

PD-AAM-280  
ISN 15676



***Resources  
Development  
Associates***

MID-PROJECT EVALUATION  
OF THE  
FISH PRODUCTION SYSTEM  
DEVELOPMENT PROJECT  
(#532-0059)  
JAMAICA

Prepared For:  
United States Agency for International Development  
USAID/Jamaica

Contract No. PDC-1406-I-02-1143-00

Prepared By:  
Phillip Warren, LAC/DR/RD, AID/Washington  
Norman L. Pease, ST/AGR/Fisheries/AID/Washington  
John B. Glude, Resources Development Associates,  
Aquaculture Consultant

May, 1982

Resources Development Associates, P.O. Box 407, Diamond Springs, CA  
(916) 622-8841

## TABLE OF CONTENTS

1.0	SUMMARY . . . . .	1
1.1	General Recommendations . . . . .	3
1.2	Recommendations Concerning Training . . . . .	3
1.3	Recommendations Concerning Extension . . . . .	3
1.4	Recommendations Concerning Inputs and Procurement of Commodities . . . . .	3
1.5	Recommendations Concerning Processing and Marketing . . . . .	4
1.6	Recommendation Concerning Production Economics . . . . .	4
1.7	Recommendation Concerning Production Systems . . . . .	4
1.8	Recommendations Concerning Research . . . . .	5
2.0	EVALUATION METHODOLOGY . . . . .	6
3.0	EXTERNAL FACTORS . . . . .	8
3.1	Economic Considerations . . . . .	8
3.2	Validity of Assumptions . . . . .	8
3.2.1	Goals/Sub-goals . . . . .	8
3.2.2	Purpose . . . . .	9
3.2.3	Outputs . . . . .	9
4.0	INPUTS AND PROCUREMENT . . . . .	11
4.1	Technical Assistance . . . . .	11
4.2	Commodities . . . . .	11
5.0	OUTPUTS . . . . .	13
5.1	Fish Production . . . . .	13
5.1.1	Project Goals . . . . .	13
5.1.2	Achievements, May 1982 . . . . .	13
5.1.3	Constraints . . . . .	14

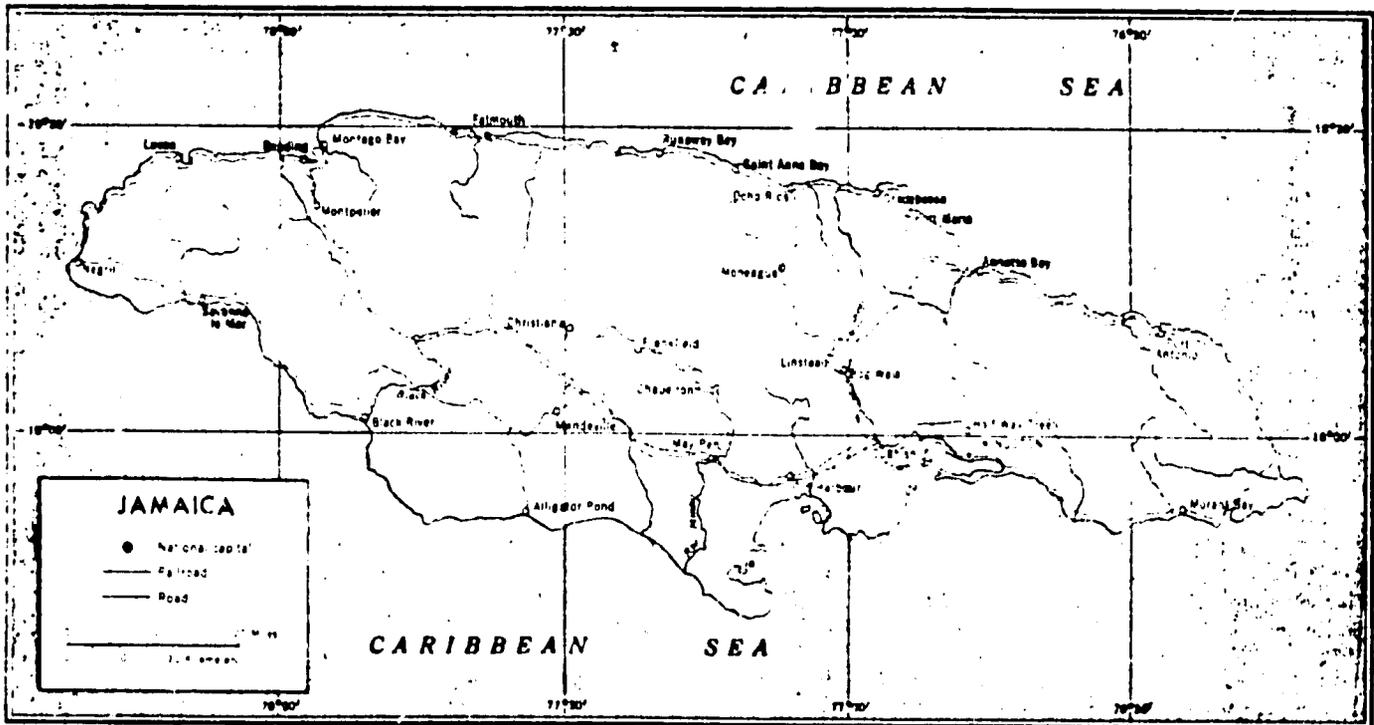
5.2	Extension Program . . . . .	15
5.2.1	Functions . . . . .	15
5.2.2	Staffing . . . . .	16
5.2.3	Extension Recommendations . . . . .	17
5.3	Training Program . . . . .	17
5.3.1	Evaluation . . . . .	17
5.3.2	Recommendation Concerning Training . . . . .	20
5.4	Credit . . . . .	20
6.0	PROJECT PURPOSE . . . . .	22
6.1	Evaluation . . . . .	22
7.0	GOALS/SUB-GOALS . . . . .	23
7.1	Evaluation . . . . .	23
8.0	BENEFICIARIES . . . . .	24
8.1	Evaluation . . . . .	24
9.0	ANALYSIS AND SPECIFIC RECOMMENDATIONS . . . . .	25
9.1	Adaptive Research . . . . .	25
9.1.1	Program Status . . . . .	25
9.1.2	Evaluation . . . . .	26
9.1.3	Recommendations Concerning Research . . . . .	27
9.2	Production Systems . . . . .	27
9.2.1	Evaluation . . . . .	28
9.2.2	Recommendations Concerning Production Systems . . . . .	30
9.3	Processing and Marketing Systems . . . . .	31
9.3.1	Evaluation . . . . .	31

