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FISH CULTURE PROJECT

(696-0112)

EVALUATION

OAR/RWANDA  
JANUARY 1985

# RWANDA FISH CULTURE (696-0112) - FORMATIVE EVALUATION

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## ACRONYMS AND ABBREVIATIONS

AID	Agency for International Development
CERAI	Integrated Rural and Artisanal Training Center (Centre d'enseignement rural et artisanal intégré)
EA	Environmental Assessment
ELADEP	Development of Lake Fisheries Project ( <u>Empoissonnement des Lacs et Développement de la Pêche</u> )
FAO	U.N. Food and Agriculture Organization
FRw	Rwandan Franc (FRw 100 = U.S.\$1.00)
GOR	Government of Rwanda
ha	hectare (1ha. = 2.471 acres or 100 ares)
IDRC	International Development Research Center (Ottawa)
MINAGRI	GOR Ministry of Agriculture, Livestock and Forestry
OAR/R	AID's Office of the AID Representative/Rwanda (Kigali)
PACD	Project Assistance Completion Date
PIL	Project Implementation Letter
PPN	GOR National Fish Culture Project ( <u>Projet Piscicole National</u> )
PP	Project Paper
PSC	Personal Services Contract(or)
REDSO/ESA	AID's Regional Economic Development Services Office/ East and Southern Africa (Nairobi)
RFMC	AID's Regional Financial Management Center (Nairobi)
UN	United Nations
UNR	National University of Rwanda

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## RWANDA FISH CULTURE (696-0112) - FORMATIVE EVALUATION

### I. INTRODUCTION

#### A. Summary Focus of the Project

A shared concern of the Government of Rwanda (GOR) and AID is to promote increased food production to keep pace with Rwanda's rapidly growing population. While the focus is necessarily on increasing the production of staple grain and tuber crops, the GOR is also giving priority to maximizing the potential of fish culture and fisheries in Rwanda. Given the scarcity of range lands, fish culture presents an attractive alternative to livestock production as a source of nutritious food while using relatively little land. Fish is nutritionally equivalent to meat as an important source of protein, calories and essential minerals.

There is a tradition of fish culture in Rwanda dating from the 1940's. The primary constraint to increasing production levels, which have generally remained marginal over the years, is the lack of effective farmer training in the techniques of fish culture. The GOR initially approached AID in October 1977 about assistance in supporting a national fish culture program based on a viable extension service. Negotiations flagged on the question of Peace Corps participation until the project as presently designed was authorized by AID in September 1981. It was agreed that Rwandan moniteurs piscicoles (fish culture extension agents) could be trained to function effectively without supplementary support from Peace Corps Volunteers. As stated in the Project Paper (PP), the project is directed towards the dual goals of increasing the availability of nutritious food for rural families in Rwanda and increasing the incomes of participating families. The purpose of the project is to develop a fish culture extension service which can provide the assistance and advice required by Rwandan families to: (1) bring back into production and effectively manage at least 80% of the (estimated) 3,000 fish ponds which already exist in the country and (2) establish 50-100 new ponds per year<sup>1/</sup>. If achieved by the scheduled completion of the project in September 1987, and in concert with the other agricultural production-oriented projects in the OAR/R's portfolio, the project purpose should have a positive impact on the project goals.

Known as the National Fish Culture Project (Projet Pisciculture Nationale, PPN), the project is being implemented through the Ministry of Agriculture, Livestock and Forestry. The PPN operates, however, from the National Fish Culture Center at Kigembe, about 20 kilometers south of Butare. The Kigembe Center has three functions: (1) it is the administrative headquarters of the PPN; (2) it is the national training center for fish culture; and (3) it is a zonal fish station for the

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<sup>1/</sup> It is noted that the statement of the project purpose in the Project Paper's Amplified Project Description does not include point (2). There is no special reference to targets for the construction of new ponds.

production of fingerlings and fish for sale. Project funds are being provided for long-term advisory support in training and extension; construction and renovation of zonal fish stations; equipment and supplies related to training, extension and the practice of fish culture; vehicles, motorcycles and bicycles for extension outreach; and local support costs for training, station management, administrative staff, vehicle operating costs, travel allowances, etc. The GOR's contribution to the project is most importantly the extension staff (moniteurs and their supervisors, the agronomes) and the PPN headquarters staff, including the Project Director. An in-kind contribution is represented by the infrastructure at the Kigembe Center and at the zonal fish stations participating in the project.

As designed, the project was to be implemented in phases. During the first phase, which would be essentially Year 1 of the project, fish culture extension services would be put in place in three of Rwanda's ten prefectures. Following training at the Kigembe Center, moniteurs would be assigned to communes to work directly with farmers in improving pond management and increasing fish production. The moniteurs would be supported and supervised by prefectural-level agronomes who would also be responsible for managing a fish station for demonstrations, fingerling production and research. In the following phases of the project, additional personnel would be trained and additional fish stations would be renovated to provide extension coverage in the remaining seven prefectures. By the end of the project, a viable fish culture extension service would be operational on a nationwide basis. To date implementation progress has been seriously hampered by internal management problems and a concomittant "ripple effect" on field activities. This situation reflects the complexity of the project's scope and also confirms the timeliness of this formative evaluation.

#### B. Purposes of this Evaluation

As stated in both the Project Paper's Evaluation Plan and the Amplified Project Description's Evaluation Plan, an external "assessment" of the project would be scheduled at the beginning of the third year of project implementation to: (1) assess the overall progress being made to achieve the project objectives and (2) suggest changes in project objectives and operations which the evaluation team deems necessary. In establishing the terms of reference for the evaluation, the Office of the AID Representative in Rwanda (OAR/R) further refined these two broad purposes. As jointly agreed with the GOR, the more specific objectives of the evaluation are to:

- "determine the status of project implementation;
- determine if the original project design remains valid;
- determine whether all participating parties are adequately contributing to project implementation;
- evaluate the training program;
- recommend where cost-savings may be effected; and recommend
- any changes needed in project documentation."

The objective related to cost-savings has been addressed in a financial review of the local operating budget for the PPN which includes both AID project funds for local support costs and revenue from various income-generating activities. The accountant's report should be reviewed in conjunction with this evaluation report.

In addition to the above objectives, the evaluation will focus on:

- an analysis of management constraints;
- progress to date in institutionalizing the fish culture extension service, including staff development and training and outreach to participating farmers; and
- an analysis of production targets and the profitability of fish culture as an on-farm and/or cooperative enterprise.

#### C. Evaluation Team Membership

Although the evaluation plans in the PP and Project Agreement indicated that the formative evaluation could be undertaken by one GOR representative and two AID consultants, OAR/R decided to broaden the membership to include other specialized services. The team members included:

- Ms. Dianne Blane, Project Development Officer, REDSO/ESA (Team Leader)
- Mr. J. Bosco Kabagambe, Aquaculturalist and Chief of the Division of Fisheries and Fish Culture, MINAGRI
- Mr. James W. Miller, Fish Culture Specialist (Contract)
- Mr. Edward Robins, Social Science Advisor in OAR/R
- Mr. Prosper Ciza, Chief of the Rural Development Division, Ministry of Plan
- Mr. Fred Guymont, Engineer, REDSO/ESA

The evaluation team wishes to thank Mr. Alphonse Karangwa, the PPN Project Director, Mr. Nathaniel Hishamunda and Ms. Pelagie Nyirahabimana, as well as Ms. Karen Veverica and Mr. John Moehl, the Training Advisor/Team Leader and Extension Advisor, respectively, from GOR and Auburn University. The team took a series of field trips to visit the Kigembe Center, zoral fish stations and private/cooperative fish ponds and greatly appreciates the many interviews with the moniteurs, agronomes and fish farmers.

#### D. Methodology of the Evaluation

The evaluation team has examined the project from various perspectives:

- institutional and administrative
- technical
- financial
- economic
- sociological/socio-economic (beneficiary participation)

Attention has also been given to project implementation management with specific reference to the OAR/R, the MINAGRI and the contractor.

The above analyses on which the recommendations are based have been supported by extensive personal and group interviews and interaction, site visits to fish culture operations both within and outside the geographic parameters of the project at present, and a documentation review. PPN and AID files, records and reports have also been studied.

## II. SUMMARY CONCLUSIONS AND RECOMMENDATIONS

### A. Summary Conclusions

#### 1. Relevance: Progress toward Achieving the Project Purpose

To develop a fisheries extension service in Rwanda which can provide the assistance and advice required by Rwandan farm families to bring back into production and effectively manage at least 80% of the approximately 3,000 fish ponds in the country (from the Project Agreement's Amplified Project Description, Annex 1).

Implementation of the project was effectively initiated with the arrival of the technical assistance team in May 1983. Given the gap of more than a year and a half between authorization of the project (September 1981) and the team's arrival, the Project Assistance Completion Date was extended by two years, from September 1985 to September 1987. With the time remaining in the project - approximately 33 months - it is apparent to the evaluation team that fish culture extension services cannot be provided on a countrywide basis. Delays have been encountered in both in-country training of moniteurs, third country training of agronomes, as well as in construction and renovation at the Kigembe Center and the zonal fish stations. Some delays are inevitable and are a fact of life in the implementation of all donor projects. To the extent that the project design reflects a "model" project, it can be faulted with being unrealistic in terms of the scope of the project, the complexity of the undertaking (especially extending a relatively sophisticated technology) and the timeframe. Management of the PPN would be an extremely challenging task in the best of circumstances. Unfortunately interpersonal and professional communications have broken down on all sides: the PPN Project Director, the technical assistance team, the MINAGRI and AID. Rather than placing the blame for poor management of the project on anyone, or all parties, the evaluation team has attempted to recommend corrective actions which, if acceptable, will hopefully remove the constraints to implementation progress. The evaluation team wishes to emphasize the importance now of quality in fish culture extension services rather than quantity (number-crunching). For this reason the team recommends that project interventions between now and the scheduled completion of the project in September 1987 be geographically limited to zones within five of Rwanda's ten prefectures. If management improvements have been realized and collaboration between all the parties has been re-established, then

progress in infrastructure improvements, training and extension activities will follow. An effective and efficient fish culture extension service will have been developed covering the five most important prefectures for fish culture in Rwanda, and it is estimated that at least 80% of the fish ponds within those prefectures will have been brought back into production. Most importantly, the Rwandan farm families will have access to the technology and inputs required to make fish culture an attractive private and/or cooperative enterprise and source of nutritious food.

2. Effectiveness: Progress in Achieving the End-of-Project Status (from the Logical Framework in the PP)

- (a) 2,400 fish ponds being adequately managed and harvested throughout the country (average yield: 15 kg/are/yr.).

In spite of poor project management which has caused delays in construction, extension, training, efficient control of the local cost budget (resulting most egregiously in delinquent salary payments to some moniteurs and support staff), progress has been made towards attaining quantifiable targets in the field. The PPN-trained moniteurs are performing reasonably well and are maintaining good morale in the absence of effective technical and administrative support from their direct supervisors; the agronomes, and the Project Director. Project activities are presently concentrated in five prefectures (Table 1). It should be noted that only those communes within the Kigali and Gisenyi prefectures with a concentration of fish farmers and ponds have been selected for participation in the PPN at this time. For this reason, it is more appropriate to speak in terms of project activities in zones rather than prefectures. Each zone will have its own zonal fish station under the management of an agronome. In the Butare project zone, however, there are two zonal fish stations: the Kigembe Center (Butare South) and at Runyinya (Butare North). There are, therefore, six PPN zones in five prefectures. It is totally unrealistic to consider expansion of the PPN into all ten prefectures during the remaining 33 months of the project. Collaborative project management, an effective extension methodology and fish culture techniques must be perfected before expansion can be considered.

The PPN is directly assisting 1,458 fish farmers, owners of 525 ponds with a total surface area of 14.7 hectares (ha.). A complete census of ponds in the PPN zones of activity indicates a total of 1,573 ponds covering 43.72 ha. (Table 2). In light of the management difficulties which have hampered progress during the first two years of project implementation and, as discussed in Section 1 above, in order to focus on quality and effectiveness of services and operations during the remaining period of the project, it is recommended that the renovation and management of 80% of the ponds in the present zones be established as a revised quantified factor in the project purpose and condition to be achieved by the end of the project. Thus 1,258 ponds (80% of 1,573) would be renovated and "adequately managed" by the end of the project in September 1987. Since the PPN is currently assisting farmers with 525 ponds, 42% of this more realistic target has been achieved to date. Because census information is still somewhat incomplete, however, the use of a new census form is recommended and presented in Table 3.

Table 1. Recommended Parameters of PPN Activity: Communes, Posting of Moniteurs<sup>4/</sup> and Number of Ponds

Prefecture	Commune	Number of Moniteurs		Number of Ponds
		1984	1985	Dec. 1985
1. Butare	1. Mbazi/Rusatira <sup>1/</sup>	1	1	39
	2. Nyanza <sup>1/</sup>	1	1	17
	3. Runyinya <sup>3/</sup>	1	1	43
	4. Shyanda <sup>3/</sup>	1	1	28
	5. Huye <sup>3/</sup>	1	1	12
	6. Maraba <sup>3/</sup>	1	1	8
	7. Muganza <sup>1/</sup>	1	1	19
	8. Kigembe <sup>2/</sup>	1	1	68
	9. Gishamvu <sup>1/</sup>	1	1	65
	10. Nyaruhengeri <sup>1/</sup>	2	1	79
	11. Kibayi <sup>3/</sup>	1	1	31
2. Gitarama	12. Nyakizu <sup>3/</sup>	1	1	43
	13. Runda <sup>1/</sup>	1	1	52
	14. Taba/Kayenzi <sup>1/</sup>	1	1	27
	15. Masango <sup>1/</sup>	1	1	21
	16. Bulinga/ Nyakabanda <sup>1/</sup>	1	1	47
	17. Mushubati <sup>2/</sup>	1	1	36
3. Gikongoro	18. Musange <sup>1/</sup>	1	1	13
	19. Mubuga/ Rwamiko <sup>1/</sup>	1	1	66
	20. Kinyamakara <sup>1/</sup>	1	1	48
4. Kigali North	21. Nyamagabe <sup>3/</sup>	0	1	32
	22. Rushashi <sup>2/</sup>	1	1	
	23. Tare <sup>3/</sup>	1	1	223
	24. Musasa <sup>3/</sup>	0	1	
5. Gisenyi	25. Shyorongi <sup>3/</sup>	1	1	
	26. Kanama <sup>1/</sup>	1	1	
	Kanama <sup>3/</sup>	0	1	202
	27. Karago <sup>2/</sup>	1	1	50
	28. Giciye <sup>3/</sup>	0	1	69
	29. Satinsyi <sup>3/</sup>	0	1	44
	30. Kibilira <sup>3/</sup>	1	1	104
<b>TOTALS</b>		<b>27</b>	<b>31</b>	<b>1,486</b>

<sup>1/</sup> PPN-trained in 1983; total of 13.

