation.

A particularly important feature that has both advantages and disadvantages is the relatively small role the program has played and is currently expected to play with regard to counterpart training and coordination. For all practical purposes, the only continuing counterpart relations are on the national level. The field or extension work is basically accomplished by PCV's working independently from the GOZ. It is the consensus of those Zairians and PCV's interviewed in small communities that the GOZ is currently in no position to provide anywhere near adequate extension services and that government programs in general are held in suspicion by local residents. Yet there continues to be a need for pure *Tilapia nilotica* stock, and government centers, some assisted by the Peace Corps, are the programmed source of this stock.

There were reports of technically aware people leaving cities after being disappointed with current hardships of urban living and seeking a new life in the country. Some of these people had tried the improved fish culture methods and met with such success that an interest was kindled in other improved agricultural technology. Although such observations are limited in number, the resulting interest in other improved agricultural methods is an interesting aspect of the impact of fish culture which bears watching in the future.

Also, some consideration is being given to using fish culture as a famine relief tool in the drought stricken Bas Zaire region near the mouth of the Zaire River. The idea appears to be another application of the Belgian approach to local food production schemes in the copper producing areas of Zaire during World War II, but the strategy may still be useful. There is no question that food is needed, and sufficient profit is possible to reward successful fish culture efforts.

Technical Evaluation

The Peace Corps in Zaire appears to have done a good job with the GOZ in selecting areas of the country where fish culture will work best. Selection of the areas of concentration has been done with proper regard to soil conditions (not too sandy or acid) and other conditions. The plankton system for the production of *Tilapia nilotica* seems well suited to the environmental conditions. No other system of fish culture appears to be more satisfactory under the circumstances. Fish culture systems based on intensive feeding of fish are not recommended for Zaire at this time. The dramatic increase of harvest production that farmers can see over natural levels when they enrich ponds is strong evidence that the plankton system works. The missing link is reliable experimental activities that could help workers better understand the cost-benefit relationships of the numerous variables available to fish producers. Specific information is needed about the benefit of compost and feed materials and expected fish production and growth with different stocking rates and species combinations. The benefits of liming also need to be evaluated.

The genetic purity of the *Tilapia nilotica* will likely decline in time as stock is mixed with other closely related species. There is a continuing need for a few central hatcheries where pure stocks can be maintained for distribution.

Mobility of extension agents, such as is provided by the motorcycles used by PCV's, seems essential to distribute pure fish stocks and to visit dispersed cooperating farmers. Unfortunately, even with this mobility the actual production area served by any one fishery PCV is small, usually less than 3 hectares in composite. Good pond sites appear to be widely scattered and not extensive in any single locality.

Economic Appraisal

LAND. Rice is the main competitor with fish for land use. In many areas, rice growth and ponds are contiguous because of the similarity of terrain required. Other than growing rice, the land often has an opportunity cost of virtually zero. Land to be used in fisheries must be located close to a water supply. Not all villages can be expected to have suitable land with an adequate water supply. Clay bottoms and dams are necessary to hold water, and sizable parts of the country have sandy or porous lateritic soils. The allocation of land to fisheries and rice is therefore determined largely by costs of preparing the land for respective uses and the value of returns when all costs are included. Integrated agriculture is the rule in Zaire in which land use will be diversified by various subsistence or cash crops,

vegetables, and some animal husbandry. When local manures are available on the farm along with vegetable and other by-product wastes, there is an incentive to use these resources in fish production. Costs and transportation difficulties will preclude long-distance transfer of other by-products to the land.

LABOR. Labor in Zaire has several alternative uses depending on the mores and customs of the community. Fishpond construction is typically men's work and the cultivation of cassava is typically women's work. Fishpond operation and construction are therefore predominantly noncompetitive with cassava cultivation, but could be competitive for labor on land clearing for the cassava production. In some areas the men seemed to do little physical labor. Opportunity cost is not out of the question — these men have decided not to go into the fields to work with wives and other family members. Their labor has potential alternatives in cultivating coffee or cocoa, gathering oil palm fruit, hunting, or seeking cash employment on a casual basis.

Unemployment and underemployment are elusive concepts in a culture in which the above work attitudes and traditions exist. Although unemployment rates of 50 percent are reported for parts of the country, they have little meaning in an area that has traditions in which men do little work, women do little work, or in which neither works on particular tasks that might be perfectly acceptable in another culture. The idea of a backward sloping supply curve for labor was suggested several times in the communities we visited. In its simplest context, if the price for labor (wage rate) were doubled, certain workers with limited material wants would only work about half as much as before. To varying degrees, this phenomenon seems to exist in the largely non-market areas of the backcountry. Similar results can exist with respect to particular harvests of crops — when the real price increases, giving the people an increased real return for their efforts, there is an incentive-destroying effect leading to less, not more, work.

This phenomenon is sometimes further complicated by peer pressure not to be "too successful" above the mean of the village in which one lives. (See following section on socio-cultural factors.) Villagers may be subtly castigated or ostracized by fellow villagers when they succeed to inordinate levels. The net result is a set of thresholds within which the family entrepreneur might wish to remain — high enough to meet minimum physical needs of the family, but below the level which may bring on adverse peer reaction.

Another factor which may reduce the incentive for hard work is the extended family arrangements leading to sharing the fruits of one's labors with relatives. Such practices can reduce the incentive for the relatives to work and, at the same time, reduce the incentive of the entrepreneur to work hard for goods from which he himself will derive minimal benefits.

Labor incentives are probably further constrained by the consequences of becoming successful enough to attract officials who may take a rakeoff in the form of a fraction of the returns in illegal taxes, outright bribes, extortion, and other forms of coercion. This type of action is common in areas where civil servants and the military are not paid or are so poorly paid that they must secure resources the best way they can. The more channels the product passes through and the more official personnel come in contact with the entrepreneur, the more he loses. The entrepreneur can be pressured into low-profile bartering and largely non-market activity in order not to attract attention to his economic endeavors.

Other things held constant, labor should be directed to the highest-return alternative available. Palm oil operations seem to be the main hired-labor alternative available. Some of these are

closing down in the area, and few other opportunities seem to be available. There appears to be plenty of labor, limited only by the will of the owner and his family to work.

The irrational pricing policies of the Zairian Government could be changed, bringing about different opportunity costs in terms of producing other commodities. The price ceilings for commodities at the farm level are generally so low that farmers are unwilling to produce them. This attempt to artificially bind prices at a low level in favor of city dwellers has discouraged production and fomented a sizable black market trade. Freely fluctuating prices or a reasonable level of prices at near equilibrium could change the appropriate use of labor for the entrepreneur. Coffee prices paid to the farmer have been forced so low that farmers have abandoned their plantings. If prices for coffee or other cash crops should increase, certain farmers with appropriate land and capital for cash crop production might consider a change in their labor allocation.

CAPITAL. Little capital is in evidence in Zaire's village life. Capital consists of resources combined with human labor to entail stored up productive capacity. Simple implements, dams, terraces, and ditches are the main examples in common use. The only capital equipment used in construction of some of the ponds are shovels and hoes, and in some cases a wheelbarrow. Most ponds use bamboo pipes although a few have plastic or metal components. Monks and valves can be replaced by cutting temporary trenches through earthen dikes or by harvesting fish with nets rather than by draining ponds. Capital is therefore small in amount, although extremely important. The lack of good shovels has been reported as an impediment to pond construction in many areas. The locally produced shovels seem to be almost worthless for this purpose.

Allocation of capital among uses does not seem to be a significant problem since the time-sequencing among enterprises is fairly flexible. Hoes and spades can be used in crop production as well as pond construction and maintenance.

COSTS, RETURNS, AND MARKETS. In the following analyses, a common format was used to suggest possible returns from fish culture based on the price of fish locally and corresponding local labor costs, table 2. Data were reported on a 0.1-hectare basis for all countries since this size pond is near the maximum that it is practical to build with hand tools. Standard amounts of labor were attributed to the construction and operation of the ponds, including 40 work days to build the system for handling water, 50 days for the pond construction, and 16 days for operation including harvesting and preparing the bottom for the next crop. A standard cost of \$20 was used for fingerlings in each of the countries. The waterway and pond construction costs were written off equally in each of the first 2 years for the various countries, leading to a smaller residual at this time than in following years. No charge was made for capital since the dam and a few simple tools represent the basic requirements, and the cost of the dam is written off according to the labor it entails. No rent was charged on land, since it had little if any opportunity cost in most situations and rental of land is not common in the areas studied.

In Zaire, returns of \$224 were calculated for the first 2 years in which construction costs were written off, then the amount increased to \$269 for following years. The labor was valued at \$1.00 per day and the fish were valued at \$3.35 per kilogram, the going rates in the area. If the owner's labor has no opportunity cost, the pond could show a greater return, since the owner's labor was imputed at \$1.00 per day cost, the same as other labor for the above calculations.

These data should be viewed as exemplary, but should be used with extreme caution since conditions vary greatly from area to area within a country and the available data were from a few market examples and a few construction experiences. A moderately low level of management was assumed in the analyses. It was further assumed that feeding with local wastes, scraps, and manures occurred in all of the countries studied.

In Zaire, the government had price controls on various commodities, including fish, but black market prices seemed to be the rule except for token amounts sent through official market channels. Coffee growing was being abandoned, purportedly due to low government price ceilings imposed for the central buying authority. Changes in price controls could shift opportunity costs significantly, thereby changing optimum enterprise mixes for farmers.

