



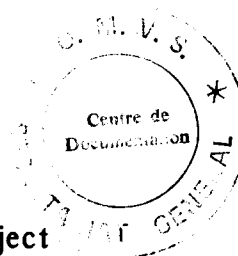
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**FARMING SYSTEMS RESEARCH ALONG THE SENEGAL RIVER VALLEY**

**FEASIBILITY STUDY OF FISH CULTURE PROJECTS  
IN THE GORGOL REGION**

by

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**Mauritania Agricultural Research Project II**

**College of Agriculture  
The University of Arizona  
Tucson, Arizona**

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Bureau of Applied Research in Anthropology,  
Farmer-to-Farmer Program**

## EXECUTIVE SUMMARY

There is a genuine need to increase the quantity and to improve the quality of fish available for consumption in Mauritania. This need results from both the reduction in natural fish production in the Senegal River caused by the Diama and Manatali dams, and from an ever-increasing demand for fish as the population along the river, especially on the Mauritanian side, grows larger.

Fisheries projects in the Senegal River Valley are some of the most appropriate projects that development agencies can undertake in Mauritania. Fishing is a way of life for a whole caste of people (the Subalbé), there is a long tradition of eating fish, and fish marketing systems are already in place. The people are aware of the decline in the river fishery and they are both receptive and willing to learn ways in which to improve and/or supplement it (i.e., through fish culture).

The objectives of this study were to:

1. Determine the present status of fish culture and any ongoing research in the Senegal River Valley.
2. Determine the feasibility of developing fish culture projects in Mauritania.
3. Identify the most appropriate site(s) for a pilot project.
4. Identify and collect samples of the freshwater river fish eaten by Mauritians.
5. Identify one or more species of edible fish, in addition to *Tilapia*, for possible culture research in Tucson.

Most of the fish culture projects and research in the Senegal River Valley are being carried out by the Fish Volunteers in the Peace Corps/Senegal Fish Culture program. This program has been in existence since 1980. Mauritania has no comparable program, despite having a greater need for more locally-based sources of fish and nearly identical environmental conditions.

Development agencies interested in initiating fish culture projects in the Senegal River Valley should be willing to make long-term commitments. Fish culture projects are feasible in the Gorgol region, but may take 10-15 years to become economically viable and self-sustaining.

## ACKNOWLEDGMENTS

I sincerely appreciate the help and support of numerous persons and organizations which made this report possible. I would especially like to thank Michael Norvelle, Project Director, AGRES II Project, for his role in seeking and obtaining approval for this study and for his support and assistance. I would like to extend my thanks to Sandra J. Porter, Program Director, Thoric Cederstrom and Daniel Sellen, Assistant Directors, Bureau of Applied Research in Anthropology, Farmer-to-Farmer Program, whose efforts led to funding this study. Special thanks are due to Mark B. Lynham, Chief of Party, and Robert W. Ackerman II, Administrative Manager of the AGRES II Project, who gave direction, diligently took care of the logistics, and provided backup support for this study. I also wish to thank James Jackson, Agricultural Development Officer (ADO), USAID/Nouakchott, Wayne Nilsestuen, ADO, USAID/Dakar, and their respective staffs, for providing background information and reports.

I am grateful to the following government officials in Nouakchott for providing information on fisheries in Mauritania: Sy Adama, Directeur de l'Agriculture, Mohamed Mahmoud Ould Jerlani, Directeur de la Pêche Artisanale, Carrera Mamadou, Representant du Centre de Recherches Oceanographiques de Nouadhibou a Nouakchott, Kane Mamadou Abdiril, Directeur Technique de la SONADER, and Ly Boubacar, Aquaculteur, Centre National de Recherches Oceanographiques et des Pêches.

Sincere thanks are also extended to the Office of Arid Lands Studies, University of Arizona, for providing cooperative support for the study. I would like to thank, in particular, Martin Karpiscak, for his assistance in developing the study's objectives; Timothy R. Frankenberger, for developing the Fishermen Interview Guide; David Atkinson, AGRES II Project, for taking care of the pre-trip logistical arrangements; Julie Tronson, who designed the cover and did the graphics for this report; and Emily Whitehead, for her work in editing this report.

I am most grateful to Kevin Turner, Kevin Nelson, Marsha Lin, Cindi Horton, and Jack Shea, Peace Corps/Senegal, and Ni Van Nguyen, USAID/Bakel, for sharing their experiences and for their hospitality. Finally, special thanks go to Kevin and Crystal Cobble, U.S. Fish and Wildlife Service, Williams Creek National Fish Hatchery, for their cooperation and assistance.

