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AN EVALUATION OF THE LOWLAND FISH CULTURE PROGRAM IN THE FLEUVE REGION OF SENEGAL

Submitted to U.S.A.I.D./Senegal by

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685-0240

INTRODUCTION

This report is intended to furnish an assessment of the Lowland Fish Culture program (685-0240) in the Fleuve region of Senegal. During the February 21 to March 3 consultation, the consultant visited the sites of seven Peace Corps Volunteers and Senegalese counterparts in addition to discussing the present status and future possibilities of the project with Eaux et Forêts, SAED, Peace Corps and USAID. The report provides a general outline of the present status of the project in addition to an analysis of its economic feasibility. Finally, project expansion is outlined in terms of responsibilities and roles of each organization involved.

PRESENT STATUS

Fish station and demonstration sites

A fish station has been completed in Richard Toll to provide fingerlings for newly constructed fish ponds on the irrigated perimeters. Constructed with machinery donated by the Compagnie Sucrère Senegalese (CSS) and materials financed by U.S.A.I.D., the station is comprised of two one-quarter and four one twentieth hectare ponds. An office, classroom and storage facilities have been constructed but remain unfurnished and, consequently, not functional. Eaux et Forêts has provided the land for the station, two laborers and one guardian. Peace Corps has supplied a Volunteer to assist with the management of the station.

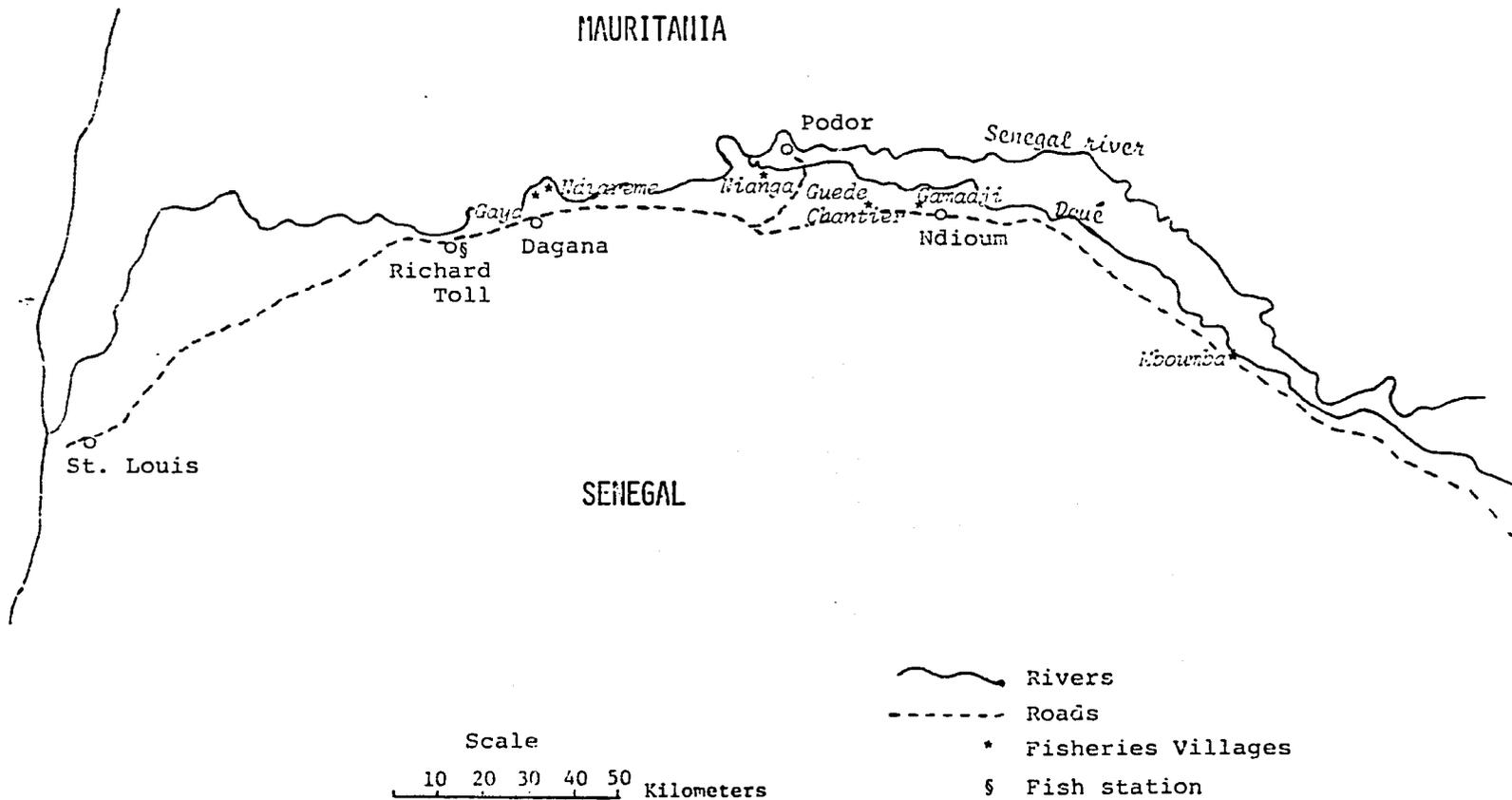
There are currently six Peace Corps Volunteers undertaking extension work on four Société d'Aménagement et d'Exploitation de terres du Delta (SAED) irrigated perimeters (see map and Table 1). With one exception, each Volunteer is assigned an Eaux et Forêts counterpart. The goal of each Volunteer/counterpart team is to construct and manage two one-half hectare ponds at each site. It is envisioned that all twelve will be in production by the scheduled completion of service of the initial group of Volunteers in November 1981. At several sites, however, the extension team will have constructed additional ponds for an estimated total of twenty-two ponds by the end of 1981. All sites will have harvested one to four crops of fish.