<sup>2/</sup> Trained under the former ELADEP project, total of 4.

<sup>3/</sup> To be trained in 1985

<sup>4/</sup> Based on Project files, results of the 5/84 pre-training qualifying text for moniteur, concentration of ponds, logistic conditions and AID funding.

Table 2. Summary Statistics and Status of PPN Activities<sup>1/</sup> December 1984

<u>A. Ponds and farmers assisted by the Project</u>	
1. Number of fish farmers	1,458 farmers
2. Number of "active" fish ponds <sup>2/</sup>	525 ponds
3. Total pond area	14.7 ha.
4. Number of farmers/pond	2.8 farmers
5. Average pond area	2.8 ares
6. Newly constructed ponds in 1984	58 ponds
7. New ponds under construction in January 1985	89 pond
8. Fingerlings (Tilapia sp.) distributed - 1984	89,000 fingerlings
9. % of total number of ponds which are active	33.3%
10. % of total number of active ponds where there is a <u>moniteur</u> (1,219 ponds) <sup>3/</sup>	43%
11. Number of ponds awaiting stocking	252 ponds
12. Number of ponds in renovation	76 ponds
13. Number of ponds stocked in 1984	378 ponds
 <u>B. Total ponds and farmers in present Project Zones<sup>1/</sup></u>	
1. Total number of fish farmers	4,370 farmers
2. Total number of fish ponds <sup>4/</sup>	1,573 ponds
3. Total pond area	43.72 ha
4. Number of farmers/pond	2.8 farmers
5. Pond area/farmer	1.0 are
6. Fish production à 4.13 Kg/are/year based on 165 pond harvests - these ponds were neither stocked nor supervised by PPN staff	18.056 kg
7. Total number of ponds in communes with <u>Moniteurs</u>	1,341 ponds
7. Total area of ponds with <u>Moniteurs</u> coverage (all not yet supervised)	37.27 ha

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<sup>1/</sup> Project zones: Butare North, Butare South, Gikongoro, Gitarama, Kigali North, Gisenyi.

<sup>2/</sup> Active means those ponds which have been stocked by the project and supervised by a moniteur trained under the project.

<sup>3/</sup> Represents the total number of ponds in the project zones assisted by the project at the time of the evaluation. It does not include the communes of Karago, Giciye, Satinsyi and Kibilira.

<sup>4/</sup> Includes a number of abandoned ponds which potentially can be renovated.

Table 3. Recommended modified census form

Census of Fish Farmers and Ponds Assisted by the National Fish Culture Project.

PPN zones	Number of Farmers			Number of Ponds		Pond Areas	
	Collective/ Coop	Individual	Institutional	Active	Not Active	Active (ares)	Not Active (ares)
1. Butare North	X	X	X				
2. Butare South							
3. Gikongoro							
4. Gitarama							
5. Kigali North							
6. Gisenyi							
<b>TOTALS</b>							

Table 4. Fish Culture Stations in Project zones with Tilapia Fingerling Production Estimates from Selected Areas.

Prefecture/Name of Fish Station <sup>1/</sup>	Number of ponds	Total Area of ponds (ares)	Area for Production %	(ares)	Potential Fingerling Production (Fingerlings/Year)
1. Butare South Kigembe	77	1,000	20	200	440,000
2. Butare North Runyinya	10	90	100	90	198,000
3. Gikongoro - Nkungu	16	210	75	157	345,400
4. Gitarama Rugeramigozi	16	180	for yield trials		
5. Kigali-Rushashi	8	120	50	60	132,000
6. Gisenyi-Ndorwa	14	56	For yield trials - 1987		
<b>Totaux</b>	<b>141</b>	<b>1,656</b>	<b>-</b>	<b>507</b>	<b>1,115,400<sup>2/</sup></b>

<sup>1/</sup> Tilapia fingerling production - based upon 2,200 fingerlings per are per year - which has already been attained in Rwanda.

<sup>2/</sup> Double this fingerling production is entirely feasible even in the cooler temperatures of Rwanda. Up to 25,000 fingerlings of Tilapia Nilotica have been produced in 100 m<sup>2</sup>/year in the Ivory Coast.

Table 5. Estimated Current Costs of Tilapia Fingerling Production at the Gikongoro Fish Station.

<u>Input</u>	<u>Cost (FRw)</u>
1. <u>Labor</u> - 10 laborers at 1/4 of time for fingerling production 10 X 100 Frw/day X 25 days/mo X 12 months : 4 =	75,000
2. <u>Feeds</u> - Spoiled bulgar or rice and rice bran at 11 Frw per Kg - Fed at 5%/day about 2,500 kgs 2,500 kg X 11 FRw =	27,500
3. <u>Transport of fingerlings</u> - Radius of 50 km from station - Truck comes 55 km from Kigembe - 110 km + 100 km = 210 kms round trip - 6 deliveries/year - 68,2 FRw cost/liter of fuel for truck - 15 l/100 km gas consumption (0,15 l/km) - 6 X 210 kms X 0,15 l X 68.2 =	12,890
<u>Total Cost for 20.000 tilapia fingerlings=</u>	<u>115,390</u>
Cost/fingerling $\frac{115,390 \text{ Frw}}{20,000} = 5.77 \text{ Frw}$	

Source: Agronome - Mr. Augustin NKURUNZIZA

Table 6. Estimated 1984 Financial Position of General Zonal Fish Stations

Station	Expenses (FRw)			Receipts (FRw)			Profit or loss (+or-)
	Pond agement	Man- Diverse <sup>1</sup>	Total	Fish Sales	Divers <sup>1</sup>	Total	
Butare-							
Runyinya	193,500	87,400	280,900	16,440	0	16,440	-264,460
Gikongoro	239,300	207,900	447,200	19,440	10,900	21,340	-425,860
Gitarama	223,048	232,192	455,200	5,380	19,140	24,520	-430,680
Kigali North	17,500	11,100	28,600	0	0	0	- 28,600
	<u>673,348</u>	<u>538,552</u>	<u>1,211,900</u>	<u>41,260</u>	<u>30,040</u>	<u>62,300</u>	<u>-1149600</u>

<sup>1/</sup> Divers expenditures/receipts are largely comprised of gardening activities of questionable economic viability.

Source: Annual Report of the PPN Extension Service, 1984; Kigembe data were incomplete.

Because of the relatively high altitude (average of 1,700 meters), cooler temperatures and very limited availability of fish feeds and fertilizers, the growing season of fish in Rwanda - 8/12 months - is longer than elsewhere. The minimum acceptable/marketable size of tilapias for local consumers, however, has not yet been evaluated. If small-size fish prove to be acceptable, a long production period-growing season may not be required.

Baseline production data collected from 165 ponds stocked with tilapias and managed without PPN assistance/support indicate a mean production of 4.13 Kg/are/year. The first ponds to be stocked and closely monitored by PPN staff will be drained and harvested following this evaluation. One pond was harvested prior to the evaluation team's departure, however, and the results were encouraging: during a production period of 288 days in a 2.26 are pond, a net yield of 7.43 kg/are/year was obtained. Thus base production was almost doubled as a result of PPN assistance and should be further increased as techniques are improved and the agronomes become effective supervisors. Much work and training of extension personnel and farmers must be done before the target yield of 15 Kg/ar/year can be obtained. Nevertheless, at least for the "best" farmers, this target is considered realistic by the evaluation team.

(b) At least 50 new ponds established during the final year of the project (note: contradicts the PP's project purpose which states that 50-100 new ponds will be established per year).

Although 1983 data on pond construction are incomplete, 58 new ponds were built in 1984. It should be noted that a growing interest in fish farming is evidenced by the 89 new fish ponds under construction in the project zones in January 1985. It is anticipated that new pond construction will exceed the target of 50-100 in each remaining year of the project.

(c) Ten prefectural fisheries stations are operational (i.e., fully staffed by trained personnel, producing 1.3 million fingerlings per year, providing training for local farmers)

Of the six fish stations in the PPN zones (Table 4), the evaluation team considers that only two - Butare north and Gikongoro - are fully operational. Management at all stations is very poor, with commercial production at best at one-half to one-third of the potential. Current tilapia fingerling production ranges from only 2% to 10% of capacity attained in the past in Rwanda (200 fingerlings/are/year). The target for fingerling production of 1.3 million per year is easily attainable. As indicated in Table 4, a minimum of 1.1 million per year can be produced at only 6 fish stations.

Cost data on tilapia fingerling production have not been collected by PPN staff. On the basis of interviews with staff, however, the evaluation team technician estimated the cost to be Frw 5.77 per

fingerling. The current estimated costs of tilapia fingerling production are presented in Table 5 and include costs for labor, feeds and transport. Improved management and increased fingerling production could reduce costs to less than Frw 2/fingerling: Tilapia nilotica fingerlings (8 gm.) are produced for less than \$ .02 each in the Ivory coast.

Station management in general is characterized by nonchalant record-keeping by the agronomes (species not separated, numbers and mean weights often lacking, inability to accurately calculate fish production, etc.), high fish mortalities (one pond at Kigembe had an 8.7% survival of tilapias produced during the period 7/25/84 to 1/18/85) and general lack of a station management plan. All zonal fish stations operated at a significant financial loss in 1984 (Table 6). Receipts from four stations Butare North, Gikongoro, Gitarama and Kigali North only equalled 5% of estimated expenses. The total operating loss in 1984 is estimated at Frw 1,149,600 (\$11,496).

Divers expenses and income are largely from gardening activities. The use of station personnel for such work is very questionable. Use of GOR-paid labor for such activities is inefficient and should be discontinued unless the crops which are cultivated are high-yielding and high in commercial value. On the other hand, integrated agriculture (crops-fish) is to be encouraged in the extension message because production is consumed by the farm family. The renovation of ponds and the construction of a modest facility including an office, store room and holding tanks are planned at all fish stations in the PPN zones.

(d) GOR providing budget adequate to support 12 professional and 50 para-professional fisheries staff members.

Apart from excessive indemnities (basically per diem for overnight site visits) paid to the agronomes and PPN headquarters professional staff with AID project funds, the GOR pays the salaries of all personnel at this level. Currently 23 of the 33 PPN moniteurs are on the MINAGRI rolls. The GOR's support of all staff is anticipated in 1986. It is recommended that the scale of indemnities now being paid to the PPN professional staff be examined with a view to reducing it and/or requiring accountability for payment, especially taking into account the GOR's ability to continue such payments after completion of the project.

#### B. Evaluation Recommendations

The evaluation team recommends that the National Fish Culture Project, in collaboration with the PPN's Management Committee, the MINAGRI, and OAR/R undertake the following operational and corrective actions which have been grouped in four categories: institutional development, research, construction and project management. It is important to note that the category of "institutional development" is further divided into four sections which correspond to the functions of the PPN: management, training and extension. The category "project management" refers specifically to the functions of the principal parties who have an inherent interest in the successful implementation of the

project, i.e., the MINAGRI, OAR/R and Auburn University. The rationale and analyses on which the recommendations are based are then discussed in detail in the following sections of this evaluation report.

1. Institutional Development

(a) Management

(1) In light of poor management of the project, which is the primary constraint to progress, and considering that about half of the project budget has been expended with little accomplished, project-related activities should be limited to the following geographic zones (Region I and II):

Region I: Butare  
Gitarama  
Gikongoro

Region II: Kigali North (Bumbogo sub-prefecture)  
Gisenyi East (the Kanama, Karago, Giciye,  
Satinsyi and Kibilira communes)

(2) The Amplified Project Description, Annex 1 of the Project Agreement, should be redrafted to reflect accurately what the project intends to achieve during its life and the implementation procedures which are being followed to achieve the intended goal, purpose and outputs. This will require a restatement of the conditions expected at the end of the project and a revised, detailed project budget.

(3) A revised 1985 work plan should be prepared. It should include a narrative discussion of the activities which will be undertaken during 1985, a schedule/calendar of events by month and a detailed budget of funding requirements which will be provided by both the GOR and AID. The revised work plan should be countersigned by the Team Leader of the technical assistance team prior to submission to the Management Committee for endorsement and to MINAGRI and AID for approval.

(4) Annual work plans for 1986 and subsequent years should be prepared in the same format and include the same level of detail as that required for the 1985 work plan. All work plans should be countersigned by the Team Leader of the technical assistance team prior to submission to the Management Committee for endorsement and to MINAGRI and AID for approval.

(5) All project-related documents and submissions to MINAGRI and AID should be countersigned by the Team Leader of the technical assistance team.

(6) Another internal evaluation of the project should be scheduled between September 1985 and January 1986. The purpose of the evaluation will be to determine to what degree close collaboration among the Project Director, the technical advisors and their counterparts, the MINAGRI and AID has been established and management improvements have been realized. The evaluation team should be limited to two members, one from MINAGRI and one from AID.

(7) A position description for the Project Director should be prepared which sharply defines his/her responsibilities for directing the national fish culture program.

(8) Position descriptions should be prepared for the Training Advisor/Team Leader and the Extension Advisor which sharply define their respective responsibilities.

(9) Position descriptions for both Rwandan A-Os, counterparts to the Training Advisor and the Extension Advisor, should be prepared which sharply define their respective responsibilities.

(10) An A-2 agronome should be assigned as the manager of the Kigembe Center as soon as possible. The manager should also assume other responsibilities which are compatible with station management.

(11) The Kigembe Center and the zonal fish stations should be operated on a self-financing basis. This policy implies that present personnel levels must be reduced and that fish will be produced for sale. This will require preparation of a detailed management plan for each station including the Kigembe Center.

(12) Revenues generated from the sale of fish and other products at the Kigembe Center and the zonal fish stations should be used to purchase fish food for commercial fish production.

(13) Financial management, with specific reference to AID procedures and requirements should be improved to assure the timely receipt of local support costs. Implementation of the project on a deficit basis is not acceptable.

(14) The Management Committee should examine the scale of indemnities now being paid on a monthly basis to the Project Director and the A-2 agronomes with a view to reducing them and/or requiring accountability for payment and taking into account the GOR's ability to continue such payments after completion of the project. Following from this recommendation the Project Director should remit to MINAGRI's "special account" (revenue generated from the sale of fish and other products at the Kigembe Center and the zonal fish stations) the sum of FRw 225,000. Access to the account should be controlled by dual signatures.

(b) Training

(15) The A-2 agronomes should receive refresher training in management and extension techniques. A proposed curriculum is attached as an annex to this report. The training course could be presented in collaboration with the National University of Rwanda (UNR) in August 1985. The Project Director and the Team Leader of the technical assistance team should continue discussions with the UNR faculty concerning course content, designation of instructors and timing.