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## I. INTRODUCTION

The University of Arizona's Mauritania Agricultural Research Project II (AGRES II), in cooperation with the Centre National de Recherche Agronomique et de Developpement Agricole (CNRADA) de Mauritanie, is conducting a number of studies on farming systems and ways in which to improve and diversify agricultural production in the Senegal River Valley. One of AGRES II's interests is the possible integration of fish culture with other farming practices. Toward that end, the consultant was requested by AGRES II, through the Farmer-to-Farmer Program, to identify and assess the various proposed and actual fish culture projects along the Senegal River Valley in Senegal and Mauritania, and to make recommendations as to how AGRES II might become involved in fish culture.

The consultant was requested by AGRES II to:

1. Determine the present status of fish culture and any ongoing research in the Senegal River Valley.
2. Determine the feasibility of developing fish culture projects in Mauritania.
3. Identify the most appropriate site(s) for a pilot project.
4. Identify and collect samples of the freshwater river fish eaten by Mauritians.
5. Identify one or more species of edible fish, in addition to *Tilapia*, for possible culture research in Tucson.

The period of consultation was 14 July to 10 August 1987.

### A. Background

A number of studies have been conducted on the need for, and the feasibility of, fish culture projects in the Senegal River Valley. Reports on these studies have been issued at an average rate of one every other year since the late 1970s (Clemens 1977; Morrison 1980; De Verdilhac 1982; and Hough 1984). Most of the reports agree on the following points: 1) There will be a significant reduction in natural fish production in the Senegal River after both the Diama Dam, near Saint Louis, Senegal, and the Manatali Dam, in Mali, are on-line. As of this writing, the Diama Dam is completed; the Manatali Dam is scheduled for completion in 1989. The environmental impact study done for the Organisation pour la Mise en Valeur du Fleuve Senegal (OMVS), (Gannett, Fleming, Corddry and Carpenter 1980) projects an annual loss of fish production in the river system and the estuary to reach 15,680 metric tons by the year 2000, with a total deficit of 212,268 metric tons by the year 2028. The full impacts of the dams won't be known until they have been on-line for 10-15 years. 2) There will be an ever-increasing demand for fish as the population along the river, especially on the Mauritanian side, grows larger, possibly tripling by the year 2000 (Centre National de Recherches Oceanographiques et des Peches 1987).

The decline of the river fishery could signal the end to a way of life for the Subalbe, or fishermen caste, who have had to turn to farming in order to provide an adequate amount of food for their families. In interviews conducted in three Mauritanian fishing villages, Djovol, Guiraye, and the old section of Kaédi (see Map 1), the consultant heard similar tales of declining catches, disappearance of species, and reduced size of remaining fish, with large fish rarely caught (see Figure 1). All of those interviewed had heard of the practice of fish culture, though admitted that they did not know how to do it themselves. They all expressed interest in learning more about fish culture and told the consultant that "fishing is both our livelihood and way of life and that anything that can help to improve fishing is most welcome" (Bocar Moktar Si/Guiraye, Yreo Dikal Ndiaye/Djovol and Sarr Abudemba/Kaédi, personal communication).

