

I. PROJECT IDENTIFICATION

1. PROJECT TITLE <b>International Center for Aquaculture- 211(d) Grant to Auburn University</b>		APPENDIX ATTACHED <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
2. RECIPIENT (specify) <input type="checkbox"/> COUNTRY _____ <input type="checkbox"/> REGIONAL _____ <input checked="" type="checkbox"/> INTERREGIONAL <u>TA Bureau</u>		4. LIFE OF PROJECT BEGINS FY <u>1970</u> ENDS FY <u>1976</u>	
		5. SUBMISSION <input checked="" type="checkbox"/> ORIGINAL <u>5/14/75</u> DATE <input type="checkbox"/> REV. NO. _____ DATE Grant NO. AID/CSC _____	

II. FUNDING (\$000) AND MAN MONTHS (MM) REQUIREMENTS

A FUNDING BY FISCAL YEAR	B. TOTAL \$	C. PERSONNEL		D. PARTICIPANTS		E. COMMOD- ITIES \$	F. OTHER COSTS \$	G. <del>XXXXXXX</del> GRANT		H. LOCAL EXCHANGE CURRENCY RATE: \$ US _____ (U.S. CANCELED)		
		(1) \$	(2) MM	(1) \$	(2) MM			(1) \$	(2) MM	(1) U.S. GRANT LOAN	(2) COOP COUNTRY	(3) JOINT
1. PRIOR THRU ACTUAL FY	800						800	800				
2. OPRN FY <u>75</u>	356						356	356				
3. BUDGET FY <u>76</u>	222						222	222				
4. BUDGET +1 FY												
5. BUDGET +2 FY												
6. BUDGET +3 FY												
7. ALL SUBJ. FY												
8. GRAND TOTAL	1378						1378	1378				

9. OTHER DONOR CONTRIBUTIONS

(A) NAME OF DONOR	(B) KIND OF GOODS/SERVICES	(C) AMOUNT

III. ORIGINATING OFFICE CLEARANCE

1. DRAFTER <b>J. Urano</b>	TITLE <b>TA/AGR</b>	DATE <b>5/14/75</b>
2. CLEARANCE OFFICER <b>L. Hesser</b>	TITLE <b>TA/AGR</b>	DATE <b>5/15/75</b>

IV. PROJECT AUTHORIZATION

1. CONDITIONS OF APPROVAL

The R & DC meeting held on 5/13/75 recommended the extension of this grant to Auburn University for two years.

2. CLEARANCES

BUR OFF.	SIGNATURE	DATE	BUR OFF.	SIGNATURE	DATE
PPC	A. Handley	5/12/75	TA/PPU	C. Molfetto	5/15/75
TA/PPU	T. Eliot	5/15/75	TA/PPU	J. Gunning	5/15/75
TA/PPU	M. Mozyński	5/15/75			

3. APPROVAL AND OFFICE USE SIGNATURE <b>Curtis Farrar</b> DATE _____ Assistant Administrator, TA/Bureau	4. APPROVAL AND OFFICE USE SIGNATURE <b>John E. Murphy</b> DATE <b>6/5/75</b> Deputy Administrator for A.I.D.
---	---

Proj. No. 9310120  
Pv

JUN 2 1975

**ACTION MEMORANDUM FOR THE DEPUTY ADMINISTRATOR**

**THRU:** ES /s/ Alexander Shukow  
**THRU:** AA/PPC, Mr. Philip Birnbaum  
**FROM:** AA/TA, Curt S. Farrar

**Problem:** To request A/AID approval of a proposed two-year grant to Auburn University's International Center for Aquaculture for the purpose of assisting developing countries in aquaculture with emphasis on the small producer and the development of aquaculture as a source of protein for the rural and urban poor.

**Discussion:** In September 1974, an intra-Agency team which included outside representation from the Rockefeller Foundation and the National Oceanic and Atmospheric Administration (NOAA) conducted a comprehensive fourth-year review of the subject grant. Some important issues were discussed including the extent that AU's competence has been increased; the scope of grantee activity; lack of state-of-the-art information; a rather parochial stance in relation to the University of Rhode Island, FAO, and others; and alternatives to extending the grant.

The results are summarized on pages 6 to 9 of the grant project statement (GPS) attached as TAB A. In brief, the team found that Auburn is an excellent institution, fully committed to the international dimension, which has been fully responsive to AID suggestions and requirements. On the other hand, certain weaknesses were identified including: an over-emphasis on production without sufficient attention to economic and social factors; a similar limitation on state-of-the-art and research; and insufficient linkages and cooperative work with sister institutions and UN organizations.

In recognition of the fact that AID's prior commitment to fisheries had been unclear and vacillating; the team recommended establishment of an AID fisheries policy. Recommendations were also submitted on: redefining the grant purpose and focus; conducting a comprehensive state-of-the art examination of the potentials, accomplishments, limits and impediments of aquaculture, coupled with a similar study on small scale fishermen by the University of Rhode Island (URI); and the development of purposeful linkages.

TAB accepted those recommendations without reservation and took the following actions:

1) A policy statement was presented to the R & D Committee which included the following:

AID policy is (1) to assist LDCs develop intensive science-based aquaculture in fresh-water and marine environments; and (2) to assist LDCs in the assessment of coastal capture fishing, particularly by small-scale artisanal fishermen.

The emphasis is on the development of fisheries and aquaculture as a source of protein for poor consumers and as a source of employment and income for small producers and laborers.

Fisheries or aquaculture ventures of a capital-intensive nature fall outside of AID's purview. Development of high-seas or distant-water fleets is excluded.\*

2) AID has arranged with the National Oceanic and Atmospheric Administration for a six to nine months detail of Mr. Philip Roedel as Fisheries Advisor, during which time we intend to work out a more formal PASA with NOAA. Mr. Roedel will manage both the Auburn and Rhode Island grants and continue to evaluate existing AID fisheries programs and to recommend policy positions for fisheries development. This will take into account small-scale fisheries, aquaculture, and the conservation and management needs of LDCs, especially those likely to be brought about by increased LDC control over coastal resources.

3) The alternatives to extending the grant were analyzed, particularly in reference to the effect on core support and the ready availability of institutional response capabilities needed by AID and the LDCs. The size of the core-staff has remained relatively static since the beginning of the grant; however, numerous changes have been made in the scientists comprising the core. Scientists brought to the campus as part of the core-staff have been shifted partially and then completely to other AID or state supported projects and activities as the overall aquaculture program has developed. In 1966 and prior to formal Agency relationship with Auburn, the fisheries department had 6 staff members which has since increased to 22. At the same time, the number of staff serving overseas providing technical assistance has increased from zero to seven.

---

\*The rationale for continued AID support is the potential of fisheries and aquaculture for easing protein deficits and providing employment and income in LDCs. This potential is briefly outlined on pages 2 to 4 of the GPS. The Administrator and both Congressional committees have strongly endorsed AID programs in fisheries and aquaculture.

As explained on pages 11 to 13 of the GPS, Auburn is the major U.S. institution with an expertise in the inland water aspects of aquaculture production. Current and projected aquaculture projects are increasing in number, scope and complexity. In order for AID to make valid contributions to these projects, the expertise must be available, including new capabilities in the economics of aquaculture production.

Auburn is not totally dependent upon AID for maintaining its expertise; however, its ability to provide international expertise would be limited if it were dependent only upon Mission contracts. Without core support, the fisheries department would exist but there is little likelihood that a viable response capability to meet AID needs would be maintained and no hope of expanding AU's concern and expertise in a systems approach to aquaculture.

Given the need for core support, the alternatives to a 211(d) grant in the utilization mode are (1) a return\* to a basic ordering agreement which includes support for core staff and (2) an increase in user charges sufficient to cover core costs. The first option was rejected because, while it would guarantee a specified level response capability closely related to demand, it would not provide sufficient funds for basic research, including state-of-the-art work in cooperation with the University of Rhode Island and others, or encourage the taking of initiative and innovative measures by Auburn. Regarding option (2), AID has been the principal customer to date; in fact, this was an issue in the review, i.e., the need for Auburn to offer its services to other donors. At this time Auburn's fishery department has no long-term institution development-type or research contracts and the projected need, outside of major projects in the Philippines, El Salvador, and Brazil, is more in terms of short-term consultation for problem identification and analysis, program design, special training, applied research, etc. While TAB is not rejecting the concept of increasing user charges to cover sustaining and administrative costs, in this case it would amount to shifting the support of essential core costs from central projects to projects for ad hoc field services which are often of a short-term nature and not firm enough as a base for personnel decisions the university must make to secure adequate and competent staff for further R & D work.