(16) Only one group of moniteurs should be trained in 1985 rather than two groups as presently scheduled. Another group of moniteurs should be trained in 1986. This recommendation is based on the team's judgment that the tentative 1985 training program is too full.

(17) The Training Advisor and her counterpart should approve the curriculum content of all training which may be scheduled and offered by "external" instructors.

(18) The Training Advisor and her counterpart should continue the preparation and printing of instructional materials on a priority basis. The instructional materials will be useful references for the agronomes and moniteurs when they have assumed their field-based extension responsibilities.

(19) A minibus should be purchased to transport trainees from the Kigembe Center to various sites for practical field work. The cost of the minibus may be partially offset by the sale of the deadlined Landrover and the Toyota Stout pick-up.

(20) The four small, abandoned houses at the Kigembe Center should be renovated to serve as dormitories for trainees. This will permit separate facilities for male and female trainees as well as lodging more conducive to effective training.

(21) The Project Director should participate in the "Francophone Development Management Seminar" offered at the University of Pittsburgh in June-August 1985. Following completion of the seminar, the Project Director should visit Auburn University.

(c) Extension

(22) Each agronome assigned to a zonal fish station within the project's regions (see recommendation no. 1) should prepare an annual work plan in collaboration with the Extension Advisor. The work plan should include quantitative targets to be accomplished during the year. Examples of such targets include the number of moniteurs to be supervised, the number of site visits to be undertaken, the number of "project ponds" to be managed, the number of new ponds which can be constructed, the number of ponds to be managed for both fingerling production and fish production at the zonal station, etc.

(23) On the basis of the annual work plan, a position description for each agronome should be prepared which sharply defines his/her responsibilities. The position descriptions should be prepared in collaboration with the Extension Advisor. A copy should be provided to the agronome, and his/her continuing assignment to the project should be annually evaluated on the basis of actual performance measured against the responsibilities and accomplishments agreed upon in the position description and annual work plan.

(24) Pursuant to the above recommendation, an annual work plan with quantitative targets and a position description should be

prepared for each moniteur assigned to communes within the project's regions. The work plan and position description should be prepared jointly by the Extension Advisor and the agronome-supervisor in collaboration with the moniteur.

(25) The agronomes should meet monthly with the Project Director, the Training Advisor, the Extension Advisor and their counterparts. On alternate months (i.e., every other month), the meetings should be held for 2-3 days in one of the zones within the project's regions in order to provide an opportunity for more effective and intensive information exchange and comparison of experiences in the field.

(26) Data collection efforts should be strengthened. An accurate census of ponds within zones should be completed as soon as possible. Other statistics and data necessary to calculate fingerling requirements (such as pond area, etc.), costs of production, etc. should be collected and analyzed on a routine basis.

(27) Project funds should not be used to renovate or otherwise improve the "colonial" ponds. Consideration might be given, however, to periodically stocking the ponds within the project's regions if excess fingerling production is available for distribution beyond the requirements of the zonal fish stations and on-farm ponds.

(28) Experimentation with mixed fish-petit\_elevage farming should be encouraged.

(29) Farmer-group demonstrations in the rural areas, at the zonal fish stations, and possibly also at the Kigembe Center, should be undertaken on a periodic basis. To reinforce demonstrations, the booklet on fish farming, "Sinon Raises Fish," should be translated into Kinyarwanda and distribute to participating farmers.

(30) The agronomes and moniteurs should advise farmers to coordinate their fish production and harvesting calendar among themselves so that the supply of fish is distributed more evenly throughout the year. The agronomes and moniteurs must then assist the farmers in following this advice.

(31) Extension activities should pay particular attention to increasing the participation of women. At a minimum, two positive steps should be taken: women moniteurs should be recruited for assignment to the PPN and efforts should be made to work with women fish farmers, either individually or in cooperative groups.

## 2. Research

(1) The recommendations for production trials made by Dr. Phelps from Auburn University should be implemented as soon as possible.

(2) The collection of socio-economic data begun in 1984 should be continued throughout the remaining period of the project. This

data should be augmented by an extensive survey of on-farm perspectives of fish culture, the results of which will be processed into the training and extension programs. The employment of a Rwandan socio-economist to perform an on-going evaluation of the impact of the project is also recommended.

### 3. Construction

(1) First priority should be given to letting contracts for the construction of storerooms, offices and holding tanks at the Kigali North, Butare, Gitarama and Gikongoro zonal fish stations.

(2) Since it is working well, the practice of using Fixed Amount Reimbursement contracting should be continued.

(3) The four small, abandoned houses at the Kigembe Center should be renovated for use as student dormitories (same as recommendation no. 20, Institutional Development). All trainees could be housed in the four buildings, and the large room which is presently designated as dormitory space can be converted into either an additional classroom or a laboratory/study area.

(4) A low priority should be assigned to the construction of a sophisticated weir at the Kigembe Center. The proposed solution of using wood piles with rocks to control the river level is judged adequate for the present.

(5) Reinforcement of the levees along the stream bed would not only be expensive (about \$60,000) but would also not withstand the stream's current. Instead the stream bed should be cleared.

(6) A general maintenance program to clear vegetation and major obstructions in the stream bed should be undertaken as soon as possible and continued on a routine basis.

(7) More effort should be made to clear vegetation in the canals at all the stations in order to reduce scouring and reduce the habitat for snails.

(8) Routine maintenance of all the facilities, both completed and proposed, must be undertaken. Tasks such as sweeping, dusting and removing insect nests should be completed on a daily basis.

### 4. Project Management

(1) The Project Director and the Team Leader of the technical assistance team must collaborate on the timely and accurate preparation of required AID documentation, especially for requesting periodic advances to cover local support costs. (See also recommendation No. 13, Institutional Development.)

(2) OAR/R must take a much stronger role in project management. This will require frequent and regular meetings with the Project Director and the technical advisors to discuss actions required from all parties to implement the annual work plan(s).

(3) The relationship of the PPN to the MINAGRI should be clarified for all interested parties. Clarification is required with regard to lines of authority, transmission of documents, required clearances for documentation, etc. Once clarified, the relationship and procedures should be followed without exception.

### III. SUMMARY AND STATUS OF PROJECT INPUTS

#### A. AID-Financed Project Inputs

##### 1. General

The project was authorized by the A/AID on September 16, 1981. The estimated total cost of the project, to be implemented over four years (later extended to six years; see below), is \$3,059,000, of which the AID contribution is \$2,470,000. The PP included several waivers: (1) a nationality waiver and a single-source, non-competitive procurement waiver to permit the procurement of long and short-term technical services from the U.N. Food and Agriculture Organization (FAO); (2) a vehicle procurement source/origin waiver; and (3) a waiver of the host country cost-sharing requirement of FAA Section 110(a). The nationality and single-source, non-competitive procurement waivers were based on the argument that (1) AID would have difficulty recruiting technicians who were fluent in French and would be willing to live in rural Rwanda; (2) the AID office would be unable to provide the requisite administrative support to long-and short-term contract personnel; and (3) the FAO was, at that time, also implementing a potentially complementary project in lake fisheries development. The Project Authorization approved the vehicle and cost-sharing waivers, but stipulated that approval of the nationality and single-source, non-competitive waivers "should be made conditional on the failure of the effort to locate an eligible firm." The effort was ultimately successful: on the basis of competition, a technical proposal from Auburn University, dated July 28, 1982, was accepted by AID. A contract with Auburn University, was not signed, however, until March 7, 1983, nineteen months after authorization of the project. Given this delay in initiating project implementation, Project Implementation Letter (PIL) No. 3 extended the Project Assistance Completion Date (PACD) by two years - from September 30, 1985 to September 30, 1987 - to permit provision of the long-term technical services for the full period of four years as authorized in the Project Paper. (It should also be noted that in the interim it was decided that Kigembe Center was within commuting distance of Butare and that, consequently, the long-term advisors would be housed in Butare with convenient access to shopping, schooling and health facilities.)

The AID contribution to the project has been incrementally funded in FY 1981 and FY 1982. The following table presents a financial summary of the AID contribution.

FINANCIAL SUMMARY  
(as of 1/25/85)

<u>Input</u>	<u>Obligated</u>	<u>Earmarked</u>	<u>Committed</u>	<u>Disbursed</u>	<u>Balance of</u> <u>Unearmarked</u> <u>Funds</u>
Technical					
Services	\$1,000,000	\$633,550 <sup>a/</sup>	\$635,550	\$253,550	\$366,450 <sup>b</sup>
Training	130,000	39,100	39,100	23,965	90,900
Commodities	250,000	179,184	148,285	147,872	70,816
Construction	465,000	112,682	112,682	88,957	352,318
Local Costs	<u>605,000</u>	<u>440,058</u>	<u>224,516</u>	<u>224,516</u>	<u>380,484</u>
TOTAL	\$2,450,000	\$1,404,574	\$1,160,133	\$738,860	\$1,260,968

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a/ \$254,551 will be added o/a 9/30/86 to fully fund the Auburn contract.

b/ Will be used for technical services related to socio-economic studies, public health follow-up, the final evaluation, etc.

Source: AID financial records

The project was authorized by the A/AID on September 16, 1981, and the Project Agreement obligating a first tranche of \$500,000 was signed with the GOR only ten days later. During 1982 however, there was effectively no project activity pending resolution of the most appropriate contracting mode: either an AID-financed host country contract with FAO or an AID direct contract with a U.S. institution (see discussion above). During that interim and subsequent to the in-country arrival of the technical assistance team in May 1983, various conditions and assumptions made in the design of the project, and reflected in the project's financial plan (both in the PP and the Amplified Project Description), either changed and/or were proven incorrect. For example, funds were budgeted to continue the services of a Togolese director of the Kigembe Center; this was not necessary with the nomination of the present Project Director in June 1982. Also, funds were budgeted to contract with a Rwandan sociologist and economist to conduct "rolling" evaluations of the effectiveness of the extension methodology and of beneficiary impact. The Project Director did not concur with this evaluation approach, and alternative approaches for socio-economic data collection and analysis are being undertaken. Given the strong recommendation that the geographic parameters of the project be restricted to five zones over the remaining life of the project and in light of numerous inconsistencies between the Amplified Project Description and the status of the project, it is further recommended that the Amplified Project Description be redrafted. The revised project description should reflect accurately what the project intends to achieve during its life and the implementation procedures which are being followed to achieve the intended goals, purpose and outputs. This will require a restatement of the conditions expected at the end of the project (see Section II.A. above) and a revised, detailed project budget. Existing ambiguities in terminology and phraseology also must be eliminated. The document should serve as a constructive basis for project management for the GOR, and AID and the contractor.

## 2. Technical Services

As mentioned above, on the basis of competition, Auburn University was awarded a four-year contract for the provision of technical services to implement the project. The effective date of the contract is March 7, 1983. The negotiated cost of the contract is \$854,551, which is being provided to Auburn on an incremental basis; \$600,000 has been provided to date. The balance of \$254,551 will be provided o/a September 30, 1986. The long-term Training Advisor/Team Leader and Extension Advisor arrived only two months following signature of the contract. Under the terms of the contract, Auburn will also provide home office backstopping and a total of nine man-months of short-term specialized services. To date, two short-term specialists have been provided. Over a two-week period in August 1983 Dr. Emile Malek, a tropical medicine/health specialist from Tulane University, studied environmental health questions related to fish culture. His findings and recommendations and the status of their implementation are discussed below in Section VI. In April 1984 Dr. Ronald Phelps, a yield trial specialist, spent three weeks in Rwanda to assist in designing a yield trial program to ensure the collection of statistically valid production data (stocking rates, inputs of fertilizers and feeds, yields at harvest, etc.) using a minimal number of experimental ponds units.

Future requirements for short-term services may include additional technical advice from Dr. Malek and assistance in analyzing the statistical data collected from the yield trials. In addition, the Auburn campus project director, Dr. Donald Moss, (Associate Director, International Center for Aquaculture), has visited the project twice, in February-March 1984 and in January-February 1985.

### 3. Participant Training

As the basic building block for a viable fish culture extension service, training is perhaps the most important component of the project. Most of the training is being provided in-country; target groups include the moniteurs, the agronomes, teachers and leaders from other Rwandan institutions, such as the teachers of the Rural Artisan Training Centers (CERAI's), and farmers. Third country training is also being provided, however, to the agronomes so that they will be technically qualified to supervise the moniteurs and to manage the zonal fish stations. To date two agronomes have completed a 10 month training program (11/83-8/84) at the Centre de Formation Piscicole in Bouake, Ivory Coast. Two Rwandans are now attending this program and will also receive refresher technical training and instruction in extension techniques and management specific to conditions in Rwanda. The problems encountered to date in providing the first agronome refresher training course are discussed in detail in Section IV.B. below. In addition, one Rwandan, now the Chief of the MINAGRI Division of Fisheries and Fishculture, completed a Master's degree-level program in aquaculture at the African Regional Aquaculture Center in Port Harcourt, Nigeria (12/82-11/83). If two more agronomes receive advanced training in fish culture in 1985-86, a total of seven will have been trained, which is the quantifiable target in the PP and Amplified Project Description. In-service training in fish culture is planned for the Rwandan counterparts to the technical assistance team; the training will be provided at Auburn's International Center for Aquaculture, tentatively in February-June 1986.

As envisaged in the design of the project, a three-month training course in fish culture technology and extension work methods would be offered at the Kigembe Center to groups of moniteurs at least annually. A total of 50 moniteurs would be trained by the end of the project. To date only group of 13 moniteurs has been trained (9/83-12/83). No moniteurs were trained in 1984 due to delays in completing the water supply system for the Center. The system will be completed in February 1985, however, so that a second group of 15-20 moniteurs can be trained during this year. Assuming a third group will be trained in 1986 and a fourth group in 1987, it is possible that at least 50 moniteurs will be trained by the end of the project. If they are assigned to communes within five zones, their extension coverage will be both more intensive and hopefully more substantive than would be the case if they worked within ten zones.

Thirteen CERAI teachers were trained in pond construction and management in two 2-week sessions in 1984, and two more groups will be trained in 1985. In addition, students from the Nyagahanga Agricultural Girls School (graduates female A-2 agronomes) have been offered apprenticeships at the Kigembe Center. Two students completed 6-month apprenticeships in 1984, and two students are now working and studying there.

With the completion of the water supply system, the full training program can be implemented in 1985. Training sessions are planned for construction foremen at the zonal fish stations in pond construction and maintenance. Moniteurs trained in 1983 and earlier under the ELADEP project will also be given refresher training. Lastly, agricultural students at the National University of Rwanda (UNR) will be offered the opportunity to conduct field research under the PPN.