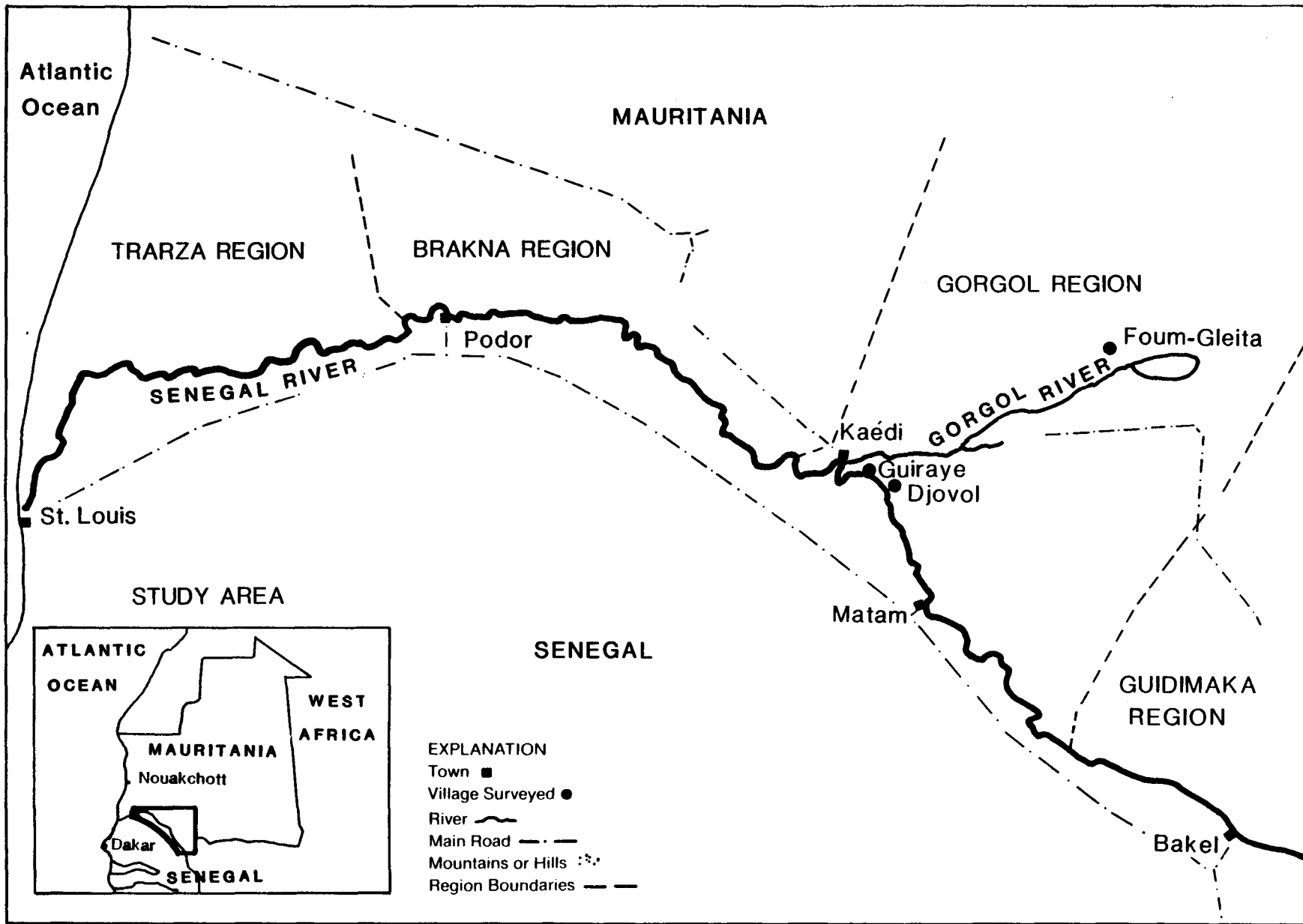
## II. PRESENT STATUS OF FISH CULTURE PROJECTS AND RESEARCH

Most of the fish culture projects and research in the Senegal River Valley are being carried out by the Fish Volunteers in the Peace Corps/Senegal Fish Culture program. The program, which has been in existence since 1980, was initiated on the basis of the positive feasibility study conducted by Dr. Howard Clemens (Clemens 1977) of the University of Oklahoma. Subsequent evaluations and reviews of the program have been periodically conducted (Clemens 1981; Shelton 1985; Duncan 1986; and Duncan 1987), in order to update the program, as the realities, problems and successes of practicing fish culture in Senegal became known.

The program was initially funded by USAID, which included the construction of the Nianga Fish Station. In 1985, USAID withdrew due to the relatively small scale of the program, and financing was then provided by Catholic Relief Services/Senegal (CRS). The program is funded through September 1987; a proposal has recently been submitted for an extension through March 1988. After that, CRS has decided to withdraw support for the program because "it is not immediately economical and CRS cannot back something for 10-15 years to see if it will become so" (Peter Gallagher/CRS, personal communication). CRS has, however, pledged to help Peace Corps/Senegal find another funding source.

The consultant had the opportunity to visit three of the present Fish Volunteers at their sites—Kevin Turner at the Nianga Fish Station near Podor, Kevin Nelson in Bakel, and Marsha Lin in Gagabé; the fourth, Cindi Horton (Matam) was visited in Dakar. Their hard work and dedication, along with that of their predecessors, has resulted in some significant findings concerning the culture of *Tilapia nilotica* in the Senegal River Valley. These findings include:

1. Only one 6-8 month growing season and, hence, one fish harvest per year is attainable. This is due mainly to low water temperatures during the winter months. Water temperatures as low as 11°C in Bakel and 14°C at Nianga have been recorded in December and January (Nelson and Turner, personal communication). Most *tilapia* grow best at around 25-30°C and will essentially stop growing below 15-18°C, with spawning occurring only after water temperatures reach 20-25°C (Shelton 1985). The major implications of a one-harvest/year program are the need for an adequate supply of seed stock each year and some holding facility, i.e., fish rearing station and/or small, brood stock ponds.



MAP 1. LOCATION OF TOWNS AND VILLAGES





Figure 1. The majority of fish caught near Kaédi, Mauritania average 150 mm.

Water availability is also a factor, for as the rice is harvested in the fall and the river level drops in late winter/early spring, pumping is halted. This is not necessarily a problem, because it is highly desirable to completely empty the pond each year for three reasons. 1) To ensure that all fish have been harvested. This also makes it possible to determine the amount and age of fish in the following year's stocking. 2) Drying out of the ponds is a good means of disease prevention. 3) Ponds can be inspected and any repairs and/or modifications made.