The station has provided approximately 50,000 Tilapia nilotica fingerlings for the initial stocking of the six demonstration ponds currently under production. Fingerlings for the seven ponds presently under construction will also be provided by the station.

Table 1. Summary of location of pond sites, project personnel and fish pond data.

Department	Dagana	Dagana	Podor	Podor	Podor	Podor
Perimeter	Dagana	Dagana	Nianga	Guédé	Guédé	Haere Lao
Village	Gaya	Ndiareme	Nianga	Guédé Chantier	Gamadni	Mboumba
SAED Chef de Perimeter	Samba Fall	Samba Fall	Ousman Sy	M. Diatta	M. Diatta	Abou Ndiaye
E & F Agent technique	-	Mamadou Sané	Ciré Seck	Assaan Diop	Ousman Darry	Abdoulaye Loun
Peace Corps Volunteer	Sean Mackey	Chuck Chopak	Andrea Hough	Cindy Bower	Bennett Buckles	Philip Carls
No. ponds completed	2	2	1	1	1	0
Surface area (hectares)	.30, .35	.40, .33	.4	.3	.5	-
No. ponds under construction	1	5	0	0	0	1
Surface area (hectares)	.08	.2 each	-	-	-	.45
Total ponds anticipated by November 1981	4	7	4	4	2	2

Figure 1. Location of fisheries sites in the Fleuve region of Senegal.



Each of the demonstration ponds utilizes water provided by SAED irrigation systems. Ponds were constructed by bulldozers and/or graders provided by SAED, Travaux Publique (TP), or CSS. The ponds are located from one to six kilometers from the participating villages. Village cooperatives provided the labor force utilized for pond construction and maintenance.

The ponds currently in production were stocked in October-November 1980 at rates ranging from 1.25 to 1.7 fish per square meter. Fingerlings stocked ranged in size from 11 to 23 grams per fish. After four and one half months of growth, the fish in these ponds weigh 90 to 125 grams apiece. A production of 500 to 750 kilograms of food fish (Tilapia greater than 50 grams) per half hectare pond per harvest is anticipated. Fish in these ponds should soon be harvested as they are increasingly channelling their energy into reproduction rather than growth. The unavailability of fry and fingerling nets has made it impossible to evaluate the standing crops of fingerlings produced in perimeter ponds and how adequately they could meet the forthcoming restocking needs.

SAED Participation

Local SAED officials have been very supportive of the project, although a lack of official inter-agency communication has hampered project progress. The extension teams have established a good working relationship with SAED perimeter officials. During the past year there has been a significant bureaucratic shuffle in SAED which has resulted in a better relationship between project personnel and SAED officials.

