The Development of an Inland Fishing Industry in Jamaica, 1976-1984

A Summative Evaluation of Two AID-Financed Development Projects

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Craig Olson, Evaluation Specialist/Team Leader
Harold Hagen, Aquatic Biologist

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Development Alternatives, Inc. 624 Ninth Street, N.W. Washington, D.C. 20001

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER ONE

INTRODUCTION AND SUMMARY

The purpose of this paper is to present a final evaluation of Fish Production and System Development (FPSD - Project No. 532-0059), an inland fisheries project in Jamaica financed by the U.S. Agency for International Development and the Government of Jamaica. The project began in 1979. Most of its components, including technical assistance, no longer receive AID financing. However, the Project Assistance Completion Date, originally scheduled for 1983, has been extended to August 31, 1985, to complete procurement of certain commodities and to permit three Jamaican students to finish their studies at Auburn and Tuskegee universities.

FPSD was preceded by another AID-financed project entitled Inland Fisheries Development (IFD - Project No. 532-0038), which ran from 1976 to 1979. Since IFD established much of the technology and institutional framework on which FPSD has been implemented, this evaluation takes into account the accomplishments and impact of both projects.

METHODOLOGY

The evaluation was carried out by a two-person team from Development Alternatives, Inc. (DAI). Field work took place November 7-14, 1984. The evaluation team presented a draft report to USAID/Jamaica on November 19 and received comments on November 21, which was also the day the team left Jamaica. This final report was prepared November 25-26, 1984, in the DAI offices in Washington, D.C.

During the eight days of field work, the team obtained information from a number of written sources, including the internal documents of the Inland Fisheries Unit (IFU) and the reports of the technical assistance team from Auburn

University.[1] The team also visited several fish farms and interviewed key respondents in the public and private sectors.[2] In addition to the IFU staff, the team met with officials of the Ministry of Agriculture (MOA); Agro 21, which is a special secretariat of the Prime Minister's office responsible for the promotion of agriculture; the Urban Development Corporation (UDC) and Aqualapia Jamaica, Ltd., which are parastatal enterprises involved in fish farming; and with seven private fish farmers (corporations and individuals).

PRINCIPAL FINDINGS AND CONCLUSIONS

The team's overall conclusion is that FPSD should be entered into the ranks of AID success stories. Like most development projects, FPSD and its parent project -- IFD -- are not without flaws. But the balance sheet of the projects' achievements and shortcomings is clearly positive.

The projects' most important achievement has been to establish a successful new industry in Jamaica. The technology and skills involved in freshwater Talapia production have been successfully transferred to a government research and extension agency as well as to private industry. A number of farmers have adopted the technology and have been able to increase their incomes through their Talapia production and sales. Since Jamaican Talapia competes well with fresh fish imports, domestic production should eventually reduce foreign exchange outflows, although production is still too small to have had a noticeable effect on the external account.

The project has also had several unintended consequences. First, contrary to the intentions of the original project designers, FPDS is no longer a small farmer development project. Although most production units created by the project are small --less than 5 acres -- many owners of these units are medium-sized farmers or business or professional people for whom fish farming is one of several business ventures. In addition, seven

very large farms -- 20-100 pond surface acres -- have sprung up and several more are planned; together, these seven large operations already produce probably 90 percent of the country's Talapia and threaten to dominate the market.

Second, at least two large commercial operations have begun to use a Talapia farming technology that is potentially more productive than the technology employed by the project. The largest of these two operations is extremely secretive about the technology as well as its costs and benefits. Should this technology, which produces hybrid all male fingerlings, thereby greatly diminishing the need for manual sexing, prove viable in Jamaica, the dominance of the large commercial farms employing the technology would be even greater than it is now.

Third, in the southeastern parishes served by the project, the production of Talapia has increased so rapidly that existing distribution and marketing channels are unable to handle it. Like many agricultural commodities, fish is a perishable commodity that must be harvested on a fixed schedule. Entire harvests can go to waste if distribution and marketing channels are not available to handle them at the time required.

Fourth, the continued growth of the acquaculture industry will require a steady supply of trained acquaculture specialists for some time to come. Although the professional training provided by the project at Auburn and Tuskegee universities and in-country through the Auburn technical assistance team has been excellent, Jamaica has not acquired its own capacity to produce qualified acquaculture specialists.[3] Considering current and foreseeable shortages of foreign exchange, Jamaica cannot afford to send students abroad for acquaculture training.

Fifth, in St. Catherine Parish, where the largest concentration of fish farming exists, the project may have exacerbated two related environmental problems: saltwater intrusion and shortages of fresh drinking water. To anticipate these problems, the

project development process should not have stopped short, as it did, with an initial environmental examination; instead, an environmental impact statement should have been prepared.

The evaluation team's principal recommendation to USAID/Jamaica is that it continue to monitor the progress of the aquaculture industry and respond favorably to future requests for particular short-term assistance. USAID/Jamaica should not finance a major follow-on project, but should stand ready to finance discrete activities such as marketing studies and overseas training. AID/Washington should extract from the aquaculture projects in Jamaica a number of valuable lessons (presented in Chapter Four) that may be applied to future aquaculture projects in other countries.

NOTES

1 See Annex A for a list of principal documents consulted.

2 See Annex B for a list of key respondents.

3 Five Jamaicans have completed degrees at Auburn; 3 (2 at Auburn, 1 at Tuskegee) are still pursuing their studies. In addition, some 25 extension officers have been trained in country through the Auburn technical assistance team.

CHAPTER TWO

PROJECT OBJECTIVES AND ACCOMPLISHMENTS

This chapter will describe briefly the activities of the project and lay out the record of its accomplishments.

PROJECT BACKGROUND AND RATIONALE

When the first AID-financed project began, the farming of the African Chichlid Tilapia mossambica (locally known as the African perch) had already been taking place in Jamaica for 25 years. However, pond construction and the cultivation techniques used by pond owners, most of whom were small farmers, were extremely primitive, with annual yields averaging only 100-300 pounds per acre.

In the meantime, Jamaica was importing 35 million pounds of fish each year for which it had to utilize some $35 million in scarce foreign exchange.[1] The price of imported fish, about $1.00 per pound, was too high for many islanders, particularly the bottom one-third of income earners whose per capita income was estimated at $187 per year. It was also estimated that low income earners were suffering a 6-gram per day protein deficiency. (These and other benchmark data are presented in Table 1.)

The rationale for the original project, therefore, as well as for its successor, was that the creation of a commercially viable inland fishing industry could simultaneously overcome several development constraints. An increase in domestically produced fish would reduce foreign exchange expenditures on imported fish. The lower price at which freshwater fish was expected to sell -- about $0.40 per pound -- would make it more available to protein-deficient consumers. And the income earned from freshwater fish sales would accrue mainly to small-scale farmers, thus alleviating rural poverty.

TABLE 1

INLAND FISHERIES DEVELOPMENT
(PROJECT NO. 532-0038)

BENCHMARK DATA (ca 1974), ORIGINAL TARGETS (1978), AND ACCOMPLISHMENTS (1979)

	Benchmark (ca 1974) (U.S. $1 = J$.91	Targets (1978) (U.S. $1 = J$1.25)	Accomplishments (1979) (U.S. $1 ≈ J$1.30)
1. Pond Acres in Tilapia			
• Twickenham Park (IFU HQ)	1.8	6.8	5.6
• Private	50 - 100 [a]	65 [b]	110
• Jamaica School of Agriculture	-	5	-
2. Farmers	-	260	75
3. Annual Food Fish (Tilapia) Production (lbs)	-	1,250,000	300,000 [h]
4. Yield (lbs/acre/year)	100 - 300 [a]	3,000	- [i]
5. Food Fish Sales Price (J$)	0.90-$1.10 [c]	0.40 [d]	0.73-1.50
6. Annual Gross Revenues (J$/per acre)	80 [e]	1,200 [f]	-
7. Fish Imports			
• Volume (lbs)	35,000,000	-	35,000,000
• Value (US$)	35,000,000 [a]	35,000,000	47,000,000
8. IFU Staff	14 [g]	22	5 [g]
9. Training			
• Long-term (M. Sc. degrees - US)	-	3	2
• Short-term (Person-months)	-	12	

Notes to Table 1

a Estimate.

b New or reconstructed.

c Imported fish, 1976.

d Tilapia, constant 1976 dollars.

e 200 lbs x $0.40.

f 3000 lbs x $0.40.

g 1976.

h Of which 70 percent from the project's own ponds, 30 percent from privately owned ponds. The data in column three are mainly from the IFD final evaluation.

i The final IFD evaluation reports that, on IFU's own ponds, annual yields were 8,000-11,000 pounds per acre. No yield data were presented for private farms.

PROJECT OBJECTIVES

The overall objective of both IFD and FPSD was to establish a commercially viable inland fishing industry in Jamaica. The first project, IFD, was aimed primarily at research and institution-building. Over its two and one-half year life, IFD was to create a capability within the Inland Fisheries Division (later called the Inland Fisheries Unit - IFU) of MOA to design and implement an aquaculture program. Project activities included technical assistance, long- and short-term training, renovation of facilities, and creation of an applied research laboratory at Twickenham Park. Although the project's emphasis was on institution building, it did include some pond construction and extension with private farmers. IFD was financed by an AID grant of $355,000 and a Government of Jamaica contribution of $622,000. The expected outputs from IFD are presented in Table 1.

The second project, FPSD, was much larger in scope and ambition and focused more on extension and production. FPSD maintained and even expanded many of the institution-building activities begun under IFD, including a larger complement of technical assistance, construction of new facilities at two different locations -- Mitchell Town and Meylersfield -- and increased training for existing and future IFU staff. But the major emphasis of the project was on expansion of pond acreage and increased production of Talapia.