Socio-Cultural Factors and Fish Culture Development

GENERAL BACKGROUND. Zaire conforms to the pattern of life found in West Africa generally as described in the "Socio-Cultural Overview" section, with some exceptions. The more serious economic problems of the country have substantially reduced the incentive to grow cash crops for market and also encouraged many experienced people with various skills to return to their home villages and attempt to improve their standard of living.

Some beliefs which restricted the consumption of fish were encountered among small groups in Zaire. In Kasai Oriental and Kasai Occidental regions, the belief prevails among the apostolic sect (*apostolo*) that one should not eat catfish. This group, however, is a small minority of the population of those regions. There is also a belief among some in the Gandajika area that people suffering from a "witch" disease, *nteta*, should not eat fish while undergoing treatment. The affliction is indicated by a temporary swelling of the hands and feet. The problem is regarded as temporary, however, and only a few are thought to be attacked by it at any given time.

LAND OWNERSHIP. The few serious land disputes involving fishponds were related to the construction of ponds on parcels that had two or more owners. Once fish culture appeared to be successful, the owner of some of the land used to construct a feeder canal demanded the product, while the owner of some land that was crossed by the water source did the same. When the conflict was brought to the local chief for a decision, he attempted to resolve it by claiming the fish for himself. As a result, no one is farming the pond. This type of conflict is unusual, however.

THEFT AND POACHING. The theft and poaching of fish from ponds remains a serious problem in some Zairian communities, but only one instance was encountered in which this reason was given for a person giving up fish farming. Estimates of the proportion of fish stolen from ponds ranged from 10 percent to 40 percent. The most vulnerable ponds were those owned by small farmers located some distance from their dwellings. The most common thieves were believed to be young boys who threw in baited hooks at night to catch the larger fish. Often the farmer was not aware of his loss until he drained the pond for harvesting and found only smaller fish and a significantly lower than expected total harvest weight. Although some of the poachers are apparently adults, only a few instances were reported in which an entire pond was drained and most of the fish taken.

Observers felt that most of the thieves came from the farmer's

Project Review

THE FRENCH FARMING EXPERIENCE (LATE 1940'S). The French introduced fish farming to Cameroon in the late forties. Their work consisted of encouraging farmers to build ponds and constructing fish stations for basic infrastructure support of the program. The stations served as fingerling-supplying outlets and furnished technical assistance for thousands of ponds in Cameroon. As was true of several other countries in West and Central Africa, activities leading to independence and the coming of independence itself led to a devastating decline in fisheries, with a collapse of infrastructure support and the accompanying disappearance of technical assistance and fingerling supplies. Although the French system was based on a relatively inefficient technology which employed run-through ponds and sometimes had a poor selection of species, it did leave some ponds that could be renovated and provided experience that can be useful for persons who might return to pond fish culture in the future.

Some of the ponds were ill planned and not worthy of renovation. In many instances, it is easier to build a new pond than to renovate an old one. Some of the fishery stations have been improved and are presently used for fingerling production, fish production, or for training purposes. The Fishery Station in Fouban is an example.

Species reported in the French program included *Tilapia nilotica*, *T. zilli*, *T. rendalli*, *Heterotis niloticus*, and *Hemichromis* sp. The ponds in the East were largely of the barrage type with a mean size of about 0.1 hectare. Other areas had "derivation" ponds with a smaller mean size.

FAO FISH CULTURE PROJECT (1973-76). In May 1973, FAO initiated a program to assist the Government of Cameroon (GOC) in organizing two fish culture demonstration centers for commercial type production and for the training of fish culture extension workers (monitors). The program was also intended to conduct fish culture experiments and related scientific research. The original program planned two centers, but only one was activated. In pursuit of the above goals, the FAO staff moved to an existing fisheries station in Fouban that had been constructed by the French during the colonial period. During the early part of the effort, 16 additional production ponds were dug, and improvements were made in existing ponds, canals, and buildings. To facilitate training, the FAO improved access roads, renovated and equipped laboratories, and built and equipped living quarters, dining, and service areas for 20 extension worker trainees. The Peace Crops/Cameroon also provided services of a volunteer to aid in the Center's training program.

FAO ended its program in October 1976, and its staff departed. The station has been continuing its activities at a significantly reduced level, staffed by GOC personnel. Its most important function has been to provide the facilities for a 6-month monitor training program that is now conducted solely by the Peace Corps.

Of the three main goals of the FAO project, the one that was most successfully accomplished dealt with fish culture experimentation and research on different types of fish suitable for production in Cameroon. Several useful studies were completed on the propagation, growth, and production of *Clarius*, *Tilapia*, and carp species. Important observations about fish pathology were also made.

The goal to demonstrate the feasibility of industrial-scale ponds in Cameroon was pursued with less success, but useful

village and some were related to him. It is commonly believed that many in the village know who the thieves are but they will not tell anyone, practicing a "conspiracy of silence." Of the few cases that were brought to the attention of the local chief, however, severe fines were given to the thieves identified.

DISTRIBUTION OF FOOD. A substantial proportion (20-60 percent in some cases, depending on family and harvest size) of the fish produced by small pond owners in Zaire (those with ponds less than a hectare in size) is consumed by the farmer and his immediate family. A smaller proportion is commonly given in small amounts wrapped in large leaves (called "kilos" but actually about half a standard kilogram) to more distant kin, neighbors, and those who may have contributed some labor to the pond or to another of the farmer's enterprises. A few farmers have informal reciprocating arrangements in which one gives the other some fish for his family and the other reciprocates when he later completes a harvest.

Almost all of the fish that are sold are sold for cash immediately at the pond site. It is not uncommon to have more customers than can be supplied at going prices, and many customers walk several kilometers for the opportunity to buy fish. Some farmers compile lists of advance orders that are filled first, and it is not unusual to deplete the quantities in this fashion. A few farmers who wish to maximize their profits by getting the best price cut down the number of gift fish to extended family members, and to avoid special pleas by relatives and neighbors for lower prices, arrange to have a third party conduct the actual sale. This method permits the farmer to be free to deal with the mechanics of draining the pond without worrying about haggling over prices. The farmer may provide the same service when his temporary "middle man" harvests sometime later.

THE CURRENT ECONOMIC CRISIS AS AN OPPORTUNITY FOR FISH CULTURE. The irony of Zaire's extremely bad present economic situation is that it provides a good opportunity for the exploitation of fish culture. The urban-based cash economy continues to decline and is in disarray. Government ceilings on many farm commodities have made them unprofitable to produce, and people, lacking incentive, have stopped producing them. The rural to urban migration pattern in which many young and better-educated people relocated to urban areas has been reversed with many Zairians of varied skills and experience returning to their home villages. This is the context in which people in Zaire may do things out of near desperation that could lead to improvements in rural well-being.

The need for food is great, but cash resources are limited. Transportation is extremely difficult and expensive. Building supplies and other commodities are scarce and available only at highly inflated prices. Price gouging is common and frequently severe. People need food that they can raise themselves to feed their families and make a profit by selling the surplus to others. In most cases, the only resources the people have are their own labor and experience, access to land, and a small amount of cash. Fish culture should not be regarded as a panacea for Zaire's problems at present or in the future, but fish culture can provide rural people with a starting point to control, improve, and benefit from their environment using their own resources. Hopefully, the economy of Zaire will improve and the agricultural sector will expand in different ways, opening up better opportunities to the rural poor. Should that improvement take place sometime in future years, fish culture will probably not be as attractive as other alternatives. In the meantime, a fish culture development effort may be one of the best matches between available technology and present community needs.



Fouban Training Station, Cameroon, showing fishponds integrated with chicken and pig culture.

data concerning the economic relationship between feeds and fish production were acquired. The information gathered indicated that commercial fish culture could succeed in the area only with a substantial increase in pond surface area and the growing of carp sustained on inexpensive organic fertilizers.

The least successful part of the FAO program concerned the training of extension workers. Most of the difficulties encountered by the FAO training effort continue to plague the current Peace Corps monitor training program. In brief, the FAO effort was hampered by a training period that was too short (3 months), having to organize a curriculum for both Francophones and Anglophones with limited staff resources, and by the enrollment of students who varied considerably in age (16 through 45), formal education, and aptitude. There was also no procedure by which a failing student could be removed from the program, barred from gaining a certificate, or prevented from securing a government post. The overall performance in the field by the trainees was judged by the FAO staff to be unsatisfactory, primarily because better candidates were lacking.

The Fouban Fisheries Station now provides a small supply of fingerlings to local farmers and serves as the facility for the monitor training program conducted by the Peace Corps. The structures built by the FAO remain impressive, but they no longer have functioning research equipment and have not had a director in place for some months. The station's potential remains, but it serves primarily to indicate that the GOC has not sought to build on FAO's work and has apparently given only moderate priority to fish culture programs.

PEACE CORPS PROGRAM (1969-PRESENT). Peace Corps volunteers have been working with fish culture in Cameroon since 1969. Their initial program was in the western Anglophone area, but in 1974 assignments were extended into eastern Francophone areas. There are currently 26 volunteers in the country, not including 15 new volunteers in the final stages of their training (by November 1979 there should be 30 active fishery volunteers in-country). The Peace Corps volunteers are integrated into programs administered by the Ministry of Agriculture. Initially they worked with the Department of Water, Forests, and Game (*Dept. Eaux et Forêts et Chasse*), but in 1974 most of the fish culture activities were shifted to a newly created parastatal organization, the National Fund for Forestry and Fish Culture (*Fonds National Forestier et Piscicole*). There is current talk of putting the Office of Fish Culture in the Ministry of Animal Industries.