SAED has placed irrigated land, earth moving equipment, rice bran and fertilizer at the project's disposal. Earth moving machines have been provided

free of charge or for the cost of the fuel consumed. To date their cooperation has been informal and has offered little opportunity for advanced scheduling of earthmoving machinery between the extension team and SAED. Thus there has been considerable uncertainty in planning pond construction and increased cost due to a less efficient organization of machine use. In addition, no SAED machinery has been made available in the eastern-most site (Mboumba), seriously hindering progress.

Eaux et Forêts Participation

The present Eaux et Forêts project staff is supportive of the program. The Director of Eaux et Forêts in Dakar has an excellent understanding of the potential for fish culture in the Fleuve region as well as the problems involved in its establishment as a viable enterprise. The working environment between the different project agencies (Peace Corps, SAED and Eaux et Forêts) operating in the Fleuve was strained at the early stages. Since the appointment of Mr. Papa Sy as interim project coordinator, this situation has greatly improved. Mr. Sy has been understanding and supportive, actively involved, and has done an excellent job of explaining the program to a vast array of visitors and officials. In addition, recent monthly meetings with the Volunteers and counterparts have been fruitful in the evaluation and coordination of fish culture activities.

All the Eaux et Forêts counterparts have had some training in fish culture and there is an active program for providing CEAO, UNDP, FAO-OIVS, USAID and French scholarships for further education. One element lacking in their training is practical experience. Counterparts should develop their extension skills by working alongside the Peace Corps Volunteers.

Village cooperatives

Village cooperatives are responsible for the management of perimeter fish ponds. Cooperatives vary greatly in size, organization and in the system for allocation of labor. Extension teams have worked with established rice cooperatives or formed new groups specifically for fish culture, adapting organizational structures as the need dictates.

The Nianga cooperative includes 370 members—a seemingly unmanageable number—but is divided into 14 subgroups. Each subgroup is responsible for sending a person to feed the fish on a rotating daily basis. The Volunteer/counterpart never know who is doing the feeding, but the word apparently passes from person to person as to how the work should be done.

At Gamadji, the 150 member cooperative has not taken full responsibility for the management of the pond. When the Volunteer is at his site, he is assumed to be responsible. When he leaves, however, the coop members do a good job of feeding, fertilizing and maintaining the water level.

At the two sites in the Dagana perimeter, ad hoc fish cooperatives were established from interested villagers. 70 members, responsible for two ponds, compose the Ndiarème coop, while Gaya has two coops of 30 men each managing one pond. This arrangement is also successful in getting villagers to work at the ponds six days a week. Cooperative members in Ndiarème have contributed 1000 CFA each for the construction of an additional five ponds and a mud brick storage facility.

The Mboumba cooperative was involved in hand dressing the dikes of a half-hectare pond and in hand digging a 30 meter drainage canal. This was a considerable undertaking and was accomplished in a short period of time by distributing the work evenly among the 250 members.

From the color (fertility) of the water and the condition of the fish, I believe that Senegalese coops are doing a far superior job of management in comparison to individual fish farmers in other African countries during the initial year of the project. Many different organizational strategies have been attempted and all seem to be working satisfactorily. The cooperatives are structurally flexible and have adapted well to fish pond management.

Peace Corps Volunteer evaluation

The Volunteers are in good spirits and have a positive attitude toward their work. In most cases, the necessary adjustment to village life and languages has been accomplished with relatively few problems. The Volunteers have gained the respect and confidence of the people they work with: counterparts, members of the cooperatives, and officials of Eaux et Forêts and SAED.

Concluding remarks

Interest and participation in this fish culture project is present at all levels within the various collaborating agencies. SAED and Eaux et Forêts officials have shown interest, support and a willingness to actively participate in the project. There is an increasing awareness of the project and its potential among agencies not directly involved. For example, FAO is posting a fish culture expert to undertake research in the Fleuve region in April. Village cooperatives are providing effective pond management. Counterparts are actively involved at the village level. Peace Corps Volunteers feel that the project is progressing very satisfactorily and not one has early terminated despite the early frustrations involved in initiating this activity. Finally, I was informed that the President of Senegal and the Minister of Rural Development are very interested in developing

fish culture. The President said in a recent speech that he wanted to bring fish culture to all regions of Senegal. The new five year plan, to be published in July, is said to contain a section on fish culture based on a report the Prime Minister asked the Secretary of State for Eaux et Forêts to prepare.