FSPD was financed through an AID loan of $2.7 million, an AID grant of $1.4 million, and a Government of Jamaica contribution of $4.9 million. The results expected from FSDP were heroic. By 1982, it was evident that most of the targets could not be reached and several were revised downward. The expected results from FSDP and its mid-project and current accomplishments are presented in Table 2.

TABLE 2

FISH PRODUCTION SYSTEM DEVELOPMENT
(PROJECT NO. 532-0059)

TARGETS AND ACCOMPLISHMENTS

	Targets (Prepared in 1979, Most Expected in 1983) (U.S. $1 ≈ J$1.30)	Accomplishments 1982 [g] (U.S. $1 = J$1.78)	Accomplishments (11/84 Unless Otherwise Indicated) (U.S. $1 = J$4.71)
1. Pond Acres in Tilapia			
• Public Sector	86 [a]	-	103
• Private Sector	1100	200 [m]	727
2. Farmers	1280	200 [h]	550 [w]
3. Annual Tilapia Production			
• Food Fish (lbs)	9,000,000 (1985)	230,000 [n]	473,500 [r]
• Fingerlings (number)	13,000,000	- [o]	2,500,000 [s]
4. Yield (lbs/acre/year)	3000 - 6000 [b]	6,600 [i]	6,900 [x]
5. Food Fish Sales Price (J$)	0.85	1.60-1.80	3.00 [t]
6. Revenues (J$/acre/year)			
• Gross			
• Large commercial farmers	5,100	10,560	20,700 [u]
• Small farmers	2,550	-	
• Net			
• Large commercial farmers	3,000	3,945	4,220 [u]
• Small farmers	2,000	-	-

	Targets (Prepared in 1979, Most Expected in 1983)	Accomplishments (1982)	Accomplishments (11/84 Unless Otherwise Indicated)
	(U.S. $1 ≈ J$1.30)	(U.S. $1 = J$1.78)	(U.S. $1.= J$4.71)
7. Fish Imports			
• Volume (lbs)	38,000,000 c/	-	-
• Value	U.S. $22,000,000 c/	J$29,000,000 v/	-
8. IFU Staff	160 d/	101 j/	115 q/
9. Training (Number of Participants)			
• Long-term	7 e/	6	8 p/
• Short-term			
• In US	15	7	2
• In-service for IFU Staff	27	20	25
• Farmers	920	450	60
10. Costs of Food Fish Production			
• Total (J$ lb)	0.58	1.00	2.39
• Price of Feed (J$/lb)	0.19	.28	.63
SELECTED INPUTS			
11. Technical Assistance			
• Long-term (Number)	3 f/	3	3
• Short-term (person mos)	12	9	12
• Peace Corps Volunteers (Number)	25	20	20

	Targets (Prepared in 1979, Most Expected in 1983)	Accomplishments (1982)	Accomplishments (11/84 Unless Otherwise Indicated)	
12. Vehicles (Numbers)			Delivered	Currently Running
• Pick-up trucks	20	]	9	7
• Flat bed trucks	2	]	2	1
• Passenger vehicles	5	] 17 k/	4	1
• Bulldozers	3	]	3	3
• Tractors	2	]	2	2
• Trail bikes	20	10	20	16 y/

Notes to Table 2

a Includes 5 additional acres at Twickenham Park, 5 acres at the Jamaica School of Agriculture, 60 acres at Mitchell Town, and 14 acres in the Western Region. These public facilities were to be used primarily to carry out research and training and to produce seed stock (fry and fingerlings).

b Small farmers were expected to have lower yields than large farmers.

c 1984 projections.

d Of which 36 professionals and 29 extension agents.

e 4 IFU staff, 2 faculty from the Jamaica School of Agriculture, and 1 from University of the West Indies.

f 90 person-months.

h Not including hobby farmers. In 1983, the target figure was revised to 600.

i Projected, not actual.

j Of which 15 were extension officers.

k No breakdown available.

m In 1983, the target figure was revised to 580.

n In 1983, the target figure was reduced to 1.323 million lbs.

o In 1983, the target figure was reduced to 2.3 million.

p Includes 1 undergraduate at Tuskegee University and 2 graduate students at Auburn University who have not yet completed their training.

q In 1983, the total was 125. The current total includes 13 extension officers.

r Extrapolated on the basis of January-October production of 394,582 pounds, reported by IFU. The private sector accounts for 86 percent of this production.

s Extrapolated on the basis of January-October production of 2.1 million, reported by IFU.

t Wholesale price.

u Average farmer (3 crops per year -- 15-week production cycle).

v From latest (1982) Department of Statistics trade data. Of the total, about J$13 million represent fish imports, competitive with Talapia.

w Includes 412 so-called subsistence and hobby farmers whose total pond acreage is 5. Thus, only 138 farmers are classified as commercial producers (see Table 3, Chapter Three).

x For a private commercial farm operating at full capacity. Based on extrapolations from the Auburn University final report. Auburn estimated that average private sector yields were 1,900 lbs. per acre per production cycle, whereas well-managed private sector yields were 2,200 lbs. per acre per cycle.

y But most are in the warehouse, not having been sold, as intended, to extension staff.

PROJECT ACCOMPLISHMENTS

The most salient accomplishment of the two projects is the successful transfer of aquaculture technology and skills, resulting in the establishment of an inland fish farming industry in Jamaica.

The transfer of technology was accomplished through a combination of training, technical assistance, and capital support. Before the first project began, there was little institutionalized knowledge of scientific freshwater fish farming in Jamaica. At present, thanks to the long- and short-term training and the technical assistance provided by Auburn University, a core group of several dozen Jamaican professionals and technicians carry out research, conduct training, or manage active aquaculture projects. The largest number of these trained staff is employed by IFU at one of the three facilities that were constructed with project money. The facilities at Twickenham Park, Mitchell Town, and Meylersfield, with some 100 acres of ponds, are well equipped to carry out research and provide most of the seed stock (fry and fingerling) used by private farmers in grow-out (food fish production) ponds. At present, 2.5 million fingerlings are produced annually for this purpose.

Of even greater importance is that Talapia production has been enthusiastically embraced by a large number of private farmers as well as by several public and private enterprises. As shown in Tables 1 and 2, food fish production, total pond acreage, and number of farmers engaged in Talapia farming are all well below target figures. What is important, however, is not accomplishments against targets, but the existence and vitality of the industry.[2]

What the evaluators observed in the field was a small, but relatively healthy and rapidly growing industry. Jamaican Talapia farmers are keenly interested in and know their subject

matter well. The farmers the evaluation team interviewed reported yields of at least 2,000 pounds per 15-week production cycle, which, given predation and other constraints, must be considered high. In addition, many new individuals, including large landowners, businessmen, and politicians, have requested assistance from IFU in establishing fish farms. In September 1984, IFU had a backlog of requests for 700 acres of ponds.

One reason for this interest is that inland fish farming in Jamaica is demonstrably profitable. The retail price of Talapia currently ranges between J$3.50 and J$4.00 per pound. Although this price is more than triple the amount at the beginning of the project, it is lower than the price of most fish imports, whose prices have skyrocketed with the deflation of the Jamaican dollar. The retail price is also competitive with most of the Jamaican marine catch. The costs of inland fish farming have, as shown in Table 2, risen faster than the price, but the annual net returns per acre are more than J$4,000. This represents a return of about 26 percent per year, which is above even the very high opportunity cost of capital in Jamaica.[3] This return is 2 percent higher than was calculated for fish farming in the IFD Project Paper and 3-4 percent higher than calculated in the FPSD Project Paper.

One objective of the two projects was to reduce Jamaica's foreign exchange outlays by substituting domestic fish production for some portion of fish imports. When IFD was designed, Jamaica was spending about $35 million per year on fish imports. The FPSD project aimed at reducing fish import expenditures to $22 million. In 1982, which is the last year for which external trade statistics are available, the fish import bill was the Jamaican dollar equivalent of about $29 million.[4] However, the 1982 fish import bill was much more expensive in terms of Jamaican dollars since the Jamaican currency underwent an effective 95 percent devaluation between 1976 and 1982.

It is difficult to pinpoint the factors that have contributed to the decrease in the foreign exchange outlays for fish. However, domestic Talapia production did not contribute significantly; the total value of Talapia production in 1982 was only J$391,000 (about $220,000), which is only 1.3 percent of the import bill. The most important factor contributing to the decrease in fish imports is the increased price, which is itself attributable in great part to the devaluation of the Jamaican dollar.

As shown in Tables 1 and 2, several IFD and FPSD accomplishments fell short of their targets. The rapid growth of the industry, moreover, has created structural problems in the areas of pricing, distribution, and marketing. In addition, the impact of the projects financed by AID and the Government of Jamaica has been significantly different in many ways than was anticipated. However, these observations, which will be elaborated on in Chapter Three, should not obscure the overall conclusion that the projects have, indeed, accomplished their principal objectives.

NOTES

1 Prices and dollar amounts are U.S. dollars, unless indicated by J$, meaning Jamaican dollars.

2 Experienced project managers know that targets in planning documents are almost always optimistic, written frequently for the consumption of higher levels of approval; once financing is secured, the planning document has served at least 90 percent of its usefulness. In free market, as opposed to centrally planned, economies, circumstances generally control projects rather than the other way around. The true test of implementation success is how well managers adapt to circumstances, not how well they doggedly pursue targets.

3 The prime lending rate is now about 22 percent in Jamaica.

4 Of this amount, about $13 million was spent for non-filleted fresh, dried or salted cod, or other types of fish that are competitive in price and in taste with Talapia.

CHAPTER THREE
PROJECT IMPACT AND DEVELOPMENTAL ISSUES

AID's assistance to the Government of Jamaica in the establishment of an inland fishing industry is, after two projects and seven years, coming to an end. What has been the impact of the two AID-financed projects? Has AID completed its work, or would further AID assistance be useful? What are the issues now confronting the industry, and what should be done about them? What lessons may be learned from the record of project design and implementation? The purpose of this chapter is to address these questions.