The general objectives of the Peace Corps fish culture support have been to improve family nutrition and farm income. The main thrust of Peace Corps efforts has been in the area of farmer extension outreach, but there has also been a significant involvement with counterpart development and renovation of government fingerling production centers. There is a current shift of emphasis to cash-sale operation of ponds rather than those intended exclusively for family use. All of the volunteers learn French or Pidgin English, and most are working at the

grass roots village level. They are generally equipped with offroad motorcycles and have a specific area assigned to service.

Volunteers generally work with counterpart fish culture extension agents. The monitors usually know the local dialects and can serve as translators for the volunteers where needed. In the course of 4 or 5 years, several districts once served by a volunteer have been turned over to local monitors who may or may not be backstopped by a regionally-based volunteer. Overall there are about 100 fish monitors with the National Fund for Forests and Fish Culture. Assignment of monitors and PCV's is indicated from Yaounde and is subject to political as well as resource considerations.

A typical established volunteer will be working with about 30 farmers at any given time and each farmer will have one or two ponds, each 200-300 square meters in area. Volunteers are generally recommending a production system based on *Tilapia nilotica* and enriching ponds with compost piles much the same as in Zaire. A typical production cycle takes 8-12 months and might yield 600-900 kilograms per hectare on an annual basis. Annual yields in excess of 2,000 kilograms per hectare are possible in many areas with proper management. Success with *Clarias lazera* has been limited, however, because of a lack of fingerlings for stocking. Carp were introduced for use in the cooler, high altitude areas. Pond spawning and artificial hatching of these two species has occurred, but the volume of successfully reared fingerlings remains at a few thousand each year for the five or six government stations involved in the propagation of these new species.

Morale of the volunteers has been good. Several have extended for a year or more and few have terminated prematurely. The study team generally felt that the ability of the volunteers to relate to and communicate with host nationals was excellent.

Overall impact of the Peace Corps involvement is difficult to assess, but the nutritional/economic impact has surely not been great. The lore of Peace Corps extension contracts is replete with first time successes, but the production cycle is so long that contacts are seldom maintained through more than a couple of crops. Although volunteers feel that at least a few of their contacts will continue with "progressive" fish culture, there is a dearth of hard data to substantiate this feeling. Even during the period of active contact, few of the cooperating farmers follow advice completely and take advantage of the full production potential possible in their pond. (See the section on socio-cultural factors for further discussion of this problem.)

The aggregate production area of fishponds in Cameroon is also quite small, something on the order of 250-500 hectares. Some success in strengthening the cadre of fish monitors can certainly be claimed. The new emphasis towards more commercial fish production may well generate dramatic examples of larger, economically viable production units. Peace Corps volunteers argue that more time is needed for their program to achieve the desired impact.

Technical Evaluation

As in Zaire, the use of *Tilapia nilotica* seems appropriate to Cameroon. Common carp and *Clarias* sp. are not likely to produce comparable yields without significant feed inputs that appear impractical because of expense and limited availability. The species do have some potential in mixed species polyculture systems. *Tilapia* growth will not be as good where temperatures are cooler.

Hatchery efficiency is not particularly good; some knowledgeable technical assistance could significantly increase the number of fingerlings produced for distribution without significant enlargement of facilities.

Fishponds on private farm in Cameroon.



Economic Appraisal

Cameroon is typical of equatorial Africa in many respects, but shows progress beyond several other countries in the area. According to *Surveys of African Economies* from the International Monetary Fund, it has had a gross national product almost equal to that of the Central African Empire, Chad, Congo, and Gabon combined. The country has a poor transportation system through its difficult terrain, and a small percentage of the population is in the industrial sector. Its population growth rate has been in the 2 percent range in recent years. The country has a relatively well-developed educational system.

Agriculture has been the predominant element in the economy in Cameroon in the past in terms of gross domestic product, table 3. The economic structure is quite slow to change in such areas, although agriculture has been declining as a proportion of the total. Table 4 shows amounts of crops grown primarily for domestic consumption in the mid-sixties. The main export crops are cocoa, coffee, cotton, bananas, palm oil and kernels, rubber, groundnuts, and tobacco.

Although Cameroon had a small fleet of deep sea fishing vessels with a catch of 10,000 tons in the mid-sixties, and coastal and inland artisanal catches of 46,000 tons (estimated), imports of fish reached almost 1,700 tons in 1964. The apparent need for fish and its corresponding demand leave a significant potential for aquaculture.

LAND. Land suitable for fishponds seems rather scarce in some areas of Cameroon, and apparently there are quite a few alternative uses for land. Coffee is the predominant agricultural

interest and will displace other uses when put on a competitive basis, i.e., when the resources are adaptable. Fishponds may provide a way to use other agricultural wastes in the normal operation of the farm enterprise. Rice would be the main direct competitor for land and, in certain instances, rice and fish may be grown on given resources at the same time. The relatively high elevation and cooler temperatures of a part of Cameroon limit fish growth in comparison with other areas of the country. Goats, sheep, chickens, and sometimes pigs are allowed to run free on the land, but these animals offer no competition to fish culture.

Mean size of farms is small in the various provinces and in the country as a whole, table 5. The cultivated land tenure consists of 79 percent customary, 12 percent squatter, 5 percent rental, and 4 percent titled. Data on average yields for food crops and cash crops, given in tables 6 and 7, show a sizable variability in productivity ranges. Although productivity varies greatly from province to province and within provinces, the data do show that sizable opportunity costs exist in other enterprises for a part of the agricultural land. These data also suggest that significant amounts of proteinaceous foods and high-calorie foods are available as was confirmed by an examination of markets in the various cities. This result must also be weighed, however, against the fact that more than 12,000 metric tons of fish were imported into Cameroon in 1977.

In the Northwest, West, and North provinces, cold mountainous grasslands are not conducive to production of tropical fish species amenable to high-volume, low-cost output. The Center-South and East provinces have some areas with

TABLE 3. GROSS DOMESTIC PRODUCT OF CAMEROON BY SECTORS, 1963-64

Sector	Percent of total
Agriculture	41.3
Manufacturing and construction	12.5
Commerce	25.5
Transportation	4.3
Other services	5.1
Public administration	9.6
Wages of domestic servants	1.7
TOTAL	100.0
Monetary sector	76.5
Subsistence sector	23.5
Private consumption	72.9
Government consumption	14.1
Gross investment	11.0
Plus exports	22.7
Minus imports	-20.7
GROSS DOMESTIC PRODUCT	100.0

Source: *Surveys of African Economies*, (Washington, D.C.: International Monetary Fund, 1968, p. 57).

TABLE 4. CROP AREAS IN CAMEROON BY REGION, 1964-65

Crop	Hectares of crops by region		
	East	West	Total
	Thou.	Thou.	Thou
Maize	232		
Millet and sorghum	632		
Paddy	13		
Yams and cocoyams	36		
Sugar cane	20		
Beans	53		
Taro	127		
Cassava	111		
Potatoes, plantains, vegetables	307	84	391
TOTAL	1,522	250	1,772
Tree crops	615	229	844
Total area cultivated	2,137	479	2,616

Source: *Surveys of African Economies*, Vol. I, (Washington, D.C.: International Monetary Fund, 1968, p. 61).

TABLE 5. FARM SIZE AND FAMILY SIZE IN CAMEROON BY PROVINCE

Province	Average farm size	Average family size
	Ha	No.
North	1.63	4.8
East	1.81	4.9
Center-South	2.01	5.1
Littoral	1.48	4.6
West	1.24	5.4
North-West	1.21	7.0
South-West	1.46	5.2
Cameroon	1.59	5.2

Source: Marcel Ngue, *Agriculture and Rural Development Statistics* (Yaounde: USAID, May 1979, I.3).

TABLE 6. AVERAGE YIELDS OF SELECTED FOOD CROPS IN CAMEROON

Crop	Mean production per ha/year	Range
	Kg	Kg
Maize	1,228	625-2,496
Rice (paddy)	1,261	269-1,938
Macabo-Toro	4,261	964-8,644
Cassava	2,927	716-6,927
Plantain	3,392	2,000-9,368
Groundnuts	499	353- 729

Source: Marcel Ngue, *Agriculture and Rural Development Statistics* (Yaounde: USAID, May 1979).

TABLE 7. AVERAGE YIELDS OF SELECTED CASH CROPS IN CAMEROON

Crop	Mean production per ha/year	Range
	Kg	Kg
Coffee (Robusta)	328	175- 474
Coffee (Arabica)	151	118- 158*
Cocoa	230	60- 304
Tea	1,688	1,667-1,700*
Cotton	611	611*
Tobacco	698	611- 730*

*Some areas do not grow Arabica coffee, tea, or cotton.

Source: Marcel Ngue, *Agriculture and Rural Development Statistics* (Yaounde: USAID, May 1979).

good fish production potential. Water is a problem in parts of the Center-South. Coastal supplies of fish limit the opportunity for aquacultural development in the Littoral and South-West provinces of the country. Problems related to land use in some parts of the country are heavy poaching of fish, lack of management ability, and lack of interest.