9.3.2.	Recommendations Concerning Processing and Marketing . . . . .	32
9.4	Production Economics . . . . .	32
9.4.1	Evaluation . . . . .	33
9.4.2	Recommendation Concerning Production Economics . . . . .	33
9.5	Fish Supplies for Jamaica . . . . .	35
9.6	Suggested Future R & D . . . . .	36

LIST OF TABLES

Table I	. . . . .	10
Table II	. . . . .	18
Table III	. . . . .	34

# INDEX MAP OF JAMAICA



## 1.0 SUMMARY <sup>1</sup>

The goals of the Fish Production System Development Project are to increase food production, income, employment, improve nutrition in rural areas, and to assist the Government of Jamaica to mitigate its foreign exchange problems. The project purpose is to develop the capacity of GOJ institutions to increase freshwater fish production throughout the country, primarily through assistance to small farmers.

The four-year project will build upon the accomplishments of the AID funded Inland Fisheries Development Grant (532-0038) which established a knowledge base for conducting freshwater fish production activities in Jamaica and developed institutional capabilities for the production of fingerlings and the extension of fish farming techniques to farmers. The project will be supported by the U.S. Peace Corps which will provide volunteers to help train fisheries extension officers and facilitate a more rapid expansion of the program during the take off phase.

The project has made significant progress toward the goals stated in the project paper during the period June, 1979 to May, 1982, however, some outputs are below the level projected for this period. Delays in initiating and staffing the project and time lost by unsuccessful negotiations to acquire a fingerling production site at Ferris Cross have caused the project to be about one year behind the projected schedule.

Nevertheless, some 450 Tilapia farms are now in operation with over 200 acres of ponds in production. Applications have been received for assistance in constructing another 200 acres of ponds and this will be accomplished as soon as the Ministry of Agriculture, Inland Fisheries Unit (MOA/IFU) technical staff and construction teams become available.

---

<sup>1</sup> This report follows the standard format but not numbering system of the Project Evaluation Summary (PES).

The present status of fish farm development and the short time remaining (about 15 months) indicate that some outputs will be below the target level at the scheduled completion date of this project. With the present rate of progress it would take an additional two years beyond the scheduled project duration to attain the goals stated in the project paper, assuming continued funding by donor agencies.

Program emphasis during the period June, 1982-August, 1983 should be directed toward recruitment and training of personnel and assistance to additional farmers in a concerted attempt to approach the original goals of the project.

Extension of the project for one additional year, 1983 - 1984, using presently allocated funds, is recommended by the Evaluation Team. Emphasis during that period should be placed also on marketing including development of marketing channels, sanitation and quality control.

As production techniques improve, it should be possible for farmers to grow fish to a larger size which would permit processing and marketing of boneless fillets, a desirable market form. This will require strategically located processing plants with freezing facilities.

Continuation of efforts for at least one additional year, 1984-1985, would be needed to reach the fish production levels stated in the Project Paper. The Evaluation Team, therefore, recommends development of a new project for funding by GOJ and donor agencies to provide continuing extension services and farmer training for 3-5 years. This project should also include maintenance of a modest level research capability at Twickenham Park to solve production problems and to continue testing of new culture methods for application in Jamaica.

### 1.1 General Recommendations

- o Extend the project completion data by one year, to August, 1984.
- o Increase emphasis on recruitment and training of staff for (IFU).
- o Maintain emphasis on assuring availability of fingerlings and fry for fish farmers.
- o Increase extension staff in order to reach more farmers.
- o Complete commodity procurement as soon as possible.
- o Develop record keeping systems within (IFU) for analysis of production economics and conduct a long-range marketing study.
- o Continue research on (a) sex control of fry by use of hormones, (b) stocking density vs. growth (c) use of hybrids and (d) minimize carp studies unless market acceptance can be assured.

### 1.2 Recommendations Concerning Training

- o Increase training beyond projected targets to maintain full staffing, even though some trainees leave the program.

### 1.3 Recommendations Concerning Extension

- o Increase the number of trained extension agents as soon as possible.
- o Increase the number of contacts with small farmers in order to expand participation in the program.

### 1.4 Recommendations Concerning Inputs and Procurement of Commodities

- o Complete procurement of all necessary commodities including trailbikes and fish farm supplies as soon as possible.

### 1.5 Recommendations Concerning Processing and Marketing

- o Conduct a marketing study as a guide for the long-range development of tilapia culture in Jamaica. This study should project domestic and export demand and identify desired product forms. If such a study is not included in the proposed (USAID/GOJ) comprehensive marketing project, it should be accomplished separately.
- o As production of larger fish suitable for filleting increases, encourage development of processing plants with facilities for preparing boneless fillets and other product forms with adequate systems for sanitation and quality controls.

### 1.6 Recommendation Concerning Production Economics

- o IFU should maintain records of production, processing and marketing costs for representative groups of farms and the sale price of the product as a basis for providing financial advice, especially to small scale farmers. The information would also be useful as a guide for the future development of tilapia farming in Jamaica. This probably will require the use of computer programs.
- o IFU should encourage farmers to keep good production and cost records to help them to know and improve their profitability.

### 1.7 Recommendation Concerning Production Systems

- o Continue application of the present system as a basis for increasing the number of small farms with emphasis on meeting the fingerling and fry requirements until the private sector can fulfill this demand.

To accomplish this, IFU should use all available facilities at Mitchell Town and Meylersfield for fry or fingerling production.

- o Test the commercial applicability of alternative systems for minimizing the effects of reproduction, including:
  - a) use of monosex fry produced by hormone treatment;

- b) development of commercially applicable systems for positive sorting of males for growth to filleting size; and
  - c) use of monosex hybrids.
- o Emphasize development of economical systems for producing large sized tilapia suitable for filleting.