OVERALL IMPACT

The most important result of the two projects is that a vital and viable industry has been established in Jamaica. Talapia competes well on the domestic market with more traditional marine fish, and well-managed farms are able to produce and sell Talapia profitably.

The evaluation has uncovered five major issues, however, that are cause for concern:

- The principal beneficiaries of the two projects are large commercial enterprises, not small farmers.
- The production technology extended by the project, although effective, may eventually prove less profitable than the technology now used on at least two large farms.
- Adequate marketing and distribution channels are not in place to handle the volume of Talapia being produced.
- The projects may have inadvertently contributed to serious environmental problems involving saltwater intrusion and the supply of drinking water.

- The future vitality and growth of the industry are in jeopardy for two reasons:

  -- The projects have failed to provide Jamaica with an institutional capability to produce trained aquaculture professionals and technicians; and

  -- IFU, which is the industry's only resource for applied research, extension, training, information, and program coordination, is overworked, demoralized, and fearful for its future.

In addition to discussing these issues of immediate concern, this chapter comments on the effectiveness of the technical assistance received from Auburn University and the Peace Corps, and of the AID design and implementation process.

BENEFICIARY ANALYSIS

The intent of the original project, IFD, was that inland fishing in Jamaica be organized around the small farmer as the principal producer. According to the IFD Project Paper, "The ultimate project beneficiaries are intended to be the low income people of Jamaica and the strategy of the Inland Fisheries Division is to specifically direct its work to this group" (page 5). The low income group was defined as "the 31 percent of the labor force which earns less than J$520 annually," which, given an average household of 4.3 persons, translates into a per capita income of J$121. (In 1974, when IFD was designed, US$1 = J$.91.) The Project Paper also states that "the principal effort will be directed toward farmers with ponds averaging 1/4 acre" (page 17). In the Project Paper's social analysis, the target group is further described (page 27) as the 80 percent of Jamaica's farmers with fewer than 5 acres of land.

The 1984 profile of principal project beneficiaries differs from that sketched by the original project designers. Most of the island's Talapia production is now in the hands of public or private enterprises or of relatively wealthy individuals whose

primary income does not come from farming. The evidence supporting this finding is derived from an analysis of existing acreage and production data, the comments of IFU staff, and the evaluators' interviews with farmers.

Distribution of Pond Acreage

According to IFU data, there are currently 550 Talapia farmers in Jamaica, whose grow-out ponds cover 727 acres (see Table 3). Of this total, however, only 138 (25 percent) are commercial units in the sense that they have been established primarily as income-generating enterprises. The other 412 are so-called hobbyists or subsistence farmers. ("Hobbyists" are well-to-do individuals who have converted backyard water tanks or swimming pools into fishponds; "subsistence" farmers are those who raise fish mainly for home consumption.) The average acreage farmed by the hobbyists and subsistence farmers is microscopic; together these 412 individuals have only 5 acres in fishponds, or less than 1 percent of total fishpond acreage. Neither the hobbyists nor the subsistence farmers market their production, and none of these farmers currently receives assistance from IFU.

The three largest farms in Jamaica are corporate entities whose combined pond acreage is 212, or 29 percent of total commercial pond acreage. The remaining 135 farms are owned by private individuals, and many of the farms are large. As shown in Table 3, only 34 commercial farms are smaller than 1 acre (which comes closest to fitting the profile established in the IFD Project Paper). The largest number of farms (76) is in the 1- to 5-acre range. However, 353 acres, which is nearly one-half the total fishpond acreage in Jamaica, is held by 7 (5 percent) of the 138 commercial farm owners.

TABLE 3

FISH FARMS IN JAMAICA, 1984

NUMBER OF FARMS BY POND ACREAGE

	Number of Farms		Acreage	
Commercial Farms				
From 21 to 98 acres	1		98	
	1		59	
	1		55	
	1		52	
	1		31	
	1		30	
	1		28	
Subtotal		7 (5%)		353 (49%)
From 0.1 to 20 acres	3		15-20	
	6		10-15	
	12		5-9.9	
	76		1-4.9	
	34		0.1-0.9	
Subtotal		131 (95%)		369 (51%)
TOTAL COMMERCIAL FARMS		138		722
Non-Commercial Farmers[a]	412		0.1[b]	
Subtotal		412		5
TOTAL OF BOTH COMMERCIAL AND NON-COMMERCIAL		550		727

a These are the so-called subsistence or hobby farmers.

b Average pond acreage.

Profile of Farms Visited

The evaluators visited nine farms producing Talapia. Each farm is briefly described below.

Urban Development Corporation Farm (UDC). This is the largest fish farm in Jamaica. It comprises 98 pond acres, 70 of which are for food fish production. Its productivity is reportedly 2,500 pounds per acre per 15-week cycle. The farm manager reported that he would have 80,000 pounds ready for harvest by January and was worried about being able to market all of it. UDC is a state-owned enterprise.

Aqualapia Jamaica, Ltd. Aqualapia is one of several joint ventures between Israeli investors and the Jamaican government. This farm is reportedly owned about 60 percent by the National Investment Bank of Jamaica (NIBJ), a state-owned enterprise, and 40 percent by the Israeli investors who also have a contract to manage the farm. Although Aqualapia is owned primarily by the Jamaican government, it is secretive about its production technology and production data. According to IFU reports, 59 acres are used for Talapia production. This is consistent with the information provided by one staff member that 130,000 pounds are now in ponds. Aqualapia's use of hybrid seed stock, aerators that reportedly cost $ 1,200 each, and other advanced technology could increase productivity to more than 10,000 pounds per acre. Most of Aqualapia's production is reportedly destined for export -- 2,200 pounds have already been shipped to the United States -- but could easily be diverted to the domestic market if the firm's high capital costs are not prohibitive. Aqualapia reportedly has plans to expand its pond production to as many as 400 acres, although the shortage of water in the area might limit these plans.

Aquaculture Jamaica, Ltd. Located in St. Elizabeth's Parish near Lacovia, this farm combines shrimp and Talapia farming on 55 pond acres. The facility includes a processing assembly line where the 0.75- to 1-pound Talapia are scaled, gutted, and packaged for domestic sale. Aquaculture Jamaica, Ltd. is wholly owned by Jamaica Broilers, Ltd., a conglomerate that owns and operates nine companies in Jamaica, including poultry plants and feed mills. The Aquaculture Jamaica, Ltd. farm manager was previously the Regional Extension Officer for the East at IFU.

Private farm near UDC. The total pond acreage at this farm is 30, of which about 20 are for food fish production. The farm is managed by two men who were previously employed by IFU. The owner is a Kingston businessman who reportedly owns or directs businesses worth several million dollars.

Private Farm. This farm comprises 4.5 acres of production ponds. Productivity is estimated at 2,000-3,000 pounds per cycle. The owner lives on the land, but does no other farming. He is in the trucking business and owns a pick-up truck and two dump trucks for hauling construction material.

Private Farm. The entire farm is 50 acres and is mainly in cattle. Five acres have been converted to Talapia production. The owner is a retired school teacher who lives on the land.

Private Farm. This farm has 7 acres in Talapia and many more acres in cattle. Productivity is about 2,000 pounds per cycle. The owner is a businessman in Old Harbour, where he owns several buildings, operates businesses in two of them, and rents out the rest. One business is used partially to retail his own fish, which he sells live from a specially built tank.

Private Farmer. This entire farm is 10-15 acres, on which the farmer raises cattle, pigs, and chickens. About 1.5 acres are used to produce Talapia. This farmer had the smallest and

poorest farm that evaluators saw, although the house in which the farmer lives is modern and has at least 3,000 square feet.

Private Farmer near Bog Walk. The entire property is 5 acres, of which 1.4 acres are in Talapia and the rest mainly in citrus, chickens, and flowers. Talapia production is about 2,000 pounds per cycle. The owner, who employs three men full time on the farm, has a full-time job in Kingston as a surveyor. He lives on the property in a large modern house and owns a Dodge van. He said that his neighbor has a 5-acre farm across the road, 3 of which are in Talapia. The neighbor is actually a businessman who lives in Spanish Town and operates a bus service; he has two full-time employees who manage the farm.

These nine farms were not chosen randomly so one cannot be sure to what extent they are representative. (The evaluators asked several times to see one or two subsistence farmers, but were told they lived too far away in the hills.) But it is clear that even the smaller units that the evaluation team visited do not fit the designers' profile of the poor farmer with 0.25 acre in Talapia. The owners of five of the six individually owned farms were, in fact, not primarily farmers at all but businessmen or professionals for whom fish farming was just one of several business enterprises in which they were engaged.

Share of Market by Large Farms

IFU does not keep data on annual production by individual farms or by size of farm. However, an analysis of the aggregate data kept by IFU led to a prima facie conclusion that nearly all of the commercial production in Jamaica now comes from a few very large farms. The analysis also revealed either that the data are not reliable or that farms are not as well managed as believed, or both; but, even admitting a very large error factor, the conclusion that large farms dominate the market still stands.

The aggregate data are as follows:

- 1984 food fish production = 473,500 pounds;[1]
- Annual production per acre on a well-managed farm = 6,900 pounds;[2]
- Acreage of three large farms:
  - -- UDC farm: 98 acres of which 70 are production ponds.
  - -- Large private farm: 52 acres of which perhaps 35 acres are in production ponds.
  - -- Large private farm in St. Catherine's Parish: 30 acres of which about 20 acres are in production ponds.

