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TERMINAL REPORT

AUBURN UNIVERSITY PROJECT

AID/csd-2270

INCREASING FISH PRODUCTION BY IMPROVED FISHCULTURES

Date: August 30, 1973

Prepared by: D.D. Moss
Assistant Director
International Center
for Aquaculture

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BACKGROUND INFORMATION

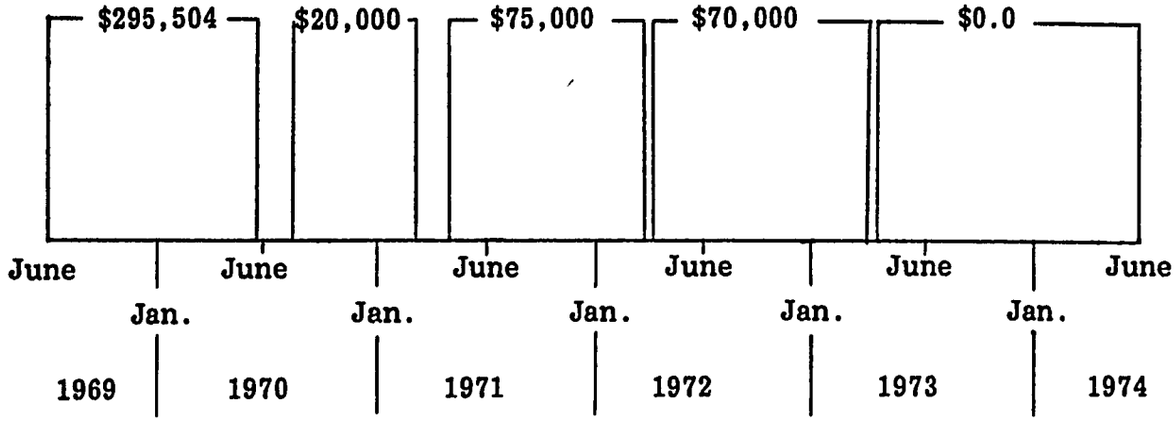
The initial project "Increasing Fish Production by Improved Fishcultures (AID/csd-1581)" was implemented June 30, 1967 and terminated June 29, 1969. During the two years that the initial project remained in effect, AID/Washington made available to this worldwide project, funds amounting to $364,972. Major work activity consisted of conducting surveys principally to assess the potential for aquaculture development in various countries in Africa and Asia as requested by USAID Missions through AID/Washington. Generally, a survey or feasibility study was conducted at no cost to the USAID Mission or the host-country government. However, follow-up work involving short-term services of fisheries specialists normally was financed directly by the USAID Mission with substantial logistical support provided by the host-country. From June 30, 1967 to June 29, 1969, 12 staff members contributed 23 man-months of short-term services to USAID Missions and host-country governments in 26 countries. Fourteen major reports were prepared and transmitted to AID/Washington for review and distribution to the appropriate USAID Mission and host-country government. A listing of the surveys carried out with indication of dates, countries visited and staff members involved is included in the Appendix.

THE CENTRALLY FUNDED, WORLDWIDE PROJECT AID/csd-2270

Project AID/csd-2270, "Increasing Fish Production by Improved Fishcultures" became effective June 30, 1969 and presently carries a termination date of June 30, 1974. As can be surmised by the project title, this is essentially an extension of Project AID/csd-1581 in that technical services in fishculture and other fishery fields are provided by the International Center for Aquaculture to various USAID Missions and host-country governments as requested through AID/Washington's Office of Agriculture, Bureau of Technical Assistance. Project AID/csd-2270, however, has the advantage of being written in language that conveniently permits the inclusion of Task Orders under the Basic Ordering Agreement. Thus, USAID Missions desiring technical services in aquaculture or other fisheries fields have the prerogative of requesting and paying for those services through a relatively simple process of issuing a Task Order under the existing basic ordering agreement or through the formalization of a separate contract. The latter procedure normally requires a much longer time period due to greater detail and effort required for document preparation and approval.

From the effective date of June 30, 1969, through the present scheduled termination date of June 30, 1974, AID's Office of Agriculture has contributed financial support to the Worldwide Fishculture Project amounting to $460,504. Over the five-year period (June, 1969 through June, 1974), approximately 64, 8, 16, 11 and 0 percent of the total amount funded by AID/Washington was

made available for project use for fiscal Years I through V respectively. The funding pattern is shown graphically in the following illustration.



A chronological resume of the major contractual features of the Basic Ordering Agreement and the funding provided under Task Orders 1 and 6 of the Worldwide Project is given below while a breakdown of expenditures for the fiscal year and the cumulative total expenditures to date may be seen in the following table.

Worldwide Contract AID/csd-2270 (Basic Ordering Agreement)

Effective Date : June 30, 1969
Expiration Date : June 29, 1970
Amendment No. 1: Extended contract to January 31, 1971
Amendment No. 4: Extended contract to June 30, 1972
Amendment No. 5: Extended contract to March 31, 1973
Amendment No. 6: Extended contract to June 30, 1973
Amendment No. 7: Extended contract to June 30, 1974

Task Order 1 (Funding Mechanism for Worldwide Contract)

Effective Date : June 30, 1969
Expiration Date : June 29, 1970
Amount Funded : ---------- $295,504

Amendment No. 1: Extended T.O. 1 to July 30, 1970
Amendment No. 2: Extended T.O. 1 to September 30, 1970
Amendment No. 3: Extended T.O. 1 to October 30, 1970
Amendment No. 4: Extended T.O. 1 to January 31, 1971
Amount Funded : ---------- $ 20,000
Amendment No. 5: Extended T.O. 1 to June 30, 1971

Task Order 6 (Funding Mechanism for Worldwide Contract)

Effective Date : April 1, 1971
Expiration Date : March 31, 1972
Amount Funded : ---------- 75,000
Amendment No. 1: Extended T.O. 6 to March 31, 1973
Amendment No. 2: Extended T.O. 6 to June 30, 1973
Amount Funded : ---------- 70,000

Total Amount Funded Under Worldwide Contract $460,504

During the year, a total of $75,359.24 was expended under the contract leaving a balance of $567.95 under the Worldwide Contract. Three staff of the International Center for Aquaculture contributed 1.5 man-months of foreign service in three countries. Over the time span of the project to date, foreign work was substantial with 19 man-months of short-term services provided by 29 staff members in 39 countries. Fifteen major reports were prepared and distributed to USAID Missions and host-country governments under the Central Project.

RECAPITULATION OF EXPENDITURES
AID/csd-2270
Worldwide Project

Item	Total Amount Budgeted 6/30/69 - 6/30/73	Amount Expended 7/1/72 - 6/30/73	Cumulative Total Expended 6/30/69 - 6/30/73
Salaries	$251,823	$ 35,118.00	$200,127.73
Overhead	98,412	13,671.28	93,461.73
Fringe Benefits	30,283	3,310.25	16,000.03
Equipment and Supplies	36,881	3,171.54	24,851.17
Travel and Transportation	37,105	3,324.72	26,350.31
Other Direct Costs	6,000	16,763.45	99,145.08
	$460,504	$ 75,359.24	$459,936.05

Total Amount Budgeted	$460,504.00
Cumulative Total Expended	459,936.05
Balance	$ 567.95

RESUME OF USAID MISSION FUNDED PROJECTS

As the result of initial surveys carried out in various countries in Africa, Asia and Latin America under the worldwide or centrally funded contract, several cooperative fisheries projects subsequently developed under direct funding arrangements by various USAID Missions. A synopsis of the contractual features of each project is presented below while a summary or progress report of each project operative during 1973 is presented later in this report.

USAID Missions, through June 30, 1974, will have contributed a total of $882,213 to various aquaculture and allied fisheries projects since the project AID/csd-2270 (Increasing Fish Production by Improved Fishcultures) was implemented June 30, 1969.

USAID Mission Funded Projects (Task Orders under AID/csd-2270)

Task Order 2 (Thailand)

Effective Date : August 1, 1969
Expiration Date : December 31, 1970
Amount funded : ---------- $ 23,647

Technical services: 5 man-months for providing training in various subject matter areas for fisheries biologists of Thai Fisheries Department and for reviewing previous research and assisting in planning future research and extension activities.

Task Order 3 (Brazil)

Effective Date : October 15, 1969
Expiration Date : October 15, 1970
Amount Funded : ---------- 28,015

Amendment No. 1: Extended T.O. 3 to October 15, 1971
Amount Funded : ---------- 43,913

Technical services: 24 man-months, advisor in fishculture research to Government of Brazil.

Task Order 4 (Brazil)

Effective Date : August 25, 1970
Expiration Date : August 31, 1972
Amount Funded : ---------- $ 65,451

Technical services: 24 man-months, advisor in fish population dynamics and reservoir management to Government of Brazil.

Task Order 5 (Peru)

Effective Date : February 15, 1972
Expiration Date : April 15, 1972
Amount Funded : ---------- 4,631

Technical services: 1 man-month in country for specialist in aquaculture to advise Peru's Ministry of Fisheries on aquaculture development.

Task Order 7 (Thailand)

Effective Date : October 1, 1971
Expiration Date : January 15, 1972
Amount Funded : ---------- 14,870

Amendment No. 1: Provided additional funds for in country travel amounting to ---------- 1,630

Technical services: 3 man-months for reviewing current research projects and planning future research and extension activities.

Task Order 8 (Brazil)

Effective Date : March 25, 1972
Expiration Date : April 30, 1974
Amount Funded : ---------- 91,285

Technical services: 12 man-months, fishculture extension specialist; 12 man-months, fishculture research advisor to Government of Brazil.

Amendment No. 1: Extended T.O. 8 to June 30, 1974
Amount Funded : ---------- 116,321

Task Order 9 (Thailand)

Effective Date : September 1, 1972
Expiration Date : February 28, 1973
Amount Funded : ---------- 14,400

Technical services: One man-month each for fisheries biologist and fisheries nutritionist to assist personnel of Thai Department of Fisheries. One man-month on campus to complete work on length-weight relationships of Thai fishes.

USAID Mission Funded Projects (Separate USAID Contracts)

USAID/ea-180 (Philippines)

Effective Date : July 23, 1971
Expiration Date : June 30, 1973
Amount Funded : ---------- $161,043

Technical services: 24 man-months with two advisors in fisheries to the Government of the Philippines.

Amendment No. 1: Provided additional funds of 83,085
Amendment No. 2: Provided additional funds of 4,530
Amendment No. 3: Extended Contract 180 to June 30, 1974

Amount Funded : ---------- 113,259

USAID/la-684 (Panama)

Effective Date : August 18, 1971
Expiration Date : September 30, 1972
Amount Funded : ---------- 119,881

Technical services: 12 man-months, advisor in fisheulture to Government of Panama plus 3 man-months short-term services for specialists as may be needed.

Amendment No. 1: Extended Contract 684 to March 31, 1973

Amount Funded : ---------- 93,091

Amendment No. 2: Extended Contract 684 to June 30, 1973
Amendment No. 3: Extended Contract 684 to February 2, 1974

Amount Funded : ---------- 34,048

USAID/la-688 (El Salvador)

Effective Date : September 27, 1971
Expiration Date : September 30, 1972
Amount Funded : ---------- 80,003

Technical services: 12 man-months, advisor in inland fisheries to the Government of El Salvador plus 4 man-months short-term services.