The use of the 211(d) mechanism, revised from the original competence development grant to a utilization mode, has the advantage of, first, being simpler and cheaper (no overhead) but equally important, assuming an adequate level of financing, the flexibility allowed would provide

---

\*Prior to the original grant, a task order arrangement with core support existed but was replaced because field demand at that time was insufficient, of limited scope, and/or unpredictable. It also did not provide AU with enough flexibility in the use of core support funds and AID's ability to influence their use was also limited.

Auburn with the means to expand its knowledge base and linkages in a more integrated and systematic approach to aquaculture specifically and, in cooperation with the University of Rhode Island and others, to fisheries in general. It also continues a collaborative association between AID and Auburn which is essential in the transfer of knowledge from U.S. universities to LDCs. The grant provides a home base where the more essential research required can be conducted. This form of research falls under joint institutional and grant funding with results being as beneficial to the U.S. as to LDCs.

4) When the decision was made in TAB to accept the team's recommendations and to convert the grant to a "utilization" phase, it was necessary to outline a new grant design and secure AU agreement in principle before a GPS could be prepared for Agency review and A/AID approval. It is important to note that in all such cases, this results in the specification of outputs and products which are wanted by AID and serve the dual purpose of (a) providing such products and (b) sustaining a viable institutional response capability which is now defined in terms of skills, functions, and man-year equivalents. In addition, detailed two-year work plans for each program sub-category of each output are prepared and submitted to the sponsoring technical office. This not only forces the grantee to plan in terms of major events and results but provides the grant project officer with information for monitoring and evaluation purposes and permits selective participation by AID (including field missions) in grant supported activities.

The grant design is outlined on pages 13 to 25 of the GPS including a budget by outputs. This budget will be further refined by major program sub-categories in the aforementioned work plans. In the Auburn grant, we will be getting several new products which we have insisted upon as a condition of grant support and which fully implement the review team recommendations, e.g.:

- education at the Ph.D. level for AID participants
- specialized short-term training on-campus and on-site for LDC officials and development agencies
- state-of-the-art survey (jointly with URI) on potential of aquaculture and fisheries in LDCs
- state-of-the-art seminar (jointly with URI) on aquaculture economics leading to establishment of development policies

- determination of optimal production systems for LDCs
- development of processing and preservation methods for fish available in LDCs
- developing a fish hatchery management workshop for LDCs managers
- development of practical feeds from in-country materials for manufacture which will reduce need for relatively expensive animal protein feeds
- technical backstopping of USAID projects
- development of an aquaculture multi-disciplinary talent bank
- an information exchange network
- closer working relationship with URI, Consortium of International Development, and FAO.

5) The GPS was reviewed within TAB, forwarded to the regional bureaus - along with the PAR and policy statement - for comment and presented to the R & DC. There were no new issues raised. Given the potential importance of aquaculture and the need for a response capability, the R & DC endorsed the choice of a utilization grant over a basic ordering agreement or other alternative and recommended its submission to you for approval but with the addition of a statement regarding the Percy Amendment (see page 28).

In summary, this is not a request for general budget support or the continuation of the current grant but a significant revision which will provide institutional response capabilities to meet the AID projected demand and, at the same time develop and provide specially designed training courses, state-of-the-art and applied research, and linkages which are deemed vital to full development and transfer of applied aquaculture technology appropriate for LDCs. The issues have been carefully reviewed at several levels within and outside the Agency and the proposed approach is deemed the optimum and least costly alternative now available.

It is not expected that the requested level of funding must be maintained indefinitely. As the knowledge base is expanded and capability is developed in production economics, funds for this purpose can be reduced or financed through other instruments,

such as research contracts, and/or other sources, e.g., IBRD. Efforts will also be undertaken to fund future required core support, at least partially, from charges for services rendered when this is advantageous to AID and acceptable to Auburn University.

With your approval, negotiations will be initiated with the grantee and a proposal for a two-year grant extension/revision will be prepared, with supplemental work plans required in greater detail, within the parameters of the project design included in the GPS. Funds are included in TAB's approved OYB at a level of \$356,000 for the proposed grant. The balance of the funds (\$222,000) to complete the grant will be provided in FY 1976, subject to availability.

Recommendation: That you approve, by signing the project (PROP) face sheet attached at TAB B, the two-year extension and revision of the institutional grant on aquaculture to Auburn University of not to exceed \$578,000 in total and subject to satisfactory negotiation with the grantee.

Attachments  
a/s

Clearances:

GC/TFHA, ARichstein  
GC, CGladson  
PPC/DPRE, AHandly (draft)

obtained on previous transmittal  
memorandum dated May 15, 1975

cc: CM/COD, RO'Brien

TA/PPU:REK hell:js:6/2/75

May 6, 1975

MEMORANDUM FOR: Research and Development Committee Members

FROM: TA/PPIJ, Carl R. Fritz

SUBJECT: Agenda for Research and Development Meeting  
May 13, 1975

You are invited to participate in the discussion on the following 211(d) "utilization mode" grant proposal at the R & DC meeting to be held on May 13, 1975, in Room 2884, NS, beginning at 2:00 p.m.

International Center for Aquaculture, Auburn University,  
KPA #2.

A memorandum dated May 5, 1975 from TA/AGR, Leon Hesser, which explains some of the details of the project is also enclosed.

Attachments: a/s

(See attached sheet for distribution)

TA/PM, C. Molfetto  
Rm. 2941, NS



DISTRIBUTION FOR RESEARCH AND DEVELOPMENT COMMITTEE MEETINGS (R & DC)

RESEARCH AND DEVELOPMENT COMMITTEE

A. MEMBERS

AFR/DP, Frank Moore  
EA/TD, Herbert Dodge  
LA/DR, Charles Stockman  
NESA/TECH, James Dalton  
GC/TF&HA, A. R. Richstein  
SER/IT, Philip Sperling  
SER/ENGR, John Rixse  
SER/CM/COD, Robert J. O'Brien  
FFP/FDD, Harrison Parker  
PPC/DPRE, Arthur Handly  
PHA/POP, Steven Sinding  
O/LAB, Benjamin Haskel

C. INFO.:

A/AID, H. Kusters w/o att.\*  
ES, Donald T. Bliss w/att.  
PPC/RB, L. Rogers w/att.  
PPC/PDA, R. Muscat w/att.  
SER/MP, N. Ayers w/o att.\*  
EA/RD, D. Loubert (Research Projects)  
A/AID, Nira Long w/att.

B. ALTERNATES

AFR/DS, John Blumgart w/att.  
AFR/NARA, Woodrow Leake w/att.  
EA/TD, Lane Holdcroft w/o att.  
LA/DP, Austin Hayman, w/att.  
NESA/DP, Richard Birnberg w/att.  
GC/TF&HA, Jan Miller w/o att.  
SER/IT, Milton L. Carr w/o att.  
  
SER/CM/COD/TAB, V. Perelli w/o att.  
FFP/POD, Peggy Sheehan w/o att.  
PPC/DPRE, Raymond G. Malley w/o att.  
PHA/PVC, William Jennette w/ att.  
O/LAB, Sigurd Moody w/o att.

D. TA OFFICES

AA/TA, C. Farrar  
M. Belcher  
E. Long  
K. Levick w/o att.\*  
T. Arndt  
S. Butterfield  
M. Kilgour  
T. Brown  
TA/PM, C. Fritz  
J. Gunning  
R. Kitchell (211(d))  
C. Molfetto  
TA/AGR, L. Hesser  
TA/DA, J. French  
TA/EHR, J. Chandler  
TA/H, L. Howard  
TA/N, M. Forman  
TA/OST, H. Arnold  
TA/RIG, M. Rechcigl  
TA/STS, J. Heilman  
TA/UD, W. Miner  
TA/PM Analysts (as appropriate)  
Project Managers (as appropriate)  
TA/AGR, R. House  
TA/PM, E. Shields, R&DC Files

(\* Attachments on request)

UNITED STATES GOVERNMENT

# Memorandum

TO : Research and Development Committee

DATE: May 5, 1975

FROM : TA/AGR, Leon Hesser *MH*

SUBJECT:

Enclosed is a proposal for a two-year 211 (d) utilization grant in aquaculture for Auburn University.

AID conducted major reviews of its grants to Auburn University and the University of Rhode Island in 1974. The review teams, while strongly recommending continued involvement in fisheries and aquaculture, urged AID to clarify its goals and develop programs tailored to these goals.\*

The goals of AID's program have been defined as follows: AID policy is (1) to assist LDCs develop intensive, science based aquaculture in fresh-water and marine environments; and (2) to assist LDC's in the assessment and management of coastal fishing stocks and in the development of coastal capture fishing, particularly by small-scale artisanal fishermen.