ECONOMIC FEASIBILITY

Construction and operational costs of the six perimeter ponds under production have been collected by extension teams. Total costs for construction were variable as type of machine (bulldozer or grader), extent of work and cost of transport to and from construction sites differed between locations. Operational costs, in contrast, tended to be similar.

As no harvests have yet been undertaken, production and market price are extrapolated from growth samples and monitoring of the local market for fresh fish. During the consultation, all ponds under production were seine sampled and the fish weighed. Market prices in the Dagana and Podor departments have been analyzed by the extension teams during the past year. Generally, prices of fresh fish have ranged from 150 to 250 CFA per kilogram. On the basis of these figures, an analysis of the costs and revenues of perimeter ponds is presented. Costs are generalized for a one-half hectare pond as this is the targeted pond size and costs and revenues can be doubled to yield figures per hectare.

Assumptions

Analysis of economic feasibility is based on the following assumptions:

A) Costs

- 1) Pond construction to date has been undertaken by different types (bulldozer, grader and backhoe) and sizes of machines. As the

cost of machine rental is difficult to quantify, it is estimated from the cost of renting a bulldozer for four hours. In actuality, the earth moving equipment has been placed at the project's disposal by SAED, CSS and TP free of charge or for the price of diesel fuel utilized.

- 2) Labor costs for construction, maintenance and harvesting are calculated at a wage of 350 CFA/day. This is lower than standard wage in urban areas, but is a generally accepted wage for farm labor. Labor costs are calculated to give an accurate reflection of the economic cost, even though in practice all work is done by cooperative members.
- 3) Water cost is based on a figure between the assessed price per hectare for rice and tomatoes (25,000 and 35,000 CFA respectively). SAED bases this figure in part on the cash benefits from rice and tomatoes. Revenues from fish culture are expected to surpass those of rice, but not those of tomatoes. At present, SAED is not charging for water although it is assumed that this will become a real cost as the activity expands.
- 4) There is no assessment for rent as existing ponds are situated on previously uncultivated land. These areas are located on sloping land, requiring considerable development costs for the production of rice or tomatoes, or in areas of high soil salinity.
- 5) Supplementary food is de-emphasized in the budget since the present production of rice bran at Ross Bethio (120 tons/year) would limit future development. Production is based on fertilizing and composting inputs with a small amount of supplementary feeding.

- 6) The marketing cost is based on the price of a horse cart to transport 50-100 kilograms of fish 5 to 10 kilometers. Round trip cost is computed at 50 to 100 CFA per trip. This cost may not be assessed on all sites as fish can be sold on the pond bank.
- 7) The price of fertilizer (13-46-0) is assessed at 25 CFA/kg as this represents the current SAED price in the Fleuve region. Water damaged fertilizer sacks have frequently been donated to the cooperatives free of charge.
- 8) The recommended price for fingerlings is 10 fish/5 CFA. Presently, fingerlings are being supplied by Eaux et Forêts at no charge. Farmers will restock ponds with fingerlings obtained at harvests thereby decreasing or eliminating completely the cost of purchasing them from the station.
- 9) U.S.A.I.D as part of project funding has purchased shovels, wheelbarrels and other tools used in pond construction and maintenance totalling 203,340 CFA/site. It should be pointed out that these tools were purchased under the assumption that fish ponds were to be hand dug and the supplied tools greatly outstripped the need. Project funds were also utilized to purchase nets for harvesting. A generalized cost for tools and nets was difficult to quantify (and hence not included) since they are being used by a number of ponds and many of these items are also present in the village. While some expenditure will be necessary for tools and nets, it should represent a very minor cost.

B) Benefits

- 1) Two harvests will be undertaken each year at six month intervals.
- 2) Other potential benefits such as improved diets and fertilized mud from the pond bottom were not calculated due to the difficulty in quantifying these benefits.
- 3) Selectivity analysis is done varying the market price of river fish and on two levels of yearly production for a one-half hectare pond. Market prices of fresh river fish vary from 150 to 250 CFA per kilogram. Presently 5 to 10 tons of ocean fish are trucked into the region daily from St. Louis. In initial preference testing of the market, it appears that fresh fish caught locally are preferred. Therefore, it is assumed that the fish produced in fish ponds will favorably compete with ocean fish which sell at a similar price. Samples of ponds currently under production produce harvests of 1000 to 1500 kg/½ hectare/year. These ponds were stocked conservatively at 1.25 to 1.7 fish/meter square. If stocking rates are doubled, production can reach 2 to 4 metric tons/½ hectare/year.