Amendment No. 1: Extended Contract 688 to December 31, 1972
Amendment No. 2: Extended Contract 688 to March 31, 1973
Amendment No. 3: Extended Contract 688 to December 31, 1973

Amount Funded : ---------- 42,996

	Amendment No. 4: Negotiations presently underway to extend Contract 688 to December 31, 1974.	
Amount Funded	: (projected) ----------	$ 61,864

SHORT-TERM SERVICES PROVIDED INTERNATIONAL FISHERIES PROJECTS UNDER TASK ORDERS, SEPARATE AID CONTRACTS AND OTHER AGENCIES

In addition to short-term work in foreign countries sponsored directly under the Worldwide Project as discussed on page 4, foreign work of similar nature was sponsored: 1) under task orders issued under the Basic Ordering Agreement; 2) through separate USAID Mission contracts; 3) by other agencies and institutions.

From the implementation date of Project AID 2270 through June 30, 1972, a two-year period, a total of 14 professors provided slightly more than 15 man-months of short-term and/or consulting services to various international groups. For the present reporting period, July 1, 1972 - August 30, 1973, 15 specialists from the International Center for Aquaculture contributed 6 man-months to various foreign fisheries activities or projects based in 14 countries. Also, travel plans have been confirmed for eight staff from the Center to provide 3 man-months of additional short-term services in six countries from the period September - December, 1973.

A synopsis of each short-term assignment completed during the year is given in tabular form below and, in turn, is followed by a brief description of the work carried out. A complete listing of all surveys and other consulting services provided to the Agency for International Development and other organizations since the initial AID-sponsored fishculture project was implemented is included in the Appendix.

DATE	COUNTRY	STAFF	PROJECT
1972			
July 16 - July 21	Thailand	Grover	USAID/Philippines
Sept. 22 - Oct. 1	Philippines	Shell, Lovell	AID/csd-2270
Oct. 1 - Oct. 28	Thailand	" "	AID/csd-2270 Task Order 9
Oct. 17 - Oct. 24	New Zealand	Schmittou	USAID/Philippines
Oct. 29 - Oct. 31	Italy	Shell, Lovell	AID/csd-2270
Dec. 17 - Dec. 23	Panama	Lovell	AID/la-684
1973			
Jan. 23 - Jan. 27	Mexico	Smitherman	AID/la-684
Jan. 23 - Jan. 27	Mexico	Moss	AID/csd-2780
Jan. 27 - Feb. 3	Panama	"	AID/la-684
Feb. 3 - Feb. 10	El Salvador	"	AID/la-688
Feb. 11 - Feb. 23	British Columbia	Davies	AID/csd-2780
April 18 - April 21	Philippines	Moss	AID/csd-2270
April 22 - May 22	Bangladesh	"	International Bank for Reconstruction and Development
May 23 - May 25	Thailand	"	AID/csd-2270
May 26 - May 31	Philippines	"	"
June 1 - June 6	Hawaii	"	"
June 11 - June 22	Guatemala	Davies	AID/csd-2780
July 1 - July 3	Mexico	Smitherman	AID/csd-2780
July 10 - July 19	Italy (FAO)	Shell	AID/csd-2780
Aug. 20 - Aug. 31	Haiti	Smitherman	AID/csd-2780
Sept. 12 - Oct. 12	Philippines	Allison	AID/ea-180

DATE	COUNTRY	STAFF	PROJECT
Oct. 12 - Oct. 17	Thailand	Allison	AID/csd-2780
Nov. 18 - Nov. 22	Colombia	Lovell, Rogers	AID/csd-2780
Nov. 22 - Dec. 1	Brazil	" "	AID/csd-2270 Task Order 8
Dec. 3 - Dec. 17	Japan	Lovell	AID/csd-2780
Dec. 3 - Dec. 17	Japan	Lovshin	USAID/Brazil

Dr. John Grover, Fisheries Advisor to USAID/Philippines Project AID/ea-180, observed catfish farming operations in Thailand from July 16 - 21, 1972. Objectives of the trip were to personally observe the techniques utilized so successfully in the large fish farms located near Bangkok, and if possible, to adopt these methods to situations prevailing in the Philippines. The major constraint facing this potential fish farming activity in the Philippines is lack of an adequate supply of trash or low quality fish for feeding the catfish.

Drs. E.W. Shell and R.T. Lovell visited the Philippines from September 22 - October 1, 1972, for the purpose of reviewing the Inland Fisheries Project (AID/ea-180). During this one-week review, the freshwater and brackishwater aquaculture research stations, respectively located at Munoz (Luzon) and near Leganes (Panay), were visited. Conferences also were held with appropriate officials of USAID/Philippines, the University of the Philippines College of Fisheries, Central Luzon State University and Auburn University contract representatives residing in the Philippines.

Drs. E.W. Shell and R.T. Lovell carried out work assignments in Thailand from October 1 - 28, 1972, under USAID Mission funding (Task Order 9). The former concentrated his efforts in reviewing the entire research program of the Inland Fisheries Division of the Thai Department of Fisheries, with emphasis on improving the effectiveness of the research program for the coming year. Dr. Lovell, on the other hand, mainly worked with biologists at the Central Bangkhen Fisheries Station and other selected fisheries stations in formulating economical rations for feeding fish and designing experiments to test various diets. A report of this work, "Inland Fisheries Progress in Thailand, 1972", was prepared and distributed to USAID/Thailand and the Thai Fisheries Department.

Dr. H.R. Schmittou, Chief of Party of the International Center's cooperative aquaculture project in the Philippines, attended the Indo-Pacific Fishery Council regional meeting held in New Zealand October 17 - 24, 1972, where he officially represented the United States by serving as it's delegate to the fishculture section of this conference.

Dr. R.T. Lovell was in Panama for a period of one week, December 17 - 23, 1972, for the purpose of assisting the Auburn University project manager, Dr. R. O. Smitherman, in designing a fish feeds laboratory planned for future construction at the fishculture research station at Divisa. Fish feeding systems to be investigated at the aquaculture station also were considered. A report, "Technical Advisory Visit to Panama on Fishculture: Fish Feeding Systems and Laboratory Design", of this work, funded under contract AID/la-684, was prepared and distributed to appropriate USAID and Government of Panama officials.

Dr. R.O. Smitherman, Project Leader of the Panama Aquaculture Project, contract AID/la-684, with Dr. D.D. Moss of the International Center for Aquaculture participated in the World Mariculture Society Workshop held in Monterrey, Mexico during January 23 - 26, 1973.

Dr. D.D. Moss was in Panama from January 27 - February 2, 1973 to carry out a project review of the Panama Aquaculture Project, AID/la-684. Conferences were held with officials of USAID/Panama and the Government of Panama. The newly constructed experimental pond facility at Divisa was visited. A report, "Review of Panama Aquaculture Project", was finalized and distributed to appropriate offices of the AID Mission and host-country government.

Dr. D.D. Moss also carried out a project review of the El Salvador Fisheries Project, AID/la-688, from February 3 - 10, 1973. In addition to substantive conferences with USAID Missions and host-country government officials, the program of expanded construction of experimental field facilities was carefully reviewed as was the applied research program in fishculture. A report, "Review of the El Salvador Fisheries Project" was subsequently made available to the USAID Mission and Government of El Salvador.

Dr. W.D. Davies attended the Technical Conference on Fishery Management and Development, sponsored by FAO and the Canadian Government, held in Vancouver, British Columbia February 12 - 23, 1973.

Dr. D.D. Moss was in the Philippines April 19 - 21, 1972, to discuss with officials of the USAID Mission and Auburn University Contract representatives a tentative agenda for an aquaculture workshop proposed to be held in the

Philippines in late 1973. Dr. Moss again stopped in the Philippines May 26 - 31, 1973, at which time the proposed aquacultural workshop was discussed principally with government officials.

An inland fisheries identification and preparation mission under auspices of the International Bank for Reconstruction and Development was carried out in Bangladesh from April 22 - May 22, 1973, in which Dr. D.D. Moss served as consultant. Following completion of work in the field, he assisted in report preparation in Washington, D.C. for a three-week period.

Dr. W.D. Davies carried out a pre-feasibility survey concerning the fisheries development on Lake Izabal, Guatemala, June 11 - 22, 1973. A report, "Lake Izabal Fisheries Survey", has been finalized and will soon be distributed to personnel in the USAID Mission and Government of Guatemala.

Dr. E.W. Shell attended a conference held in Italy from July 10 - 19, 1973, in which discussions and ideas were exchanged among directors of various international centers, FAO and granting agencies regarding the form that future programs in fisheries development and aquaculture programs should take.

Dr. R.O. Smitherman very soon after returning from a long-term tour in Panama, departed campus August 20, 1973, to carry out a survey in Haiti and to formulate a logical program of aquaculture development there at the request of the USAID Mission. After the return of Dr. Smitherman on August 31, a report will be prepared for submission to AID/Haiti.

LONG-TERM AQUACULTURAL PROGRAMS SUPPORTED BY USAID MISSIONS

Cooperative aquacultural programs of a long-term nature were operative in Brazil, El Salvador, Panama and the Philippines, with a total of seven professors contributing 6.3 man-years to these projects during the year. From the initiation dates of the various cooperative aquaculture projects through December, 1973, slightly more than 15 man-years of long-term technical assistance have been contributed by the eight staff specialists from the International Center for Aquaculture.

Resume and Present Status of Auburn University's Participation in the Brazil Fisheries Project

A short-term survey of fisheries development in Northeast Brazil was carried out June 27 - September 3, 1966 by a Team of three professors (Dendy, Shell, Prather) from Auburn's Fisheries Department under personal contracts with the U.S. Bureau of Commercial Fisheries. Preliminary investigations were on the potential of the irrigation and water supply reservoirs constructed by DNOCS (National Department of Works Against the Droughts) to supply under management large quantities of fish for local consumption in this food-deficient area. The Team recommended that a program involving the intensive management of ponds for fish production should be initiated in addition to reservoir investigations.

Upon return of the same Team to Northeast Brazil, August 7 - September 20, 1967, a suitable area for a pond research station was located below the dam of Pereira de Miranda Reservoir at Pentecoste. However, land for this site could not be made available. From August 19 - September 21, 1968, an Auburn Team

(Shell, Prather, Jeffrey) investigated and approved an alternate site on DNOCS lands near its Training Center. Subsequently, a plan for a modern fishcultural experiment station was prepared. Construction at this site began in early 1969 under a USAID - DNOCS project with assistance by Mr. Harris Magnusson and Mr. George Reese, USAID/Brazil.