The emphasis is on the development of fisheries and aquaculture as a source of protein for poor consumers and as a source of employment and income for small producers and laborers.

Fisheries or aquaculture ventures of a capital-intensive nature fall outside of AID's purview. Development of high-seas or distant-water fleets is excluded.

Fisheries or aquaculture ventures aimed at the production of high-value products for export or for domestic markets, particularly the tourist trade, may be appropriate especially if they have substantial employment-generating effects. The priority is on production of fish as a source of relatively low-cost protein and as a source of employment.

\* The rationale for recommending continued AID support is the potential of fisheries and aquaculture for easing protein deficits and providing employment and income in LDC's. This potential has been documented in the PSAC and other reports and is briefly outlined on pages 2-4 of the Auburn grant proposal. Beyond this, the U.S. has particular high quality skills to contribute to development of both aquaculture and fisheries. Demand for these skills for AID grantees is good. The Administrator and both Congressional committee's have strongly endorsed AID programs in fisheries and aquaculture.



Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

AID has arranged with NOAA for the six to nine months detail of Mr. Philip Roedel as Fisheries Advisor. It is his job to continue to evaluate the existing AID fisheries program and to recommend policy positions for fisheries development. This will take into account small-scale fisheries, aquaculture, and the conservation and management needs of LDCs, especially those likely to be brought about by increased coastal state control over coastal resources.

The attached grant proposal outlines the program we have developed with Auburn University.

Attachment: a/s

PROPOSAL FOR CONTINUING SUPPORT UNDER  
THE AGENCY FOR INTERNATIONAL DEVELOPMENT  
INSTITUTIONAL GRANTS PROGRAM

Applicant: Auburn University  
Auburn, Alabama

Date: April 29, 1975

Grant Title: International Center for Aquaculture

Amount and Term of Grant: 2 years - \$578,200

AID Sponsoring Technical Office: TA/AG

GRANT PROJECT STATEMENT  
(Utilization Phase)

211(d) Institutional Grant

Auburn University

Table of Contents

<u>Subject</u>	<u>Page</u>
I. Relevance of Problem Area and Need for Expertise	2
A. The Problem	2
B. Needs	4
II. Grantee Performance and Results to Date	6
III. Grantee Commitment to Long-term Involvement	10
IV. Rationale for Revision/Extension	11
V. Revised Grant Project Design	13
A. Purpose	13
B. Objectives	14
C. Budget	25
VI. Complementary Actions and Management Considerations	26

## I. Relevance of Problem Area and Need for Expertise

### A. The Problem

The recent World Food Conference called for doubling the world's food supply by the year 2000.

It is necessary to increase the world's caloric and protein production by 1985 by approximately 50 percent of 1965's production. This 50 percent increase is an average figure. For some people the increase needed is much greater. Table I indicates the increased proportion of caloric and protein needed for the world and three LDCs. India, Pakistan, and Brazil will need to approximately double their food production by 1985. They, among others, do not have the extra 15 years that average world figures indicate. At current levels of production and distribution, approximately 20 percent of the population of LDCs are undernourished in caloric terms, and approximately 60 percent are receiving diets that are nutritionally deficient, particularly in terms of protein content.

Table 1. Needs for calories and proteins in 1985 expressed as percent increase over needs estimated for 1965.

Needs	Population Estimate	World	India	Pakistan	Brazil
Calories	High	52	108	146	104
	Low	43	88	118	92
Protein	High	52	110	145	109
	Low	45	93	121	98

Source: President's Science Advisory Committee, The World Food Problem 1967, Vol. I, p. 49.

Aquaculture,<sup>1</sup> like agriculture, is a form of land and water utilization but it has certain attributes that give it tremendous potential in complementing agriculture in the production of food. Because of its high protein content, fish are one of several protein sources that can contribute to an improvement of dietary levels in LDCs. The protein content of fish, as compared to red meats and rice, is shown in Table 2.

<sup>1</sup>/ Aquaculture is defined as the growing, or culture, of aquatic organisms under controlled conditions in either fresh, brackish, or sea water.

Table 2. Protein in fish, red meats, and rice

Item	Percent of Moisture-Free Flesh
Shrimp	88
Flounder	80
Channel catfish	79
Red Meats	40-50
Rice	7

Source: R. T. Lovell, "Benefits of Fish Culture of Developing Countries, c. 1973, Table 8.

In addition to having a high protein content, fish are also efficient feed utilizers in comparison to domesticated livestock species (see Table 3). Fish are not necessarily in competition with land animals or humans for their feed especially since they are able to utilize aquatic plants and wastes in addition to agricultural wastes.

Table 3. Efficiency of feed utilization per 1000 grams of feed intake for various animal species

Species	Liveweight gain (grams)	Protein gain (grams)
Catfish	715	118
Chickens	356	101
Pigs	292	30
Sheep	185	22
Steers	163	26

Source: President's Science Advisory Committee, The World Food Problem, 1967, vol. II, 352.

Recent total yield of capture fisheries for food consumption was 45 million metric tons (MMT) and the yield from aquaculture fisheries was about five MMT. 2/ The yield from capture fisheries is expected to double to about 90 MMT by 2000. The yield from aquaculture production is expected to increase ten-fold to 50 MMT by 2000. Currently, aquaculture production accounts for about 10 percent of the world's catch and by 2000 this proportion will increase to about 36 percent.

✓The potential for aquaculture is great as a means of increasing the availability of protein in LDCs. Aquaculture is the only form of food production that can be increased significantly, especially when practiced on marginal agricultural lands or lands not suitable for agricultural production.

2/ Consultative Group on International Agricultural Research, Report of the TAC Working Group on Aquaculture, 1973, p. 1.

Aquaculture production does reach the Agency's target population, the rural poor. The Technical Advisory Committee (TAC) Working Group on Aquaculture states that

the bulk of world aquaculture production is clearly for human consumption, and at least 75 percent of the current production serves directly as food of the common man in the countries of production.

Fish farming has been an integral part of rural development in some countries. By combining fish culture with pig, cattle or duck raising, and in some cases with rice cultivation, small scale farming practices have been evolved which contribute substantially to rural economy and nutritional standards. It is of special significance in developing countries that aquaculture can be carried out at different levels of organization and sophistication. While large-scale commercial operations should be promoted under certain conditions; aquaculture can also be very successfully undertaken by the small farmer with limited capital investment. In fact, much of the development so far has been along these lines. <sup>3/</sup>

B. Needs.

Many constraints must be overcome before the potential of aquaculture can be fully realized. Aquaculture is an ancient practice in many countries, especially in Asia, but scientific aquaculture is relatively young. Among these are the following, although they are not equally applicable to all LDCs.

1. There is a need for a continued and concentrated research effort on those fish species groups of most importance to LDCs that have been identified as having the greatest potential for increased production. These species include carps, catfish, milkfish, mullets, Tilapia, and shrimp and areas of research include reproductive Physiology and disease control.

2. There is a need for an assured availability of fingerlings to stock ponds or reservoirs. This requires further research in artificially spawning fish in captivity, and as such is related to the above need for species research, and the development of adequate hatchery facilities.

/ 3. There is a lack of an adequate number of trained personnel to adequately develop aquaculture to its fullest potential. These personnel include scientifically trained researchers, fish hatchery managers, and fisheries extensionists.

4. In many LDCs there is a lack of a fisheries policy, which will affect the level of resources devoted to research and training activities.

---

<sup>3/</sup> Ibid, p. 6



5. There is a need for the development of suitable feeds for intensive fishculture. Natural aquatic plants are a basic source of food and agricultural wastes, such as pig manure, are another source. As the level of feeding increases the yields also increase. Economically optimal levels of feeding and types of foodstuffs need to be identified.

6. Efficient pond management methods must be further developed including stocking and feeding techniques as well as disease control methods.

7. A projected ten-fold increase in aquacultural production will require a similar expansion in the number of hectares utilized for fishculture. The TAC estimates that three to four million hectares are now in production and that there may be as much as 30 million hectares of fresh, brackish, and salt water swamp areas suitable for some level of aquaculture production. There will be financial costs to the preparation of swamps and other areas into ponds for aquaculture production. There will be a need in LDCs to allocate their scarce capital resources between a variety of options.

8. There is a need for socio-economic studies regarding the demand and the supply of fish and fish products. Economic studies of the type would assist in the decisions associated with 7 above and provide information on the economics of aquaculture in relation to other agricultural products.