LABOR. Fisheries use labor which may be employed in many other enterprises in Cameroon, but except for the pond construction time, it may not be competitive with other types of production. During harvest of coffee and other cash or food crops, labor would be competitive, yet normal pond operations require so little labor that the competition may be of no consequence. Pond construction can also be arranged in a time sequence in which it has little competition with other farming activities. Excess family labor, including use of children's time, may not interfere at all with the breadwinner's main job. Tables 6 and 7 suggest that there are significant opportunity costs in other cash and food crop enterprises for the farm owner. Each case must be resolved on an individual basis.

Peace Corps volunteers mentioned conditions suggesting a backward-sloping supply curve for labor in some areas. This condition seems to be fairly common in the area.

CAPITAL. The capital used in most pond construction is minimal. It has competitive uses but is of such small value that it can be ignored for competitive purposes for the family production types of ponds. Larger commercial ponds could require a significant amount of capital whose opportunity costs in other uses would have to be considered.

COSTS, RETURNS, AND MARKETS. Peace Corps records on 379 ponds in seven different departments in Cameroon yielded a weighted mean production of 727 kilograms per hectare per year. The overwhelming majority of the fish were *Tilapia nilotica*, but there were small quantities of catfish and carp. The mean size for a total of 863 ponds was slightly less than 0.2 hectare. The total impact of production is therefore very small, regardless of input efforts and costs. About 50 percent of the ponds were fertilized with local manures, and most received composting of grass, cassava leaves, grain, wastes, and other available products.

Data in table 2 show that during the first 2 years a loss of \$12.18 would occur from operation of a 0.1-hectare pond but thereafter a positive return of \$85.02 per year would occur. Specific areas would yield much greater returns, but care must be used in selection of species to suit the climate. Labor in construction and operation was valued at \$2.16 per day and fish was priced at \$1.92 per kilogram. Small fish in the market sold for around \$1.68 per kilogram, while larger fish sold for as high as \$2.88.

Socio-Cultural Factors and Fish Culture Development

GENERAL BACKGROUND. The potential for the diffusion and continued use of fish culture technology is significantly less attractive in Cameroon than that observed in Zaire. This is particularly the case with the more prosperous areas of the country (West Cameroon) in which a substantial majority of the population is located. This lower potential can be attributed to the higher economic and nutritional status of Cameroonians in comparison with Zairians, which directly affects their motivation to engage in fish farming.

It is visibly apparent that the quality, quantity, and variety of foods available in Cameroon are relatively high. Although a recent nutritional survey conducted by the University of California at Los Angeles (UCLA) indicated that some sectors of the population are not adequately fed, there is an abundance of

vegetable and animal protein at prices which offer less incentive to farmers to engage in fish farming. The income available to many rural families through the cultivation of such cash export crops as coffee, cocoa, and tobacco is quite attractive and significantly more than that which can be secured by marketing fish. Where practiced, fish culture is generally regarded as supplementary to other agricultural activity and, for some, as a hobby. "La jalousie" is a part of village life and tends to constrain those who aspire to, or accomplish, more than those around them.

Apparently because of the availability of fish and other animal proteins on the local market, the Cameroonians are more selective in the types of fish they will buy. Some prefer fish of 500 grams and above. Others have complained of the boniness of small tilapia. *Clarias* catfish is the most popular among consumers. In terms of taste preferences, other freshwater varieties tend to be favored over tilapia.

The institution of palm wine drinking seems much like that encountered elsewhere. It appears to be economically more important there, however, with many village men regularly tapping their trees to sell wine for cash in nearby local markets. In general, local village markets are active and sizable.

Traditional culture appears to be more deeply entrenched and pervasive in rural Cameroon than in the other countries visited, particularly with regard to secret societies. In communities without a regular police force, jail, or other forms of modern administration, which are small enough so that conflicts could become seriously divisive, secret societies with their supernatural backing, masks, costumes, and nightly operations act as a deterrent to offenders. An offender or deviant can be punished by an impersonal and unidentifiable body representing the traditional interests of the community. The fact that the societies continue to thrive in many communities suggests that they may have filled a need and meted out justice in a form acceptable to the villages in which they persist.

AGRICULTURAL SKILLS — GARDENING AND ANIMAL CARE. In general, the experience in Cameroon indicates a relatively high level of skill on the part of rural people in both gardening and animal care. Many farmers have considerable experience in basic agricultural methods, particularly the cultivation of cash crops for export (coffee, cocoa, and tobacco), which may have influenced or reinforced the practice of similar skills in other forms of productivity. Some groups also have lengthy successful experience with the rearing of cattle for market. There remains, however, only a moderate incentive to transfer such skills to fish culture.

THEFT AND POACHING. Stealing of fish from ponds is not regarded as a serious problem in Cameroon and does not seem to influence farmers' decisions to engage or not engage in fish farming. Such offenses are regarded as serious and have often been the object of local tribunals. Those apprehended have been given harsh fines and reprimands. Estimates of the proportion of fish lost to poachers range from 10 to 20 percent. Only one case was encountered of a farmer giving up his fish culture because of theft problems.

SEX ROLES AND FISH CULTURE DEVELOPMENT. In a few ethnic-tribal groups, the men take a more active role in the growing of subsistence foods than they do elsewhere in West Africa. The only women directly involved with fish culture tend to be prosperous widows or successful entrepreneurs with other interests, and these represent less than 5 percent of all fish farmers. Although wives may aid their husbands at some phase of his farming, such as during the harvest, the only continuing

female participation involves the few wives who sell their husbands' fish at pondside or at the village market.

Some of the low status assigned to fish farming may be attributed to the perception on the part of many males that it does not legitimately qualify as a cash crop (i.e., men's work). If such is the case, women as well as qualified adolescents may be the best target group for fish culture. Some Peace Corps volunteers have suggested that fish culture could be effectively diffused and practiced by a 4-H Club-type organization adapted to the needs of Cameroonian village youth.

DISTRIBUTION OF FOODS WITHIN THE FAMILY. Given the greater availability of food in Cameroon, the general level of nutrition should be significantly better than in some other parts of West Africa. More and better quality foods appear to be available to the younger and lower status members of the family. It is apparent that making appropriate foods available to the consumers in Cameroon and West Africa generally is only a part of the solution and that an educational and information program is required to improve the consumer knowledge about basic nutrition.

Nigeria

Project Review

Nigeria is a large country in which internal communication and travel are difficult, so observations were centered in two areas: Oyo State, where the best organization of fisheries is reputed to be, and Bendel State, where a large land clearing and pond development scheme is underway.

Oyo State, with its capital in Ibadan, has a fisheries organization within the Ministry of Agriculture. The fisheries organization has three functions: operation of government freshwater production fish farms of which there are eight, operation of four fish seedling production centers, and management of the capture fisheries, especially in the 10 large reservoirs within the state. An American fisheries advisor provided by AID on a cost reimbursement basis had worked with the Government at Ibadan earlier, and several of the staff who worked with the advisor continue in significant fisheries administrative positions in the country.

The production farms are first responsible to demonstrate effective systems and also to serve as marketing centers. Each farm is reported to have about 12 hectares of ponds.

The fish seedling production centers sell fish fingerlings to farmers as referred by extension biologists and have also distributed fish to other states and even to other countries. *Tilapia*, *Heterotis*, and *Clarias* are the kinds of fish produced. The center visited at Oyo City had really just started as a project this year and had an FAO expert assigned with it. To date, they claimed to have distributed 38,200 *Tilapia* and *Clarias* fingerlings. There were 28 private ponds, ranging in size from 1 to 4 hectares, functioning in their service area. Producers were told to expect crops of 500-1,000 kilograms per hectare in 9 months if directions were followed, including feeding or manuring with dining hall scraps, cow dung, cassava roots, and basic slag. Extension service was provided in a 5 to 50-kilometer radius and consisted of pond site evaluation, stocking recommendations, and assistance in purchasing fingerlings.

Bendel State Farm is a land clearing and commercial agricultural development scheme that includes a large fish farm at Aviara. Malcolm Johnson, an advisor from Auburn University, has helped with the development of the fish project from the beginning some 4 years ago. The project has been

plagued with difficulties, mostly financial, but now has 320 hectares of delta jungle forest cleared and 40 hectares of ponds in common carp production with plans to develop 120 more hectares of ponds as soon as the rainy season subsides. The advisor reports this to be the largest and best constructed venture in West Africa. Common carp are being raised because feeds are available and large fish are desired, which sell at a good price. Although sales are just beginning, the demand, even by low income people, is substantial. Return on investment has been projected at 30 percent per year. Interest in the project by other states and private investors is high, and a training school has been proposed as well as a research component to be incorporated into the farm. Earlier problems with fry production appear to have been solved with maturation of breeding stock, although fingerling output still is not as good as expected. Attempts to feed and grow *Heterotis* have not been competitive with carp.

Technical Evaluation

Although Nigeria has a number of fishery biologists and schools for training, their efficiency needs to be improved to inspire confidence. It is clear that funds for station operation are limited and central control creates bureaucratic entanglements making field operations difficult. Few of the biologists have actually been trained in aquaculture and have a grasp of the practical aspects of pond management. Complaints were heard about foreign experts who were brought in attempting to apply temperate region techniques in the tropical environment. Other reports were heard of Oriental specialists being brought in on projects for which support failed to materialize.