Task Order 3 to Auburn University's worldwide project, AID/csd-2270, was approved and initiated November 21, 1969. Under this contract, Dr. Norris Jeffrey began a 2-year tour in Northeast Brazil with the primary duty of advising on construction of the experimental station and training DNOCS field personnel in developing systems of aquaculture. Task Order 4, AID/csd-2270, provided technical services of Dr. William Davies, a fisheries biologist with expertise in reservoir fisheries management, for the period November, 1970 to September, 1972. Subsequently, the USAID Mission, after consultation with the Government of Brazil, decided to discontinue technical services on fish management aspects of reservoirs of the Northeast and increase emphasis on aquaculture. Task Order 8 (AID/csd-2270), providing one technician each in fishculture extension and fish-culture research fields was formalized March 25, 1972 with advisors in those disciplines arriving at duty posts May 19, 1972 and June 16, 1972, respectively. Task Order 8 presently is funded through June, 1974 after which it apparently will be allowed to terminate.

Counterpart training opportunities for Brazilian staff affiliated with the Fisheries Project have been provided by USAID/Brazil, but these principally were in the form of short-term tours to the International Center for Aquaculture and other institutions. Amaury da Silva received 9 months practical training

in fishculture techniques at Auburn University, while two other biologists, Helio Melo and Odilo Dourado, received specialized training in related fishery fields of limnology and fisheries biology for similar periods of time. Also, four Brazilian biologists took part in a special 2-month training tour of various fish hatchery, aquaculture, and fisheries research stations in the United States. The first two Brazilian biologist to be enrolled in an advanced degree program in aquaculture at Auburn University arrived on campus only on June 10, 1973, with another participant scheduled for arrival in September, 1973. Since a Master's degree program requires a minimum of 2 years to complete, it is unlikely that present participants will complete their degree programs and return to work with the Brazil Aquaculture Project prior to mid-1975. Even then, it would be highly desirable that the returnees work for a couple of years under the guidance of experienced aquaculture advisors in order that the Brazilians can rapidly gain experience and confidence in carrying out an effective aquaculture program for Northeast Brazil.

Outstanding progress has been achieved during the past year. In line with the increasing importance of fisheries in the Northeast, a separate Department of Fisheries was established within DNOCS. Previously, all fisheries work was administered under the Department of Agriculture and Irrigation; consequently, top level decisions concerning fisheries projects were made by persons who had little appreciation or understanding of fisheries. Now that fisheries has been elevated to departmental status, improved communication, cooperation and enthusiasm for aquaculture program is beginning to be translated into an improved research effort resulting in more productive and meaningful outputs.

Adaptive research at the Pentecoste Fishculture Station carried out during the past year indicates good potential for fishculture:

a) Hybrid Tilapia stocked at the rate of 8,000 fingerlings per hectare resulted in total production of 920 kg/ha and 1,586 kg/ha with fertilization and feeding respectively during a growing period of 253 days.

b) Tambaqui (Myletes bidens) and the Pirapitinga (Mylosoma sp.), fish species obtained from the Amazon River, both were tested on a preliminary basis to assess their suitability for intensive fish-culture. These two fish species grew at a very high rate, readily accepted pelleted ration, were tolerant of poor water quality, were easily harvested and brought a good price when marketed. Net production for Tambaqui was 2,294 kg/ha with the fish growing from 6 to 1,245 grams (2.7 lbs) in 13 months. With Pirapitinga the net production was 2,207 kg/ha and the fish grew from an average of 9 to 992 grams (2.2 lbs) in 13 months.

A very important project concerned with developing spawning techniques for producing fingerlings of these two fish species is being initiated.

The fishculture extension program also is producing good results. A number of farmers involved with fishculture operations in the Sao Francisco River Valley were visited. One farmer who started growing fish eight years ago in a four-hectare pond, now has 70 hectares of ponds in production. These fish farmers are making profits in their fishculture operation and they appear

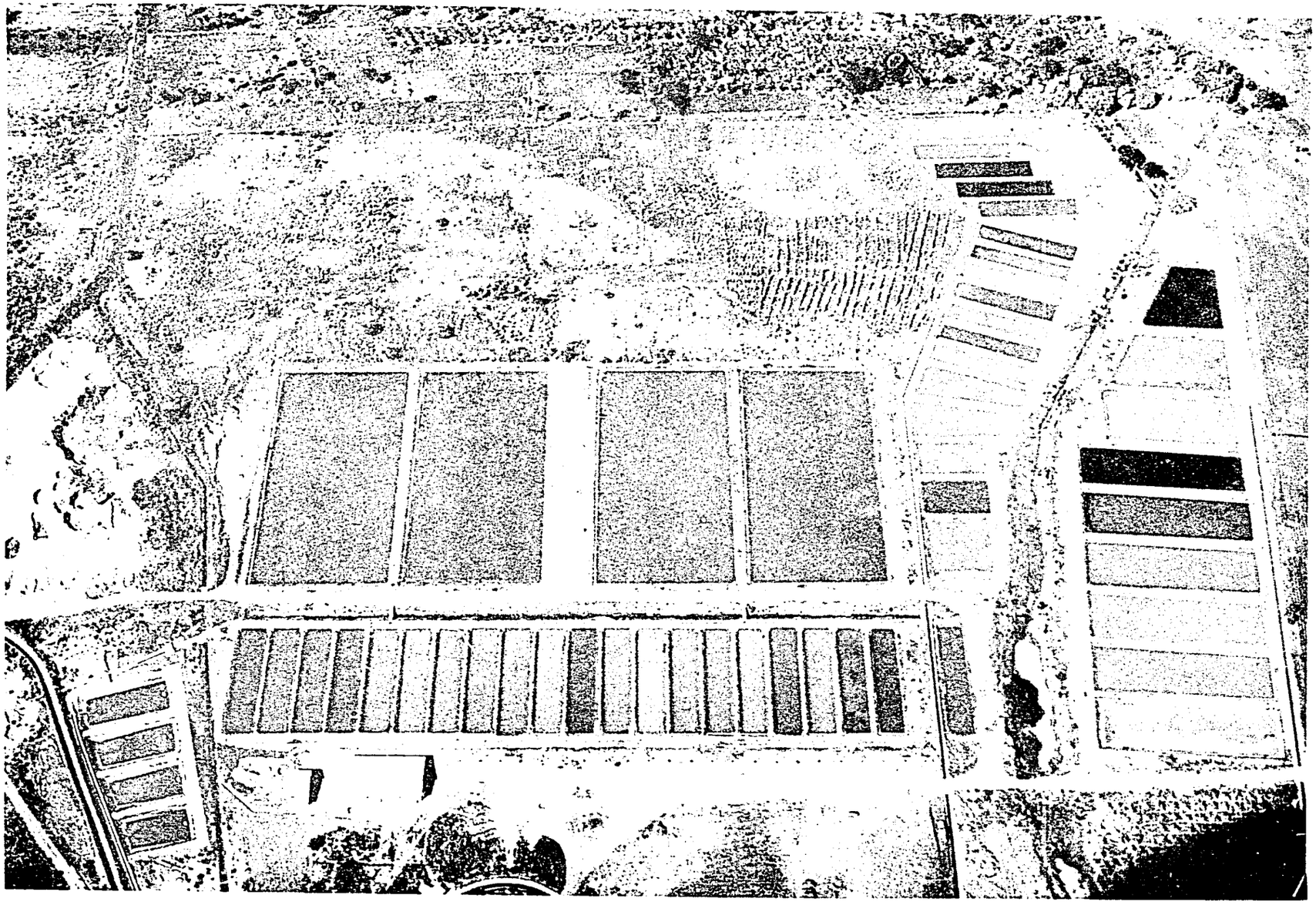
very eager to adopt improved management methods. Hence, a highly effective extension program could be developed upon the presently small but existing fish farming base.

It should be noted that the Pentecoste Fishculture Station (see photograph) is a well-designed aquacultural testing facility. With a total of 54 ponds comprising nearly 12 surface acres of water, it not only is the largest aquacultural testing facility in Latin America, but it also would serve as an excellent site for training extension fishculturists and holding short courses for farmers interested in implementing fish farming programs.

We at the International Center for Aquaculture are well aware of the increasing constraints that many USAID Missions are facing due to continued reduction of monies made available to AID's foreign assistance program. This particular project, however, has outstanding potential for developing and improving methods of aquaculture that can provide substantial quantities of high quality protein at relatively low cost inputs to Brazil. We strongly feel that every effort should be made to secure adequate financial support from private foundations, the private sector and other funding sources in order that this facility can firmly be established as the International Center for Fishculture for the entire Latin America Region.

Resume and Present Status of Auburn University's Participation in the El Salvador Fisheries Project

The El Salvador Cooperative Fisheries Project was formalized September 27, 1971. Dr. David R. Bayne was employed under contract AID/la-688 on January 1, 1972, and upon completion of orientation programs on campus and Washington, he arrived on post January 28, 1972. As the fisheries advisor



View of the Pentecoste Fishculture Station, Ceara State, Northeast Brazil. Largest ponds in center are 1.25 acres each while lower ponds are 0.1 acres in surface area. Ponds on extreme left and right of photograph range in size up to 0.25 acres. Total number of ponds - 54; Total water area - 11.4 acres.

to the Government of El Salvador, Dr. Bayne is coordinating a program of fisheries development in El Salvador that consists of three major work areas: 1) investigations of the fisheries resources of the major lakes and other natural waters of El Salvador; 2) the aquaculture research programs at Santa Cruz Porrillo Fishculture Station; 3) the renovation and expansion program at the Fishculture Station.

In February 1971, when Dr. D.D. Moss of the International Center for Aquaculture conducted the initial fisheries survey[1] in El Salvador, freshwater fisheries activities in the country were carried out principally by a single biologist of the fisheries section. At that time, the fisheries section was a very small administrative unit under the Department of Forestry, Ministry of Agriculture. Renovation of fish ponds at Santa Cruz Porrillo, which for all practical purposes had received inadequate maintenance for many years, had begun with assistance of the Peace Corps and USAID/El Salvador. Also, other programs were being initiated that were concerned with an inventory of existing farm ponds and natural lakes of the country and the contribution of these waters in terms of fish harvested.

In January, 1972, the Fisheries Section was administratively elevated to the status of a Department under the General Direction of Renewable Natural Resources of the Ministry of Agriculture. At that time, there were six host country biological technicians (none of whom had completed university degree programs), four Peace Corps Volunteer biologists and a supporting staff of

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[1] Inland Fisheries Survey Report for El Salvador by D.D. Moss. Project: AID/csd-2270, April 30, 1971. 48 p.

two. During the past year, four additional biologists, three of whom have college degrees in biology, and two additional supporting staff were employed. Also, a graduate civil engineer was assigned full-time to the Department to direct all construction and renovation activities at Santa Cruz Porrillo Fisheries Station. The four Peace Corps Volunteers, whose normal duty tours terminated in 1972, were replaced, with the exception of one who extended for another year. The Volunteers all possess Bachelor of Science degrees in fisheries and one has a Masters' degree in limnology.

The Department of Fisheries now has increased responsibilities in that in addition to inland waters, it also has been charged to manage and develop fishery resources of brackish and salt waters.