#### 1.8 Recommendations Concerning Research

- o Accelerate research to develop a production level system for controlling sex of the tilapia fry by hormone treatment.
- o Continue and expand research to evaluate the effect of increased stocking density on growth of tilapia under various pond and feeding situations.
- o Continue evaluation of various tilapia hybrids for use in Jamaica.
- o Minimize carp studies unless a market analysis indicates significant demand in Jamaica.

## 2.0 EVALUATION METHODOLOGY

The Project Paper specifies a mid-project objective evaluation and this was requested by the USAID (Jamaica Mission and Government of Jamaica). The evaluation was conducted May 16 - 29, 1982 by a three man team including W. Phillip Warren - LAC/DR/RD, Norman L. Pease - S & T/Agri/Fisheries and John B. Glude - RDA Aquaculture Consultant.

The scope of work for this evaluation was as follows:

- a) To assess current status of National Inland Fish Production Program in terms of number of farmers participating, number of surface acres of water in production and pounds of food fish harvested vis-a-vis project targets.
- b) To assess the extent to which institutional capability to provide extension, research, credit and other support services, has been established.
- c) To evaluate the effectiveness of the training programs established at Twickenham Park and the University of the West Indies.
- d) To assess the construction works at Twickenham Park, Meylersfield and Mitchell Town.
- e) To review the current state of development of the National Inland Fisheries Extension Service.
- f) To conduct a cost/benefit analysis of project.

Members of the Evaluation Team interviewed mission and Ministry of Agriculture officials, project staff, Peace Corps volunteers and fish farmers as indicated by the following list of persons contacted.

The team inspected project facilities at Twickenham Park, Mitchell Town and Meylersfield, visited small and large fish farms operated by the private sector and attended a fish farmers meeting.

## List of Persons Contacted

### USAID

Donald R. Yeaman, Agriculture Development Officer  
Robert Mowbray, Assistant Agriculture Development Officer  
Fitz Barkley, Project Manager  
John Jones, Mission Evaluation Officer  
Dr. Thomas Popma, Sr. Resident Technical Advisor  
Brian Nerrie, Extension Advisor  
James Bowman, Extension Advisor  
Arthur Patrick, Capital Development Officer  
Roy Manning, Consultant, Farm Planning

### Government of Jamaica (GOJ)

Derek Sangster, Parliamentary Secretary

### Ministry of Agriculture (MDA)

Roy Moo Young, Project Director  
Vivine Clark  
Winston Charlton, Construction  
Sharon Chambers, Research  
Althea Cooper, Production and Marketing  
Betty Cook, Extension and Training  
Mrs. Mendez, Accounting  
Norman Boyd, Farm Manager

### Peace Corps

Tim Brown, PCV  
Eugene McDonald PCV

### Private Sector

Tony Clarke, Jamaica Aqua Farms Limited  
Phillip Campbell, Jamaica Aqua Farms Limited  
Trevor Thompson, Urban Development Corp.  
Mr. Barker, Tilapia Farmer  
Mr. Ruddy, Tilapia Farmer  
Mrs. McFarlene, Tilapia Farmer  
Mr. Badal, Tilapia Farmer  
Hedley Brown, Tilapia Farmer  
Maynard Bacchus, Tilapia Farmer

### 3.0 EXTERNAL FACTORS

#### 3.1 Economic Considerations

At the time of design and approval of this project in 1979, Jamaica was recovering somewhat from a serious economic decline but still had high unemployment and an inflation rate of 18 percent.

Unemployment continues to be high, but the rate of inflation has been reduced significantly. Nevertheless, the exchange rate has dropped from J\$1.00 = US\$0.80 in 1979 to J\$1.00 = US\$ 0.56 in 1982 thereby increasing the cost of imported items.

#### 3.2 Validity of Assumptions

The following discussion of goals, sub-goals, purpose and outputs summarize the views of the evaluation team regarding the validity of the assumptions upon which this project was based.

##### 3.2.1 Goals/Sub-goals

"Increase food production." Some 450 farmers are now producing tilapia, thereby increasing domestic food production by over 200,000 lbs. annually. This indicates that the original assumption was valid.

"Reduce foreign exchange drain caused by food imports." Increased domestic production has a slight impact on reduction of imports. If tilapia production continues to expand, the impact could be significant.

"Increase income and employment and improve nutrition in rural areas". Most of the new fish farms are small and located in rural areas, thereby contributing to these goals. This indicates that the original assumption was valid.

"Establish the foundation for a regional training program in fish production." A training program has been established and at least one foreign student from the region has received training. Continuation of the training program at Twickenham could provide excellent opportunities for establishing a regional training center.

### 3.2.2 Purpose

"To develop the capacity of the Government of Jamaican institutions to increase fish production." This has been demonstrated by the success in developing some 450 fish farms.

### 3.2.3 Outputs

The validity of assumptions regarding project outputs is summarized in Table I and discussed below.

The project planning anticipated availability of personnel and facilities early in the project which would have permitted attainment of most of the outputs marked "overly optimistic". In practice difficulties in recruiting and training staff, delay in construction of IFU farms and facilities such as the dormitory for trainees and closure of the Jamaica School of Agriculture made some of the goals unattainable during the project period. Delays of this type, however, are not unusual, especially in developing countries, and should have been anticipated during the planning of the project. Analysis by the Evaluation Team indicated that most or all of the original project goals could be reached if the project were continued for an additional two years.