Basic aquaculture will certainly work as well in Nigeria as in many other regions. Surveys indicate that plenty of sites for pond development exist. Swamp lands in the Niger delta might also be used for culture of brackishwater-tolerant species.

The large commercial approach bears watching and may prove to be the impetus to get fish farming moving. Intensive fish culture with feeding is a question of economics, and it now appears that Nigeria has the economic foundation necessary to make such systems practical on a large scale.

Economic Appraisal

Nigeria has had a great deal of economic progress which has increased at a significant rate since the oil boom. This substantial increase in economic activity has, however, resulted in varied problems for the economy. In 1979, *U.S. News and World Report* reported a per capita income of \$400 in Nigeria. The sudden increase in income has strained capacities for various types of capital improvements, both private and public. According to the above source, unbalanced income distribution, corruption, waste, and inflation are still problems. The country borrowed close to \$2 billion in 1978 and its agricultural base has been undermined. The above results have necessitated austerity programs, import restrictions, and new taxes on certain imports.

The Wall Street Journal in 1978 reported essentially the same conditions mentioned above. The government is now attempting to lower expectations of the populace and to quell the flow from rural areas to the cities. The push toward going back to the basics should favor exploitation of non-petroleum resources, such as are used in fish culture.

LAND. Nigeria has a wide variety of land types, much of which is adaptable to fishponds. The land in general has positive opportunity costs, rice being the primary competitor. A multi-



Hand labor is important in pond operation and maintenance (Nigeria).

plicity of cash and food crops is grown, and more animal protein would help fill food demands from this resource.

LABOR. There seems to be a sizable excess of labor in Nigeria which could be employed in pond fish culture. There is a positive opportunity cost in some instances, involving use of labor in cropping systems or on other jobs. In many instances the excess family labor will have a low, if not zero, opportunity cost.

CAPITAL. Except for the large commercial pond operations, the capital involved in ponds is of minimal importance in Nigeria. It will not enter into calculations on costs and returns in the following analysis.

COSTS, RETURNS, AND MARKETS. The productivity of ponds in Nigeria was assumed to be the same as in Zaire, 910 kilograms per hectare. The price per kilogram used in calculations was \$2.70. Most of the fish volume from ponds was tilapia. The returns for the first 2 years showed a loss of \$25.62, but following years showed a positive residual of \$159.78. A labor charge of \$4.12 per day was used in the calculations, based on laborers' wages in the area (see p. 16 and table 2, p. 8).

Socio-Cultural Factors and Fish Culture Development

GENERAL BACKGROUND. As in other parts of the region, Nigerian farmers traditionally avoid the use of swamps and bottom lands which have excellent potential for fish culture and the cultivation of some types of crops. In some communities, streams and other wet areas have been regarded with superstition, or as places where spirits reside. These areas were traditionally considered to be sacred, as were some trees and animals.

At present, Nigeria is one of the most rapidly changing

societies in Africa, largely because of the significant increase in income derived from oil exports. Industrial expansion continues at a rapid pace, providing many new employment opportunities and altering traditional social patterns. Nigeria's cities, already among the continent's largest, continue to grow and attract people from rural areas. As a result, many villages are populated by the very young and the very old, those who have less opportunity or interest in moving to urban centers. Economic growth in other sectors and the availability of food imported from abroad (and paid for by oil revenues) has significantly reduced the incentive to improve village-level agriculture. The influx of oil wealth has apparently encouraged many to believe that there is no direct link between income and the amount of labor that one applies in an enterprise, and this has reduced initiative.

Perhaps the best target groups for small-scale fish culture would be villagers in the poorer regions of the country who still have to cope with the annual "hungry season" (April, May, and June), the period in which they must live off stored foods while waiting for a new harvest, and those who are interested in profit alternatives.

AGRICULTURAL SKILLS — GARDENING AND ANIMAL CARE. Although the agricultural skills found among Nigeria's rural population are comparable to those of the other countries visited, there are a number of successful medium- and large-scale poultry and other agricultural enterprises. Nigeria also enjoys a much higher proportion of technically trained people in its labor force. This factor, combined with competition for land and the amount of investment required for pond construction, suggests that the greatest potential for fish culture in many areas in Nigeria is with industrial-scale activities.

CONCEPTS OF LAND OWNERSHIP. Rapid industrialization and urbanization in the Lagos, Ibadan, and other populous regions have increased the competition for land and made it

difficult for rural farmers to expand their holdings. These areas are unlikely targets for small-scale fish farming.

As the Department of Fisheries must survey and make a feasibility study of pond sites before aspiring farmers may secure government loans, land ownership disputes have been rare. Experiments with communal ponds have not succeeded.

THEFT AND POACHING. Owners of larger ponds in Nigeria can usually afford the services of a sentinel and can also construct fences to prevent theft. As a result, their losses were considerably lower.

SOCIAL LIABILITIES FOR HOST COMMUNITIES. Many villages have had fishponds for some years and have become accommodated to them. The use of better methods to manage the ponds has brought about no serious problems, although a few efforts involving communal ponds apparently terminated with bad feelings among those involved.

Those who are most attracted to new pond development tend to be the more prosperous villagers, such as the owners of the local mini-bus service, merchants, civil servants, and well-to-do landowners. If fish culture in Nigeria becomes lucrative and widespread, fish farmers who are already financially secure would benefit the most. This would tend to further accentuate the economic differences between the villagers.

USE OF PROFITS. Fish culture has not been particularly profitable in Nigeria. It is regarded as an auxiliary enterprise or "something extra" by most of those involved in other, more lucrative economic pursuits. More prosperous people see it as a kind of hobby. Smaller farmers use the cash for school fees, medical care, financial emergencies, and ceremonial obligations, of which there are many throughout the year. Compared with other sources of income in Nigeria's economy, the money earned from fish culture at present is negligible and provides little incentive for small farmers.

Liberia

The Republic of Liberia, founded in the first part of the 19th Century by freed slaves who immigrated from America, is a small country of about 1,750,000 people. Rubber, iron ore, and timber are its most important resources and exports. Agricultural production has experienced modest improvements over the last several years, and the country has encouraged development efforts on the part of AID, the Peace Corps, UNDP, the World Bank, and other international donors. Because of the long coast (537 kilometers), indigenous capture fisheries have been a small but traditionally important specialty of some Liberian seaside villages and ethnic groups. Over the last 20 years, marine fisheries have been given significant priority over inland fisheries development, and an efficient fleet of fishing vessels has been created by the Mesurado Corporation, a large agricultural and industrial concern.

Project Review

AID conducted a small-scale pond fish culture program from 1951 through 1967. An American technical advisor was provided to create and sustain research and demonstration programs based at the Central Agricultural Experiment Station at Suakoko. Initially, some farmers in the immediate area built ponds as did the Firestone plantations. Experiments were conducted on a number of species in cooperation with local counterparts, one of whom was sent to the United States for an

advanced degree in fisheries biology and who returned to direct the station in the mid-1960's. AID's accomplishments were primarily in the establishment of fish station facilities, the conduct of several experiments, and the training of Liberian fish culturists. Following the AID project, the Government of Liberia (GOL) gave rather low priority to fish culture but continued to staff the station. More recently, the GOL has indicated a much stronger interest in fish culture. The resources and staff required to maintain a successful program are not now available, however. The GOL recently employed a Ph.D. level biologist from Pakistan to advise and conduct research at the station, but more resources and trained staff are required to build a continuing program of experimentation able to provide important information about the biological and economic aspects of fish culture under local conditions. The only proposed non-GOL support will come from the U.S. Peace Corps, which will shortly place two fish culture volunteers at the station. They will be responsible for setting up demonstration projects in rural areas. The volunteers' experience will guide future PC/Liberia efforts concerning fish farming. If the program succeeds, some expansion can be anticipated.

A most interesting direction for fish culture in Liberia concerns industrial-scale production. In conjunction with their large poultry, small livestock, rice, and cassava operations, the Mesurado Corporation is also in the process of developing fishponds of about 140 hectares next to the country's major highway. With a future estimated production of 700 tons per year, the Mesurado ponds could have a significant impact on the amount of protein available on the market. It is doubtful, however, that it would have beneficial effects on the diets of the rural poor in many areas who reside some distance from distribution points and who have little cash income.

Conditions appear good for the development of community fish culture in Liberia if it is included in a more comprehensive rural development and agricultural extension program. Although previous extension efforts were on a small scale and incorporated fish farming into the routine of only a few farmers, there are currently two large-scale integrated rural development projects in which fish culture could play a useful role. There is also a project proposal with USAID to significantly expand and upgrade the capacity of the Central Agricultural Experiment Station at Suakoko where fish culture systems could be tested. Over a 12- to 15-year period, it is anticipated that an integrated agricultural experiment and extension program will be implemented involving both American experts and Liberians selected for graduate training at American universities. It would be particularly useful to include fish culture along with the other basic agricultural sciences to be involved in the program. Although such an effort would be premature at present, some research should examine Liberia's potential for rice-fish cultivation, a form of integrated production that has worked well in certain rice-growing countries.

Technical Evaluation

The Liberian fish culture experience is insufficient to give a sound technical assessment. Ponds that were seen were generally deeper than necessary and little managed for fish production. There is no reason to think fish would not grow, but, as in any tropical country, there needs to be a careful assessment of the extent of suitable sites for development. A report from the adjacent Sierra Leone suggests that many locations are too sandy or acidic, and porous lateritic soil conditions exist that are unfavorable for good fish production. There are no real hatcheries or operating test facilities or trained local aquaculturists in-country, so any efforts for massive fish culture

development will have to start from a low level. In turn, the proposal to strengthen the Central Agricultural Experiment Station includes some interest in fish. The large integrated rural development projects might prove to be a vehicle for distribution of production once local feasibility is demonstrated.