Financial support for the Cooperative Fisheries Project by the Government of El Salvador (GOES) has vastly improved for the current year over that made available to the project in 1972. Capital improvement funds allocated for the renovation of existing and construction of new facilities at Santa Cruz Porrillo Fishculture Station may be summarized as follows:

Year	Funds Budgeted by MAG	Project Use
1972 (Jan.)	₡ 15,000	Construction of 6 earthen ponds and drilling of deep well.
1972 (Dec.)	₡135,000	Additional pond construction, shop and garages and repairs of existing laboratory and aquarium buildings.
1973	₡119,000	Additional pond construction, second deep well and completion of renovation of station buildings.
Total Capital Improvement Funds Budgeted by GOES for Fishculture Project	₡269,000 ($107,600)[1]	

[1]One ₡ is equivalent to U.S. $0.40

In addition to the capital improvement budget amounting to ₡269,000 ($107,600) made available to the cooperative fisheries project, the Fisheries Department has substantially increased its operating budget from ₡110,000 in 1972 to ₡227,000 for 1973. The Government of El Salvador is also considering initiating a community fish pond development program that, if implemented, will carry an initial budget of ₡131,250 and be administered by the Fisheries Department.

Renovation of the existing pond facilities at the Fishculture Station essentially was completed during 1972. Dams of ponds were repaired, bottoms of ponds were graded to facilitate draining and water inflow and outflow structures of ponds were repaired as needed.

Construction of six new 0.1-acre earthen ponds was nearly complete in February, 1973. Unfortunately, practically no construction work was possible during the latter one-half of 1972 as the initial construction budget of ₡15,000 had been expended by June, 1972. Construction on the earthen pond complex was resumed in December following release of additional funds (₡135,000). It was anticipated by project engineers and the head of the Fisheries Department that construction of at least 18 and possibly the entire group of 32 new earthen ponds would be completed by late 1973.

A well to supply water to the new earthen pond cmplex was drilled (another is under construction) and found to have a capacity to deliver 800 gallons per minute of good quality water.

Plans were prepared by project engineers and construction initiated on 15 of 30 concrete ponds, each with a surface area of 20 square meters. Building plans for a combination warehouse - workshop-garage complex also were finalized and the site for this building was cleared and terraced. Also, the foundation

and walls for the wet-laboratory building has been completed.

Renovation of the main laboratory building was carried out; broken window panes and damaged screens were replaced, offices partitioned and painted, one bathroom completely renovated and new sewage lines laid and a chemistry laboratory air-conditioned and supplied with chemicals and various equipment items. Although the renovation program of existing buildings has not yet been entirely completed, very substantial progress was achieved during the year.

Yield trails to compare production of two fish species (Tilapia aurea and Tilapia mossambica) were carried out under different test conditions at the Santa Cruz Porrillo Fishculture Station. The former consistently out-produced the latter Tilapia species in ponds receiving organic and inorganic fertilizers. Also, it was found that Tilapia aurea generally grew more rapidly and attained a greater average size than T. mossambica. The carnivorous guapote tigre, Chichlosoma managuense, was found to be an effective biological control agent for Tilapia when stocked at a ratio of 1:1.

Research was begun to systematically evaluate the culture potential of selected native species of fish. Two popular food fish, mojarra negre (Cichlosoma macracanthus) and juilin (Rhamdia guatemalensis) are being tested in replicated pond trials receiving organic fertilization. The juilin may prove a valuable fish in mixed culture with Tilapia. It does not reproduce in ponds with clean bottoms, grows to an acceptable size in 4 to 6 months, and feeds on insects and small fishes.

Fish pens, with surface area of 0.01 hectare and constructed of wooden posts and a board frame covered with one-half inch galvanized chicken wire, are being evaluated as possible production units for natural waters and constructed ponds or lakes that cannot be drained.

A pelleted supplementary feed containing coffee pulp, an inexpensive and commonly availab by-product of the coffee industry, is being tested. The coffee pulp ration, containing 11.3% digestable protein and 30% pulp, is being evaluated with Tilapia aurea. Other feed ingredients, in addition to the coffee pulp are: corn meal, 24%; molasses, 20%; cotton seed meal, 14%; wheat bran, 10%; urea, 1% and bone meal, 1%. These feed ingredients are readily available in El Salvador and the low cost of coffee pulp results in a total feed cost, excluding pelleting, of only $1.72 per 100 pounds of ration. Preliminary results with this ration were sufficiently encouraging in pen culture experiments to justify further testing in replicated earthen ponds.

One large experimental pond was managed for commercial production to obtain information on management costs and investment returns. The pond was stocked per hectare with 10,000 male Tilapia and 5,000 guapote tigre and receives . ry daily applications of chicken manure. Total fish production was in excess of 3,000 kilograms/ha and over 1½ tons of fish were sold to people coming to the Fishculture Station within a 3-day period. A table giving the costs and profits of this pilot fish production effort follows.

Investigations began in 1971 on the large lakes of the country and were continued and broadened to include work on some of the smaller natural bodies of water. The following large lakes were visited by the Lake Survey Team at

COSTS AND PROFITS OF FISH PRODUCTION
EL SALVADOR

The data are based on the production of tilapia and Guapote Tigre culture during six months carried out in a 1.5 ha pond located at the National Fishculture Station, Santa Cruz Porrillo, 1972 - 1973.

A. INITIAL COSTS

	¢	$
Estimate Cost of Construction (1.5 ha pond)	8,000.00	3,200.00
Seine Net (locally made)	300.00	120.00
Containers for Transporting Fish	50.00	20.00
TOTAL	8,350.00	3,340.00

B. FIXED ANNUAL COSTS

Amortization of Construction of the Pond Over 20 Years	400.00	160.00
Seine Nets and Other Equipment Amortized Over 5 Years	70.00	28.00
TOTAL	470.00	188.00

C. COSTS OF PRODUCTION

Fingerlings, 15,000 @ ¢.015	225.00	90.00
Fertilizer		
Chicken Manure, 15,185 lbs. ¢0.03/lbs.	456.00	182.40
$(NH_4)_2 SO_4$, 66 lbs. Superphosphate	11.00	4.40
Labor, ¢2.63/day - man day		
Stocking	118.00	47.20
Fertilizing	24.00	9.60
Sampling	37.00	14.80
Harvesting and Marketing	108.00	43.20
Repairing of the Pond	168.00	67.20
TOTAL	1.147.00	458.80

D. ANNUAL GROSS PRODUCTION

7,772 lbs. (¢0.40/lb.)	3,109.00	1,243.60
737 lbs. (¢0.20/lb.)	147.00	58.80
TOTAL	3,256.00	1,302.40

E. ANNUAL GROSS PROFIT	3,256.00	1,302.40
FIXED ANNUAL COSTS	470.00	188.00
ANNUAL COSTS OF PRODUCTION	1,147.00	458.80
ANNUAL NET PROFIT	1.639.00	655.60

EQUIVALENT TO: C1,092.00 = $436.0ó/ha/year or $177/ac/year

When the last harvest was made in January 1973, more than 3,000 lbs. of fish were sold during four days on the fishculture station, Santa Cruz Porrillo, Depto. De Sn. Vicente, El Salvador, C.A. The price of the fish at the station was ¢0.35 = $0.14/lb. which is about one-half the price of fish selling at fish markets.

least twice, usually for a month during the dry season and another month during the wet season: Lago de Guija (42 Km^2), Lago de Coatepeque (25 Km^2), Lago de Olomega (24.2 Km^2) and the reservoir La Presa 5 de Noviembre (20.0 Km^2). The small natural lakes visited included Laguna Verde (0.075 Km^2), El Espino (1.0 Km^2), Chalchuapa (0.050 Km^2), Laguna de Metapan (3.125 Km^2) and Laguna de Jocatal (1.10 Km^2). The time spent investigating each of the small lakes varied greatly with the size of the lake and the degree of complexity of the existing fishery.

The objectives of the work carried out on the lakes were to:

1. Estimate total harvest of each lake in 1972.

2. Determine the average length, average weight, and percentage by weight of each species in the total catch.

3. Evaluate various fishing techniques used and their effects upon the fishery. Determine catch per unit effort and size distribution of fishes caught with different types of gear. Experiment with new types of fishing gear.

4. Gather data on processing and marketing in each location and determine a market value of the catch.

5. Gather biological information, including stomach analyses, observations on fish reproductive conditions (egg counts) and phytoplankton analyses.

6. Gather water chemistry information at each location.

7. Establish a select census in each of the large lakes consisting of four of the best and most dependable professional fishermen, each fishermen being paid to collect and record catch data each month.

All of the field work has been completed and research papers are being prepared for publication. In the case of the large lakes, the 1971 and 1972 results were consolidated into one report.

A farm pond evaluation study that was begun by the Pond Survey Team in 1971 was completed and the results and conclusions have been prepared for publication. The study was designed to provide current information in the following areas:

1. Number, size, location, condition and current use of all existing farm ponds in El Salvador.
2. Fish species being used and management practices employed.
3. Major problems limiting fish production.
4. An estimate of actual annual production.
5. An estimate of potential annual production based upon production obtained in selected farm ponds that are stocked, managed and harvested by biologists of the Department.
6. Processing and Marketing techniques employed.

The results of this study emphasized the great need that exists for a sound promotion and extension program. For example, of the 53 hectares of farm ponds in the country, only approximately 10% are being managed to produce harvestable crops of fish. Owners of almost half of the unused ponds expressed interest in fishculture but lacked the knowledge of how to pursue it. Estimated total annual production of pond-reared fishes was less than 7,000 Kg.

This study along with research trials at the Fishculture Station have provided valuable information that has been compiled by various members of the Department into "A Fishculture Manual for El Salvador". This manual contains sections on the importance of fishculture, pond construction, pond management, biology of culture species, processing and marketing aspects and the possibilities of forming owner cooperatives.

The Agricultural Extension Service that comprises a department within a completely different division of the Ministry of Agriculture has a fairly extensive network of field offices located throughout the country. Unfortunately the extension agents have had no exposure to fishery training as there has been no contact in the past between the Department of Fisheries and the Agricultural Extension Service.

At this point in the evolution of Salvadoran fishculture, the lack of effective promotion and extension is the most critical limiting factor. The degree of success in the next few years will be measured by how well this deficiency can be remedied.

Two candidates have been selected to receive fishery training at Auburn University. Both are employees of the Department of Fisheries with more than two years experience.

Cesar Abrego Funes received GOES and AID clearance to study to complete the B.S. with a major in Fisheries and was enrolled as a special student in fisheries at Auburn University during the summer quarter, 1973.

Cecilio Garcia Ramirios, who has also studied at the University of El Salvador, is presently being processed by the GOES and is expected to enroll in courses at Auburn University, starting in September, 1973.

Mr. Jose Cabrero, in January, 1973, was appointed to head the Fisheries Department. Although trained academically as a biologist and with considerable working experience in fields of plant sciences, Mr. Cabrero had no formal or practical training in fisheries. It was recommended that USAID/El Salvador provide travel funds for the Head of the Department of Fisheries to participate

in a study tour of the International Center for Aquaculture, Auburn University, and other selected fishculture research and training facilities. This would allow the Head of the Fisheries Department, who has the responsibility of administering the Cooperative Fisheries Project, to observe, first-hand, the various facets of an on-going aquaculture training and testing facility, and also visit selected commercial food fish farming facilities. Mr. Cabrero participated in this special 30-day training program in May, 1973.