If these three farms operate at full capacity, they should, with a total of 125 acres in grow-out ponds, produce 862,500 pounds of fish per year, which is nearly twice the 473,500 pounds of annual production reported by IFU for the whole country. Even if these farms are getting only two harvests per year (that is, operating at about two-thirds capacity), they should produce 575,000 pounds per year, which is still more than the reported country-wide annual production.

It is possible, of course, that the aggregate production and yield data are highly inaccurate. Auburn University, in the final report of its technical assistance team, estimated that 1984 production would reach 604,000 pounds.[3] Auburn also estimated that well-managed commerical ponds were producing 7,800 pounds per acre per year of food fish.[4] If this higher yield figure is used and if the three large farms mentioned above operate at full capacity, their combined annual production should reach 975,000 pounds, which is 61 percent higher than Auburn's own estimate of annual production for the entire country.

In the extreme case that, even on a well-managed farm, actual yields are only one- half as high as reported yields and that these farms operate only at two-thirds capacity, annual

production per acre would be only 2,300 pounds (6,900/2 x 0.67). How many production acres would it take at this yield and at this partial capacity to attain the annual production of 473,500 reported by IFU? The answer is 206 (473,500/2,300), which is less than the number of production acres of the five largest farms, assuming that one-third of their acreage is in brood and nursery ponds (see Table 3). Thus, even if the annual yield data are highly overestimated, it is apparent that the vast majority of Talapia production comes from large farming units.

An analysis of the current situation indicates that the dominance of the large farms is likely to increase. According to the latest IFU project update, IFU has a backlog of request for the construction of 700 pond acres, which "consists of many requests for construction of 5-15 acre fish farms and a number of requests for farms 100 acres and over" (page 5).[5]

The Change from Small to Big

The evolution of IFD and FPSD from projects aimed at working primarily through small farmers to projects in which the principal actors are large comercial enterprises is not easy to trace. It is difficult to know whether a deliberate decision to change strategies was made or whether project personnel were simply swept along by market and socio-political forces. Project planners, however, were aware that this change was taking place.

When FPSD was designed in 1979, it was already anticipated that a larger amount of production would come from large farms. Of the 1,280 farmers projected to participate in FPSD, 1,020 (80 percent) were to retain the profile set forth in the IFD Project Paper, but 260 (20 percent) were to be medium to large farms. However, large farms were expected to consist of government farms or cooperatives comprising small or landless rural inhabitants. Even large individual fish farms were supposed to be modest in absolute terms with an average of 30 acres of land of which only 3 acres would be in fishponds.[6]

It is apparent from the large numbers of very small farmers that still exist that in the beginning the projects did expend a great deal of effort in reaching the small farmer. But beginning with the second project, and particularly after 1981, IFU concentrated more of its resources on large production units. The very small farmers are now virtually irrelevant to the inland fishing industry. One reason for this is that the Jamaican government itself is now, through its ownership and operation of the two largest fish farms in the country, in direct competition for markets with the original target group.

There are probably two major reasons that the change occurred. The first involves the distribution and marketing advantage of large entities in an aquaculture industry. With respect to production, large size does not necessarily confer important economies of scale. In Talapia farming, fixed costs are less than 20 percent of total costs even for 1 acre; most costs, such as of water (if purchased), fuel for pumps, seed stock, feed, fertilizer, and labor, vary directly with the size of the farm. Start-up costs, such as pond excavation and equipment purchase, can be high, but also vary with the size of the operation, and both projects provided for loan schemes that favored the small farmer in offsetting those costs. The real advantage of size comes from the economies of distribution. Large farms are more likely than small farms to have their own trucks. Because they have more frequent harvests, they are also able to guarantee a more regular supply to a buyer.

In addition to these natural market forces, it is likely that the shift in emphasis from the small farmer to large operations can be partially explained by shifts in government policy. Between the time that the first project was designed and the second project started, the Governments of Jamaica and the United States changed leadership. Reacting to adverse economic conditions, the new governments of both countries probably placed

more emphasis on production and growth and relatively less on the distribution of benefits. The FY 1985 Jamaica Country Development Strategy Statement, for example, states:

> While this analysis indicates that there are major basic human needs unmet, and several glaring areas of inequity, macroeconomic data supports the more basic postulate that the economic pie is so small that sharing it more equitably will not appreciably improve the lot of those most disadvantaged. (page 31-32)

With waning policy support after 1980 from AID and the Jamaican government to pursue a small farmer production strategy, and with greater empahsis placed on increasing production, it was not difficult for IFU and its expatriate advisers to focus on increasing production in big lots. It is easier to conduct extension work with a small number of large farmers than with a large number of small farmers. For IFU, the path of least resistance was to assign its resources to the large farmer.

EFFECTIVENESS OF THE PRODUCTION TECHNOLOGY

The technology put in place by the technical assistance team from Auburn University and currently extended by IFU is known as the monosex technology, in which male and female fingerlings are separated by hand with only males introduced into grow-out ponds. This basic technology has been adequate to satisfy market needs in Jamacia. Current production has at least momentarily outstripped the ability of existing distribution channels to handle it; IFU reports that by January 1985 there will be 300,000 pounds of mature Talapia ready for market.

Alternative Technologies

There are, however, alternative technologies now being used and others being considered for use in Jamaica. These technologies have a real potential to disrupt and possibly

replace the currently used monosex fingerling system. These alternatives -- hybridization, sex reversal through hormone use, and high density culture -- are designed to produce a nearly 100-percent male progeny, which could eliminate waste of female finglerlings, promote extra growth (hybrid vigor), and reduce labor expense in sexing. Other possible advantages would be the ability to grow fish to a large and potentially more saleable size without worry of undetected females reaching sexual maturity and spawning, which reduces overall growth and uniformity of size at harvest. Use of hormones and triple cross hybridization produces all male colored (pink to red) fry that more clearly resemble the high-priced marine snapper.

Should the alternative technologies become capable of producing large volumes of nearly 100 percent male fingerlings and of selling them to the smaller farmer, they could create a monopoly and dictate both production and marketing. It is hoped that there would be enough competition between large producers for this fingerling trade to prevent monopoly, but nothing is guaranteed.

At present, it is not possible to predict which technology will utlimately prevail in Jamaica. Fish culture is an inexact science, and much of its progress depends on the flexibility of the producer to change technologies in a relatively short time. It is possible that the different technologies may survive side by side, with each adapted to a different type of producer or market.

For the Jamaican government, the key is to maintain a research capacity that permits continual testing of different technologies and rapid adaptation. With results as impressive as they have been in the few years of Tilapia culture in Jamaica, it would be regrettable to change only because results of an alternative technology have been spectacular in other countries. It would be equally regrettable to assume that there will never be a need to change. Jamaica has committed itself to a

leadership role in warm water fish production both for domestic use and for export. For this reason, the government must remain fully aware of new technology and stand ready to change on short notice.

IFU and its advisers have been correct in establishing an active research program. As the government role in supplying seed stock decreases, it should be replaced by an even more active research and support role. Outside direction in this area is needed. Plans to divest some facilities should be reconsidered if some irreplaceable applied research function might be lost.

Problems with the Current Technology

With respect to the current technology, the team's site visits revealed some problems. These are discussed below.

Fish Mortality and Predators

It was observed that large numbers of fish-eating birds are attracted to the Tilapia ponds. A data check showed that in the two IFU fingerling farms the loss from fry to fingerling is 9 or 10 to each survivor. The chronoic shortage of fingerlings would indicate that studies should be carried out to determine true mortality from birds. These studies might include mesh netting along the sides of the ponds versus no netting, and deepening pond edges after each draining versus no deepening. Control of predators can be expensive and labor-intensive, but the predation mortality appears considerable. These particular bird species require a very high food intake, and their presence in large numbers is meaningful. In addition to birds, other predators such as crocodiles are reported to congregate in rearing ponds.

Ponds of Inappropriate Size

At one government and one private facility, single ponds of approximately 10 surface acres were observed. At a government demonstration site, these ponds should have a more modest size. This would have put underutilized (almost unworkable) units into better production. Equally important would be a credibility factor when demonstrating proper construction to potential farmers. Ponds too deep for Tilapia culture should also have been modified unless the station in question is used for research and testing of other species requiring deeper ponds.

Feeding Methods and Feed

At several sites, it was apparent that a great deal of feed was wasted through careless feeding methods. At one large facility, feed was shoveled into the ponds in such a way that much of it could not have been recovered by the fish. Feed-to-fish conversion records that the team examined were so uniform as to be suspect about good record keeping.

Many farmers also appear to feed only one or two size of feed to all sizes of fish. Obviously, this is wasteful. With the amount of feed now used in Jamaica, the feed mills certainly can use more dies to produce a broader range of pellet size. The cost of feed causes much concern to farmers. Better use of the commodity is one way to reduce production costs.

Research in this entire area of fish feed production and utilization, and in fish nutrition, could pay immediate dividends. As an example, demand feeders, which cost very little to make, could have a potential use in both fingerling and production ponds.

SHRIMP, OYSTER, AND FIN FISH POLYCULTURE

The evaluation team was asked to assess IFU's capability to perform research needed to ascertain the potential for shrimp and oyster culture as well as polyculture using various fin fish and shellfish species. This request coincides with a recent decision by MOA to upgrade IFU to a Department of Aquaculture, thus recognizing the role that IFU has played and will continue to play in both mariculture and freshwater fish and shellfish production. The team made site evaluations at Bowden in St. Thomas Parish for mangrove oysters; at the Aquaculture Jamaica, Ltd. farm of Jamaica Broilers, Ltd. in west central Jamaica; and at the Aqualapia Jamaica, Ltd. farm, which is now in the start-up and research phase of polyculture.