2. Fish should be stocked at a rate of 2 fish/m<sup>2</sup> and organic and/or inorganic fertilizer applied at a rate of 5 kilograms per hectare every 2 weeks (5kg/ha/2 weeks). This stocking rate results in greater individual growth rates and a larger average size at harvest (80-100 g fish). Fish size is very important for, in general, the larger the fish, the greater the price at which it can be sold (Mauritanian fishermen, personal communication).
3. In order to have acceptable growth rates during the growing season, both the maintenance of an algal bloom and the supplemental feeding of fish, are required (see Figure 2). In experiments conducted at Nianga, the following results occurred (Lowerre 1986).

<u>Feeding Regime</u>	<u>Growth Rate</u>
Algal bloom only (by animal manure):	.14 g/day
Algal bloom (by fertilizer) & rice bran:	.42 g/day
Algal bloom, 80% rice bran & 20% fish meal:	.70 g/day

4. Realistic yield expectations are 1,000-2,000 kg/ha/yr. In general, the smaller the size of the pond, the easier it is to manage, the more productive it is, and the less susceptible it seems to fish predation and theft. At the Nianga fish station, with the stocking and fertilization rates described above, the 3,300 m<sup>2</sup> ponds produced 850 kg/ha, and the 275 m<sup>2</sup> ponds (see Figure 3) produced 1,300 kg/ha (Turner 1987). Studies by Reizer et al (1972) of eight natural bodies of water in the region of Podor, also found that waters with larger surfaces tended to yield less. The range of fish production in these ponds was 375 kg for a 5-ha pond to 10 kg for 150- and 200-ha ponds. One 65-ha pond yielded only 1.5 kg, however.

#### A. Foum-Gleita Reservoir

The consultant visited the reservoir at the dam site on 3 August, but due to an afternoon arrival and proximity to a major holiday (Tabaski), no fishing nor marketing activity was encountered. Two recent reports written on improving and managing the Foum-Gleita fishery (De Verdilhac 1982 and Lazard 1986) are recommended reading for any interested parties.

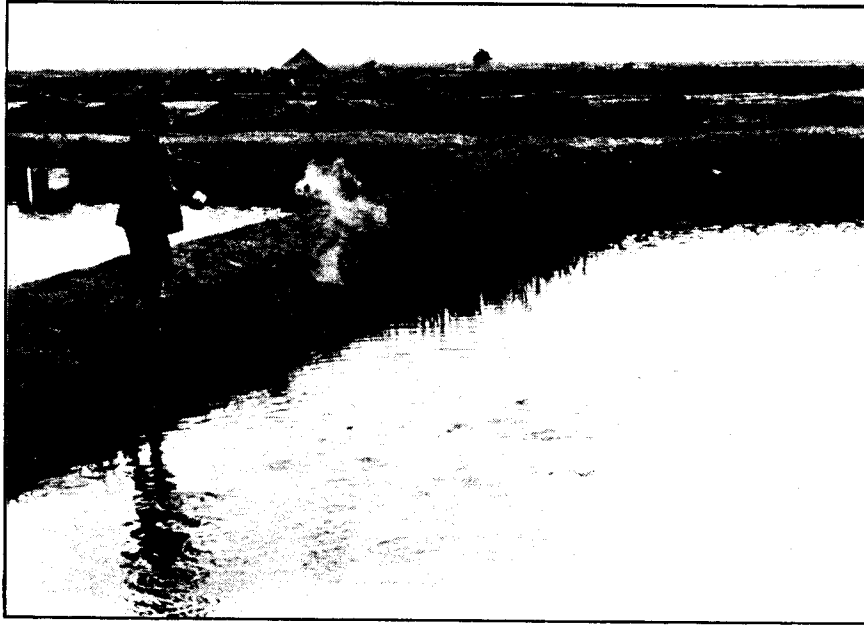


Figure 2. Supplementing the diet of *Tilapia nilotica* with rice bran and fish meal is essential to obtain desired growth rates.