Although the freshwater fisheries program has existed since 1948, there are few technical publications. Much of what if known of research and evaluation conducted earlier was passed along by word of mouth. Efforts are now being made to establish regular channels for publishing important papers related to fisheries research, evaluation, management and extension.

Four papers were published this past year. They are:

Sanchez y Dominguez, Carlos. 1972. Embriologia del Camaron de Rios. Agricultura en El Salvador. 12 (2):11 - 13.

Bowman, David. 1972. Cultivo de la tilapia en agua dulce y salada. Agricultura en El Salvador 12 (2):24.

Garcia Ramirios, Cecilio. 1972. Investigacion sobre algas. Agricultura en El Salvador 12 (2):25.

Johnson, K., A. Argumedo y M. Ramirez Hidalgo. 1972. Evaluacion de los Principales Lagos de El Salvador. Agricultura en El Salvador. 12 (2): 26 - 32.

Resume and Present Status of Auburn University's Participation in the Panama Aquaculture Project

The Panama Aquaculture Project was formalized August 18, 1971 following a survey[1] conducted April 27 - May 20, 1970 by two staff (Smitherman and Moss) of the International Center for Aquaculture. Dr. R.O. Smitherman's employment

[1]Fishculture Survey Report for Panama by R.O. Smitherman and D.D. Moss. 63 p. September 1, 1970.

under the contract AID/la-684 was effective January 1, 1972, and following completion of an intensive language training program in Washington, he arrived on post February 3, 1972. After 18 months in-country, Dr. Smitherman returned to campus on August 4, 1973. This project will be serviced until February, 1974, through periodic short-term visits of staff from the International Center. The project then may be extended based upon the decision of the Ministry of Agriculture and USAID/Panama.

The original plans for this project as agreed to by the Government of Panama and USAID/Panama called for the development of two aquacultural facilities: 1) a fishculture research or testing facility basically consisting of a water storage reservoir and 100 one-tenth-acre earthen ponds plus a laboratory building and several concrete tanks, to be constructed at the Tocumen Agricultural Station with cooperation and support from the Faculty of Agronomy, University of Panama; and 2) a combination fish hatchery and demonstration-extension aquacultural facility, consisting of about 60 one-acre production ponds, plus 30 one-tenth-acre hatchery ponds with related buildings, to be constructed at a suitable inland site near Santiago in Veraguas Province.

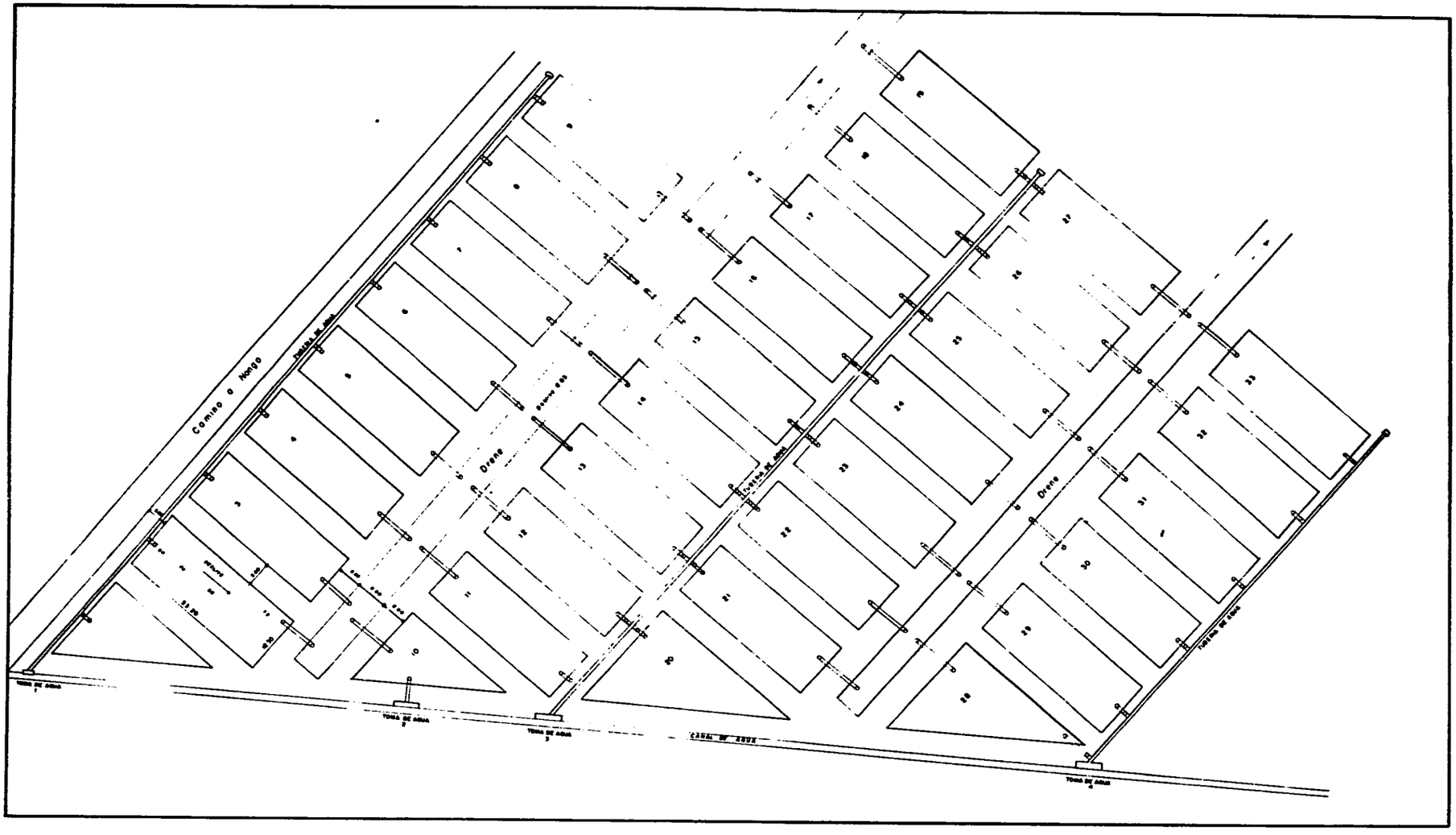
The basic plan as outlined above appeared to be sound in that the University-based aquaculture project would provide staff capability for developing, through testing and research, improved methods of fish farming and also develop an effective teaching program in aquaculture for fisheries biologists and extension agents. On the other hand, the demonstration-extension aquacultural facility would serve principally to demonstrate improved methods of fish farming to individuals and groups who were interested in growing fish and other aquatic animals.

The function of the fish hatchery was to provide small fishes in adequate numbers to land owners with ponds throughout Panama and also to supply fingerling fish needed for culture at the demonstration-extension aquacultural facility.

Very soon after Dr. Smitherman's arrival in Panama, we learned of the decision of the Government of Panama to combine the research-demonstration-extension functions of the aquaculture project and locate the project in its entirity at the Divisa Agricultural Vocational School (INA).

During the 1.5-year period (February 3, 1972 - August 3, 1973) that this project has been operating, construction was completed on 33 earthen ponds of approximately 0.1 acre each. Each pond can be filled and/or drained individually, an essential feature for optimum usefulness of ponds in a hatchery or testing facility.

The construction plan for the aquaculture facility is a good, functional plan (see diagram on following page) with the water supplying the ponds provided by a two-stage pumping system from the Santa Maria River. Large earth-moving equipment was used in construction of several of the ponds with the result that adequate compaction of soil of some of the earthen dams was not achieved. To prevent excessive loss of water through seepage, corrective procedures were initiated which involved repacking of certain dams. In the immediate area of the existing earthen ponds complex, there are about 4 additional acres of land that also can be converted into ponds. However, if a large demonstration-extension fish farming facility is to be developed as specified in the original project agreement, other sites suitable for pond construction must be located.



Plan of the experimental earthen pond complex at the Aquacultural Research Station located at Divisa, Panama. There are 29, one-tenth-acre ponds and 4 of miscellaneous size.

A fisheries laboratory building was designed with the assistance of architects from the Ministry of Commerce and Industry, Dr. R.O. Smitherman and Dr. R.T. Lovell, International Center for Aquaculture, Auburn University. Dr. Lovell's report, "Technical Advisory Visit to Panama on Fishculture: Fish Feeding Systems and Laboratory Design", describing work activities carried out and recommendations made during his visit to Panama from December 29 - 23, 1972, was finalized and distributed to the AID Mission.

At present three Panamanians are receiving special training at Auburn University, Department of Fisheries and Allied Aquacultures, under funds provided through the Aquaculture Project (AID/la-684). Sr. Rene Sanchez, specializing in fish feeds and nutrition, arrived on campus February 8, 1972 while Sr. Remberto Rosas, specializing in fish technology, started his study program at Auburn on June 12, 1972. Sr. Richard Pretto arrived on campus June 10, 1973, and immediately began graduate work in aquaculture. Also, short-term training consisting of six weeks of practical fishculture work was provided by USAID/Panama at Turrialba, Costa Rica, to Daniel Castillero and Leopoldo Zapata, employees of the Agriculture School (INA) at Divisa. Although neither was immediately assigned to work with the Aquaculture Project after their return from Turrialba on May 28, 1972, one now is working full-time with the Aquaculture Project.

The training phase of the Aquaculture Project is viewed by the International Center for Aquaculture as being the most important single ingredient for a successful aquaculture program. The best designed and constructed fishcultural and fishery laboratory facility will accomplish very little unless there is an

adequate staff of trained and dedicated men who will work industriously to make the program a success. Additional implementation on the training aspects of the aquacultural project is urgently needed.

Since the aquaculture project was finalized with the International Center for Aquaculture and AID/Washington in August, 1971, subsequent to a project agreement between the GOP Ministry of Commerce and Industry and USAID/ Panama, numerous high-level adminstrative changes occurred within the Ministry. For example, there were no less than 3 different ministers for MCI within a period of 18 months. The decision to relocate the aquaculture project on Ministry of Agriculture lands at Divisa, apparently was made without adequate prior negotiations and formal understanding between appropriate administrators of the two ministries (MAG & MCI). The end result was confusion among project managers and an unwillingness for them to assume individual responsibility toward the fishculture project without direct and specific instructions from their immediate supervisors.

With rather unsettled conditions that prevailed during the first year of the aquaculture project, it is surprising that even as many as 33 ponds were constructed. This reflects great credit for those individuals in USAID Mission and the two ministries who worked closely with the aquaculture project.