#### 4. Commodities

A procurement source/origin waiver for vehicles and motorcycles was approved concurrently with authorization of the project. The waiver authorized the purchase of four pick-up trucks, a passenger sedan and 22 motorcycles. Three Toyota Stout pick-ups have been purchased, one for the use of each advisor and his/her counterpart and one for general use at the Kigembe Center. The later vehicle is now basically deadlined following two collisions. Instead of a fourth pick-up, a Nissan Patrol (4WD) long wheel-base station wagon was purchased for its greater practicality and passenger-carrying capacity. A Toyota Corolla sedan was also purchased and is used exclusively by the Project Director. It is recommended that the deadlined Toyota Stout pick-up and a Landrover "inherited" from the former ELADEP project be sold and that the proceeds be used to at least partially meet the costs of purchasing a minibus. The minibus will be used to transport trainees for site visits, the essential complement to classroom instruction. Upon his assignment to a project zone, each agronome is given basic equipment and a motorcycle to support his extension duties, including periodic visits to supervise the moniteurs. Each moniteur is also given basic equipment as well as a bicycle to visit farmers in his commune(s) of responsibility.

Dormitory and office furnishings for the Kigembe Center were locally purchased. Office supplies and equipment, including reference and teaching materials, have been purchased as well as aquaculture equipment used for training and fish production. Each moniteur is given a basic tool kit including boots, a fish measuring board, a spring scale, bucket and thermometer. Fish handling equipment which has been purchased includes seine and dip nets, sorting baskets, surveying equipment for pond construction, agitators for the transport boxes. etc. Given the specialized nature of most of the equipment procurement, Auburn University has been contracted as the procurement services agent.

## 5. Construction

Construction activities under the project are focussed on improvements at the Kigembe Center and zonal fish stations. In PIL No. 5, dated May 25, 1983, OAR/R approved the construction plans and specifications for a training facility at Kigembe. It was estimated that the construction would be completed within seven months. Although the contractor performed well, delays in requesting and receiving advances and making payments to the contractor resulted in a considerable delay to May 1984 - in completing the structure. Construction of an office/storeroom complex, including fish holding tanks, at each of the zonal fish stations, plus the renovation of three houses at the Kigembe Center have not been started. Approval of this construction is contingent upon AID approval of the 1984 PPN work plan. Again, the repercussions of poor project management have resulted in considerable delays in project implementation. See also section 6. below.

The detailed discussion of the construction component of the project and recommendations based on current conditions and budgetary constraints are presented below in Section V.B., Construction.

## 6. Local Costs

The project budget in the PP and Amplified Project Description includes vehicle operation and maintenance, the employment of local support staff (an unspecified number of moniteurs, a secretary, chauffeurs, guards, etc.) for the Kigembe Center and the zonal fish stations and the costs of outreach activities with other training institutions under the category of "local support costs". For the purposes of AID financial management, however, local costs have been broadened to include in-country training, local consultant services (none procured to date but proposed for socio-economic research), housing rental for counterparts, staff indemnities, etc. This budgetary component of the project, as a major element for implementation of the annual work plans (the other major element being construction), has been extremely poorly administered. Requests for advances have not been prepared on a timely basis, and OAR/R approvals of these requests have frequently been delayed pending detailed documentation related to proposed expenditures. To the extent that the annual work plans have been prepared by the Project Director without the direct input and collaboration of the technical advisors, they have not been approved by AID and funds for all local costs -- including the local support costs -- have not been released. It is recommended that efforts to straighten out a 1984 work plan be discontinued and redirected to preparing a 1985 work plan which is acceptable to all parties.

### B. GOR-Financed Project Inputs

The value of the GOR's contribution to the project is estimated at the equivalent of \$589,000, or 19% of the total estimated cost of the project. This in-kind contribution represents personnel salaries and the existing infrastructure of ponds and facilities at the Kigembe Center and

zonal fish stations. In addition to the Project Director, the GOR has assigned two Rwandan agronomists, both graduates of the UNR Faculty of Agriculture, as counterparts to the technical assistance team. Their salaries were paid from project funds for the six months between their actual assignment (July 1984) and their permanent employment with the MINAGRI (December 1984). Project funds are also being used to pay their housing rental pending renovation of the houses at Kigembe. According to the Amplified Project Description, AID will finance a declining percentage of the personnel costs of "some semi-skilled staff" over the life of the project. This has not proven necessary. The GOR is paying the salaries of 23 of the 33 moniteurs working under the PPN and will pay all salaries by the end of 1986. The GOR also pays the salaries of the 5 agronomes working under the project. In general the GOR can be congratulated for directly employing necessary extension personnel to implement the PPN.

#### IV. INSTITUTIONAL DEVELOPMENT

##### A. Management

Certain "regions of high fish culture potential" have the greatest possibility of demonstrating successful fish culture in Rwanda. Once proven in such regions, there should be a natural diffusion of technology to other parts of the country following the classic "spread effect" when extending an innovation. Considering such criteria as pond numbers, pond density, farmer interest, topography and availability of water, different zones with high fish culture potential have been identified. Considering the time remaining before the Project Assistance Completion Date, the facility of supervision and the budget remaining for local costs, it is preferable that PPN effort be focused in those zones before moving on to other zones. Such zones have the greatest possibility of demonstrating profitable fish culture once a technical package adapted to Rwandan conditions is developed. That is why it is necessary to implement without delay an experimental protocol of yield trials in order to provide pond production data in different areas of the country.

Project personnel utilize different documents, including the Project Paper, PROAG and the Auburn Contract, as the basis for project implementation. This has resulted in confusion and, in some instances, actual disagreement. Consequently there is a need to follow one single document that contains the essential elements for the project implementation. Consensus is an important prerequisite to the formulation and development of a work plan describing the project methodology and the nature and schedule of its interventions.

OAR/R and the technical assistance team have been concerned about the prior year work plans which have been prepared unilaterally by the Project Director. Through joint preparation and approval of work plans by various groups involved, the project will be strengthened and substantial progress achieved. This aspect is probably the most important element for project development in particular and Rwandan fish culture development in general. The project is unlikely to achieve its goals in the absence of a well-designed work plan.

The Kigembe Station and the other zonal fish stations should be financially self-sufficient. At present those fish stations are managed by the agronomes responsible for fish culture in the areas where the center is located. The Kigembe Center, which is not now supervised by an agronome, should be provided with an agronome gestionnaire. He may exercise other functions compatible with the management of that station to avoid under-employment.

Zonal stations should not, as a general rule, have a moniteur assigned to them on a full-time basis since the moniteurs are mainly extension agents. Routine station operations should be supervised by a foreman who is supported by the agronome and possibly the moniteur assigned to the area surrounding the station.

Permanent zonal stations staff should be reduced to the bare minimum and include::

- two three laborers for pond management (e.g., water regulation, feeding, fertilizing, etc)
- three five laborers for station upkeep (e.g., cutting grass, cleaning canals, etc.)
- Two night watchmen.

Additional laborers for labor-intensive jobs should be hired on a temporary basis when needed. To keep the staff to a minimum, task work should be employed whenever possible.

As for fish culture system, since few fish feeds are available, a small rural fish culture integrated into the general agricultural development program should be developed. That is a system liable to contribute to the availability of feeds in rural areas. In this respect agricultural by-products can be efficiently used as the main source of fish feeds. One can also associate fish culture with pig or duck raising or with rice growing.

## B. Staff Development and Training

### 1. The Agronomes

As indicated in Table 7, five agronomes are presently assigned to the PPN. Three more will be assigned during 1985, so that the total staff strength through the end of the project will be eight agronomes with refresher training to sharpen their weak managerial and technical skills. As previously discussed, the zonal fish stations -- all managed by agronomes -- have been operating at significant financial losses across the board (Table 6). The agronomes' monthly reports are often not completed on time and contain incomplete and even fabricated information.

Table 7. Posting of Agronomes: Present Status and Proposed for 1986 and 1987

PPN Zone	Present Number in 1985	Future Recruitment
1. Butare N.	1 <sup>1</sup> / <sub>1</sub>	0
2. Butare S.	1	1 <sup>2</sup> / <sub>2</sub>
3. Gitarama	1	0
4. Gikongoro	1	0
5. Kigali - Bumbogo	1 <sup>3</sup> / <sub>3</sub>	0
6. Gisenvi	0	2 <sup>2</sup> / <sub>2</sub>
Subtotals	5	3 <sup>2</sup> / <sub>2</sub>
Total	8	

- 1/. Although officially assigned since october 1984, this agronome has not actively taken up his responsibilities.
- 2/. Two Agronomes will return from training in Ivory Coast in August 1985, and a third will be tranferred to the Project soon. Posting will be decided as necessary within the Project zones.
- 3/. Although officially assigned to the PPN in January 1984, this agronome only began his field work in October 1984.

Even more importantly, the agronomes do not routinely and regularly visit the moniteurs (2-3 times per month is recommended). Their lack of motivation and professionalism in their work is frequently cited by PPN supervisory staff and MINAGRI staff as cause for particular concern. The evaluation team does not understand why the Project Director tolerates such poor performance by the agronomes.

## 2. Training of the Agronomes

In an effort to strengthen the agronomes' managerial and technical skills, it is recommended that a series of training sessions be offered in collaboration with the National University of Rwanda. As may be confirmed by the university professors and the technical assistance team, several (3-4) week-long sessions are proposed. A draft course outline, which addresses the agronomes' most obvious needs, is attached as Annex A. The following themes summarize the proposed training:

- The Agronome as an Agent of Development
  - The Agronome as Manager
  - Technical Problems in Rural Fish Culture Development in Rwanda
- Agronomes should be taught the "training-and-visit method" of extension as well as techniques in using visual aids. Improvement of communication

skills should also be stressed. In the course of the training sessions, each participant group should analyze fish culture development in Rwanda, emphasizing the socio-cultural and economic constraints as well as the technical problems. In the process of strengthening skills, in managing money, people and equipment, the agronomes should develop a more professional attitude towards their work. Personnel organization and efficient use of time should be stressed. Each agronome should complete the training program with a position description and first annual work plan in hand.

The technical component of the training program can be offered by PPN staff in 2-3 morning or afternoon sessions per week, with the majority of class time devoted to managerial and developmental training offered by UNR faculty. Obvious technical skill needs include fish handling, station management, pond construction, surveying techniques and cost estimating. Homework assignments and quizzes should be given regularly. Periodic evaluations to determine how effectively the agronomes are absorbing the course material will also be essential.

On the basis of preliminary discussions, UNR faculty members have expressed interest in assisting PPN staff to conduct this type and level of training through the university's outreach program (extension universitaire). It appears that other projects also have similar training needs. For example, the FAO Agricultural Intensification Project (RAW/81/001) in the Butare prefecture has indicated serious interest in having its agronomes participate in such a training program. "Outside" participation would help to reduce costs and would also promote future interaction among agronomes working in different disciplines (fish culture, livestock, agriculture, etc.).

For any training to be effective, all trainees should be provided with suitable dormitory-type lodging. Trainers should have a place to study and, for no more than 4-5 students. This is not the situation at present at the Kigembe Center; the training facility includes one 5 X 9 meter room with 10 bunk beds to accommodate 20 trainees. To remedy this situation, it is recommended that four small, abandoned houses on the property be renovated to serve as student housing. The cost of renovation would be marginal, especially in comparison with the benefit of a residential situation more conducive to effective training and accommodation of both men and women. All trainees should be required to stay in the dormitory even if they live nearby. This keeps everyone together and on time for classes and field visits and also promotes team spirit.

### 3. Estimated Cost of Training and Equipment for the Agronomes

The costs of a revamped training program for the agronomes along the lines discussed above should be included in the 1985 PPN work plan and covered by the project budget. Similar training in the Ivory Coast cost about \$132.00/trainee/week in 1983. The Agricultural

Institute in Bouake (IAB) provided food and lodging for about \$9.00/trainee/day. University faculty participated at a cost of \$19.50 per contact hour. To train a group of 14 agronomes, total daily costs were \$18.86/ trainee (Miller, 1983). The cost of training moniteurs in the Ivory Coast was about half the cost of training agronomes.

Upon his assignment to a project zone, each agronome is given a motorcycle and several items of equipment (Table 8). The total cost of the equipment is \$1,991.25. This total, however, includes the cost of the motorcycle and helmet (\$1,675.00) which is reimbursed by the agronome over time (about \$70.00 per month) from his monthly indemnity. The adjusted, "real" cost of equipping an agronome is therefore \$316.25.

Table 8: Cost of Equipping an Agronome

<u>Equipment Item</u>	<u>Cost</u>	
	<u>Frw</u>	<u>U.S.\$</u>
1 Yamaha Ag 175 motorcycle	(160,000) <sup>1/</sup>	(1,600.00) <sup>1/</sup>
1 Motorcycle helmet	(7,500) <sup>1/</sup>	(75.00) <sup>1/</sup>
1 Nylon backpack	1,900	19.00
1 pocket calculator	700	7.00
1 kidney belt	2,500	25.00
1 handheld level	4,525	45.25
1 portable typewriter	<u>22,000</u>	<u>220.00</u>
TOTAL	Frw 31,625	\$316.25

<sup>1/</sup> Reimbursed over time.

#### 4. Proposed Bimonthly Rotating Meetings

Development and training of senior staff should include participation in bimonthly meetings held on a rotating basis in each of the five prefectures. Senior PPN staff, the technical assistance team and the agronomes should meet at the prefectural headquarters for these meetings which should last 2-3 days. The local agronome would host and arrange accommodations which would be paid by each participant from his/her indemnity allowance. Field visits to ponds should be organized to enable staff to thoroughly review and evaluate all local activities related to fish culture. The exchange of ideas and constructive criticism would be encouraged, and group resolution of practical problems would be emphasized. Group discussions should focus on reviewing local efforts and recommending future work. Such meetings would bring agronomes more into the mainstream of PPN activities and would also insure that senior PPN staff regularly visit each project zone. It is hoped that such meetings will strengthen team spirit among the PPN professional staff, although this obviously depends to a great extent on the PPN's top leadership.

5. The Moniteurs

As of January 1985, 33 moniteurs are working in communes in PPN zones:

Per Table 1: 27 moniteurs

-2 moniteurs in the Karago and Kibilira communes; inclusion of these communes in the Gisenyi zone is proposed for the future.

Sub-Total 25

+8 moniteurs now on board but who did not pass the pre-training qualifying test and may consequently be reassigned.

Adjusted Total 33 moniteurs

Of the 33 moniteurs, 13 were trained at the Kigembe Center by the Training Advisor and counterpart in 1983. A group of moniteurs was not trained in 1984 due to delays in completing installation of the water supply system at the Center. The second group of moniteurs will be trained in 1985.

In the field, the PPN-trained moniteurs have shown themselves to be motivated and knowledgeable workers. To alleviate confusion and to provide more effective extension coverage, it is recommended that the PPN only be responsible for stocking ponds in those areas, or communes within zones, where moniteurs are active. Moniteurs will update a census of fish farmers and ponds (see Table 3) within their area of responsibility on a monthly basis. Two times per year the moniteurs will undertake a complete census of fish farmers and ponds within all zones.