There remains much to be learned about specific aspects of fish production and many constraints which must be effectively overcome. However, much is also known about the technical aspects of aquaculture production and significant production levels can be achieved through an expansion of the land area used for aquaculture together with a progressive application of improved techniques. In the Philippines an improvement in milkfish culture techniques enabled average annual production from commercial ponds to increase from 300-400 kg/ha to 1,000 kg/ha over a five-year period. In India the adoption of moderately intensive polyculture techniques in pilot areas of Indian carps increased yields from 600 kg/ha to 4,000-5,000 kg/ha in a two-year period.

There are opportunities for short-term gains in aquaculture production as well as making a significantly greater amount of protein food available in LDCs. The Agency has had and can continue to have a role to play in the increasing yields of aquaculture production through a continuing relationship with the International Center for Aquaculture, Auburn University.

## II. Grantee Performance and Results to Date

Auburn University was awarded a 211(d) grant of \$800,000 for a five-year period on June 24, 1970. The grant was made after a three-year period during which the Agency and Auburn had executed a General Technical Services contract and a Basic Ordering Agreement, which carried funding for core support. The objectives of the 211(d) grant were:

1. To add to the faculty, experts with competence in selected fields so as to provide broader technical assistance in aquaculture to developing nations.
2. To develop a library containing worldwide literature on aquaculture and more effective methods of dissemination of information on aquaculture.
3. To provide training and educational opportunities through short courses, symposia, and University courses for professional staff members of AID, other federal agencies and private foundations, for students interested in careers in international development, for Peace Corps Volunteers, and for foreign nationals.
4. To develop a worldwide collection of data on important food fishes and other aquatic organisms presently cultured or that appear suitable for culture.

The first objective, to develop faculty competence in the international aspects of aquaculture, has been of primary importance throughout the period of the grant. Particular faculty emphasis has been given to aspects of aquaculture that are of greatest importance in the solution of problems in LDCs. The size of the core-staff has remained relatively static since the beginning of the grant; however, numerous changes have been made in the scientists comprising the core. Scientists brought to the campus as part of the core-staff have been shifted partially and then completely to other projects as the overall fisheries and aquaculture program of the University has developed. Generally, they have held joint appointments between the grant and other projects. These joint appointments have resulted in a larger number of scientific specialities being represented on the core-staff than would be possible otherwise. In 1966, and prior to a formal Agency relationship with Auburn, the fisheries department had six staff members which has since increased to 22. Moreover, the number of staff serving overseas providing technical assistance has increased from zero to seven.

The second objective, to develop library materials relating to aquaculture, is an on-going task and the University Library staff has been involved in acquiring necessary materials. These materials have been catalogued and included in the University Library where they are available to all students and staff for study. Virtually no progress has been made in developing more effective methods of dissemination of information on aquaculture.

The third objective, to provide training and educational opportunities, has required more effort and time than other objectives. Most of the training emphasis has been on graduate degree training. Since 1966 graduate enrollment has increased from 26 to 67 with the number of foreign students going up from five to 34. By 1974 Auburn had provided training to 121 foreign students in the technical aspects of fisheries production. In past years most of the foreign students have been trained at the M.S. level and these graduates have returned to their respective countries to work on the technical aspects of fisheries. Auburn is now beginning to train foreign students at the PhD level. It is expected that these students will return home to teach in Universities or Colleges. After a period of time, some of the training now undertaken by Auburn will be shifted to the LDCs.

A new emphasis is being given by Auburn to provide short-term, non-degree practical training. New approaches to training are being developed and will be conducted at Auburn and overseas.

The final objective, to develop a worldwide collection of data on potentially suitable fish for culture, is, in part, related to the second objective. New acquisitions to the University Library have emphasized the collection of data on important or potentially important food fishes.

The original grant proposal has been described as being "rather typical of some of the early grants in terms of its vagueness and generalities". 4/ An evaluation of Auburn's performance becomes subjective when attempting to assess the competency of the institution given the vagueness of the initial documents. Specific indices such as X number of faculty or X number of students trained may be necessary but are not sufficient conditions to institutional competency. The Auburn review team, however, concluded that, "Given this lack of specific indices, the obvious peer recognition of its competence as an international center and its record of response to AID initiatives - the team can only conclude that indeed Auburn University has successfully achieved the purpose of the original grant." 5/

The past work of Auburn University has been directed toward identifying and solving the technical constraints and increasing aquaculture production. At the beginning of the AID relationship with Auburn a number of short-term visits were made to LDCs throughout the world. These trips can be considered as orientation trips: to familiarize the Auburn staff with the level of international aquaculture production and to familiarize LDC government and Mission officials with Auburn's capabilities.

4/ R. E. Kitchell, "Comprehensive Review of Auburn University 211(d) Grant on Aquaculture", Nimeo, October 21, 1974, p. 16.

5/ Ibid, p. 16.

~~Summary~~ \*A number of specific country-level projects has characterized the current international involvement of Auburn. Three technical advisors from Auburn are working in the Philippines on fresh and brackish water aquaculture. Two technical advisors are working in Brazil at the Pentecoste Aquaculture Research Facility. This facility exists because of the initial recommendations made by an Auburn team and the interest and support of the Brazilian Government. An Auburn staff member is also assisting in El Salvador at the Santa Cruz fisheries station. Short-term technical advisory services continue to be provided.

In conjunction with the Brazil project, research was conducted on the culture of the all male hybrid of the male Tilapia hornorum and the female T. nilotica. At the present time the Pentecoste station is the only research organization in the world producing and working with the all male hybrid. The results of the research have been significant enough to cause the Brazilian government to allocate \$300,000 of its budget to the expansion of existing hatcheries so that 2,000,000 male hybrid Tilapia fingerlings can be produced annually.

During the grant period Auburn has not developed an effective network of linkages with other universities and agencies, particularly with the University of Rhode Island. This problem will be a specific part of the revised grant project design. This is not to say that Auburn has had no outside contacts with other institutions.

Auburn is a participant in a cooperative research project on Aquatic Food Animals sponsored by the Cooperative State Research Service of the U.S. Department of Agriculture. Agricultural experiment stations in North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Mississippi, Louisiana and Texas; the Tennessee Valley Authority; the U.S. Fish and Wildlife Service; the National Marine Fisheries Service; and the Economic Research Service and Agricultural Research Service of the U.S. Department of Agriculture. Not all of these participants have active projects but all are involved in exchange of information obtained for the culture of that species is applicable to a variety of cultured fishes. The cooperative project involves research and development in the following areas:

1. Production and management.
2. Water pollution and quality.
3. Fish diseases.
4. Product development and quality control
5. Market research and economics.

Auburn's linkage with the cooperative project provides ready access to a significant portion of information being developed in warm-water aquaculture in the U.S. Pertinent information obtained through the cooperative project can quickly be made available to international linkage points.

Auburn also has a linkage with the University of Rhode Island. Although the two Universities are involved in widely divergent aspects of fisheries work, there are some projects where the linkage is beneficial. The University of Rhode Island has a strong program in resource economics; especially in the area of exploitation of wild stocks of fish. Auburn has relatively little expertise in this area. Already in FY 1975 the two Universities have cooperated in AID funded projects on Lake Victoria in Tanzania, in Costa Rica and on Lake Tanganyika in Zaire.

Linkages have also been established with several foreign universities through Auburn's involvement in the Philippines, contacts have been established with the University of the Philippines and Central Luzon State University. Auburn has trained staff members from each university. The Federal University of Santa Maria in Brazil requested that Auburn locate a professor that could teach aquaculture. A recent Auburn graduate began teaching there this year.

A member of the Auburn staff at the Pentecoste Aquaculture Research Facility has lectured on aquaculture at the Federal University of Ceara in Fortaleza. Auburn has a cooperative research project in fish breeding with the Hebrew University of Jerusalem. Kasetsart University, in Thailand requested assistance from Auburn in locating a consultant to help develop a curriculum in aquaculture. Auburn is currently training a Ph. D. student who is a member of Kasetsart's faculty.

Auburn has established a number of linkages with international development agencies. Auburn recently submitted a bid at the request of FAO for an aquaculture project in Jordan. In April 1975, another staff member will participate as part of a scientific advisory panel on an aquaculture development project sponsored by FAO in Hungary. One member of Auburn's staff served as a technical advisor on two projects for the World Bank. Auburn serves as a referee for research proposals in inland fisheries and aquaculture for the International Foundation for Science in Stockholm, Sweden.

The International Center for Aquaculture at Auburn has established strong effective linkages with a number of LDCs as a result of AID-funded projects. These countries include Brazil, Peru, Colombia, El Salvador, Panama, the Philippines, Thailand, Tanzania and Zaire. Auburn will be responsible for the construction and management of a 1000-acre fish farm in Nigeria that is to be financed by the Nigerian Government; thus establishing another overseas linkage.