The team found that IFU technical and administrative personnel are knowledgeable in shellfish culture and have used innovative technology to expand their program, especially in oyster culture at Bowden. One example is the use of scrap tires from a local tire factory for spat collection. There was no evidence that IFU had incorporated a recommendation to use a tray system of culture made by an Auburn University adviser in May 1983 in place of the tire system, but a recent research study showing a heavy spat set on cement-coated tire pieces indicates that IFU personnel are capable of initiating and directing applied research programs. A cage culture test of Tilapia is scheduled to start in mid-November 1984, based on technology currently in use in commercial Tilapia culture in Japan and other Asian countries.

The IFU staff is greatly concerned about a program to dredge a docking area for banana boats near their research farm. The actual dredging, plus the pollution potential from ships and banana washing, poses a serious threat and suggests a need for an environmental impact analysis. This oyster project is supported not by AID but by Canadian grants. It does, however, demonstrate

the capability of IFU administrative staff to integrate technologies generated in an inland freshwater program in Tilapia into a polyculture system.

The development of the giant freshwater prawn (Macro-brahium rosenbergi) and hybrid Tilapia polyculture system has occurred almost entirely in the private sector, mainly at the Aquaculture Jamaica, Ltd. farm. The contribution of IFU, however, has been significant in pond design and construction and in supplying senior-level staff. The technical operations manager is a former regional extension officer who gained skills and background from the IFD and FPSD programs. His ability to manage efficiently a large production facility that is now viable is additional proof of the ability of IFU to perform research and ascertain the potentials of the more exotic shellfish and polyculture programs. It is possible that the prawn/Tilapia system can be expanded into a highly compatible and profitable program.

IFU has also been involved in some research and development using the small Brazilian freshwater shrimp. The team did not inspect this technology, but prospects for its exanded use are reportedly not great. A program for mariculture of marine shrimp is being considered but apparently remains in the distant future.

A positive factor concerning shellfish research and production is the obvious interest of the faculty of the University of West Indies (UWI) Zoology Department in marine ecology and mariculture. There is a good working relationship between IFU staff and the university in these areas, and it is probable that a training and research support role would be greater in marine-related programs than it would be in freshwater aquaculture.

MARKETING AND DISTRIBUTION

The evaluation team found that fish distribution and marketing have recently become a serious problem. The problem extends from the small farmer through the large corporate producer. Nearly every farmer visited pointed to harvest-ready ponds with few interested buyers in sight.

The Problem

Neither IFU nor FPSD allocated any resources to the distribution and marketing of Talapia. The reasons for this appear to be twofold. First, a sufficient domestic market was assumed to exist by virtue of the large volume of fish imports ($35 million in 1976). Second, it was assumed that distribution and marketing would be handled by the Agriculture Marketing Corporation (AMC), a state enterprise that was responsible for the marketing of many agricultural commodities.

In hindsight, these assumptions, although logical at the time, have proved at least partially unsound. Fish imports, as well as the domestic marine catch, are extremely varied, ranging from expensive salmon to relatively inexpensive cod. Fish also enter in varied states of processing, including scaled gutted, filleted, fresh, smoked, dried, and canned. Jamaican Talapia, in contrast, is sold almost entirely fresh and unprocessed. No systematic surveys or market tests were scheduled by the projects or have otherwise been carried out to determine the extent to which fresh, unprocessed Talapia competes with this variety of imports. In addition, AMC was liquidated after the 1980 elections.

The projects have been aware of the marketing and distribution problem. The 1982 mid-project evaluation discussed it, and at least one report made suggestions about how to study and potentially resolve the problem.[7] During project

implementation, IFU staff also learned that the traditional small-scale middlepersons -- "higglers" -- who distribute much of the marine production into rural and market places -- would nct function in the same fashion for freshwater farmers. Tilapia farmers are generally unwilling to sell their product on the consignment arrangement to which the higgler is accustomed. However, until very recently, action to resolve the marketing problem has been delayed or avoided. In the meantime, the Prime Minister's office, through Agro 21, continues to encourage more farmers to become involved in Talapia production.[8]

Another problem is that no market studies have been conducted in the export sector, where the demand and import entry price are far more fickle and risky. Worldwide fish marketing is a tightly controlled industry, subject to a variety of export and import regulations. Should the export market not develop as rapidly as production on the large corporate farms, the large Tilapia exporter who is vertically integrated with infrastructure from production through marketing will have to sell even more fish on the domestic market.

Response to the Problem

Some actions to deal with the marketing crisis have recently been taken. A group of small and medium growers have decided to form a marketing association and are considering cooperation with large corporations that have the infrastructure needed for advertising, display, and marketing as well as distribution systems that are in place. Initiative in this area is being considered jointly by IFU personnel and Agro 21.

IFU has also pledged to activate and enlarge the farmers' market at Twickenham Park. However, this action will tie up government pesonnel and facilities, which are not in oversupply. The Twickenham Park market was not meant to be more than a

temporary facility, and its location away from a large population center cannot be expected to attract sales of the magnitude needed for immediate relief.

Independent entrepreneurs have also started to use innovative methods to market their own fish. Examples include tank sales from meat markets and portable wagons in urban areas. However, most farmers still harvest and sell from their own ponds. The innovative outlets may eventually move a relatively large poundage of Tilapia, but this will take considerable time to evolve. Even as these outlets expand the markets, more ponds are surveyed, constructed, planted, and harvested.

It is likely that existing distributors will eventually begin to market Talapia in larger quantities, but it is unclear how soon this will happen. The large distributors are already in close contact with Agro 21 and with large producers, but also understand the technical constraints to bringing Tilapia of the right size and the right form from the pond into the limited spaces on their meat counters. Shelf space in any marketing facility is limited and is allocated only after it is determined, during extended sales studies, how well a product sells. A firm such as Grace Kennedy that imports large quantities of frozen marine fish will not likely yield space of a popular species such as snapper or grouper unless equal or greater profit can accrue from Tilapia. In the meantime, the staying power of the small farmer will be greatly taxed.

Fish Processing and Handling

One report written under the auspices of Auburn University concluded that new outlets or marketing schemes depend greatly on an expanded source of ice.[9] However, in a warm climate such as Jamaica's, the movement and sale of iced fish may be too expensive. As electricity costs mount, as they have recently,

the added cost could make Tilapia less competitive. This suggestion of using ice should be re-evaluated to determine the real costs.

The alternative is to consider other food-processing technologies. Salt fish is readily accepted in Jamaica, and Tilapia can be salted or dried. Canning is expensive, and initial tests on canned Tilapia (primarily soup-fish-size females) were not effective. Canning of larger sizes as fish-based products might be considered. It would appear that retort pouch technology might have a good potential because of its lower costs and the variety of forms in which the fish might be prepared and sold. Retort pouches have the added advantage of providing long-term storage without the space problem of cans. Extrusion products using fish and a grain or vegetable product should also be tried. Examples include Tilapia and rice or Tilapia and cassava.

It should not be assumed that delivery will automatically follow the market. For example, fresh fish will travel only short distances and for a short time unless delivery is in water or ice. Extruded, salted and dried, canned, or retorted products can be distributed by common carrier over long distances and less expensively. Long-term storage is cheap. These very simple factors should be considered along with cultural, social, and economic realities of product acceptance as the marketing strategy evolves.

The monosex production technology generally produces smaller fish (0.5 pound) than do hybrid or sex reversal technologies (0.75-1 pound minimum). There is good evidence to suggest that only the larger fish will be accepted into the export market and much of the restaurant and supermarket trade. The small to medium farmer can obtain a large size by holding his fish longer, but only at the risk of unsorted females reproducing. The mixed size harvest that would result from reproduction in ponds will be

less attractive to the large processor who can buy more uniform-sized fish from the large corporate farms that use hybrid or sex-reversed technology.

TECHNICAL ASSISTANCE

Auburn University

Auburn University has a well-deserved reputation as a leading U.S. university in providing technical assistance to warm-water fishing projects. The university's accomplishments in Jamaica have not diminished that reputation.

Auburn's most important achievement was in the transfer of scientific aquaculture technology to IFU and to farmers. Culture techniques involving brood ponds, nursery ponds, and grow-out ponds were first tested at the Auburn experiment station site, and then taught to IFU personnel both in Jamaica and at Auburn. The Auburn team also recognized that a different species (T. nilotica rather than T. mossambica) would result in better consumer acceptance and greater production potential from faster growth, older reproduction age, and more usable flesh.

The Auburn team was instrumental in developing fish extension services independently from the MOA Extension Service. The team correctly assessed that the rapid evaluation of fish farming required farmer consultation with more specialized agents.

Sites selected and rejected show evidence of a staff well trained in recognition of water and soil relationships and land use constraints. Ponds were well designed and constructed, with the exception of a few ponds that were too large or too deep. These designs were apparently produced by an Auburn specialist more familiar with catfish than with Tilapia farming.

The Auburn team also recognized the importance of an adequate diet for Tilapia, and the extension branch was instrumental in convincing feed mills to produce a suitable Tilapia feed formula. A question, however, should be raised concerning why an alternative, lower cost diet was not formulated or at least a list of local ingredients produced. At present, many Tilapia feed components are imported and costs have continued to rise. This is one factor contributing to the current market glut, since farmers claim they cannot sell at lower prices and still provide feed at the recommended daily level. Advisers should have anticipated this potential problem.

The technical assistance advisory team assumed, as did most Jamaican government agencies, that the demand for fresh fish in Jamaica would exceed Tilapia production potential, thus allowing technical assistance for marketing and fish handling to be scheduled near the end of the project when large farm production would be on line and export markets might be considered. This was an error.

Intensive market investigations should have been introduced at the same time as the IFD study on production potential. There should also have been some measure taken concerning where or when buyer resistance appears. Alternative solutions should have been established to provide market outlets other than the traditional schemes that were based on marine products. A food technology specialist should have been assigned very early in the project to examine alternative ways that freshwater fish might be prepared and delivered into the market. The report on strategies for marketing states that "there is neither a set of goals for the marketing group nor a methodology to conduct market development for Tilapia."[10] Very little has been done since that report, and the marketing and distribution problem is increasing.