In conferences with officials of MCI and MAG, it was indicated during the project review in January, 1973, that the Aquaculture Project was to be transferred to the Ministry of Agriculture. With the transfer process, capital investment funds passed from MCI to MAG as follows:

Year	Funds Budgeted by MCI	Aquaculture Project Use
1972	$ 50,000	Phase I Construction of Fisheries Laboratory Building
1973	58,000	Phase II Pond Construction Phase II Construction of Fisheries Laboratory Building
	15,100	Pelleting machine and other equipment and supplies
Total GOP Project Funds Transferred from MCI to MAG	$143,100	

The Ministry of Agriculture, upon completion of the project transfer to MAG, necessarily assumed responsibility for providing an operating budget on an annual basis for development of an adequate staff to conduct the fishculture program at Divisa. In fact, the measure of interest that MAG expressed for the Aquaculture Project may be assessed by the adequacy of the staff and operating budget made available to the Project in the future. A minimal staff for the initial fishculture program should include: a project director who has been trained in fisheries and has substantial experience in aquaculture; several biologists; a ponds foreman to supervise routine pondculture operations; a crew of 4 to 6 laborers.

With the transfer of the Aquaculture Project to the Ministry of Agriculture, cooperation between staff of the fishculture project and other division of the Divisa Agriculture School or Institute improved significantly.

Resume and Present Status of Auburn University's Participation in the Philippines Inland Fisheries Project

The original survey[1] to assess the potential and need for aquaculture development in the Philippines was carried out by two staff (Swingle and Moss) from September 2, to October 12, 1967. This Auburn Team recommended the establishment of two aquacultural experimental stations where adaptive research to develop improved methods of aquaculture could be developed in both freshwater and brackishwater environments. The freshwater aquacultural facility was recommended for construction at Mindanao State University while the brackishwater station was proposed at Leganes near Iloilo City.

Although the proposal was received with interest by the Philippines Government, it was some three years before we received indication that the Government and USAID Mission wanted to proceed with the Inland Fisheries Project. The Auburn Team (Swingle and Moss) returned to the Philippines, July 6 - August 14, 1970 at the request of USAID/Philippines to locate additional sites for the Freshwater Research Station since the Philippines Government determined that this Station should be located on Luzon rather than Mindanao. A site suitable for development of a Freshwater Research Station was located on lands owned by Central Luzon State University near Munoz.

A contract (AID/ea-180) between USAID/Philippines and Auburn University was finalized July 23, 1971, with the College of Fisheries of the University of the Philippines being designated to serve as the action group to administer and supervise the Inland Fisheries Project on behalf of the Government.

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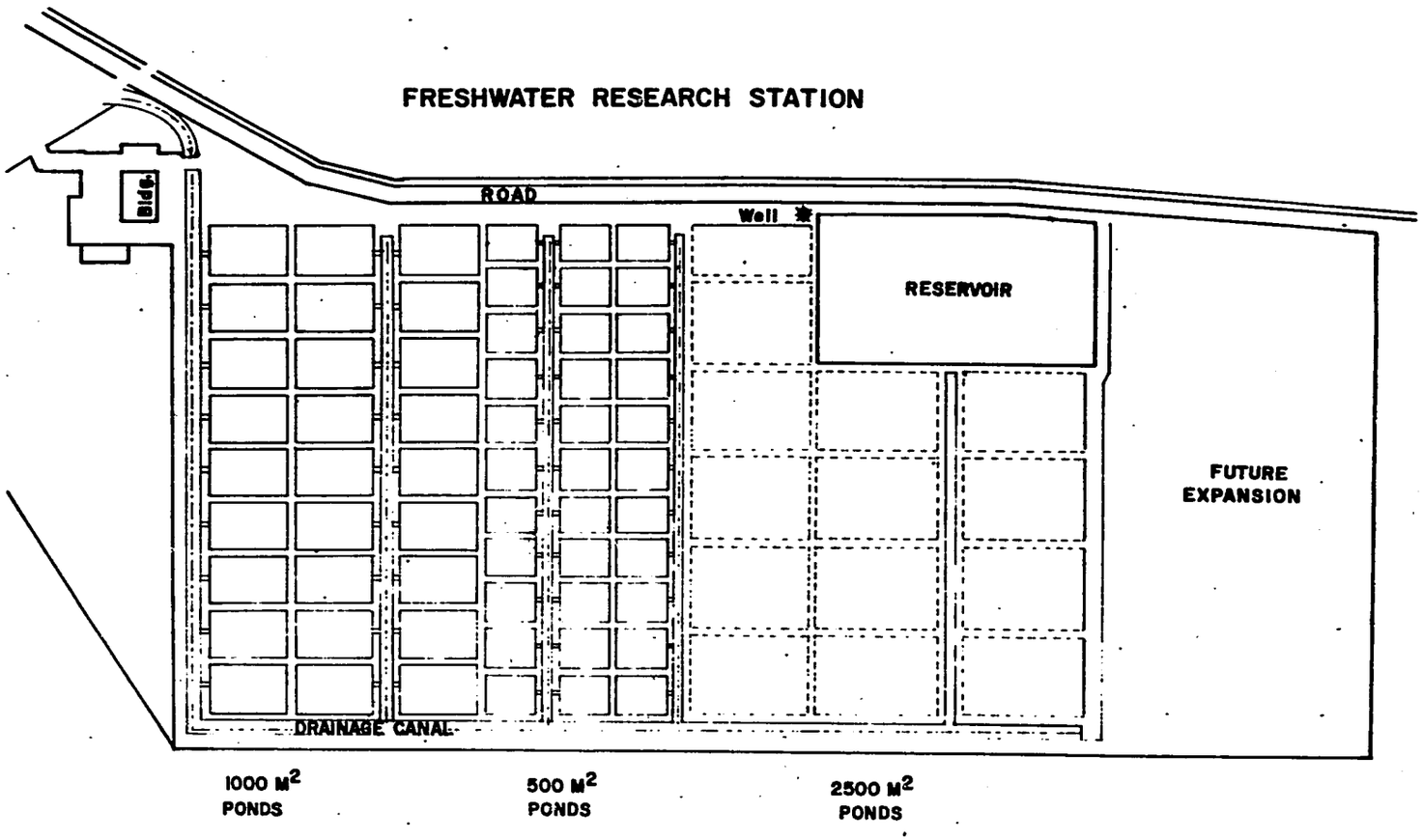
[1] Report of Fishculture Investigations in the Philippines by H.S. Swingle and D.D. Moss. 58 p. October 10, 1967. Revised August 15, 1969.

The contract provides for two specialists in aquaculture to work in the Philippines giving training and supervising the construction and research at both freshwater and brackishwater aquaculture research stations. Dr. H.R. Schmittou arrived in the Philippines September 1, 1971, and assumed responsibilities as Project Leader. Dr. John Grover was employed under this project on August 1, 1971, and following completion of orientation programs at the International Center for Aquaculture and Washington, he arrived in Manila January 4, 1972.

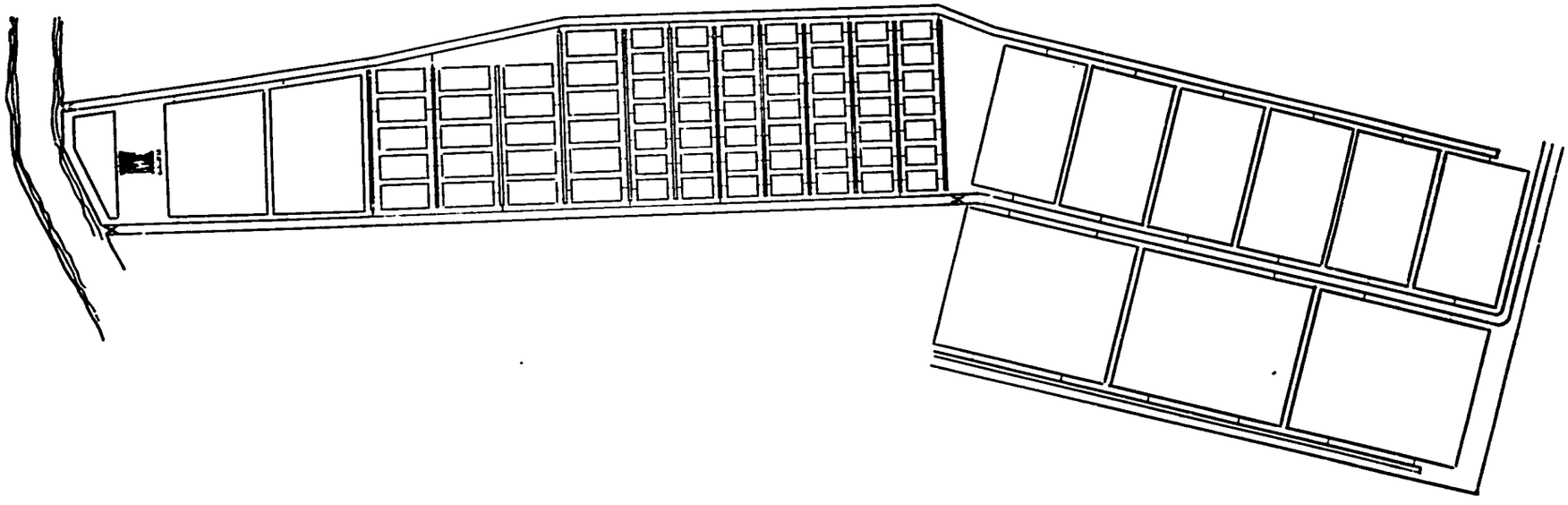
Under this cooperative project, two aquaculture research facilities are under construction. The freshwater research station, located at Central Luzon State University near Munoz, consists of 27 one-fourth-acre and 33 one-tenth-acre earthen ponds (refer to plan on following page). Construction of the experimental ponds has been completed and some of the ponds are now in production tests. A deep well with a capacity to deliver over 400 gallons per minute was drilled to supply the fish ponds during the dry season. Also, construction was completed on the combination administration - laboratory building.

Dr. John Grover, moving with his family from Manila, took up residence at Munoz on September 15, 1972 as this move would enable an effective research program to be started just as soon as the water lines were installed and the ponds filled with water.

Construction coninues on the initial 37-acre portion of the brackishwater aquaculture facility at Leganes on Panay Island (refer to plan). Since construction here was chiefly by manual labor with inadequate supervision by the contractor, progress has been slow and quality of work inferior. Even so, all dikes for



Plan of the freshwater experimental pond complex nearing completion at Central Luzon State University, Philippines.



General plan of the Brackishwater Aquaculture Research Station, near Iloilo, Panay, Philippines. The number and size of earthen ponds presently under construction include: 3 ponds, 5 acres each; 6 ponds, 1 acre each; 21 ponds, 0.25 acres each; 49 ponds, 0.1 acre each; 3 miscellaneous size ponds, 6 acres; 9 raceway units. Total number of experimental ponds and raceways - 91; Total water area, excluding water supply canals - 37 acres.

the 500 and 1,000 m^2 ponds have been completed while the main water supply canals are about 80% complete. It is anticipated that this pond facility will be completed and under operation by early 1974. Well-drilling operations at the Leganes site have not been entirely successful although a well drilled to a depth of about 500 feet is producing free-flowing water (25 gpm) that is slightly saline and high in iron.