### III. Grantee Commitment to Long-Term Involvement

Auburn has been involved in warm water inland aquaculture production technology since 1934. In that year the first experimental ponds were built and the first project approved to study the utilization of impounded run-off water from the watershed to produce fish for farm families in rural Alabama. In a short time Auburn developed aquacultural techniques that provided high quality animal protein year-round in rural diets without requiring refrigeration; that aided in flood and erosion control through the storage of runoff waters high on the watershed; and that reclaimed some of the nitrogen and phosphorus fertilizers from the flood water draining from the agricultural lands.

Since 1967 Auburn, in association with AID, has greatly expanded its aquaculture program to include a major international dimension. As a result, Auburn is the world's leading institution in the fresh and warm water aspects of aquaculture. As stated by the Agency review team, "it is clear that indeed Auburn University has done everything requested of it by AID. It is equally clear that they are the outstanding institution in the entire world in the area of aquaculture production technology in warm water areas. Its commitment to the international dimension is total and, in fact, the international fisheries program is a source of great pride to the university as a whole." 6/

Auburn has been in the process of developing a relatively closed system of aquaculture production which efficiently utilizes water, agricultural wastes & aquatic plants and nutrients. Among Auburn's major contributions to aquaculture are the following:

1. Development of procedures for the construction of small ponds to impound run-off water from the watershed.
2. Development of economical systems of water utilization and management so that only run-off water is necessary for aquaculture.
3. Development of techniques for testing the suitability of species of fish for aquaculture.
4. Development of techniques for the use of inorganic fertilizer for aquaculture.
5. Development of polyculture systems of aquaculture using species that complemented each other in the pond.
6. Development of feeds for warm-water fishes.
7. Studies on the problems resulting from parasites and diseases in cultural fishes.
8. Major contributions to the channel catfish farming industry, the largest aquaculture industry in the U.S.

---

6/ Ibid, p. 16

The Fisheries Department at Auburn, of which the International Center for Aquaculture is a part, receives funds from other than AID. These sources and amounts are shown in Table 4 for the period, July 1974 to June 1975.

Table 4. Source and amount of funds for Fisheries Department, Auburn University, FY 1975.

Source of Funds		Amount
State appropriations		\$287,502
University teaching funds	145,333	
University agricultural research funds	127,669	
Personnel benefits on salaries	14,500	
AID - 211(d) grant		170,432
Other Federal appropriations		79,000
Hatch Act funds	73,000	
Personnel benefits on salaries	6,000	
Total		\$536,934

Funds from the 211 (d) grant accounted for 32 percent of the Department's budget in FY 1975. In addition to the direct funding of the Department's activities the university also provides indirect support for these activities. This includes the provision of three buildings for classroom, laboratory, and office use; administrative services and computer time; an 1,400 acre research area; funds for construction of 223 earthen research ponds; and funds for construction of service buildings on experimental pond area.

#### IV. Rationale for Revision/Extension

The potentials for aquaculture production suggest the opportunity for making a major impact upon increasing world protein supplies. The Agency has a commitment to assist the rural poor and a variety of strategies address this goal. AID's past involvement in the field of aquaculture has built a foundation of research and knowledge that can be applied to LDC field conditions. While not all projects will be equally successful, as befits innovation, there are many on-going projects sponsored by AID and host country governments.

Aquaculture production in the Philippines is currently 98,900 tons annually and a production target of 300,000 tons has been established for 1978. <sup>7/</sup> The government is requesting an AID-loan of \$20 million to develop a College of Fisheries in association with the aquaculture research station at Iloilo. AID and Auburn will continue to have an involvement in aquaculture production in the Philippines. For many years fish were intercropped in rice paddies but the increasing use of pesticides in rice production caused a decline in fish production.

<sup>7/</sup> Philippine Council for Agricultural Research, Monitor, Vol III, No. 1 Jan 75 p. 4

Rice varieties are now being developed at IRRI (International Rice Research Institute) which are resistant to certain pests. Auburn's staff in the Philippines is assisting with research on the intercropping of fish with these new rice varieties.

The Oceanic Foundation in Hawaii has a contract to perform research on the artificial propagation of the milkfish. This is a major fish in the Filipino diet and present milkfish culture techniques are restricted by the inadequacy of natural seed supplies. A breakthrough on the production of this fish will greatly enhance aquaculture production in the Philippines. Auburn is also planning to sponsor an aquaculture workshop in Thailand in the latter part of 1975. A fourman survey team is scheduled to go to Indonesia in May.

In Latin America, Auburn has had a long involvement with the Pentecoste Aquaculture Research Facility in Brazil. The Brazilian government has committed about \$3.8 million to the expansion of the Facility and hatcheries in addition to normal maintenance, exclusive of salaries, over the next five years. Auburn will continue to have a technical assistance and training function in association with the development of Brazilian aquaculture. Colombia is interested in developing a shrimp production project, with the involvement of Auburn, and has a \$3 million AID-loan application pending for the implementation of this activity. Panama is planning to utilize four man months of consultation services with Auburn this year.

Auburn is involved as one of several advisors in a feasibility study of the expansion of a fishery cooperative in Zaire. As mentioned above, Auburn has signed a contract to develop and manage a 1,000 acre fish farm. This project is being funded by the Nigerians but the results of the project may have implications for other African nations.

All of these projects have the potential for contributing to increased aquacultural production. Of major importance are the on-going projects in Brazil and the Philippines. Increases to aquaculture production in these two countries could have strong ramifications upon other Latin American and Southeast Asian countries respectively.

Auburn is the major U.S. institution with an expertise in the inland warm water aspects of aquaculture production. The University of Rhode Island has expertise in coastal and artisanal fisheries along with a strong knowledge of the economics of fish. The University of Oregon is a leading institution in cold water aquaculture, e.g. trout farming. Since the Agency has shifted away from the direct-hire of technicians it has become even more important that U.S. institutions be available with current and relevant knowledge of specific disciplines as they relate to international problems and concerns.



Auburn is not totally dependent upon AID for maintaining its expertise in aquaculture, however, its ability to provide international technical assistance would be limited if they were dependent only upon mission contracts. The Director of the International Center for Aquaculture indicated that, "this expertise cannot be purchased by the pound, ton or crate. Regular 'buyer-seller' relationships cannot be used to transfer expertise from the Universities to AID. New types of agreements, cooperative agreements possibly, must be developed to effectively provide for the orderly building, storage and delivery of this expertise." <sup>8/</sup> Auburn's Fisheries Department would still exist if AID funding ceased, however, the International Center for Aquaculture component of the department would not be able to provide its past level of assistance to AID and the quality of its international expertise would gradually diminish.

Current and proposed aquaculture projects with which AID is involved are becoming increasingly complex. In order for AID to make valid contributions to these projects the expertise must be available. Moreover, there is a need for new levels of information to be available to decision-makers. In addition to Auburn's unequalled competence in the technical aspects of aquaculture production, there is also a need to develop their capabilities in the economics of aquaculture production.

#### V. Revised Grant Project Design

##### A. Purpose

The goal of the aquaculture sector is to provide more protein food and increase rural incomes and employment opportunities in JDCs from the increased use of aquaculture and inland fisheries. The purpose of the grant extension is to focus and maintain an institutional response capability at Auburn University to assist developing countries in aquaculture with emphasis on the small producer and the development of aquaculture production as a source of protein for poor consumers. This is to be accomplished through the maintenance and augmentation of the core staff and response capability developed with the present 211(d) grant awarded to Auburn University with emphasis being given to outreach and utilization. The focus of the grant extension has been more specifically defined to reflect Agency goals and review team recommendations in addition to Auburn's interests. The major recommendations of the Agency review team of Auburn's 211(d) grant were:

1. The discipline base applied to aquaculture should be broadened.
2. While continuing with Auburn's concentration upon warm water and inland fisheries there should be a strengthening of its total systems competence within this focus.

<sup>8/</sup> E. W. Shell, "Response to Issues", memo, c. September 1974, p. 11

3. Auburn's response capabilities in planning at both project (micro) and national (macro) level should be further increased.

4. State-of-the-art efforts undertaken by Auburn should give priority to questions concerning the effectiveness of aquaculture in providing protein for the poor and in providing income and employment for small producers. A comprehensive examination, during the period of the grant extension, should be made of the potentials, accomplishments, limits, and impediments of aquaculture development in LDCs. A result of such a study should be the development of a set of national fisheries policies to increase fisheries production.

