

PD-AAX-116  
54122

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

L. TRANSACTION CODE

A = Add  
C = Change  
D = Delete

Amendment Number

DOCUMENT CODE

3

COUNTRY/ENTITY  
Bureau for Science and Technology

1. PROJECT NUMBER  
936-4180

BUREAU/OFFICE  
Office of Agriculture

S&T/AGR

2. PROJECT TITLE (maximum 40 characters)  
Aquaculture Research and Support

3. PROJECT ASSISTANCE COMPLETION DATE (PACD)

MM DD YY  
019 | 310 | 913

7. ESTIMATED DATE OF OBLIGATION  
(Under "E" below, enter 1, 2, 3, or 4)

A. Initial FY | 818 |

B. Quarter | 1 |

C. Final FY | 912 |

8. COSTS (\$000 OR EQUIVALENT \$) =

A. FUNDING SOURCE	FIRST FY 1988			LIFE OF PROJECT		
	B. FX	C. L/C	D. Total	E. FX	F. L/C	G. Total
AID Appropriated Total	968		968	4,840		4,840
(Grant) S&T/AGR	( 255 )	( )	( 255 )	( 1,275 )	( )	( 1,275 )
(Loan)	( )	( )	( )	( )	( )	( )
Other U.S. Missions, Regional						
2. BUREAUS & AID/W	713		713	3,565		3,565
Host Country						
Other Donor(s)						
TOTALS	968		968	4,840		4,840

9. SCHEDULE OF AID FUNDING (\$000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH CODE	D. OBLIGATIONS TO DATE		E. AMOUNT APPROVED THIS ACTION		F. LIFE OF PROJECT	
			1. Grant	2. Loan	1. Grant	2. Loan	1. Grant	2. Loan
(1) FN	200 I	077	-0-		1,275		1,275	
(2)								
(3)								
(4)								
TOTALS			-0-		1,275		1,275	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each)  
319 | 876 | 963 | 968 | 790 | 973 | 11. SECONDARY PURPOSE CODE 100 I

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code	R/AG	TECH	BR	NUTR	XII	BS
B. Amount	\$1,173	\$2,500	\$2,000	\$2,100	\$4,270	\$2,950

13. PROJECT PURPOSE (maximum 400 characters)

The project purpose is to assist LDCs improve their capabilities in aquaculture to: 1) increase income and employment in the fisheries sector; 2) improve management strategies to conserve national resources and optimize sustained yields; and 3) improve fish distribution and marketing systems.

14. SCHEDULED EVALUATIONS

Location MM YY | MM YY | Final MM YY  
019 | 019 | 012 | 910 | 912 | 913

15. SOURCE/ORIGIN OF GOODS AND SERVICES

000  741  Local  Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a \_\_\_\_\_ page PP Amendment)

17. APPROVED BY

Signature: Dr. Duane Acker  
Title: Director, F&N  
Date Signed: MM DD YY

18. DATE DOCUMENT RECEIVED BY AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM DD YY

## PROJECT AUTHORIZATION

ENTITY: Bureau for Science and Technology  
PROJECT TITLE: Aquaculture Research and Support  
PROJECT NUMBER: 936-4180

1. Pursuant to section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the project, Aquaculture Research and Support, involving centrally funded planned obligations not to exceed \$1,275,000 in grant funds over a five-year period from the date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs for the project.

The project may also include such additional funding up to \$3,565,000 contributed for this purpose by regional bureaus, AID missions and AID/W offices, other than S&T/AGR.

2. The goal of the project is to increase the availability and utilization of high protein fish food and contribute to food security and reduce dependency on imported food. It will also improve the socio-economic position of the farmers, increasing income at the farm level and providing more employment for farm families, and others. It will support adaptive research, training technology transfer and networking to strengthen human resources and institutional capacity to develop and implement economically efficient, socially acceptable and environmentally sound programs for increasing the production of fish.
3. The agreements which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority shall be subject to the following terms and conditions, together with such other terms and conditions, as A.I.D. may deem appropriate.

0

4. Source and Origin of Commodities, Nationality of Services

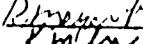
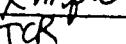
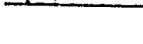
- a. Commodities financed by A.I.D. under the project shall have their source and origin in the cooperating country\* or the United States, except as A.I.D. may otherwise agree in writing. Except for ocean shipping, the suppliers of commodities or services shall have the cooperating country or the United States as their place of nationality, except as A.I.D. may otherwise agree in writing.
- b. Ocean shipping financed by A.I.D. under the project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States.

\*Each country where research, training, technical, or other assistance takes place under the project shall be deemed to be a cooperating country for the purpose of permitting local cost financing of goods and services for the activity being conducted in such country. Such activities may be undertaken in any country included in A.I.D. geographic code 935.

  
 Duane Acker  
 Agency Director  
 for Food and Agriculture  
 Bureau for Science and Technology

Clearances:

S&T/AGR, David Bathrick  
 Elizabeth Roche  
 Tejpal Gill  
 S&T/PO, Gerald F. Gower  
 GC, Stephen Tisa

 date 29/Dec/87  
 date 14/3/87  
 date 29 Dec 87  
 date 1/1/87  
 date \_\_\_\_\_

Aquaculture Research and Support

Project No. 936-4180

Certification of the Procurement Plan

I certify that the procurement plan for the Aquaculture Research and Support project (936-4180) was developed with full consideration of maximum involvement by minority and women-owned firms, historically Black colleges and universities and minority controlled PVOs in the provision of goods and services, and that this project is not appropriate for Minority or Gray Amendment contracting. We know of no minority institutions with an on-going program of the type required which have the requisite faculty and facilities needed to implement this project. However, to ensure consideration of minority organizations as defined in the Gray Amendment, we will work with the Office of Procurement and the Office of Small and Disadvantaged Businesses to identify all potential organizations and institutions which may be available to work with Auburn University in the areas of aquaculture, aquatic ecology and fresh water fisheries management.



Duane Acker  
Agency Director  
for Food and Agriculture  
Bureau for Science and Technology

WANG:5292g:MMozynski:9/21/87



SECTOR COUNCIL FOR AGRICULTURE

RECORD OF S&T PROJECT REVIEW COUNCIL MEETING

COUNCIL MEETING DATE: November 4, 1987

Project Office: S&T/AGR PID PP X Project No: 936-4180

Project Title: Aquaculture Research and Support

Proposed Contractor: Auburn University

Proposed Project Period: January 1, 1988 - December 31, 1992

Proposed Budget Period: Same Budget: (000) \$1.275 S&T/AGR  
3.565 Mission/RB

(If any, prior total est. cost: -0- )

(Grand total after adding this action: \$4.840 Million )

2. The members of this Council and their findings are specified below:

<u>Office Symbol</u>	<u>Name/Signature</u>	<u>Date</u>	<u>Endorsed</u>	<u>Not Endorsed</u>
AFR/TR/ARD	Kenneth Prussner	<u>12/2/87</u>	<u>[Signature]</u>	_____
ASIA/TR/ARD	Gary Lewis	_____	_____	_____
BIFAD/s	John Stovall	_____	_____	_____
IAC/DR/RD	Steve Wingert	_____	_____	_____
FFC/PDPR	Donald McClelland	_____	_____	_____

3. It is the decision of this council that this project be:

\_\_\_\_\_ ENDORSED \_\_\_\_\_ NOT ENDORSED

SIGNATURE [Signature] Date 1/12/88  
 Duane Acker, S&T/FA  
 Chairperson

Any dissenting opinions are attached.





JAN 4 1988

ACTION MEMORANDUM FOR THE AGENCY DIRECTOR FOR FOOD AND AGRICULTURE  
BUREAU FOR SCIENCE AND TECHNOLOGY

FROM: ST/AGR,  David Bathrick

SUBJECT: Approval of Aquaculture Research and Support project  
(936- 180) Document #418002

ACTION: Your approval is required to authorize a five - year project, Aquaculture Research and Support (936-4180), which has an authorized life of project cost of \$1,275,000 from the Agriculture, Ru-al Development and Nutrition Account, Section 103 of the Foreign Assistance Act of 1961, as amended. The total project cost is \$4,840,000 of which \$1,275,000 will be funded by ST/AGR and up to \$3,565,000 will be funded by mission, regional bureau, and other AID/W funds to be obligated under a companion basic ordering agreement (BOA).

Discussion: This new project is consistent with the objectives of AID's Food and Agricultural Policy and Strategy to enable LDCs to become self-reliant in food, assure food security, and contribute to broadly-based economic growth. Aquaculture can contribute to these objectives. Although aquaculture contributes only 13 percent of the total fish harvested today, its contribution is increasing each year at a rate of 7 percent of the previous year's contribution. FAO has estimated that the demand for fish will increase dramatically in the future. Most of this increased demand will have to be met through aquaculture, since the limit is rapidly being, or perhaps has been, reached for harvest of fish through capture fisheries. Auburn University, through its International Center for Aquaculture (AU/ICA), is ideally suited to assist A.I.D. with tapping this potential. Through twenty years of association with A.I.D., AU/ICA has developed an outstanding capability in aquaculture research, teaching and technical assistance. This is complemented and supported by extensive facilities with climatic and environmental conditions similar to those found in most developing countries.

The new project will consist of four integrated activities in research, technology transfer, training, and networking. The research focus will be on developing, testing and transferring economically viable and socially and culturally acceptable technologies aimed at increasing fish yields. During January a detailed work plan, which will focus on the research strategy, will be jointly developed. Decision-aids (simulation models) will be developed, tested and validated at AU and in the LDCs by researchers, extension agents, and others who will take the research results, latest technologies and related information to the LDC fish farmers' ponds. Research topics will include genetics and feeding, fish disease, economic analysis, integrated farming, hatchery management, and aquatic ecology.

Technology transfer activities include assistance with policy analysis for aquaculture investment decisions as well as the provision of information services. Long-term degree training and short-term technical training will be provided both at Auburn and in selected LDCs. Workshops and seminars will also be held both at Auburn and in LDCs. Auburn will continue to expand the international network of aquaculture experts in order to facilitate access to the most current research data and information by LDC scientists and institutions.

Agency Policy: The project will be implemented in accordance with relevant agency policies, including those on food and agriculture, development of human resources and institutional capabilities, and expanding the role of LDC scientists and institutions. It has been designed to achieve the objectives of the focus statement for the 103 account, which is to increase incomes and expand the availability of nutritional foods while maintaining and enhancing the natural resource base.

Funding: Funding of \$255,000 for the first year of this project was originally included in the FY 1988 CP p.31 under the previous project, Aquaculture Technology Development, (931-1314). ST/AGR has identified this project as being of high priority and funding for the five year project is included in the ST/AGR budget plans. The cost estimates are appropriate for the planned level of effort described in the Project Paper. Furthermore, the estimated costs for buy-ins through the companion basic ordering agreement are appropriate as determined by mission responses to two ST/AGR queries. Finally, we have determined that the cost sharing commitments of Auburn University exceed the 25% reference point and are otherwise consistent with agency policy.

Justification to Congress: An Advice of Program Change is being cleared by the appropriate AID officials and will be sent to the Congressional Committees shortly.

Clearances Obtained: The Project Paper was prepared in consultation with the Sector Council for Agriculture and its subcommittee for Fisheries and Aquaculture. It was endorsed by the Sector Council\* on November 4, 1987 with the recommendation that more emphasis be placed on how the project would assist missions in assessing the economic, social and institutional factors relative to aquaculture to provide a basis for decisions on where investments should be made in the use of LDC project funds and country resources. This has been addressed in the Project Paper (pages 59-60 and Appendix I). The decision-aids (simulation models) that will be developed, tested and validated at AU and in LDCs will be designed to demonstrate

\*see attached record of S&T project review council meeting

the effects of alternate investment strategies to LDC decision makers. This information and other information related to LDC applications will be made available at regular intervals.

Certification of Procurement Plan: Certification per accepted S&T procedures that the procurement plan for this project was developed with full consideration of maximum involvement by minority and women-owned firms, historically Black colleges and universities and minority controlled PVOs in the provision of goods and services, and that the project is not appropriate for minority or Gray amendment contracting is attached as Tab 3.

Method of Implementation - During the project design stage, it became apparent that a cooperative agreement and a companion basic ordering agreement with the International Center for Aquaculture, Auburn University would be the most efficient and economical method to successfully implement the scope of work outlined in the attached project paper (Tab 5).

Selection of Recipient - To identify the proper source to implement this project, S&T/AGR considered the following universities that were rejected for the reasons cited; University of Rhode Island, Oregon State University, Mississippi State University and Texas A&M University. Unlike AU/ICA, none of these universities has made a major concerted effort entirely devoted to aquaculture which is applicable to conditions in LDCs. The programs at each of these institutions, while addressing certain specific aspects of aquaculture, lack broad capability and experience in warm water, freshwater fisheries, especially with low-priced species most suitable for development in LDCs. In addition, none of these universities has a well developed, comprehensive graduate training program especially designed for training LDC students in aquaculture; nor do they have the complementary library and information services. Finally, none of them has the established international network of aquaculturists that Auburn has developed.

In consideration of the above and in accordance with Amendment No. 1 to the Delegation of Authority No. 850 dated December 18, 1981 to the Agency Directors regarding award of grants/CAs without consideration of other sources, I recommend that you determine that AU/ICA is the most appropriate entity to carry out a program in aquaculture by signing the memorandum to M/SER/OP requesting that the cooperative agreement be awarded to AU/ICA without competition. (Attached as Tab 6). In addition, attached as Tab 7, is a justification and authorization pursuant to 41 USC 253(c)(3) and FAR subsection 6.302-3 for awarding to AU/ICA, without competition, the companion BOA and the delivery orders issued thereunder, which will generate data to be fed directly to the ICA activities. We have consulted with M/SER/OP and expect that the BOA justification will be approved.

Project Evaluation

Comprehensive evaluations are planned over the life of the five-year project by a panel comprised of scientists, international experts, and a representative from the Bureau for Private Enterprise to determine if the project inputs are being provided as planned, that conditions and covenants of project workscope are being met, and that project outputs are being accomplished as planned. Management reviews will be conducted annually by the ST/AGR project manager.

Recommendation: That you indicate your approval of the Aquaculture Research and Support project (936-4180) by signing 1) the attached Project Authorization (Tab 1), and the Project Data Sheet (Tab 2); 2) the certification of the Procurement Plan (Tab 3); 3) the Sector Council for Agriculture Project Endorsement (Tab 4); 4) the memorandum to M/SER/OP requesting that the CA be awarded to AU/ICA without competition (Tab 6); and 5) justification and authorization for awarding BOA and individual orders thereunder to AU/ICA without competition (Tab 7);.

Attachments:

- Tab 1 - Project Authorization
- Tab 2 - Project Data Sheet
- Tab 3 - Certification of the Procurement Plan
- Tab 4 - Sector Council for Agriculture Project Endorsement
- Tab 5 - Project Paper
- Tab 6 - Memo to M/SER/OP requesting that CA be awarded to AU/ICA without competition.
- Tab 7 - Justification and Authorization For Other Than Full and Open Competition for awarding the BOA and individual orders thereunder to AU/ICA without competition.

APPROVED: Duane Acker by JRS

DISAPPROVED: \_\_\_\_\_

DATE: January 12, 1988

Clearances: S&T/AGR/RNR:RNeal: R. Meyer for Date 29 Dec 87  
 S&T/AGR/RNR:TGill: R. Meyer for Date 29 Dec 87  
 S&T/AGR:ERoche: ERoche Date 12/21/87  
 S&T/PO:GGower: Km for Date 11/11/87  
 GC:Triedler: (in draft) Date 22 Dec 87

DRAFTEDBY:RNEAL:ryh:revised:12/18/87:Wang#5423g

AQUACULTURE RESEARCH AND SUPPORT

PROJECT NUMBER 936-4180

Project Paper

1

Aquaculture Research and Support  
Project No. 936-4180  
Table of Contents

	<u>Page</u>
Acronym Listing .....	i
Glossary of Terms .....	iii
Preface .....	1
I. Background .....	2
A. Perceived Problem and Need for Aquaculture .....	2
1. Perceived Problem .....	2
2. Need for Aquaculture .....	3
3. Donor Assistance .....	4
4. Future Needs of the LDCs .....	5
a. Africa .....	5
b. Asia .....	5
c. Near East .....	6
d. Latin America .....	6
e. Caribbean and Oceania .....	6
B. Mission Requirements .....	8
Table - Summary of Mission Responses .....	8
C. Sustainability .....	9
II. Implementing Agent .....	10
A. Program proposal from Auburn University .....	10
B. Market Search .....	11
C. Authority .....	11
1. Cooperative Agreement .....	11
2. Basic Ordering Agreement .....	11
D. Auburn University's Prior Activities in Aquaculture .....	12
1. Auburn University's Aquaculture Program in U.S. ....	12
a. Facilities .....	12
b. Teaching Program .....	13
c. Library Facilities .....	13
d. International Aquaculture Network .....	14
e. Other Departments of Auburn University .....	14
E. Auburn University's Involvement in the LDCs .....	14
1. Asia and Near East .....	15
2. Latin America and Caribbean .....	16
3. Africa .....	18
African Natural Resources Management Support project ....	19
F. Evaluation of the Current Project - (Aquaculture Technology Development - 931-1314 .....	19
1. Positive Comments .....	19
2. Recommendations for Changes .....	19
a. Annual Workplans .....	19
b. Role of AU in Aquaculture .....	20
c. Change in Reporting Requirements .....	20
d. Project Management Responsibilities .....	20
3. Terminal Evaluation (Aquaculture Technology Development) .	20

Aquaculture Research and Support  
Project No. 936-4180  
Table of Contents (Continued)

	<u>Page</u>
III. Project Goal, Purpose, Outputs and Inputs .....	20
A. Project Goal .....	20
B. Project Purpose .....	21
C. Project Outputs .....	21
1. Applied and Developmental Research .....	22
a. Activities .....	22
b. Assumptions for Achieving Research Outputs .....	22
2. Technology Transfer .....	23
a. Activities .....	23
b. Assumptions for Achieving Technology Transfer Outputs .....	23
3. Training .....	23
a. Activities .....	23
b. Assumptions for Achieving Training Outputs .....	24
4. International Networks .....	24
a. Activities .....	24
b. Assumptions for Achieving Networking Outputs .....	25
D. Project Inputs - Cost Estimates and Annual Person-Months ....	25
1. Cost Estimates .....	25
a. S&T/AGR's Funding .....	26
b. Missions, Regional Bureaus and Other AID/W Offices ..	26
c. Auburn University, Department of Fisheries and Allied Aquaculture, International Center for Aquaculture ...	26
i. AU's Contribution .....	26
ii. Equipment and Facilities .....	26
Table 1 - Inputs by Source of Funds - Five-Year Budget .....	27
Table 2 - Inputs by Project Components - Five Year .....	27
Table 3 - Inputs by Line Items - Five-Year Budget .....	27
2. Annual Person-Months .....	28
a. S&T/AGR Funded .....	28
b. Mission Funded .....	28
c. AU/FAA/ICA Funded .....	28
Table 4 - Inputs by Person-Months .....	28
IV. Project Management .....	29
A. S&T/AGR Responsibility .....	29
B. Management Review Group .....	30
C. AU/DFAA/ICA Responsibilities .....	31
1. Management Responsibilities .....	31
2. Specific Responsibilities .....	31
3. Sustainability of Knowledge in LDCs .....	32
D. Management Reviews and In Depth Evaluations .....	32
1. Management Reviews .....	32
2. In Depth Evaluation .....	32

- 3 -  
 Aquaculture Research and Support  
 Project No. 936-4180  
 Table of Contents (Continued)

	<u>Page</u>
V. Project Implementation .....	34
A. Cooperative Agreement .....	34
1. Terms of the Cooperative Agreement .....	34
a. Length of Service .....	34
b. Five-Year Budget .....	34
c. Person-Months .....	34
2. Scope of Work .....	34
a. Applied and Developmental Research .....	34
i. Aquaculture .....	35
ii Aquatic Ecology .....	36
iii Fresh Water Fisheries Management .....	36
b. Technology Transfer .....	36
i Decision Aids (Simulation Models) .....	36
ii Problem Solving Activities .....	36
iii Transfer of Information .....	36
c. Training .....	37
d. International Networks .....	37
3. Substantial Involvement .....	37
4. Annual Work Plans .....	39
a. Work Plan Details .....	39
b. Due Dates of Work Plan .....	39
c. Annual Expenditure Reports of Work Plan .....	39
5. Reporting Requirements .....	39
a. Quarterly Reports .....	40
b. Project Implementation Plan .....	40
c. Technical and Research Reports .....	40
d. Annual Activity Reports .....	40
e. Training Activities .....	40
f. Impact Analysis Reports .....	40
g. Environmental Impact .....	41
h. Trip Reports .....	41
i. Financial Reports .....	41
B. Five-Year Companion Basic Ordering Agreement .....	41
1. Purpose of the Basic Ordering Agreement .....	41
2. Activities .....	42
a. Aquaculture .....	42
b. Aquatic Ecology .....	42
c. Fresh Water Fisheries Management .....	42
3. Benefits to AID .....	42
4. Relationship to Cooperative Agreement .....	42

Aquaculture Research and Support  
Project No. 936-4180  
Table of Contents (Continued)

	<u>Page</u>
5. Terms of the Basic ordering Agreement .....	43
a. Period .....	43
b. Operating Mode .....	43
i. Technical Assistance Delivery Orders .....	43
ii. Oversight Requirements .....	44
iii. Assessment Criteria .....	44
c. Cost Reimbursement .....	44
d. Statement of Work .....	45
i. Short- and Medium-Term Technical and Advisory Services .....	45
ii. Long-Term Assistance .....	46
e. Requests for Proposals by Delivery Orders .....	46
f. Completion of Orders and Reports .....	46
i. Delivery Orders .....	46
ii. Reports .....	47
iii. Environmental Impact .....	47
VI. Program Factors .....	47
A. Conformity with Agriculture, Rural Development and Nutrition Program Priority .....	47
B. Relationship to AID's Policy and Strategy .....	48
1. Improving Country Policies .....	48
2. Strengthening Human Resources and Institutional Capacity .	48
3. Expanding the Role of the Private Sector .....	48
4. Providing Food Aid and Food Security .....	49
C. Conformity with S&T's Ribbon Project Approach .....	49
D. Relationship to the Fisheries Sector Assessment and the Umbrella Project .....	50
1. Fisheries Sector Assessment .....	50
2. Fisheries Sub-Sector Project .....	50
E. Relationship to other S&T/AGR Project .....	51
1. Collaborative Research Support Programs .....	51
2. International Agricultural Research Center .....	51
3. Other S&T/AGR Projects .....	51
F. Relationship to Other Activities .....	52
1. Title XII - Joint Memorandum of Understanding .....	52
2. PVO Development Activities .....	53
G. Relationship to Mission and LDC Programs .....	53
H. Relationship to Previous Activities in Aquaculture .....	53
I. Women in Development .....	54
J. Environmental Considerations .....	55

Aquaculture Research and Support  
Project No. 936-4180  
Table of Contents (Continued)

	<u>Page</u>
VII. Factors Affecting Project Selection and Further Development .....	55
A. Social Considerations .....	55
1. Socio-Economic Context .....	56
2. Socio-Cultural Feasibility .....	57
a. Development of Adaptive Technologies through Research	57
b. Training Programs at AU/DFAA and In-Country .....	58
c. Technical Assistance .....	58
3. Socio-Anthropological .....	58
4. Beneficiaries .....	58
a. Producers or Farmers .....	58
b. Consumers .....	59
c. Communities .....	59
d. Governments .....	59
B. Economic Considerations .....	59
1. Justification for Investment .....	60
a. Aquaculture as an Efficient User of Natural Resources	60
b. High Protein Foods .....	60
c. Fish as Income for Farm Families .....	60
2. Alternative Implementation Strategies .....	61
a. International Institutions .....	61
b. Private Sector .....	61
c. Mission Funding on an Ad-Hoc Basis .....	61
d. One Institution .....	62
C. Relevant Experiences with Similar Projects .....	62
D. A.I.D. Support Required .....	63
References .....	64
Appendix A	Logframe
Appendix B	Line Item Budgets
	Five-Year Budget
	First Year Budget
Appendix C	Summary of Mission Responses to Request for Expressions of Interest
Appendix D	List of Institutions in the Aquaculture Network
Appendix E	Environmental Threshold Determination
Appendix F	Summary of Evaluations
Appendix G	Auburn University, Department of Fish and Allied Aquaculture, International Center for Aquaculture - Summary of International Participation
Appendix H	External Assistance in Aquaculture, 1978 - 1983
Appendix I	Description of Research and Development Research Activities
Appendix J	Economic Justification
Appendix K	Project Strategy

Aquaculture Research and Support  
Project Number 936-4180  
Acronym Listing

AID	Agency for International Development
APM	AID Project Manager
AU	Auburn University
AU/DFAA/ICA	Auburn University, Department of Fisheries and Allied Aquaculture, International Center for Aquaculture
AU/ICA	Auburn University, International Center for Aquaculture
BARD	Bi-National Agricultural Research Development Fund - Israel
BOA	Basic Ordering Agreement
CA	Cooperative Agreement
CARE	Cooperative for American Relief Everywhere
CLUSA	Cooperative League of the USA
CRS	Catholic Relief Service
CRSP	Collaborative Research Support Program
CWID/SECID	Center for Women in Development, Southeast Consortium for International Development
EOPS	End of Project Status
ERS	Economic Research Service
ESPOL	Escuela Superior Politecnica Del Litoral - Ecuador
FAO	Food and Agriculture Organization of the United Nations
g	gram
ha	hectare
IAN	International Aquaculture Network
IARCS	International Agricultural Research Centers
IBRD	International Bank of Reconstruction and Development
ICA	International Center for Aquaculture
ICLARM	International Center for Living Aquatic Resources Management
IDRC	International Development Research Center - Canada
IIMI	International Irrigation Research Institute
JMOU	Joint Memorandum of Understanding
kg/ha/yr	Kilogram per hectare per year
LDCs	Less Developed Countries
LWR	Lutheran World Relief
MRG	Management Review Group
MT	Metric Tons
NARCS	National Agriculture Research Centers

Aquaculture Research and Support  
Project Number 936-4180  
Acronym Listing

NSF	National Science Foundation
NH <sub>3</sub>	Toxic Nitrogenous Waste - Ammonia
NO <sub>2</sub> , N <sub>2</sub>	Nitrogen Compounds
NOAA	National Oceanic and Atmospheric Administration
NRMS	Natural Resources Management Support (African project)
PI	Principal Investigator
PP	Project Paper
SEAFDEC	Southeast Asian Fisheries Development Council
SECID/CWID	South East Center for International Development, Center for Women in Development
S&T	Bureau for Science and Technology
S&T/AGR	Bureau for Science and Technology, Office of Agriculture
UNDP	United Nations Development Program
USDA	United States Department of Agriculture

Aquaculture Research and Support  
Project Number 936-4180

Glossary of Terms

Aquaculture	The husbandry of aquatic animal and plants at densities greater than those found under natural conditions
Detritus	Small organic particles in water
Fecundity	Capacity to produce numbers of offspring
Ichthyology	Branch of zoology dealing with fishes
Limnology	Study of freshwater bodies, with reference to their physical, biological, and chemical features
Marron	Australian freshwater crawfish
Plankton	Small free floating organisms in water
Polyculture	The cultivation of several fish together that have different food habits

## Aquaculture Research and Support

Project No. 936 4081

### Preface

The Office of Agriculture, Directorate for Food and Agriculture, Bureau for Science and Technology recommends that \$4,840,000 be authorized for a new five-year project, "Aquaculture Research and Support". It is recommended that this project be implemented under a Cooperative Agreement (CA) and companion Basic Ordering Agreement (BOA) with Auburn University, Department of Fisheries and Allied Aquaculture, International Center for Aquaculture (AU/FAA/ICA). Of the total \$4,840,000, \$1,275,000 will be provided by S&T/AGR for the CA to assist AU/FAA/ICA to expand its ongoing aquaculture program and adapt it to the needs of the LDCs; and \$3,565,000 is expected to be provided by missions, regional bureaus and other AID/W offices for Delivery Orders under the BOA.