Economic Appraisal

GENERAL BACKGROUND. Liberia has strong ties to the United States, going back to its settlement by freed slaves from this country. Its economy is based largely on exporting iron ore and rubber. Iron ore has had a rather difficult market since the mid-1970's, damaging the country's economic stability. Other minerals of importance are gold and diamonds. Rice, coffee, and sugar are among the variety of agricultural crops that are cultivated extensively.

LAND. Liberia has some land adaptable to fishponds, but a high proportion of soils in the nation are gravelly and laterite types which do not hold water well. Rice is the main competitor for land from an opportunity cost standpoint.

LABOR. Excess labor seems to be available in Liberia as in the other countries surveyed. Unemployment and underemployment are common and the day labor rate was fairly low, as shown in the data on costs and returns of fish production. Large rubber plantations have a sizable demand for labor. Mining is also an alternative use of labor. A large number of crops can be grown, but these offer little conflict in the labor market because of the minimal amount of labor entailed in fish farming operations.

CAPITAL. Capital requirements were minimal for small fishponds. Large commercial operations require a high amount of capital, however, but are self supporting and not subject to needs of government aid on technology management.

COSTS, RETURNS, AND MARKETS. Liberia seems to have a weaker market for fresh fish in terms of prices paid in the market than do the other countries in the study. Relatively cheap frozen fish and coastal proximity seemed to affect prices in some instances. Conditions for production seem to merit use of a 910 kilograms per hectare rate as in Zaire from pond fish culture involving tilapia in the majority of operations. At \$1.25 per kilogram, a 0.1-hectare pond would show a loss of \$19.10 during the first 2 years and a positive return of \$64.15 thereafter. Large commercial operations with local manures and good management should be able to give much higher productivity than the small farm ponds.

Socio-Cultural Factors and Fish Culture Development

GENERAL BACKGROUND. Although Liberia has borrowed several features from American society over many decades, indigenous West African traditions remain active, particularly in inland rural areas. There are several tribal-ethnic groups which specialize in capture fisheries, but the vast majority of the population is involved with rural agriculture. Fish is a popular food, being distributed in smoked or frozen form in all cities and in most larger towns.

The pressure toward conformity in village life is as great in rural Liberia as elsewhere in the region, but the schism between traditional and more westernized persons seems wider. Some have suggested that many villagers regard those who have left to seek a better way of life in urban areas as "outsiders" who are no

longer accepted as members of the community. Where this view prevails, those adopting a different way of life do so at the expense of their standing in their home communities. Such difficulties are apparently regarded as being well compensated for by the advantages, however, and the rural to urban migration of young people continues to be extensive. As a result, many rural communities are populated by the very young and very old and many of the remaining farmers are older people with little exposure to modern agricultural methods. Plantation jobs are said to be particularly attractive because they permit workers to improve themselves without having to share the fruits of their labor with their extended families. Although wages are not high, workers do receive free medical care, free education for their children, and subsidized housing and food, benefits which cannot be transferred to others.

A related but more distinctive feature of Liberian society is the traditional differentiation between those who are the descendants of the former slaves from America who founded the republic and the indigenous people who make up the bulk of the population. The "Americans" have been active in the diffusion of Western technology and ideas, and a much larger proportion of them have been trained in technical fields. Many have been active in the creation and management of medium- and large-scale agricultural enterprises. Like most other developing areas, Liberia faces several dilemmas centering about the development of industrial type agricultural projects which offer considerable economies of scale, and those which can serve the needs of the rural poor who have little cash with which to buy the commercially produced foods.

A further important difference between Liberia and the other countries visited is the much greater role of rice in the daily diet. Rice consumption is as high as anywhere in Asia (much greater than in the other countries visited) and is by far the most important crop cultivated by rural farmers. Even those who make much more money growing cash crops devote a good part of their labor to the less profitable and highly labor intensive cultivation of rice. For most, it would be regarded as unthinkable not to cultivate some rice for family consumption.

AGRICULTURAL SKILLS — GARDENING AND ANIMAL CARE. There is a considerable range in the level of agricultural skills found in Liberia. The country has some sophisticated, industrial-scale agricultural projects which promise to expand. Poultry production is being carried out on a large scale and is quite successful. Industrial-scale fish culture, initiated with the help of Taiwanese technicians, shows considerable potential.

Rural farmers work extremely hard in the cultivation of their rice, but the labor available for small-scale agriculture in many villages is limited because of rural to urban migration and the low status that farming has in the eyes of younger people. The potential for small-scale aquaculture in Liberia lies primarily with small acreage, rural landholders who have appropriate sites and wish to engage in a supplementary form of productivity. Increased pond fish culture may produce some cash from local sales, but the bulk of the fish produced would be for family consumption.

CONCEPTS OF LAND OWNERSHIP. Attitudes and practices regarding land ownership are much like those observed elsewhere in West Africa. A study currently underway by the Land Tenure Center of the University of Wisconsin will provide an in-depth analysis of land holding in Liberia which should be valuable in future development plans.

THEFT AND POACHING. As in the other places where cultivation of communal ponds has been attempted, there has

been a lack of consensus regarding harvest rights which has led to accusations of theft and the prompt failure of some projects.

SEX ROLES AND FISH CULTURE DEVELOPMENT. A major difference between Liberia and the other countries visited deals with the division of labor and decision making on the part of man and wife. The cultivation of other crops, including cash crops, commences only after the rice has been planted. The labor intensive character of rice production in Liberia, most of which takes place in upland areas, requires a much greater effort on the part of males than was encountered in the cultivation of other subsistence foods in the countries visited earlier. In December and January, the men clear the land and burn off wild vegetation. Both men and women then plant the rice seed. Women are responsible for weeding. Harvesting is done by both men and women, who use short knives in cutting one head at a time.

There is a realistic possibility that village women would be a much better target group for the diffusion of fish culture than would men. In some areas, they engage in traditional, low-productive fish culture in the period following the annual dry season. It is also true that in many tribal-ethnic groups in Liberia, the senior wife is the prime decision-maker and manager of family affairs. She makes decisions about the division of labor, gives work assignments, controls marketing, and may even recruit other wives for her husband. In many areas, female demonstration agents working with senior wives may be an effective way of promoting fish culture technology and management skills.

DISTRIBUTION OF FOOD WITHIN THE FAMILY. Liberian practices regarding the distribution of food within families followed the pattern encountered elsewhere in West Africa. It would be anticipated, however, that efforts to improve nutritional practices should, where appropriate, be aimed toward senior wives.

CONSIDERATIONS FOR PROJECT IMPLEMENTATION

Socio-Cultural Considerations and Recommendations

Program Design and Administration

1. Every project should make provisions for an extension effort, staffed by local people wherever possible, to ensure the continuation of a fish culture program over the long term. Without an effective local extension component, there is little probability that farmers would continue to practice fish culture.

2. Excessive administrative layering of fish culture programs under other agriculture or fishery programs should be discouraged, since such organization decreases the probability that a program will be effective in responding to local needs.

3. Differences between the perceptions of PCV's, AID staff, and local government officials are common, due in part to different program criteria and to the fact that individuals in each organization seek to inform different groups. These differences in points of view should be considered as inevitable and should not significantly detract from overall project function.

4. Coercive fish culture efforts, which in the past have required individuals or communities to construct ponds, have been significantly less effective and productive than guided voluntary efforts. They also have created considerable

resistance to the practice of fish culture in many communities. Compulsory programs should not be encouraged or supported.

5. Efforts to build and operate communal ponds have generally failed wherever they have been attempted in West Africa. They should not be encouraged.

Training

1. The training of PCV's and local fish monitors should continue to emphasize instruction in socio-cultural aspects of technology transfer, innovation, and social change, employing case studies or examples from areas similar to those in which the volunteers will be working. Such training should equip PCV's and monitors to objectively describe their experience and that of the people with whom they will be working.

2. With regard to the training of PCV's, local monitors, or farmers, a small quality program with a limited number of participants is preferred over a larger but less effective effort of lower quality.

3. If possible, some experimentation should be undertaken in which both PCV's and their counterparts are trained jointly in-country.

4. The language training of PCV's working in fish culture should include the basic vocabulary of fisheries and pond construction.

Program Implementation

1. There is a tendency for second "generation" or beyond PCV's working in fish culture to continue to work with farmers who in the past have been the most receptive to innovations and most successful in fish culture efforts. This should not be permitted. Instead, fish culture programs should seek to extend the technology to new clients. If no other suitable potential farmers are available in the area, consideration should be given to phasing out the program from the community involved and to monitor the efforts of farmers once the PCV has gone.

2. PCV's and monitors should attempt to identify and gain the support of influential individuals or interest groups in the community who may be affected by fish culture projects. Some contact with such persons, even if brief, tends to be beneficial to a project. A new way of doing things is often perceived as a threat to the existing community order simply because it is unknown.

3. Although both PVC's and local monitors are often encouraged to work to improve the well-being of the least fortunate individuals in a community, most successful fish farmers are those who have been successful in other endeavors and have other agricultural efforts underway. They should be recognized as potentially the most receptive target group in typical communities.

