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Progress Report III
on the
Brazil Aquaculture Project

Submitted
by

Leonard L. Lovshin
Project Leader

USAID - Auburn University
Task Order No. 8
Contract AID/csd-2270

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INTRODUCTION

This is the third semi-annual report concerning the activities of the Auburn University Contract, Task Order No. 8, Contract AID/csd-2270.

Project objectives, status of project upon arrival and progress in the first year of the Contract can be found in the semi-annual reports submitted by the author on December 16, 1972 and June 30, 1973. This report will deal with the author's activities within the Convenio, DPAN, during the period June 30, 1973 through December 30, 1973.

Progress in the Third Quarter of the Contract

1) Construction — The past six months has seen no new additions to the existing research station in Pentecoste. Major construction work is now centered on the 100 ha of land owned by DNOCS below the Pentecoste Reservoir Dam. Excavation of 48, 400 m^2 earthen ponds and central drainage canal has been completed. Work will soon begin on secondary water

entrance canals and individual pond drains. These new ponds should be ready for use by June, 1974 and will bring the total number of experimental pond units to 104 containing 26 acres of water. This will make the combined facilities of the experimental fishculture research center at Pentecoste the largest in Latin America and one of the largest in all the tropical world.

2) Research

Hybrid Tilapia — To test the cultural potential of hybrid Tilapia, an experiment utilizing three treatments, replicated twice, at one level of stocking has now been in progress for nine months. Hybrids stocked at 8,960/ha are being treated with either 1,400 Kg/ha/week of cow manure, 56/Kg/ha of triple superphosphate and ammonium sulfate every two weeks, or 1,400Kg/ha/week of cow manure and a ration composed of 50% wheat chaff and 50% castor bean meal fed as a moist feed ball at 3% of the body weight of fish in the pond, 6 days a week. At the end of ten months, seine samples indicate that an average of 1,272 Kg/ha with organic fertilizer, 1,823 Kg/ha with inorganic fertilizer, and 4,095 Kg/ha with organic fertilizer and ration were produced assuming 100% survival of fish stocked. This experiment will be terminated in three more months so that the maximum production per hectare for a one year period for each of the three treatments can be determined. A summary of the results for this experiment over a nine month period can be found in Table 1.

TABLE 1

Summary of Results of Hybrid Tilapia Experiment After Ten Months

Stocking Level	8,960/ha					
Treatments	Organic Manure		Inorganic Manure		Organic Manure & Ration	
Ponds[1]	22	24	21	26	23	25
Avg. weight of fish at stocking, g	20.4	20.6	22.1	21.7	20.2	19.9
Total weight of fish stocked, g	6,530	6,620	7,100	6,950	6,470	6,380
Avg. weight of fish after ten months, g	153	131	220	187	504	410
Total weight of fish,[2] g	48,960	41,920	70,400	59,840	161,280	131,200
Feed Conversion					3:1	3.6:1

[1] Pond = 360 m^2

[2] Assuming 100% survival

Culture of Tilapia nilotica with Pescada do Piauí (Plagioscion squamosissimus) — In an effort to control reproduction in T. nilotica cultures, an experiment was designed to test the effectiveness of Pescada do Piauí as a predator in mixed culture with T. nilotica. Nilotica were stocked into four earthen ponds ranging in size from 271 m^2 to 342 m^2 at the rate of 5,000/ha. Two of the four ponds were stocked with Pescada do Piauí at the rate of 2,000/ha. All ponds were fertilized with organic manure at the rate of 500 Kg/ha/week for four months and fed twice a day with a ration composed of 50% wheat chaff and 50% castor bean meal fed as a moist feed ball. The Tilapia were fed 3% of the weight stocked in each pond for the first month. Because the Tilapia reproduced in all ponds, it was not possible to recalculate the feeding rate each month by seine sample and then feed 3% of the estimated body weight of the fish in each pond. The feeding rate was doubled each month until the maximum rate of 95.8 Kg/ha/day was being fed after five months. The maximum feeding rate was held three months without any fish mortality. A summary of the results of this experiment can be found in Table 2. Pescada do Piauí was clearly able to control T. nilotica reproduction although the fish grew very poorly and represented only a small proportion of the total fish production. The use of a predator raised the weight of harvestable fish produced, but lowered the total production of fish. Pescada do Piauí proved to be a difficult

TABLE 2

Summary of Results of *Tilapia nilotica* Stocked with the Predator Pescada do Piaui (*Plagioscion squamosissimus*) Experiment