Peace Corps

The initial IFD project report proposed that Peace Corps volunteers (PCV) be used to extend fish farming technology to small farmers. PCV were active until late 1982 when they were withdrawn from the project.

The earliest PCV were not always well grounded in aquaculture techniques. Even though later arrivals were better trained, their role diminished as the thrust of the project moved toward the large farmer with more ponds. Since there is a growing gap in the availability of services for the small farmers, perhaps a redefined role for PCV could be of value. The traditional role of the PCV in developing countries is to live and work in rural environments. PCV could assume responsibility for raising fish in small ponds and for harvesting, preparing, and preserving the fish for local consumption. This use of PCV would free IFU staff of time-consuming tasks and could help move the project back toward reaching its target population.

TRAINING

The project's training program for extension staff and farmers has worked well. The quality of training, the facilities at Twickenham Park, and the follow-through support program are all appropriate and functional. Interviews with farmers who have attended the training schools indicate that they understand the basic technology that was presented. They have used the training to increase their own production and have shared ideas with neighbors and fellow fish farmers. The training provided at Auburn University, for senior IFU staff, has also been excellent.

However, there now exists a problem related to the continuation of training for extension officers and specialized senior IFU staff. IFU suffers from a high attrition rate of senior-level staff. This problem should not have been unexpected

because the rapidly growing private sector had no real choice other than to hire away these personnel. The movement of personnel from the public to the private sector may be seen as positive, provided a replacement pool for the public sector is available.

The FPSD design anticipated that the continuation of training would be provided through the Jamaica School of Agriculture (JSA) and UWI. It was further assumed that participants for long- and short-term foreign training would return to positions with IFU and that PCV would be available along with Jamaican government experts from supportive disciplines.

These assumptions were erroneous. JSA was closed down in mid-project.[11] The Jose Marti Secondary School has provided some training, but it is not adequate. Courses promised by UWI are not available, with the exception of a six-week overview of aquaculture for senior students. One staff member trained in the United States refused to return to IFU, and delays in foreign training have resulted in the few additional personnel still in the United States not returning to Jamaica until 1985. Confusion about the value and role of PCV led to their withdrawal in 1982.

JSA has started up again; it is now called the Jamaica College of Agriculture, but there is no current provision for extensive training in aquaculture. One or two courses are being considered, but no criteria have been established for staff qualifications.

The situation at UWI appears equally bleak. There is some interest in aquaculture, but the two faculty members most qualified to teach are overworked now and profess stronger interest in marine or freshwater ecology. UWI could offer guidance to graduate students as it has done in the past, but the production level would be low. Excellent training is available

in the United States (Auburn University, etc.), but Jamaica has no foreign exchange to send students abroad now that AID support is being withdrawn.

Some suggestions for short- and long-term solutions to this training problem are discussed below.

Short-term

- Identify personnel within IFU (and possibly Agro 21) who are effective educators and attempt to have them establish seminars or training programs designed to review current world literature, research results at Twickenham Park; Aqualapia Jamaica, Ltd.; and Aquaculture Jamaica, Ltd. Students could be identified at UWI or good secondary schools who have an interest in or aptitude for biological science, especially aquaculture.

- Make every effort to contact and convince the people responsible for reorganizing JSA to include a broader sector than only one or two courses in Aquaculture. Offer to provide some temporary teaching assistance and perhaps research demonstrations at Twickenham Park if needed.

- Exploit the interest of UWI faculty in marine science to offer training that would enhance the abilities of undergraduates who might consider a technical career in oyster farming, shrimp culture, or polyculture. This area has great potential for growth in Jamaica.

Long-Term

- Use every effort to convince the business and government sectors that the continued growth of aquaculture is dependent on a continuing supply of college-trained people. Perhaps Agro 21 could help identify support for scholarships or additional faculty at either JSA or UWI. University administrators should be reminded that tuition-supported students can be attracted from other Caribbean countries if a good program is in place. Pressure should move from the top level down to the department.

- Although in-country university training is preferable, support for foreign training is available and should be sought. This is especially important in speciality areas that might be needed as aquaculture becomes more sophisticated. Examples might be in fish processing and handling, food technology, nutrition, and marketing of fish products.

Should efforts fail to stimulate university-level training in a reasonable time, trade schools might be developed. Industry is frequently more interested in this level of support, and certainly aquaculture could be identified as a growing trade area in Jamaica. The type of training infrastructure is not as important at this stage as is the need to have some continuation of the ongoing program.

Although the technical assistance team identified production training needs early enough in the project to schedule both domestic and foreign training to coincide with production growth, it did not anticipate a need for training a replacement for the single marketing specialist in the organizational hierarchy. The void left by the move of this individual to the private sector could account for some of the failure to anticipate the current marketing problem.

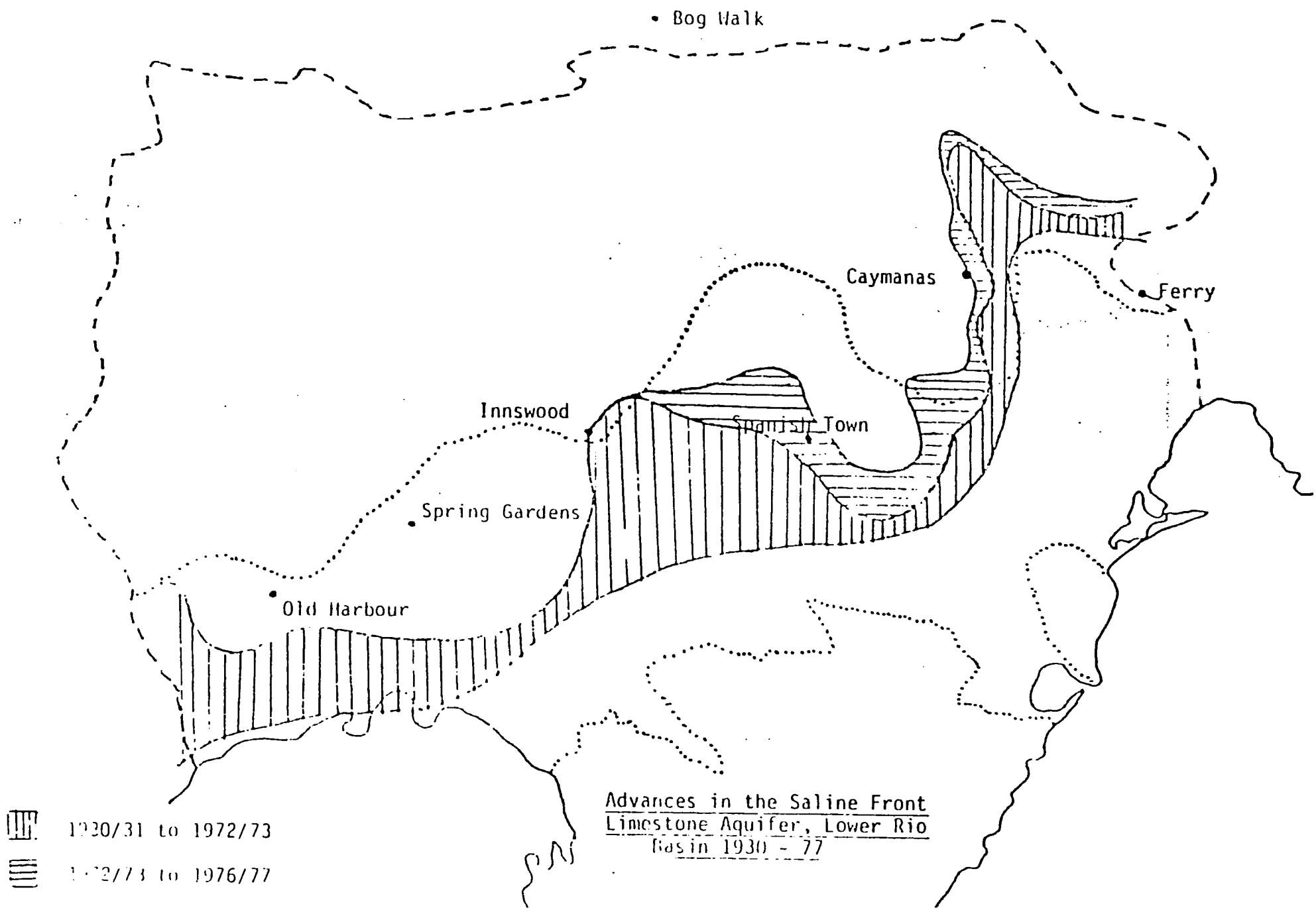
ENVIRONMENTAL CONCERNS

In the FPSD Project Paper, mention is made of an initial environmental examination that received a negative determination on June 25, 1979. Although the evaluation team could not locate any data directly associating fish farming with environmental damage, there are some real areas of concern. It is appropriate that these concerns be addressed now when Jamaican government officials at the highest level are expressing views in the media about the importance of environmental integrity.

The initial IFD project indicated that land areas to be used in the FPSD follow-up project were marginally productive as underutilized areas and were to be small in size. Most would be located inland. As the program expanded and potential profits were visualized from large operations, Tilapia farms began to occupy land closer to the ocean, often in swampy or saline zones. Today's ponds are typically very shallow (3-5 feet) in relation to surface area and are constructed in tightly compacted units. Water resources are variable, but many larger farms pump from irrigation canals. At present, no well pumping is allowed in these sectors because of a very real problem of saline intrusion, which would be accelerated, and of the fear of contaminating deep freshwater wells used for drinking. The map on the following page shows saltwater intrusion inland to and beyond Spanish Town, demonstrating how this is taking place and how acute the problem has become.