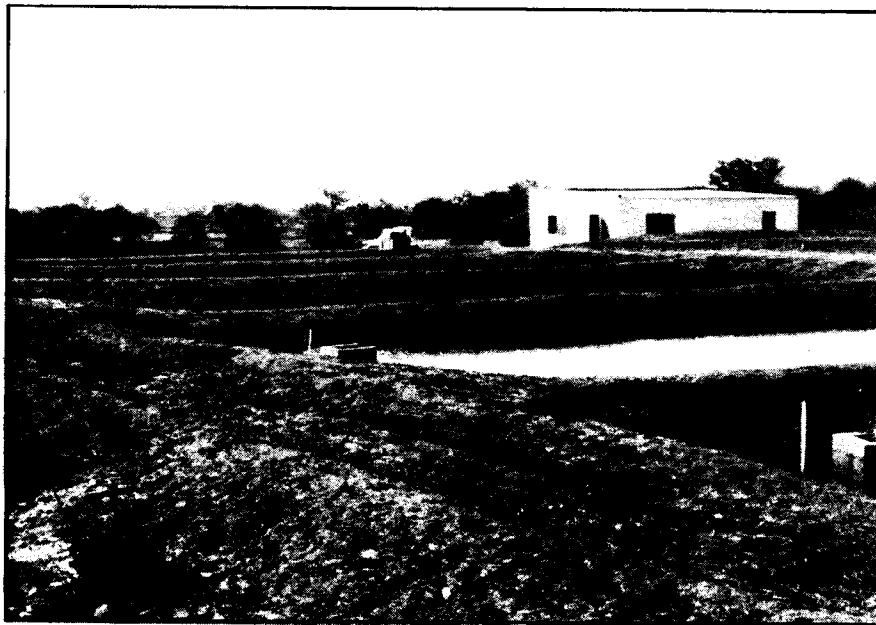


Figure 3. The 275 m<sup>2</sup> fish ponds at the Nianga Fish Station were more manageable and productive than the 3,300 m<sup>2</sup> ponds.

## **B. Proposed Fish Culture Development Project**

The Centre National de Recherches Océanographiques et des Pêches (CNROP), with funding from the Centre de Recherches Pour le Développement International du Canada (CRDI), is proposing to conduct a three-year study of the status of fisheries and fish culture in the Senegal River Valley, starting in early 1988. Their main objectives include:

1. To define the extent of fresh water utilization.
2. To evaluate the possibilities and make recommendations appropriate for a rational fisheries development program.
3. To inform and sensitize the rural population about new fish culture techniques.
4. To complete and to balance the ichthyological stocking of certain lakes and reservoirs.
5. To encourage the rural population to undertake some fish culture activities.

In addition to these objectives, CNROP, with the collaboration of other organizations already working in the study area, plans to identify the most appropriate sites for fish rearing station(s) and fish culture projects. The study will also look at sociological and economical aspects, including market surveys and village meetings.

## **C. Justification for Inland Fish Culture in Mauritania**

In addition to the reasons listed in the Background section of this report, there is further justification for attempting fish culture projects on the Mauritanian side of the Senegal River. For example, the OMVS report (1980) lists fish culture and joint agriculture-fish production projects as two mitigation measures for the loss of estuarine and freshwater fisheries and shellfisheries caused by the Diama and Manatali dams.

Another mitigation measure that should be instituted is a fish restocking program for the Senegal River. Funding for the construction and management of a series of fish rearing stations should be provided by the same government agencies that approved the construction of the two dams. Precedents for such actions have been set in the United States, where the U.S. Army Corps of Engineers has provided funds for the construction and long-term management of a series of salmon and trout fish hatcheries on the Columbia River and some of its major tributaries, after dams were built on them by the Corps. The problem with this is identifying which agency, or agencies, should provide the funding (and if they are capable of doing so). With three countries involved—Mali, Mauritania, and Senegal—the problem is compounded. OMVS is the most obvious institution.