The S&T/AGR funded portion of the project will assist AU/FAA/ICA to expand its ongoing aquaculture program and adapt it to meet the needs of the LDCs. It will give priority to research to develop aquaculture, aquatic ecology, and fisheries management technologies and successful transfer this information from Auburn University (AU) to LDC extension workers, researchers and others using a systems approach of "transfer by simulation" or "decision packages"; some training activities directly related to the transfer of information; and networking with other national and international organizations and institutions.

The funding from missions, regional bureaus, and other AID/W offices will be implemented by Delivery Orders issued against the BOA on a case-by-case basis. These Delivery Orders will cover activities which are related directly to the research funded under the CA and may include funding for adaptive research; transfer of the latest aquaculture, aquatic ecology and fisheries management technologies; training at AU and in the LDCs; and/or participation in the international network of aquaculture, aquatic ecology, and fisheries management specialists.

In addition, AU is making a substantial contribution in support of this international program and will be contributing approximately \$392,000 annually or \$1,960,000 over the life of the project. Its contribution will fund: 1) research which can be adapted to LDC environments; 2) drafting and publicating research results; 3) attendance at international workshops and seminars to become aware of the latest technology developed in aquaculture, aquatic ecology, and fisheries management under programs sponsored by other donors, institutions, and organizations; 4) on-campus consultation with foreign visitors; 5) responses to LDC requests for information which are not funded by AID; 6) university teaching programs and 7) assistance to international organizations, (e.g., World Bank, FAO, and UNDP) which is not otherwise funded from other sources. AU's contribution will be verified in its reporting system to S&T/AGR. The format will be developed by the Principal Investigator (PI) at AU/FAA/ICA and the AID/S&T/AGR Project Manager (APM).

In addition, AU will provide from its own resources equipment and facilities in support of this international program. Additional funding is also obtained from the State of Alabama, private companies, and other government agencies to implement programs which will generate knowledge that can be adapted to conditions in the LDCs.

## I. Background

### A. Perceived Problem and Need for Aquaculture

1. Perceived Problem - We know that the world will be faced with a billion extra mouths to feed by the year 2000 and important steps must be taken immediately to meet the forthcoming demand for animal protein. Even now, there are 450 million undernourished people in the World with problems of inadequate food supply, extreme poverty, poor nutrition, disease, poor transportation and limited economic and educational opportunities in the LDCs. While the proposed project does not deal with transportation, it will provide increased food supplies, help raise the economic conditions of the poor, provide additional nutrition and thus help prevent disease, and provide limited educational opportunities to the rural poor.

The U.S. demand for fish - which includes fresh and frozen fish and shellfish - has sharply increased in recent years. Many groups have been advising U.S. consumers to cut back on red meat intake and increase fish and poultry consumption. Recent surveys indicate that U.S. consumers have begun responding by significantly increasing their per capital fish consumption. From 1980 to 1984, weekly expenditures for fish rose by 34 percent and poultry rose slightly above 10.5 percent; whereas total food outlays climbed only 19 percent (USDA, 1987). By contrast, from 1980 to 1984 expenditures of the other three major meat groups either fell (beef by 12.6 percent, and pork by 6.5 percent).

The trend for future fish consumption also looks favorable. In two recent USDA projections covering a 40-year period from 1980 to 2020, fish led all foods in terms of expected growth in per capital expenditures (up 45 percent). By contrast, consumption of the three other primary meats are projected to rise by much smaller amount, i.e., poultry by 13 percent, pork by 20 percent, and beef by 26 percent.

2. Need for Aquaculture - From the earliest history, fish have been an important source of food, but no significant effort has been made to domesticate this source of high protein food. There has been a common misconception among the nations of the world that, because 70 percent of the world is covered with water, the supply of fish is inexhaustible. However, harvests of this valuable natural resource in the LDCs are not keeping pace with demand. Aquaculture (fish farming) is taking on new importance as over-fishing depletes the supply of ocean fish. Fish production from aquaculture production is increasing rapidly and is expected to increase by at least 40 percent by the year 2000. Therefore, many countries are depending upon aquaculture to provide new supplies of fish required for the future.

FAO has indicated that the future demand for fish will increase to over 130 million metric tons (MT) by the year 2000 (present production is only 83 million tons which includes 22 million MT from aquaculture). FAO has also indicated that the major potential for growth in fisheries production will be through aquaculture as harvests from the ocean and from natural freshwater sources are increasing very slowly, if at all.

Although aquaculture has grown rapidly in the last 25 years, it accounts for no more than 13 percent of the world fish production. Ten thousand years ago, man succeeded in domesticating cattle and poultry, but today only 13 percent of the fish is produced through fish farming.

This anachronism can be remedied through the implementation of advanced aquaculture, or fish farming with substantial economic gains. Much of the unrealized potential lies in the characteristics of fish themselves. Because they are cold-blooded animals, fish require less feed than other animals. Cattle, for example, require 8 to 10 pounds of feed per pound of weight gain; poultry need 2.5 to 3.5 pounds of feed per pound gain. Fish, on the other hand, will gain a pound in body weight on only 1.5 to 2.5 pounds of feed.

In addition, fish are an excellent source of high quality protein. Total fish production provides almost eight times more protein than total production of red meat and five times more than pork.

Aquaculture has the advantage of requiring little space to produce large quantities of high-quality food, which makes it especially attractive in countries where land holdings are small. The vast spaces needed to cultivate livestock simply are not required to raise fish. Progressive aquacultural systems in use throughout the world are two to ten times more productive than equivalent terrestrial systems per unit area.

Furthermore, aquaculture is profitable. A fish farmer can realize returns from his investments that are usually several times greater than those received from agricultural crops. In addition, fish represent a ready source of foreign capital to underdeveloped nations.

Real contributions to personal income, employment and nutrition have been demonstrated where aquaculture is flourishing in LDCs. Use of underutilized resources means costs of production are low, while strong demands for fish insure good prices. Pond development has usually been associated with conservation efforts linked to flood control, soil protection and other efforts to enhance land value and conserve natural resources. Nutritional needs for amino acids present in animal protein are well documented. Fish can be produced through aquaculture in areas where needs for animal protein are the greatest.

Prices are lower than other forms of animal protein (milk, eggs, meat) when efficient aquacultural practices are followed. Part-time, seasonal employment for fish farming can provide supplemental income at times when other employment opportunities are limited.

### 3. Donor Assistance

A 1984 FAO Survey of External Assistance to the Fisheries Sector in Developing Countries from 1978 - 1983 indicated that of the \$368 million of international aid devoted to the fisheries sector, aid to aquaculture development increased from 8.4 percent to 17.5 percent during that period. This represents a growing commitment by donors to promote production increases of fresh water fish through aquaculture. However, this represented only 14.3 percent of the total assistance in the fisheries sector. (See Appendix H)

The major capital assistance donors have been the World Bank and the Asian Development Bank. Most capital aid for aquaculture to date (which can take the form of both loans and development grants) has been provided for development in Asia, mainly for inputs and facilities for the culture of higher-priced species such as shrimp intended for export. Recently, capital assistance has been concentrated more on credit-support projects which directly encourage the private sector to produce aquaculture products both for domestic and for export markets.

Technical assistance funds for aquaculture have been provided by multilateral and bilateral aid agencies for infrastructural support through strengthening applied research, long- and short-term technical training, and extension services, and for needed linkages between public and private sector interests.

Even though some progress has been made, AID and other donors/lenders recognized that future assistance to aquacultural programs is still vital. Production of fresh water fish is not keeping pace with demand. Assistance is still needed for capital investments to build ponds, reservoirs, and hatcheries, and for software inputs such as research, intellectual leadership, technology transfer, training and networking. The World Bank and other international donors can provide the funding for capital investments and Auburn University through S&T/AGR, missions, and regional bureaus can provide a substantial portion of other inputs (software) needed.

4. Future Needs of the LDCs - FAO has identified the following requirements to increase production of fish through fish farming:
  - a. Africa - will require continuous assistance at all levels. FAO has indicated that assistance should be directed towards pond culture, carefully selected types of integrated farming, and fisheries enhancement programs. Inland aquaculture merits the greatest public support, leaving the private sector to develop brackish water and marine aquaculture potential. Assistance priorities are policy-making and planning, production and marketing. Research and development should be restricted to low-technology applications and confined to well-supported centers participating in the international network.
  - b. Asia - is the vanguard of aquaculture development where fish farming is an important industry, although some countries still remain weak in this sector. The private sector is established and has taken the initiative in most countries. Assistance continues to be required for certain sectoral components, such as national management and infrastructure, which lag behind fish production technology.

Increased attention should be directed to such activities as: 1) planning, marketing, credit, and legal provisions; 2) applied research on certain species applicable to local conditions, 3) selecting new culture systems designed to increase production, and 4) the interaction with other activities to develop regional and national capacities to provide support not only in bio-technological training, but throughout the sector.

For Asia, reaching projected aquaculture production targets will depend largely on the improved availability of credit financing and operating capital, particularly for small- and medium-sized farm systems, to enable existing aquacultural technologies to be utilized by the private sector.

- c. Near East (Mediterranean and Middle East) - policy-making and planning are considered high priorities for the North African countries; whereas, national and local infrastructure is needed in all countries in this region. Assistance is needed for training scientists and extension workers.
  
- d. Latin America - remains comparatively weaker in aquaculture development, but has considerable potential. Priorities are with higher-valued products and semi-intensive systems. AID's support for inland fisheries activities throughout the region has been effective and successful, within the context of low per capita consumption of fish in most AID assisted LAC countries. There is little tradition for consuming cultured fish. This behavioral pattern must be changed if food production is to keep pace with the increasing population. Individual owner/operators are unable to obtain land and water rights. Priorities for production assistance should be aimed at fisheries enhancement projects in lakes and reservoirs.

Assistance has to be increased at all levels with emphasis on policy-making, planning, training, and extension production-oriented research and marketing. Active regional programs and inter-regional cooperation could advance the limited opportunities for the countries in this area. Priority in Latin America should be given to research and development of viable production operations. In particular, value-added products must be developed which can be used to help consumers accept fish as part of their diets.

Capital assistance projects should pay attention to socio-economic problems of ownership for land-based aquaculture operators as existing land ownership policies continue to limit the effective application of capital aid for aquaculture in many countries in this region.

AID's supported activities in freshwater aquaculture have brought about an effective and successful transfer of technology as a result of interventions in the past, for example in Costa Rica, Jamaica, Ecuador, Panama, El Salvador and Brazil.

- e. Caribbean and Oceania - The island communities in the Caribbean and Oceania cannot compete in international markets for aquaculture products, with the exception of a few indigenous high-value crops. Production, and therefore assistance, must be geared to national and tourist markets. While the most profitable national investment in Oceania is reef management with enhancement through aquaculture where necessary, in the heavily populated islands of the Caribbean the priority is for protein from freshwater fish production.

All island communities need infrastructure in training and extension services, and for local input resource development. Research and development is not a priority. Regional cooperation will provide benefits, particularly for upper- and mid-level management levels. The priority is for policy-making and planning to identify specific needs and to limit investment to rational levels.

- B. Mission Requirements - S&T/AGR cabled the missions asking for expressions of interest in a new project. Sixteen missions responded; 10 responded positively, 3 indicated possible requirements, and only 5 indicated that assistance was not contemplated at this time. Appendix C provides additional information.

Summary of Mission Responses

<u>Region and Country</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>
<u>Africa</u>			
Guinea-Bissau	-	Yes	-
Niger	-	Yes	-
REDSO/WCA	Yes	-	-
Rwanda	Yes	-	-
Sierra Leone	Yes	-	-
Swaziland	-	-	-
Togo	Yes	-	No
Zaire	Yes	-	-
<u>Asia and Near East</u>			
Bangladesh	Yes	-	-
Egypt	Yes	-	-
India	-	-	No
Jordan	Yes	-	-
Sri Lanka	-	-	No
Tunisia	-	-	No
<u>Latin America and the Caribbean</u>			
Dominican Republic	-	-	No
El Salvador	Yes	-	-
Guatemala	Yes	-	-
Panama	-	Yes	-
<u>Total number of cables received</u>	10	3	5

Certain missions with aquaculture programs did not respond to the cable; e.g., in Asia, the missions in Indonesia, Thailand, and the Philippines did not respond; in Latin America and Caribbean, the missions in Ecuador, Honduras, and Jamaica did not respond; and in Africa, Burundi mission did not respond.

The Africa Bureau approved a new project on July 2, 1987, "Natural Resources Management Support" which has as its purpose increasing the quality and level of natural resources management activity in AID's country and related regional programs in Sub-Saharan Africa, and in PVO programs supported by AID. It is anticipated that aquaculture (fish farming) activities will be funded under this project, and the Africa Bureau will be requesting assistance from AU/FAA/ICA.

- C. Sustainability - This project will promote the sustainability of freshwater fish in the LDCs by: 1) developing and testing economically viable and socially and culturally accepted technologies aimed at increasing fish yields in LDCs; 2) transferring these technologies through the use of decision packages, publications, training manuals and audiovisual cassettes; 3) providing short-, medium-, and long-term assistance for project design, assessment, feasibility studies and evaluations; 4) providing opportunities for long-term academic training at the graduate degree levels, and intensive non-degree and short-term training at the technical level; 5) promoting international networks to pool the resources and scientific talents of aquaculture experts; and 6) reducing the costs of production.

It is expected that as a direct result of the assistance provided under this new project: 1) more high quality animal protein will be available in the LDC market place; 2) farm employment and income will increase in the fisheries sector providing low-income households with greater resources to meet their needs; 3) private agricultural marketing and distribution systems will be promoted; 4) market-oriented, efficient, low-cost production on small family fish farms will be encouraged on a sustainable basis; 5) low cost food will be available to farm families; 6) sound nutritional and food consumption principles will be incorporated into the design and implementation of aquaculture development activities; 7) food security objectives will be promoted; and 8) foreign exchange will be saved by reducing dependency on imported fish.

II. Implementing Agent

- A. Proposal Received - S&T/AGR has received a proposal from AU/FAA/ICA which provides information on the impact and status of the program, identifies problem areas to be addressed and proposes a program for the new five-year project. The proposal provides for programs in research, technology transfer, training, maintaining and establishing new networks and linkages with scientists and institutions in developed and developing countries.

The proposal recommended the following areas of emphasis:

1. Production, harvesting, processing and marketing fish through aquaculture;
2. New production systems information through research on fish seed production;
3. Improving the application of current aquaculture technology;
4. Information and research network to improve the information base in aquaculture in developing countries;
5. Providing information on aquaculture to developing countries; and
6. Improving the knowledge base in aquaculture in LDCs by providing short-, medium-, and long-term degree and technical training;

The above areas are those which S&T/AGR has identified as important to be addressed during the next five years to achieve the goal and purpose of this new project. The outputs and the magnitudes of the outputs and inputs are indicated in the project design summary (logical framework). The implementation of the program will be covered in the annual work plans as mutually agreed by S&T/AGR and AU/FAA/ICA.

B. Market Search - To assure that the most qualified institution is selected to implement this project, the Office of Agriculture reviewed the qualifications of several institutions; e.g., the University of Rhode Island, Oregon State University, Mississippi State University, and Texas A&M University. Auburn University was selected as it is the only institution that has the following combination of unique facilities and capabilities to implement this project: 1) extensive warm water research facilities; 2) large staff with extensive international experience in tropical aquaculture; and 3) aquaculture training programs at the graduate, undergraduate and technical levels geared to the needs of LDC students.

C. Authority

1. Cooperative Agreement (CA) - The selection of Auburn University to implement the cooperative agreement is consistent with the terms and conditions cited in Handbook 1, Supplement B, 25E3 a. and b. and Handbook 13, 2B, and Handbook 13, 6B, 1. These Handbook references provide for the selection of one institution to implement a CA when the principal purpose of the relationship is the transfer of funds to the recipient in order to accomplish a public purpose of support or stimulation authorized by Federal Statute, and substantial involvement is anticipated between A.I.D. and the recipient during the performance of the proposed activity. Appropriate approval required under Handbook 13, 2B, 2 will be obtained prior to awarding the CA to Auburn University.

In this case, the purpose of the CA is to assist AU/FAA/ICA pursuant to Section 103 of the Foreign Assistance Act of 1961, to: 1) utilize and enhance its resource base in international aquaculture developed over the past two decades in cooperation with AID and other donors; 2) expand the level and range of its collaboration with U.S., LDC, and regional public and private organizations and international institutions; 3) increase its applied and development research activities in the area of aquaculture science technology; and 4) provide facilities for training of LDC students at the undergraduate, graduate and technical levels. A.I.D.'s substantial involvement in the implementation of the project is discussed below at V.A.3.

2. Basic Ordering Agreement (BOA) - The selection of Auburn University to implement the companion BOA is authorized under 41 U.S.C. 253 (c) (3), and Subsection 6.302-3 of the Federal Acquisition Regulations, (FAR) which state that full and open competition need not be provided for when it is necessary to establish or maintain an essential engineering, research, or development capability to be provided by an educational or other nonprofit institution. FAR Subsection 6.302-3 also states that the justification may be appropriate when it is necessary to establish or maintain an essential capability for theoretical analyses, exploratory studies, or experiments in any field of science and technology.

The selection of a companion BOA to implement this project is consistent with the criteria cited in FAR Subsection 16.703. The BOA will function as a companion ordering instrument to the cooperative agreement with AU/FAA/ICA. It will be used for "buy-ins" from missions and AID/W offices and bureaus other than the cognizant AID project office. Activities under the proposed BOA will be limited to those initiated, implemented or directly related to the cooperative agreement. Other services of a similar nature, but not associated with the cooperative agreement, will not be placed under the BOA.

D. Auburn University's Prior Activities in Aquaculture

1. Auburn University's Aquaculture Program in U.S. - was founded in 1934, during the Great Depression. In the South, that was a particularly acute period of suffering not unlike the current conditions in the LDCs. The University, faced with the challenge of helping to feed the rural poor, developed a comprehensive aquaculture program of research, technical assistance and training. Under this program, new techniques were developed, and scientists and extension agents were trained to provide farmers with the latest aquaculture technologies. Small, medium, and large fish farms were developed on poor lands which were unsuitable for other agricultural development. These farms became profitable enterprises producing fish for consumption by the farmers' families and for sale which contributed substantially to easing the food crisis and increasing farmers' income during those trying times.

Auburn University has pioneered research in aquaculture - fish farming in warm-water, inland ponds since 1934 and is today the world leader in scientific and humanitarian aquaculture development. It has expertise in water harvesting -- the capture of rainfall in specially built ponds. It has worked with CARE, the Peace Corps, and other private voluntary organizations to meet the ever increasing demand for food due to skyrocketing population in the LDCs. Since 1967 Auburn has been providing assistance to AID under various contracts, grants, and cooperative agreements. A total of \$14.0 million has been invested in basic and applied research, technical assistance, training and networking. It has developed as a center of excellence recognized world wide for its aquaculture program.

- a. Facilities - The International Center for Aquaculture is a part of the Department of Fisheries and Allied Aquaculture. The field facilities are located on a 1600-acre tract on land which is part of a larger tract utilized by the Alabama Agricultural Experiment Station. There are over 230 earthen ponds with a surface area of approximately 215 acres. In addition, there are 96 concrete ponds and 200 plastic pools.

Located near the ponds are service buildings, equipment storage buildings, shops, feed and fertilizer storage and a large fish holding-handling building, a combination laboratory-processing plant for research and development in fish technology, a new building for research and development on fish spawning and reproduction, and a laboratory for fish nutrition. This is an excellent facility unlike any other in the U.S., and its environment is similar to the tropical conditions found in the LDCs.

A unique aspect of the pond facilities is the arrangement and organization into a large water harvesting and storage area. There is virtually no groundwater available in the area which is also the case in many LDCs. The ponds are arranged to collect and impound the rainfall on the tract. The series of ponds require little or no pumping either for filling or draining and if replicated in the LDCs would eliminate or substantially decrease the need for expensive energy to pump water to the ponds.

The Department has modern facilities, including research laboratories equipped for work in water quality, pathology, bacteriology, virology, parasitology, nutrition and aquatic ecology which provide excellent training facilities for LDC scientists and extension workers.

- b. Teaching Programs - The teaching programs encompass a broad spectrum of subject matter ranging from classical ichthyology to fishpond engineering, including classical fishery biology; stream, pond, and lake management; water quality, aquatic ecology, and fish pathology; fish processing; aquatic agronomy and fish farming; and aquaculture economics. The program is oriented primarily to fish, their habitat and to their contact and use by man.

Since the first international student studied aquaculture at Auburn, more than 450 students from 66 countries have attended the University, 300 have received advanced degrees. These international alumni are playing an important role in the growth and development of aquaculture in their respective countries, and are an effective, ever increasing network of scientists involved in aquaculture activities.

- c. Library Facilities - The Sciences and Technology Section of Auburn University provides the library resources for FAA/ICA. Approximately 350,000 volumes support the mission of the Department. Within that number, approximately 8,700 volumes, including 369 serial titles, deal with fish or aquatic ecosystems.

- d. International Aquaculture Network - The International Aquaculture Network (IAN) links scientists from over 70 less-developed countries in Latin America, Asia, and Africa in a cooperative effort to combat world hunger. Via the IAN linkup, scientists from around the world have access, almost instantaneously, to the latest production and research information on fish production. The new IAN centers will be connected by modern communication and advanced telex systems to provide a timely, continuous flow of information on new research results, innovative teaching, production, and marketing trends, and opportunities for international cooperation.
  - e. Other Departments of Auburn University - FAA/ICA draws on the resources of the following departments within the University to provide support to its international program: Agricultural Economics; Rural Sociology; Agricultural Engineering; Botany, Microbiology, Plant Pathology; Research Data Analysis; Parasitology; Economics; Sociology, Veterinary Medicine, and Nutrition and Foods.
- E. Auburn University's Involvement in the LDCs - By the 1960s Auburn University became directly involved in international aquaculture when economic and technical assistance in aquaculture was provided to Southeast Asia. Since the program began, Auburn University has provided long-term assistance to 12 countries (Brazil, Colombia, Egypt, El Salvador, Ecuador, Honduras, Indonesia, Jamaica, Nigeria, Panama, Philippines and Rwanda). If the person-months that Auburn scientists spent in these countries were added together, they would total more than 100 years. In addition, Auburn provided short- and medium-term vital assistance to 80 countries to initiate, improve, and expand their aquacultural programs. (See Appendix G for additional information on the international program.)

Under AID funded aquaculture programs, AU/FAA/ICA specialists contributed significantly to the development and implementation of many successful LDC projects, such as the following:

1. Asia and Near East

- Egypt - A sectoral analysis followed by a feasibility study led to a five-year Egyptian Aquaculture project to support aquaculture at the National Aquaculture Center located in El-Abbasa. AU/FAA/ICA has provided a design consultant to improve operating system for approximately 250 ponds with a water surface of over 200 acres. To date this industry has utilized salt-laden and marshy lands that are not suited for terrestrial agriculture to produce tilapia, carp, and mullet for Egyptian markets. AU/FAA/ICA developed training programs specifically designed to meet the needs of this Center and trained approximately 200 extension agents to assist fish farmers and others to maximize production through efficient use of aquaculture systems. In addition, senior Egyptian scientists are receiving graduate degrees at Auburn University.
  
- Indonesia - From 1976 to 1981 Auburn University under a mission funded project provided assistance and equipment to increase brackish water fisheries production in seven districts in the provinces of Aceh and North Sumatra. Since the project began, eight fish farms were constructed to demonstrate new techniques and provide intensive fish culture training programs to the local farmers. Farm managers were trained to operate the fish farms and 40 extension agents trained to provide field assistance to farmers. Milkfish and shrimp fry surveys and economic feasibility studies were undertaken of farm operations, including fry transportation and distribution. In addition, assistance was provided to increase the role of local producer associations, process credit applications, evaluate market expansion potential, and maximize the use of mangrove forest areas.  
  
Resulting annual production increases exceeded 4,000 tons of marketable milkfish and shrimp.
  
- Philippines - Auburn University provided assistance to the GOP to increase aquacultural fish production. Assistance was provided to the University of Philippines College of Fisheries, Central Luzon State University, and the Bureau of Fisheries and Aquatic Resources to: 1) organize and support aquaculture programs effectively; 2) undertake research to generate new aquacultural technology; and 3) train aquaculturalists in both private and public sectors and extension workers to transfer technology and assist fish farmers in putting research results into practice.

The basic institutional framework of a coordinated aquaculture program was successfully established. A freshwater station was constructed with 74 ponds consisting of 7.6 hectares and a brackish water station with 180 ponds with 18 hectares of water. A deep water milkfish culture system was developed under the Inland Fisheries Project. Seven Ph.D.s and ten Master of Science degrees were earned by staff at AU. Aquaculture extension programs were established in two pilot areas and 56 fisheries extension workers provided direct assistance to the farmers. This has resulted in a very successful project and substantial increases in farmed fish production.

## 2. Latin America and Caribbean

- El Salvador - AU/FAA/ICA scientists provided assistance to Government of El Salvador (GOES) which resulted in increased fish harvests from freshwater lakes and ponds. This assistance included research, training of scientists and technicians, expanding extension activities, and increasing the production of fingerlings. GOES scientists and officials were so impressed with the efficient operation of the initial program that they expanded the program. The technical staff was increased from 5 to 39 and the budget from \$49,600 to \$447,600. Under the fingerling production program, the fisheries station now has 48 ponds covering 6.1 hectares of water surface.
  
- Brazil - From 1969 through 1978 Auburn University provided assistance to the Government of Brazil (GOB) in reservoir management, fish culture and fish culture extension. During that period a fisheries research center was established at Pentecoste, Ceara, which is currently recognized as one of the outstanding tropical freshwater fishery research and training organizations in Latin America. It contains an excellent laboratory, teaching complex, earthen ponds and concrete tanks, and a total water area of 20.0 hectares. It offers short- and long-term training in intensive and extensive fish culture, reservoir management, hatchery management and reservoir limnology.

Research undertaken at the Center has demonstrated the technical and economic feasibility under Brazilian conditions of culturing male tilapias using agricultural by-products and animal manures as feeds and fertilizers. Improved reservoir management techniques increased production substantially. In one year, 15,702 metric tons of fish and shrimp were captured in the Center's reservoirs.

- Ecuador - Ecuador is presently the prime nation in the Latin America in aquaculture development -- principally from shrimp culture which is being practiced in some 150,000 acres of coastal ponds. Auburn University is providing assistance to Escuela Superior Politecnica Del Litoral (ESPOL) in marine and freshwater aquaculture to design and supervise the construction of an aquaculture field research facility. Priority has been given to native fish species that feed low on the food chain. The research has proven that the growth of the local species can be increased significantly under controlled conditions.
- Honduras - Auburn University designed the fish hatchery system and extension service which has lead to improving the nutritional status of rural families in the areas involved. New and improved fish varieties were used in the program. New production technologies were introduced and demonstrated to area farmers. Training was provided to private and government aquaculturalists.

USAID is now in the process of developing a bilateral contract with AU which will maintain the technical services of an ICA staff in-country following termination of the CRSP Pond Dynamics program in Honduras.