C) Other assumptions

- 1) The economic period of the benefit/cost analysis is assumed to be 10 years, a somewhat arbitrary figure chosen as a length of time needed for the new technology to be fully accepted and understood. A shorter period would of course reduce the benefit/costs rates.
- 2) The discount rates used in this analysis are 10% and 15%. Since there is no free market for money in Senegal, this rate represents a range of worldwide opportunity cost; the higher level the more realistic.

Table 2. A breakdown of the costs and revenues of a generalized half hectare pond in the Fleuve Region of Senegal. Units are in Francs CFA.

I. Capital investment (Pond construction)	
Machine rental (bulldozer D7 X 4 hours @ 20,000 CFA/hour	80,000
Materials for inlets, outlets and water control structures (cement, rebar, PVC pipe and lumber)	29,100
Labor: 40 man days @ 350 CFA/day	14,000
Total	123,100
II. Operational costs (per year)	
Water	30,000
Fingerlings: 15,000 @ 10/5 CFA	15,000
Fertilizer: 520 kg @ 25 CFA/kg	26,000
Supplementary food, composting and transportation	20,000
Marketing	7,500
Labor: 32 man days @ 350 CFA/day	11,200
Rent	-
Total	120,900
III. Revenue	
Sale of fish 1500 kg @ 175 CFA/kg	262,500

Table 3. Benefit cost analysis for perimeter fish ponds. Basic analysis 1500 kg/ha hectare/year @ 175 CFA/Kg
Units in Francs CFA

Year	Project Cost			Present Worth		Benefit	Present Worth	
	Capital	Operational	Gross	at 10%	at 15%		at 10%	at 15%
1	123,000	120,900	244,000	221,818	212,174	262,500	238,636	228,261
2	-	120,900	120,900	99,917	91,418	262,500	216,942	198,488
3	-	120,900	120,900	90,834	79,494	262,500	197,220	172,598
4	-	120,900	120,900	82,575	69,125	262,500	179,291	150,085
5	-	120,900	120,900	75,069	60,109	262,500	162,992	130,509
6	-	120,900	120,900	68,245	52,268	262,500	148,174	113,486
7	-	120,900	120,900	62,041	45,451	262,500	134,704	98,683
8	-	120,900	120,900	56,401	39,522	262,500	122,458	85,812
9	-	120,900	120,900	51,273	34,367	262,500	111,326	74,619
10	-	<u>120,900</u>	<u>120,900</u>	<u>46,612</u>	<u>29,885</u>	<u>262,500</u>	<u>101,203</u>	<u>64,886</u>
Total	123,100	1,209,000	1,332,100	854,786	713,813	2,625,000	1,612,948	1,317,427

Benefit/cost ratio: 10% $\frac{1,612,948}{854,786} = 1.89$
 15% $\frac{1,317,427}{713,813} = 1.85$

Net Present worth (in Francs CFA)
 10% 1,612,948 - 854,786 = 758,162
 15% 1,317,427 - 713,813 = 603,614

IRR = 100% (greater than)

D) Sensitivity Analysis

To test the sensitivity of the basic analytical parameters to potential errors in assumption, several sensitivity tests, all taken at 15% discounting factor are noted below:

Test 1: Production of 1000 kg/½ hectare/year at a price of 150 CFA/kg.

Test 2: Production of 2000 kg/½ hectare/year at a price of 150 CFA/kg.

Test 3: Production of 1000 kg/½ hectare/year at a price of 250 CFA/kg.

Test 4: Production of 2000 kg/½ hectare/year at a price of 250 CFA/kg.

These figures were chosen as they represent the low and high ends of market price and yearly production of fish. The benefit/cost ratios, net present worth, and internal rate of return were computed for the basic analysis (Table 2) and the four test summarized below:

Conditions	B/C ratio (15%)	NPW (15%)	IRR
Basic analysis	1.85	603,614 CFA	100%
Test 1	1.05	39,003	27.6%
Test 2	2.12	801,818	100%
Test 3	1.76	540,878	100%
Test 4	3.51	1,795,572	100%

Under all sensitivity tests, fish culture is shown to be economically feasible given the stated assumptions. The number of harvests required to repay capital investment costs varies from 1 (Test 4) to 9 (Test 1). As these represent maximum and minimum combined production and marketing conditions, the actual value should be intermediate. Variability in pond size,

demand for fish and production should vary in the region presently covered by the project, although it is doubtful that all variables will minimize and prove the endeavor unfeasible on a regular basis.