TABLE I

THE VALIDITY OF ASSUMPTIONS REGARDING  
PROJECT OUTPUTS BASED ON ANALYSIS BY THE EVALUATION TEAM

<u>Outputs</u>	<u>Magnitude</u> <u>August 1983</u>	<u>Validity</u>
IFU personnel	160	Valid
Small fish farmers	1280	Overly optimistic
Large fish farmers	260	" "
Surface area of ponds	1100 A.	" "
Increase fish production	6 million lbs.	" "
Reduced foreign exchange	\$ 42 million	" "
Increased income of small farmers	22%	Valid
Increased employment	513,500 days	Overly optimistic
Establish regional training program	10% of students enrolled in aqua- culture courses at UWI and JSA	Overly optimistic
Peace Corps Volunteers(25)	267 months	Valid
Equipment and commodities procured and opera- tional	listed	"
Research ponds expanded at Twickenham Park	by 1981	"
20A ponds established at Ferris-Cross(built at Savanna-la-mar) Cross	by 1981	"
Credit program for farmers	by 1980	Overly optimistic
Farmers trained	920	" "
Technical assistant to farmers	260	Valid
IFU staff training	96 mo.	"
UWI faculty training	one person	Valid
Train students at JSA and UWI	50	"
Fish culture curricula established	UWI	"
Fish culture curricula established	JSA	JSA Terminated
Fingerlings produced/ annum by 1983	13 million	overly optimistic
Pounds of fish produced/ annum by 1983	6 million	" "

## 4.0 INPUTS AND PROCUREMENT

### 4.1 Technical Assistance

USAID has a contract with Auburn University to provide the project with three advisors including one Senior Technical Advisor and two Extension Advisors.

The responsibilities of the advisors are to help maintain program momentum and provide technical back-stopping to the various activities. Specifically, the Senior Technical Advisor is to design and assist in research activities, organize training of IFU personnel, teach formal courses in aquaculture and advise on the selection of participants for overseas training. This position will continue for the duration of the project.

The Extension Advisors will serve as counterparts to the Jamaican Regional Fisheries Extension Officers in the eastern and western regions. They will assist and teach pond surveying and design, prepare detailed management plans for fish production and prepare literature for use in aquaculture extension.

Considering the unavoidable delays which were encountered during project implementation, it appears that all three advisors are adequately fulfilling their duties. The Evaluation Team concluded that the technical assistance provided by Auburn is appropriate for fish farming in Jamaica and is helping to establish fish farming on a solid technical basis.

Auburn was also to provide nine (9) months of formal in-country training. Three (3) months have been provided and the rest will be provided as IFU personnel are available.

### 4.2 Commodities

Commodity procurement has been slow but generally has not seriously delayed the project. However, only 17 of 29 vehicles and 10 of 20 trail bikes have been received. Also spare parts for the trail bikes have not arrive. These shortages are constraining expansion activities and this will become more serious when the expansion staff becomes complete.

Although the Project Paper listed various fish harvesting equipment, no information was available concerning the amount received. At present there is a shortage of seines. The team recommended that more webbing floats and leadlines be purchased and assembled into seine nets locally.

As feed and fertilizer can be purchased locally to meet the needs of the project instead of being imported as proposed in the Project Paper, the funding designated for importing these might be used for other project needs with proper approval.

## 5.0 OUTPUTS

### 5.1 Fish Production

#### 5.1.1 Project Goals

The major goals of increased food fish production specified in the Project Paper required facilities to produce seed (tilapia, fry or fingerlings) trained personnel to provide assistance to new fish farmers and various support activities. Fingerling production centers in the east at Mitchell Town and in the west at Meylersfield were scheduled to be built. In addition, the Twickenham Park Station was to be expanded to provide the needed research and development capability. Fingerling production, about 60% by the private sector and 40% by IFU, was scheduled to reach 13 million per annum by August, 1983.

Personnel requirements of IFU were 160 personnel including 36 professionals by the end of the project. These were to be distributed among the 3 sites. A sufficient number of extension agents were to be trained to maintain a staff of 25. Approximately 920 farmers were scheduled to take a short-term training course or have equivalent informal training.

Food fish production by the private sector was projected to reach 6 million pounds annually by 1983 with 1100 acres of fish ponds in operation.

#### 5.1.2 Achievements, May 1982

IFU pond construction at Twickenham Park and Mitchell Town was completed on schedule. The delay in acquiring a site in the west slowed construction at Meylersfield for approximately one year but it is now complete except for the fingerling sorting building. Annual fingerling production is approximately 1.2 million or 9% of the project goal. Food fish production is approximately 230,000 lbs. or 4% of the goal. Slightly over 200 acres of ponds have been constructed for the private sector with additional requests for another 200 acres on file. Thus, pond construction has achieved 18% of its goal.

The fishery unit is at 63% of its staffing goal and extension agents are at 56% of the goal. Farmer training is considerably below the goal of 920 with 450 (49%) informally trained to date. This includes 250 "hobby" farmers who have received the same amount of informal instruction time from the extension agents as farmers in commercial production even though their ponds are very small. Since the facilities at Twickenham Park have only recently been completed, all farmers have received their instruction informally or in extension meetings.

### 5.1.3 Constraints

Various factors which were beyond the control of the staff have delayed the project. For example, the delay caused by the unsuccessful negotiations for the fingerling site in the west at Ferris Cross created a one year delay in establishing the Meylersfield facility. This retarded the country-wide fingerling production, the farmer training program and the extension service which was to have been initiated in the west.

The closing of the Jamaican School of Agriculture and the lack of qualified professors at UWI has severely curtailed the training of the IFU personnel. It is our understanding that a qualified professor has returned from training and will develop courses in fisheries and aquaculture. The void created by the closing of the JSA has not been filled and the location of an alternative training arrangement should be pursued by the attrition of personnel from the program and the lack of highly trained, qualified staff is a serious drawback. Also the shortage of qualified construction staff has severely limited pond construction for farmers. The general understaffing of the IFU has led to a delay in reaching the goals for fingerling and food fish production.

## 5.2 Extension Program

### 5.2.1 Functions

The IFU Extension Program is responsible for educating potential fish farmers and the public concerning fish farming. Education and promotion are handled through the news media, extension meetings and personal contact. Once a farmer is interested in the program, an Extension Specialist will visit his farm to discuss fish production in detail and explain what is required to be successful. A survey of the farmer's land, availability of water and soil composition will be conducted to see if pond construction is feasible. If these tests are positive, the pond layout is prepared and a benefit/cost estimate is made for the farmer. At this point, discussions are held again to determine if the farmer still wants to go into fish production.

The extension agent may have to discuss financing for pond construction and provide recommendations to the farmer on obtaining credit. After construction is completed, and ponds are filled with water, the Extension Agent will instruct the farmer on fertilization and feeding and then stock the pond with fingerlings.