- Jamaica - Auburn University provided three resident advisors to the Government of Jamaica (GOJ) to: a) increase food production, income, and employment; b) improve human nutrition in the rural areas; and c) decrease foreign exchange spending for food. During the first three years of the project over 652,000 pounds of food fish and 3 million fingerlings were produced. In 1986, 1000 ponds were under operation by the private sector in which 2.2 million pounds of fish were cultured and marketed.

A fish hatchery demonstration facility was established which can now produce thirteen million tilapia fingerling annually. A country-wide fisheries extension program was established to provide assistance to 1,280 existing farms, with 1,100 surface acres of water resulting in an annual production of 6 million pounds of fish.

- Panama - In 1981 Auburn University provided assistance to GOP to expand the number and increase the productivity of fresh water fish pond projects in poor rural communities. Approximately 22 projects were implemented to build and demonstrate ponds of different sizes to: 1) perform research on fingerling production; 2) integrate fish ponds with small-scale irrigation for terrestrial farming, livestock, poultry production, and reforestation; and 3) experiment on different sizes of continually harvested ponds. Agricultural production cooperatives were used to channel credit to the pond projects. This project has been very successful.

### 3. Africa

- Rwanda - AU/FAA/ICA scientists assisted the Government of Rwanda (GOR) to increase fish production in rural ponds by using improved fish culture technologies. Technical training programs were designed and extension agents were trained in culture systems, including the stocking of fingerlings, pond management inputs, and harvesting market size fish.
- Sierra Leone - An evaluation conducted by AU/FAA/ICA indicated that small-scale aquaculture is practical and needed in certain regions of the country. Fish production of 1,200 to 3,000 kg/ha/yr was reported in upland swamps that had been developed for paddy rice production.
- Burundi - A study undertaken by AU/FAA/ICA determined that there is a great potential for further exploitation of Burundi's inland waters.
- Niger - AU/FAA/ICA has been actively involved in training Peace Corps Volunteers for capture fishery positions with the Department of Water and Forests in Niger since 1978. AU submitted proposal to restructure the Peace Corps program to provide more meaningful focus to volunteer assistance. The proposal indicated that an opportunity existed for collaborative effort with the Niger Department of Water and Forests and external assistance from the Peace Corps, USAID, FAO and Auburn University for rationale development of Niger River fishery. A catch assessment analysis has provided data on benefits, economic and nutritional, resulting from the fishery and has led to a strategy for self-regulation to protect and sustain the fishery resource. In fact, FAO is presently considering using the methodologies developed under this project in other African country aquaculture projects.

- African Natural Resources Management Support (NRMS) project is a new activity in FY 1987 which is designed to increase the quality and level of natural resources management activity in Sub-Saharan Africa, and in PVO programs supported by A.I.D. It will provide an excellent opportunity to promote the use of underutilized land not suitable for other crops for fish farming to: 1) increase the income of small farmers; 2) make more high quality protein available for local consumption; and 3) decrease the dependency on imported food. The latter will promote food security in the participating countries and save foreign exchange for other priority purposes.

F. Evaluations of the Current Project - Aquaculture Technology Development - The project was evaluated by a team of specialists in July 1984 from the National Science Foundation (NSF). The team's comments are summarized below:

1. Positive comments - The team expressed its great respect for the international aquaculture program that is being implemented under a cooperative agreement with Auburn University and stated:

"The activities on the campus and abroad are, on the whole, well conceived and carefully executed and should, by all means, be continued at a level that enables Auburn University to deliver the program and the services that the international aquaculture community has been led to expect and has received from the University. Auburn has achieved an excellent reputation around the world for the practicality of its efforts because of the high quality and commitment of its staff and its willingness to meet the perceived needs of those it is serving. During the almost 20 years that Auburn has been functioning abroad, a tremendous amount of experience and talent has been acquired which is unique among universities in this country dealing with fisheries problems. It is important, therefore, that this capital base be maintained and nurtured so that Auburn can meet changing needs of aquaculture in LDCs and can continue to be an effective part of the USAID fisheries program."

2. Recommendations for Changes - The team recommended the following changes for future activities:

- a. Annual Work plan - The team recommended that an annual work plan be prepared which includes the goals, objectives and proposed scope of work for the coming year, as well as, some built-in provision for evaluating the achievements.

Action - An annual work plan has been prepared under the existing project and will be a requirement of the new project.

- b. Role of AU in Aquaculture - The team cited an apparent problem of identifying the role of AU in terms of what is needed in aquaculture; what is going on in other research and training institutions around the world; and/or what changes are required if AU is to play an important continuing role in a changing world.

Action - Under the networking activities of the new project, AU will be required to identify its role in aquaculture in collaboration with other donors, institutions, and countries.

- c. Change in Reporting Requirements - The team stated that AU often unduly relied on statistical summaries such as the number of man-days in the field or the pounds of documents shipped, but failed to provide adequate rationale for the program.

Action - The reporting section of the new project will require critical path indicators, impact analysis, technical and research reports, and trip reports which will provide adequate description of the program.

- d. Project Management Responsibilities - The team cited problems of communication between ICA and USAID/S&T/AGR.

Action - The project management section of the new project will clearly define the responsibilities of the AID/S&T/AGR project manager and those of the Principal Investigator at AU.

3. Terminal Evaluation - will be conducted within three months after the current project, Aquaculture Technology Development, terminates. The outcome of that evaluation will play an important role in the annual work plans.

Additional information on the NSF evaluation and the Summative Evaluation performed by S&T/AGR is included in Appendix F.

### III. Project Goal, Purpose, Outputs and Inputs

- A. Project Goal - The goal of the project is to improve the quality of life of poor LDC residents, both economically and nutritionally through effective sustained use of renewable natural resources.

The success of the aquaculture industry in the economic production of animal protein through pond culture has already been demonstrated in a number of LDCs. (See PP. 14 through 17 for specific examples.) As a consequence, LDC interest in fish farming is increasing steadily. Therefore, there will continue to be a need for short-, medium- and long-term technical assistance and training to transfer the latest aquaculture technologies developed at AU/FAA/ICA to LDC scientists and extension workers to be taken to the farmers' ponds in the LDCs.

- B. Project Purpose - The purpose of the project is to assist LDCs improve their capabilities to: 1) increase income and employment in the fisheries sector; 2) improve management strategies to conserve national resources and optimize sustained yields; and 3) improve fish distribution and marketing systems. (The latter will be funded primarily by delivery orders under the BOA.)

S&T/AGR's continued support of AU/FAA/ICA's program will help to maintain the international focus developed over the past two decades. It is expected that as a direct result of the assistance provided under this new project:

1. More high quality animal protein will be available in the market place;
2. Farm employment and income will increase in the fisheries sector providing low-income households with the resources to meet their needs;
3. Private agricultural marketing and distribution systems will be promoted;
4. Market-oriented, efficient, low-cost production of small family fish farms will be encouraged on a sustainable basis;
5. Low cost food will be available to farm families who are unable to purchase it on the local market; and
6. Sound nutritional and food consumption principles will be incorporated into the design and implementation of aquaculture development activities.
7. Food security objectives will be supported by reducing dependency on imported fish.
8. Foreign exchange will be saved for other priority purposes.

- C. Project Outputs

1. Applied and Developmental Research - The research focus will be on developing, testing and transferring economically viable and socially and culturally accepted technologies aimed at increasing fish yields. Decision-aids (simulation models) will be developed, tested and validated at AU and in the LDCs by researchers, extension agents, and others who will take the research results, latest technologies and related information to the LDC fish farmers' ponds. These aids will be based on AU's Department of Fisheries and Allied Aquaculture (FAA ) research being implemented in the following areas:

a. Activities (See Appendix I for description and justification for the Applied and Developmental Research activities listed below)

i. Aquaculture

- Fish diseases and pathology
- Genetics and breeding
- Hatchery management
- Nutrition
- Processing and quality assurance
- Production systems
- Water quality and hydrology
- Integrated farming; e.g., fish/rice, fish/poultry, and fish/irrigation.
- Aquaculture economics

ii. Aquatic Ecology

Improved management of aquatic ecosystems to protect natural resources from degradation

iii. Fresh Water Fisheries Management

Improved methods to optimize yields and preserve resources for future generations.

iv. Decision aids for transfer of data by simulation to be tested in 3 countries, one in each region.

b. Assumptions for achieving research outputs:

i. Missions and LDCs will fund research in LDCs.

ii. Fish farmers will use innovative and improved techniques developed by FA.

iii. Missions and LDCs will utilize their facilities and equipment to collaborate with AU on the promotion of improved fish production methods.

## 2. Technology Transfer

### a. Activities

i. Problem solving assistance will include short-, medium-, and long-term assistance for project design, assessment, feasibility studies and evaluations covering the following areas; aquaculture, aquatic ecology, fresh water fisheries management, private sector involvement, policy and planning, fish distribution and marketing, and credit.

ii. Transfer of information will include library and informational services maintained on aquaculture, aquatic ecology, and fisheries management. Services will be provided to LDCs to create and maintain informational services. AU/ICA publications and research findings will be disseminated to LDCs, national, and international institutions. Training manuals and audiovisual cassettes for training will be developed.

### b. Assumptions for achieving technology transfer outputs

i. Missions, LDCs and other donors will request assistance from AU/FAA/ICA and provide the necessary funding.

ii. Technologies developed by FAA can be adapted to LDC environments in an efficient and economical manner.

iii. LDC fish farmers will use these techniques to improve production and increase efficiency.

iv. Expanded awareness of constraints facing the fish farmers, will result in the increased use of improved, effective, and economical methods.

## 3. Training

### a. Activities

i. Long-term academic training at the undergraduate and graduate degree levels - each student is provided with information and philosophy on the use of water-based culture to produce food and income. The factors contributing to production (pathology, nutrition, reproduction, processing, culture and marketing) are taught. Aquaculture is presented as an ecological approach to rational utilization of renewable natural resources.

In addition, courses in public and business administration, natural resources economics and related studies will be available to students who plan to hold administrative positions in the fisheries sector.

- ii. Intensive non-degree and short-term training is provided to improve the knowledge base in aquaculture in developing countries.
- iii. Production of comprehensive training manuals for use in the LDCs.
- iv. Seminars and workshops.
- v. Computer utilization training.

b. Assumptions

- i. Missions and LDCs will sponsor LDC scientists and experts and provide the training costs, as required.
- ii. AU/FAA will allocate spaces for LDC scientists and experts to obtain degrees and train at AU.
- iii. LDCs, IARCs, and missions will provide facilities and needed resources for in-country training activities.

4. International Networks

- a. Activities - S&T/AGR will promote more aggressive involvement of AU in the aquaculture, aquatic ecology and fresh water fisheries management programs of other institutions, especially with ICLARM to obtain information on reproduction, genetics, nutrition of cultured species, and integrated agricultural-aquacultural food production systems involving species such as tilapia and carps.
  - i. Existing networks will be continued and new contacts will be established with scientists, experts, and international, national, and regional centers and institutions. (A partial listing of institutions which are, or will be members of the international network is attached as Appendix D.)
  - ii. Conferences and international workshops on aquaculture will be held.

- iii. The International Aquacultural Network's (IAN) advanced communication and computerized telex system will continue to expand its data base and provide fishery scientists around the world with rapid access to up-to-date information about theory and practices of aquaculture. This network links scientists from 70 nations in a cooperative effort to combat world hunger.
- iv. Publications and scientific journal articles will be produced, selectively collected and disseminated to LDCs and international and national organizations, including the ICA Communicae.

b. Assumptions

- i. Interest and support from members of the International Aquaculture Network (IAN) will be continued.
- ii. Members of IAN will sponsor, fund and attend meetings, conferences, and seminars.
- iii. Members of IAN will provide current data on aquaculture which can be included in the IAN data base.

D. Project Inputs - Cost Estimates and Annual Person-months

1. Cost Estimates - The total cost of this five-year Aquaculture Research and Support activity is estimated at \$6,800,000 which includes an S&T/AGR core budget of \$1,275,000, and an expected \$3,565,000 contribution from the missions, regional bureaus, and other AID/W offices under the Basic Ordering Agreement. Auburn University is expected to contribute another \$1,960,000. These cost estimates are based on the calculated level of effort needed; i.e., facilities, personnel, travel and allowances, supplies and services and other requirements necessary to achieve targeted outputs of the types and magnitude as set forth in the logical framework (Appendix No. 1). In addition, national, regional, and international institutions are expected to assist in the funding of certain activities when they are being implemented in the LDCs.

- a. S&T/AGR's funding - It is anticipated that S&T/AGR will contribute \$255,000 annually or \$1,275,000 over the five-year period to cover the core costs of maintaining an international focus for: 1) research adapted to the needs of the LDCs; 2) technology transfer, including a computer base information system; 3) training at the undergraduate, graduate and technical levels; and 4) maintaining and expanding the international network system.
- b. Missions, regional bureaus and other AID/W offices

S&T/AGR anticipates that the missions, regional bureaus and other AID/W offices will request and fund assistance totalling \$713,000 or \$3,565,000 over the life of the project to: 1) carry out research in the LDCs; 2) transfer the latest aquaculture, aquatic ecology and fisheries management technologies developed at AU/FAA/ICA to the LDCs; 3) fund training opportunities at AU and in LDCs; and 4) participate in the network and linkages with the international community. This level for buy-ins is based on historical trends of mission funded requests for assistance.
- c. Auburn University, Department of Fisheries and Allied Aquaculture, International Center for Aquaculture - AU/FAA/ICA is making a substantial contribution in support of this international program and will be contributing approximately \$391,200 annually or \$1,960,000 over the life of the project.
  - i. AU's contribution will cover: 1) research which can be adapted to LDC environments; 2) drafting and publication of research results; 3) attendance at international workshops and seminars to become aware of the latest technology developed in aquaculture under programs sponsored by other donors, institutions, and organizations; 4) on-campus consultation with foreign visitors; 5) responses to LDC requests for information which are not funded by AID; and 6) assistance to international organizations, (e.g., World Bank, FAO, and UNDP) which is not otherwise funded from other sources. AU's contribution will be verified in certain reports designed by APM in consultation with the AU PI.
  - ii. Equipment and Facilities - In addition, AU will provide from its own resources equipment and facilities in support of this international program. It also obtains funds from the State of Alabama, private companies, and other government agencies to implement programs which will generate knowledge applicable to conditions in the LDCs.

Table 1 - Inputs by Source of Funds - Five-Year Budget  
(In thousands)

	Re-		Tech		Train-		Net-		Grand	
	%	search	%	Trans	%	ing	%	working	%	Total Amount
Office of Agriculture	27	\$ 638	9	\$ 191	19	\$ 255	21	\$ 191	19	\$1,275
Auburn University	50	1,176	5	196	29	392	21	196	29	1,960
Total Cooperative Agree. Missions, Regional Bureaus and Other AID/W Officer -	77	\$1,814	18	\$ 387	48	\$ 647	42	\$ 387	48	3,235
Total BOA	23	535	82	1,782	52	713	58	535	52	3,565
Total - Project Components	100	\$2,349	100	\$2,169	100	\$1,360	100	\$ 922	100	\$6,800

Table 2 - Inputs by Project Components - Five-Year Budget  
(In thousands)

	A.I.D.								Grand	
	S&T/AGR		Missions		Total AID		AU/FAA/ICA		Total	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Basic & Adapted Research	50	\$ 638	15	\$ 535	24	\$1,173	60	\$1,176	34	\$2,349
Technical Transfer	15	191	50	1,782	41	1,973	10	196	32	2,169
Training	20	255	20	713	20	968	20	392	20	1,360
Networking & Linkages	15	191	15	535	15	726	10	196	14	922
Total - Project Components	100	\$1,275	100	\$3,565	100	\$4,840	100	\$1,960	100	\$6,800

Table 3 - Inputs by Line Items - Five-Year Budget  
(In thousands)

	A.I.D.								Grand	
	S&T/AGR		Missions		Total AID		AU/FAA/ICA		Total	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Salaries, Wages & Benefits	66	\$ 835	-	\$ -	17	\$ 835	67	\$1,315	32	\$2,150
Consultants	-	-	50	1,800	37	1,800	-	-	27	1,800
Operating Expenses	2	30	2	60	2	90	4	75	2	165
Travel	4	50	20	705	16	755	1	20	11	775
Indirect Costs (39%)	28	360	28	1,000	28	1,360	28	550	28	1,910
Total Line Item	100	\$1,275	100	\$3,565	100	\$4,840	100	\$1,960	100	\$6,800

2. Annual Person-months - It is expected that from all sources, 238.3 person-months will be provided from all sources over the five-year period, including professional and support staff. Person-months to be funded by S&T/AGR; missions, regional bureaus and other AID/W offices; and AU/FAA/ICA are listed below:
- a. S&T/AGR funded - It is expected that S&T/AGR will fund 37.6 person-months of professional staff and 15.0 person-months for support staff for a total of 52.6 person months.
  - b. Mission funded - It is expected that the missions, regional bureaus, and other AID/W offices will fund 77.4 person-months of professional services and 25.0 person-months for support staff for a total of 102.4 person-months.
  - c. AU/FAA/ICA - It is expected that Auburn University will support 64.6 person-months of professional staff and 18.7 person-months for support staff for a total of 83.3 person-months in support of international activities in aquaculture.

Table 4 - Inputs by Person-months  
Average Annual Person-months by Project Components

	<u>S&amp;T/AGR</u>		<u>A.I.D.</u>				<u>AU/FAA/ICA</u>		<u>Grand Total</u>	
	<u>%</u>	<u>Per Mo</u>	<u>Missions</u>		<u>Total AID</u>		<u>%</u>	<u>Per Mo</u>	<u>%</u>	<u>Per Mo</u>
			<u>%</u>	<u>Per Mo</u>	<u>%</u>	<u>Per Mo</u>				
Basic & Adapted Research	51	19.3	18	14.2	29	33.5	64	41.5	42	75.0
Technical Transfer	14	5.2	48	37.2	37	42.4	9	5.8	27	48.2
Training	18	6.9	19	14.9	19	21.8	18	11.5	18	33.3
Networking & Linkages	17	6.2	15	11.1	15	17.3	9	5.8	13	23.1
Total - Professional Staff	100	37.6	100	77.4	100	115.0	100	64.6	100	179.6
- Support Staff		15.0		25.0		40.0		18.7		58.7
Grand Total Person-months		52.6		102.4		155.0		83.3		238.3

For additional information on the funding of this project, please refer to Appendix B.

IV. Project Management

A. S&T/AGR Responsibilities - S&T/AGR/RNR Project Manager will be Responsible for:

1. Approving the annual work plans, including the proposed research to assure consistency with the needs of the LDCs. The process of approval will be completed not later than 30 days after receipt of the original work plan, or annual revision thereof, from AU/FAA/ICA.
2. Assuring that the activities are consistent with the focus of the Agency's agriculture, rural development, and nutrition program to increase the incomes of the poor majority and to expand the availability and consumption of food while maintaining and enhancing the natural resource base.
3. Monitoring the critical path indicators and work plans.
4. Coordinating AU/FAA /ICA activities with other S&T/AGR/RNR projects and programs.
5. Establishing linkages with S&T/AGR projects funded under the Collaborative Research Support Program, International Agricultural Research Centers and other S&T/AGR programs. For a complete listing, please refer to Section VI. E., pages 50 to 53.
6. Coordinating and providing support to mission funded activities; i.e., field experiments, training and demonstrations.
7. Maintaining contact with field missions, regional bureaus and Private Voluntary Agencies to: 1) keep them informed of the aquaculture program and the advances in technology; 2) identify targets of opportunities in for aquaculture involvement to increase income and employment opportunities of the rural poor; and 3) facilitate response to mission requests for assistance to be funded under the companion basic ordering agreement.
8. Communicating directly with PI at AU/FAA/ICA on matters related to mission requests or other information required in the performance of the cooperative agreement and the delivery orders under the basic ordering agreement.
9. Approving scientists and consultants hired by AU under the Cooperative Agreement.
10. Scheduling and coordinating external project evaluations and internal management reviews.
11. Clearing all travel requests for AU scientists and experts traveling to LDCs.

11. Determining the type and frequency of reports to comply with the requirements of the cooperative agreement. These reports will be in addition to those required under the Standard Provisions of Cooperative agreements for fiscal purposes.

12. Scheduling Management Reviews and In depth Evaluations

B. Management Review Group (MRG)

A Management Review Group (MRG) has been established and consists of the AID Project Monitor (APM) and the AU/FAA/ICA Principal Investigator (PI) as equal members. (This is the principal and formal means by which the APM and the PI exercise joint responsibilities to implement the requirements of this project). In addition, representatives from the regional bureaus, missions, other contractors and grantees implementing related AID projects, and network partners may participate in the MRG activities on an "as needed" or "as appropriate" basis.

The MRG will meet at least semi-annually, and will carry out the following functions:

- Review the multi-year strategic plan and subsequent revisions and make recommendations, as appropriate;
- Review the ICA annual work plans and budgets and subsequent revisions and make recommendations, as appropriate;
- Review the annual changes in output priorities, resource allocations, and end-of-project status (EOPS);
- Recommend terms of reference and issues for in depth evaluations to be carried out independently;
- Identify projects for collaboration with this aquaculture project; and
- Seek ways and means to increase the effective utilization of ICA capability to remove constraints inhibiting fresh water fish production in the LDCs.

- C. AU/FAA /ICA Responsibilities - The scope of work described in this project includes activities for which AU/FAA/ICA is highly qualified. As indicated in Section F, Page 19 and Appendix F, the previous project was evaluated by a National Science Foundation panel of experts who expressed great respect for AU/FAA/ICA's aquaculture program and recommended its continuation at a level commensurate to the needs of the LDCs.
1. Management Responsibilities - AU/FAA/ICA will provide a Principal Investigator (PI), Dr. Shell who will have overall responsibility for implementing the project. He will be assisted by an Associate PI, Dr. Moss with primary responsibility for administrative aspects of AU/FAA/ICA operations. The Associate PI assists the PI in coordinating activities in Asia and Near East, Africa, Latin America. The PI draws on the expertise of the many Departments of Auburn University and the Management Review Group (MRG), and works closely with the AID Project Manager.
  2. Specific responsibilities include:
    - a. Assuring that the project is implemented in accordance with the scope of work included in the CA and BOA in collaboration with the AID project manager and MRG;
    - b. Developing and revising annual work plans and obtaining annual approval of the APM prior to implementation. Annual work plans will contain the activities, major events, and target completion dates;
    - c. Maintaining close working relationships and communicate regularly with S&T/AGR/RNR project manager, regional bureaus, missions, IARCs, national agricultural research centers (NARCs), and project managers of the projects listed on pages 51 through 53.
    - d. Developing and implementing the required reporting structure to conform with project reporting requirements (see Section V. A. 4. and 5., pages 39 through 41);
    - e. Overseeing the timely completion of all reports set forth in Section V. A. 4. and 5., pages 39 through 41;
    - f. Obtaining clearance from APM to hire scientists and consultants to implement project activities;

- g. Obtaining approval of the requesting missions prior to sending scientists and other professionals to LDCs;
  - h. Implementing the annual work plan within the time-frame and financial resources allocated;
  - i. Coordinating the work of the AU/FAA/ICA headquarters, including those funded from other sources; e.g., country projects, PVO, and MOU; and
  - j. Assuring that appropriate U.S. Government environmental procedures are used during the implementation of this project.
3. Sustainability of Knowledge in LDCs - AU's obligation to provide aquaculture information to LDCs, does not cease when the activity terminates. AU will maintain the University and provide the latest assistance and information on aquaculture to LDC institutions, scientists, and experts. The assistance includes training; technical assistance to governments, institutions, and missions; seminars and workshops; and maintaining the international network. However, it should be noted that these activities must be funded from other sources after the project terminates.

D. Management Reviews and In Depth Evaluations

1. Management Reviews

Management reviews will be conducted annually by the S&T/AGR project manager in consultation with the AU/FAA/ICA; and the MRG, collaborators and other interested participants of the activities funded under this project, as appropriate. The reports required under Section V. A. 4. and 5., pages 39 - 41 will become an integral part of the review process.

2. In Depth Evaluation

An in depth evaluation will be performed at the end of the second year to determine the future direction of the project. The next in depth evaluation will be performed at the end of the fourth year to review the progress made in achieving the established goal and purpose and to address follow-on project development and the future issues involved in utilizing the technology and concepts developed under this project. The cost of each evaluation will be charged to the Agricultural Technology Research and Development project no. 936-4109.

These in depth evaluations will be performed by an external panel of experts in aquaculture and fresh water fisheries research and will involve the whole system to determine required changes in any single component.

The evaluation factors will include project achievement in establishing decision-aids (simulation models) to demonstrate the application of these models for making responsible choices which result in desired outcomes in LDCs. These evaluations will be based on monitoring reports, inspection of physical facilities, the recipient's progress reports, technical publications, and trip reports.

Special attention will be given to validating the effectiveness of these models and obtaining feedback from their use. Future needs for assistance (e.g., extension, training, collaboration, new models, and research) will be examined to format the system replication. Key issues affecting replication will be examined closely by the evaluations.

In addition, the evaluation team will be required to review the following:

- Validity of the assumptions in the logframe and the critical performance indicators;
- Methodologies used to achieve the outputs and whether the outputs are being achieved as planned;
- Alternative methods of achieving outputs with savings to the project;
- The recipient's management effectiveness to carry out the scope of work described in the annual work plans;
- Expenditures to determine whether they correspond to the scope of work in the annual work plan;
- Unforeseen internal or external factors which may have a specific adverse or beneficial impact on the project; and
- Methodologies used to transfer technology to LDC national, regional, and/or international organizations and institutions to determine their effectiveness, timeliness, and acceptance by the recipients.
- Determine whether the program is still consistent with the Focus of the Agency's agriculture, rural development, and nutrition program to increase the incomes of the poor majority and to expand the availability and consumption of food while maintaining and enhancing the natural resource base.

The evaluation team will recommend to S&T/AGR the future direction and funding of the project; and/or the appropriate changes in the project design and/or work plans to maximize use of S&T/AGR's limited funds.

V. Project Implementation

A. Cooperative Agreement - The building blocks of the proposed CA are: applied and development research, training, technical assistance and networking which are interacting components of the aquaculture program to be implemented by AU/FAA/ICA staff and at the various facilities of the University and in the LDCs. The training component will include formal degree programs at the undergraduate and graduate levels and specialized training programs for groups such as Peace Corps volunteers, fish farmers, and aquaculture development specialists both at the university and at LDC country sites. The technical assistance portion will draw on the inter-disciplinary team from across the campus with a sensitivity to local LDC conditions and environments. In addition, technical assistance will be provided in a range of levels from analysis of soils to fresh water fish diseases.

1. Terms of the Cooperative Agreement

- a. Length of Service - The term of the Cooperative Agreement will be from January 1, 1988 - December 31, 1992, or in accordance with the terms agreed to by the recipient and the Grants Officer, but not to exceed five years.
- b. Five-Year Budget - The proposed budget for the five-year period under the Cooperative Agreement is \$3,235,000, of which \$1,275,000 is provided by the S&T/AGR to strengthen the capabilities of AU/FAA/ICA to expand its program to cover research and other activities in aquaculture and fresh water fisheries in the LDCs, and \$1,960,000 is to be provided by Auburn University. Tables covering the annual budget projections are attached as Appendix B.
- c. Person-months - The estimated annual person-months to be provided under the cooperative agreement are 135.3; of which 52.6 will be funded by S&T/AGR, and 83.3 by AU/FAA/ICA.