An extensive field research program was initiated by the Auburn staff, and counterpart personnel of the University of the Philippines, College of Fisheries in privately-owned ponds with selected fish farm operators on Luzon with good success, although many of the tests were lost due to destructive typhoon rains that occurred during July, 1972. Research was also conducted in a demonstration fish farm of the Philippines Fisheries Commission at Iloilo in cooperation with PFC personnel. Preliminary tests with milkfish production ponds using only phosphate fertilization in most cases resulted in higher total yields of milkfish than the more time-consuming and costly pond management methods that are traditional to many of the fish farmers. The resident Auburn staff also developed and presented a series of seminar programs for fish farmers and Philippines Fisheries Commission. They also planned and carried out a training program for fishculture extension agents that consisted of a one-week program of lecture - laboratory demonstrations with a follow-up field practice exercise extending over a period of about 3 months.

Under the participant training component of the Inland Fisheries Project, 8 staff memers of U.P. College of Fisheries and Central Luzon State University are currently enrolled in advance degree programs at Auburn University. Three of these (Mr. Catalino Dela Cruz, Mr. Rafael Guerrero and Mr. Arsenio Camacho)

are working towards the Ph.D. degree while another, Mr. Romeo Fortes, will complete course work for the Ph.D. degree at Auburn but return to the Philippines to do his research. The first group should complete all requirements for the Ph.D. degree and return to work with the Inland Fisheries Project by mid-1974. The second group of participants (Miss Gaudiosa Almazan, Mr. Rodolfo Arce, Mr. Emmanuel Cruz and Mr. Rodolfo Ventura) have completed their first year of a scheduled 2-year academic program for the Master of Science degree. A third group which likely will be the last to receive training abroad, also consists of four Filipino staff affiliated with the Inland Fisheries Project and these staff are expected to arrive on campus in September, 1973.

Technical Assistance to the Inland Fisheries Project presently will be provided under Project AID/ea-180 through June 30, 1974. We feel the aquaculture advisors from the International Center for Aquaculture should continue to serve at the Freshwater Research Station (CLSU) and at the Brackishwater Research Station near Iloilo for a minimum period of two years following the return of the first participant group in 1974. Although these participants will have had a personal experience in designing, carrying out and writing up their own research project, none will have the breadth of experience to permit them to effectively supervise a large scale testing program as is envisioned for each of the research stations.

The World Bank and the Government of the Philippines has recently signed a fisheries development loan amounting to nearly 12 million dollars with approximately 4 million allocated exclusively for aquaculture development. The Inland Fisheries Project is the only research component presently functioning in the entire fisheries area within the Philippines. Thus, technical assistance to

the Inland Fisheries Project should not only be continued beyond 1974, but it also should be expanded. With financial support from USAID and the Foundations and technical assistance from Auburn's International Center for Aquaculture, the Inland Fisheries Project should firmly be established and supported as the International Center for Tropical Aquaculture for Asia.

CAMPUS-BASED ACTIVITIES

Coordination of International Fisheries Projects

With the staffing of cooperative fisheries projects in Brazil, El Salvador, Panama and the Philippines--resulting in a total of six professors on long-term assignments during 1973--backstopping services on campus have increased significantly.

Coordinating and backstopping of the foreign fisheries projects sponsored by USAID Mission continues to be one of the most important responsibilities of campus-based staff. It is essential that project leaders of the various foreign fisheries programs receive technical assistance from specialists of the International Center or staff of other departments on campus. In addition to assistance provided to field staff in various technical fields, a significant amount of administrative backstopping is necessary to keep the foreign fisheries project operating smoothly. For example: budgets for each of the projects must be re-negotiated on an annual basis and often more frequently; qualified staff must be recruited and trained; short-term services of staff specialists from the International Center must be arranged for servicing the various foreign projects; purchase orders for equipment and supplies must be prepared, submitted for bids and the materials subsequently forwarded to the appropriate country project; field projects must be reviewed periodically; proposed plans for aquaculture testing and extension programs must be evaluated; reports must be edited and printed; requests from field personnel for reprints and information on specific problems encountered in the field must be processed; inquiries from USAID Missions and host government fisheries officials must be answered; good programs for meaningful field trips

for international graduate students under AID-sponsorship must be organized.

During 1973, backstopping and coordination was provided for the foreign projects principally under the Central Project, AID/csd-2270. However, since funding for the Central Contract has progressively decreased since 1971 and ceased completely after June 30, 1973, backstopping and campus coordination costs had to be pro-rated to the various country projects.

Technical Reports

Several major reports were published during the reporting period. These reports are referenced below with indication of the specific task order or contract under which the short-term services were provided, names of staff carrying out particular projects, dates in-country and date of publication of the final report. It should be noted that all AID reports are included whether or not the corresponding work was requested by task orders under the Central Project or carried out under USAID contracts or other auspices. The reason for this is that almost without exception, all reports prior to the final typing and printing required an appreciable amount of staff time that was supported by the Central Project for correcting, revising and editing. The reports are as follows:

AID/csd-2270 T.O. 3 (Brazil) End of Tour Report

Progress Report on Fisheries Development in Northeastern Brazil, I. Aquaculture, by N.B. Jeffrey. 29 p. August 30, 1972.

AID/csd-2270 T.O. 4 (Brazil) End of Tour Report

Progress Report on Fisheries Development in Northeastern Brazil, II. The Reservoir Fisheries of Northeast Brazil, by W.D. Davies. 46 p. September 15, 1972.

AID/csd T.O. 8 (Brazil)

Fishculture Extension Project - Brazil, June 1 - November 30, 1972, by J.W. Jensen. 7 p. December 20, 1973

Progress Report I on the Brazil Aquaculture Project, by L.L. Lovshin. 10 p. January 10, 1973.

Some Observations on the Capture and Transport of Mapara, Hypophthalmus edentatus, from the Tocantins River, Para State, Brazil, by L.L. Lovshin and Brazilian staff. 10 p. February 5, 1973.

Preliminary Pond Tests of the Tambaqui, Colossoma bidens, by L.L. Lovshin and Brazilian staff. 8 p. July 15, 1973.

Preliminary Pond Tests of Pirapitinga, Mylossoma bidens, by L.L. Lovshin and Brazilian staff. 7 p. July 18, 1973.

Fishculture Extension Project - Brazil, December 1, 1972 - June 20, 1973, by J.W. Jensen. 31 p. July 20, 1973.

Progress Report II on the Brazil Aquaculture Project, by L.L. Lovshin. 16 p. August 15, 1973.

AID/csd-2270 T.O. 9 (Thailand) - October 1 - 28, 1972

Inland Fisheries Program in Thailand 1972, by E.W. Shell and R.T. Lovell. 60 p. December 31, 1972.

AID/la-684 (Panama)

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AID/csd-2780 (Guatemala) June 11 - 22, 1973

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Identification and Preparation of Inland Fisheries Project for Bangladesh, by IBRD Mission Team including D.D. Moss. Under preparation August, 1973.

Participant Training Programs

With the establishment of various fisheries projects abroad and the emphasis on the academic training of host country personnel, the enrollment of foreign students sponsored by AID has increased appreciably. The numbers of foreign students enrolled in graduate and special study programs in the Department of Fisheries and Allied Aquaculture during 1973 are given below with indication of country and sponsoring agencies.

Country	Number of Students	Sponsoring Agencies
Brazil	2 1 (Sept., 1973)	USAID Mission and Government of Brazil
Cambodia (Khmer)	1	Republic of Khmer
El Salvador	1 1 (Sept., 1973)	USAID Mission and Government of El Salvador

Guatemala	1	Private funding
Panama	3	USAID Mission and Government of Panama
Peru	1 (Sept., 1973)	USAID Mission and Government of Peru
Philippines	8 4 (Sept., 1973)	USAID Mission and Government of the Philippines
Taiwan	1	Private funding
Thailand	9	USAID Mission and Government of Thailand
TOTAL	33	

A very considerable amount of staff time is required to formulate good academic and research programs for the 33 foreign students who are enrolled in graduate and/or special training programs in aquaculture and fisheries at Auburn University. We feel that this is a type of activity that should be financially supported under the Central Contract.

Dr. D.D. Moss, with participants from the Philippines, visited the University of Georgia's Agricultural Experiment Station at Tifton, Georgia on August 30 - 31, 1972, for the purpose of observing intensive fishculture operations in raceways. The group also visited the Gold-Kist Fish Processing Plant at Quitman Georgia. During the period December 12 - 15, 1972, Dr. Moss with 10 participants from Panama, Philippines and Thailand visited the Fish Farming Experimental Station at Stuttgart, Arkansas and observed fish farming operations and fish processing facilities in the region. On March 19 - 20, 1973, Dr. Moss, with other departmental staff (Shell and Pamatmat) accompanied Mr. Manu Potaros and Mr. Cherdchan Amatyakul, officials from the Thai Department of Fisheries, on a tour of the Alabama Marine Resources Laboratory at Dauphin Island to observe laboratory

facilities, review research in progress and examine the newly constructed brackishwater experimental pond complex at Gulf Shores. Dr. Moss also arranged and accompanied the 2 Thai visitors on a tour of trout production farms and the Dale Hollow National Trout Hatchery in Tennessee from April 4 - 6, 1973.

Other Activities

One trip was made to Washington September 5 - 7, 1972, for the purpose of conferring with various AID officials, principally on the future of the worldwide project, AID/csd-2270. Participating in these conferences from Auburn University were Dr. Ben T. Lanham, Vice-President of Auburn University, and Drs. H.S. Swingle, E.W. Shell and D.D. Moss, staff of the Department of Fisheries and Allied Aquacultures. Dr. Erven Long, Director, Office of Research and University Relations and Dr. Omer Kelly, Director, Office of Agriculture, represented the Agency for International Development.

Additional trips to Washington were made October 3 - 4, 1972 by D.D. Moss and December 7 - 8, 1972 by E.W. Shell and D.D. Moss. The latter two visits were held to consider and formulate a program for the proposed aquaculture workshop in the Philippines in 1973. In 1973, trips were made to Washington to confer with the AID/Washington fisheries project manager for the Central Project as follows: January 3 - 4 (Shell and Moss); March 12 - 13 (Moss); March 28 - 30 (Moss); June 10 - 11 (Moss); July 15 - 16 (Moss and Schmittou).