The farmers will now be encouraged to attend the one week training course provided by IFU which will begin soon. The Extension Agent will continue to visit the farmer bi-weekly to advise on general pond management practices. At harvest time the extension agent may encourage other farmers in the area to assist in the harvest, locate market for the fish, participate in the actual fish harvest and help transport the fish to market. The agent and the farmer will hold discussions again to determine if any changes are needed in the production system before starting the next fish crop.

### 5.2.2 Staffing

The IFU was expected to have 20 additional extension personnel, a total of 25 on board by June 1982. Presently, IFU has one Regional Extension Officer and ten Extension Agents and four more will return from training. The Regional Extension Officer is expected to go to the private sector soon and there will then be a need for two Regional Extension Officers and 11 more Extension Agents.

The project has suffered from the loss of trained personnel usually to the private sector. Well trained Extension Agents are in demand for management of larger commercial tilapia farms. This loss has been detrimental to the expansion of the IFU program for small farmers. It seems the project will not be able to meet its goal of 920 farmers with 1,100 acres of ponds producing 6 million pounds of fish annually unless some drastic measures are taken to recruit and retain Extension Agents in the IFU project.

To help in this situation, the formal level of training of Extension Agents may have to be re-evaluated. For example, secondary school graduates may be able to fulfill part of the duties of Extension Agents if they receive appropriate training.

Twenty-five Peace Corp Volunteers (PCV) were to be working in extension throughout the project. So far there have been twenty PCV provided to the project. Overall, their contribution has been considered as positive. The first group reportedly was not trained as well as later groups. The Peace Corps Aquaculture Trainer from Oklahoma State University visited IFU recently to determine the particular needs of Jamaica and is expected to modify his courses to better train the PCV coming to Jamaica.

Extension activities have also been delayed because the lack of trail bikes and spare parts. This problem has still not been eliminated.

The Evaluation Team was given the impression that there is no scheduled program of extension meetings for fish farmers. Although the one-on-one contact may be necessary in developing the program, alternative methods will have to be incorporated as farmers become experienced and more new farmers get into fish production.

Since the one-week course to be provided by IFU for farmers has not been taught, Extension Agents have informally trained about 150 farmers in fish production techniques

### 5.2.3 Extension Recommendations

1. Increase the number of trained extension staff as soon as possible.
2. Increase the number of contacts with small farmers in order to expand the program.

## 5.3 Training Program

### 5.3.1 Evaluation

Table II lists the project's inputs identified as training or support for training. At the time of this evaluation, most of the activities are on schedule. Areas that are behind schedule include:

- 1) The one-week courses in pond management and production technology for farmers to be taught at Twickenham Park;
- 2) formal in-country training by short-term technical assistance;
- 3) the training of Extension Agents, Fish Managers, and professional fisheries personnel;
- 4) UWI students trained in aquaculture.
- 5) farmers trained.

Some of the categories above are contingent on another. For example, the lack of one-week courses to be taught

TABLE II  
STATUS OF TRAINING IN RELATION TO PROJECT GOALS

	<u>Magnitude</u> <u>Aug. 1983</u>	<u>Status</u> <u>May, 1982</u>
1. In-service training for new hatchery and extension staff	27	20
2. Twelve months training for Research and Training Officer	1	0
3. Fourteen months aquaculture extension training for Regional Extension Specialists	2	2
4. Twenty-four months aquaculture training for a Regional Production and Extension Officer	1	1
5. Auburn fifteen-week course for Fishery Extension Agents	12	7
6. <sup>1</sup> One-week courses at Twickenham Park in Pond Management and production technology	--	--
7. JSA staff trained to teach aquaculture farm management and extension	2	2 <sup>2</sup>
8. UWI staff member to receive nine months post-Doctoral training	1	1
9. Funds for curricula development at JSA and UWI for regional aquaculture	--	--
10. <sup>1</sup> Formal in-country training by short-term technical assistance	9 pm	3 pm
11. <sup>1</sup> Farmers trained (informal and formal)	920	450
12. <sup>1</sup> Extension Agents, Fish Farm Managers, professional fish personnel	90	31
13. JSA students trained in aquaculture	45	45
14. <sup>1</sup> UWI students trained in aquaculture	20	0

<sup>1</sup> Behind schedule

<sup>2</sup> One still in training - should complete by August 1982

at Twickenham Park is reflected in the low number of farmers trained. The farmers that have been trained received instruction informally through personal contact or in extension meetings. The informal approach may be a more realistic method of training farmers, particularly for those who can not stay away from their farm for a week. However, the formal training for farmers at Twickenham Park should continue to be available and provided particularly at intervals when the farmers may not be so busy with crops, etc. Also, the training facilities could be used to train personnel as they become available to IFU, i.e., secondary school graduates, PCV, etc.

The short-term technical assistance to conduct formal in-country training should be completed in the near future in order to benefit the project. This training was to have been completed within the first two years of the project. Trained personnel will be more valuable to project implementation and should help overcome mistakes made in the past and help expand the program more rapidly.

The project paper mentions some funds would be used to develop curricula for regional aquaculture training at JSA and UWI. Although JSA is now closed, this activity could be continued at UWI as they develop their aquaculture courses.

The UWI staff member has recently returned from training and after developing a curriculum, plans to begin teaching courses in fisheries and aquaculture in Oct. 1983, after the scheduled completion date of this project.

All scheduled training activities should be moved up in priority and implemented as soon as possible. Lack of trained personnel has had a definite effect on reaching project goals especially for extension personnel. Although over 20 extension personnel have been trained, only 14 are still working on the project. This rate of attrition has greatly affected the

part of the project focused on reaching farmers.

The private sector has been offering attractive incentives to trained personnel. Salary and benefits are said to be much better than those provided by MOA/IFU. As the private sector expands in fish production, their requirement for trained personnel in aquaculture will increase. More emphasis may need to be placed on providing training for private sector personnel other than farmers.

The closing of JSA is making it difficult to find a facility that can continue to offer the training required by the project. Some alternate institution should be identified in or out of Jamaica as soon as possible that can provide necessary trained personnel.