5. Auburn should develop more effective linkages with other universities, other donor agencies, and within AID. 9/

B. Objectives / Outputs

The further refinement and maintenance of an institutional response capability at Auburn is characterized by an emphasis upon aquaculture production economics and a production system requiring minimum financial inputs. The grant extension will provide funds to develop this knowledge and to transmit it through: formal education and training opportunities, advisory services, publications, and a collegial network of linkages. As a result of this work, information will be available which will allow for the further assessment of the contribution of aquaculture production to a country's protein needs as well as to increased incomes and employment opportunities. Additionally, the system of aquaculture production that Auburn is developing requires a minimum of inputs. Therefore, it is a system which is feasible for a small producer to utilize.

Specifically, the program to be funded by the grant revision and extension has five primary objectives:

1. To provide education and training opportunities in inland fisheries and aquaculture related to international development.

2. To continue to develop and improve the knowledge base of Auburn including the development of a capability in production economics as related to aquaculture.

3. To develop a more effective capability for advisory services and actively promote its utilization.

4. To continue to collect, analyze, publish and disseminate information.

5. To develop a strong professional network of linkages between Auburn and LDC institutions, international development agencies, and U.S. institutions.

---

9/ R.E. Kitchell, "Comprehensive Review of Auburn University 211 (d) Grant on Aquaculture", Mimeo, October 21, 1974, pp. 25-27.

These objectives are explained in detail below:

1. Education and training (114 mm - \$196,850)

The first major output of the grant extension is to increase and improve training opportunities. Aquaculture technology is not a material or a ready-made set of techniques which can be readily transferred. It is knowledge residing in people which can effectively be transferred to LDCs, primarily through training people in this knowledge. Funds from the present grant are being utilized to support the current training program which is considered to be excellent. There are, however, a number of changes that were made to make the education of foreign students and the training of short-term visitors more responsive to their needs. In order to meet this output the following activities will be undertaken:

a. Support of core staff for education and training activities (24 man months). Good graduate training requires good formal coursework but, more importantly, it requires a continuing series of personal encounters between the teacher and the student. These encounters are costly in terms of faculty time, but they are absolutely essential in training graduate students and are very important to the training of international students.

Tuition and fees paid by graduate students at most Land Grant Universities provide only a fraction of the cost of training those students. At Auburn the difference in what the student pays and the actual cost is provided by appropriated funds from the state legislature. When students in the program are residents of the state, the use of appropriated funds is a practical solution to the problem of making up the difference between fees and tuition and costs. Auburn now has 61 graduate students in the fisheries program: only 13 are Alabamians while 22 are international students. International development organizations and the LDCs must be prepared to bear a larger part of the cost of training graduate students at Auburn in the future; especially since the program is expected to include 35-40 foreign students by next year. Grant funds will be used to provide staff time for the graduate training program, especially for the personal supervision or training of students for international development work. Teaching-load standards generally prescribe not more than 16 active graduate students per teacher. Assuming that fees and tuition pay a portion of teaching costs, grant funds will be utilized for approximately 24 man-months of teaching effort.

b. Provide specialized training for graduate students (36 man-months). Many of the foreign students have had little formal fisheries and aquaculture training and have relatively limited knowledge of the practical aspects of the field. Most of the international students are at Auburn for 18-24 months. This period is too short to make up for their undergraduate deficiencies and train them at a graduate level. In order to train more effectively there is a need to provide these students with specialized training. Auburn plans to take advantage of those times between academic quarters. These intervals will be used to good advantage to provide training in the practical aspects of the aquaculture and those subject areas they may have missed as undergraduates. Included in this specialized training would be participation in routine activities of the experimental fish farm, observation of research activities, attending short-courses specifically designed to meet their needs, visiting a wide variety of commercial fish farms in different states and visiting Federal and State fisheries and aquaculture laboratories.

With the number of foreign graduate students now attending Auburn, and that are likely to attend within the next two years, there is a need for 12 man-months of effort for training coordination, scheduling activities, maintaining contacts with commercial fish farms and government laboratories, teaching shortcourses, and accompanying students on field trips. The person with responsibility for the special training activities should also visit the home countries of some of the students. These visits would be for the purpose of learning something of the training received before the student come to Auburn and the nature of the type of work they will be expected to do when they return home. The professor also would be able to advise missions on the types of training available and help plan more effective training programs in fisheries and aquaculture. These types of contacts would be beneficial to Auburn in matters relating to admission of students, course content, courses required in the curriculum, and teaching schedules. In addition, 24 man-months of effort will be provided through graduate research assistants, secretarial services, and field labor.

c. Provide specialized short-term training for officials of LDCs and international development agencies. (18 man-months). A large number of visitors requiring specialized training go to Auburn each year for visits ranging up to two months, for example, 75 people visited in FY 1974. Because they are present for such short periods of time they can not be included in the formal training program of the Department. Seminars, shortcourses, visits with appropriate staff specialists, field demonstrations, and field trips must be arranged especially for them. Scheduling and supervising this type of

training requires considerable staff time. Work will also commence on designing, testing, and evaluating short-courses, workshops, etc., which can be held in-country aimed at selected audiences, e.g. agriculture decision-makers. Auburn will utilize

grant funds for approximately eight man-months of effort to administer and coordinate this type of training. It is anticipated that the same person responsible for providing specialized training for international graduate students would also be responsible for this activity. An additional 10 man-months of effort from graduate research assistants, secretaries, and field laborers will be required to support this activity.

d. Support of training activities. (36 man-months)

Auburn provides a portion of the funds for the purchase of supplies, equipment and pond operation associated with training and the remainder is provided by research funds. International students are generally provided with funds for fees and tuition and some funds are available for each student to purchase supplies and equipment used in thesis and dissertation research. Training funds must be utilized to pay a portion of the cost associated with the training of short and long-term students in aquaculture. It is planned to utilize 36 man-months of effort from graduate research assistants, secretaries, and field laborers in this activity.

2. Extended Knowledge Base (204 man - \$214,860)

The grant will enable Auburn to continue strengthening its knowledge in the field of aquaculture and inland fisheries and to develop additional knowledge of economics and marketing as related to fish production. In order to meet this output the following activities will be carried out:

a. Support of core staff for a continued expansion of knowledge base, (126 man-months). During the present five-year grant period, grant funds have supported a total of 216 man-months of core staff effort (including Research Associates, Assistant Professors, Associate Professors, and Professors) and 109 man-months graduate research assistant effort. This support has resulted in Auburn's increased competence in the technical aspects of aquaculture production which consists of a complex interaction of a variety of disciplines. This variety of disciplines is absolutely essential in order to provide the necessary knowledge for the development of efficient fish production systems.

The distribution of effort among the various aquacultural disciplines is projected as follows:

	FY 76	FY 77	Total
<u>Discipline</u>	<u>(man-months)</u>	<u>(man-months)</u>	<u>(man-months)</u>
Economics and marketing	21	27	48
Production systems	12	12	24
Pond ecology	8	8	16
Processing and technology	6	6	12
Spawning and rearing	6	6	12
Pathology	4	4	8
Nutrition	<u>3</u>	<u>3</u>	<u>6</u>
Total	60	66	126

As indicated above, the effort to be devoted to economics and marketing is the greatest of all the disciplines. This REFLECTS the new focus of the grant extension. The work to be done within the other disciplines focuses primarily upon developing an efficient system of aquaculture production that requires a minimum amount of purchased inputs. This work will enable the small producer to undertake aquaculture production on an economic basis.

1. Economics and marketing. The amount of effort utilized in these areas is to be significantly increased over the two year period to 48 man-months from a present annual level of 2.4 man-months. This is responsive to the review team's recommendations and Auburn's interests. Although data in economics and marketing is limited, it is important in the development of viable and effective aquaculture production systems in LDCs. Auburn proposes to establish joint appointments between the Department of Fisheries and Allied Aquacultures and the Department of Agricultural Economics and Rural Sociology in order to develop their competence in these fields.

During the grant extension available information on economics and marketing in aquaculture will be assembled. Attention will be directed to the role of existing and potential aquacultural production in local diets and on price and income activities. The effect of aquaculture production upon rural incomes and employment opportunities will be examined. The results of such studies will be used in the establishment of policies relating to aquaculture development.

Aquaculture development is to be viewed from a perspective broader than that of economic feasibility with traditional cost-benefit analyses. There is also a need for social analyses based on aquaculture products as a source of protein and its acceptability.