Table 9: Posting of Moniteurs. Present status and proposals for 1986 and 1987. Fishculture Project. USAID, Rwanda. 1985

PPN zone	Present		Estimated Future		Number to be Trained	
	Total	Number	1986	1987	1985 II	1986 III
	Number	Trained				
1. Butare N.	8	2	6	8	4	2
2. Butare S.	9	4	6	9	2	3
3. Gitarama	8 <sup>1/</sup>	5 <sup>2/</sup>	5	6	1	1-2
4. Gikongoro	3	3	4	4	1	0
5. Kigali N.	4	2 <sup>2/</sup>	4	6	3	2-3
6. Gisenyi	1	1	2	6	1	3-4
<u>Sub-total</u>	<u>33</u>	<u>17<sup>3/</sup></u>	<u>27</u>	<u>39</u>	<u>12</u>	<u>11-14</u>
<u>Total</u>					<u>23 - 26</u>	

- 1/ Includes 2 untrained A3 agronomes working as extension agents.
- 2/ Includes 1 trained moniteur who failed the Moniteur qualifying test. It is proposed that this moniteur be replaced.
- 3/ The 17 includes: 13 trained PPN  
 2 trained ELADEP  
 2 trained by ELADEP to be replaced (failed by entry test)

## 6. Training of the Moniteurs

The evaluation team interviewed a number of moniteurs in the field and found them to be well trained. They understood technical problems and, following the training-and-visit method of extension, maintained a regular schedule of visits to fish farmers. With the exception of two, all the moniteurs who were interviewed were dynamic and communicated freely in French. Although French is not necessary for the moniteur to perform his job effectively, if he is weak in his French-speaking ability, he will tend to be weak in other essential skills, including basic math and a general ability to communicate. This observation was confirmed by senior Rwandan staff. It is therefore recommended that all moniteurs be proficient in French and that their training be conducted in French. This will also allow the technical assistance team to train and support Rwandan instructors participating in moniteur training.

The course content for the moniteurs' training program is appropriate, and its practical emphasis is applauded. In view of experience gained from fielding the first group of moniteurs, some

modifications have been suggested, including a greater emphasis on extension methods and demonstrations in the rural milieu, the importance of feeding fish, the importance of pond fertilization and the need to prevent entry of wild fish into the ponds. Math tutoring and swimming lessons are possible additional subjects for instruction. The use of visual aids, including video recording equipment, in training can be very useful in helping trainees present better demonstrations. In this regard, it is recommended that trainees present both impromptu and prepared lectures and demonstrations of the class and in primary schools throughout the period of training. This will strengthen their abilities to communicate effectively.

It is suggested that the first week of training serve as a "total immersion"/intensive initiation to fish culture. This training technique has proven effective and is used to introduce trainees to all the major themes of practical fish farming extension in the first six days of training: ponds are drained; fish are fed, handled and transported; production and feed quotients are calculated; demonstrations are given; trainees' math ability is tested; homework is assigned, etc. This technique prepares trainees for what will follow during the training program and serves as a powerful motivator.

Training should be organized to provide two weekly homework assignments and one test per week. The trainees' time must be fully occupied. Of course such attention calls for dedicated instructors who arrive on time with a prepared presentation. If an instructor is absent, the training director must be prepared to substitute.

Given the need to provide refresher training to the agronomes (see Section 2 above) and other planned training activities, it is recommended that only one group of moniteurs be trained in 1985. The Training Advisor and counterpart are encouraged to invite "outside" instructors to assist in conducting the training. Possible instructors include UNR faculty and Mr. Roger Larribe, an extension specialist with the FAO Agricultural Intensification Project. The latter contact offered to present classes on extension methods including "l'approche au paysan." (Mr. Larribe was very effective in assisting with the training of fish culture extension agents in Central African Republic where a member of the evaluation team was based.) It is recommended that the Training Advisor and counterpart approve the curriculum content of all training which may be offered by "outside" instructors. This will assure a measure of quality control on the content, will help in training Rwandan instructors and facilitate preparation of a training manual(s). This latter recommendation should be applied to all levels of training.

#### 7. Estimated Cost of Training and Equipment for the Moniteurs

Based on the cost of training 13 moniteurs over a period of three months in 1983, a unit cost of Frw 317, or \$3.17, has been calculated. The costs are presented in Table 10. This compares favorably with similar training conducted in the Ivory Coast.

Table 10: Costs of Training Moniteurs

Location: Kigembe Center  
 Number of Trainees: 13  
 Training Period: 3 months, from 9/5/83 - 12/2/83 representing 425 hours of instruction

<u>Input</u>	<u>Cost (FRW)</u>
Food - 130 Frw/trainee/day	189,547
Classroom materials - paper, pens, etc.	33,617
Equipment	74,278
Medicines	2,900
Night guards - 2-3 months	22,500
Kitchen staff - " "	24,000
Steward	9,000
Hostel Manager	<u>36,000</u>
Sub-Total	391,842
Minus costs attributed to retraining 10 <u>moniteurs</u> during a portion of training period (8/28/83-9/3/83)	<u>-20,324</u>
Adjusted Total	Frw 371,518 = \$3,715.18

Summary: Frw 28,578/trainee - 3 months  
 Frw 317/trainee/day

It now costs \$244.25 to equip a moniteur (Table 11). Some 50% of this is the cost of a bicycle. Costs are approximately double in Ivory Coast, although the Ivorien moniteur is provided additional equipment and tools (such as wheelbarrows) which he can loan to fish farmers for pond construction. The costs of training and equipping moniteurs may increase as the annual training expands and more visual aids and manuals are used.

Table 11: Cost of Equipping a Moniteur

<u>Equipment Item</u>	<u>Cost</u>	
	<u>Frw</u>	<u>U.S.\$</u>
1 bicycle + saddle bag	12,500	125.00
1 bucket	350	3.50
1 pair of rubber boots	1,200	12.00
1 hand scale (peson)	750	7.50
1 agricultural dictionary	350	3.50
1 Appointment book	400	4.00
1 seine net 7.5m x 1.2m x 6mm	4,200	42.00
1 dip net	600	6.00
1 canvas backpack	900	9.00
1 handheld level	1,700	17.00
1 folding rule w/secchi disc attachmt.	700	7.00
1 knotted string for measuring ponds	-	-
1 pocket thermometer	<u>775</u>	<u>7.75</u>
Total	Frw 24,425	\$244.25

### 8. Specialized Training Programs for Other Groups and Institutions

Efforts to train other groups, such as the CERAI teachers, scouts, UNR students and specialized workers on zonal fish stations (construction foremen, etc.) indicate the importance which the PPN training staff places on supplementary extension outreach. Those Rwandans who have received such specialized training are now supporting the PPN with an effective voice for fish culture development at many different levels and in different institutions. The phased practical training course which has been developed for CERAI teachers is both innovative and effective. The practical training course for station workers addresses the identified need for improved station management.

### 9. Annual Goal-Setting and Accountability

Each agronome assigned to a zonal fish station should prepare an annual work plan in collaboration with the Extension Advisor and counterpart. Although an annual work plan may be developed during the agronomes' refresher training program (see Section 2 above), the work plan should again be reviewed and approved by the Extension Advisor. The work plan should include quantitative targets to be accomplished during the year. Examples of such targets include:

- the number of new fish farmers
- the number of renovated fish ponds
- the number of new fish ponds
- the number of "project ponds" ("active") ponds to be managed
- the number of moniteurs to be supervised
- the number of site visits to be undertaken
- the type of data to be collected on pond construction
- the number of pond harvests with complete data
- the number of practical demonstrations to be undertaken
- the number of ponds to be managed for both fingerling production and fish production at the zonal fish station.

On the basis of the annual work plan, a position description for each agronome should then be prepared which sharply defines his/her responsibilities. The position description should be prepared in collaboration with the Extension Advisor and counterpart. A copy should be provided to the agronome, and his/her continuing assignment to the PPN should be annually evaluated on the basis of actual performance measured against the responsibilities and accomplishments agreed upon in the position description and annual work plan.

Pursuant to the above recommendations, an annual work plan with quantitative targets and position description should also be prepared for each moniteur. The work plan and position description should be prepared jointly by the Extension Advisor and counterpart and the agronome-supervisor in collaboration with the moniteur.

This personnel management technique will result in more responsible staff. On the basis of annual performance evaluations and accountability to quantifiable targets, the "best" agronome and moniteur of the year can be identified. Awards can be presented, and thus a competitive team spirit to perform well is encouraged.

#### 10. Refresher Training

Annual retraining of both agronomes and moniteurs is recommended in an effort to maintain motivation and keep staff informed of new techniques in fish culture technology and extension methodology. After new moniteurs have been trained, it is advisable to schedule their first refresher training within six months. Newly trained personnel can become easily discouraged when first starting fish culture extension work, and a short recyclage can quickly and effectively solve some frustrating problems and improve morale in general. The organization of such refresher training sessions and the selection of appropriate themes are facilitated if staff complete questionnaires several months before the training. The highest priority problems are thus identified and can serve as the primary themes.

#### C. Development and Operation of the Zonal Fish Stations

It has been stated above that management of the zonal fish stations must be greatly improved. The proposed training sessions in improved methods of handling fish for station laborers is a step in the right direction. Another important step which should be taken in the future is the operation of each fish station on a self-financing basis. This will require reducing personnel and selling both fingerlings and commercial-sized fish. An economic evaluation of each station, including both production and financial (profit and loss) projections, should be conducted as the first step.

Improved fingerling production techniques should be immediately employed. It is suggested that the techniques used in Ivory Coast, and discussed in the Extension's Advisor's trip report on his visit to the Tropical Forestry Center, also be used in Rwanda. These techniques are summarized in Annex B. Even with modifications of the Ivory Coast techniques to suit conditions in Rwanda, it is estimated that at least 5,000 fingerlings/are/year, or one-fifth of the fingerling production achieved in Ivory Coast (25,000 fingerlings/are/year), can be produced. A key factor in high fingerling production is heavy feeding and fertilization. In this regard, the Runyinya (Butare North) zonal fish station appeared to be the best managed; the ponds had the best phytoplankton blooms of all the stations visited by the evaluation team. Such good green water, as observed at Runyinya, is the key to successful Tilapia production.

Following the completion of pond renovations at each station, a detailed management plan should be prepared and then implemented. This is a serious need for all stations, especially Kigembe. Documentation of pond management at all stations now lacks details. Species have often been weighed together and reported as "varied;" and sub-samples have not

been taken to determine mean weights. It is also very obvious that fish-handling techniques are poor; station records have indicated repeated cases of low survival rates of fish - often less than 50%. Such calculations were frequently not possible when mean and total weights at both stocking and harvest were not recorded.

A review of individual pond records indicates many management problems which apply to all the zonal fish stations. These problems are summarized in Table 12. It should be noted that a review of the records at Kigembe indicate that the best-managed ponds were those tended by trainees.

Table 12: General Fish Station Management Problems in Rwanda

- Poor fish-handling techniques resulting in high mortality at pond harvests
- Tilapia brood ponds with mixed species
- limited feeding of low-quality fish feeds
- very little fertilization of ponds
- activities poorly documented (lack of numbers and mean weights of fish, etc.)
- low productions
- lack of station management plans
- large annual financial losses
- fish stocked in wrong ponds by workers
- productions incorrectly calculated

The total requirement for fingerlings for fish culture in Rwanda could easily be met from 2-3 well-managed regional fingerling production stations. The advantages are obvious from both the practical and economic points of view. Because Rwanda is a relatively small country, fish can be delivered from the south to the north in less than ten hours. Fish transport has already been perfected by the PPN staff; for example, on two occasions, tilapia fingerlings were transported. A total of about 15,000 fingerlings were transported with less than 5% mortality.

If there are about 4,000 ponds covering 120 hectares in Rwanda, only 1.75 ha. of ponds would be required to stock all the ponds at the current density of 1 fingerling per 1.5m<sup>2</sup>. This calculation assumes that a fingerling production rate of 5,000 fingerlings/are/year can be achieved, as discussed above. With 77 ponds of varying sizes, including commercial production-sized ponds, covering ten hectares and on-site training facilities, the Kigembe Center and national fish farm is one of the finest government fish stations in Africa. In 1984 a total of 10,354 Kg. of fish were harvested. Of this total, only 2,509 kg of marketable fish were sold; and estimated 690 kg of fingerlings (about 69,000) were distributed; and 3,402 Kg. of fish were used to stock other ponds. It therefore appears that 3,757 Kg. of fish are unaccounted for. Unfortunately such poor management has gone on for years. This example reinforces the recommendation for the preparation and implementation of sound station management plans. Good management of commercial production is, in the long term, in the best interests of rural fish culture development. If fish culture cannot be demonstrated to be an economically viable enterprise on government stations, can the practice be extended to farmers?

#### D. Extension Methods

Although a sound extension methodology is being practiced in the PPN, several suggestions are offered where improvements can be made. Each moniteur should have a fish culture manual or guide for easy reference when he encounters farmers' problems. Also, both organized and impromptu practical demonstrations should be offered to groups of farmers whenever and wherever possible. Although Rwandans do not need to be convinced to practice fish farming, they must be taught sound fish pond management practices.

Another valuable extension technique is the use of visual aids, and it is suggested that moniteurs and agronomes be provided with several different types of aids. In many countries the booklet "Simon Raises Fish" has been successfully used to support extension messages. This black-and-white, 48 page guide to fish farming was developed in the Central African Republic. Farmers are encouraged to color each page with attention drawn to such details as the color of a pond before and after compost applications. Although the booklet is composed of full-page drawings with little text, a story is presented which conveys many technical pointers in fish culture, such as construction of proper dike slopes, appropriate fish species for culture, feeds and fertilization, harvesting fish, etc. Fish culture conditions in Rwanda may, however, necessitate either an adapted version of the booklet or the publication of a similar guide. For example, "Simon Raises Fish" recommends a stocking density of two fingerlings/m<sup>2</sup>; this may be too high for conditions in Rwanda.

Such a booklet can be a very valuable aid for extension agents on their daily visits with farmers. If a farmer has a practical problem, such as poor dike construction, or no method of screening entry water or no compost pile, the extension agent can discuss the problem and then show the farmer how "Simon" solved the same problem. This type of booklet is something "written" and that is very important and convincing to farmers. With multiple copies, the moniteur can also use a booklet or guide for group demonstrations. Three or four farmers can share one copy during such meetings.

The following table lists other extension aids which have been developed and successfully used in fish culture extension in Africa. The use of a combination of these aids is recommended to strengthen the PPN extension service.