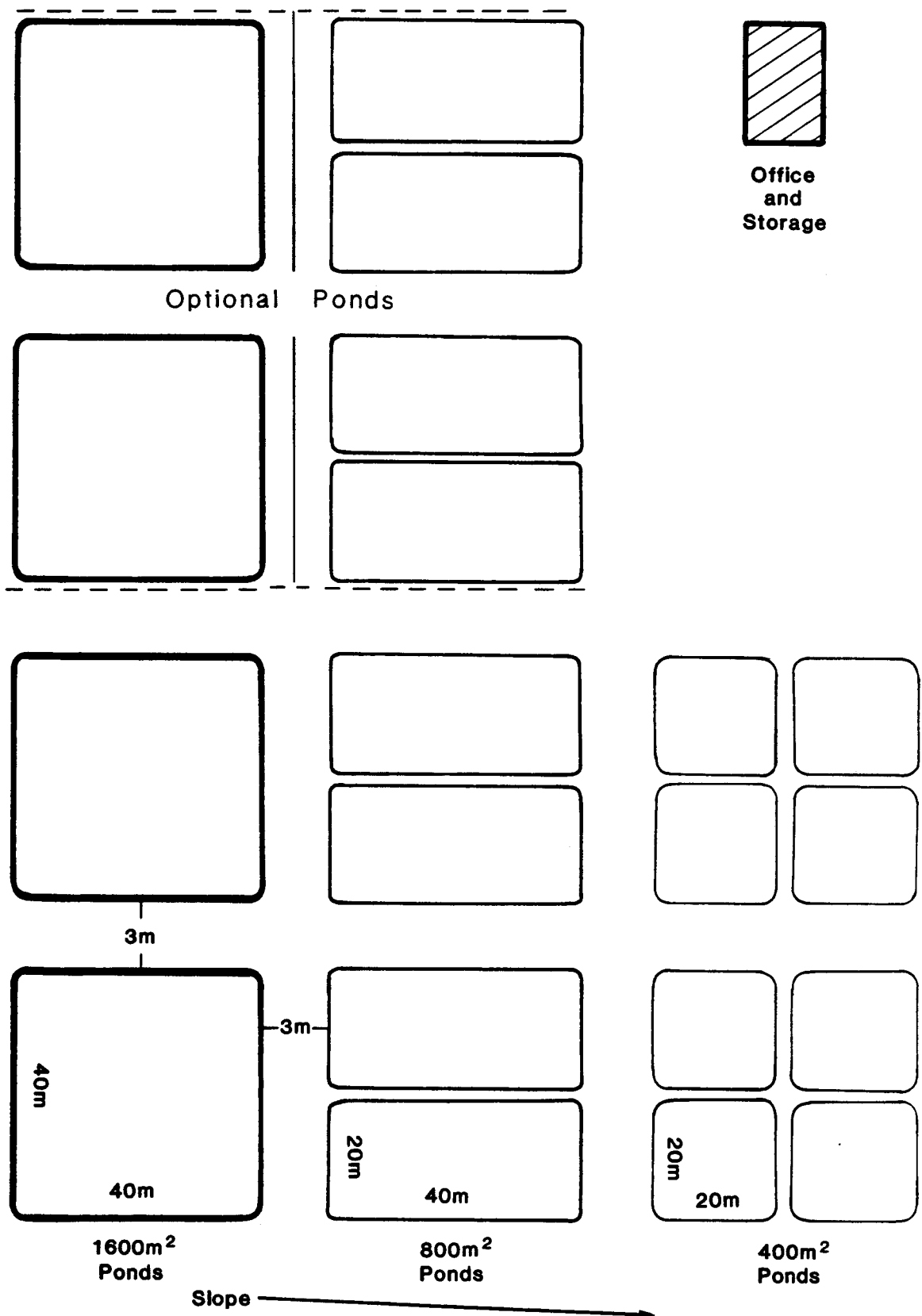
Senegal has had an ongoing fish culture program since 1980, while Mauritania has no comparable program. It is the view of the consultant, after spending time in both countries, that the situation in Mauritania is more acute and the need for agricultural development projects of all kinds greater. Senegalese farmers and fishermen still have the option (though it is unlikely that they would do so) of migrating to other parts of the country. Mauritians do not have this option. For many of them, the Senegal River Valley is their last stand and hope. The Senegalese side has a paved, all-season road on which the distribution of ocean fish is facilitated. Mauritania has no such road. In fact, many villages are cut off during the rainy season. The need for more locally-based sources of fish is apparent in Mauritania.

### III. RECOMMENDATIONS

Following are recommended actions for AGRES II, CNRADA and USAID.

1. Establish and develop a close working relationship with CNROP during its three-year fisheries study. This should be relatively easy to do, as CNROP plans to be based in Kaédi during the study. This will also help to eliminate any duplication of efforts. Contact person: Ly Boubacar, Nouadhibou.
2. Request copies of the Peace Corps/Senegal Projet Pisciculture quarterly reports as they become available to keep abreast of any new findings and developments. Contact person: Jack Shea, Dakar.
3. By the first of January 1988, identify a site adjacent to, or part of the rice perimeter just east of Kaédi, to build a fish rearing station. A fish station is a crucial first step in the development of a fish culture program. It is a source for fingerlings, plays an important role in the awareness and interest phases of the program, and serves as a training center. As stated previously, its creation can be justified on the basis of a restocking program alone. Fingerling production for stocking ponds and research potential enhance that justification. An alternate site would be directly downstream from the dam at Fom Gleita. When such a site has been identified and all land use and tenure problems worked out, a funding proposal should then be drawn up and submitted to USAID. The 3-ha station should initially have two 1,600 m<sup>2</sup> ponds, four 800 m<sup>2</sup> ponds, and eight 400 m<sup>2</sup> ponds, with plans to add two 1,600 m<sup>2</sup> and two 800 m<sup>2</sup> ponds, should initial trials and experiments prove successful (see Figure 4). This configuration lends itself to trial replications during experiments. Duncan (1987) reports pond construction to be about \$3,500/ha in Senegal, so if that holds true in Mauritania, pond construction for the station would be about \$10,000 if all twenty ponds were built. If possible, the ponds should be built on a slope to allow the option for higher ponds to drain into lower ones, for maximum water use. **IMPORTANT NOTE:** Dr. Howard Powles, of CRDI, the organization that is funding the three-year fisheries study, told the consultant that CRDI, although unable to provide funds for the construction of a fish station, is receptive to providing funding for research carried out at such a station, should one be built.