Auburn plans to sponsor a state-of-the-art seminar in aquaculture economics within the first eight months of the extension period. Seminar participants will include representatives from institutions and agencies with economics expertise, e.g., FAO, AID, and the University of Rhode Island. This seminar will enable Auburn and the other participants to determine priorities within the field of aquaculture economics. Based upon the results of the seminar, Auburn will develop plans for one or two major workshops to be held during the second year of the grant extension.

2. Production Systems. One of the primary advantages of aquaculture is its adaptability and suitability for use in a wide variety of pond production systems. When considering the large number of species available for production in either monoculture or polyculture, the number of different types of aquatic habitats available for culture, and the different levels of management that can be applied, there is a large number of production systems that can be used in LDCs. Auburn proposes to utilize 24 man-months of effort in improving its knowledge base on various production systems and response capability in this area. Particular emphasis will be given to polyculture. Polyculture involves the stocking of several complementary species of fish into a pond. This allows for the potential utilization of all food resources within a pond with a minimum of inputs. Auburn has been working with fish species which are important in LDCs in an attempt to determine which species to stock, optimal size for stocking, and optimal time for stocking. As these determinations are made Auburn will be able to advise LDCs on the optimal mix of fish species to be used in the development of aquaculture production.

3. Pond Ecology. There is a special need for core staff support in pond ecology. Management of the natural food supply in ponds through management of the pond ecology is especially important in LDCs. In many countries supplemental feeding is impractical. In those cases, increased production can be obtained only through manipulation and management of the natural food supply. Even in cases where supplemental feeding is used, the natural food supply contributes significantly to total production in the pond. Natural foods also serve to balance inadequate or poor quality rations often used in LDCs. Aquatic insects, zooplankton, and phytoplankton provide vitamins and amino acids which may be low or lacking in poor quality feeds.

The focus of this work will be upon the effect aquaculture production has upon the environment. This work will be directed to the maximum utilization of naturally present food materials. Since fecal materials are also utilized there will be a minimal deleterious effect upon downstream water uses.

4. Processing and Technology. Auburn proposes to utilize 12 man-months of effort in improving the knowledge base and providing response capability in this area. Of particular interest is the development of processing techniques that will make it practical to utilize fish for food that are poorly utilized because of small size and degree of bonyness. The technology is available to separate fish flesh from bones resulting in comminuted flesh. There is now a need for product development, i.e., to determine the best ways of utilizing comminuted flesh. For example, Auburn is currently working on the deboning of the Tilapia and using the comminuted flesh as an extender with shrimp and crab products. It is also planned that Auburn will work on improving the methods of preservation that are appropriate to LDCs and responsive to consumer demand.

For example, in the Philippines milkfish production is increasing and the distribution system functions well for fresh fish. There is a need to develop preservation methods in order to assure the full utilization of the increased production. Auburn will be able to undertake the requisite research in a new laboratory building which is being completed.

5. Spawning and Rearing. One of the primary limiting factors to increased fish production in LDCs is the lack of an adequate number of fingerlings for stocking production ponds. This limiting factor is the result of a lack of information on spawning the various fishes in captivity, a poor understanding of the care and rearing of recently hatched fish, and a lack of understanding of fish hatchery management. The ideal culture fish is one characterized by demand spawning, i.e. the fish spawns when the culturist wants it to and produces a predictable quantity of eggs. The common carp is the only fish which is easily responsive to demand spawning and that produces fry with low mortality rates. Auburn will continue its work on spawning and emphasis will be directed to Tipapia, Chinese grass carp, Israeli carp, silver carp, and other species of importance in aquaculture in LDCs. In conjunction with this, Auburn will develop a research proposal which will utilize techniques known about the spawning of the common carp and apply them to other species.

Auburn also considers the problems of fish hatchery management to be of major interest. The university will develop plans for a fish hatchery management workshop to be conducted during the second year of the grant extension. Additionally, Auburn will provide a response capability in the area of fish hatchery management. This will enable Auburn to interact directly with the fish hatchery manager and provide assistance on problems encountered at the hatchery.



6. Pathology. Auburn has good support for work in fish pathology and progress is being made in improving the knowledge base in this area. Intensively cultured fish are highly susceptible to disease. In tropical countries the constant water temperature is highly conducive to fungal, bacterial, and parasitical infections. Auburn will focus its work upon skin and gill parasites which are a major cause of fish pathology in LDCs.

7. Nutrition. Improvement of the knowledge base on nutrient requirements of a variety of fish species being cultured is important. The Agency's focus in aquaculture production is upon the small producer and in developing a system requiring minimum inputs. There is a need to develop practical feeds that can be manufactured from a wide variety of ingredients that are found locally in LDCs. Auburn plans to use six man-months of effort in determining methods of reducing the need for relatively expensive animal protein feeds. For example, one way of reducing this dependency is by stocking a pond with tiny forage fish which serve as a source of protein for predator species. Various agricultural wastes may also serve as nutritious fish feeds.

b. Support of staff research and development activities. (78 man-months) The second activity, the support of research and development activities, is necessary to provide support to the core staff. The required support personnel include graduate research assistants (24mm), secretaries (8mm), and field and student laborers (46mm). The required support equipment and supplies includes laboratory supplies, fish feeds, office supplies, telephone charges, printing, scientific books and journals, and travel.

### 3. Advisory Capacity (34mm - \$78,690)

The third major output to be accomplished during the grant extension is to develop a more effective capability for advisory services and actively promote its utilization. Many projects now undertaken by Auburn have a major extension component. There is a need to further develop an inland fisheries and aquaculture extension methodology at Auburn. A number of activities will be undertaken to achieve this output and include:

a. Develop core staff and institutional response capability. (24 man-months). For the effective utilization of the results of Auburn's research an extension and advisory service capability must be available. At the present time, extension in inland fisheries and aquaculture is being done largely by persons who learn how to do it on the job. Auburn will provide professional training to those persons who will be responsible for developing training programs for in-country fisheries extension agents.

b. Provide personnel for technical backstopping of AID and overseas projects. (6 man-months). Virtually all of Auburn contract work in LDCs requires advisory services or technical backstopping. In technical backstopping Auburn provides information or services that are required for effective contract performance and may involve nothing more than the provision of books, pamphlets, or answers to specific technical questions which are forwarded to a field project leader. Auburn also provides services such as analyzing a feed sample for protein content or pesticide concentration or determining the amount of phosphorus and nitrogen in a fishpond fertilizer. It is expected that specific contracts will pay for the technical backstopping, but funds from the grant will be used to offset part of the costs of having the broad range of specialists available at Auburn.

c. Provide personnel to serve as coordinators of projects in LDCs. The success of a well-planned project depends, in large measure, on the personal and technical capability of the project coordinator. Good technical knowledge is essential as is knowledge of the applicability of methods to specific field situations. The coordinator must also have the ability to communicate his ideas effectively and in the right spirit to his counterparts. He also should have an innate interest in helping people and the confidence that given the proper conditions he can make a difference in people's lives in LDCs.

It is difficult to locate people with all of these characteristics. In the first place there are relatively few aquaculturists in the U.S. and even fewer have any experience in international development. Unlike agriculture, the pool from which Auburn can draw specialists in international aquacultural development is small. Hopefully this situation will improve in the future but there is a need to develop a talent pool of expertise from which Auburn can draw its project leaders both at Auburn and from U.S. institutions

and agencies. Auburn needs to develop a mechanism for providing specialized training for new staff before they are assigned overseas and for holding returning staff for a period on campus before they are reassigned to other projects. Auburn desires to be able to choose and attract good people and give them adequate training before they are sent overseas. For orderly management of its international program, the university plans to establish a core of experts from Auburn and else where to use as project coordinators.

d. Provide personnel for advisory services, (4 man-months). The potential for aquaculture in many LDCs is great but there have been project failures because of poor project planning. Even with good technical assistance and good technical backstopping, poorly conceived and planned projects will fail to contribute much to aquaculture development in LDCs. Auburn plans to participate more actively in the formation of projects through the provision of four man-months of release time, and will maintain its staff expertise and experience in project planning and development.

4. Information Capacity(26mm - \$61,850)

The fourth output is the collection, analysis, publication and dissemination of research information. It is extremely important for the rapid development of aquaculture that research results be published and disseminated quickly and effectively. When appropriate, staff members will participate in those international meetings and seminars where there is good opportunity to disseminate information, especially those sponsored by FAO and other international development agencies. Results of research and development activities will also be disseminated to three different audiences: scientists, administrators, and producers. Reprints from the published articles will be purchased and distributed through Auburn's regular mailing list, which presently goes to about 600 persons in 34 countries. Information obtained as a result of staff activities will be provided regularly to AID.