Table 13. Various Visual Aids Used in Fish Culture Extension in Africa

- booklets for introducing fish farming
- technical booklets such as "Simon Raises Fish"
- a flip-chart format of the general and technical booklets
- posters
- printed tee-shirts
- Viewmaster with stereo-paired pictures (used in Ivory Coast; a model is in Rwanda)
- flannelograph (as demonstrated in Ivory Coast, an animated moniteur can progressively develop ideas with this for group demonstrations)
- films on technical subjects (FAO is possible source)
- Slide shows (film strips can be shown on a 12v projector)
- blackboards
- music cassettes (traditional groups recorded music/songs about fish farming in Ivory Coast)

## V. TECHNICAL ASPECTS

### A. Fish Culture Technology and Techniques

#### 1. General Observations

The fish culture techniques which are being applied in the PPN are generally valid and represent proven methods developed in both Rwanda and other African countries. The experience and performance of the technical assistance team are evaluated as technically sound and very positive. The introduction of improved fish transport techniques, the use of holding tanks and the extension methodology have already had a positive effect on fish culture development. The moniteurs' training course has proven to be very effective. Under these circumstances, the evaluation team was disappointed to hear the Project Director's critical remarks challenging the technical competence of the technical assistance team. On the basis of consultations with all the PPN staff at all levels, the evaluation team has concluded that these criticisms are unfair and unfounded. The evaluation team seriously counterproductive to the success implementation of the PPN and to the advancement of fish culture in general in Rwanda.

#### 2. Feeding and Fertilization

Feeding and fertilization must be greatly improved if fish culture is to succeed in Rwanda. As has happened in other countries, the present baseline production of 4.13 kg/are/year is so low that farmers may abandon their ponds. Although there is strong competition for organic wastes and agricultural by-products, the PPN should attempt to demonstrate that fish culture offers an efficient and productive use of these products. (The report "The Technical, Economic, Financial and Social Feasibility of Small-Scale Rural Fish Culture Development in Rwanda," by U.W. Schmidt and M.M.J. Vincke from the FAO Fisheries Department (December 1980) proposes several strategies along these lines which should be evaluated by the technical assistance team.)

The evaluation team's visits to rural ponds did not indicate that farmers are practicing either heavy feeding or composting. Compost piles should be turned and be exposed to pond water. Although good phytoplankton blooms were present in several ponds, feeding and composting must be greatly increased. Demonstrations are a useful technique to convince farmers of the benefit of these practices. The evaluation team noted that some farmers insist on letting water continually flow in and out of their ponds. This is a very bad technical practice because water fertility is never improved. Fertility can only be improved through stagnation. This problem was also observed at several zonal fish stations.

### 3. Associated Husbandries and Integrated Farming

It is recommended that raising pigs, ducks and chickens in association with fish ponds be encouraged. Initial experimentation may be possible in collaboration with another project which is working to improve small animal husbandry. Very good results are being obtained in raising pigs and ducks with fish in Zambia and Central Africa Republic. For example, in Bangui, fish production was increased from 3 tons/ha/year to more than 10 tons/ha/year when wastes from one pig/are of pond surface directly entered the pond. Similar results have been attained in Asia. Although there may be problems in developing this type of associated culture in Rwanda, many adaptations of pig-fish have been developed to take into consideration traditions and local customs. Considerable documentation is available on this subject.

### 4. Fish Production Duration and Stocking Density

Much discussion during the evaluation concerned the density of stocking Tilapia and the length of production which is required to produce marketable fish in Rwanda. The cool climate in Rwanda would seem to call for a reduced stocking density from the 2/m<sup>2</sup> (20,000/ha.) used in other African countries. Slower growth would be expected. On the other hand, initial production data, although inconclusive, indicate that temperature is not a negative factor for growth as originally assumed Rwandan conditions. It has been determined, however, that feed and fertilizer inputs play a major role in fish production, and for this reason the PPN should exploit all possible sources.

The technical specialist on the evaluation team recommends consideration of a greater stocking rate for Tilapia. Fish survival in rural ponds is a continuing problem, and a greater initial stocking rate would insure both more fish at harvest and serve to increase production. Stocking density is also based in part on the preferred size of fish at harvest. From an economic point of view, the fish farmer should raise fish only to the minimum acceptable size for the local market. A special study to evaluate market demands and the general consumer preference for the size of a fish should be undertaken to resolve the question of stocking density.

## 5. Sampling

Now that moniteurs have seines, periodic sampling -- perhaps every six weeks -- should be done on a regular basis. If the results of a sample are poor, i.e., initial fish growth is found to be slow, the moniteur has some positive leverage to encourage the farmer to increase feeding and composting and/or stop other poor practices, such as letting water continually flow through a pond.

## 6. Model Farmers and Model Ponds

In an effort to intensify sound pond management practices by farmers, it is recommended that concentrated extension services be provided by the moniteurs and agronomes to selected "model farmers." This extension technique is being practiced in other agricultural/rural development projects. The PPN should seek further information on the relative success of this approach.

### B. Engineering Construction

#### 1. Assumptions in the Project Paper

The PP envisioned construction activities in a number of locations throughout Rwanda. The largest portion of construction would occur at Kigembe which was proposed as a national training center in fish culture. Construction activities would then focus on 3 of 10 prefectural fish stations - Butare (Runyinya), Gikongoro and Gitarama. Renovation and equipping of the other 7 prefectural stations would occur over the remaining life of the project.

At Kigembe renovation of the three existing houses and the office/garage/storage building, plus the construction of new facilities for training and administration were outlined. New building requirements included a dormitory for 20 students, a multi-purpose hall and a kitchen/store.

The PP outlined only minor renovations for the building containing the office, garage and storage rooms. The garage would be converted into additional office space. The houses, however, required more extensive repairs including plumbing, roofing, painting and new doors and windows. Since the potable water supply system for the complex had deteriorated, it would have to be completely replaced.

Building construction and renovations at Kigembe would be carried out by local contractors and for the most part use locally available materials including brick, mortar, timber and metal roofing.

The PP envisioned only minor maintenance work to the fish ponds and interior distribution canals at Kigembe. Work would include repairs to inlet and outlet structures and would be required on the main supply

canal and the weir that diverts water into the supply canal. A permanent weir below the existing wood and stone dam was recommended. If the weir proved impractical, the PP recommended installation of improving the existing diversion weirs. Recommendations were also made to line the supply canals to minimize scour and seepage losses and to prevent weed growth. Canals would be designed with sufficient water velocities and side slopes to minimize snail habitats.

The PP noted that the river could be used for hydroelectric power production with the installation of a mini-hydro facility producing 3-7 kw of power. A feasibility study could be done through another AID project (Alternative Energy Project). Funding for the mini-hydro unit was not, however, included in the project budget.

At each of the ten prefectural fish stations a small warehouse of 60 square meters would be constructed using bricks, mortar, wood and corrugated iron roofing sheets. All design and construction work would be done by Rwandan firms. Inspections would be performed by the technical assistance team. A REDSO engineer would review the design work and also make regular inspections.

Although the PP noted that no sophisticated construction was required, the need for a competent works staff to maintain the Kigembe Center and the ten prefectural fish stations was stressed. A truck would be supplied to the maintenance team along with sets of basic tools for Kigembe and the ten other centers.

The construction cost estimates presented in the PP are as follows:

<u>ITEM</u>	<u>UNIT</u>	<u>COST (\$)</u>
<u>Kigembe</u>		
Houses (3)	350 m <sup>2</sup>	8,800
Office/storage/garage building	85 m <sup>2</sup>	850
Potable water system	600	2,400
Dorm/kitchen/multi-purpose hall	220 m <sup>2</sup>	82,000
Ponds	lump sum	2,500
Main Canal	200 M	6,000
Weir	lump sum	7,500
Erosion control	lump sum	300
Drying pads	200 m <sup>2</sup>	2,000
<u>Prefectural Fish Stations (10)</u>		
Pond/canal	lump sum	5,000
Warehouse/office	500 m <sup>2</sup>	150,000
	Sub-Total	267,350
Engineering services (10%)		26,650
Contingencies (15%)		44,100
	<u>Total Construction</u>	<u>\$338,200</u>
Truck (1T. flatbed)		15,000
Tools (11 sets)		11,000
	<u>Total Equipment</u>	<u>\$26,000</u>

2. Actual Experience: Implementation Progress to Date

Although the PP did not include a detailed construction plan, construction to date has fallen well behind schedule. The only building construction has occurred at Kigembe with the completion of the administration/training facility. The potable water system should be completed by the end of February 1985. Renovation of the office/storage/garage building should be completed about the same time. Funds for the construction of an office/warehouse and fish holding tanks for the Gitarama, Kigali, Butare North and Gikongoro zones and the renovations to the three houses at Kigembe will be made available when the work plan for 1984 is accepted.

Construction of the Kigembe training facility was carried out under a FAR procedure using a Rwandan contractor. The facility was designed by a local architect engineer. Inspection visits were made monthly by the REDSO engineer and weekly by the OAR/R's engineer (PSC). No major problems were encountered during construction and the work was completed in May 1984. It should be noted, however, that the construction contract was signed until approximately two years after the signing of the Project Agreement. Construction of the potable water system and renovation of the office/storage/garage building is also being done under FAR procedures. All future construction will likewise use FAR procedures.

Construction funds earmarked in PILs total Frw 9.53 million: Frw 6.38 million for the construction of the training center and Frw 3.15 million for the water system, office/storage/garage building and for some minor changes to the new training building. When earmarked, the Frw 9.53 million was equivalent to \$103,140. The earmarked funds can be compared to the estimates in the Project Paper as follows:

	<u>Earmarked</u>	<u>P.P. Estimate</u>
Training facility	\$ 74,376	\$82,000
Water system	18,174	2,400
Renovation to office	<u>10,590</u>	<u>850</u>
Total	\$103,590	\$85,250

While the training center came in under budget, the water system and renovations to the office/storage/garage building were greater than estimated in the PP. The water system must be approximately 1.1 km long, rather than the 600 meters estimated in the PP and installation has also included capping springs and construction of a storage tank with corrections for nearby villages. Renovations to the office building also were more extensive than originally planned and included extensive demolition of walls, construction of new walls, installation of metal doors and window frames, windows, painting and installation of electrical wiring and fixtures (in anticipation of electrification within several years). The costs were compared to the costs of similar construction in Rwanda to determine reasonableness. Estimates were discussed in detail with contractors.

Construction of a permanent weir and electrification of the training facility at Kigembe were considered in late 1983 early 1984. A design for the weir was submitted by a local firm and costs for both diesel power and photo-voltaic cells were estimated. Both of these items however, have a low priority in terms of present construction activity. The wood and stone weir functions, although it has to be replaced after heavy flows in the river. During its reconstruction, which takes a few days, there is little disruption of the activities at the fish ponds since water from the supply canals is only needed on an intermittent basis. A less costly design for the weir has been prepared by the PSC engineer. Basically, wooden piles would be driven into the river bed at intervals across its width and stones would then be used to control the height of water.

As discussed above, funds for electrification of the Kigembe Center were not included in the project budget. Capital costs for a generator would be about \$23,000, while operating costs for fuel, assuming 4 hours per day of running time, would be about \$6,200 per year. The mini-hydro option was not analyzed in detail because it would involve the construction of a weir and because the other capital costs for the penstock, turbine, generator, housing and distribution system would be too great. Within the context of the GOR's rural electrification program, however, trunk lines will probably be placed in the environ of Kigembe within the next several years. It may then be feasible to tap into that system.

Little work has been done to date on lining the supply canals at Kigembe, although minor maintenance work (i.e., cleaning of vegetation) has been done. Seepage does not seem to be a major problem. The project Director has suggested a major undertaking to reinforce the levees along the river bed with concrete walls. There is some evidence of damage to a couple of levees. The technical assistance team has reinforced levees in several zones by installing clay cores to prevent seepage.

### 3. Recommendation

Construction is not a major component of the project in budgetary terms; out of total AID funding of \$2.47 million, construction is budgeted at \$340,000. Unless construction is speedily completed, however, training and extension activities will suffer.

The first priority should be to let contracts for the construction of storerooms/offices and holding tanks at the Kigali, Butare North, Gitarama and Gikongoro zonal fish stations. Without these, training and fingerling production will suffer. Preliminary designs and estimates of materials are in hand. The practice of using FAR contracting should be continued since it is working well. Other contracting methods, such as direct AID or AID-host country contracts, would take appreciably longer. Because of the size of the contract for the four stations, which will be approximately \$75,000, the PPN might have to procure some of the building materials and turn them over to the contractor. This should not present a problem as long as quotes from at least three suppliers are obtained to demonstrate conformity with sound business practices and AID small-value procurement procedures. It is noted, however, that in most cases there is only one supplier of a particular material (e.g., PVC pipe).

Although only recently completed, the training administration facility at Kigembe will be stretched if 15-20 trainees are resident as intended. There is now inadequate space for sleeping accommodations, a dining room, a kitchen and offices for Director, the technical assistance team and the secretarial and accounting staff.

One viable option is to renovate four small abandoned houses on the center's property about one half kilometer from the facility. Renovation would cost about \$3,000 per house, or a total of \$12,000. All the trainees could be lodged and the present dormitory room can be turned into a classroom or lab/study area. The present dormitory requires bunk beds with little or no separation between them and no provision for separate male and female sleeping quarters.

A lower priority should be assigned to the construction of a sophisticated weir at Kigembe. The solution of using wood piles with rocks to control the water level seems adequate.

Although the Project Director has expressed interest in reinforcing the levees along the river bed, this is an expensive task, about \$60,000, that cannot be directly related to the extension and training focus of the project. The existing levees, except in a few areas, are in good shape. Some work might be done (with non-project funds) to shore up the weaker levees. Before this is attempted, however, a general maintenance program to clean out vegetation and major obstructions in the river bed should be undertaken. These obstructions channel the flow around the main river bed, causing scouring of the levees.

The PP pointed out the need for proper operation and maintenance of the buildings and the canals and ponds. To date performance, particularly canal and pond maintenance, has been spotty. More effort should be made to remove vegetation in the canals to reduce scouring and reduce the habitat for the schistosomiasis-causing snails.

The degree of technical backstopping being provided by the technical assistance team with help from the REDSO and OAR/R engineers is adequate to properly supervise the design and construction activities.

## VI. SOCIAL SOUNDNESS

### A. Project Impact and Beneficiary Incidence

The first ponds stocked by the PPN were drained in February, 1985. Based on that small sample, yields varied between 4-15 kg/are/year. The average was 8 kg/are/year. An estimation of 3-4 kg/are/year for ponds outside the project zone has been solicited from PPN personnel

and farmers. A yield of 7-8 kg/are/year among PPN ponds is considered good at this time. To date, there is not sufficient production data to indicate the extent of the impact of the PPN upon pond yield. If the yields continue to average 7-8 kg/are/year among ponds first stocked by the PPN this past year, then a significant first-year yield goal will have been reached. The distribution of the harvest continues to be largely unknown, especially for ponds with higher production levels.