2. Scope of Work

- a. Applied and Developmental Research - decision-aids (simulation models) will be developed, tested and validated. These aids will be based on AU's Department of Fisheries and Allied Aquaculture (FAA ) research results in the following areas:

i. Aquaculture

- (a) Fish diseases and pathology - improved rapid and accurate disease diagnosis for improved fish health
- (b) Genetics and breeding - improved techniques for hatchery production of catfish, carps and tilapia
- (c) Hatchery Management - Improved hatchery management techniques on selection and care of brood animals, on spawning methodology, on hatching, and on culture of early life history stages of fish, crustaceans and molluscs.
- (d) Nutrition - Improved methods for determining nutritional requirements, feed formulations, nutrient deficiency, designs, feed practices, and dietary toxicity signs.
  - At least two methods adapted for LDC environments.
- (e) Processing and quality assurance - improved methods for quality control in marketed products, and uses for by-products.
- (f) Production systems - Improved information systems or "packages" on farm management, production, harvesting and marketing.
  - At least two systems adapted for LDC scientists use and distributed to at least two countries in each region.

- (g) Water quality and hydrology - Improved information and recommendations related to water quality used in aquacultural operations.
  - (h) Integrated farming systems developed; e.g., fish/rice, fish/livestock, fish/poultry, and fish/irrigation.
  - ii. Aquatic Ecology - Improved management of aquatic ecosystems to protect natural resources from degradation.
  - iii. Fresh Water Fisheries Management - Improved methods to optimize yields and preserve resources for future generations.
- b. Technology Transfer
- i. Decision aids (simulation models) for transfer of data by simulation to be tested in 3 countries, one in each region.
  - ii. Problem solving activities - Although most of the technical assistance will be funded under the companion basic ordering agreement, there will be some activities funded under the cooperative agreement. These activities will include short-term TDY to inform certain LDCs of the latest technologies developed in aquaculture, aquatic ecology, fresh water fisheries management, private sector involvement, policy and planning, and credit.
  - iii. Transfer of information - Library and informational services covering aquaculture, aquatic ecology, and fisheries management; services to LDCs to maintain informational services; publications and research findings disseminated to LDCs, national, and international institutions; and training manuals and audiovisual cassettes for training.

c. Training

- i. Although most of the training activities will be funded under the participant training program, and/or by the missions, regional bureaus and other AID/W offices under the companion basic ordering agreement, the CA may provide some training for non-degree and short-term training.
- ii. Production of comprehensive training manuals for use in the LDCs.
- iii. Audiovisual cassettes for training in LDCs.
- iv. Seminars and workshops.
- v. Computer programming training.

d. International Networks

- i. Existing networks will be continued and new contacts will be established with scientists, experts, and international, national, and regional centers and institutions.
- ii. Conferences and international workshops will be held on aquaculture.
- iii. The International Aquacultural Network computerized telex system will continue to expand its data base and provide fishery scientists around the world with instant access to up-to-date information about theory and practices of aquaculture. This network links scientists from 70 nations in a cooperative effort to combat world hunger.
- iv. Publications and scientific journal articles will be produced, selectively collected and disseminated to LDCs and international and national organizations.

3. Substantial involvement of the Agency for International Development (AID) in the management of the cooperative agreement and the basic ordering agreement is anticipated. Participation and collaboration by AID is expected, in particular, as follows:

- AID will be consulted during the development of the AU/FAA/ICA annual work plan and have the right of final approval of all areas in the work plan which involves the use of AID resources.

- AID will be consulted and will have right of approval of revisions in the annual work plan which involves the use of AID resources.
- AID will have final approval in the selection of sites, methodologies, and strategies to be used in field activities funded under this agreement.
- AID will be involved in clearance of field visits to LDCs, IARCs, and institutions in developed countries which are funded by S&T/AGR, other AID/W offices, and USAID overseas field missions.
- AID will be involved in the selection of key personnel if the following scientists leave AU/FAA:

Scientists

Area of Specialization

Dr. Shell  
Dr. Moss

Principal Investigator  
Assistant

- AID will be involved in the selection of consultants hired by AU/FAA /ICA to be funded under this agreement.
- AID will be involved in the selection of the trainees and participants to attend workshops, conferences, and seminars.
- AID will be involved in scheduling meetings and reviews of the Management Review Group (MRG).
- AID will be involved in revisions of major design elements of project.

The above specific involvement is in addition to the normal program monitoring of the recipient's program and the other administrative requirements established by the Standard Provisions of the cooperative agreement.

4. Annual Work Plans - In keeping with the concept of management-by-results, work plans will be prepared for each output or major sub-output.
  - a. Detail of Work Plan
    - A summary statement regarding the proposed type and magnitude of the output and categorized by project components; i.e., research, technology transfer, training and networking;
    - The baseline, i.e., results achieved in previous project years under the previous activities funded by AID;
    - Activities planned for remainder of project duration with emphasis on maximum detail for the next operational year
    - Milestones and scheduled completion dates for reporting and monitoring
  - b. Due dates of Work Plan - The first work plan will be submitted to S&T/AGR no later than 30 days after the cooperative agreement is signed. Thereafter, the work plan will be revised annually and will be due in AID/S&T/RNR 60 days prior to the anniversary date of the cooperative agreement; i.e., November 1. S&T/AGR will review the contents of the proposed work plan, if this has not already been accomplished in a MRG meeting, and grant final approval of the contents as proposed or modified by mutual agreement between AU/FAA/ICA and S&T/AGR. The process of review and approval will be completed not later than 30 days after receipt of the original work plan, or annual revision thereof, from AU/FAA/ICA.
  - c. Annual Expenditure Reports of Work Plan - AU/FAA/ICA will submit an annual expenditure report of each work plan no later than 30 days at the end of each fiscal year. These expenditure reports will cover S&T/AGR and AU funding by: 1) project line item; and 2) estimated distribution by project component; i.e., research, training, technology transfer and networking. The format will be collaboratively developed by S&T/AGR Project Manager and the Principal Investigator at AU/FAA/ICA.
5. Reporting Requirements - In addition to the annual work plans and expenditures described above, AU/FAA/ICA will submit the following reports within the specified time period. These reports will provide pertinent data required for S&T/AGR to monitor project activities.

- a. Quarterly reports - Quarterly reports are required which briefly describe any program and budgetary deviation from the annual work plan, the current status and planned future activities to be undertaken during the next quarter. The format will be developed by AU/FAA/ICA and S&T/AGR at a later date.
- b. Project Implementation Plan - Critical path indicators and work plans will be developed 60 days after the Cooperative Agreement is signed and will be used by the evaluation team.
- c. Technical and Research Reports - Technical research activities of the project will be summarized in reports and distributed to the appropriate missions, LDCs and IARCs to encourage use of the technology developed. Normally such reports will be completed 60 days after completion of the activity. Journal articles and other publications are encouraged. Manuscripts should be submitted to the S&T/AGR Project Manager prior to publication. Ten copies of the publications resulting from AID funding are to be forwarded to S&T/AGR.
- d. Annual Activity Reports - An Annual Report of the AU/FAA/ICA's international activities will be prepared. Although principally a technical document, it nevertheless must include pertinent statistics on quantitative information regarding the project and its activities described in scope of work. An Impact Analysis Report (as defined in paragraph 7 below) will be appended to this report which will be considered an instrument for technology transfer. A minimum of five copies should be submitted to the S&T/AGR Project Manager no later than 90 days after the end of each project year.
- e. Training Activities - Summary of training activities undertaken under and in conjunction with this project is required annually, including the numbers of trainees by gender, nationality, training site, type of training activities, duration and purpose.
- f. Impact Analysis Report - An annual report will be submitted as an annex to the Annual Activity Report as described in paragraph 4 above which summarizes the impact of AU/FAA/ICA activities in the public and private sector in terms of increased income and employment, improved management strategies to conserve national resources and optimize sustained yields; and improved fish distribution and marketing.

This will provide a feedback system for measurement and evaluation of the impact of services and training provided.

The impact analysis is defined as a measurement of results generated by activities undertaken by AU/FAA/ICA in accordance with the project description in the project paper and the scope of work in the Cooperative Agreement. For the most part, the impact analysis will be qualitative in nature, and quantified only as appropriate and will cover activities funded under this project and/or the previous activities implemented by AU/FAA/ICA in aquaculture.

- g. Environmental Impact - If it appears that outputs of this project may have a significant effect on the environment, AU will notify AID prior to the implementation of such outputs to allow AID to review and revise, if necessary, the Negative Determination (Appendix E) and to prepare an environmental assessment or environmental impact statement, if appropriate.
- h. Trip Reports - Trip reports will be prepared for each TDY assignment or trip to an LDC. The report will contain, but not be limited to, the following information: 1) logistical information, i.e., type of activity, geographical area of activity, dates of TDY, and team composition; 2) objective of TDY, including scope of work, as appropriate; 3) activities performed while on TDY; 4) summary of any technical reports resulting from TDY; 5) summary of identifiable techniques or information which could be transferred to other LDCs; and 6) summary of future potential needs of, or opportunities for, assistance to LDCs or missions, including possible networking potential. One copy of this report will be forwarded to S&T/AGR not later than 30 days after the staff member returns to AU/FAA/ICA. The trip report generally will not exceed four pages.
- i. Financial Reports - The recipient shall prepare all financial report in accordance with Handbook 13 LM entitled "Financial Reporting Requirements" (Source: OMB Circular A-110)

B. Five-Year Companion Basic Ordering Agreement

1. Purpose of the Basic Ordering Agreement - A companion instrument (basic ordering agreement) will be negotiated with the Department of Fisheries and Allied Aquaculture, Auburn University (AU/FAA) to provide AID with short-, medium-, and long-term technical advisory services for planning, designing, testing, and evaluating programs and projects related to the aquaculture, aquatic ecology and fisheries management research being implemented under the cooperative agreement.

2. Activities - Delivery orders funded under the BOA may include activities in following research areas:
  - a. Aquaculture
    - Fish diseases and pathology
    - Genetics and breeding
    - Hatchery management
    - Nutrition
    - Processing and quality assurance
    - Production systems
    - Water quality and hydrology
    - Integrated farming; e.g., fish/rice, fish/poultry, and fish/irrigation.
    - Economics
  - b. Aquatic Ecology
  - c. Fresh Water Fisheries Management
3. Benefits to AID - The recipient's program will benefit the Agency directly through its guidance, demonstration and technical interventions. The Agency will benefit indirectly from the recipient's: 1) research to develop decision support aids, and to collect environmental data on aquaculture and fresh water fisheries programs; 2) cadre of scientists and experts in aquaculture, fisheries biology and aquatic ecology; and 3) facilities and equipment necessary to carry out applied and developmental research and to support technology transfer, training and networking activities.
4. Relationship to Cooperative Agreement - The activities funded under this basic ordering agreement will be related directly to the cooperative agreement with AU/FAA/ICA and will identify, and generate data which will be fed directly to the recipient's program funded under the CA. Upon S&T/AGR and mission approval of the recipient's proposal and the necessary funding, the recipient may provide missions and/or AID/W with specified reimbursable services that directly address project and program needs related to aquaculture, aquatic ecology and fresh water fisheries management.

The practical experience, on-site information, and insights gained through the basic ordering agreement will be fed directly back into the institution's program design, research, academic curricula, teaching materials and the research agenda which are developed and implemented under the cooperative agreement.

It is also intended that the occasion for delivery orders under the basic ordering agreement shall arise from work financed under the cooperative agreement. Delivery orders which are identified by the recipient may be approved and funded by USAID missions, regional bureaus, and/or other AID/W offices. Delivery orders identified and requested by the regional bureaus, missions and LDCs must be funded by the requesting office or mission.

Much of the field work under this basic ordering agreement will be for feasibility studies and program analysis; project and program design and evaluation of computer decision packages; field research and testing of the decision system; collecting environmental data on the risk factors of aquaculture; in-country and AU/FAA/ICA training and demonstrations; assistance to the regional resource centers for training and technical information to encourage developing country entrepreneurs to establish private fish ponds.

5. Terms of the Basic Ordering Agreement

- a. Period - The basic ordering agreement will function concurrently with the Cooperative Agreement; i.e., January 1, 1988 and terminates on December 31, 1992.
- b. Operating Mode
  - i. Technical assistance delivery orders to be performed under the basic ordering agreement will be identified by: i) regional bureaus, missions, LDCs, and other AID/W offices; ii) S&T/AGR and the Directorate for Food and Agriculture; and iii) AU/FAA/ICA in the course of its research work under the Cooperative Agreement. These delivery orders will be congruent with the research program activities under the cooperative agreement, but in addition, will require Agency oversight. They usually will be funded by AID missions, regional bureaus and/or other AID offices. However, delivery orders may also be funded by S&T/AGR and other Government agencies such as the USDA and Peace Corps.

- ii. Oversight Requirements - The Delivery Orders will be implemented by the recipient with oversight by AID's Office of Agriculture, Bureau for Science and Technology and the mission or office requesting and funding the technical assistance, training and applied research related to the research being implemented under the Cooperative Agreement. Each Delivery Order will require AID's concurrence on: a) the appropriateness of the field service requested to the Cooperative Agreement's program description for the research; b) the adequacy of the scope of work to achieve the proposed objective of the request; and c) criteria for satisfactory completion of the services.
  - iii. Assessment Criteria - AID will use the following additional criteria in assessing the appropriateness of proposed work under the delivery orders.
    - Potential of the field service to contribute to knowledge generation and program development by furnishing an opportunity to produce new insights, or knowledge consolidation by allowing the testing or refinement of existing concepts, methods, or approaches; and
    - Extent to which the field services will further expand the networking and collaboration among institutions working on common problems.
- c. Cost Reimbursement
- i. The recipient shall be reimbursed the allowable cost of performance in accordance with the Delivery Order provisions included herein. The cooperating parties have established the following estimated budget for the technical delivery orders issued hereunder. It is agreed that the total estimated cost to the Government is \$3,565,000. The line item budget for the five-year budget is included in the Tables attached as Appendix B.
  - ii. The parties agree to use their best efforts to maintain the level of resources identified for the period indicated; however, it is understood that the budget levels for each period are approximations, and acquisition of services is not obligatory hereunder.
  - iii. The recipient shall furnish to the Government, when and as ordered, services up to and including the level-of-effort provided in Section 4 below.

d. Statement of Work - This basic ordering agreement only provides for AU/FAA/ICA's performance of technical and professional services which shall be performed only as authorized by delivery orders issued in accordance with the "ordering" provisions hereof. The types of activities may be provided under this BOA include:

i. Short and Medium Term Technical and Advisory Services will:

- Plan, organize, reorganize and implement aquaculture, aquatic ecology, and fisheries management programs or projects and their integration into the overall LDC strategy for agricultural development, including extension services, contract farmers, and parastatal and private organizations. Decision-aids packages (simulation models) will be used for this activity.
- Identify, analyze and recommend solutions to managerial, financial and operational problems in use of software programs.
- Advise LDC governments on plans on involving aquaculture, aquatic ecology, fresh water fisheries management, and fish distribution and marketing systems.
- Analyze staff, equipment and facility requirements and/or recommend: 1) types, capacity and location of facilities for ponds; 2) quality control for raising fish; and 3) capital investment requirements and operational costs for establishing fish ponds and fish marketing systems.
- Field test results of research develop under the cooperative agreement in LDC environments.
- Hold seminars, conferences, and workshops for disseminating information related to the cooperative agreement.
- Hold short-term intensive technical training courses in the LDCs and at Auburn University.
- Participate in the aquaculture network.

ii. Long Term Assistance will:

Provide assistance and the scientific backstopping required for the successful operation of the specific LDC projects, including:

- Long-term testing of research technologies developed at Auburn University.
- Conducting short-term and non-degree training courses and co-sponsoring workshops on specific topics of research.
- Assisting scientists to conduct applied research experiments which were designed at Auburn University.
- Assisting in USAID Mission aquaculture, aquatic ecology, and fisheries management projects using techniques developed at the University.
- Promoting and facilitating the establishment of small fisheries businesses using techniques developed at the University.
- Publishing regional newsletters and information bulletins to disseminate research data developed at the University and other fisheries institutions.

e. Requests for Proposals by Delivery Orders - Within ten (10) working days after receipt of the information provided by the Government in its request for proposal, the recipient will provide to the Contracting Officer a proposal for accomplishing the work. The proposal shall be accompanied by such documentation as may be requested by the Government, including, but not limited to, biographical data for individuals to be furnished under the contract, budgetary estimates, and a technical proposal to include a time-phased schedule for completion of work.

f. Completion of Orders and Reports

i. Delivery Orders - Each delivery order shall request the recipient to perform specific services related to the cooperative agreement and this basic ordering agreement. The expenditures must not exceed the amount obligated under each delivery order. The recipient shall complete all of the activities specified in the each order within the time specified.

- ii. Reports - Within 30 days after completion of the delivery order, the recipient will submit the appropriate number of reports required to the requesting mission or office and five copies to the S&T/AGR Project Manager.
- iii. Environmental Impact - If it appears that outputs of this project may have a significant effect on the environment, AU will notify AID prior to the implementation of such outputs to allow AID to review and revise if necessary, the Negative Determination (Appendix E) and to prepare an environmental assessment or environmental impact statement if appropriate.

## VI Program Factors

- A. Conformity with Agriculture, Rural Development and Nutrition program priorities - This project gives priority to increasing incomes of the poor and expanding the availability and consumption of food. It promotes the improvement and expansion of certain developmental areas, including: 1) farm employment and income to enable low-income households to purchase available foods; 2) private agricultural marketing and distribution systems; 3) market-oriented, efficient, low cost production on small family fish farms on a sustainable basis; 4) food assistance targeted to people currently unable to exercise market demands; and 5) the design and implementation of sound nutritional and food consumption principles.

Aquaculture makes efficient use of one of the most important natural resources - water. Very little water used in aquaculture is consumed. By contrast, when a field of corn is irrigated, the water is used, but when fish are removed from a pond, the water is still available for a variety of uses. Aquaculture also promotes the wise stewardship of water. For an effective, economical aquaculture program, fish farmers in many areas of the developing world learn to harvest water from rainfall runoff and store it in ponds. This stored water is available, when the rains cease, not only for fish production, but for livestock, irrigation and domestic uses.

Aquaculture makes efficient use of land resources. As proven effectively in Alabama, Latin America and Southeast Asia, fish can be raised on lands that are unsuitable for agriculture. Hilly, swampy, salt laden, and water-logged lands and nutritionally depleted soils can be utilized for fish ponds where crops cannot be grown economically.

Increased fish production and the availability of fish products in the market place will increase the income of the farmers and others who depend on fish and fish products for making a living. Even small ponds, properly managed, can add significantly to total farm income, whether the fish are consumed on the farm, bartered or sold for cash. Integrated with other farming methods, fish production can contribute substantially to making small land holdings profitable in LDCs. This has been demonstrated in Panama, a country with no previous tradition or experience in fish farming.

- B. Relationship to A.I.D.'s policy and strategy - The objectives of A.I.D.'s Food and Agricultural Policy and Strategy are to enable LDCs to become self-reliant in food, promote food security and contribute to broadly-based economic growth. This project is consistent with these objectives and the four elements of the policy listed below:
1. Improving country policies - Poor fishery management policies and poor implementation of policies are the most critical factors blocking improved resource utilization and expanded production. Policy constraints to fish production, marketing, and consumption will be removed and mechanisms to obtain the full potential for fish production through aquaculture will be promoted.
  2. Strengthening human resources and institutional capacity with special emphasis on science and technology - In LDCs fishery sciences lag far behind agricultural sciences in terms of trained researchers, administrators, technicians and managers. Assistance will be provided to developing country institutions through training and research to enable them to generate, adapt and apply improved science and technology for increasing the efficiency of aquaculture systems.
  3. Expanding the role of the private sector - Problems related to fish farming and opportunities for expansion of aquacultural enterprises can best be addressed by increasing private sector involvement. Efforts will be made to expand the role of the developing country private sector in fisheries and aquaculture as an alternative to parastatal organizations. The private sector presently operates most aquaculture systems and expansion in fish farming will naturally and easily stay in the private sector. As with terrestrial agriculture, the comparative efficiency of the private sector to operate fish farms (aquaculture) leads rather naturally to increased involvement by the private sector. Generally, credit and resources are available where the technology is available and where policies are appropriate to encourage open market purchasing of inputs and sale of outputs.

Further, FAO has indicated that governments and government-nominees prove to be poor producers. Few benefits, if any, in terms of export earnings or food accrue to the country. For the most part, governments are owner/non-operators with little commitment to the continuous management and operational needs of the projects, and do not perform within the right business environment which compels them to maximize or increase income.

4. Providing food aid and food security - This project will contribute in a fundamental way to increase food self-reliance and food security by assisting LDCs to increase the efficiency of aquaculture systems to maintain an adequate supply of high quality animal protein. In addition, increased fish production will reduce the dependency on imported fish and save scarce foreign exchange.

Most governments give priority to aquaculture for food products for domestic consumption in their development plans for food security and improved nutrition. This is equally important for land-locked countries with little or no access to marine fish, and countries with productive marine and inland fisheries which are perhaps already exploited at a high level. Countries which may not (or need not) prioritize aquaculture are generally those with natural fish resources which are as yet relatively underexploited.

- C. Conformity with S&T's ribbon project approach - This project will continue the ribbon approach established under the previous project (Aquaculture Technology Development, project Number 931-1314, which was initiated in FY 1978 and will terminate on December 31, 1987) which linked with and supported the efforts of a wide-range of bilateral, regional, and global projects related to aquaculture and managed fish production and marketing systems. There are many benefits of this ribbon approach. Some of the benefits are listed below:

- By pooling the resources and scientific personnel of individual projects, each has access to a much greater level of inter-disciplinary expertise which is especially beneficial for projects in small and poor LDCs. The results in one country can be effectively applied to other countries with similar environments.

- International collaboration of the members of the network will contribute to a holistic effort which will increase the efficiency of fish production through improved aquaculture systems. International linkages provide countries with new information, ideas, and technologies and contribute to breaking down the barriers of scientific isolation so commonly found in the LDCs.
- The pooling of regional expertise and infrastructure greatly reduces the costs required by individual projects and nations to develop their own programs in aquaculture.
- Sharing of expertise among several aid donors and international institutions (e.g., International Center for Living Aquatic Resources Management (ICLARM), FAO, and U.S. institutions) promises in the long-term to reduce the LDCs' dependency on any one donor for assistance.

D. Relationship to the Fisheries Sector Assessment and the Umbrella Project

1. Fisheries Sector Assessment

A sector assessment is being developed to: 1) outline the present importance of fish in the LDCs; 2) determine the status of developmental efforts and the potential for increased development in line with the above AID agricultural focus; 3) identify constraints to initiating, maintaining, and expanding an economical viable fisheries sector and recommend the appropriate courses of action to eliminate them; 4) identify employment opportunities in the fisheries sector; and 5) prioritize the courses of action and focus A.I.D.'s role, in relation to other donors. This assessment will be completed by the end of December 1987.

This new project "Aquaculture Research and Support" will provide essential background information for the aquaculture section of the sector assessment and form the basis for future aquaculture initiatives.

2. Fisheries Sub-Sector project

The future of the Fisheries Sub-Sector project will be determined by the outcome of the Fisheries Sector Assessment. However, S&T/AGR plans to include this project in our portfolio for the next five years. If a Fisheries Sub-Sector project is developed, it will be included under that umbrella. If not, it will be implemented, as in the past, as a separate project.

E. Relationship to Other S&T/AGR Projects - To utilize available technology, AU PI and S&T/AGR PM will investigate the possibility of collaborating with contractors, grantees, and participating agencies that have contracts and/or agreements with S&T/AGR.

1. Collaborative Research Support Programs (CRSP) - to increase pond production.
  - Pond Dynamics (936-4023) - to utilize the data generated under this CRSP to enhance the knowledge base, eliminate duplication of effort, and to provide the missions and LDCs with the latest technologies and principles for sound aquaculture management and improved practices to increase fish production.
  - Fisheries Stock Assessment (936-4146) - to obtain data on improved methods for regulating harvesting rates to maximize sustainable yields.
  - Soil Management (931-1311) - to obtain data on soil characteristics for: 1) use in prevention of erosion and physical deterioration of earthen structures; and 2) the selection of the most appropriate sites for ponds for fish farming
  - Small Ruminants (931-1328) - to integrate fish farming with raising of small ruminants to maximize the fish yields.
2. International Agricultural Research Centers to coordinate aquaculture activities being funded
  - International Center for Living Aquatic Resources Management (ICLARM) - to obtain information on reproduction, genetics, nutrition of cultured species, and integrated agricultural-aquacultural food production systems involving species such as tilapia and carps.
  - International Fertilizer Development Center - (931-0054) - to obtain information on fertilizers being applied to farmer's fields that could be detrimental to fish ponds in the area.
  - International Irrigation Management Institute (IIMI) - to identify irrigation systems which can be used for aquaculture.
  - International Rice Research Institute (IRRI) - to identify rice production systems which can be used for raising fish.
3. Relationship to Other S&T/AGR projects
  - Fisheries Development Support Services (936-4024) - to obtain data on socio-economic and mariculture which can be used in the development of aquacultural industries in the LDCs.

- Reproductive Studies on Milkfish (936-4161) - to obtain information on maturation and spawning, on larval survival, nutritional requirements, and environmental parameters for proper culture of fish.
- Water Management Synthesis II (936-4127) - to explore the possibility of raising fish in irrigation ditches.
- International Benchmark Sites Network (936-4054) - to obtain information on computer modelling and to integrate aquaculture with other agricultural production programs.
- Agricultural Policy Analysis (936-4084) - to obtain data to assist LDC decision-makers to obtain knowledge and understanding of key policy issues and constraints affecting aquaculture.
- Farming Systems Support (936-4099) - to integrate the use of aquaculture into the farming systems approach in the LDCs. This approach is designed to improve farm productivity and income by assessing the farmers' conditions and developing methodologies to efficiently and rapidly improve farming conditions.
- Technology of Soil Moisture Management (936-4021) and Soil Management Support Services (931-1229) - to obtain data on farming systems, water harvesting and systems modelling; and to identify appropriate sites for ponds in LDCs.
- Integrated Pest Management and Environmental Protection (936-4142) - to identify areas where pesticides are being used which may prove detrimental to fish raised in ponds, lakes, and other fresh water.

In addition, environmental data may be produced under this project which could prove helpful to identifying conditions suitable for fish production especially in semi-arid rainfed zones of the LDCs.

#### F. Relationship to Other Activities

1. Title XII - Joint Memorandum of Understanding (JMOU) - Between Auburn University and University of Arkansas-Pine Bluff - The research results and the information obtained from this JMOU on inland fisheries management, information and research network, farming systems, and other aquaculture activities will be used in the decision packages.

2. PVO Development Activities - These activities promote community and rural development through harvesting water from small watersheds and storing it in ponds for aquaculture and integrated agriculture. PVOs involved are Cooperative for American Relief Everywhere (CARE), Catholic Relief Services (CRS), Heifer Project International (HPI), Lutheran World Relief (LWR), Center for Women in Development (a project of the Southeast Consortium for International Development (CWID/SECID), and Save the Children. The data collected under these activities will be used in the decision packages.

G. Relationship to Mission and LDC Programs - This project will maintain and extend the skills and knowledge of the scientists at Auburn University developed over the last two decades to LDCs, missions, regional bureaus, and national and international institutions and organizations. Research will be conducted at AU by scientists and LDC graduate students and adapted to country specific situation.