FIGURE .  
POSSIBLE FISH STATION DIAGRAM



4. Investigate the possibility of sending Mauritanian nationals to a university in the United States, such as Auburn University, for fish culture training. CNROP is also proposing to do this, so a joint sponsorship might be worked out.
5. Solicit Peace Corps/Mauritania for two Fisheries Volunteers, with at least B.S. and, preferably, M.S. degrees in aquaculture and/or fish biology. Their primary duties would be to manage the fish station and conduct training for SONADER extension agents and interested fishermen and/or farmers. Their own extension duties would be minimal. A qualified Mauritanian, such as Ly Boubacar, or some equally qualified person, would take over after that. This idea has not been discussed with Mr. Boubacar, so his willingness to work in such a position and his availability after the three-year CNROP study are not known. (Note: Obtaining one or two Fisheries Volunteers from Peace Corps/Mauritania may be a problem. Richard Toliver, the Peace Corps Director, told the consultant that in his opinion, there are too many problems involved with fish culture and the Mauritanian Government's priority is to develop its ocean fisheries. If the Peace Corps is unwilling to provide Fisheries Volunteers, then AGRES II should consider hiring a professional aquaculturist for the initial 2-4 years.)
6. By 1 May 1988, after a source of fingerlings has been found, construct one or two 500 m<sup>2</sup> ponds adjacent to the Belinabé research plots west of Kaédi. Combined fish and rice culture trials could initially be done in these ponds. Water levels should be a minimum of .5 meters.
7. By 1 January 1989, identify two marigots and have them divided into manageable sizes (about 1,000 m<sup>2</sup>). This work will most likely need to be done by a bulldozer. For free-standing ponds that rely solely on rainfall and/or runoff, a minimum depth of 3 meters is needed due to an average evaporation rate of about 11 mm/day. (A minimum of 6 months of water is needed.)
8. Cage culture trials should be attempted both in the marigots and the Senegal River. Cage culture has a small initial investment and no pumping costs. An attendant is required, however, to guard and tend the fish.
9. Encourage USAID to integrate fish ponds into the Dirol Plain project. The ponds could be located in the "pool" areas, at an elevation of 6.2 and 6.3 meters, or near the start of the Dirol Creek channel proper. Another option is to keep enough water in the Dirol Creek channel, after the plain is drained, to permit at least a 6-month growing season. The consultant realizes that there will be land use questions to resolve in the Dirol Plain before fish ponds can be constructed. Also the issues of who would feed and have rights to the fish would also have to be addressed.
10. A viable option for AGRES II is to wait until the three-year study by CNROP is completed before implementing any of the above recommendations. Findings from the CNROP study should be much more comprehensive and complete. The most significant aspect of the CNROP study, besides its duration, is that it will be conducted by Mauritanian nationals.



Figure 5. Locating fish ponds adjacent to rice perimeters provides access to a reliable water supply.



#### IV. CONCLUSIONS AND COMMENTS

There is a genuine need to increase the quantity and to improve the quality of fish available for consumption in Mauritania. It is likely that there will be a further decline in both quantity and quality of fish once the two dams on the river are completed. Now is the time to start fisheries projects that will help lessen the impacts of these dams. There are a number of development organizations that are interested in fish culture projects along the Senegal River in Mauritania, but none of them have yet to make any financial commitments to implement such projects.

Fisheries projects in the Senegal River Valley are some of the most appropriate projects that development agencies can undertake in Mauritania. Fishing is a way of life for a whole caste of people (the Subalbé), there is a long tradition of eating fish, and fish marketing systems are already in place. The people are aware of the decline in the river fishery and they are both receptive and willing to learn ways in which to improve and/or supplement it (i.e., through fish culture).

This report is not an economic analysis. Long-term economic viability is needed for any program to be deemed successful. Fish culture is feasible, but most likely will not be economically viable in Mauritania, in the short run. Dr. Bryan Duncan (personal communication), of Auburn University, believes that any development agency interested in initiating fish culture projects in the Senegal River Valley should be willing to make commitments of 10-15 years. This is the minimum amount of time needed to determine whether such projects will become economically viable and self-sustaining.