4. Any village-level development effort should consider "costs and rewards" in relation to the potential fish farmer's status within the community. The "audience" which the potential farmer seeks to please may regard increased material rewards as less important than adhering to traditional or conventional forms of "unproductive" conduct.

5. Instruction and demonstration should emphasize, at all phases, the ways in which fish culture is often analogous to a biological system with which the farmer is familiar, such as the growth of children, the raising of small animals, or the cultivation of cassava or other crops.

6. Demonstration ponds should replicate the actual

conditions and use the same resources available to farmers in the area concerned. Farmers tend to reject a system which produces unrealistically high yields that cannot be attained in the field.

7. PCV's should not become involved in repetitive support tasks, such as supplying fertilizer, food, or fingerlings for ponds, but should maintain their advisory roles up to their most practical limit, emphasizing the need for independent effort on the part of the client farmer. This approach would encourage the development of behavioral patterns that would continue in the absence of a supportive PCV.

8. Fingerlings should be sold at modest prices to farmers rather than given to them without charge. The attitude prevails in West Africa, as elsewhere, that "something given for nothing has no value." A modest charge would infuse the fingerlings with some value in the eyes of the farmer, and his concern for them would be accordingly greater.

9. During the harvest of their individual ponds, farmers should be encouraged to have a third party (non-kin) handle the actual sales. This method would increase profits and the probability that he would continue fish culture by reducing claims for gift fish on the part of relatives.

10. If ponds fail or have low levels of productivity, an effort should be made to identify and disseminate the reasons for the failure among other potential fish farmers in a community.

11. The role of "magic" in community life should not be minimized or ignored. An understanding of local beliefs which can work to promote the success of fish culture should be encouraged among PCV's or monitors. For example, some "magic" can be useful in discouraging the theft of fish in ponds, thereby promoting a better harvest.

12. Given the colonial heritage found in many rural areas which gives higher status to "Europeans" and the accompanying belief that such outsiders can do things that indigenous people cannot, model ponds should not be built or managed by PCV's themselves. The success of a pond solely built by a PCV may be attributed to his racial status or place of origin rather than to the methods he or she employed. Although personal credibility is important, PCV's should emphasize the fact that it is the methods used which produce success and that any farmer with the resources can do the same.

Information Efforts

1. Some West African groups give the written word higher credibility than the spoken word. Ideas or techniques expressed in French or English are sometimes also seen to be more valid than those presented in a local language. In areas where such beliefs prevail, publications in a "prestige" language could be used to promote a program. The degree of literacy would limit the success of such materials in some instances.

2. In communities which have been bombarded by extensive information efforts or well-publicized government development programs, a modest or low profile information program to diffuse information about fish culture may be more effective than a large-scale, "hard-sell" effort. Over-claiming the benefits of fish culture should be strongly avoided.

Project Evaluation

1. The criteria for judging the "success" or "failure" of fish culture projects should make use of conventional measures of productivity (number of ponds built, kilos of fish produced per

hectare, profitability) but also consider less tangible benefits such as:

- the instruction of local monitors and farmers;
- increases in the well-being of the concerned population of a more temporary nature;
- the growth of awareness of the mutual social and economic interests on the part of the community residents;
- the promotion of improved, effective methods or principles of production;
- the growth of knowledge and habits which may be transferred to other forms of agricultural productivity (small animal husbandry, poultry);
- the expression of American interest in the rural population of the country concerned.

2. Any evaluation of the PCV's or monitors should be relative to what can be realistically expected in a community, recognizing that great differences commonly exist between villages and areas (i.e., acceptance of new ideas, level of agricultural experience, local political structure).

Public Health and Environmental Discussion

The environmental advantages of pond construction in soil and water conservation are well understood and need not be repeated in this report. In any event, the scale of expected development is so small that negligible environmental impacts are foreseen. The one area of concern is the role of pond development in the spread of water-borne diseases. A discussion of the more common water associated diseases follows.

Schistosomiasis

Schistosomes are small parasitic blood flukes that cause a disease known as schistosomiasis or bilharzia. At least three species infective to man are endemic to West Africa and are of concern because of their chronic debilitating effect on the general health of the host. Schistosome eggs are discharged in human feces or urine and upon contact with freshwater hatch into small miracidia that must penetrate the body of selected snail species if they are to survive. Within the snail, a secondary host, the immature flukes undergo a further metamorphosis to larval cercariae that emerge from the snail and may penetrate the skin of a suitable mammalian host coming in contact with water containing the cercariae. Once in the definitive host, the flukes enter the circulatory system where they migrate and may mature, mate, and produce new eggs. The eggs break out of capillaries into the gut or bladder or may accumulate in the liver, lungs, and other tissues causing inflammation, lesions, and reduced capacity to work and resist diseases.

Increased rate of infection with schistosomiasis has been associated with some irrigation and water storage projects in West Africa so there is concern that development of fishponds will also exacerbate the problem. A few of the Peace Corps volunteers working with aquaculture in the Central African Empire have contracted the disease and volunteers are now generally counseled against activities that might lead to their exposure. Reliable data about specific distribution and incidence of infections are generally not available. Most of the fisheries people who were asked about the disease expressed the opinion (sometimes erroneously) that, "It is not a problem in our area." While it is likely true that schistosomiasis is not a problem in many local areas, infections are widespread enough and migration of carriers is common enough that any project development should take into account the risks and incorporate procedures to minimize these risks.

Well constructed ponds should have steep sides and little shallow area where snail-enhancing vegetation would abound. Unfortunately, few ponds meet these specifications. All too many weed-choked and half full ponds were observed in which snails could proliferate. At least two fish species common in West African fish culture, *Clarias lazera* and *Tilapia machrochir*, have been claimed to feed upon and eliminate unwanted snails. Biological control using these fish species or other known molluscivores offers some potential.

West Africans were not observed to use human night soil in fishponds, indicating that the idea is not aesthetically attractive in the region. However, pit latrines and selected direction of urination away from water should be encouraged. Small children may be particularly difficult to discipline in this regard.

Treatment of schistosomiasis in humans is possible, but drugs used are harsh and any one treatment might not be 100 percent effective. Control of the disease usually focuses on eradication of the vector snails or education and human sanitation. Snails favor slow moving or shallow standing freshwater where attached algae abound, such as when there is an accumulation of aquatic weeds and dead vegetative matter. It is possible to dry or chemically treat streams and ponds, but the treatment must be repeated to control repopulation. Chemical treatment involves expense and sophistication not thought practical for subsistence-level farmers in West Africa.

Malaria

Mosquito-borne malaria is prevalent in most of West Africa and because mosquitoes spend their early life in water, the concern has been expressed that building ponds will increase

mosquito breeding habitat. Many fish, however, will eat mosquito larvae so the concern is not justified provided ponds are not too congested with grass and weeds that offer protection to mosquito larvae. On the other hand, pond development frequently involves clearing and use of swampy areas more favorable to mosquito breeding prior to development.

River Blindness (Onchocerciasis)

River blindness caused by the parasite transmitted through the bite of the bloodsucking flies of the genus *Simulium* is not considered related to pond development. The larval flies are aquatic, but frequent areas of rapid current that generally are not appropriate for pond construction. Formation of large reservoirs that inundate stretches of river rapids have generally reduced the incidence of river blindness.

Sleeping Sickness

Sleeping sickness transmitted by the tsetse fly is also endemic to much of West Africa and limits areas available for livestock grazing. Tsetse flies need moist shade, such as found under trees along water courses in the savannah. One of the control measures is to cut out trees near which the flies breed. To the extent that pond development removes trees, there would be a reduction in the number of flies, but pond development might also bring people into areas where chances of exposure are greater. In turn, the fact that livestock cannot thrive in the area suggests that animal protein coming from fish would be all the more welcome in the diets of local populations.