#### 5.3.2 Recommendation Concerning Training

Increase emphasis on training at all levels and expand beyond projected targets to compensate for attrition.

#### 5.4 Credit

Crop lien loans to small farmers total about eight to date. Although additional applications were filed some were rejected because of bad credit rating, etc.

During a portion of the project period, about one year, there were no crop lien loans available since GOJ diverted available funds to hurricane victims.

The crop lien program has now been reinstated as the Small Farmer Loan Program and limits have been increased from J\$6000 to J\$10,000 as of July 1981. At the same time, the interest rates were increased from six percent to nine percent.

The increase in amount of credit a small farmer can obtain for fish production will be helpful as other input costs increase. The increase in the interest rate however, will mean

that fish farmers will have to become more efficient than anticipated in the project paper.

The Extension Agents will have to be more aware of costs and returns to the small farmers from a fish production system. New means of cutting expenses for small farmers may have to be considered in the IFU research program.

## 6.0 PROJECT PURPOSE

"To develop the capacity of the Government of Jamaica institutions to increase fish production throughout the country and to establish fresh-water fish farming as a viable farming activity islandwide."

### 6.1 Evaluation

The Inland Fisheries Unit is being developed and is doing an outstanding job with available resources to expand fish farming throughout Jamaica.

## 7.0 GOALS/SUB-GOALS

Sector goal: "Increase food production"

- Sub-goals:
- a) "Reduce foreign exchange drain of food imports."
  - b) "Increase income and employment and improve nutrition in rural areas."
  - c) "Establish the foundation for a regional training program in fish production."

### 7.1 Evaluation

Farmers are producing fresh-water fish for consumption that were not available before in the country. Fish provide a valuable source of protein to the diet. Employment has been generated in the areas of fish production, marketing and processing and providing supplies and equipment to fish farmers. The amount of fish produced to date would have only a minor effect in reducing the foreign exchange drain but has increased income in rural areas. A U.W.I. faculty member has returned from aquaculture training and is developing curricula for courses in aquaculture and fishing. Also, the facilities at Twickenham Park could well be used for training Aquaculture Specialists from other countries within the Caribbean Region.

## 8.0 BENEFICIARIES

"The major beneficiaries of the project will be small farmers who will benefit from increased income through utilization of marginal land for fish production and improved diet through access to fish protein which has not been traditionally available in rural areas."

### 8.1 Evaluation

The project has helped 450 farmers to become involved in fish production. About one-half of these farmers have approximately 0.01 acre ponds which provide fish for their own consumption. Others have larger ponds to produce fish for sale and for their own consumption. "Urban and rural consumers will also benefit through increased, more dependable, lower priced supplies of fish." This project should produce good results as it develops.

## 9.0 ANALYSIS AND SPECIFIC RECOMMENDATIONS

### 9.1 Adaptive Research

A major activity of IFU at the Twickenham Park facility is to test the applicability of various fish culture systems in Jamaica. This requires research laboratories, ponds and tanks for holding the fish, office space and equipment for analysis of results, and well trained scientific personnel and supporting staff. Although modest, the Twickenham Park station provides satisfactory facilities for the adaptive research needed during the early stages in the development of fish farming in Jamaica. The facilities and equipment at this station as well as the scientific staff may not be adequate for more specialized studies such as pathology, genetics, processing technology, product evaluation and production economics which will become more important as fish farming expands.

#### 9.1.1 Program Status

Research at the Twickenham Park station has led to a shift from the culture of the dark skinned Tilapia mossambica, which was introduced to Jamaica many years ago, to the more desirable silvery Tilapia nilotica. In addition to better market acceptance, T. nilotica is easier to culture to marketable size in mixed sex systems since reproduction, which limits growth of females and overstocks ponds with progeny, begins at 4 months instead of 3. The change of species was largely accomplished in March/April 1981 and all fingerlings supplied to the farmers are now T. nilotica.

Tilapia research recently completed or in progress includes the following:

- Testing of growth of T. nilotica at various stocking densities.
- Testing of toxicants such as tobacco dust to kill unwanted tilapia remaining in ponds after harvesting.

- Testing the applicability of culturing hybrids of T. mossambica and T. nilotica which are mostly males.
- Testing the use of hormones such as methyl testosterone to produce monosex male fry.

Other research includes:

- Evaluation of various carps (grass, mirror, common, big head and silver) for polyculture in Jamaica with or without tilapia.
- Testing the use of small tarpon as predators to control the number of tilapia fry in grow-out ponds.
- Determining the potential of using unwanted female tilapia fingerlings for preparation of fish silage to feed swine.

#### 9.1.2 Evaluation

The research projects concerning tilapia generally have been appropriate, well designed and well conducted, but the analysis of results of some recent experiments appears to be lagging. Also, the results of some work such as the evaluation of sex control by use of hormones have been inconclusive because of an associated or coincidental mortality. The high potential for decreasing the cost of producing all male fingerlings by this method makes it important that this activity be given high priority.

The research concerning Chinese carps is obviously of lower priority than that regarding tilapia culture. Although carps are well accepted in Asia and parts of Europe, there is no clear indication that there would be significant demand for these species in Jamaica. Also, it is likely that the export potential in the United States would be very limited should local production exceed demand. Therefore, the carp project should be continued at a low level pending completion of an analysis of the demand in Jamaica.

### 9.1.3 Recommendations Concerning Research

1. Accelerate research to develop a production scale system for controlling sex of the tilapia fry by hormones.
2. Continue and expand research to evaluate the effect of increased stocking density on growth of tilapia under various pond and feeding situations.
3. Continue evaluation of various tilapia hybrids for use in Jamaica.
4. Minimize carp studies unless a market analysis indicates significant level of demand in Jamaica.

### 9.2 Production Systems

Various systems have been used in other countries for tilapia farming and some of these may be applicable in Jamaica. Also, it may be possible to devise new procedures to reduce the cost of growing tilapia or to produce more acceptable products. Production systems are based on a combination of the following factors: farm size; broodstock and seed (fry or fingerling) supply,; stocking density; feeds; grow-out cycle; market; and product form.