Among farmers whose ponds had not been reached by the PPN at the time of their last harvest, it has been reported (see Annex C) that no more than 25% of the harvest, usually meager, is sold; the remainder is consumed on the farm, either fresh or in preserved form (usually as flour). With yields as low as 10 kg/12-18 month period for small ponds (3 ares), neither the nutritional nor the financial impact of fish culture has been significant to date. It very much remains to be seen over the remaining 30 months of the PPN whether production can be increased to a level whereby income and improved nutrition become significant.

Fish farmers in the PPN have been selected in a democratic manner to date, insofar as the attributes of individual farm families have been suppressed in favor of geographical criteria. The marais to be reached by the extension program is identified, and those ponds concentrated within it can become project ponds. Some are individually owned, while others are operated by the members of a cooperative. The ponds are in various states of (dis)array. In contrast to the procedure followed in other projects in Rwanda for extending technology, which is through a "progressive" farmer program, pond accessibility is the basic criterion for participation in the PPN. Where ponds are concentrated, the impact of the moniteur's message is more efficiently spread. The content of that message is compatible with the Rwandan agro-economic environment: locally available and readily obtainable materials are promoted for use in improved fish culture. These include bamboo inlet and overflow tubes; farm waste, in the form of colocase and cabbage leaves, as fish feed; pond waste, such as mud, as field fertilizer; and on-farm fingerling production. The purchase of fish feeds has been advised only for farmers undertaking intensive fish culture. The PPN therefore promotes a self-reliant technology.

The PPN has necessarily followed a policy of limited farmer participation in order not to over-extend the capability of its extension service. While some families thus have been excluded the PPN will offer publicized demonstrations of fish culture techniques sur le terrain; it is hoped that interested farmers will attend them, even if extension staff cannot yet visit their farms.

A potentially more serious problem concerns the allocation of marais land to farmers wishing to practice fish culture. Farmer participation in the PPN presumes access to a pond. The present system followed by the commune limits farmer access to the marais whether for agriculture or

fish culture. It is the bourgmestre, the senior administrator of the commune, who ultimately approves or disapproves a farmer's request for a parcel in the marais. The rich agricultural land in the valleys, once used as pasture for the beloved cattle of the wealthy, now is farmed by those fortunate enough to have been allocated a parcel. More Rwandans want parcels in the marais than there are sites available. The criteria by which a bourgmestre allocates parcels are not publicized. It is likely they are idiosyncratic. Nor is there a national policy on the percentage of land in the marais which may be devoted to fish culture. As the marais is heavily farmed in the dry season (June-September) and during times of anticipated food shortage (such as the final 6 months of 1984), when beans and sorghum may be cultivated in addition to the ubiquitous sweet potato, the uses to which the marais is put and the decisions governing them are of considerable importance. The significance for the PPN is twofold: with the construction of new ponds, and especially if fish culture becomes more profitable, participation in the PPN may be increasingly a function of political factors; secondly, fish farmers are advised to grow crops whose by-products can be fed to fish, such as colocase, sweet potato, cabbage and manioc, as well as high-value crops which can benefit from the irrigation potential and nutrients from the pond, such as carrots, tomatoes and eggplant, near the pond. This symbiosis is desirable biologically, and also encourages better pond surveillance. The policy pursued by the commune with regard to the association of parcels in the marais and the crops to be raised therein thus have a direct impact upon the make-up of the participant farmers and the availability and accessibility of food waste for feeding fish. It is recommended that the technical assistance team monitor the allocation and use of marais land as they bear upon the PPN. The investigation of these topics will be pursued as well through the socioeconomic survey to be undertaken in March 1985.

The role of women in fish culture has not been clearly demonstrated to date. Ndengejeho (1980 Etude Préparatoire d'un Projet Piscicole) reports that family labor for fish culture is divided among men, women and children; the women are responsible for stocking and feeding. On-farm interviews during the first two years of the project, however, reveal otherwise: ponds appear to be managed entirely by either men or women. It is possible, then given the high proportion of male-operated ponds, that the PPN will have little direct impact upon women. It is advisable, therefore, to make an explicit effort to include women in PPN activities. At present, there is one women's cooperative participating in the PPN; the counterpart of the Training Advisor is a woman; and women from the Nyagahanga Women's Agricultural School have received training. Although PPN has not identified women's cooperatives specifically for participation, priority has been given to fish cleaning and preparation. Programs are likewise planned for the regional health center, where attendance by women is significant. In order to prevent a potential male monopoly in fish culture and the revenue-generation it represents, it is recommended that the PPN strengthen efforts to include women in its activities. Women's cooperatives should receive preferential treatment, and women should be recruited for extension staff. Those activities which the Project has planned for reaching women should likewise be implemented.

## B. Data Collection

Knowledge of fish culture practices in Rwanda at present is incomplete; the PPN is in the process of identifying and rectifying inadequacies in this area.

Ndengejeho (1980, op. cit.), a sociologist at the National University of Rwanda, surveyed Rwandan attitudes toward the cultivation and consumption of fish before the project design phase. He reported wide-spread interest in fish both as food and as elevage. No negative values were attached to either. Based on these results, the project was designed in good conscience. The interest in fish, as a consumption item first and a marketable one second, has since been substantiated in on-farm interviews. Although Ndengejeho's survey was restricted to 4 communes - 2 in Butare and 2 in Gikongoro - these results are valid as well in the other prefectures in which the PPN operates. Of the other conclusions advanced in the survey, the following have likewise been substantiated by on-farm interviews: there is "available" time which farmers are willing to devote to fish culture (ranging from a few hours each day to a few each week, these estimations still represent an important unknown in Rwanda); there is a receptivity to extension agents and their messages; and there is food available for feeding. In contrast to the report, it has been found: farmers are divided in their opinions of the relative merits of farming individually or

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cooperatively (the report indicated strong support for cooperatives); labor is not divided between men and women on the same pond) see discussion above); virtually all farmers know how to feed fish (the report cited statements that fish could subsist on "soil and water"); and land is not readily available to farmers for pond construction in the marais (see discussion above).

To provide the PPN with the basic socioeconomic data to develop the content of the training and extension programs and ultimately to assess its progress and impact, a strategy was developed by the OAR/R anthropologist in collaboration with the technical assistance team. Technical information, such as pond dimensions, stocking rates, yield, species type, etc. is collected on a regular basis by the moniteurs. It is reasoned that the record they keep of fish culture activities among their target farmers enables them to do their job better. It promotes moniteur-farmer dialogue as well. The PPN is additionally keeping a record of the number of visits made by the moniteurs, the activities of the agronomes and other administratively necessary information. There was some question at first of the reliability of the reports which the technical assistance team was receiving; more recently, the team has called apparent inconsistencies to the attention of personnel and has worked with them in upgrading the quality of the reports.

The second component of the data collection effort was to be undertaken by a Rwandan sociologist under the supervision of the OAR/R anthropologist. The latter had made three field trips in 1984 to collect pre-survey data and to field-test questions. Initiation of the survey was delayed, however,

when the sociologist was no longer available and pending the formulation of an alternative approach. The survey will be undertaken in March 1985, using enumerators from the Enquete Agricole, and will be supervised by the OAR/R anthropologist. The objective of this survey is to provide information to the technical assistance team on current fish culture practices and farmer attitudes and preferences. The areas of inquiry include: species preferences, preferred characteristics in fish for consumption and sale, feeding and fertilizing practices, division of labor, division of revenue, consumption habits, extension activities, perception of cooperatives, and so forth. The results should be available in April. These data will enable the PPN to assess progress in reaching its goals, and to be responsive to farmers' needs in the process. Engaging a Rwandan sociologist and economist either full-time or part-time, as was recommended in the Project Paper, is not foreseen at this time. It is desirable, nonetheless, to follow the evolution of the PPN, especially its socioeconomic impact, and it is recommended therefore that the Project Paper's approach be implemented. The employment of one Rwandan, a socioeconomicist, should be adequate.

### C. Public Health Considerations

An Initial Environmental Examination, completed concurrently with preparation of the PID, recommended a more complete assessment of the project's potential environmental impacts, especially with regard to impacts on the health of fish farmers and PPN staff. An Environmental Assessment (EA) was therefore completed in November 1980 and was attached to the PP. The EA concluded that (a) the only significant health problem which could result from fish culture is an increase in the incidence of schistosomiasis and malaria and (b) this potential increase could be either eliminated or minimized if three basic recommendations were followed:

- Elimination of vegetation extending into the pond which would provide a breeding ground for the schistosome-bearing snail;
- Inclusion of a snail-eating species of fish in the ponds (i.e., the practice of polyculture); and
- Pond monitoring to assure that mosquito larvae and snail populations remain low.

The PP financial plan includes funding for two person-months of specialist services over the life of the project to provide environmental/public health monitoring.

As discussed above in Section III.A.2, Technical Services, in August 1983, Dr. Emile Malek, a tropical medicine/health specialist from Tulane University, spent two weeks in Rwanda to study particularly the incidence of schistosomiasis in relation to fish culture. Dr. Malek examined a large, representative number of ponds in several prefectures; the snail species responsible for transmission of the disease was identified in some of the ponds. In his report "Impact of Fish Ponds on Public Health in Rwanda with Specific Reference to Schistosomiasis," Dr. Malek made four recommendations. The recommendations and the status of their implementation are summarized below:

1. Urine and fecal samples collected from all PPN extension staff and pond workers should be collected and examined every six months to identify infection with urinary and/or intestinal schistosomiasis. Infected employees would be treated. As first step, sterile specimen containers were procured in the U.S. by Auburn University. The first set of samples has been collected from Kigembe Station personnel and is now being analyzed at the UNR medical laboratory. Results should be available momentarily. As a preventive measure, all moniteurs are provided with a pair of boots to wear in the pond.

2. Pond management techniques to minimize snail infestation and malaria larvae growth should be taught in all PPN training courses. Such techniques, including polyculture using both snail-eating fish and herbivorous fish to eliminate aquatic vegetation, deepening pond edges to discourage the growth of submergent vegetation and the removal of grasses and other vegetation from the pond when not consumed by fish, are being taught in the PPN courses. Classroom instruction in these techniques is complemented by practical work in the ponds at the Kigembe Center and other sites.

3. All PPN training courses should include instruction in snail control and prevention measures. This is also being done; for example, pond inflows should be screened to prevent snails from entering the pond. In

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addition, the PPN training staff has produced and published leaflets on preventive measures against both schistosomiasis and malaria within the context of fish culture.

4. Samples of snails from ponds should be periodically collected and examined for schistosome infestation. To date the moniteurs have been taught to classify the incidence of snails in ponds but have not yet started to record their observations on their monthly evaluation forms. If a moniteur classifies a pond as having a high incidence of snail infestation, he is charged with working closely with the fish farmer(s) to implement pond management techniques and complementary control and preventive measures as discussed above. Samples of snails have not been collected pending the procurement of collection bottles and a microscope. In general, the moniteurs have not observed a significant incidence of snail infestation in ponds, and consequently implementation of this recommendation is of a lower priority than other tasks.

In the interest of continuing specialized monitoring, Dr. Malek may return to Rwanda in 1985.

#### D. Nutritional Aspects

One of the goals of the project is to increase the availability of nutritious food for rural families in Rwanda. Indeed, this is the reason most often given by farmers themselves for practicing fish culture. Given generally low recorded yields to date, however, the amount of fish in the diet of most Rwandans is negligible. Production will be monitored and fish

farmers will be periodically surveyed to identify the pattern of the distribution of the harvest. If yields increase, will more fish be preserved? Will neighbors sell fish to one another? To encourage a more regular supply of fish for consumption by farm families, multi-pond ownership is encouraged. If either a farmer or a cooperative manages 7-8 small ponds, it is possible to harvest one pond per month throughout the year. This would be an especially sound practice for a cooperative which may have access to greater areas of land for pond construction.

The high nutritional value of fish and the need for increased animal protein consumption in Rwanda argue favorably for the application of manure and agricultural by-products in fish farming. This angle should be used by PPN staff in promoting increased feeding of fish and fertilization of ponds. Can the PPN demonstrate that fish farming offers a more efficient and productive use of manures and feeds than other types of agriculture?

#### E. Recommendations

The socioeconomic impact of the project, barely discernable at present, will be revealed in the months remaining as two fundamental questions are answered:

- What are the incremental costs to farmers of increasing inputs into fish culture?
- Is fish culture in Rwanda profitable?

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The program of interventions of the Project is extending, and the people it trains will be judged successful or not on the basis of the answers to these questions.

At this time, the following recommendations are made:

- (1) data collection efforts should continue, agronomes' and moniteurs' reports should be closely supervised for accuracy;
- (2) an effort should be made to work with women's fish culture cooperatives and women moniteurs should be recruited for assignment to the PPN;
- (3) the allocation and use of the marais as they relate to fish culture should be monitored;
- (4) a Rwandan socioeconomicist should be engaged by the Project to monitor impact;
- (5) the monitoring and control of snail and malaria larvae populations in fish ponds should be implemented in accordance with the recommendations in Malek's (1983) report;
- (6) fish pond harvests should be staggered to more evenly distribute the supply of fish throughout the year.

## VII. ECONOMIC FEASIBILITY

Economic information and data on fish farming in Rwanda is seriously lacking. Records have not been kept on pond construction costs and the costs of fish production. In their feasibility study of fish culture in Rwanda (op. cit., December 1980), Schmidt and Vincke postulate that a 500 m<sup>2</sup> pond could provide a minimum gross return of FRW 6,000 per year. They further calculated that, by using family labor and agricultural wastes, the farm family could earn a minimum cash income of FRW 2,250/500m<sup>2</sup> pond and also consume 45 kilos of fish per year. Fish culture is also compared with a number of other agricultural activities. Although their calculations compare with results documented elsewhere, unfortunately they are not based on actual results in Rwanda.

In light of the lack of hard economic information, it is increasingly urgent that the PPN initiate data collection efforts on the factors of fish production, including the costs of pond renovation, construction and maintenance. The identification of "model" farmers should provide a dependable source of data. Moniteurs and agronomes should be taught how to collect and record such information and data in the course of their refresher training.

## VIII. RESEARCH

Since the project is focused on the establishment of a viable fish culture extension service, all research should have a direct application in extension. The yield trials proposed by Dr. Ronald Phelps (consultant from Auburn University in April 1984) represent a practical research response to questions raised in extension and will be launched at the Gitarama zonal fish station as soon as the renovations are completed within the next 4-6 months.

Tilapias have been correctly selected as the best fish for extension in Rwanda. Although they have some limitations in cooler climates, they are hardy, disease-resistant, spawn naturally in private ponds and are appreciated by all consumers. Thus fish farmers can easily be taught all aspects of tilapia farming; they can produce their own seed stock; and no specialized or expensive equipment is required. This is not the case with carp or catfish farming. Tilapia is an excellent fish to introduce fish husbandry to African farmers.