SELECTED REFERENCES

- (1) ACKERMAN, W. C., G. F. WHITE, AND E. B. WORTHINGTON (Editors). 1973. *Man-made Lakes: Their Problems and Environmental Effects*. Geophysical Monograph 17, American Geophysical Union, Washington, D.C. p. 847.
- (2) AGENCY FOR INTERNATIONAL DEVELOPMENT. 1970. *AID Economic Data Book: Africa*. Washington, D.C.
- (3) ANTHONIO, Q. B. O. AND M. O. IJERE. 1973. *Uboma Development Project 1964-1972*. London: Shell International Petroleum, Ltd. (Mimeo).
- (4) CLARKE, R. C., I. A. AKINBODE, AND Y. O. K. ODEBUNMI. 1967. *Case Studies of Four Nigerian Villages: Western Region*. Ibadan: Department of Extension and Rural Sociology, Univ. of Ibadan. (Mimeo).
- (5) DI PALMA, SALVATORE, JOHN H. GROVER, STEPHEN MALVESTUTO, KATERINE VANDEMAELE, AND DIANNE BLANE. 1976. *Burundi Highland Fisheries Development*. International Center for Aquaculture, Auburn University, Auburn University, Ala.
- (6) DISCUSSION PAPER NO. 4/79. 1979. *Agriculture Economics*. Ibadan: International Institute of Tropical Agriculture. (Mimeo).
- (7) DODD, P. C. AND P. D. STARR. 1976. *The Community in Nutrition*. Edited by D. L. McLaren. Wiley and Sons.
- (8) DUNCAN, B. L. 1975. *Review of Peace Corps Fisheries Program in the Central African Republic*. International Center for Aquaculture, Auburn Univ., Auburn University, Ala.
- (9) ERASMUS, C. J. 1961. *Man Takes Control*. Minneapolis: University of Minn. Press.
- (10) FOOD AND AGRICULTURE ORGANIZATION. 1975. *Aquaculture Planning in Africa*. Rome: United Nations Development Programme.
- (11) _____ 1977. *Developpement de la pisciculture Cameroun conclusions et recommandations du project*. p. 32.
- (12) GRIVETTI, L. E. 1979. *The Rationale, Promise and Realities of Aquaculture: a Cultural-nutritional Perspective*. Unpublished Paper Presented at Woods Hole Conference. 14 pp.
- (13) HOGENDOORN, H. 1977. *Aspects of Two Years of Fish Culture Development in the Republic of the Cameroon*. Food and Agriculture Organization of the United Nations. p. 57 (restricted).
- (14) INTERNATIONAL MONETARY FUND. 1979. *International Financial Statistics*. Vol. XXXII No. 6.
- (15) ITA, E. O. 1978. *A Preliminary Report on the Fish Stock Assessment of IITA Irrigation Reservoir and the Management Proposal*. Kainji Lake Research Institute.
- (16) KOTÉY, R. A., C. OKALI, AND B. E. ROURKE (Editors). 1974. *Economics of Cocoa Production and Marketing*. Legon, Ghana: Institute of Statistical, Social and Economic Research.
- (17) LAGEMAN, J. 1977. *Traditional African Farming Systems in Eastern Nigeria*. Manchen: Weltform Verlag.
- (18) MOORE, MICHAEL. 1978. *Cameroon Fisheries Program Evaluation and Recommendations*.
- (19) MOSS, D. D., G. B. PARDUE, AND M. J. DANNER. 1969. *Fishculture Survey for West Central Africa*. Agr. Exp. Sta., Auburn Univ., Auburn University, Ala.
- (20) OBENG, L. E. (Editor). 1969. *Man-made Lake: the Accra Symposium*. Ghana Univ. Press. p. 398.
- (21) OFFICE OF NUTRITION, DEVELOPMENT SUPPORT BUREAU, AGENCY FOR INTERNATIONAL DEVELOPMENT. 1978. *United Republic of Cameroon, National Nutrition Survey: Summary Report and Recommendations*. Washington, D.C. DN-AAA-222-3, ARC-CM 64-1A265, 833/79.
- (22) OKALI, C. D. OBEN, T. OJO-ATERE, AND T. LAWSON. 1979. *An Evaluation of Farmer's Knowledge and Use of Hydromorphic Toposequences in the West State of Nigeria: Finding from Selected Areas in Oshun River Basin*. Discussion Paper No. 4/79. Agricultural Economics. IITA, Ibadan.
- (23) OLUWANI, H. A., I. S. DEMA, ET AL. 1966. *Uboma: A Socio-economic and Nutritional Survey of a Rural Community in Eastern Nigeria*. London: Geographical Publications, Ltd.
- (24) OMOLOLU, A. 1976. *Nutrition in Nigeria*. Nigeria Nutrition Newsletter: 1:148-159.
- (25) ONAKOMAIYA, SAMUEL O. 1975. *International Trade in Specialty Foodstuffs in Nigeria*. Ibadan: Nigerian Institute of Social and Economic Research.
- (26) ONGLA, JEAN. 1972. *An Economic Survey of Food Production Variables in the Zone of Intervention: Yemesson*. Yaounde: Department of Rural Economy, Univ. of Cameroon.
- (27) PEACE CORPS. 1975. *Peace Corps/ Cameroon Fisheries. Mid-service Conference Report*.
- (28) _____ 1978. *Liberia Agriculture Extension Project Plan* (Typescript).
- (29) _____ 1977. *Peace Corps/Zaire Fish Culture Program Status Report*.
- (30) SHELL, B. P. 1972. *Nigeria, Ltd. Community Development Projects: Village Study Book (Taaba)*. Lagos. (Mimeo).
- (31) _____ 1973. *Nigeria, Ltd. Community Development Projects Dept. East: Village Study Book (Kpite Village, Ogani Division)*. Lagos. (Mimeo).
- (32) USAID. 1979. *Project Implementation Document: Cameroon Small Farmer Fish Production*. Project 631-0022. Washington, D.C.
- (33) VINCKE, M. 1972. *Liberia: Inland Fisheries and Fish Culture Development*. Rome: Food and Agriculture Organization of the United Nations. (Mimeo).

ITINERARY AND PEOPLE

Date of first contact

July 23, Auburn — Washington, D.C.

Richard Neal, AID
William Johnson, AID
Winton Fugille, AID
Michael Wiseman, AID

July 24, Washington, D.C. — Rome

Mary Hope Katsouras, National Academy of Science

July 25, Rome

Michael Mistakidis, FAO
Michel M. J. Vincke, FAO
Andre G. Coche, FAO
Ulrich Schmit, FAO

July 25, Rome

Jean Gaudet, FAO

ZAIRE

July 27, Rome — Kinshasa

Harry Rea, Associate Director for Fisheries, Peace Corps/Zaire

J. Hawes, USAID

Mughusu Longani, Director, Fishculture Project, Department of Rural Development

Also visited the International Fair in Kinshasa and toured the fish culture display and other demonstrations about improved village life in Zaire.

July 28, Kinshasa — Kikwit, Bandundu Region

July 29, Misimbi Village and Lusanga

Ed Gerard, PCV

Marina Baudoin, PCV

Cheri MacLean, PCV

Thomas Randolph, PCV

Mark Orlic, Aquaculture Project Manager for Lever Brothers Co., Lusanga

July 30, Kikwit area

Citoyen Mamvaka, cooperating farmer

Fred Martin, PCV

Gaby Taylor, Field Director, OXFAM/Zaire

July 31, Kikwit — Kinshasa

Mark Underwood, PCV

Steve Ivis, PCV

Visited Masi-Manimba Department of Agriculture Fish Station and private ponds

August 1, Kinshasa

Baudouin de Marcken, Director, Peace Corps/Zaire

L. Voth, USAID

August 2, Kinshasa — Cameroon

N. Sweet, Director, USAID/Zaire

W. Boehm, USAID

Fenton Sands, USAID

Ken Koehn, USAID

World Bank Offices

CAMEROON

August 3, Yaounde

Connie Freeman, Director, Peace Corps/Cameroon

Rowland Thurlows, Peace Corps

John Moehl, PCV

Paul Olson, PCV

Eric Witt, USAID

August 4, Yaounde

Visit to native markets

August 5, Yaounde — Bafoussam

Toukan Roger Elei, Chief of Batoufam

Ana Hiott, PCV

August 6, Bafoussam — Foumban

Sarah Cook, PCV

Tim Henry, PCV

Cathy Wanat, PCV

Foumban Fish Culture Center

August 7, Bafoussam — Bamenda

John Barah

Muka Moses

Ku-Bome Fish Farming Station

Bafoussam Fish Station

August 8, Bafoussam — Yaounde

August 9, Yaounde — Mbalmayo

Peace Corps Fisheries Training Group

Mbalmayo Fish Station

"Bishop's" Fishpond

August 10, Yaounde — Douala

Paul McCabe, World Food Program

Mr. Gara, FAO Country Representative

James Williams, USAID Director

John Woods, USAID

August 11, Douala — Lagos

NIGERIA

August 11, Douala — Lagos

August 12, Lagos

August 13, Lagos

M. A. Obakin, Federal Department of Fisheries

A. M. Ajana, NIOMR

Kenneth Davis, U.S. Embassy

Tiffany Industries Americas Corp. Office

Dr. Hank Knipscheer, Agricultural Economist, IITA

August 14, Lagos — Ibadan

August 15, Ibadan

Okigbo, IITA

Durodolo Apanpa, Oyo State Fisheries Division

O. Ojo, Oyo State Fisheries Division

Agodi Fish Farm

Mr. Durodolo Apampa, Department Chief of Fisheries, Oyo State

August 16, Ibadan — Oyo

S. Alabi Ogum, Permanent Secretary, Oyo State

N. I. Oke, Oyo State Fisheries Division

F. O. Olatunji, Oyo State Fisheries Division

Oyo Fish Farm

Mr. A. A. Adetunji, Sr., Fisheries Superintendent, Oyo State

August 17, Ibadan — Benin

Dr. J. K. Olavemi, Sr., Lecturer, Department of Agricultural Economics

University of Ibadan

August 18, Ibadan — Lagos

Malcolm Johnson, Bendel State Tiffany Project

LIBERIA

August 19, Monrovia

August 20, Monrovia

Jack Cornelius, USAID

Soloman Sherman, USAID

Frederick M. Zerbaby, USAID

J. Elijah Ricks, Ministry of Agriculture

James Stevenson, Peace Corps

August 21, Monrovia — Suakoko

Dr. Jarrett, Ministry of Agriculture

Mr. Jenson, Ministry of Agriculture

Dr. Bhutta, Ministry of Agriculture

Peter Youn, Bong County Rural Development Project

University Farm at Fendell

Central Agriculture Experiment Station Suakoko

Bong County Agricultural Development Project

Baker Farm

Sangai Mesurado Farm Complex

August 22, Monrovia

Dr. Art Haegler, Agricultural Economist, Agricultural Sector Analysis Project, USAID