APPENDIX

I. CHRONOLOGICAL LIST OF OVERSEAS WORK CARRIED OUT UNDER AID PROJECTS BY STAFF OF THE INTERNATIONAL CENTER FOR AQUACULTURE

II. CHRONOLOGICAL LIST OF REPORTS BY GEOGRAPHICAL REGIONS ON INTERNATIONAL AQUACULTURAL PROJECTS PREPARED BY STAFF OF THE INTERNATIONAL CENTER FOR AQUACULTURE

CHRONOLOGICAL LIST OF OVERSEAS WORK CARRIED OUT UNDER A.I.D. PROJECTS BY STAFF OF THE INTERNATIONAL CENTER FOR AQUACULTURE

DATE	COUNTRY	STAFF	PROJECT
June 27 - September 3 1966	Brazil	Dendy, Shell, Prather	AID/BCF/PASA
September 2 - October 12 1967	Philippines	Swingle, Moss	AID/csd-1581
October 12 - October 18 1967	Taiwan	" "	"
October 18 - October 23 1967	Japan	" "	"
October 23 - October 29 1967	Vietnam	" "	"
October 29 - November 12 1967	Thailand	" "	"
November 13 - November 16 1967	Malaysia	" "	"
November 16 - November 23 1967	Thailand	" "	"
November 23 - November 29 1967	East Pakistan	" "	"
November 29 - November 30 1967	Nepal	" "	"
November 30 - December 17 1967	India	" "	"
December 17 - December 19 1967	Italy (FAO)	" "	"
August 17 - September 20 1967	Brazil	Dendy, Shell, Prather	AID/BCF/PASA

DATE	COUNTRY	STAFF	PROJECT
May 14 - June 4 1968	Philippines	Swingle, Smitherman	AID/csd-1581
June 4 - June 18 1968	Thailand	" "	"
June 18 - June 27 1968	East and West Pakistan	" "	"
August 19 - September 21 1968	Brazil	Shell, Prather, Jeffrey	AID/BCF/PASA
October 19 - October 26 1968	Italy (FAO)	Swingle, Schmittou, Rogers	AID/csd-1581
October 27 - November 23 1968	East Pakistan	" " "	"
November 23 - November 29 1968	Thailand	" " "	"
November 29 - December 7 1968	Philippines	" " "	"
December 7 - December 9 1968	Hong Kong	" " "	"
March 30 - April 4 1969	Italy (FAO)	Moss, Pardue, Danner	AID/csd-1581
April 5 - April 11 1969	Senegal	" " "	"
April 11 - April 12 1969	Cameroon	" " "	"
April 12 - April 19 1969	Central African Republic	" " "	"
April 19 - April 26 1969	Cameroon	" " "	"
April 26 - May 3 1969	Nigeria	" " "	"

DATE	COUNTRY	STAFF	PROJECT
May 3 - May 9 1969	Togo	Moss, Pardue, Danner	AID/csd-1581
May 9 - May 17 1969	Ghana	" " "	"
May 17 - May 23 1969	Ivory Coast	" " "	"
May 23 - May 24 1969	Senegal	" " "	"
May 24 - May 28 1969	Italy (FAO)	" " "	"
April 14 - May 17 1969	Thailand	Swingle, Smitherman	AID/csd-1581
May 5 - May 22 1969	Guyana	Shell	AID/Un. of Florida
August 11 - August 13 1969	Italy (FAO)	Swingle, Pardue, Schmittou	AID/csd-2270
August 14 - August 19 1969	East Pakistan	" " "	"
August 19 - September 21 1969	Thailand	" " "	AID/csd-2270 Task Order 2
October 6 - October 18 1969	Colombia	Swingle, Pagan	AID/csd-2270
October 18 - October 28 1969	Ecuador	" "	"
November 21, 1969 - October 15, 1971	Brazil	Jeffrey	AID/csd-2270 Task Order 3
February 4 - March 22 1970	India	Moss	AID/nesa-145 Univ. of Tenn.
April 27 - May 22 1970	Panama	Moss, Smitherman	AID/csd-2270

DATE	COUNTRY	STAFF	PROJECT
May 22 - June 6 1970	Peru	Moss, Smitherman	AID/csd-2270
June 6 - June 18 1970	Paraguay	" "	"
June 18 - June 25 1970	Brazil	" "	"
July 6 - August 14 1970	Philippines	Swingle, Moss	AID/csd-2270
October 30, 1970 October 15, 1972	Brazil	Davies	AID/csd-2270 Task Order 4
November 1 - November 8 1970	Philippines	Swingle, Allison	AID/csd-2270
November 8 - November 11 1970	Thailand	" "	"
November 11 - November 13 1970	Malaysia	" "	"
November 13 - December 2 1970	Thailand	" "	"
December 3 - December 9 1970	Israel	" "	"
December 9 - December 11 1970	Italy (FAO)	" "	"
January 10 - January 16 1971	Colombia	Smitherman	AID/csd-2270
February 15 - March 5 1971	El Salvador	Moss	AID/csd-2270
March 5 - March 19 1971	Costa Rica	Moss, Lovell	AID/csd-2270
March 14 - March 15 1971	Nicaragua	" "	"

DATE	COUNTRY	STAFF	PROJECT
March 19 - March 20 1971	Panama	Moss, Lovell	AID/csd-2270
March 21 - March 22 1971	Puerto Rico	" "	"
March 22 - March 27 1971	Haiti	" "	"
March 23 - April 2 1971	Ecuador	Swingle	AID/csd-2270
April 2 - April 9 1971	Puerto Rico	"	"
May 10 - May 13 1971	Panama	Moss	AID/csd-2270
May 13 1971	Costa Rica	"	"
May 13 - May 15 1971	Panama	"	"
May 11 - June 7 1971	Peru	"	AID/csd-2270
June 7 - June 11 1971	Brazil	"	"
May 15 - May 26 1971	Japan	Schmittou	AID/csd-2780
May 26 - June 2 1971	Philippines	"	"
June 2 - June 12 1971	Taiwan	"	"
June 12 - June 16 1971	Hawaii	"	"
July 18 - August 29 1971	India	Moss	AID/nesa-145 Univ. of Tenn.

DATE	COUNTRY	STAFF	PROJECT
September 1, 1971 June 30, 1973	Philippines	Schmittou	AID/ea-180
August 23 - September 15 1971	Panama	Moss, Smitherman	AID/la-684
October 3 - October 9 1971	Philippines	Swingle, Shell	AID/csd-2270
October 10 - November 6 1971	Thailand	" "	AID/csd-2270 Task Order 7
November 6 - November 10 1971	Italy (FAO)	Shell	FAO of the UN
November 6 - November 15 1971	Turkey	Swingle	AID/csd-2270
October 18 - November 20 1971	Ecuador	Gilbert, Roberts	AID/csd-2780
November 20 - December 4 1971	Ecuador	Roberts	AID/csd-2780
January 4 - January 14 1972	El Salvador	Moss	AID/la-688
January 17 - January 20 1972	Brazil	Shell	AID/csd-2270
February 27 - March 18 1972	Nicaragua	Davies, Pierce	AID/csd-2270
February 28 - March 1 1972	Nicaragua	Moss	AID/csd-2270
March 2 - March 16 1972	Brazil	Jeffrey	AID/csd-2270
March 2 - March 31 1972	Peru	Moss	AID/csd-2270 Task Order 5
July 16 - July 21 1972	Thailand	Grover	USAID/Philippines

DATE	COUNTRY	STAFF	PROJECT
September 22 - October 1 1972	Philippines	Shell, Lovell	AID/csd-2270
October 1 - October 28 1972	Thailand	" "	AID/csd-2270 Task Order 9
October 17 - October 24 1972	New Zealand	Schmittou	USAID/Philippines
October 29 - October 31 1972	Italy	Shell, Lovell	AID/csd-2270
December 17 - December 23 1972	Panama	Lovell	AID/la-684
January 23 - January 27 1973	Mexico	Smitherman	AID/la-684
January 23 - January 27 1973	Mexico	Moss	AID/csd-2780
January 27 - February 3 1973	Panama	"	AID/la-684
February 3 - February 10 1973	El Salvador	"	AID/la-688
February 11 - February 23 1973	British Columbia	Davies	AID/csd-2780
April 18 - April 21 1973	Philippines	Moss	AID/ea-2270
April 22 - May 22 1973	Bangladesh	"	International Bank for Reconstruction and Development
May 23 - May 25 1973	Thailand	"	AID/csd-2270
May 26 - May 31 1973	Philippines	"	AID/csd-2270
June 1 - June 6 1973	Hawaii	"	AID/csd-2270

DATE	COUNTRY	STAFF	PROJECT
June 11 - June 22 1973	Guatemala	Davies	AID/csd-2780
July 1 - July 3 1973	Mexico	Smitherman	AID/csd-2780
July 10 - July 19 1973	Italy (FAO)	Shell	AID/csd-2780
August 20 - August 31 1973	Haiti	Smitherman	AID/csd-2780
September 12 - October 12 1973	Philippines	Allison	AID/ea-180
October 12 - October 17 1973	Thailand	"	AID/csd-2780
November 18 - November 22 1973	Colombia	Lovell, Rogers	AID/csd-2780
November 22 - December 1 1973	Brazil	" "	AID/csd-2270 Task Order 8
December 3 - December 17 1973	Japan	Lovell	AID/csd-2780
December 3 - December 17	Japan	Lovshin	USAID/Brazil

CHRONOLOGICAL LIST OF REPORTS BY GEOGRAPHICAL REGIONS ON INTERNATIONAL AQUACULTURAL PROJECTS PREPARED BY STAFF OF THE INTERNATIONAL CENTER FOR AQUACULTURE

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Fishculture Survey Report for West Central Africa, by D.D. Moss, G.B. Pardue, and M.J. Danner. 115 p. June 30, 1969. Revised October 15, 1969.

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Report on Pondfisheries and International Limnological Symposium in Israel, August 6 - 28, 1968, by H.S. Swingle. 25 p.

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Fisheries of Turkey, by H.S. Swingle. 22 p. January 20, 1972.

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Report of Fishcultural Investigations in India, by H.S. Swingle and D.D. Moss. 23 p. February 16, 1968. Revised August 15, 1969.

Report on the Development of the College of Fisheries, University of Agricultural Sciences, Bangalore, India, by D.D. Moss. 119 p. March 20, 1970.

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Report of Fishcultural Investigations in East Pakistan, by H.S. Swingle and D.D. Moss. 15 p. February 26, 1968. Revised August 15, 1969.

Fishculture Project Report for East Pakistan - Final Report, by H.S. Swingle, H.R. Schmittou, D.D. Moss, and W.A. Rogers. 132 p. February 1, 1969. Revised October 15, 1969.

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Aquacultural Survey in Japan, by H.R. Schmittou. 68 p. February 1, 1972.

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Report of Fishcultural Investigations in the Federation of Malaysia, by H.S. Swingle and D.D. Moss. 15 p. February 26, 1968. Revised August 15, 1969.

Report on the Proposal to Make the Malacca Tropical Fishculture Research Institute into an International Research Center for Freshwater Aquacultures for Southeast Asia. A confidential report by H.S. Swingle and Ray Allison. 19 p. January, 1971.

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Report to the Government of the Philippines - Organization and Operation of the Limnology Project 1959 - 60. FAO United Nations Report 1319, by J.S. Dendy. 25 p. 1961.

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Inland Fisheries Progress in Thailand 1972, by E.W. Shell and R.T. Lovell. 60 p. December 31, 1972.

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Manual De Piscicultura, by staff of the Cooperative Fisheries Project. 42 p. June, 1973.

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Fishculture Survey Report for Haiti, by R.T. Lovell and D.D. Moss. 30 p. May 30, 1971.

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Lake Izabal Fisheries Survey, by W.D. Davies. 27 p. August 1, 1973.

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Progress Report on the Development of Fisheries in Northeast Brazil. I. Aquaculture. A. End of Tour Report by N.B. Jeffrey. 29 p. August 30, 1972.

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