RECOMMENDATIONS

General Directions

The introduction of fish culture into the Fleuve Region is marked with exciting promise. Based on its apparent economic feasibility, the interest generated among villagers and government officials, the relative ease of integration into existing agricultural operations, and the accomplishments of the project to date, continued and expanded project support is warranted.

The project is in a formative stage. Until clearer answers are obtained concerning such matters as marketing, productivity, and organization, expansion should proceed at a cautious pace. At this time, it is important for project structures and methodology to remain flexible, trying new ideas and adapting to differing circumstances. Close monitoring of the project should be continued along with on-going evaluation.

Project Organization

The commitments, responsibilities, and working relationships of SAED, Eaux et Forêts, Peace Corps, U.S.A.I.D. and the village cooperatives should be delineated and officially agreed upon. As project directions and opportunities become more clearly defined, agreements can be renegotiated.

A discussion of these parameters for each organization follows:

A) SAED

SAED has entered into no formal association with the project yet has provided extensive support for the project on an informal basis. SAED should be fully informed of the current status of the project and of any intentions to continue and/or intensify present efforts.

The land, machinery, and irrigation facilities necessary for the implementation of fish culture in the Fleuve region are all controlled by SAED. To establish fish culture within the scheme of agricultural development for the Fleuve region, a formal agreement including SAED in the project must be reached.

SAED's obligations should include providing the following basic items:

1. Land. If site expansion is considered, land should be set aside in order that ponds are not in scattered locations with respect to the workers attending them.
2. Machinery for pond construction. Progress was hampered during the initial two years of the project by the lack of available machinery.
3. Water. Ponds should have access to an adequate supply of fresh water on a year around basis.

SAED's role in the implementation of fish culture can be patterned after its current arrangements for rice and tomato production. Perimeter organization differs with respect to managerial responsibilities and financial obligations. The large western perimeters of Richard Toll, Dagana, and Nianga have centralized pumping units and require intensive SAED management. The eastern perimeters, with fields irrigated by small pumps

placed along the river, are much less dependent on SAED management. As a result, financial arrangements for the implementation of fish culture will likely vary by perimeter.

SAED may choose to invest in fish ponds and receive a return on their investment from each harvest. The establishment of a revolving fund for credit could provide the funds necessary for construction and management. An alternative pattern for development would be for the cooperative to raise the necessary capital. SAED would be paid for digging the pond and would receive adequate operating cost coverage.

A working relationship between SAED and the farmer or cooperative is needed in terms of integrating fish culture as a crop. Both parties will be interested in realizing a profit and developing a mutually beneficial relationship of pond construction and fish production. A business arrangement balancing construction and operational cost payments against production and marketing yields must be agreed upon.

Precise costs to be assessed by SAED are difficult to quantify at this time. Leaving room for future adjustments, an agreement can be arrived at that will make fish culture a profitable venture for both SAED and the village cooperative.

B. Eaux et Forêts

U.S.A.I.D. project funds should continue to be channelled through Eaux et Forêts. Eaux et Forêts should provide effective coordination of regional fish culture activities.

Eaux et Forêts should continue to provide qualified agents as counterparts to Peace Corps Volunteers. Given sufficient experience, a

counterpart will be able to continue serving as an extension agent, providing technical advice on his own. The number of counterparts should correspond with the duties they will be expected to assume.

The duties of the counterpart are extremely important. He is responsible for monitoring pond management on a daily basis. He must be present at stocking to see that fish receive proper handling and that the correct number of fish are stocked. He must also be present at all harvests to insure that proper records are taken and that the fish are properly accounted for and marketed.

The project director stationed at Richard Toll should be responsible for the supervision of counterparts.

C) Peace Corps.

Peace Corps will be expected to field qualified fisheries Volunteers. Volunteers have traditionally done this type of work in fisheries programs in the developing nations with demonstrated success.