While AU has modest funds to assist foreign visitors at the University, additional funds are required to maintain the international focus. S&T/AGR and AU, under the cooperative agreement, will provide funds for the core budget as described in Section V. A. on pages 32 through 39. However, in order to implement the total program proposed in this PID, additional funds must be provided by the requesting missions, regional bureaus, LDCs, and national and international institutions to implement those activities described in Section V. B. on pages 41 through 47.

H. Relationship to Previous Activities in Aquaculture - This proposal for a new project to be implemented under a CA and BOA with AU/FAA/ICA grew out of the successful program developed under the previous activities and the continuing need in the LDCs for assistance to maintain, develop, support, and implement aquaculture research and development activities in the LDCs. The current project (Aquaculture Technology Development) is scheduled to terminate on December 31, 1987. A terminal evaluation will be scheduled for March 1988. This evaluation will assist the APM and PI to identify areas of emphasis within the scope of work (project outputs) defined on pages 20 through 24 of this project.

Previous support furnished AU/FAA/ICA primarily with the response capability to provide assistance and training upon request to missions, LDCs, and international, national, and regional organizations. Other activities included research and networking. A wealth of data on aquaculture, including aquatic ecology and fisheries management was collected, and disseminated to the developing countries. These data are readily available for use in the LDCs.

This new project "Aquaculture Research and Support" will be funded from three sources: 1) S&T/AGR, 2) AU/FAA/ICA, and 3) missions, regional bureaus and other AID/W offices. The S&T/AGR funding will give priority to research and technology transfer - the development and successful transfer of aquaculture technology from Auburn University to researchers and extension agents in a timely and acceptable manner using a systems approach of "transfer by simulation" who will take the information to the farmers' ponds; some training activities directly related to the transfer of information; and networking with other national and international organizations and institutions.

The S&T/AGR funded portion of the project will assist AU/FAA/ICA to expand its ongoing aquaculture program and adapt it to meet the needs of the LDCs. It will be funded under a cooperative agreement at a level of \$3,235,000, of which A&T/AGR will provide \$1,275,000 and AU/FAA/ICA \$1,960,000.

Other training will be funded primarily under the participant training program and delivery orders under the companion basic ordering agreement (BOA). Training under the latter category will be directly related to the research program. In addition, research and development assistance will be provided to missions upon request which will be funded primarily by delivery orders issued against the BOA. The BOA is planned at a level of \$3,565,000.

(See Tables 1, 2, and 3 on page 27 for additional information on the source of funding for the CA and BOA)

#### I. Women in Development

In the LDCs the division of labor on the basis of sex tends to vary from country to country and by ethnic group and local community. In general, however, women are primarily responsible for the production of food to be consumed by the family, while males are concerned with cash crops. Given these social patterns, especially in West Africa, fish is considered a cash crop and the family ponds are dug and maintained by the individual male farmer, sometimes assisted by kin.

However, there is no fundamental reason for women not to become actively involved in aquaculture activities. Fish farming offers great opportunities for LDC women to improve the nutritional level of their family diets and to obtain additional income from the sale of fish. This is especially true in those countries where the male is absent from the family farms for extended periods of time seeking employment elsewhere. Women can manage the fish ponds, including filling, stocking, feeding, and harvesting of fish. They can play a predominant role in the cottage industries associated with the manufacture of small scale fishing gear such as nets and lines and in the processing of fish. In certain LDCs the marketing of fish tends to be almost exclusively a profession of women.

AU/FAA/ICA supports activities which promote participation of women in aquacultural development. Emphasis is placed on assisting women to prepare for aquacultural positions in their home countries. AU/FAA/ICA has been working with the American Association of University Women to place LDC women at the University under scholarship programs. Another women concentrating on bacteria research wants to establish a private fish/crustacean disease center in her home country, Panama, to serve all of Latin America.

J. Environmental Considerations

This project is designed to increase the availability and utilization of high protein fish food and thus contribute to food security and reduce dependency on imported food. It will also improve the socio-economic position of the farmers, increasing income at the farm level and providing more employment for the farm families and others. It will support adaptive research, training, technology transfer and networking to strengthen human resources and institutional capacity to develop and implement economically efficient, socially acceptable and environmentally sound programs for increasing the production of fish.

The proposed activities of this project fall in the area described in AID's environmental procedure regulations, paragraph 216.2(c)(2)(iii) "Analyses, studies, academic or research workshops and meetings" which states that these classes of activities will not normally require an environmental examination under AID's regulations. The project itself only proposes an agrotechnology transfer mechanism and directly supportive activities. Under these guidelines, this activity clearly qualifies for a Negative Determination which was approved with the Project Identification Document. (Appendix E)

It is possible that an output of this project will be a set of practices, procedures, guidelines of research results which when used could require an environmental examination. If this happens, it will be the responsibility of AU to notify AID that an environmental examination is required prior to the implementation of the activities and to assure that appropriate U.S. Government procedures are followed.

VII. Factors Affecting Project Selection and Further Development

- A. Social Considerations - S&T/AGR does not anticipate major undesirable social consequence will result from the activities funded under this project. This assumption is based on experience gained over the past two decades. In most LDCs, as in the developed world, fish are accepted as a desirable food, high in nutritional value.

In many parts of the world fish ponds are part of the rural environment, and where they are not, the introduction of pond culture has been readily accepted in most cases. Furthermore, fish ponds generally are considered an attractive activity from the community viewpoint. The research, technology transfer, training and networking aspects of this project therefore pose no social problems.

1. Socio-economic Context - For hundreds of years, traditional fish farming has been a means of producing food intended for immediate consumption at the farm and village level. However, because of recent advances in technology, aquaculture has been identified as a potential growth sector for LDCs and thus is increasing rapidly in importance.

There are numerous reasons for the recent and rapid development of aquaculture in the last 40 years: a) fish and other aquatic animals remain the cheapest sources of animal protein; b) they are widely recommended for basic nutrition, preventive medicine, and recuperative diets; c) they have the highest feed conversion rates of the animal groups; and d) weight for weight, fish require fewer units of energy, demand less growth space, and have a higher productivity than any other domestic farm animals, including poultry.

Modern aquaculture practices are producing cash crop surpluses at the farm level and for sale in LDC villages and accessible urban areas. Some of these practices have been integrated with other agricultural activities; e.g., rice, livestock, and poultry. In recent years, through the attention of specific biological research carried out at such institutions as AU/FAA, production of high-value species has increased substantially and these species are now in demand from both the domestic and international markets. The latter has increased the foreign exchange earnings of the producing countries.

It should be noted that although a fish farmer operates an aquaculture project primarily with maximizing profit in mind, consciously or not, he also contributes to the socio-economic development of his community and the entire country. The demand for material inputs (backward linkages) and the supply of fish and fish products (forward linkages) by the aquaculture project trigger a chain of economic activities which enhances further growth in the economy.

The demand for material inputs like feeds, and fertilizers increases the income of local input producers who, in turn, demand more of food and commodities, thereby stimulating the generation of further employment and income. Coupled with this, the increased supply of fish into the local market increases economic activity by: 1) depressing fish prices to the benefit of the consuming public, 2) increasing foreign exchange reserves through exportation of fish to other countries; and 3) inducing savings in foreign exchange with the reduction of imported food.

In addition, taxes paid by the fish farmers also promotes socio-economic development with the construction of public goods like roads, buildings, and other public facilities and the provision of public services like subsidized education, health care, and other freely acquired forms of government assistance. As a labor-intensive operation, the aquaculture project helps alleviate unemployment and poverty in the community with the hiring of otherwise unemployed or underemployed workers thereby providing them a source of income and consequently improving their standard of living.

In retrospect, the pursuance of a privately funded aquaculture project serves both the private motive of profit generation and the higher social goal of socio-economic progress. Viewed in this context, privately funded aquaculture project are proven to be financially and socio-economically feasible with eventually benefit all sectors; the private fish farmers, the community, the aquaculture industry, and the national economy.

(See pages 3 through 8 for additional justification for supporting this project in aquaculture.)

2. Socio-cultural Feasibility - The socio-cultural factors that could detract from the project's effectiveness are limited, but important.
  - a. Development of adaptive technologies through research - Careful attention will be given to support research designed to meet the needs of the end-users, the LDC farmers. The research will be oriented toward developing economically viable and socially accepted technologies to increase fish production in the LDCs.

The results of assistance to aquaculture research and development are not always productive unless carefully monitored and directed. Emphasis has been on applied biotechnical research, and this must continue especially where the work is directed towards increasing production. However, there is also a need to undertake more broadly-based research, working on problems associated with economic analyses, marketing, social and cultural backgrounds of target groups, labor analyses, etc. For the most part these have been neglected by assistance projects, but will be considered under this project.

- b. Training programs at AU/FAA and in-country - The training and information activities will take into account the economic and social dimensions of the proposed new technologies. For example, training at AU and in-country will be designed to remove constraints which inhibit production in the LDCs.
  - c. Technical assistance - The role of technical assistance is to advise, guide, stimulate and assist decision makers, coordinators, extension workers, trainees, and/or farmers in the area of aquaculture, aquatic ecology, and fisheries management. Short-, medium- and long-term assistance will be provided at timely intervals to: a) identify and remove constraints inhibiting production; b) perform evaluations, assessments, and feasibility studies; and d) prepare training material and hold training programs at the graduate, postgraduate and technical levels at AU/FAA and in LDCs.
3. Socio-Anthropological - The above activities will involve interaction at all levels of society and therefore, it may be necessary at times to use anthropologists and/or social scientists funded primarily under delivery orders to work in selected missions. This is particularly true in the case of identifying constraints and recommending solutions where difficult social situations exist or where farmers are reluctant to change their farming practices to incorporate innovative ways to increase fish production.
  4. Beneficiaries - The beneficiaries of this international program in aquaculture will be:
    - a. Producers or farmers - The main targets of international assistance in aquaculture continue to be the producers, particularly the existing or potential 'small farmers' in the rural poor areas of world. The purpose is to increase the incomes (in cash or in kind) of such individuals. To the extent that the farmers produce more fish than can be consumed by their families, the excess will be sold at local markets bringing additional income.

- b. Consumers - Other intended beneficiaries of international assistance for aquaculture development within the public sector are the consumers, particularly among the rural poor. Fresh aquaculture products, especially the native freshwater and brackish water fish, continue to be a prime source of fresh animal protein for this main target group as fish are farmed and marketed within the village communities. The quantifiable evidence of this traditional market is difficult to confirm, especially because rural village markets are not organized and structured and no records are maintained of their volumes or values; also because there is considerable barter between farmers as well as auto-consumption and theft.

It is difficult to differentiate between farm produced and wild-caught fish. The main evidence of the nutritional benefits of aquaculture in rural areas is that fish farming is widely practiced and that there is production. Quantifying the nutritional benefits of aquaculture production among the rural poor remains a priority for assistance organizations to determine.

As new ponds are put into operation or existing ponds expanded to produce more fish, new employment opportunities will exist to manage the production facilities and process fish for consumption.

- c. Communities - benefit from expanded aquaculture production which provides more job opportunities for the local people. The recognition that aquaculture products, even among the communities of the rural poor, has to be marketed in some way has been largely neglected by the technical assistance projects to date. This is an area which needs specific attention to maximize the profits from fish farming.
- d. Governments - benefit by fulfilling their commitments in plans and policies to help the local farmers economically improve the nutritional levels and living conditions of the masses. In addition, by substituting domestic fish production for some portion of fish imports is another way some LDC government can benefit from freshwater aquaculture and thus save scarce foreign exchange. Decision aids developed by AU/ICA will be useful to governments in applying the extensive experience of AU/ICA to the decision making process for given localities. Both government and private sector investment decisions can be based upon the planned inputs from AU/ICA.

- B. Economic Consideration - The following types of economic considerations are relevant to this project: 1) whether investments to increase aquaculture production and marketing systems are economically justified; and 2) what are the alternative approaches.
1. Justification for Investment - This project impacts directly on A.I.D's Food and Agricultural Policy and Strategy by assisting LDCs to become self-reliant in high protein food, assure food security, contribute directly to broad-base economic growth, and make efficient use of natural resources. The importance of aquaculture as a distinct sector of the economy may be considered on these grounds:
    - a. Aquaculture as an Efficient User of Natural Resources - Many inland fish operations are carried out on lands unsuitable for crop and livestock production. The pond culture of fish can be implemented on salted lands, marsh lands, coastal flats, mangrove swamps and other marginal agricultural lands.  
  
Fish are grown with other crops such as rice, hogs, ducks, and livestock which increases the efficiency of the total farm system.
    - b. High Protein Foods are Produced that Contribute to Improved Nutrition and Income - Through aquacultural production there can be an increase in animal protein and farm income of rural families in LDCs without any major changes in land use patterns.
    - c. Fish as income for the farm families - The returns from fish production can be higher than from many other farm enterprises because the average cost of producing a unit of fish is low and the average market price high.
    - d. Turnaround time for aquaculture is much less than for livestock - The time lag for animal protein production from the project startup is only about four months for aquaculture versus two to three years for cattle.
    - e. Unemployment and underemployment can be reduced - By offering capture fishermen currently facing only sporadic seasonal fishing with the opportunity for year-round employment.
    - f. Returns on investment are generally much high than in alternative animal protein enterprises - Recent studies show that returns from aquaculture investments range from 8% to 50% whereas most livestock enterprises experience returns below 10%.
    - g. Initial capital requirements for aquaculture are lower than for most livestock enterprises - Because of the labor-intensive nature of aquaculture compared to the extensive land and feed production investments required in most livestock systems.

The project emphasis will be to develop, test and transfer economically viable and socially and culturally acceptable technologies that are institutionally feasible and aimed at increasing fish yields. The project's research agenda will provide information on these points and others in order to assist LDCs in the investment decision making process.

2. Alternative implementation strategies - The following alternative approaches were considered in selecting the implementation strategy and only the last one is considered to be appropriate for this project.

a. International institutions - The International Center for Living Aquatic Resources Management (ICLARM) and the FAO were considered, but rejected as they do not have the facilities and equipment to provide LDCs the services needed to develop and maintain economically efficient, socially acceptable and environmentally sound programs. They can not provide the necessary backstopping to support research, technical assistance, training, and networking. In addition, they do not have the facilities for research, nor can they provide cost-sharing financial assistance to the project.

Southeast Asian Fisheries Development Council (SEAFDEC) was considered, but rejected as it is working only on problems faced by that region and is not concerned with African and Latin American problems. In addition, it is facing both management and financial problems which could cause problems later on during the implementation of this project.

b. Private sector - The U.S. private sector was considered, but rejected as the private sector firms have little aquaculture experience in the humid tropics. Moreover, they do not have the sophisticated facilities and equipment required for research and training LDC participants, and are not in a position to cost share. We anticipate that AU/FAA/ICA will contribute \$1,960,000 or approximately 61 percent to the CA from its own resources.

c. Mission funding on an ad-hoc basis - Ad-hoc funding by missions was considered, but rejected as this would not accomplish the project objectives of developing an integrated, long-term approach to the problems and solutions of developing and improving aquaculture programs. The continuity and coordination of efforts which is needed to implement a successful aquaculture program would not exist, even in the short-term. Advanced planning would not be possible and the grantee/contractor could not provide the fast turn-around which will be possible under a CA and BOA with one institution.

In addition, the experience gained from mission-funded delivery orders under the companion BOA will be fed directly back into the research agenda, simulation models, and expert systems funded under the cooperative agreement. It is also intended that the occasion for mission funded activities shall arise from research financed under the cooperative agreement.

- d. One institution - The selection of one institution with existing facilities and experience is considered the most efficient and economical solution to providing the needed assistance to LDCs to establish and maintain efficient aquaculture production and marketing systems. AU/FAA/ICA has submitted a five-year proposal for aquaculture research and development in the LDCs and S&T/AGR and is recommending that AU/FAA/ICA be selected without competition as the implementing agent for this project. It is recognized worldwide as the major center for research and training in aquaculture. Its modern facilities are unequalled elsewhere for theoretical, practical, and operational training in fish production methodologies, fish diseases and pathology, genetics and breeding, hatchery management, nutrition, integrated production systems, water quality and hydrology, aquatic ecology, and fisheries management.

The staff at AU/ICA has extensive international experience dating back two decades. Networks and linkages have been established with scientists and experts and with U.S., LDC national, regional and international institutions and organizations involved in the husbandry of aquatic animals at densities greater than those found under natural conditions. No other institutions is comparatively qualified to effectively and economically implement this proposed project.

For additional information on the qualifications of Auburn University, please refer to pages 9 through 17.

- C. Relevant Experience with Similar Projects - This proposal grew out of the highly successful results realized under the previous projects funded with Auburn University by AID and its predecessor agencies and the continuing need for assistance in aquaculture in the LDCs.

- D. AID support required - This project will be managed by S&T/AGR in consultation, as required, with representatives from NOAA, the Joint Subcommittee on Aquaculture, the Management Review Group, regional bureaus, missions and other AID/W offices. The present AID staff and procedures are adequate for the successful management of this project. The project manager will maintain liaison with the grantee and communicate with the Principal Investigator (PI), as required. He/she will give prior approval before activities are undertaken. AU/FAA/ICA will prepare annual work plans and progress reports describing activities undertaken in the previous years and setting forth activities and objectives of the activities to be undertaken in the coming year.

The first work plan will be completed within 30 days after the CA is signed and will cover the period January 1, 1988 through December 31, 1988. The subsequent work plans will be due 60 days prior to the anniversary date of the CA. Progress reports will be required and will include not only the research, training, technology transfer and networking activities, but also the impact on the LDCs' fish farming industry.

Clearances:	GC	Stephen R. Tisa	<u>(draft)</u>	<u>10/13/87</u>
	SER/OP	Jay M. Bergman	<u>(draft)</u>	<u>10/6/87</u>

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R E F E R E N C E S

- 1977 Project Paper - Aquaculture Technology Development,  
Project No. 931-1314
- July 1984 NSF Evaluation - Aquaculture Technology Development,  
project No. 931-1314
- October 1986 AGR Evaluation - Aquaculture Technology Development,  
project No. 931-1314
- FY 1982 CRSP - Pond Dynamic/Aquaculture  
WFC/NF/84/2 FAO - News Feature  
January 1985 Journal - World Mariculture Society - Annual  
Meeting
- October 1985 Futurist - Article by Lester R. Brown, President,  
Worldwatch Institute
- 1985 JMOU - S&T - Joint Memorandum of Understanding  
with Auburn University and the  
University of Arkansas
- ADCP/REP/1986/23 FAO - Observations on International Technical  
Assistance to Aquaculture
- ADCP/REP/1986/24 FAO - Programme Advisory Note on  
International Technical Assistance to  
Aquaculture
- ADCP/REP/1986/25 FAO - Future Economic Outlook for Aquaculture  
and Related Assistance
- Feb. 1986 USDA - Economic Research Service (ERS). U.S.  
Demand for Food: Household  
Expenditures, Demographics, and  
Projections, Technical Bulletin No. 1713
- July 1987 USDA - Economic Research Service (ERS). Food  
Spending in American Households,  
1982-1984. Statistical Bulletin No. 753
- FY 1987 - 1991 S&T - Central Program Strategy Statement
- March 1987 Special - Infofish Marketing Digest Report  
FY 1988 AID - Congressional Presentation  
Various AU - Reports, publications, and documents  
published by AU/FAA/ICA
- March 1987 FAO - Article by Colin E. Nash, Programme  
Leader, Aquaculture Development and  
Coordination Programme

APPENDIX A  
LOGFRAME

# AQUACULTURE RESEARCH AND SUPPORT

PROJECT NUMBER 936-4180

Project Design Summary - Logical Framework

S&T/AGR: 10/31/87

**PROJECT DESIGN SUMMARY  
LOGICAL FRAMEWORK**

Appendix A  
Page 1 of 6

Life of Project:  
From FY 1988 to FY 1993  
Total U.S. Funding \$4,840,000  
Date Prepared: June 24, 1987  
Revised 9/1/87

Project Title & Number: Aquaculture Research and Support 936-4180

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p><b>Program or Sector Goal:</b> The broader objective to which this project contributes: To improve the quality of life of poor LDC residents, both economically and nutritionally through effective sustained use of natural resources.</p>	<p><b>Measures of Goal Achievement:</b></p> <ul style="list-style-type: none"> <li>- Increased supply of animal protein in selected target areas in LDCs.</li> <li>- Increased sustainable utilization of living aquatic resources.</li> <li>- Improved conservation techniques of living aquatic resources.</li> <li>- Expanded areas of aquaculture production.</li> <li>- LDC governments include aquaculture and fisheries in their agricultural planning activities.</li> </ul>	<p><b>MEANS OF VERIFICATION</b></p> <ul style="list-style-type: none"> <li>- Target area baseline and evaluation statistics on:                             <ul style="list-style-type: none"> <li>- Fish availability in the market place</li> <li>- Strategies for management of living aquatic resources</li> <li>- House-hold budget surveys.</li> <li>- Host country national planning documents</li> <li>- Fisheries production statistics</li> <li>- Extension service statistics</li> <li>- Cooperative agreement annual reports</li> </ul> </li> </ul>	<p><b>Assumptions for achieving goal targets:</b></p> <ul style="list-style-type: none"> <li>- AID and LDCs place high priority on promotion of fish and fish products.</li> <li>- Aquaculture is appropriate for social and economic conditions in selected areas.</li> <li>- Missions and LDCs contribute to success of project.</li> <li>- LDC fish farmers will use improved techniques recommended by ICA to increase fish production and utilization.</li> </ul>
<p><b>Object Purpose:</b> To assist LDCs improve their capabilities to:</p> <ol style="list-style-type: none"> <li>1) Increase income and employment in the fisheries sector.</li> <li>2) Improve management strategies to conserve national resources and optimize sustained yields.</li> <li>3) Improve fish distribution and marketing systems.</li> </ol>	<p><b>Conditions that will indicate purpose has been</b></p> <ol style="list-style-type: none"> <li>1) - Farm employment and income will increase in the fisheries sector providing low-income households with the resources to purchase available food.</li> <li>2) - Sound nutritional and food consumption principles will be incorporated into the design and implementation of aquaculture development activities</li> <li>3) - More high quality animal protein will be available in the market place.                             <ul style="list-style-type: none"> <li>- Private agricultural marketing and distribution systems will be promoted.</li> <li>- Market-oriented, efficient, low-cost production of small family fish farms will be encouraged on a sustainable basis.</li> </ul> </li> </ol>	<p>1), 2), and 3)</p> <ul style="list-style-type: none"> <li>- Comparison of post-project evaluation with baseline statistics.</li> <li>- In depth and impact evaluations</li> <li>- Trip reports</li> <li>- On-site visits and reports</li> <li>- LDC statistics and reports</li> <li>- Market reports</li> <li>- FAO reports</li> <li>- Annual and other progress reports prepared by ICA under the CA and BOA</li> <li>- Specific projects reports covering foreign exchange earnings</li> </ul>	<p><b>Assumptions for achieving purpose:</b> 1), 2), 3)</p> <ul style="list-style-type: none"> <li>- Marketing systems, developed by AU will be used by LDCs.</li> <li>- LDCs commit adequate resources to aquaculture on a continuing basis.</li> <li>- Other donor agencies provide critical technical assistance on a timely basis.</li> <li>- Adequate LDC personnel and scientists are available to serve the project.</li> <li>- LDC fishermen will use modern techniques developed by AU/ICA for fish farming.</li> <li>- Missions and LDCs will finance LDC scientists and experts at AU/ICA for degree, non-degree and technical training.</li> <li>- Missions and LDCs will sponsor training programs in national and regional institutions.</li> </ul>

64

LOGICAL FRAMEWORK

Appendix A  
Page 2 of 6

From FY 1988 to FY 1993  
Total US Funding \$4,480,000  
Date Prepared June 24, 1987

Project Title & Number: Aquaculture Research and Support 936-4180

Revised: 9/1/87

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p><u>Applied and Developmental Research</u></p> <p><u>1. Aquaculture</u></p> <p>a. <u>Fish diseases and pathology</u> - Improved rapid and accurate disease diagnosis for improved fish health</p> <p>b. <u>Genetics and breeding</u> - Improved techniques for hatchery production of catfish and tilapia</p> <p>c. <u>Hatchery Management</u> - Improved hatchery management techniques on selection and care of brood animals, on spawning methodology, on hatching, and on culture of early life history stages of fish, crustaceans and molluscs.</p> <p>d. <u>Nutrition</u> - Improved methods for determining nutritional requirements, feed formulations, nutrient deficiency signs, feeding practices, and dietary toxicity signs.</p> <p>e. <u>Processing and quality assurance</u> - Improved methods for quality control in marketed products, and uses for byproducts.</p> <p>f. <u>Production Systems</u> - Improved information systems or "packages" on farm management, production, harvesting and marketing</p> <p>g. <u>Water Quality and Hydrology</u> - Improved information and recommendations related to water quality used in aquacultural operations</p> <p>2. <u>Aquatic Ecology</u> - Improved management of aquatic ecosystems to protect natural resources from degradation</p> <p>3. <u>Fisheries Management</u> - Improved methods to optimize yields and preserve resources for future generations.</p> <p>The research results will be included in the decision support system to assist users to solve specific problems or make the appropriate</p>	<p><u>1. Aquaculture</u></p> <p>a. At least four methods adapted for LDC environments and used in at least two LDCs</p> <p>b. At least five methods adapted for LDC environments and used in at least three LDCs,</p> <p>c. At least two methods adapted for LDC environments and used in at least one LDC.</p> <p>d. At least two method adapted for LDC environments and used in at least one LDC.</p> <p>e. At least one method developed and used in at least one LDC.</p> <p>f. At least two systems adapted for LDC scientists use and distributed to at least two countries in each region.</p> <p>g. At least two information systems adapted for LDC use and distributed to two countries in each region.</p> <p>2. At least three methods developed, adapted, and used at at least two LDCs</p> <p>3. At least two methods adapted for LDC environments and used in at two LDCs.</p>	<p>1), 2), 3)</p> <p>- Research reports and publications</p> <p>- AU/ICA's technical and research publications and reports</p> <p>- Annual progress and activity reports</p> <p>- Trip reports</p> <p>- Site visits</p> <p>- Mission and LDC reports</p> <p>- In depth and impact evaluations.</p>	<p><u>Assumptions for achieving outputs 1), 2), 3)</u></p> <p>- Missions and LDCs will fund research in LDCs</p> <p>- Fish farmers will use innovative and improved techniques developed by AU/ DFAA/ICA</p> <p>- Missions and LDCs will utilize their facilities and equipment to collaborate with AU on the promotion of improved fish production methods</p>

LOGICAL FRAMEWORK

Project Title & Number: Aquaculture Research and Support 936-4180

Appendix A  
Page 3 of 6

From FY 1988 to FY 1993  
Total U.S. Funding \$4,840,000  
Date Prepared: June 23, 1987