Although evaporative loss is not great in a humid climate such as Jamaica's, it is nevertheless a potential problem. A request for data on annual loss from a typical large operation could not be met, but an estimate of as much as 1.5 feet of surface water per acre per growing cycle was given. Thus, an acre of shallow pond used three times per year would actually need more than one extra filling just to meet the loss. In high density culture where high speed paddles are used throwing the water into the air, and 10-15 percent of the water is typically drained and replaced periodically to eliminate concentrated waste, the amount of water needed is greatly increased.

Although water is drained into a holding ditch as the fish are harvested, and then reused, it has the potential of becoming more saline as it is reused. In many parts of the world where high density culture is practiced, the water is brackish, and Tilapia are known to thrive in this environment. A recommendation has been made by a technical adviser to fund the sinking of a saline well at Mitchell Town for evaluation and


Bog Walk
Caymanas
Ferry
Innswood
Spanish Town
Spring Gardens
Old Harbour
1930/31 to 1972/73
1972/73 to 1976/77
Advances in the Saline Front
Limestone Aquifer, Lower Rio
Basin 1930 - 77

demonstration of brackish-water farming. Should this take place and prove successful in increasing production, it is probable that other large farmers, especially those planning farms of several hundred acres, will request permission to sink saline wells. The project evaluators strongly suggest that an environmental assessment be made of existing impacts of Tilapia farms on water quality and loss before other schemes such as saline wells are permitted. Construction of ponds in areas with very high saline water tables poses a problem since evaporative loss there could have an effect similar to well pumping.

Another environmental concern regards the concentration of protected birds in areas of fish farms. A study is now under way to determine the extent to which these birds are responsible for mortality and economic loss. If predation is a serious problem as is the case in most areas of the world, and which the evaluators strongly suspect is the case in Jamaica, farmers will inevitably take measures to control the loss. The ongoing research may help prevent a confrontation between farmers and conservationists and is therefore appropriate and important.

Although AID-sponsored projects in aquaculture do not include the IFU projects in marine oyster culture, comments have been solicited. The oyster culture research station at Bowden is in immediate danger of being polluted by a banana-boat docking facility. It is hoped that environmental awareness will extend to this project and that a damage assessment will be made before any construction starts.

INSTITUTIONAL FRAMEWORK AND PROJECT CONTINUATION

As the principal implementing agency for IFD and FPSD, IFU has done an excellent job. The senior staff at IFU are capable, well trained, dedicated, and hard working. One of the projects' most positive achievements is that IFU, with its three facilities at Twickenham Park, Mitchell Town, and Meylersfield, has developed, and now manifests, an institutionalized capability to

carry out the research, extension, and seed stock production that is necessary for the support and growth of an inland fishing industry in Jamaica. The development of this capability has been facilitated by the solid policy and financial support for IFU from AID and the Jamaican government throughout the life of the two projects.

IFU is now, however, in a period of transition. First, IFU is rapidly losing staff to the private sector or, in one case, to Agro 21. Ten staff (six professional and technical and four laborers) have left IFU over the last year, reducing total staff from 125 to 115, well below the 160 considered optimal by project designers. A government hiring freeze has made it difficult to replace these staff even if qualified candidates were available.

Second, AID funding is being withdrawn, one consequence which is that IFU will lose its special project status, which will lead to an effective 25-percent pay cut for most staff. A recent decision by MOA to elevate IFU to departmental status reflects continued government support for inland fisheries and increases job security for most project staff, but this is scant compensation for the pecuniary losses most IFU staff will have to bear.

Third, IFU has recently found itself in a confusing situation of conflicting roles and responsibilities with Agro 21 and with certain elements of the private sector. Agro 21 has effectively assumed responsibility for the promotion of new fish farms in the medium- to large-scale categories, particularly those involving foreign investment or foreign markets. Applied research on Tilapia production is carried out at Aqualapia Jamaica, Ltd., which is reluctant to share its information with IFU even though Aqualapia is mainly a state-owned enterprise that received technical assistance in pond design and construction from IFU. Recommendations have also been made that some or all

of IFU's functions should be transferred to the private sector. All of these circumstances have left the IFU staff confused, demoralized, and uncertain about the future of their institution.

It is the evaluators' judgment that some IFU functions should be transferred to the private sector, but that divestment should proceed within a solid and coherent policy framework. The most likely candidate for divestment is the brood and nursery pond facility at Mitchell Town. In a mature inland fishing industry, fry and fingerling production should become a specialized domain within the private sector, just as chick hatcheries are in the poultry industry.

The inland fisheries industry in Jamaica, however, is not mature. It is now barely reaching adolescence and is suffering the growing pains of uncertainties about technology and unarticulated markets that inevitably accompany this growth. The evaluators believe, therefore, that the Jamaican government should proceed with caution in any planned divestiture to ensure that its consequences will not exacerbate the current chaos with respect to supply channels and marketing within the industry and will complement overall government policies.

IFU should retain at least three functions. These are training, extension, and research. IFU has done a superb job of training extension staff and farmers and is carrying out much-needed research on production. This capability, which has taken seven years to develop, should not be summarily dismantled. However, the government will have to raise salaries substantially to keep the remaining IFU staff from jumping to the private sector.[12]

As IFU is elevated to departmental status within MOA, it also becomes the logical candidate to provide policy coordination and guidance to all elements of the industry. IFU should be permitted to take the lead in determining an overall strategy for

the growth of the industry with due regard for whatever environmental and equity directions it receives from the government. In particular, IFU should coordinate the series of marketing studies that are long overdue.

The evaluators do not recommend that AID launch a major new inland fisheries project in Jamaica. However, the evaluators do recommend that AID assist IFU, the MOA Marketing Division, and the industry in general in several discrete ways. One way would be to provide technical or financial assistance to help IFU carry out an overall strategy study. Another way would be to assist with the financing of marketing studies. A third way would be to carry out a human resources study to determine what the industry's training needs will be for the next 10 years. AID should then consider financing this training either through fellowships to U.S. universities or through the development of a secondary and tertiary inland fisheries training capability within Jamaica.

AID's intervention in the inland fishing sector in Jamaica has been, for the most part, fruitful. Although it is now time to let the industry develop mostly on its own, AID should keep a watchful eye on the industry that it has helped create to determine how it can still assist on an occasional basis.

AID DESIGN POLICIES AND PROCEDURES

The two AID project papers -- IFD and FPSD -- reflect a generally sound planning process. The overall concept of promoting inland fisheries in Jamaica in the mid-1970s was undeniably timely and feasible. The strategy of starting with a small research and institution-building project followed by a production project was clearly correct as it permitted flaws in procedure and technology to be corrected at an early stage before sunk costs became prohibitive; the most salient example of this was the decision to switch fish species from T. mossambica to T.

nilotica in about 1979. The benefit-cost analyses that were carried out in 1976 and again in 1979 have proved remarkably accurate, notwithstanding the soaring prices, plummeting currency, and other economic problems that Jamaica has had to face during project implementation.

The design also had flaws, however. The most egregious was the lack of a strategy to ensure that small farmers would become the main producers and beneficiaries of the project. Rather than evolving an extension strategy that focused on outreach to the smallholder, the planning documents simply stipulated that this would happen. It should have been foreseen that the industry, once its feasibility had been demonstrated, would inexorably be taken over by large corporate and private interests unless a strategy was developed to prevent it.

Passing mention has been made already of two other somewhat less serious design flaws. One concerns the lack of an environmental impact statement, which should have been prepared for a project that planned to utilize such large amounts of land, and, especially, water. The other concerns the levels at which targets were set. It is difficult to know in retrospect whether the designers really believed that more than 1,000 farms would, by 1983, produce several million pounds of Tilapia or whether these figures were generated to impress higher levels of decision making. In any case, they were unnecessary: the actual figures -- 550 farms producing about 500,000 pounds -- are sufficient to qualify the project as a success.

Another ill-conceived decision was to provide trail bikes on a lease-purchase option to extension staff. Most extension staff were simply not interested in owning or even using these bikes. As a result, only 4 of the 20 vehicles provided by AID are now in use. The rest are in storage.

Finally, one more quixotic observation should be made on the consequences of the buy-American provisions of the Foreign

Assistance Act. Almost all of the vehicles that were purchased by AID for the project were left-hand drive and American made. According to the IFU Director, at least one-third of these vehicles have broken down and cannot be repaired because of Jamaica's lack of foreign exchange to import spare parts (see Table 2).[13] It may be tilting at windmills, but it should be suggested, anyway, that Congress should decide whether is it the purpose of U.S. foreign assistance to promote development or to subsidize the American automobile industry.

NOTES

1 Extrapolated from IFU data, see Table 2, Chapter 2.

2 Based on yields of 2,300 pounds per 15-week production cycle, with three harvests per year, reported by IFU and confirmed by farmers who were interviewed.

3 Thomas J. Popma; Frank E. Ross; Bryan Nerrie; and James Bowman. The Development of Commercial Farming of Talapia in Jamaica, 1979-1983, Kingston: Ministry of Agriculture, page 4. The Auburn estimate, made in June 1984, was reportedly based on an extrapolation from first and second quarter production, which may have been slighly higher than in subsequent months. The evaluation team's estimate was extrapolated from reported production from January through October 1984. See notes to Table 2.

4 Popma et al., page 37. The actual figures reported were 2,500 kgs. per ha per harvest times 3.5 harvests per year.

5 While the evaluation team was in country, the IFU director was constantly receiving requests for assistance in fishpond construction from government officials and other influential people. When the evaluators completed their 4-hour journey to Meylersfield, they were informed that the chief extension officer was not available because he was supervising the construction of the 15-acre fish farm of a high government official.