5. Linkages and Networks(12mm- \$25,950)

The final output is to establish, where practical, linkages with appropriate institutions in LDCs and the U.S. Cooperative research projects in agriculture conducted by Land-Grant Universities under the auspices of the Cooperative State Research Service of USDA have demonstrated repeatedly the value of research linkages and research networks. Accomplishments of such projects can be considerable when there are elements of mutual interest and mutual need for information on the part of the research workers involved. However, where projects are initiated without those elements the results are often poor.

Linkages between research facilities in different countries, when working on common problems in aquaculture, will also be beneficial in the future, but are of lesser importance now because of the shortage of trained staff and adequate facilities in many of the countries. Until an enlarged research and development capability is established in those countries, formal linkages will probably not be rewarding; however, there will be opportunities during the next two years for Auburn's staff to establish linkages with a number of research groups in LDCs. As Auburn's staff travels in the LDCs while servicing AID projects they will be encouraged to seek out potential linkage counterparts for exchange of information and a discussion of future plans in order to facilitate the utilization of Auburn's expertise. Auburn will continue to develop already established linkages with appropriate officials and institutions in Brazil and the Philippines. The university has an opportunity to develop links with various African nations as a result of a contract Auburn has signed with Nigeria.

In addition to its linkages with LDC institutions the Auburn staff will take a more active role in developing contacts with U.S. institutions and agencies. Auburn will contact them more frequently and provide them with up-to-date information on its work and on important developments and problems in the fields of aquaculture and inland fisheries. The necessary contacts can be made and maintained through more widespread distribution of annual reports of the International Center for Aquaculture; distribution of annual reports and end-of-tour reports of overseas projects; distribution of publications developed specifically to provide information to potential users; and through seminars presented to personnel of international development agencies, universities, and LDCs. It is expected that Auburn will further develop and maintain linkages with the UNDP, FAO, the Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and universities. Since Auburn is developing a competency in aquaculture economics there will be a common professional interest with work undertaken by the University of Rhode Island. Auburn will work with the University of Rhode Island on the proposed seminar on aquaculture economics. Auburn will work with Sea Grant's extension program personnel to further develop its fisheries extension methodology. FAO has an interest in programs in aquaculture on a world-wide basis which is, of course, of mutual interest to Auburn. The university has and will continue to develop its links with FAO. A possible joint research project between Auburn and the University of Arizona will establish a link to the Consortium of International Development (CID) and mutual interests in watershed management. Grant funds will be utilized to pay for the salaries and travel expenses of staff persons.

C. Budget

The budget for the grant extension describes annual expenditures for the two-year period by years, inputs, and outputs.

GRANT EXTENSION BUDGET

Inputs

	<u>FY 76</u>	<u>FY 77</u>	<u>Total</u>
Salaries and Wages	\$161,000	\$181,200	\$342,200
Personnel Benefits	29,000	32,600	61,600
Travel	18,000	18,000	36,000
Graduate Research Assistants	30,600	32,500	63,100
Equipment and Supplies	30,000	33,000	63,000
Library and Printing	<u>6,000</u>	<u>6,300</u>	<u>12,300</u>
Total Inputs	\$274,600	\$303,600	\$578,200

<u>Outputs</u>	<u>FY 76</u>		<u>FY 77</u>		<u>Total</u>	
	<u>(\$)</u>	<u>(mm)</u>	<u>(\$)</u>	<u>(mm)</u>	<u>(\$)</u>	<u>(mm)</u>
Education & training	\$ 96,700	57	\$100,150	57	\$196,850	114
Knowledge base	95,840	99	119,020	105	214,860	204
Advisory capacity	39,000	17	39,690	17	78,690	34
Information capacity	29,840	13	32,010	13	61,850	26
Linkages & networks	<u>13,220</u>	<u>6</u>	<u>12,730</u>	<u>6</u>	<u>25,950</u>	<u>12</u>
Total Outputs	\$274,600	192	\$303,600	198	\$578,200	380

## VI. Complementary Actions and Management Considerations

Auburn currently has staff members assigned to AID-funded technical assistance projects in Brazil, El Salvador, and the Philippines. Additionally Auburn personnel will be assigned to the non-AID-funded fish farm in Nigeria. Auburn's competencies are being utilized on major long-term aquaculture development projects.

In addition to these on-going projects, other AID-funded projects are in various states of Agency review for which Auburn may be involved.

A PROP entitled Technical Assistance Advisory Services in Aquaculture was reviewed and approved by the R&DC on March 18. This proposed project will enable the Agency to take advantage of Auburn's expertise and have them provide advisory services on aquaculture production to LDCs, missions, and TAB. Approximately 24 trips to LDCs have been included in the project budget over a three-year period.

Another PROP entitled the Regional Research and Training Facility for Aquaculture is ~~being developed~~ for R&DC review. This project follows the continuum that has been evolving during the long relationship of Auburn and AID in Northeastern Brazil. Technical assistance provided by Auburn helped to identify the need for an aquaculture research facility and subsequently helped to develop the research program. Brazil has budgeted approximately \$3.8 million exclusive of salaries, to maintain and expand the Facility in the next five years. Brazil is interested in developing the Facility into a regional center for aquaculture serving the needs for Latin America. The proposed project is designed to provide technical assistance and training, in conjunction with Auburn, to help create this regional center.

As designed, the proposed project has national, regional, and international implications. Nationally, the project proposes to make a concerted effort at applying research results to field conditions. The successful application of the research results will result in an increasing amount of fish production. On a Latin American regional basis it is projected that the Pentecoste facility will serve as a research and training facility for the region. With the regional focus at Pentecoste it is expected that linkages can be developed and maintained with "outreach" fish culture stations in Colombia, El Salvador, and Mexico. Assisting in the

development of institutional linkages between Latin American fish culture stations is the fact that Auburn has been working in Columbia and El Salvador. On an international basis this proposal could be considered as a "pilot project." If the project is successful - in increasing aquaculture production and the subsequent improvement of diets in addition to developing intra-regional linkages then it may serve as a basis for developing similar regional facilities in Asia and Africa.

As stated previously, the Filipino government is in the process of requesting an AID-loan of \$20 million to develop a college of fisheries at Ililo. If approved, this project will involve both Auburn and the University of Rhode Island. Additionally, a breakthrough in milkfish spawning techniques by the Oceanic Foundation could involve Auburn in additional research and the application of new spawning techniques.

One of the constraints to increasing aquaculture production is in spawning and raising juvenile fish in hatcheries for distribution to farmers. Auburn is developing a research proposal which addresses the problem of fingerling production. Another research proposal that has long been in the planning stage is a cooperative project between Auburn and the University of Arizona. The two universities intend to focus upon an integrated watershed system that includes the management of water resources for the production of vegetables, livestock, and fresh water fish in small watersheds before the water escapes onto large plains.

The International Center of Aquaculture is, in many respects, a technical assistance arm of AID. The university has developed an excellent department staffed by a large number of skilled professionals. The facilities and staff are far beyond what is needed by the state of Alabama. Auburn will be a prime candidate for a program research grant under Title XII if that form of research program becomes a reality. If for some reason this does not happen, it will very likely be necessary for the Agency to continue funding some of Auburn's activities under the 211(d) authority or in some other form. The proposed grant extension is funded at an increased level relative to the initial grant so that Auburn's capability in aquaculture production economics can be developed. It is expected that any future grant requests will be at a level to support a core staff in order to respond to mission and LDC requests for assistance. Additional funding for Auburn's activities will be through research contracts, mission-funded contracts, and other international development agencies' contracts.

The work that Auburn is performing is applicable to tropical countries throughout the world. The university has responded to requests for training and advisory services from all of the Agency's regional bureaus. Therefore, continued central funding and management of this grant is appropriate.

An evaluation of the grant will be made after one year. This evaluation will determine Auburn's progress to the grant extension purpose and the need for an extension of the grant.

The Agency has had a long relationship with Auburn university. As a result of a great deal of work by both Auburn and AID there now exists an opportunity to fully exploit the potentials of aquaculture development. The continued utilization and development of Auburn's competencies and capabilities is one way of meeting the challenge of doubling world food supplies.

#### Role of Women

Because the proposed grant is to develop and maintain an institutional response capability in an intermediary U.S. institution, rather than to assist an LDC directly, the activity is somewhat outside the Percy Amendment. None-the-less, in AID's negotiations, the grantee will be apprised of the intent and importance of the Percy Amendment and urged to consider arranging, whenever feasible, for participation of women in substantive capacities in grant activities, e.g., in training programs or in the technical staff resources to be utilized in the institution's several areas of response capability. These actions would serve to demonstrate the role of women to the LDCs.