Treatments	*T. nilotica* + Predator		*T. nilotica* Alone	
Stocking Level	*T. nilotica* - 5,000/ha + Pescada do Piauí - 2,000/ha		*T. nilotica* - 5,000/ha	
Ponds	38 - 342 m^2	41 - 271 m^2	39 - 320 m^2	40 - 316 m^2
Total Production Kg/pond				
Tilapia	73.3	56.4	113.980	120.000
Pescada	6.1	4.6	—	—
Total Production Kg/ha				
Tilapia	2,146.8	2,081.5	3,556.1	3,804.0
Pescada	179.3	168.0	—	—
Net Production Kg/ha				
Tilapia	2,049.5	1,988.2	3,462.5	3,702.8
Pescada	46.9	31.1	—	—
Avg. Weight of Fish at Stocking, g				
Tilapia	19	19	19	20
Pescada	66	69	—	—
Avg. Weight of Pescada at Harvest, g	100	123	—	—
Percent Survival of Pescada	89.7%	68.5%	—	—
Feed Conversion of Tilapia	4.1 to 1	4.8 to 1	2.4 to 1	2.3 to 1
Weight of Harvestable Fish (75g +), Kg/pond	50.8	40.8	6.4	6.0
Percentage of Harvestable Tilapia 1/	69.0	72.3	5.6	5.0
Days of Experiment	238	238	238	238
Fertilizer Applied, Kg/pond	332.9	262.6	305.6	305.6
Feed Fed, Kg/pond	283.5	215.5	269.7	272.2

1/ A_T value as defined by Swingle (1950)

fish to handle as they were easily killed if not handled with extreme care and returned to the water as rapidly as possible. Minimum dissolved oxygen encountered in ponds with Pescada was 1.4 ppm. When dissolved oxygen levels approached 1.5 ppm, water was added to the ponds to improve oxygen levels as Pescada is reported to die when dissolved oxygen reaches 1 ppm.

Pescada do Piauí was fairly successful in controling Tilapia nilotica reproduction. Pescada is easily obtained from local reservoirs and the author feels that the experimental results warrant further testing to determine optimum stocking rates of both species to obtain the maximum number of harvestable Tilapia.

Tilapia nilotica raised in association with Pigs — Two earthen ponds of approximately 3,800 m^2 were stocked with 3,800 Tilapia nilotica fingerlings. One pond was fertilized with cow manure at the rate of 750 Kg/ha/week. The second pond had a pig sty located on the bank with a corral that allowed the pigs to enter the water. The pig sty was 36 m^2, with a cement floor, wood sides, and palm frawn roof. Twenty five pigs with an average weight of 17.9 Kg were placed in the sty and fed a daily ration of corn, wheat chaff, meat meal, nut meal, manioc, and grass at 5% of their body weight. Waste feed and pig waste products were washed into the pond daily. The pond received no other fertilization excepting that associated with the hog raising. After 150 days, the

pigs averaging 55.7 Kg were sold and the two ponds were drained and fish harvested. Results of the experiment can be found in Table 3. The pond containing Tilapia raised in association with pigs had a total production 11 times greater than the pond with cow manure only. A large number of a wild predator species, Traira, Hoplias malabaricus were also captured at pond draining and this undoubtably was a partial cause of the low fish production of this pond. However, the remaining Tilapia captured were of a much smaller average size than the Tilapia harvested from the pond with pigs, indicating a slower rate of growth in the pond without pigs due to less natural food available because of lower fertility levels.

An economic analysis of the Tilapia and pig experiment can be found in Table 4. It appears that the economic benefits of raising pigs and fish together are greater than raising fish along with feeding over the same time period.

The total production of Tilapia nilotica of 1,902 Kg/ha over 150 days compares favorably with the production of T. nilotica alone with feed. However, when T. nilotica are raised with pigs, feed is provided by waste feeds not utilized by the pigs and pig fecal products which act as fertilizers, enriching the pond. Thus, the farmer gains two cash crops while providing feed for only one.

It is the author's opinion that the profit from pigs raised with all male Tilapia hybrids would be even greater because all fish would be of a marketable size, resulting

TABLE 3

Summary of Results of Tilapia nilotica Raised in Association with Pigs

Treatment	Pigs	No Pigs
Weight of Fish at Harvest, Kg/pond		
Tilapia	723.1	47.4
Trairn	—	13.1
Piaba	—	6.2
Total Production, Kg/pond	723.1	66.7
Total Production, Kg/ha	1,902	175
Net Production, Kg/pond	673.2	21.6
Net Production, Kg/ha	1,770	56.8
Avg. Weight of Fish at Stocking, g	13 g	12 g
Weight of Harvestable Fish, Kg/pond	172.2	21.1
Manure, Kg/pond	—	5,985
Manure, Kg/ha	—	15,750
Feed Conversion		
Pigs	5.2 to 1	—
Pigs + Fish	2.9 to 1	—
Days of Experiment	150	150

TABLE 4

Preliminary Economic Analysis of Pigs
Raised in Association with Tilapia nilotica
on Privately Owned Farms in Ceará[1]