6 One problem was that neither IFD nor FPSD provided an adequate definition of the target group. There are numerous references in both project papers to the "small" or "subsistence" farmer or to the "1/4 acre fish farmer." Inadequate attention, however, was given to the socioeconomic profile of the targeted beneficiary. Was the intended beneficiary to be primarily a farmer or could the beneficiary be a businessperson or professional who also farmed? If primarily a farmer, how large or small could the

beneficiary's holding be? Was there any provision for the landless poor?

7 Gregory M. Sullivan, Strategies for Marketing Talapia Nilotica in Jamaica, May 1983.

8 See the Agro 21 brochure on fish farming.

9 See McAlister, Report on Fish Processing, Handling and Preservation Seminars, 1983.

10 Sullivan, Strategies for Marketing.

11 Its facilities have now become the police training academy.

12 The highest salary in IFU is currently J$24,300, which is perhaps 50 percent of that which qualified individuals can command in the private sector.

13 On the day the evaluators visited Meylersfield, they set out on the four-hour journey in one of the surviving 1982 Dodge Omnis, only to have to turn back after one hour when the vehicle developed an electrical problem. They then completed the journey in a 1977 British Ford (allowed to be purchased by AID by mistake) for which spare parts were more readily available.

CHAPTER FOUR

CONCLUSIONS, RECOMMENDATIONS, AND LESSONS LEARNED

This chapter includes the principal conclusions that were derived from the analytic sections in Chapter Three, restates the major recommendations, and lists the lessons learned.

CONCLUSIONS

1. The overall conclusion is that the AID-Government of Jamaica inland fisheries projects have been successful in that they have established a new, healthy, and rapidly growing industry in Jamaica.

2. Inland fish farming in Jamaica is profitable for the relatively small number of medium-sized and large farmers who are currently engaged on a commercial basis. However, the intent of the project to raise the income of the rural poor has not been achieved.

3. Current production technology is adeqate to meet present and near future market demand. The threat of alternative technology used by large corporate farms to capture much of the domestic market, however, is real, and that potential must be addressed soon to ensure a continued marketplace for small to medium farmers who have a considerable investment at stake. The credibility of IFU is potentially in question if the current thrusts of large farms to dominate markets is not relieved through promotion and marketing programs.

4. The program has expanded so quickly that is has outpaced the development of infrastructure to handle potential problems of unaccounted mortalities and environmental problems.

5. The project should not have assumed a virtually unlimited market for Tilapia and no problems of distribution. Project designers should have realized that time is needed to change fixed habits in a mixed society. The present overproduction of fish causes and will continue to cause problems and economic hardship. The staying power of the small farmer will be severely tested, and with more large farms coming into production, it will not be surprising to see Tilapia farming in Jamaica dominated almost entirely by large corporate entities. An exception would be the entrepreneur who is vertically integrated so that he can grow, deliver, and sell his own product. Some small farmers can and will continue to thrive as they always do, but they will essentially be in the backwash of the program.

6. The role of Auburn University has been persuasive and positive from the inception of the projects. The Auburn advisers defined the need for more fish protein and identified suitable fish species to meet that need. They used their considerable facilities well and sent competent personnel to Jamaica to oversee the project. Their training program both in the United States and in Jamaica has produced results best demonstrated by the ability and confidence of IFU personnel to continue their tasks.

As principal designers and implementers, the Auburn advisers should not have assumed, however, that attention to distribution and marketing could be delayed until near the end of the project. The advisers should also have raised an early flag about the effect of their highly successful production program in attracting the large business sector and should have taken measures to ensure that the original target population was protected.

7. The original plans for the use of PCV were well conceived. However, as the thrust of the project shifted early and rapidly toward large farming, PCV were found to be increasingly unneeded and underqualified. As a result, they were phased out of the project by 1982. It is possible that a redefined role with the now-neglected small farmer could be established.

8. Training has been good at all levels of this project. IFU personnel contacted were found to be highly professional and skilled. The quality of infrastructure completed on government and private sector lands demonstrates the ability of extension personnel to transfer the techniques that they had learned. Farmers do understand the program.

However, an immediate problem exists in the disintegration of a planned training network through JSA and UWI. Every effort must be made to provide a temporary bridge and to work for an in-country training program in aquaculture.

9. Environmental concerns were addressed in a cursory fashion and found to be negative in the early project plans. Changes in emphasis toward large ponds and farms built within an environmentally sensitive ecosystem suggest a need to re-address this issue. Secondary concerns involving protected predatory bird species are a potential problem.

10. The AID project design was generally sound with respect to the feasibility and timeliness of introducing fish farming in Jamaica. However, the design lacked an overall strategy for reaching the target population; arrived at unnecessarily optimistic participation and production objectives; lacked an environmental impact statement; and should have sought a waiver on vehicle procurement, given the difficulties of obtaining spare parts for American-made vehicles on the island.

11. The future role of IFU, and with it the institutional support needed by the industry, is in jeopardy as a result of the withdrawal of AID funding, staff attrition, and competing institutional interests.

RECOMMENDATIONS

1. AID should not launch a major new project in inland fishing but should be prepared to respond favorably to requests for discrete assistance in such areas as strategic planning, marketing, human resources assessments, and training.

2. The Peace Corps should respond favorably to requests for its assistance in extending inland fisheries technology to the small farmer, but only if AID and the Jamaican government take strong measures to ensure that the small farmer is not squeezed out of the market.

3. The Jamaican government should carry out an overall study and a more specific marketing study for the industry to establish a strategic plan for the industry's continued growth and vitality. AID should be prepared to assist in the financing of these stuides.

4. The Jamaican government should take immediate steps, with AID assistance, to determine how it will ensure a continued supply of trained professionals and technicians for the aquaculture industry.

5. The Jamaican government should take measures to retain the capable senior staff of IFU who are now deserting to private industry in large numbers.

6. The Aquaculture Department should become the principal department for policy coordination as well as research and extension with respect to aquaculture on the island. Plans should be laid to divest IFU of its fry and fingerling production responsibilities.

LESSONS LEARNED

1. Tilapia farming is a viable industry in Jamaica and potentially in similar developing countries in the Caribbean and elsewhere.

2. In trying to develop an industry around smallholder production, specific plans (that is, a strategy) must be developed early on to keep large farmers from seizing control of the industry. One possibility that might have worked in Jamaica would be to have large entities responsible for brood and fingerling production as well as processing and distribution, with small farmers serving as principal grow-out producers on a contract basis. No strategy will be effective, however, if not supported strongly by the donors and host country government.

3. Production is easier to set in motion than marketing, which must overcome social, cultural, and economic barriers. Assumptions of ready markets for fish products is the single most common mistake made in fish expansion programs in developing countries.

4. Aquaculture is such a relatively new and inexact science that new technology will appear constantly. The time needed to test each new idea is seldom afforded in field situations, where economic conditions rather than scientific aptness will prevail.

The oft-quoted axiom, "Give a man a fish a day and you feed him -- teach a man to fish and he feeds himself" is one sentence too short. It should continue to read, "Then teach him how to preserve and distribute the surplus." Perhaps this should be the first sentence.

5. Most universities have a tendency to use in-house expertise to the extent that more objective, often business-oriented, ideas are often neglected. It is not likely, for example, that a successful fish farm operator would accept assumptions of unlimited market and no distribution problems without careful pre-study.

6. Changes in project direction must include environmental reassessment, especially when new technologies are involved.

7. Activities such as research and training, which are not directly remunerative, are difficult to sustain beyond the time that donor funding for a project is withdrawn. Government commitment to sustain these activities should, therefore, be obtained early in a project, and the commitment should be monitored throughout its life.

ANNEX A

PRINCIPAL DOCUMENTS CONSULTED

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ANNEX B

KEY RESPONDENTS

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KEY RESPONDENTS

Ministry of Agriculture

H. T. Ramdatt, Director, Division of Production and Extension

Hopeton Fraser, Deputy Director, Division of Production and Extension

Lloyd Thompson, Financial Analyst, Division of Production and Extension

Inland Fisheries Unit

Roy Ricardo Moo Young, Director

Sandra Cooke, Branch Chief, Extension

Noel Thompson, Regional Extension Officer - East

Wayne Stevenson, Farm Manager, Mitchell Town Fish Production Center

Hector Jathan, Farm Manager, Meylersfield Fish Production and Extension Center

AID/Washington

Robert Mowbray, Assistant Agricultural Development Officer, Rural Development Division, Bureau for Latin American and the Caribbean

USAID/Jamaica

Jaime Correa, Assistant Agricultural Development Officer

Dennis Darby, Project Specialist

Robert Friedline, Program Officer

Pat Jacobs, B & A Officer

Rick Mangrich, Project Officer

Bill McCluskey, Agriculture and Rural Development Officer

Arthur Patrick, Mission Evaluation Officer

Agro 21

Jurij Homziak, Director, Aquaculture

George Metcalfe, Director of Marketing

Franklin Ross, Manager of Aquaculture

Others

Trevor Thompson, Fish Farm Manager, Urban Development Corporation

Rawle Tyson, Technical Operations Manager, Aquaculture Jamaica Ltd.

Keith Williams, Fish Distributor, Spanish Town

The owners or managers of seven other fish farms

ANNEX C

ACRONYMS

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AID	Agency for International Development
AMC	Agriculture Marketing Corporation
DAI	Development Alternatives, Inc.
FPSD	Fish Production System Development Project (Second AID-financed Project)
IFD	Inland Fisheries Development (first AID-financed project)
IFU	Inland Fisheries Unit (key implementing agency of the Government of Jamaica)
JSA	Jamaica School of Agriculture
MOA	Ministry of Agriculture
NIBJ	National Investment Bank of Jamaica
PCV	Peace Corps Volunteers
UDC	Urban Development Corporation (operates a 98-acre fish farm in St. Catherine Parish)
UWI	University of the West Indies