The evaluation team observed four tilapia species: Tilapia macrochir, rendalli, mossambica and nilotica (recently introduced with seed stock from Auburn University). The T. mossambica is said to be a poor competitor and is slowly disappearing. The T. macrochir is known to be a slow grower and produces fewer offspring than either T. nilotica or T. rendalli. This observation should be confirmed, however, in the proposed yield trials.

Efforts should be concentrated on T. nilotica and T. rendalli because of their reproductive capacity and ability to achieve good growth on poor quality feeds, including various leaves. The latter species is especially adept at feeding on leaves. Initial growth of T. nilotica on rice bran at the Runyinya fish station offers promising results. Growth from 8 gm. to 60 gm. of individual weight in 55 days has been reported; this equals an individual net daily gain of almost one gram.

The evaluation team recommends that applied research be undertaken as soon as possible in private farmers' ponds to test production of the three tilapia species in monocultures. Similar experiments can be initiated in small ponds (3-4 ares) at either the Kigembe Center or one of the other zonal fish stations. This will permit the collection of some production data pending the initiation of the yield trials at the Gitarama station. The following table summarizes this proposal.

Table 14. Proposed Applied Research on Tilapia Growth

	No. of Ponds		Species	Density	Standardized treatment
	Private	Station			
1.	4	2	<u>T. macrochir</u>	1/1.5m <sup>2</sup>	Compost + feeding (both according to availability)
2.	4	2	<u>T. rendalli</u>	1/1.5m <sup>2</sup>	"
3.	4	2	<u>T. nilotica</u>	1/1.5m <sup>2</sup>	"

Such preliminary studies will both permit the objective selection of a species (or species) for use in extension and provide good information for the upcoming yield trials. The compost and feeds should be chosen based on availability. All treatments should be standardized. In order to undertake this research in rural ponds, the PPN must seek the collaboration of private fish farmers who would only be asked to participate in feeding with the moniteur. All fish, compost and feeds should be furnished by the PPN. Fish harvests would belong to the farmer. Since many fish ponds will be scheduled for harvesting within the next month or two, many should become available for these growth trials. The agronomes and moniteurs would be responsible for closely monitoring this research. Monthly samples should be taken, and all ponds should have screened entry water. The ponds could also serve a dual purpose as model farmers' ponds for demonstrations.

It is not within either the scope or competence of the PPN to undertake research on carp and catfish. Any fundamental research or ichthyopathological studies, if indeed necessary, should be proposed for consideration by the AID-funded Collaborative Research Support Project with the University.

## IX. PROJECT MANAGEMENT

### A. General

All parties who are involved with the implementation of the PPN are unanimous that implementation progress has suffered from poor management. In an effort to correct this situation and to assure that the emphasis between now and the scheduled completion of the project in September 1987 is on quality and not quantity, the evaluation team has made two necessarily strong recommendations which may be "hard to swallow" but which should be accepted: (1) to limit the PPN's geographic coverage for extension services at least in the near term, to six zones within five prefectures with the understanding that over the long term the GOR can gradually expand the PPN's to the remaining five prefectures and (2) to schedule another internal evaluation of the project before January 1986 to determine if close collaboration among the interested parties has been established and management improvements have been realized.

To a certain extent, all the interested parties can be faulted with poor project management. The situation with regard to the parties who are directly involved with the implementation of the project - i.e., the Project Director, the technical assistance team and their counterparts, the agronomes and the moniteurs - has been discussed in the preceding sections of this report. The following sections address the status of project management from the perspective of the parties who are involved with the implementation of the project in a supervisory capacity - i.e., AID-OAR/R, the GOR Ministry of Agriculture, Livestock and Forestry, and Auburn University.

### B. AID-OAR/R

Given the number of projects in its program portfolio and the relative complexity of several of them, including the Fish Culture project, OAR/R is too thinly staffed to provide intensive project management and monitoring. Staff arrivals and departures invariably also result in loss of management continuity. The project has suffered from both constraints; within the past two and a half years, the project has been managed by three different officers: a Project Development Officer, followed by an Assistant Agricultural Officer and now by a Project Development/Program Officer. Back-up support on programmatic questions is provided by the AID Representative and on technical questions by the Agricultural Development Officer. The project manager prepares and/or clears all implementing documents and also monitors the financial status of the project with reports and records kept by AID/Washington for management of the Auburn contract and the Regional Financial Management Center (Nairobi) for non-contract transactions. A full set of project files is maintained, though the evaluation team found that documents have been often misfiled by either subject matter or date. It is suggested that the project manager reorder the files and then closely monitor all filing of correspondence, AID documents, project reports, etc.

In the opinion of the evaluation team, poor project management in general has been most seriously reflected in the lack of acceptable and approved annual work plans which in turn has adversely effected the timely receipt of periodic advances for local costs. In the latter case AID's documentation requirements and procedures have been explained to the Project Director, and it is hoped that a regular schedule for requesting an advance every two months to cover estimated expenses over three months has been established and will be maintained. The stalemate concerning approval of the 1984 work plan has just now been satisfactorily resolved. One of the first opportunities to evidence closer collaboration among the Project Director, the technical assistance team and the OAR/R will be the timely preparation, review and approval of the 1985 work plan. The evaluation team has made recommendations concerning the content of the work plan and

procedures for its review and approval. In any case, OAR/R must take a much stronger role in project management to assure that questions are raised and answered, misunderstandings are ironed out and both written and oral communications are frequent and constructive. This may require regularly scheduled meetings of the OAR/R with the Project Director and the Team Leader of the technical assistance team and also of the PPN Management Committee. In the interest of stronger and sound project management, the OAR/R should take the lead in calling such meetings.

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#### C. COR - MINAGRI

The evaluation team was never completely comfortable with explanations concerning the relationship of the PPN to the MINAGRI. Bureaucratic channels, including lines of authority, transmission of documents, required clearances for documentation, etc., should be clarified. Once clarified, the relationship and procedures should be followed by all parties without exception. More specifically, the Project Director should not bypass the MINAGRI Director of Fisheries and Fish Culture to discuss and/or resolve implementation issues with the senior and highest levels of the Ministry's staff. This has resulted not only in misunderstandings and frustrations but also in a weakening of the MINAGRI's capability to provide effective and efficient backstopping to the PPN.

#### D. Auburn University

OAR/R is satisfied with Auburn's management of the contract. Recruitment and assignment of the technical assistance team was well-handled and timely. Likewise Auburn has responded well to requests for the short-term specialists. The campus-based project manager visits Rwanda at least once a year; the two visits to date have been very well received under the contract, the OAR/R project manager recently requested Auburn to send copies of its periodic financial reports which are submitted to AID/W to draw down the Letter of Credit. Auburn willingly complied with this request. Response-time to direct-relay telegrams and to communications through AID/W is also satisfactory.

**DRAFT COURSE OUTLINE FOR A TRAINING PROGRAM FOR AGRONOMES**

To be offered in collaboration with the National University of Rwanda.

1. THE AGRONOME AS AGENT OF DEVELOPMENT

- 1.1 The rural milieu - methods of approaching the farmer
- 1.2 Socio-cultural factors
- 1.3 Regional factors favorable towards innovation
- 1.4 Role and function of the Agronome - setting a good example
- 1.5 Extension methods - Animation
- 1.6 Use of visual aids in extension
- 1.7 Communications in extension
- 1.8 Organization and supervision of extension agents

2. THE AGRONOME AS MANAGER

- 2.1n Personal organization - use of time
- 2.2 Organization of workers
- 2.3 Organization of production and commercialization
- 2.4 Preparation of a budget
- 2.5 General management - inputs, outputs
- 2.6 Production economics - "prix de reviens"
- 2.7 Cost estimating - for construction projects - man-days of labor, materials, etc.
- 2.8 Documentation - reports
- 2.9 Attitude towards work -- professionalism, leadership and setting a good example

3. TECHINICAL PROBLEMS IN RURAL FISH CULTURE DEVELOPMENT IN RWANDA

- 3.1 Intensive Tilapia fingerling production method
- 3.2 Evaluation of rural fish farming
- 3.3 Manipulation of fish
- 3.4 Fish feeds and pond fertilization
- 3.5 Analysis of pond harvest results
- 3.6 Fish farming economics - costs of construction, pond renovation, fingerling production, commercial fish production.
- 3.7 Pond renovation, construction, cement work and surveying

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**Tilapia/milotica fingerling production as practiced in the Ivory Coast, 1984**

1. Spawning Pond - 12.5 ares - stocked with 68 brood stock/are at 1 male: 3 females (17 M: 51F/are).
2. Fingerling growing ponds - 6 ponds of 6 ares each
  - You need 1 are of spawning pond to 4 ares of growing ponds
  - Fingerlings are stocked at 50 to 100/m<sup>2</sup>
3. Feeding
  - All fish (broods and fry) are fed at 6% of their estimated total body weight at least twice daily
  - Feed - 23% Protein - composed of 70% rice bran, 20% cottonseed cake (or peanut cake) and 10% fish meal
  - The feed is finely ground and distributed around the entire pond
4. Management
  - Fry are seined from the brood pond 45 days after the broods were stocked. A very fine mesh net is used. Three or 4 sweeps are made through the pond and all fry are transferred to the growing ponds. Fish are always carried in buckets of water! A total weight is made and a sub-sample is weighed and counted. The average weight and the total number of fry can be extrapolated.
  - The feeding is then recalculated and increased.
  - After the first seining, the brood pond is seined every 15 days.
  - The brood pond is harvested and drained after 5 months.
5. Production - 70 fry/are/day or 25,550/are/year
6. Individual costs - "Prix de Reviens" - 7 CFA/fingerling of 5oz (3 months old). Costs include feed and labor - 1 nightwatchman, 2 laborers, and one head laborer.
7. Production figures include the total area used:
  - 1 brood pond of 12,5 ares
  - 6 Fingerling ponds of 6 ares each = 36 ares.

**SUMMARY SOCIOECONOMIC DATA COLLECTED IN INTERVIEWS WITH FARMERS, MONITEURS  
AND AGRONOMES - 1984**

1. Consumption vs sale of fish; % of total farm income derived from sale of fish; uses for revenue derived from sale of fish:
  - 75% of harvest is consumed
  - remainder is sold for 100 FRw/kg; sold for 40 FRw/piece
  - revenue from the sale of fish represents a very small % of total farm income
  - increased (potential) income from fish would be used for a great many things: home repairs, food purchases, in case of illness, vehicle purchase
  - small % of harvest is preserved, by grilling, grinding, and then drying the flour
  
2. Number of visits made by the moniteur, and their duration:
  - twice/month; farmers report durations of 30 minutes to 1 hour -- moniteurs report duration of 1 hour to 1/2 day
  
3. Division of labor by sex; hired labor; availability of labor;
  - mostly men practice fish culture, but there are women's cooperative groups involved in fish culture
  - women do not work on the ponds belonging to men
  - laborers can be hired for 120 FRw/8 hr day
  - family farm labor is least available during the beginning of the rainy season, and is most available during July and August; people are busiest in July and August, cultivating the marais
  
4. Farmer receptivity to extension; extent of farmer sensibilization:
  - management of ponds stocked by the project is good
  - agro. report: there is some mistrust of moniteurs among farmers, but most farmers are receptive to the extension effort
  - moniteur report: farmers follow moniteur's recommendations
  - farmer report: more moniteur visits are desirable, as are more materials; if fish culture technology increased yield, farmers would devote more time to practicing fish culture; farmers will experiment with new techniques
  - moniteur report: moniteurs must adapt themselves to the needs of the farmer; moniteurs must work cooperatively with administrators
  
5. Feeding and fertilizing fish:
  - all farmers contacted know how to feed fish, but average feeding is once/1-2 weeks
  - leaves of colocas, cabbage, sweet potatoes, and banana are fed to fish
  - farmers claim to feed fish 1-2 times/week; moniteurs report once/1-2 weeks

- little fertilization practiced; animal fertilizer used on fields
- increasingly compost is added to the pond

6. Individual vs collective ponds

- mixed opinions: most reports emphasize the difficulty of working in groups, the freedom of working alone; some reports that, in principle, it is better to work as a member of a cooperative.
- cooperative members speak of sanctions against those members of the coop who fail to do their share; accordingly, the coop works well

7. Farmer perception of problems:

- lack of fingerling
- difficulty in transporting fingerling
- not enough moniteurs
- distance of pond from house is too great
- no knowledge of drainage techniques and other current technologies
- difficulty in transporting fish to market

8. Moniteur perception of project goals:

- to improve pond technology
- to improve management of pond
- to increase yield

9. Reasons for practicing fish culture:

- farmer: belief in the profitability of fish culture
- fish is nutritious food
- government promotes fish culture

ANNEX D

**DOCUMENTS LEFT WITH AID FISH CULTURE PROJECT**

1. Guide aux étangs scolaires pour les Cantonnements Piscicoles. Projet FAO/PNUD-IVC/77/003, Ivory Coast by J. Miller, October 83. 19p.
2. Fish feeds and feeding in developing countries. ADCP/FAO Aquaculture Program. ADCP/REP/83/18, 1983. 97p.
3. Aspects of training fish culture extension workers in Africa. CIFA conf., Cairo, January 83 by J. Miller and C. Nugent, October 1982. 20p.
4. Draft - Guide aux Vulgarisateurs de la Pisciculture en Afrique. Projet Piscicole FAO/UNDP-IVC/77/003 by J. Miller, edited Project, 1983. 41p.
5. Note Technique - Construction des barrages villageois de pisciculture - March à Suivre. Projet FAO/UNDP-IVC/77/003n Mai 1983. 14p.
6. Fiche Technique. La vidange d'un étang. Projet FAO/UNDP-IVC/77/003, Rome. 2p.
7. Rapport Partiel - Stage de Recyclage des Assistants (APVA) Piscicoles. Projet FAO/PNUD-IVC/77/003 par J. Miller, Avril 1983. 24p.
8. La Pisciculture en eau douce - comment débiter. FAO "Apprentissage Agricole" 27, FAO, 1980. 43p/
9. La Pisciculture, c'est l'affaire de tous. Projet FAO/PNUD-IVC/77/007, 1983.
10. Pisciculture Continentale - L'eau. FAO - Formation #4 by A. Coche et H. Vanderwel, FAO. 1983
11. Situation et perspectives des services de vulgarisation des peches continentales en Afrique - FAO. CIFA conf., Cairo, January 1983. 19p.
12. Un an de formation et de vulgarisation de la Pisciculture en Cote d'Ivoire. Projet FAO/PNUD-IVC/77/003. Document du Projet par J. Miller 1984. 32p.