The production system selected for Jamaica is for the farmers to stock their ponds with monosex male fingerlings, produced in a government hatchery, and to harvest 0.3 - 0.5 lb. fish after 12 - 15 weeks. Harvesting time is important, since the sexing of fingerlings is never perfect and a few females are included with the males. After 12 - 15 weeks, the females would mature and their progeny would overstock the ponds resulting in a reduction in growth rate of the older fish.

This system requires the Inland Fisheries Unit (IFU) to operate facilities at Mitchell Town and Meylersfield for production of fingerlings and sorting of males for sale to the smaller

farmers. Farmers with one acre of ponds or more are encouraged to buy mixed sex fry at 0.3 cents each, grow them to fingerling size in a nursery pond and sort out males for stocking in grow-out ponds. IFU extension workers encourage farmers with over 20 acres of ponds to maintain broodstock, produce their own fry and grow them to fingerlings for stocking in grow-out ponds. More than half of fingerlings are now grown by the private sector.

IFU helps new farmers to get started by supplying them initially with free fingerlings and thereafter with fingerlings at a subsidized price which recently was increased from 5 cents to 10 cents each. Some farmers are reluctant to grow their own fingerlings from purchased mixed sex fry because it requires 0.4 acres of fingerling ponds to stock 1.0 acres of grow-out ponds. The use of 29% of the pond space for production of fingerlings is obviously less economical than buying fingerlings at a subsidized price and using all of the available pond area for growing fish to marketable size. In some cases, however, a farmer might have to wait several weeks to get delivery of male fingerlings from an IFU station and this delay might make it more economical to buy fry from an IFU station and grow them to sorting size in his own nursery ponds.

#### 9.2.1 Evaluation

The present IFU stations will be unable to produce enough monosex fingerlings by the present method to supply the increasing number of small scale fish farmers. One solution already in practice is to encourage farmers to produce their own from purchased fry or to maintain their own broodstock. A second solution would be to encourage development of commercial seed producers who could sell mixed sex fry or male fingerlings to growers at a profit. To encourage this, the government might gradually remove the subsidy on fry and fingerlings.

A third alternative would be to develop a commercially applicable system for producing all male fry by hormone treatment. This would make it possible to increase production of the IFU stations and to reduce the seed cost, since all of the fry would be usable whereas, at present, the females are grown to fingerling size and then are discarded. After thorough testing, this system could also be used by private farmers since it would reduce the pond space needed for seed production. Furthermore, with an economical supply of nearly 100% monosex males, it would be possible to extend the grow-out period beyond the present 15 weeks to produce the larger fish needed for filleting. However, the technology for mass production of monosex fry by hormone treatment is not yet ready for commercial application.

Several other systems have been used with greater or lesser success to control over reproduction of tilapia. These include the crossing of certain species to produce nearly all male progeny, culture of mixed sexes in raceways or cages, introduction of predatory species which will feed on the fry and higher density of stocking. Some of these systems may be applicable at certain places in Jamaica.

The project paper expressed concern regarding the necessity of importing fish meal as a protein component for tilapia feed. However, it has become possible to use chicken offal from the Jamaican broiler industry as a principal source of protein for tilapia feed. This has greatly reduced the need for imports since fish feed imports, which was estimated in the project paper at US\$5 million for 1979-1985.

The production system selected by IFU was a logical choice for the initial development of tilapia farming in Jamaica. Although no part of this system requires high technology, the more difficult aspect, production of monosex finger-

lings, is accomplished by the government. The production cycle, fingerlings to marketable size, can be accomplished in 10 - 15 weeks, yielding a rapid return and permitting up to three crops per year.

The project has accomplished its primary objective of establishing economically viable tilapia farming given the technical and financial assistance now provided by government. Profitability projections indicate that farms will continue to be economically viable even when the owners have to produce their own seed or buy it at unsubsidized prices, purchase their own harvesting nets and get their fish to market in good condition without government help.

Government efforts obviously must continue in the current direction to reach the expansion goals specified in the project paper. It is equally important, however, to modify procedures to reduce production costs.

#### 9.2.2 Recommendations Concerning Production Systems.

1. Continue application of the present system as a basis for increasing the number of small farms with emphasis on meeting the fingerling and fry requirements until the private sector can fulfill this demand. To accomplish this IFU should hire and train adequate numbers of personnel and use all available facilities at Mitchell Town and Meylersfield for fry and fingerling production.
2. Test the commercial applicability of alternative systems for minimizing the effects of reproduction, including:
  - a) use of monosex fry produced by hormone treatment;
  - b) development of commercially applicable systems for positive sorting of males for growth to filleting size; and

c) use of monosex hybrids.

3. Emphasize development of economical systems for producing large sized tilapia suitable for filleting.

### 9.3 Processing and Marketing Systems

Tilapia nilotica culture is just beginning in Jamaica, although the less desirable Tilapia mossambica were initially grown in farms and are still caught in streams and lakes where wild stocks exist. Farm production was only 230,000 pounds in 1981 and virtually all of this was sold at retail or to small scale retailers known as "higglers" as whole fish at the farms or at nearby government installations. Processing, if any, consists of removal of guts and gills and scales, but most are sold fresh in the round. Institutional buyers may freeze the fish. Some of the larger producers have recently began hand filleting of 0.5 lb. fish on an experimental basis to determine processing costs and market acceptance.

Consumers will buy tilapia as small as 0.25 lb. but prefer 0.5 lb. fish. Even 2½" (0.04 lb.) fish sell for 30¢ per pound as "soup fish". Reportedly, Jamaicans dislike fish with many bones, so some market resistance to smaller tilapia is expected. It appears that boneless fillets cut from larger fish (0.75 - 1.50 lbs.) would be an acceptable product form for Jamaica and in the future for export markets. Mass production of fillets would require a large labor force or use of mechanical filleting machines.

#### 9.3.1 Evaluation

As farm production expands, selling tilapia in Jamaica and later in export markets may require other product forms. These might include smoked or salted products prepared from headed, gutted and skinned fish or fish sticks and portions

prepared from the comminuted flesh separated by a mechanical deboning machine. Procedures for preparing these products are well known and may be applied by processors without government assistance.