The demands placed on a Volunteer should take into account the time it takes to integrate into a new culture and begin to work effectively. A reasonable estimate of four ponds could be constructed by a first year Volunteer given adequate material support. Second year Volunteers will be concerned with management and construction. Third year Volunteers will be responsible for the supervision and support of first and second year Volunteers, as well as assuming management duties for as many as twelve ponds. These Resource Volunteers should have a pick-up truck placed at their disposal. The Volunteer posted at the station should be a senior Volunteer and be given the position of Volunteer Leader.

Peace Corps has the capacity to provide from five to twenty Volunteers per year as dictated by project funding levels and expansion needs. Volunteers will be encouraged to extend for a third year; historically fifty percent of Peace Corps Fisheries Volunteers stationed world-wide do extend. Project expansion will not exceed Peace Corp's ability to supply personnel for some time.

D) U.S.A.I.D.

Financial assistance can be used by the project in a variety of ways, including financing for:

1. Constructing a demonstration pond at each new site or the establishment of a system of revolving credit through SAED.
2. Transportational needs of Volunteers and counterparts (motorcycles, pick-up trucks, gas, parts).
3. Equipment: surveying levels, nets, tools.
4. Station expansion

For the next two years, current funding levels (\$100,000 to 200,000) should prove adequate. Continued funding levels will be dependent upon the desired intensity of expansion.

E. Village Cooperatives

Care must be taken to establish fish culture as a profitable business for the entire cooperative. Pond returns will need to reward each member sufficiently according to his contribution. If the cooperative is large, management duties will likely be assumed by a small group who would receive a greater share to the returns. Expansion should not entail a rapid construction of many ponds in scattered villages, but a concentrated effort to develop each new site on secure financial footing.

Decisions concerning cooperative membership, organization, and the division of labor have been successfully made by each village involved. Villages should continue to determine their independent courses for fish culture development.

Richard Toll Fish Station

The Richard Toll station has a current capacity to supply fingerlings for fifty to one hundred ponds annually. This assumes that fingerling demand is spread equally throughout the year which is not the case with a young, developing program. A greater fingerling production capacity is needed. Ponds needed for experimental research and training purposes are not available and all ponds are currently employed in fingerling production.

Expansion into other Regions of Senegal

In 1977 I visited the Fleuve, Thiès, Diourbel, Sine-Saloum and Casamance regions. The potential for fish culture in other regions does not approach that in the Fleuve. Generally this is due to a lack of infrastructure for fish culture including water and land. Expansion of this activity into other regions would be inadvisable at this time.

Management

A) Stocking rates

Present sampling indicates no difference in growth rates between ponds stocked at 1.25 fish per square meter and ponds stocked at 1.7 fish per square meter. The stocking rate should be increased to 3.0 fish per square meter. If subsequent growth rates are not lowered, fish should be stocked at even

higher densities. An increase of fish from 2 to 3 per square meter should increase production from 1 ton/harvest/1/2 hectare pond to 1.5 tons.

B) Fertilizing

Inorganic fertilizers are inexpensive and readily available. The growth of fish from this energy input should be maximized. Composting of manure, rice straw, tomato vines, and other organic wastes should supplement fertilization by inorganics. Fertilizing will increase production three to five fold over production in ponds receiving no management.

C) Feeding

Feeding is important for maximum production. The Fleuve region, however, is scarce on fish food material. Adequate sources of food need to be identified, prices set, and procurement procedures arranged. The cost effectiveness of feeding will need to be determined. Production by fertilization with only a minimal reliance on external food supplies may be necessary for a large-scale program.

Feeding has an important motivational value for the farmer and should be continued if only at a low level. Satisfaction and a sense of responsibility are derived from seeing fish fed daily.

D) Species of fish

The project should concentrate on *Tilapia nilotica* monoculture. No other species of fish has as few management problems with as great a production potential. Polyculture should be avoided. The difficulties involved with its control and the degree of potential harm outweighs any intended benefit.

E. Harvesting

The production of fingerlings will dictate the point at which the pond will need to be harvested. The rate of growth is slowed, then halted, by overproduction of fingerlings by Tilapia in a pond environment. Growth must be achieved through good management practices before the fish reach breeding maturity.

F. Cage Culture

Cage culture is an exciting idea for the utilization of large bodies of water when other fish culture methods are impractical. There are, however, many serious drawbacks. I cannot name a single farmer who stayed with cage culture and is still in business. Not least among the problems involved, cage culture requires feeding fish a complete diet feed, a non-existing commodity in Senegal.