Revised 9/1/87

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p><u>Output</u> <u>Technology Transfer</u> <u>1. Problem Solving</u> Short, medium, and long-term assistance for project design, assessment, feasibility studies and evaluations in areas of:</p> <p>a. Aquaculture, including</p> <ul style="list-style-type: none"> <li>- Diseases and pathology</li> <li>- Genetics and breeding</li> <li>- Hatchery management</li> <li>- Nutrition</li> <li>- Processing and quality assurance</li> <li>- Production systems</li> <li>- Water quality and hydrology</li> </ul> <p>b. Aquatic Ecology, including</p> <ul style="list-style-type: none"> <li>- Ecological Services</li> <li>- Ichthyology</li> <li>- Reservoir studies</li> <li>- Stream studies</li> </ul> <p>c. Fisheries Management, including</p> <ul style="list-style-type: none"> <li>- Reservoir and river fisheries</li> <li>- Farm pond fisheries</li> </ul> <p><u>2. Transfer of Information</u></p> <ul style="list-style-type: none"> <li>- Library and informational services maintained covering aquaculture, aquatic ecology, and fisheries management.</li> <li>- Services to LDCs to maintain informational services</li> <li>- AU/ICA publications and research findings disseminated to LDCs, national, and international institutions.</li> <li>- Training manuals and audiovisual cassetts for training.</li> </ul> <p>(Also see outputs under the training section)</p>	<p><u>Magnitude of Outputs:</u></p> <p>1. Short, medium, and long-term assistance provided in response to over 100 requests</p> <p>Decision aids (simulation Models) will be developed, and tested in at least 3 countries, one in each region.</p> <p>2. - Main library in the Sciences and Technology Section and the College of Veterinary Medicine Library will continue to provide research and teaching materials AU/ICA.</p> <ul style="list-style-type: none"> <li>- Assistance and information provided upon requests</li> <li>- At least 1,000 publications/research findings, and reprints prepared and distributed annually</li> <li>- ICA Communique prepared, printed, and mailed to 500 LDC scientists, extension workers, and others quarterly.</li> <li>- At least 3 manuals developed and used in 15 LDCs.</li> <li>- At least one cassette prepared and demonstrated in at least 2 countries annually.</li> </ul>	<p>1 and 2</p> <ul style="list-style-type: none"> <li>- Reports from AU/ICA</li> <li>- Site Visits</li> <li>- Mission reports</li> <li>- Trip reports</li> <li>- Impact and in depth evaluations</li> <li>- Expanded awareness of fishery problems and access to solutions</li> <li>- Communications with knowledgeable fishery international and national scientists and institutions.</li> </ul>	<p><u>Assumptions for achieving outputs 1. and 2.</u></p> <ul style="list-style-type: none"> <li>- Missions, LDCs, and other donors will request assistance and provide the necessary funding.</li> <li>- Technologies developed by AU/DFAA/ICA can be adapted to LDC environments.</li> <li>- LDC fish farmers can use these techniques to improve production and</li> <li>- Expanded awareness of constraints facing the fish farmers, will result in the increased use of improved, effective, and economical methods</li> </ul>

LOGICAL FRAMEWORK

Appendix A  
Page 4 of 6

From FY 1988 to FY 1993  
Total U.S. Funding \$4,840,000  
Date Prepared: June 23, 1987  
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Project Title & Number: Aquaculture Research and Support 936-4180

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p><b>Training</b></p> <ol style="list-style-type: none"> <li>Long-term training at the undergraduate and graduate degree levels for LDC scientists                     <ul style="list-style-type: none"> <li>Bachelor of Science</li> <li>Master of Aquaculture</li> <li>Master of Science</li> <li>Doctor of Philosophy</li> </ul>                     Subject matter include:                     <ul style="list-style-type: none"> <li>Classical fishery biology</li> <li>Stream, Pond and Lake Management</li> <li>Water Quality</li> <li>Aquatic ecology</li> <li>Fish pathology</li> <li>Fish Processing</li> <li>Aquatic Agronomy and fish farming</li> <li>Ichthyology</li> <li>Fishpond engineering</li> </ul> </li> <li>Non-degree and short-term training at AU/ICA and in LDCs. Possible subject areas are:                     <ul style="list-style-type: none"> <li>Aquaculture</li> <li>aquatic ecology</li> <li>fisheries management</li> <li>Pond construction and management</li> <li>Nutrition</li> </ul> </li> <li>Comprehensive training manuals are produced for LDC use.</li> <li>Prepare audio/visual cassettes for training in LDCs</li> <li>Seminars and workshops</li> <li>Computer programming capability to model complex system</li> </ol>	<p><i>Magnitude of Outputs</i></p> <ol style="list-style-type: none"> <li>At least 20 LDC graduate and undergraduate scientists will study at AU/DFAA/ICA annually</li> <li>-At least four training courses held at AU/ICA -At least two training courses will be given annually in at least two LDCs during LOP</li> <li>-Three manuals developed and used in at least 15 LDCs</li> <li>-At least one cassette will be prepared and demonstrated in 2 countries annually</li> <li>-Two workshops held at AU/ICA -Workshops held in 5 LDCs for LOP</li> <li>At least 10 LDC technicians trained in modelling systems for fisheries</li> </ol>	<ol style="list-style-type: none"> <li>Copies of training courses and reports from AU/ DFAA/ICA and copies of the transcripts</li> <li>-Copies of in-service and on-the-job reports. -Evaluations -Trip Reports -Mission reports</li> <li>-Copies of training manuals, and reports from missions on the use of the manuals</li> <li>Copies of cassettes and training reports</li> <li>Reports and evaluations</li> <li>-AU/ICA reports -Site visits</li> </ol>	<p><i>Assumptions for achieving purpose</i></p> <ol style="list-style-type: none"> <li>1., 2., 3., 4., and 5.</li> <li>Missions and LDCs will sponsor and fund training costs, as required.</li> <li>AU/ DFAA will provide training opportunities for LDC scientists</li> <li>LDCs, IARCs, and missions will provide facilities and the needed resources for in-country training activities.</li> </ol>

LOGICAL FRAMEWORK

Appendix A  
Page 5 of 6

From FY 1988 to FY 1993  
Total US Funding \$4,840,000  
Date Prepared June 23, 1987

Project Title & Number Aquaculture Research and Support 936-4180

Revised 4/1/87

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
<p><i>Output</i></p> <p><b>Networking and Linkages</b></p> <ol style="list-style-type: none"> <li>Existing networks and linkages will continue and new contacts will be made with international, national, and regional centers and institutions.</li> <li>Conferences and international workshops will be held on aquaculture</li> <li>The International Aquacultural Network computerized telex and satellite system will continue to expand its data base.</li> <li>Publications and scientific journal articles will be produced, selectively collected and disseminated to LDCs and international and national organizations.</li> </ol>	<p><i>Magnitude of Output</i></p> <ol style="list-style-type: none"> <li>Collaboration with institutions in the U.S., other developed countries, national, and international and in LDCs will continue with new members being added.</li> <li>One conference or international study group will be held annually.</li> <li>One computerized system</li> <li>1,000 publications and journal articles will be produced, collected and disseminated annually.</li> </ol>	<p>1., 2., 3., and 4.</p> <ul style="list-style-type: none"> <li>Reports from AU/ICA and national and international institutions</li> <li>Reports from institutions and governments from the developed world</li> <li>Minutes of formal meetings, conferences, and seminars.</li> <li>Copies of reports generated from the formal meetings, conferences, and seminars.</li> <li>Attendance at meetings, conferences, and seminars.</li> <li>Visits to AU/ICA</li> </ul>	<p><i>Assumptions for achieving outputs</i></p> <p>1, 2, 3, and 4.</p> <ul style="list-style-type: none"> <li>Interest and support from members of IAN will continue.</li> <li>Members of IAN will sponsor, fund and attend meetings, conferences and seminars.</li> <li>Members of IAN will provide current data on aquaculture which can be included in the data base.</li> <li>Members of IAN will maintain their satellite communication equipment in excellent working conditions.</li> </ul>

10

PROJECT DESIGN SUMMARY  
LOGICAL FRAMEWORK

Appendix A  
Page 6 of 6

Life of project:  
From FY 1988 to FY 1993  
Total U. S. Funding \$4,840,000  
Date Prepared: June 23, 1987

Project Title: Aquaculture Research and Support - 926-4180

Revised 9/1/87

NARRATIVE SUMMARY		OBJECTIVELY VERIFIABLE INDICATORS				MEANS OF VERIFICATION		IMPORTANT ASSUMPTIONS																																																																																														
Inputs:		Implementation Target (Type and Quantity)																																																																																																				
<p>Table 1 - Inputs by Project Components - Five-Year Budget (In thousands)</p> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="4">A.I.D.</th> <th rowspan="2">Grand Total</th> </tr> <tr> <th>S&amp;T/AGR</th> <th>Missions</th> <th>Total AID</th> <th>AU/DFAA/ICA</th> </tr> <tr> <th></th> <th>Amount</th> <th>Amount</th> <th>Amount</th> <th>Amount</th> <th>Amount</th> </tr> </thead> <tbody> <tr> <td>Basic &amp; Adapted Research</td> <td>50</td> <td>\$ 638</td> <td>15</td> <td>\$ 535</td> <td>24</td> <td>\$1,173</td> <td>60</td> <td>\$1,766</td> <td>34</td> <td>\$2,349</td> </tr> <tr> <td>Technical Transfer</td> <td>15</td> <td>191</td> <td>50</td> <td>1,782</td> <td>41</td> <td>1,973</td> <td>10</td> <td>196</td> <td>32</td> <td>2,169</td> </tr> <tr> <td>Training</td> <td>20</td> <td>255</td> <td>20</td> <td>713</td> <td>20</td> <td>968</td> <td>20</td> <td>392</td> <td>20</td> <td>1,360</td> </tr> <tr> <td>Networking &amp; Linkages</td> <td>15</td> <td>191</td> <td>15</td> <td>535</td> <td>15</td> <td>726</td> <td>10</td> <td>196</td> <td>14</td> <td>922</td> </tr> <tr> <td>Total - Project Components</td> <td>100</td> <td>\$1,275</td> <td>100</td> <td>\$3,565</td> <td>100</td> <td>\$4,840</td> <td>100</td> <td>\$1,960</td> <td>100</td> <td>\$6,800</td> </tr> </tbody> </table>											A.I.D.				Grand Total	S&T/AGR	Missions	Total AID	AU/DFAA/ICA		Amount	Amount	Amount	Amount	Amount	Basic & Adapted Research	50	\$ 638	15	\$ 535	24	\$1,173	60	\$1,766	34	\$2,349	Technical Transfer	15	191	50	1,782	41	1,973	10	196	32	2,169	Training	20	255	20	713	20	968	20	392	20	1,360	Networking & Linkages	15	191	15	535	15	726	10	196	14	922	Total - Project Components	100	\$1,275	100	\$3,565	100	\$4,840	100	\$1,960	100	\$6,800																						
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<p>Means of Verification:</p> <ul style="list-style-type: none"> <li>- Project Management Information System</li> <li>- Project Records</li> <li>- Mission Records</li> <li>- Project Evaluations</li> <li>- Project Audits</li> <li>- AU/DFAA/ICA Vouchers</li> </ul>																																																																																																						
<p>Important Assumptions:</p> <ul style="list-style-type: none"> <li>- Assumptions for providing inputs:</li> <li>- S&amp;T/AGR's budget will not be reduced</li> <li>- Missions will fund special orders under the BOA.</li> <li>- AU/DFAA will contribute the needed resources from the University's budget.</li> <li>- Networking and technology transfer mechanisms are in place.</li> <li>- LDC institutions will contribute staff and facilities for the successful completion of activities in LDCs.</li> </ul>																																																																																																						

APPENDIX B  
FIVE-YEAR BUDGET

**AQUACULTURE RESEARCH AND SUPPORT**

**Project Number 936-4180**

**Proposed Line-Item Budget**

**for**

**Five-years and First year**

**S&T/AGR:10/31/87**

Aquaculture Research and Support  
Proposed Five-Year Budget - January 1, 1988 - December 31, 1992  
(In thousands)  
Summary

Line Items	January 1, 1988 - December 31, 1992				
	Total AID			AU/DFAA	
	S&T/AGR	Missions	Total	ICA	Total
<u>Salaries and Wages</u>					
Director, AU/DFAA/ICA	\$	\$	\$	\$	\$
Research Assoc. DFAA/ICA Center Assoc. Graduate Students					
<u>Total Experts &amp; Scientists</u>	\$ 570	\$ -	\$ 570	\$1,000	\$1,570
Support Staff	100	-	100	50	150
<u>Total Salaries</u>	\$ 670	\$ -	\$ 670	\$1,050	\$1,720
<u>Benefits - (25%)</u>	165	-	165	265	430
<u>Total Salaries &amp; Benefits</u>	\$ 835	-	\$ 835	\$1,315	\$2,150
<u>Consultants</u>	\$ -	\$1,800	\$1,800	\$ -	\$1,800
<u>Operating Expenses</u>					
Office Supplies, Materials & Equipment	15	30	45	15	60
Printing & other Office Expenses	15	30	45	10	55
Library Material				50	50
<u>Total Operating Expenses</u>	\$ 30	\$ 60	\$ 90	\$ 75	\$ 165
<u>Travel</u>					
Domestic	\$ 15	\$ -	\$ 15	\$ 10	\$ 25
International	35	705	740	10	750
<u>Total Travel</u>	\$ 50	\$ 705	\$ 755	\$ 20	\$ 775
<u>Total Line Item Costs</u>	\$ 915	\$2,565	\$3,480	\$1,410	\$4,890
<u>Indirect Cost - (39%)</u>	\$ 360	\$1,000	\$1,360	\$ 550	\$1,910
<u>Grand Total</u>	\$1,275	\$3,565	\$4,840	\$1,960	\$6,800

Aquaculture Research and Support  
Proposed First Year Budget - January 1, 1988 - December 31, 1988  
(In thousands)  
Summary

Line Items	January 1, 1988 - December 31, 1988				
	Total AID			AU/DFAA	
	S&T/AGR	Missions	Total	ICA	Total
Director, AU/DFAA/ICA	\$	\$	\$	\$	\$
Research Assoc.					
DFAA/ICA Center Assoc.					
Graduate Students					
<u>Total Experts &amp; Scientists</u>	\$ 114	\$ --	\$ 114	\$ 200	\$ 314
Support Staff	20	-	20	10	30
<u>Total Salaries</u>	\$ 134	\$ --	\$ 134	\$ 210	\$ 344
<u>Benefits - (25%)</u>	33	-	33	53	86
<u>Total Salaries &amp; Benefits</u>	\$ 167	--	\$ 167	\$ 263	\$ 430
<u>Consultants</u>	\$ -	\$ 360	\$ 360	\$ -	\$ 360
<u>Operating Expenses</u>					
Office Supplies,					
Materials & Equipment	3	6	9	3	12
Printing & other					
Office Expenses	3	6	9	2	11
Library				10	10
<u>Total Operating Expenses</u>	\$ 6	\$ 12	\$ 18	\$ 15	\$ 33
<u>Travel</u>					
Domestic	\$ 3	\$ -	\$ 3	\$ 2	\$ 5
International	7	141	148	2	150
<u>Total Travel</u>	\$ 10	\$ 141	\$ 151	\$ 4	\$ 155
<u>Total Line Item Costs</u>	\$ 183	\$ 513	\$ 696	\$ 282	\$ 978
<u>Indirect Costs - (39%)</u>	\$ 72	\$ 200	\$ 272	\$ 110	\$ 382
<u>Grand Total</u>	\$ 255	\$ 713	\$ 968	\$ 392	\$ 1,360

**Appendix C  
Mission Responses**

**AQUACULTURE RESEARCH AND SUPPORT**

**Project Number 936-4180**

**Mission Responses to Cable Request for Information**

**Summary and Individual Cables**

**S&T/AGR:1C/31/87**

Aquaculture Research and Support  
Project No. 936-4180

Summary of Mission Responses

<u>Region and Country</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>
<u>Africa</u>			
Guinea-Bissau	-	Yes	-
Niger	-	Yes	-
REDSO/WCA	Yes	-	-
Rwanda	Yes	-	-
Sierra Leone	Yes	-	-
Swaziland	-	-	-
Togo	Yes	-	No
Zaire	Yes	-	-
<u>Asia and Near East</u>			
Bangladesh	Yes	-	-
Egypt	Yes	-	-
India	-	-	-
Jordan	Yes	-	No
Sri Lanka	-	-	-
Tunisia	-	-	No
<u>Latin America and the Caribbean</u>			
Dominican Republic	-	-	No
El Salvador	Yes	-	-
Guatemala	Yes	-	-
Panama	-	Yes	-
<u>Total number of cables received</u>	10	3	5

Aquaculture Research and Support  
Project Number 936-4180

<u>Region and Country</u>	<u>Prior Activity</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>	<u>Comments</u>
Africa Guinea-Bissau	Yes, Training workshops for PVOs		Yes		Pleased that ICA being continued. COGB placed great importance on fisheries sector. If program develops, Mission will request ICA's assistance.
Niger	Yes, Fisheries Mgt. in Niger River in collaboration with Peace Corps, FAO and Fisheries Department		Yes		Does not anticipate needing services in near future, but can attest to ICA's professional capabilities.
REDSO/WCA	Yes, Dr. Duncan visited Cote D'Ivoire	Yes			Requested info on assistance to non-AID countries U.S. firm plans to import American Channel Catfish into country.
Rwanda	Yes, technical assistance and training in support of bilateral fish culture development	Yes			Fish Culture is major activity in Marais where farming systems improvement project will be implemented. AU/ICA has provided excellent TA in the past.
Sierra Leone	Yes, training and tech. assistance to PVOs	Yes			Interested in utilizing ICAS's services for possible improvements in fisheries and aquaculture development.
Swaziland	None			No	Expect ICLARM to provide short to medium-term requirements.

WANG:1591C:MMozynski:6/1/87:Revised 6/25/87:9/01/87

Aquaculture Research and Support  
Project Number 936-4180

<u>Region and Country</u>	<u>Prior Activity</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>	<u>Comments</u>
<u>Africa (continued)</u>					
Togo	Yes, technical assistance and training	Yes			Designing an Agr. Sector Strengthening Grant for improving private and public rural institutions to achieve greater productivity & increase revenues. Small-scale inland fish-culture is being used to increase profit and food supply.
Zaire	Yes, technical assistance and training	Yes			Mission very pleased with ICA. Will need short-term extension scientists for new project involving AID, Peace Corps and GOZ. Additional short term assistance may be required for evaluations and specific extension problems, e.g., dominant role of males in fish farming.

WANG:1591C:MMozynsk1:6/1/87:Revised 6/25/87:9/01/87

Aquaculture Research and Support  
Project Number 936-4180

<u>Region and Country</u>	<u>Prior Activity</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>	<u>Comments</u>
<u>Asia and Near East</u>					
Bangladesh	Yes, ICA has kept USAID informed of fisheries activities in Region and provided technical assistance to PVOs	Yes			Mission will provide the fisheries sector with training (in-country and Abroad), TA, and assurance of recurrent cost funding. Major activities during next phase will be integration of fisheries testing through research on farming systems sites and strengthening on-station fisheries research.
Egypt	Yes, technical assistance and training	Yes			Mission has invested Approximately \$24 million in facilities, equipment and training at the National Aquaculture Center in Abassa which is scheduled to expire 8/31/87. Mission requests Richard Neal to assist in designing continuation of project. Results of Neal's proposal will provide clearer indication of future needs.
India	Yes, technical assistance and training			No	No program or projects involving aquaculture.
Jordan	Yes, technical assistance	Yes			Interested in TA for developing: 1) fresh and brackish water aquaculture through cooperatives and private sector entrepreneurs; and 2) raising fish in settlement ponds for livestock feed industry.

Aquaculture Research and Support  
Project Number 936-4180

<u>Region and Country</u>	<u>Prior Activity</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>	<u>Comments</u>
<u>Asia and Near East (Continued)</u>					
Sri Lanka	Yes, technical assistance			No	Mission aware of distinguished record of ICA in providing leadership in promoting aquaculture in LDCs and the strong capability to support Missions. However, aquaculture not identified in Mission's CDSS and therefore, it is anticipated that no assistance will be required.
Tunisia	Yes, Training			No	Mission has no plans to participate in the cooperative agreement.

WANG:1591C:MMozynski:6/1/87:Revised 6/25/87:9/01/87

Aquaculture Research and Support  
Project Number 936-4180

<u>Region and Country</u>	<u>Prior Activity</u>	<u>Positive</u>	<u>Possible</u>	<u>Negative</u>	<u>Comments</u>
<u>Latin America and the Caribbean</u>					
Dominican Republic	None			No	Mission realizes the importance of both marine and fresh water fisheries for LDCs. However, Mission has not identified nor planned for any involvement in the fisheries sector for at least the next two years.
El Salvador	Yes, Recent involvement RFP for Aqua. Sector Assessment	Yes			Need TA in Management of existing and the design of new projects.
Guatemala	Yes, fisheries & aquaculture sub-sector review. ICA was thorough and professional	Yes			S&T/AGR should continue AU/ICA's activities. Current activities limited to CARE's integrated aquaculture/animal extension. Foresee using ICA for technology transfer and training.
Panama	Yes, involved in 2 projs.		Yes		Auburn participated in two projects; managed fish production and Pond Dynamics CRSP. Focus shifted from tilapia to cultured shrimp because of greater economic potential. Anticipate very little need for TA other than through CRSP.

**Appendix D  
Aquaculture Network**

**AQUACULTURE RESEARCH AND SUPPORT**

**Project Number 936-4180**

**Institutions in the Aquaculture Network**

**S&T/AGR:10/31/87**

Aquaculture Research and Support  
936-4180

International Network - Partial Listing of Institutions

International Institutions

ADAB	Australian Development Assistance Bureau
CARE	Cooperative for American Relief Everywhere
CLUSA	Cooperative League of the U.S.A.
FAO	Food and Agriculture Organization of the United Nations
FAO/ADCP	Food and Agriculture Organization of the United Nations, Aquaculture Development and Coordination Programme
IBRD	International Bank of Reconstruction and Development
ICLARM	International Center for Living Aquatic Resources Management
IDRC	International Development Research Center, Canada
LWR	Lutheran World Relief
RF	Rochefeller Foundation
SECID/CWID	South East Center for International Development, Center for Women in Development
UNDP	United Nations Development Program

National Institutions

BARD	Bi-National Agricultural Research Development Fund, Israel
CIFAD	Consortium for International Fisheries and Aquaculture Development
CLSU	Central Luzon State University, Nueva Eciza, Philippines
ESPOL	Escuela Superior Politecnica Del Litoral, Ecuador
ICAR	Central Institute of Freshwater Aquaculture, Bhubaneswar, India
IIP	Instituto de Pesca, Mexico City, Mexico
IPB	Institute Pertanian, Bogor, Indonesia
KISR	Kiwait Institute for Scientific Research, Kiwait City, Kiwait
KU	Kassetart University, College of Fisheries, Thailand
MNRH	Ministry of Natural Resources, Honduras
NACA	National Aquaculture Center, Abassa, Egypt
NDA	National Directorate of Aquaculture, Panama
NSFH	Nong Sua Fish Hatchery, Thailand
NIFI	National Island Fisheries Institute, Thailand
NUR	National University of Rwanda
RU	Riau University, Pakkanbaru, Sumatra, Indonesia
SFC	Shanghai Fisheries College, Shanghai, China
UASCF	University of Agricultural Sciences, College of Fisheries, Bangalore, India

67

International Network - Partial Listing of Institutions

National Institutions

UH	University of Honduras
UPCF	University of the Philippines College of Fisheries, Manila, Philippines
UPV	University of Philippines in the Visayas
UDSCDG	Universidad De San Carlos De Guatemala
ZZBIPRIP	Zavod ZA Biologiju I Patologiju Riba I Pcela Veterinarski Fakultet Sveucilista U Zagrebu, Zagreb, Yugoslavia
ZEAP	Zamorano Escuela Agricola Panamericana, Tegucigalpa, Honduras

Regional Institutions

INFOPACHE	FAO Regional Fish Marketing and Advisory Service for Africa - Located in Ivory Coast
INFOPESCA	FAO Regional Fish Marketing Service - Located in Latin America
INFOFISH	FAO Regional Program for Asia/Pacific Region for providing services during Post Harvest Periods

U.S. Institutions

AU/DFAA/ICA	Auburn University, Department of Fisheries and Allied Aquaculture, International Center for Aquaculture
ICA/A	International Center for Aquaculture, Auburn University
MSU	Michigan State University
NAS	National Academy of Sciences
NJMC	New Jersey Marine Consortium
OI	Oceanic Institute, Hawaii
OSU	Oregon State University
UAPB	University of Arkansas. Pine Bluff
UCD	University of California, Davis
UF	University of Florida
UH	University of Hawaii
UK	University of Kentucky
UM	University of Michigan
URI	University of Rhode Island
WCU	Western Carolina University

International Network - Partial Listing of Institutions (continued)

U.S. Government

AID

Agency for International Development

JSA

Joint Subcommittee on Aquaculture established within the Office of Science and Technology Policy. Members include:

The Secretary of the Department of Agriculture

The Secretary of the Department of Commerce

The Secretary of the Department of the Interior

The Secretary of the Department of Health and Human Services

The Administrator of the Agency for International Development

The Chief of the Corps of Engineers

The Secretary of the Department of Energy

The Administrator of the Environmental Protection Agency

The Governor of the Farm Credit Administration

The Director of the National Science Foundation

The Administrator of the Small Business Administration

The Chairman of the Tennessee Valley Authority

NOAA

National Oceanic and Atmospheric Administration

PC/OPATS

Peace Corps, Office of Program and Training Support

**Appendix E  
Environmental Determination**

**AQUACULTURE RESEARCH AND SUPPORT**

**Project Number 936-4180**

**Environmental Threshold Determination**

**S&T/AGR:10/13/87**

MEMORANDUM

TO: : S&T/PA, Duane Acker  
FROM: : S&T/AGR, David B. Bathrick  
SUBJECT: : Environmental Threshold Determination  
REFERENCE: : Aquaculture Research and Support

On the basis of the Initial Environmental Examination (IEE) attached, I recommend that you make the following Environmental Threshold Determination:

1. The proposed Agency action is not a major Federal action which will have a significant effect on the human environment.
2. The proposed Agency action is a major Federal action which will have a significant effect on the human environment, and:
- a. An Environmental Assessment is required;
  - b. An Environmental Impact Statement is required.
- The cost of and schedule for this requirement are fully described in the referenced document.
3. Our environmental Examination is not complete. We will submit the analysis no later than \_\_\_\_\_ with our recommendation for an environmental threshold decision.

Approved: Richard Neal 10-7-87

Disapproved: \_\_\_\_\_

Date: \_\_\_\_\_

Clearance:

Environmental Officer Conditallin Date 9/1/87

S&T/AGR, Richard Neal R. Neal Date 9/1/87

**Aquaculture Research and Support**

**Initial Environmental Examination**

Project Location : Worldwide

Project Title : Aquaculture Research and Support

Project Number : 936-4180

Life of Project : Five Years

IEE Prepared By : Mary E. Mozynski

Date : September 1, 1987

Action Recommended : Negative Determination

Concurrence:

 10-7-87  
S&T/PA, Dr. Duane Acker

Date: \_\_\_\_\_

Aquaculture Research and Support  
Project Number 936-4180

Initial Environment Examination

The project is designed to assist LDCs improve their capabilities to: 1) increase income and employment in the fisheries sector; 2) improve management strategies to conserve national resources and optimize sustained yields; and 3) improve distribution and marketing systems of fish. It will fund only research, technology transfer, training, and networking which will have little or no direct effect on the physical and natural environment as defined under Environmental procedures 22, CFR Section 216.2 (c) (1), (2) (i), (ii), (iii), (v), and (xiv) - "Analyses, Studies, Academic or Investigative Research, Workshops and Meetings". Under these environmental guidelines, the activities under this project clearly qualify for a negative determination and normally will not require the filing of an Environmental Impact Statement or the preparation of an Environmental Assessment. It is possible that the outputs of this project will be a set of procedures, guidelines or research results which, when used, could require such assessment. If that occurs, Auburn University will assure that appropriate U.S. Government procedures are followed.