Long-range planning for the expansion of tilapia farming should include a marketing study to project domestic and export demand and to identify desired product forms. The Project Paper indicated that plans were being formulated for a joint USAID/GOJ marketing project which would include tilapia, but the fisheries portion of this project has not yet been implemented. Without this project, it would be desirable to include a marketing component in the Fish Production System Development Project.

#### 9.3.2 Recommendations Concerning Processing and Marketing.

1. Conduct a marketing study as a guide for the long-range development of tilapia culture in Jamaica. This study should provide a projection of domestic and export demand and identify desired product forms. If such a study is not included in the proposed USAID/GOJ Comprehensive Marketing Project, it should be accomplished separately.
2. As production of larger tilapia increases, encourage development of processing plants with facilities for preparing boneless fillets and other product forms with adequate systems for sanitation and quality controls.

#### 9.4 Production Economics

The profitability of large and small scale tilapia farms projected in the Project Paper (1979) indicated favorable benefit/cost ratios. Farms using fertilizer and supplemental feed have ratios of 3.00 to 6.11; those using fertilizer only had ratios of 1.81 to 2.42. All farms, except for a few subsistence ponds, now use prepared feeds as well as organic or inorganic fertilizer.

#### 9.4.1 Evaluation

The projected profitability of large scale farms operating under average conditions in 1982 is compared with the 1979 projections in Table III. Although time did not permit a complete analysis of current operating costs, it is clear that profitability of tilapia farming is at least as high and probably higher than estimated in 1979. This is largely because the sale price has increased more than the cost of production inputs and because production can now be projected at 6,600 lbs/acre/year up from 6,000 lbs.

It also appears from the analysis summarized in Table III that large farms can well afford to pay the real cost of male fingerlings or mixed sex fry whether purchased from a government hatchery or a commercial seed producer or produced on their own farms. Furthermore, the high productivity of well managed farms such as that operated by Mr. Barker (up to 7,800 lbs/acre/yr.) indicates significant potential for increasing profitability as the industry develops.

It is important that IFU encourage farmers to maintain cost records which will permit evaluation of profitability of selected operations and the industry as a whole. The largest farms could undoubtedly improve their profitability by use of low priced micro-computers to maintain and analyze cost, production, and water quality records.

#### 9.4.2 Recommendation Concerning Production Economics

1. IFU should maintain records of production, processing and marketing costs for representative groups of farms and the sale price of the product as a basis for providing financial advice, especially to small scale farmers. The information would also be useful as a guide for the future development of tilapia farming in Jamaica. This probably will require the use of computer programs.
2. IFU should encourage farmers to keep good production and cost records to help them improve their profitability.

TABLE III  
COMPARISON OF NET RATE OF RETURN PER ACRE PER YEAR  
FOR AVERAGE LARGE FARMS - 1979 and 1982.

<u>ITEM</u>	<u>1979<sup>(6)</sup></u>	<u>1982</u>
Conversion rate of feed	1.5	1.5
Pounds of fish produced/A	6000	6600 <sup>(1)</sup>
Total feed costs	1710 <sup>(2)</sup>	2772 <sup>(2)</sup>
Total fertilizer costs	189	78
Total fingerling costs	900	1800 <sup>(4)</sup> - 2160
Harvest costs		660
Water	75	120 - 150
Labor	564	540
Maintenance	25	25 <sup>(3)</sup>
Replacement (15 year average)	<u>230</u>	<u>230 <sup>(3)</sup></u>
Total costs	3693	6225 - 6615
Sale price/lb.	<u>85 <sup>(5)</sup></u>	<u>1.60 <sup>(5)</sup></u>
Returns/A (1979 = 6000 lbs.; 1982 = 6600 lbs.)	5,100	10,560
Operating costs/lb.	0.62	0.94 - 1.00
Profit on operating costs/lb	0.23	.66 - .60
Profit on sales	27%	41% - 38%

1 - Maximum 7,800 lbs./A/yr at Barker's farm.

2 - 1979 = 0.19/lb; 1982 = 0.28/lb.

3 - Cost 1982 unavailable

4 - 1979 = 0.05; 1982 = 0.10 (IFU), 0.12 (private).

5 - 1979 = 73 - 1.50; 1982 = 1.60 - 1.80.

6 - From Project Paper.

## 9.5 Fish Supplies for Jamaica

At the debriefing session on May 26, the Evaluation Team was requested to suggest actions needed for Jamaica to meet its need for fish. The following discussion is included in response to this request.

A Jamaican official reported at a recent International fisheries conference at Kingston that current demand for fish in Jamaica is 80 million pounds. Jamaican landings are 20 million pounds leaving a deficit of 60 million pounds now provided by imports.

Tilapia farming at the completion of the current project is scheduled to reach 6 million pounds which will still leave a shortfall of 54 million pounds. Meeting the fish supply deficit by tilapia farming would require 10,000 acres of ponds--far more than could reasonably be projected for Jamaica.

An alternative is for Jamaica to increase marine fisheries landings to meet this demand. At the present time, pelagic fish stocks which might migrate near to Jamaica are considered to be underutilized. This could be because local fishermen do not understand the migrating patterns of pelagic fish or that they do not have proper vessels or fishing gear to catch these species. In addition, deep water species which are not being harvested at present might provide the basis for a new fishery.

In contrast, the inshore waters of Jamaica are reportedly overfished. Therefore, it would be advisable to initiate a coastal fishery management program to develop a scientific basis for management, especially of demersal species. A sound management program would facilitate recovery of these stocks and thereby increase harvest levels.

## 9.6 Suggested Future R & D

The following projects are suggested to help Jamaica meet its fish requirements:

### JAMAICAN COASTAL FISHERY DEVELOPMENT PROJECT

- Duration - 5 years
- Cost - \$7.5 million
- Goal - To identify unexploited fishery stocks, including pelage fish stocks, which could be harvested by Jamaican fishermen. To develop fishing gear and fishing vessels most suited for the new fisheries.

### JAMAICAN COASTAL FISHERY MANAGEMENT PROJECT

- Duration - 5 years
- Cost - \$5 million
- Goal - To identify and quantify Jamaican coastal fishery stocks and recommend catch levels and other conservation methods to ensure that fish stocks reach a maximum sustainable yield level.