CONCLUSION

Fish culture in the Fleuve region of Senegal has great potential-- as great as any area of Africa I have visited. The infrastructure located on irrigated perimeters readily lends itself to fish culture and village cooperatives are doing an excellent job of managing fish ponds.

To the extent possible, the project should be aimed at the village cooperative in order to establish a self-sufficient system of fish ponds. Use of local funds and materials should be maximized and outside inputs kept to a minimum.

It is hoped that this report can initiate a dialogue between U.S.A.I.D., Peace Corps, Eaux et Forêts and SAED toward delineating the future of fish culture as a technology in the Fleuve region. While the initiative appears both socially and economically feasible, this assessment is based on several organizational "givens" that have yet to be officially agreed upon.

ANNEX A

ITINERARY

- February 15, 1981 Leave Norman Oklahoma
- February 16 Arrive Dakar
Meet Ken Barber, APCD/Environmental projects
Lorraine Isaac, PCD
Joe Salvo, AID
Ted Kasckow, PCV
Maura Sene, APCD/Administratio
Alioune Ndiaye, APCD/Public Administration
Kirk Miller, RMO
- February 17 Meet with: Floyd Spears, Hgmt Officer/AID
Lance Jepson AID/AGR
David Shear, AID/S Director
Ken Barber, APCD
Celestine Diallo, APCD/Education
Felipe Tejada, APCD/Rural Development
- February 18 Meetings with: Joe Salvo, AID
Ken Barber, APCD
Abdoul Oumar FALL, Eaux et Forêts assistant to
Director
Ted Kasckow, PCV
Andrea Hough, PCV
Charles Chopak, PCV
Papa Sy, Chef de Section Dagana and Acting Fisheries
project coordinator in Richard Toll for
Eaux et Forêts.
- February 19 Visit Fish station in Richard Toll and perimeter
of Dagana (villages of Gaya and Ndiarème)
Meetings with: Mr. Samba Fall, SAED/Chef de
Périmètre Dagana
Modune Guéye, Chef of Fish groupment
Amadou Noctar Diop, President fish cooperative
- February 20 Visit perimeters of Guédé and Nianga and villages
of Guédé Chantier, Gamadji, and Nianga.
Meetings with: Assane Diop, Agent technique Eaux
et Forêts, Guédé Chantier
Mr. Diatta, SAED/Chef de Périmètre Guédé
Ousman Derry, Agent technique Eaux et Forêts,
Gamadji
Ousman Sy, SAED/Chef de Périmètre Nianga
Andrea Hough, PCV
Bennett Buckles, PCV
Cindy Bower, PCV

February 21 Meetings with: Mr. Sarr, Eaux et Forêts
 Chef de Secteur Podor
 Ciré Seck, Agent technique Eaux et Forêts Nianga
 Ousman Sy, SAED
 Travel to Mboumba and visit pond and
 PCV Phil Carls

February 22 Conference with PCVs, Pape Sy and Agent techniques
 on Economic feasibility, program expansion
 and PCV needs.

February 23 Conference continued: Formulation of an expansion
 plan, fish management problems of sites
 and Volunteer life in Senegal

February 24 Conference completion—role of PCV in Podor
 Sample fish at Nianga pond
 Discussion with Papa Sy
 Report writing

February 25 Report writing
 Meet Sam Rea, AID/Program
 John Balis, AID/Agriculture Director
 Joe Salvo, AID/Agriculture
 Sample ponds at Gaya and Ndiarème

February 26 Return to Dakar
 Meet with John Balis, AID
 Meet with Lorraine and Amos Isaac, PCDs
 Confer with Ken Barber, APCD

February 27 Meet with Cheikh Cissakho, Secretary of State
 of Eaux et Forêts
 Confer with John Balis, AID; Ken Barber, PC and
 Joe Salvo, AID
 Meet with Melvin McCaw, AID/Deputy Director
 Confer with Ken Barber on project design

March 1 Report writing
 Meet with Ken Barber, APCD on project needs

March 2 Report writing
 Meet with Amos Isaac, PCD and Ken Barber, APCD
 Meet with Sam Rea, AID/Program, Barbara Howard,
 AID/OMVS and Paul Wengler, AID/PDO
 Meet with Peter Ames and Jas Thrall, AID consultants

March 3 Report writing
 Meet Ray King, AID/Controller

March 4 Depart Dakar