A. Land Use

Aquaculture has few negative effects on land use. In fact, aquaculture can have a positive effect on the land by:

1. Making efficient use of natural resources as aquaculture can be carried out on lands unsuitable for crop and livestock production. Pond culture of fish can be implemented on coastal flats, mangroves, swamps and salted, marsh, and other marginal agricultural lands.
2. Using the excess water stored for aquaculture can be used for irrigation, help raise the water table of the immediate area, and reduce the water runoff in highly eroded areas.
3. Raising Livestock beside the ponds and using the waste for fertilizing the fish pond.
4. Increasing the income of farm families. Farmers can obtain more profit from raising fish as the average cost of producing a unit of fish is lower than other agricultural products and the average market price higher.

B. Water Quality

Aquaculture results in increasing the nutrient level of the water in the ponds. When ponds are drained into receiving streams or rivers, the nutrient is rapidly diluted with little or no effect on the environment.

No chemicals are added to the ponds while they are being used for fish farming. However, the fertilizer created by the fish can be spread on the land to increase production of cereal grains and other agricultural products.

C. Atmospheric

Fish farming will not result in air pollution, noise pollution, or other adverse effects on the atmosphere.

D. Natural Resources

Aquaculture will not result in the loss of nutrients or sediments from the farmers' fields. Aquaculture ponds receiving runoff water are located high in the watershed and even a density of 12 ponds per square mile would modify the runoff of only approximately 15 percent of the land area. Similarly farm ponds can control flooding.

Aquaculture is an efficient user of natural resources. Many inland fisheries operations are carried out on lands unsuitable for crop and livestock production (See A. 1. above).

E. Cultural

Fish can be grown in rotation with other crops such as rice, hogs, ducks, and livestock which increases the efficiency of the total farm system and adds to the farmer's income.

The introduction of aquaculture in a region may create certain problems to the local communities where religious, historical or archeological sites are located. These must be identified and steps taken to inform the inhabitation that fish ponds need not interfere with their preservation.

This project will benefit directly the following individuals:

1. Consumers who will gain from the increased availability of high protein foods, and to a small extent from increased opportunities for employment.
2. Producers or farmers who will benefit from increased income, and to a small extent, by auto-consumption of products and family employment.

Others who will directly and/or indirectly benefit will be the communities as a whole, including governments, which fulfill commitments in plans and policies, and institutions which participate to achieve goals and objectives of this project.

F. Socio-Economic

There are a variety of socio-economic benefits resulting from aquaculture. The fish produced provide a source of high protein and income to the farmers. The introduction of aquaculture often serves as the focus for introducing other income producing concepts in a community. The inputs used in aquaculture are often agricultural by-products that are in low demand for other uses. There may be some competition for resources, but it is often limited and the use for aquaculture justified on the basis of benefit/cost ratio. The returns from fish production can be higher than from many other farm enterprises because the average cost of producing a unit of fish is lower and the average market price higher.

G. Health

The effects of aquaculture on health are positive. The nutritional benefits from aquaculture can be significant in countries where malnutrition is a major factor contributing to serious health problems.

The introduction of aquaculture into an area rarely has a measurable adverse effect on water-associated diseases. The clearing of marshy lands for fish ponds will reduce the level of water-associated diseases and the concentration of insects. Aquaculture ponds are small enough that disease organisms and their vectors can be controlled.

H. General

Aquaculture will have no negative international or controversial impact.

I. Other Possible Impact

The introduction of new fish species will not have an adverse impact on the environment. Only those species will be introduced which can be grown successfully in the LDCs. In addition, no agricultural chemicals are used in fish ponds and therefore, the water will not be polluted by toxic materials.

Aquaculture Research and Support

Project Number 936-4180

<u>Impact Areas and Sub-Areas</u>	<u>Impact Identification*</u>
<b>A. <u>Land Use</u></b>	
1. Changing the character of the land through:	
a. Increasing the population	N
b. Extracting natural resources	M +
c. Land clearing	M +
d. Changing soil character	M +
2. Altering natural defenses	N
3. Jeopardizing man or his work	N
4. Other factors:	
- Reducing pesticide pollution and contamination	N
<b>B. <u>Water Quality</u></b>	
1. Physical state of water	N
2. Chemical and biological status	L +
3. Ecological balance	L +
4. Other factors	N
<b>C. <u>Atmospheric</u></b>	
1. Air additives	N
2. Air pollution	N
3. Noise pollution	N
4. Other Factors	N
<b>D. <u>Natural Resources</u></b>	
1. Diversion, altered use of water	H +
2. Irreversible, inefficient commitment	L +
3. Other factors	N
<b>E. <u>Cultural</u></b>	
1. Altering physical symbols	N
2. Dilution of cultural traditions	M
3. Other Factors	N

Aquaculture Research and Support

Project Number 936-4180

<u>Impact Areas and Sub-Areas</u>	<u>Impact Identification*</u>
<b>F. <u>Socio-Economic</u></b>	
1. Changes in economic/employment patterns	M +
2. Changes in population	N
3. Changes in cultural patterns	M +
4. Other factors	N
<b>G. <u>Health</u></b>	
1. Changing a natural environment	M +
2. Eliminating an ecosystem element	N
3. Other factors	
- Reducing pesticide poisoning	N
<b>H. <u>General</u></b>	
1. International impact	N
2. Controversial impact	N
3. Larger program impact	N
4. Other factors	N
<b>I. <u>Other Possible Impacts</u></b>	
1. Introduction of new fish species	N
2. Agricultural chemicals	N
3. Other factors	N

\* The following symbols are used for this Impact Identification

N = No	Environmental Impact	+ = Beneficial Impact
L = Little	Environmental Impact	- = Negative Impact
M = Moderate	Environmental Impact	
H = High	Environmental Impact	
U = Unknown	Environmental Impact	

**Appendix F  
Summary of Evaluations**

**AQUACULTURE TECHNOLOGY DEVELOPMENT**

**Project Number 936-1314**

**Summary of Evaluations**

**S&T/AGR:10/31/87**

Aquaculture Technology Development  
Project No. 931-1314

Evaluation Summary

I. Summary Statement

This is an eleven-year project scheduled to terminate on December 31, 1987. It is one of several fisheries projects supported by S&T/AGR/RNR which focus on subject matters ranging from raising fingerlings in ponds to harvesting large marine fish in the oceans (e.g., milkfish); and from small ponds on poor LDC farms to fishing in a 200 mile radius off shore. The Aquaculture Technology Development project deals exclusively with the husbandry of aquatic animal and plants at densities greater than those found under natural conditions.

It was established in FY 1978 to further AID's efforts in aquaculture as a follow-on activity to previous grants and contracts dating back to FY 1967. It is being implemented under a cooperative agreement (CA) with Auburn University, Department of Fish and Allied Aquaculture, International Center for Aquaculture (AU/DFAA/ICA).

As of July 1986, 82 scientists and experts at AU/DFAA/ICA have provided 9,302 person-days of short-term services and other support to 86 LDCs. During that same period, the services of 35 professionals contributed 107 person-years of long-term advisory services which contributed to the successful implementation of fisheries and aquaculture development programs in many LDCs, including Brazil, Colombia, Egypt, El Salvador, Honduras, Indonesia, Jamaica, Nigeria, Panama, Philippines, and Rwanda.

In addition, during this same period Auburn University has provided degree training for 230 students from LDCs, including 50 Ph.D. degrees; 143 M.S. degrees; 25 Master of Aquaculture degrees; and 12 B.S. degrees. Over 200 LDC participants have received non-degree training at the Auburn University campus and at institutions located in the LDCs. The University also has provided research opportunities for 45 visiting scientists. (For additional information on services provided and training of LDC scientists and experts, please refer to Appendix G.)

II. Evaluations

A. National Science Foundation Evaluation

1. Background and Findings

In July 1984, the project was evaluated by a panel of specialists under the auspices of the Division of International Programs, National Science Foundation. The purpose of the evaluation was to review the activities funded by AID and implemented by AU/DFAA/ICA, particularly those activities funded under the current CA funded by S&T/AGR.

The Panel expressed its great respect for the AU/DFAA/ICA's aquaculture program and recommended its continuation at a level commensurate to the needs of the LDCs. It noted:

- a. That Auburn University has achieved an excellent reputation worldwide for its practical application of aquaculture technology in Africa, Asia and the Near East, and Latin American and Caribbean which has resulted in many successful projects;
- b. The highly professional, experienced, competent and committed scientists, experts, and other staff members at the University exhibit a strong desire to serve the world community, especially the LDCs;
- c. The willingness of the University to meet the perceived needs of the LDCs in terms of increasing the income of the poor farmers and the availability of high protein foods; and
- d. The positive impact that AU/DFAA/ICA has had on the programs in the LDCs;

2. Recommendations

After careful review of the AID program, the Panel made the following recommendations based on the findings of the evaluation:

- a. That AID continue support to Auburn after the termination of the present cooperative agreement to enable the University to maintain and nurture its capital base, to continue to meet the needs of aquaculture in LDCs, and to play an effective role in the mission's fisheries program;
- b. That the support be continued at a level commensurate to the needs of the LDCs;
- c. That annual work plans be prepared by AU/DFAA/ICA in collaboration with S&T/AGR and these work plans provide base line data on which to structure future evaluations; and
- d. That effective mechanism be established for long-range planning and analysis of ICA's role in international aquaculture in terms of what is needed, what is going on in other research and training institutions around the world, and what changes are required at Auburn University to assure an important role in the future of international aquaculture.

9/8

B. Internal Summative Evaluation

In October 1986, the project manager, Dr. Richard Neal and the NOAA advisor, Mr. Kenneth Osborn prepared a summative evaluation in which they commented on the NSF evaluation and the steps taken to comply with these recommendations. These actions are listed below:

1. A management consultant was engaged in March 1985 to:
  - a. Review the NSF Panel evaluation report;
  - b. Conduct an analysis of design, planning and management of the project; and
  - c. Recommend steps to improvement the project design.

It should be noted that the consultant agreed with the analysis and recommendations made by the NSF Panel.

2. A strategic process was established by AU/DFAA/ICA for improving the planning, monitoring, management, and evaluation processes of the project. These processes will assist AID in developing or clarifying its own comprehensive fisheries strategy and policies. They will also assist AU/DFAA/ICA in maintaining and expanding its operational fisheries research network.
3. AU/DFAA has established a worldwide network of teachers, scientists and administrators working in aquaculture. Initially the network included primarily foreign alumni of the aquaculture and fisheries program at Auburn, including approximately 230 foreign students who have been awarded degrees and approximately 200 additional trainees who have attended non-degree programs. The network is being expanded to include scientists and institutions from the developed world and international organizations. A partial listing of the international, national, and U.S. institutions in the network is included in Appendix D.
4. Annual work plans are being developed with joint participation by AID/S&T/AGR. Future work plans will be based on problems identified by the AU/DFAA/ICA, S&T/AGR, missions, regional bureaus and other AID/W offices dealing with the production, harvesting, processing and marketing of fish obtained through fish farming (aquaculture).
5. A Management Review Group (MRG) has been established with representatives from the regional bureaus, other AID/W offices, AU/DFAA, and S&T/AGR. The MRG will meet at least annually and carry out the following functions.

- a. Review the new multi-year strategic plan and subsequent revisions for improving the planning, monitoring, management, and evaluation processes of the project and make recommendations to S&T/AGR as to changes which may be required;
  - b. Review the annual work plans and make recommendations to S&T/AGR as to changes which may be required;
  - c. Participate in annual management reviews;
  - d. Assist in establishing terms of reference and issues for in depth evaluations to be carried out independently;
  - e. Identify need for and facilitate coordination with other projects;
  - f. Seek ways and means to increase the effective utilization of AU/DFAA/ICA's capabilities to resolve issues and problems in the LDCs.
7. A Companion Basic Ordering Agreement (BOA) will be issued under the new project to expedite effective mission access to the talents of AU/DFAA/ICA.

# AQUACULTURE RESEARCH AND SUPPORT

**Project Number 936-4180**

Summary of International Participation

S&T/AGR:10/31/87



SUMMARY OF NINETEEN YEARS (1967-1986) OF INTERNATIONAL SERVICE ACITIVTY  
International Center for Aquaculture  
Department of Fisheries and Allied Aquacultures  
Auburn University, Alabama 36849  
July 1986

The Agency for International Development (AID) initiated the first contractual arrangement with Auburn University in July 1967 for the purpose of obtaining technical expertise in fisheries and aquaculture for its Washington offices and for various USAID Missions around the world. During the nineteen-year-period ending July 1986, Auburn University, through its International Center for Aquaculture, has achieved an impressive record in foreign service activities in fisheries and aquaculture development.

International activities consisted of two principal types:

- 1) Short-term services of specialists in various fisheries areas were provided to foreign governments through AID and various other international organizations in carrying out surveys with appropriate recommendations or by providing solutions for specific fishery-related problems.
- 2) Long-term services of fishery specialists serving as advisors primarily to USAID Missions or host-country governments.

Short-term service activities between 1967 and 1986 are summarized as follows:

Number of countries visited	Total number of country visits	Number of staff-member visits	Number of staff participating	Number of person-days (visits)
86	502	691	82	9,302

During the same nineteen-year period, Auburn's International Center for Aquaculture provided the services of 35 professional staff who contributed 107 person-years of long-term advisory services in fisheries and aquaculture development in Brazil, Colombia, Ecuador, Egypt, El Salvador, Honduras, Indonesia, Jamaica, Nigeria, Panama, Philippines, and Rwanda.

Including both short-term and long-term services, approximately 132 person-years have been dedicated to overseas work by Auburn personnel since 1967.

SUMMARY  
AID CORE GRANTS AND CONTRACTS

<u>PERIOD</u>	<u>ITEM</u>	<u>FUNDING \$ K</u>
67-69	BASIC AGREEMENT	\$ 365
69-74	BASIC ORDERING AGREEMENT TASK ORDERS	835
70-78	INSTITUTIONAL GRANT	1,438
74-77	BASIC ORDERING AGREEMENT TASK ORDERS	367
77-81	UNIV. SERVICES CONTRACT	349 -
78-81	TECH. DEV. GRANT	1,102 -
80-85	STRENGTHENING GRANT	500
82-86	COOPERATIVE AGREEMENT	2,250 ✓
82-86	AQUACULTURE CRSP HONDURAS	500
	PANAMA	500
67-77	OTHER AID CONTRACTS	<u>59</u>
	TOTAL	\$ 8,265
	COUNTRY PROGRAMS	<u>+5,829</u>
	GRAND TOTAL	\$14,094

ICA  
INTERNATIONAL SERVICE ACTIVITIES  
LONG-TERM - SINCE 1967

<u>COUNTRY</u>	<u>PERSON/YRS.</u>	<u>FUNDING \$ K</u>
<u>BRAZIL</u>	<u>13.9</u>	<u>562*</u>
<u>COLOMBIA</u>	<u>9</u>	<u>952</u>
<u>EL SALVADOR</u>	<u>4</u>	<u>175</u>
<u>HONDURAS</u>	<u>2.8</u>	<u>329</u>
<u>PANAMA**</u>	<u>4.8</u>	<u>517</u>
<u>JAMAICA**</u>	<u>13.5</u>	<u>1,143</u>
<u>EGYPT</u>	<u>3.5</u>	<u>754</u>
<u>NIGERIA</u>	<u>5.5</u>	<u>726</u>
<u>RWANDA**</u>	<u>8.0</u>	<u>854</u>
<u>INDONESIA</u>	<u>7.3</u>	<u>584</u>
<u>PHILIPPINES</u>	<u>17.7</u>	<u>794</u>
<u>THAILAND</u>	<u>-</u>	<u>55*</u>
<u>HONDURAS CRSP**</u>	<u>5</u>	<u>500*</u>
<u>PANAMA CRSP**</u>	<u>5</u>	<u>500*</u>
	<u>TOTAL 100.0</u>	<u>\$5,829</u>

\*INCLUDED UNDER ON-CAMPUS CORE GRANTS  
\*\*PROJECTS UNDER IMPLEMENTATION JUNE 84

Long Term International Fisheries Projects  
Implemented by ICA

**SOUTHEAST ASIA**

Philippines (17.7 p/y)

Grover  
Schmittou  
Leary  
Crance

Indonesia (7.3 p/y)

Cremer  
Duncan

\*Thailand (5 yr)  
various ICA  
staff

**AFRICA**

Nigeria (5.5 p/y)  
Johnson

Rwanda (8 p/y)  
Veverica  
Moehl

\*Niger (2 yr)  
Malvestuto  
Sullivan

Egypt (3.5 p/y)  
G. Jensen  
Johnson

**CARIBBEAN, CENTRAL AND SOUTH AMERICA**

Colombia (9 p/v)

Popma  
Scully  
Phelps

Ecuador (2 p/y)

Popma

Brazil (13.9 p/y)

Jeffrey  
Davies  
J. Jensen  
Lovshin

Panama (1.8 p/y)

Smitherman

El Salvador (4 p/y)

Bayne  
Hughes

Honduras (2.8 p/y)  
Hughes

Panama (3 p/y)  
Lovshin

Jamaica (13.5 p/y)  
Randolph  
Woodruff  
Nerrie  
Bowman  
Popma

\*\*Honduras CRSP (5 p/y)  
Green

\*\*Panama CRSP (10 p/y)  
Hughes  
T-Coddington

\*Long term projects in Thailand and Niger were serviced by periodic short term visits of various ICA staff.

\*\*Collaborative Research Support Project (CRSP) in Pond Dynamics supported through Title XII, AID Bureau of Science and Technology.

ICA  
INTERNATIONAL SERVICE ACTIVITIES  
SHORT-TERM - SINCE 1967

NUMBER OF COUNTRIES	80
NUMBER OF COUNTRY VISITS	439
NUMBER OF STAFF PARTICIPATING	72
NUMBER OF STAFF-MEMBER VISITS	574
NUMBER OF PERSON DAYS	7,697 DAYS
(JUNE 1984)	(21.1 YRS)

EXAMPLES OF SHORT-TERM INTERNATIONAL WORK

CONDUCT IN-COUNTRY TRAINING PROGRAMS

ASSIST USAID IN PREPARING PROJECT DOCUMENTS

DESIGN AND PLAN AQUACULTURE STATIONS

REVIEW AND EVALUATE AQUACULTURE AND FISHERIES PROGRAMS

SPECIFIC PROBLEM AREAS RELATING TO FISH FEEDS AND NUTRITION,  
FISH PARASITES AND FISH DISEASES, HATCHERY MANAGEMENT, POND  
CONSTRUCTION, ETC.

SHORT-TERM WORK CARRIED OUT  
BY THE STAFF OF THE  
INTERNATIONAL CENTER FOR AQUACULTURE  
AUBURN UNIVERSITY, AL 36849  
1987

DATE	COUNTRY	STAFF	PROJECT	DAYS
01/05/87-01/06/87	Kenya	K. Veverica	RWANDA PROJECT	01
01/15/87-02/05/87	Ecuador	D. B. Rouse	PSG	22
01/15/87-01/31/87	Rwanda	B. L. Nerrie	RWANDA PROJECT	17
01/15/87-01/31/87	Rwanda	J. Molnar	RWANDA PROJECT	17
01/19/87-02/14/87	Nepal, Thailand			
	Indonesia	B. L. Duncan	PVO PROJECT	27
01/19/87-02/14/87	Nepal, Thailand			
	Indonesia	H. R. Schmittou	PSG	27
01/19/87-02/05/87	Ecuador	J. Crance	COOP AGREE	16
01/22/87-02/01/87	Tunisia	J. W. Jensen	PEACE CORPS	11
02/10/87-02/21/87	Honduras	K. H. Yoo	PVO PROJECT	12
02/20/87-02/22/87	Burundi	K. Veverica	RWANDA PROJECT	02
02/20/87-02/22/87	Burundi	J. Moehl	RWANDA PROJECT	02
02/26/87-03/19/87	Rwanda	D. D. Moss	RWANDA PROJECT	20
03/17/87-03/22/87	Sierra Leone	B. L. Duncan	PVO PROJECT	06
03/20/87-04/15/87	Thailand	C. E. Boyd	ASIA DEV BANK	27
03/23/87-03/25/87	Togo	B. L. Duncan	PVO PROJECT	02
03/23/87-04/06/87	Bolivia	R. P. Phelps	PVO PROJECT	16
03/26/87-04/02/87	Senegal	B. L. Duncan	PVO PROJECT	08
03/29/87-04/11/87	India	A. Bocek	PVO PROJECT	14
03/29/87-04/06/87	Panama	R. P. Phelps	CRSP & PVO	09
04/02/87-04/06/87	Ivory Coast	B. L. Duncan	PVO PROJECT	05
04/07/87-04/10/87	Honduras	R. P. Phelps	CRSP & PVO	04
04/11/87-04/13/87	Guatemala	R. P. Phelps	PVO PROJECT	03
04/12/87-04/19/87	Bangladesh	A. Bocek	PVO PROJECT	08
06/14/87-06/19/87	Senegal	B. L. Duncan	PVO PROJECT	06

SHORT-TERM WORK CARRIED OUT BY STAFF OF THE INTERNATIONAL CENTER FOR AQUACULTURE AUBURN UNIVERSITY, AL 36849 1986	<table style="width: 100%; border-collapse: collapse;"> <tr> <td></td> <td style="text-align: right;">DY</td> <td style="text-align: right;">MO.</td> </tr> <tr> <td>J/PVO</td> <td style="text-align: right;">217</td> <td style="text-align: right;">7.2</td> </tr> <tr> <td>CA</td> <td style="text-align: right;">147</td> <td style="text-align: right;">4.9</td> </tr> <tr> <td>PC</td> <td style="text-align: right;">30</td> <td style="text-align: right;">1.0</td> </tr> <tr> <td>PSG</td> <td style="text-align: right;">38</td> <td style="text-align: right;">1.3</td> </tr> <tr> <td>USAID</td> <td style="text-align: right;">34</td> <td style="text-align: right;">1.1</td> </tr> <tr> <td>CRSP</td> <td style="text-align: right;">12</td> <td style="text-align: right;">0.4</td> </tr> <tr> <td>OTHER</td> <td style="text-align: right;">87</td> <td style="text-align: right;">2.9</td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black;"></td> <td style="border-top: 1px solid black;">565 = 18.8 = 1.57 yr.</td> </tr> </table>		DY	MO.	J/PVO	217	7.2	CA	147	4.9	PC	30	1.0	PSG	38	1.3	USAID	34	1.1	CRSP	12	0.4	OTHER	87	2.9			565 = 18.8 = 1.57 yr.
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DATE	COUNTRY	STAFF	PROJECT	DAYS
01/06/86-01/19/86	Indonesia	B. L. Duncan	JOINT/PVO	13
01/20/86-01/24/86	Thailand	B. L. Duncan	JOINT/PVO	04
01/21/86-02/02/86	Bolivia	R. P. Phelps	JOINT/PVO	13
01/25/86-01/31/86	Sri Lanka	B. L. Duncan	JOINT/PVO	06
02/06/86-02/28/86	Rwanda	D. D. Moss	RWANDA PROJECT	22
03/01/86-03/19/86	India	D. B. Rouse	USDA/OICD	19
03/04/86-03/18/86	Cameroon	B. L. Duncan	JOINT/PVO	14
03/04/86-03/18/86	Cameroon	F. H. Meriwether	JOINT/PVO	14
03/19/86	Kenya	B. L. Duncan	JOINT/PVO	01
03/19/86	Kenya	F. H. Meriwether	JOINT/PVO	01
03/20/86-03/25/86	Sudan	B. L. Duncan	JOINT/PVO	05
03/20/86-03/25/86	Sudan	F. H. Meriwether	JOINT/PVO	05
04/10/86-04/18/86	Egypt	J. H. Grover	COOPERATIVE AGREE	09
04/14/86-04/18/86	Antigua	D. B. Rouse	USAID/PRIVATE SECTOR	05
04/25/86-05/11/86	Niger	S. P. Malvestuto	COOPERATIVE AGREE	17
05/12/86-05/28/86	Senegal	B. L. Duncan	JOINT/PVO	17
05/11/86-05/17/86	El Salvador	R. P. Phelps	COOPERATIVE AGREE	07
05/26/86-06/03/86	Bolivia	R. P. Phelps	JOINT/PVO	09
06/01/86-06/30/86	Ecuador	S. P. Malvestuto	PEACE CORPS	30
06/15/86-06/21/86	Dominican Republic	L. L. Lovshin	AID/MOOREHOUSE COLLEGE	07
07/01/86-08/02/86	Kenya & Zimbabwe Uganda, Congo	R. E. Brummett	JOINT/PVO	33
07/17/86-07/24/86	Jamaica	B. L. Nerrie	RWANDA PROJECT	07
07/21/86-08/04/86	Panama	C. E. Boyd	STRENGTHENING GRANT	05
07/22/86-08/04/86	Egypt	J. H. Grover	COOPERATIVE AGREE	14
07/26/86-07/31/86	Honduras	C. E. Boyd	STRENGTHENING GRANT	06
07/27/86-08/02/86	Egypt	L. L. Lovshin	JOINT/PVO	06
07/24/86-08/08/86	Egypt	R. P. Phelps	COOPERATIVE AGREE	16
08/02/86-08/10/86	Thailand	J. A. Plumb	FAO	08
08/03/86-08/15/86	Egypt	L. L. Lovshin	COOPERATIVE AGREE	13
08/07/86-08/22/86	Egypt	D. B. Rouse	COOPERATIVE AGREE	16
08/11/86-08/25/86	Somalia	K. H. Yoo	JOINT/PVO	14
08/14/86-08/24/86	Egypt	D. D. Moss	COOPERATIVE AGREE	11
08/15/86-08/25/86	Bangladesh	J. H. Grover	JOINT/PVO	11
08/25/86-09/13/86	Sri Lanka	J. H. Grover	JOINT/PVO	20
09/01/86-09/14/86	Indonesia	B. L. Duncan	JOINT/PVO	14
10/18/86-11/01/86	Honduras	R. P. Phelps	CRSP POND DYNAMICS	06
09/07/86-09/27/86	Guatemala	L. L. Lovshin	USAID/COOPERATIVE AGREE	20
09/07/86-09/20/86	Guatemala	W. C. Shelton	USAID/COOPERATIVE AGREE	13
09/07/86-09/12/86	Panama	R. P. Phelps	CRSP POND DYNAMICS	06
09/14/86-09/19/86	Thailand	B. L. Duncan	JOINT/PVO	07
09/14/86-10/02/86	Panama	D. B. Rouse	PROGRAM SUPPORT GRANT	14
09/23/86-09/26/86	Jamaica	J. A. Plumb	AQUALPIA LIMITED	03
09/28/86-10/02/86	Brazil	R. T. Lovell	BRAZILIAN COLLEGE OF ANIMAL NUTRITION	05
11/16/86-11/20/86	Mexico	R. P. Phelps	AU/AG. EXP. STA.	04
11/19/86-11/29/86	Guatemala	L. U. Hatch	COOPERATIVE AGREE	11
11/20/86-11/29/86	Guatemala	R. P. Phelps	JOINT/PVO	09
11/30/86-12/14/86	Guatemala, Panama, Costa Rica, El Salvador, Belize, Honduras	D. D. Moss M. E. Marvel	AU INT. PROG. AU INT. PROG.	18 18
12/07/86-12/20/86	Ecuador	C. E. Boyd	PROGRAM SUPPORT GRANT	13
12/02/86	Ecuador	T. J. Popma	JOINT/PVO	01