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## APPENDIX A

### LIST OF PEOPLE CONSULTED

#### Government of Mauritania

Sy Adama – Directeur de l'Agriculture

Mohamed Mahmoud Ould Jerlani – Directeur de la Pêche Artisanale

Carrera Mamadou – Représentant du Centre de Recherches Océanographiques de  
Nouadhibou à Nouakchott

Kane Mamadou Abdiril – Directeur Technique de la SONADER

Ly Boubacar – Aquaculteur, Centre National de Recherches Oceanographiques et Des  
Pêches.

#### University of Arizona/AGRES II

Michael Norvelle – Project Director, Tucson, Arizona

Mark Lynham – Chief of Party, Kaédi, Mauritania

Robert W. Ackerman II – Project Administrative Manager, Kaedi

David Atkinson – Project Administrative Manager, Tucson

Timothy Frankenberger – Anthropologist and Agricultural Economist

Martin Karpiscak – Research Scientist, OALS, Tucson

#### USAID/Senegal

Wayne Nilsestuen – Agricultural Development Officer

Jean LeBloas – River Basin Development Officer

Khoi-N-Le – Irrigation Officer

Ni Van Nguyen – Irrigation Project Coordinator in Bakel

P. Andre DeGeorges – Environmental Advisor, Organisation pour la Mise en Valeur  
du Fleuve Gambia (OMVG).

**USAID/Mauritania**

James Jackson – Agricultural Development Officer

Harouna Hanefi – Assistant Agricultural Development Officer

**Peace Corps/Washington, D.C.**

Harry Rea – Fisheries Sector Specialist, Office of Training and Program Support

**Peace Corps/Senegal**

Jack Shea – Associate Peace Corps Director/Fisheries

Cindi Horton – Peace Corps Volunteer/Fisheries

Kevin Turner – Peace Corps Volunteer/Fisheries

Kevin Nelson – Peace Corps Volunteer/Fisheries

Marsha Lin – Peace Corps Volunteer/Fisheries

**Catholic Relief Services/Senegal**

Peter Gallagher – Deputy Director

**Centre de Recherches Pour le Developpement International (CRDI)/Senegal**

Dr. Howard Powles – Program Officer (Fisheries)

**Auburn University, Alabama**

Dr. Bryan Duncan – Water Harvesting and Aquaculture Project

**Mauritanian Fishermen (Subalbé)**

Sarr Abudemba – Kaédi

Bokar Moktar Si – Guiraye

Yero Dikal Ndiaye – Djovol

## APPENDIX B

### ITINERARY

<u>Dates</u>	<u>Activities</u>
14 - 21 July	In Nouakchott, Mauritania: Met with Government of Mauritania fisheries and agriculture officials, USAID personnel, and obtained pertinent reports.
22 - 23 July	In Dakar, Senegal: Met with USAID, Peace Corps, CRS, and CRDI personnel, obtained pertinent reports.
24 - 25 July	In Saint Louis, Dakar. Visited Diama Dam.
26 - 27 July	Traveled to, and met with PCV Kevin Turner of, the Nianga Fish Station near Podor, Senegal.
28 - 30 July	Traveled to Bakel, Senegal, and met with PCV Kevin Nelson and saw one of his work sites.
31 July	Traveled to, and day of rest in, Kaédi, Mauritania.
1 - 9 August	Based in Kaédi. Toured and/or visited Maghama, M'bout, Foun-Gleita and the Dirol Creek area. Surveyed the market in Kaedi. Interviewed the fishermen of Guiraye, Djovol and Kaédi. Met with Marsha Lin in Gagabé, Senegal, and toured her pond sites.
10 August	Traveled to Nouakchott.
11-13 August	Wrote draft report in Nouakchott.
14 August	Departed Nouakchott for return to the U.S.A.

## APPENDIX C

### FISHERMEN INTERVIEW GUIDE

- A. **Name of Fishermen**
- B. **Location**
- C. **Fishing Sites**
  - Location
  - Distance from home
- D. **Fishing Methods/Patterns**
  - Traditional
  - Recently adopted
  - Seasonality
- E. **Environmental Effects on Fish Populations**
  - Past, present, and preferred species
  - Qualities of remaining fish (size, appearance, signs of disease)
- F. **Other Fishing and Fish Culture Techniques**
  - Awareness and receptivity
  - Awareness and availability of fish's food preferences
  - Willingness to culture fish in ponds/marigots
  - Possible sources of fish food
  - Who would tend, harvest, dress, and sell fish?
- G. **Importance of Fish in Diet**
  - Local vs. ocean fish
  - Amount consumed per day/week/month
  - Fresh vs. dried
  - How prepared?
- H. **Marketing**
  - Where are fish bought/sold?
  - Amount & price of fish bought from outside sources
  - Amount & price of local fish sold
  - Need for greater supply?
- I. **Role of Women**
- J. **Suggestions for Improvements**
- K. **Perceived Constraints**
- L. **Perceived Benefits**