SUMMARY OF FACULTY INVOLVEMENT  
IN THE INTERNATIONAL DEVELOPMENT PROGRAM  
JULY 1986

PROFESSIONAL STAFF NAME AND TITLE	SHORT-TERM ASSIGNMENTS IN			LONG-TERM ASSIGNMENTS IN		
	LATIN AMERICA	AFRICA	ASIA	LATIN AMERICA	AFRICA	ASIA
*BAILEY, CONNER-ASST. PROF.	X			X		
BAYNE, DAVID-ASSOC. PROF.	X		X		X	
BOYD, C. E.-PROFESSOR	X		X	X		
*CLONTS, H. -PROFESSOR						
CREMER, M.C.-SENIOR ADVISOR			X	X		
DAVIES, WILLIAM D.-PROFESSOR	X		X	X	X	
DUNCAN, BRYAN-ASSOC. PROF.	X		X	X		
DUNHAM, REX-ASST. PROF.						X
GOODMAN, RANDELL-POND MGR.						
GREEN, B. W.-RES. ASSOC.					X	
GRIZZLE, JOHN-ASSOC. PROF.						
GROVER, JOHN-PROFESSOR	X		X	X		X
*HATCH, UPTON-ASST. PROF.	X					
HUGHES, DAVID, RES.-ASSOC.	X				X	
JENSEN, JOHN,-FISH EXTENSION SPEC.	X				X	
JOHNSON, M. C.-ASSOC. PROF. (RET.)	X		X	X		X
*JOLLY, CURTIS-ASSOC. PROF.			X			X
LOVELL, RICHARD. T.-PROFESSOR	X		X	X		
LOVSHIN, L. L.-PROFESSOR	X		X	X	X	X
MALVESTUTO, STEPHEN P.-ASSOC. PROF.	X		X			X
MOEHL, J. F.-RES. ASSOC.			X	X		X
*MOLNAR, J.J.-PROFESSOR	X					
MOSS, DONOVAN D.- PROFESSOR	X		X	X		X
NERRIE, BRIAN-RES. ASSOC.	X		X		X	X
PHELPS, RONALD P.-ASSOC. PROF.	X		X	X		
PLUMB, JOHN A.- PROFESSOR	X					
POPMA, THOMAS-ASST. PROF.	X		X	X	X	
PRETTO, R. C.-ADJUNCT PROF.	X			X	X	
ROUSE, DAVID B- ASST. PROF.	X					
ROGERS, W. A. -PROFESSOR				X		
SCHMITTOU, H. R.-PROFESSOR	X		X	X		X
SHELL, E. W.-DEPARTMENT HEAD	X		X	X		
SMITHERMAN, R. O. -PROFESSOR	X		X	X	X	
SNOW, JACK, R.-ASSOC. PROF. (RET.)	X			X		
STARR, PAUL-PROFESSOR			X	X	X	
STREET, DONALD-ASSOC. PROF.	X		X			X
TEICHERT-CODDINGTON, D. RES.-ASSOC.					X	
VEVERICA, KAREN-RES. ASSOC.			X			X

\*OTHER DEPARTMENT AFFILIATION

DEPARTMENT OF FISHERIES AND ALLIED AQUACULTURES FACULTY  
INVOLVEMENT IN INTERNATIONAL DEVELOPMENT PROGRAM  
IN FISHERIES AND AQUACULTURE  
June 1983

PROFESSIONAL STAFF NAME AND TITLE	Short-term Assignments in			Long-term Assignments in		
	Latin America	Africa	Asia	Latin America	Africa	Asia
Bayne, David-Assoc. Prof.	X					
Bowman, Jim-Res. Assoc.	X	X		X		
Boyd, C. E.-Professor	X	X	X	X		X
*Clonts, H. -Professor						
Davies, William D. Assoc. Prof.	X	X	X	X		
Duncan, Bryan-Assoc. Prof.	X	X	X			
Dunham, Rex-Asst. Prof.						X
Goodman, Randell-Pond Mgr.						
Green, B. W.-Res. Assoc.				X		
Grizzle, John-Assoc. Prof.						
Grover, John-Assoc. Prof.	X					
*Hatch, Upton-Asst. Prof.		X	X			X
Hughes, David, Res. Assoc.	X					
Jensen, John, Fish Extension Spec.	X			X		
Johnson, M. C.-Assoc. Prof.				X		
Lovell, Richard. T.-Professor	X	X			X	
Lovshin, L. L.-Assoc. Prof.	X	X	X			
Malvestuto, Stephen P.-Asst. Prof.	X	X	X	X	X	
Moehl, J. F.-Res. Assoc.					X	
*Molnar, J. A.-Assoc. Prof.	X	X			X	
Moss, Donovan D.-Professor	X					
Nerrie, Brian-Res. Assoc.	X	X	X			X
Phelps, Ronald P.-Assoc. Prof.	X	X		X		X
Plumb, John A.-Assoc. Prof.	X			X		
Popma, Thomas-Asst. Prof.	X	X				
Prather, E. E.-Assoc. Prof.	X			X		
Pretto, R. C.-Adjunct Prof.	X					
Ramsey, John-Unit Ldr.,CFU	X		X	X		
Rouse, David B.-Asst. Prof.	X			X		
Rogers, W. A.-Professor						
Schmittou, H. R.-Professor	X		X			
Shell, E. W.-Department Head	X	X	X			X
Smitherman, R. O.-Professor	X		X			
*Starr, Paul-Assoc. Prof.		X	X	X		
*Street, Donald-Assoc. Prof.		X	X			
*Sullivan, Greg-Asst. Prof.	X	X			X	X
Veverica, Karen-Res. Assoc.			X		X	
					X	

\* Other departmental affiliation

AUBURN UNIVERSITY

EXISTING INTERNATIONAL DEVELOPMENT

CONTRACTS AND GRANTS

AID Title XII Collaborative Research Support Program (CRSP),  
implemented summer 1980. Cooperative program with University of California at Davis and Oregon State University for collaborative research in aquaculture with institutions in developing countries.

Aquaculture CRSP, PANAMA

implemented January 1, 1983, with two ICA staff in-country for projected 5-year duration of project.

Aquaculture CRSP, HONDURAS

implemented January 1, 1983, with one ICA staff in-country for projected 5-year duration of project.

AID Cooperative Agreement, implemented January 1, 1982, to extend 5-year period. Consolidated elements of the previous AID University Services Contract and AID Aquaculture Technology Grant.

Cooperative Marine Technology Program for Middle East, implemented January 7, 1980, through New Jersey Marine Consortium with AU; this tri-national cooperative research program in aquaculture and marine science involves institutions in U.S., Egypt and Israel.

Bi-national Agricultural Research Development Fund (BARD) for collaborative research in fish nutrition between Auburn University and Israel, implemented October, 1983.

USAID Aquaculture Development Project- Rwanda, implemented March 7, 1983, with two long-term advisors in-country for four years.

USAID Fisheries Education Project- Indonesia, under subcontract with University of Kentucky with one long-term advisor in-country for two years starting October, 1986.

USAID Aquaculture Research Ecuador (ESPOL) - under subcontract with University of Florida with one long-term staff in-country for two years beginning June, 1985.

AID Title XII - Program Support Grant under Joint Memorandum of Understanding executed by AID/W in 1986 with University of Arkansas-Pine Bluff and Auburn University. PSG is anticipated to continue for four additional years.

AID Joint Private Voluntary Organization Water Harvesting- Aquaculture Project, with Western Carolina University as lead institution. Project was implemented in 1984, to extend for a five-year period, with ICA providing technical services on world-wide basis.

Appendix H  
Aquaculture Assistance by Donors  
1978-1983 Inclusive

## AQUACULTURE RESEARCH AND SUPPORT

**Project Number 936-4180**

External Assistance to Aquaculture, 1978 - 1983 Inclusive

S&T/AGR:10/31/87

## APPENDIX H

## External Assistance to Aquaculture, 1978-1983 inclusive

Donor	Total US \$	% Share
World Bank	83,570,000	22.7
Asian Development Bank	88,142,000	23.9
Inter-American Development Bank	18,182,000	4.9
UN System and Trust Funds	37,141,000	10.1
European Economic Community	14,458,000	3.9
Japanese Bilateral Aid	12,066,000	3.3
Other Bilateral Assistance	68,649,000	18.7
Other Donors <sup>1</sup>	45,859,000	12.5
Total External Assistance to Aquaculture	368,067,000	100.0
Total External Assistance to Fisheries	2,566,434,000	
Percent Share of Aquaculture in Fisheries		14.3

Source: FAO Fisheries Circular No.755, Revision 1, 1984

Note 1: Includes African Development Bank, NGO and TCDC Funds, OPEC, etc.

# AQUACULTURE RESEARCH AND SUPPORT

**Project Number 936-4180**

Applied and Developmental Research

S&T/AGR:10/31/87

Description of Research  
and Developmental Activities

Applied and Developmental Research - The research focus will be on developing, testing and transferring economically viable and socially and culturally accepted technologies aimed at increasing incomes, improving nutrition and sustaining natural resource uses. Decision-aids (simulation models) will be developed, tested and validated at AU and in the LDCs by researchers, extension agents, and others who will take the research results, latest technologies and related information to the LDC fish farmers' ponds. These aids will be based on AU's Department of Fisheries and Allied Aquaculture (FAA) research in the following areas:

1. Fish Diseases and Pathology

A wide variety of parasites, and bacterial, fungal and viral diseases affect fish especially in the LDCs where the risks of disease transmission are enhanced under crowded conditions of aquaculture. The stresses of growth under crowded conditions with less than optimal environmental conditions often increase susceptibility of the fish to pathogens. Finally, severe environmental conditions may be pathogenic themselves. Conditions such as low oxygen levels, high ammonia levels, or the presence of pesticides and heavy metals may be directly pathogenic. Prophylactic and diagnostic capabilities are required in the LDCs as well as techniques for treatment of diseases when they occur.

Most fish diseases have been identified and treatments are available for broad categories of diseases occurring in both temperate and tropical waters. However, diagnosis usually requires the skills of a trained pathologist with a well equipped microbiological and histological laboratory. Fish farmers in LDCs are not able to recognize common diseases or to determine appropriate treatments without help from skilled scientists. Further, new diseases are constantly emerging. Certain of these diseases involve pathogens which have invaded the animals under stress due to other factors. Especially in LDC hatcheries, diseases are a common cause of mortality and catastrophic losses.

Research is needed to further define environmental requirements for various species commonly cultured in the tropics. As new diseases occur and new treatments become available, research must be continued to recognize and treat diseases without risk to human health. Broad use of pesticides and herbicides in developing countries poses continued risks of diseases to the fish in fish ponds. The effects of some new pesticides may be difficult to diagnose initially.

## 2. Genetics and Breeding

Genetic improvement and selective breeding offer the greatest potential for improvement of aquaculture today. The Technical Advisory Committee of the Consultative Group for International Agricultural Research has identified genetics as one of two priority areas for research on aquaculture to be undertaken by the international agricultural research centers. Because fish reproduce at a young age and produce tremendous numbers of eggs, there are significant opportunities for genetic improvement for culture purposes. Nevertheless, only a few species have been improved genetically (rainbow trout, common carp, a few tilapia) while more than 150 species are being reared. New biotechnological methods are available for genetic manipulation that hold considerable promise for enhancement of desirable traits. In spite of the impressive potential for research progress in this area, relatively little has been done to date. Major genetic research requires a long-term commitment by an institution with extensive facilities, preferably in the tropics.

Auburn University has experience with catfish and tilapia genetic improvement. Tilapia research will be continued in support of LDC-based aquacultural development. Research needs include improved technology for production of all-male progeny, and development of strains with rapid growth, high fecundity and consistent red color.

## 3. Hatchery Management

Sound hatchery management technology for most fresh water species is available, if not already in use in LDCs. For most species the needs are to introduce existing technology and to continue to refine and improve methods to suit tropical conditions. Greater efforts are needed in training and technology transfer while research needs for hatcheries will be covered under pathology, nutrition, and water quality as described below.

The tilapias, the "aquatic chicken" of tomorrow, pose a special problem. As mouth breeders, they typically produce only hundreds of offspring per spawning rather than thousands. Consequently, large numbers of breeding adults are needed to produce hundreds of millions of fry per year which must be produced in major LDC hatcheries to meet the need for animal protein. Research is needed on: a) methods for increasing the frequency of spawning; b) methods for handling large numbers of spawners and their offspring; c) sex reversal techniques; and d) mechanization of fry harvesting at spawning facilities.

4. Nutrition

In the critical area of fish nutrition, technology is still in the "dark ages" technically. Nutritional requirements are understood for only a few fish (trout, salmon and catfish); yet fish have a very wide range of feeding habits in nature. Some fish are clearly better suited to their desired role for humans; i.e., converting plant protein to animal protein. In developing countries, some aquaculture is practiced on an extensive level, i.e., allowing fish to feed on natural foods available in fish ponds such as algae and zooplankton). As aquaculture progresses, fish ponds are first fertilized to increase growth of natural foods. This is followed by supplemental feeding to increase production, if this process is economically profitable.

At all levels of aquaculture, a better understanding of the nutritional requirements of fish is needed. Tilapias are raised at all levels of intensity, including in extremely high density production systems where complete rations are provided. Research on the nutritional requirements of fingerlings and adults is needed to improved feed efficiency and thereby reduce costs. Standard nutritional studies are required to define nutritional needs completely (amino acids, lipids, carbohydrates, minerals, vitamins and trace elements.) It has been demonstrated that fish can be more efficient converters of plant matter to animal protein than either birds or other mammals.

5. Processing and Quality Assurance

Fish farmers have several important advantages over marine fishermen who may capture their fish at great distances from marketing and processing facilities. Fish produced through aquaculture can be harvested when market demand is strong and when processing and transport facilities are available. Thus fish can be delivered to the market place in good condition. Although this often leads to a higher price for "cultured" fish, the opportunity exists to add additional value to the product through special handling or treatment (e.g. smoking) designed for speciality markets.

Technology transfer and education are the primary needs in this subject area with research on improved application and refinements of existing technologies being an additional need. Food preferences, traditions and habits require research in areas which may be site-specific.

6. Production Systems

The physical aspects of managing production in ponds, cages, or tanks have received relatively little attention in the past. The physical manipulations required to improve pond management are: a) quality of water source, b) depth of water, c) size and configuration of ponds, d) water exchange rate, e) soil cultivation and/or liming between crops, f) physical parameters of cages or tanks, g) fish transfer practices to improve space use efficiency, h) harvesting, partial harvesting and thinning practices, i) feeding methods (timing, rates, locations), j) fertilization practices (timing, rates), k) water aeration methods (natural or mechanical) and rates, l) fish species or species combination stocked, m) stocking densities, and n) predator and competitor control practices.

Each management procedure entails additional costs to the farmer and therefore economic analyses must be an integral part of this research. In addition, this research cannot be separated from other research being implemented on nutrition, water quality and hydrology, or integrated farming as these research areas obviously overlap considerably.

The facility needs for research are large and expensive as experimentation must be replicated on at least a semi-commercial scale. Pond size is an important variable and extrapolation of results from small ponds is not always valid. In addition, research is needed particularly on evaluation of management practices that are feasible to apply in developing countries. The more sophisticated practices used in the developed world are not designed for conditions in the LDCs. For example, some practices require dependable electrical supplies, maintenance and repair of sophisticated equipment, or access to dependable supplies of chemicals or pharmaceuticals that are not available in all locations.

7. Water Quality and Hydrology

Water quality of source water and the maintenance of water quality are the two major research topics included in this subject area. It may be possible to use source water from surface or ground water without expensive treatment. However, in the many LDCs water must be improved before it can be used for aquaculture through various treatments ranging from simple to complex processes.

The greatest problem in most cases is the maintenance of suitable water quality in production ponds, hatcheries or other production facilities where the water is being "used" or degraded. Fish remove oxygen, add carbon dioxide, nitrogenous wastes and feces which make the water less suited for raising fish. Plants (principally algae), on the other hand remove carbon dioxide, add oxygen and generally remove the waste products of fish thus improving water quality for fish life. In low density, extensive culture systems, a suitable balance between plant and animal life may be maintained which permits rapid growth of fish. More often, however, desired fish densities are such that supplemental steps must be taken to maintain suitable water quality.

The research needs of water quality and hydrology are closely tied to research on production systems, but involve an understanding of the complex chemistry and biochemistry of heavily loaded water systems.

Analytical methods are known, but a full understanding is lacking of nutrient cycling, ph-alkalinity systems, the role of bacteria, soil-water chemistry, and other specific related systems. The Pond Dynamics CRSP is addressing some aspects of these problems and Auburn University is involved in this CRSP. Nevertheless, many practical problems remain to be addressed that can lead to improved efficiency of production through better water management.

#### 8. Integrated Farming

Integrated farming is a general term applied to: a) production of fish using animal manure as fertilizer; b) the simultaneous production of aquatic plants (e.g. rice) and fish; c) the alternation of fish and crop production on certain sites; and d) the multiple use of stored water for fish production and other domestic and agricultural uses. Variations of these systems have been used successfully in China for hundreds of years. These integration systems contribute to the sustainability of agriculture through water conservation and runoff control, recycling of nutrients through the crop - livestock - fish - crop cycle, soil improvement, more intensive land use, and increased food production. All four forms of integrated farming identified above have important applications to food production in LDCs. Asian farmers are leaders in this field and have widely applied integrated fish/crop farming practices in economically successful ways.

Research needs for integrated farming in the LDCs are site specific. Economical, biological and cultural differences between countries and regions may require that research on methods suitable for Africa and Latin America must be adapted before appropriate for use in Africa and Latin America. For example, the Chinese carp species used traditionally in Asia for integrated farming are not as acceptable in all parts of the world.

New combinations of livestock or crops and fish production techniques need to be refined. In addition, extension and training are required in the LDCs to develop successful programs.

9. Aquaculture Economics

Aquaculture is an accepted practice and a routine production method that is economically viable in the developed and developing world. In Asia, it is an industry firmly established with production equivalent to 1.6 kg per person per year, and in the Philippines, the production is as high as 5.5 kg per person per year. In Latin America and Africa, production is much less. Nevertheless, aquaculture is an viable farming enterprise in those countries where it is practiced.

Therefore, economic research is an evaluation tool for identifying constraints to improved economic efficiency of aquaculture. Adequate economic data are necessary for informed decisions on the appropriate use of inputs (water, land, fertilizer, and other resources). National governments can use economic data to help establish policies that will encourage or discourage aquacultural practices of given types in given areas. Development planners weigh the employment, income, and export potential of aquaculture against other enterprises to determine where scarce funds and other resources should be applied to maximize the economic growth potential.

Research needs relate primarily to documentation of research and production trials in economic terms so data can be utilized as described above. Factors such as market demand with changing supply, detailed production costs, and changes in input costs (particularly of underutilized resources as demand increases) are not readily analyzed without economic research. Excellent technical development efforts have often failed because of inadequate parallel economic research. Auburn University's International Aquaculture Center is working closely with the Agricultural Economics Department of the University in the area of aquacultural economics. These departments have developed a strong capability that has made significant applied contributions to the field. Continuing economic research will be a part of nearly all applied research and development activities.

One possible approach that will be explored by Auburn would be to utilize a new methodology that is described in a recently completed FAD/UNEP pilot study, using Costa Rica's Gulf of Nicoya as the study site. That study resulted in the development of a new aquaculture site identification system that combines the ongoing Geographic Information System (GIS) with satellite remote-sensing technology to provide a variety of information useful for general planning for aquaculture development, as well as to identify and rank individual locations. The system integrates and analyzes diverse kinds of resource, environmental, and economic data in order to be able to quickly identify and rank individual locations that appear well-suited to aquacultural development. The pilot study also demonstrated that individual LDCs can purchase an easy to use and inexpensive microcomputer-driven image processing and GIS system for as little as \$50,000 to \$60,000.

# AQUACULTURE RESEARCH AND SUPPORT

**Project Number 936-4180**

Economic Justification

S&T/AGR:10/31/87

## APPENDIX J

### ECONOMIC FACTORS IN AQUACULTURE IN DEVELOPMENT

#### AQUACULTURE RESEARCH AND SUPPORT

Project Number 936-4180

#### Setting

Importance of Fisheries: It has been demonstrated in a number of recent studies that fish as a source of animal protein are both economically viable and often more culturally acceptable to LDCs than comparable protein from red meat sources. Religious beliefs may limit the extent to which pork (Muslim countries) or beef (Hindu countries) can be utilized. The lack of in-country feed grain and oilseed supplies may further constrain beef fattening and pork production. Since many LDCs lack hard currency to import from abroad, domestic fish production is often the only remaining viable choice for animal protein production.

Limitations of Capture Fisheries: Despite the interest in expanding the production and utilization of fish, there are other important physical, institutional, and economic constraints to consider. First, the widespread enactment of the 200-mile limit has meant that those countries with limited coastal shorelines must look elsewhere for expanding fish supplies. Since 1970, over 80 nations have extended their sea limits. Second, the availability of production technology and extension services for initiating or

expanding capture fisheries output frequently is lacking. Third, the infrastructure for supplying needed inputs and for marketing fish including processing, storage and transportation has never been created. Fourth, the fact that currently used fishing grounds are often overfished leads to non-attainability of maximum sustainable yield (MSY) from the perspective of both the economic and biological optimum levels of exploitation. Fifth, potential consumers of fisheries products have never been educated regarding appropriate ways to prepare and consume fish products. Sixth, sole reliance on cost-benefit analysis to evaluate individual projects has been replaced by more sophisticated evaluation of other aspects including measuring the extent of socio-economic improvement, more detailed identification of project beneficiaries, and assessment of potentially adverse environmental impacts.

Advantages: Aquaculture has developed to some extent in response to the limitations associated with capture fisheries. Aquaculture depends on key input over which the producer exercises more control than in the case of capture fisheries. These inputs include land, laborer, fry or fingerlings, water, fertilizer, feed, and management. As inputs have improved over time, unit aquaculture yields have risen. For example, in the Philippines, yields have risen steadily by about 5 percent annually since the mid-1950s. By contrast, capture fishery yields are virtually constant overall and are declining for some species. Individual fishermen often find that they are not able to compete with others due to rapidly increasing fishing intensive, or boat and equipment upsizing on the part of others fishing in the same waters. Given the fact that capture fisheries are frequently labeled by economists as examples of "a zero sum game" in which the gains of one party are at the

expense of another, and with capital requirements increasing, aquaculture is becoming more attractive. Given the oftentimes predatory capture fisheries environment, it should not be surprising that aquaculture is often becoming the sole supplier of additional foodfish given that the supply limits of capture fisheries have been reached with little prospects for significant future increases. The result has been an increasing emphasis on searching for appropriate means for expanding aquaculture production.

### Aquaculture, Fisheries and Pork Production Comparison

A 1972 study by Shang compared the relationships among various fisheries, aquaculture, and hog production practices in Taiwan in the late 1960s. The fresh water aquaculture production practice was for tilapia and carps. This was compared with two other fisheries practices - milkfish production in brackish water and oyster production in shallow sea - and with pork production. The comparisons are displayed in table 1. Aquaculture production was generally in the middle of the four production system comparison statistics. The output in terms of kg/man-year was highest for oyster production (45,575 kg/man-year) followed by pork (12,000) and aquaculture (10,453) with brackish water output far behind at 5,098. In terms of production costs per kg, shallow sea oyster production (16 cents/kg) - about half of the fresh water costs (31 cents), with brackish water milkfish at 37 cents and pork at 43 cents. The protein cost followed a similar pattern with oysters the least cost (160/1000 grams), with aquaculture at 280 cents, brackish water at 353 cents and pork a distant fourth place at 681 cents.

## Aquaculture Economics in the Philippines

A 1985 study of alternative aquaculture production systems was issued by the International Center for Living Aquatic Resources Management (ICLARM). In this report, a number of scenarios were reported comparing tilapia production at various stages and with different techniques. The technologies included hatcheries, cage culture, rice-fresh culture, and freshwater fishponds. A wide range of net cash incomes, initial investment requirements, ratio of return to investment and labor requirements are displayed in table 2.

Although positive net income was reported for all seven scenarios, the range of these net cash incomes to initial investment requirements was very wide. Two cage culture scenarios (numbers 3 and 4) had very high ratios (3.58-3.92) however the very lowest ratio was found in another cage culture practice in two freshwater lakes at 0.22. The freshwater fishponds in Central Luzon also had a very low ratio (0.24) The use of rice paddies to grow tilapia also had fairly high ratio (2.31-2.76).

The labor requirements ranged widely from very high for hatcheries (660 man-days per farm per year) to only 39 man-days/season for rice-fish culture. This highlights the wide range of aquaculture scenarios that are possible under 1980s technology in the Philippines, one of the most seasoned nations in using aquaculture production as an important component of the food production system.

Table 1. Relationship between net production and various fishery and aquaculture production practices in Taiwan, under average management, 1966 and 1968

Production System	Commodity	Output kg/man-year	Output kg/hectare	Production cost/kg (U.S. cents)	Protein Cost/1000 grams (U.S. cents)
Brackish water	Milkfish	5098	2112	37	363
Fresh water	Tilapia, carps	10453	1537	31	280
Shallow sea	Oysters	45575	1292	16	160
Hog farm	Pork	12000	n.a.	43	681

Source: Shang, Yung C. Comparison of the Economic Potential of Aquaculture, Land Animal Husbandry and Ocean Fisheries: The Case of Taiwan. Economic Research Center, University of Hawaii, Honolulu, 1972. 15 p.

Table 2. Philippine tilapia economics, selected production systems, 1981-1983 studies, expressed in Philippine pesos

Scenario No.	Production System and Location	Unit	Net Cash Income	Initial Investment	Ratio of Returns to Investment	Labor Required Unit	Level
1	Tilapia hatcheries	farm	34,781	22,850	1.52	Man-days (MD)	660
	Cage culture:						
2	2 Freshwater lakes	farm	793	3,579	0.22	MD/farm	183
3	San Pablo City, small-size grow-out	farm	25,140	7,022	3.58	MD/season	54
4	San Pablo City, medium-size grow-out	farm	56,369	14,363	3.92	MD/season	56
5	Los Banos, small farm grow-out	farm	1,570	2,450	0.64	MD/season	178
6	Rice-fish culture, Luzon						
	1981 wet season	hectare	4,623	2,000a	2.31	MD/season	39
	1982, dry season	hectare	5,516	2,000a	2.76	MD/season	44
7	Freshwater fishponds, Central Luzon	farm	12,067	53,108	0.24	MD/hectare	62

Note: a. Average per hectare development cost of rice-fish culture paddy fields but does not include initial land costs.

Source: International Center for Living Aquatic Resources Management (ICLARM), Philippine Tilapia Economics. Edited by I.R. Smith, E.B. Torres, and E.O. Tan. Manila, 1985. 261 pages.

## Aquaculture Research and Support

Project Number 936-4180

Project Strategy

The strategy for achieving the purpose is to sustain a balanced program of training, research, technical assistance and information transfer that will strengthen the aquaculture sector in many developing countries and will lead to improved use of natural resources, increased employment and incomes and increased availability of high protein foods. The AU/FAA/ICA with its wealth of experience is well qualified to determine the appropriate mix of program elements to achieve the purpose on a country by country basis. It has consistently demonstrated its ability to do so effectively. This mix of program elements will provide highly trained people, new information to fill critical information gaps, technical knowhow and problem solving expertise based on ICA's extensive experience in LDCs, and a flow of the latest available information pertaining to aquacultural development.

The impact of the application of new information by trained LDC personnel with experienced assistance will be: (1) improved aquacultural technology in use that permits more efficient use of available resources, (2) increased use of underutilized resources (poor land, water, labor, organic wastes) through aquaculture, (3) application of resource enhancing practices that conserve water, reduce soil erosion, improved soil fertility and encourage increased use of local inputs in agriculture, and (4) application of new technology that is profitably integrated with small-scale agriculture, that provides new employment and income and that is a source of new, nutritional food supplies.

The AU/FAA/ICA has demonstrated its ability to deliver these results consistently in the past using this approach and is expected to continue to do so.