1 Hectare Fish Ponds	Raising Period - 150 Days
Investments:	
Land	--
Construction of Ponds, Inlets & Drains	Cr$ 15.935,00[2]
Fishing Seine	500,00
Feed Storage Houses	300,00
Tools and Equipment	150,00
Pig Stics 97 m^2	5.240,00
Total	Cr$ 21.975,00
Costs	
Fixed:	
Administration	--
Maintenance	Cr$ 321,00
Amortization	885,00
60 Pigs Weighing 1.176 Kg (at Cr$ 3.14/Kg.)	3.822,00
Total	Cr$ 5.028,00
Variable:	
Feed (11.460 Kg at Cr$ 0,32/Kg)	Cr$ 3.667,20
Fertilizers	370,00
Water	--
Fingerlings (10,000 units)	600,00
Interest Rates w/o Work Capital	65,00
Operation	130,00
Harvesting Fish	20,00
Maintenance	16,00
Marketing Costs	80,00
Various Other Expenses	100,00
Total	Cr$ 5.048,20
Gross Income	
60 Pigs (live) Weighing 3.342 Kg(at Cr$ 3,70/Kg)	Cr$ 12.365,40
Sale of 458 Kg. of Fish of Commercial Value of Cr$ 3,50/Kg and Each Weighing More Than 75 g	1.603,00
Sale of 1.450 Kg of Fish of Non-Commercial Value at Cr$ 1,00/Kg with Each Weighing Less Than 75 g	1.450,00
Total	Cr$ 15.418,40
Net Income (Profit)	Cr$ 5.342,20 (U.S.$ 890.37)

[1] Analyzed by Edson Rodrigues Lira, Economist, Centro de Pesquisas Ictiológicas, National Department of Work Against Droughts.

[2] $1.00 U.S. = Cr$ 6.00

in a higher profit. Experiments carried out this year will test the economics of raising Tilapia hybrids with pigs.

Mixed culture of Tilapia hybrids and Mirror Carp (Cyprimus carpia) — To test the hypothesis that larger fish productions can be gained from raising Tilapia hybrids and Mirror Carp together than by raising either species alone, an experiment was designed utilizing three treatments, each treatment replicated three times. Mirror Carp were stocked into three ponds at the rate of 2,240/ha, Tilapia hybrids were stocked into three ponds at the rate of 8,960/ha, and Tilapia hybrids and Mirror Carp were stocked in three ponds at the rates of 8,960/ha and 1,400/ha respectively. All treatments receive organic manure at the rate of 1,400/Kg/week Those treatments containing hybrids are fed 3% of the estimated body weight of Tilapia hybrids per day and the treatment containing Carps alone is fed 3% of the estimated body weight of the fish per day. All ponds are fed a ration of rice polishings, fed as a moist feed ball, 6 days a week. The calculated average weight and average total production for each treatment at the end of five months can be found below.

Treatments	Carp	Tilapia Hybrid	Tilapia Hybrid + Carp
Avg. Weight at Stocking, g	16	45	T = 45 C = 18
Avg. Weight after Five Months, g	334	270	T =224 C =281
Avg. Total Production after Five Months, Kg/pond	26.7	86.4	85.7
Avg. Total Production after Five Months, Kg/ha	748	2,419	2,400

These partial results indicate that the two treatments containing Tilapia hybrids have a much higher production than the treatment contining only Carp. Interesting to note that the treatment with Tilapia hybrids and Carp has a production equal with that of the treatment with Tilapia hybrids alone and that at this time, it does not appear that the addition of Carp increases production. This experiment will be terminated in several months and a conclusive interpretation of the data will then be made.

Tilapia hybrid and male Tilapia nilotica — The author has read of several fishery biologists that have written that the Tilapia hybrid shows hybrid vigor and is a faster grower than either parent species. The author, however, has not been able to find any reports comparing the growth of Tilapia hybrid with male Tilapia nilotica which grows much more rapidly than the female Tilapia nilotica. To test the hypothesis that Tilapia hybrids grow faster than male Tilapia nilotica, an experiment was designed utilizing three treatments, each treatment replicated twice. Tilapia hybrids were stocked into two ponds at the rate of 10,000/ha, male Tilapia nilotica were stocked into two ponds at the rate of 10,000/ha and Tilapia hybrids and male niloti were stocked together into two ponds at 5,000/ha and 5,000/ha respectively. All treatments are receiving chemical fertilizer at the rate of 56 Kg/ha every two weeks and are being fed a ration of rice polishings. All treatments are being fed equally at 3% of the average body weight of fish in all ponds. Results after 4 months of growth are given below.

Treatments	T. hybrid	♂T. nilotica	♂T. hybrid / ♂T. nilotica
Avg. Weight at Stocking, g	60	63	65
Avg. Weight after 4 Months	298	267	297
Avg. Total Production after 4 Months, Kg/pond	104.3	93.7	104.0
Avg. Total Production after 4 Months, Kg/ha	2,920	2,624	2,912

At this time, the data is too inconclusive to make any comparison between Tilapia hybrid and male Tilapia nilotica. However, a few interesting observations can be made. The Tilapia hybrid is relatively easy to capture with a seine while the male Tilapia nilotica is very difficult to capture. The average weight of fish in the treatment containing Tilapia hybrids and nilotica together most likely reflects the growth of Tilapia hybrids because the majority of the sample is composed of Tilapia hybrids. When the experiment is terminated, Tilapia hybrids and male Tilapia nilotica will be separated and the growth of each calculated separately. It is also interesting to note that 60 g fish are able to reach the market size of 250 g within 4 months under the conditions of this experiment. Using a larger fingerling would allow a farmer to harvest 3 crops per year instead of two. Calculated total production per year using this data is 8,760 Kg/ha.

Reproduction — The author is happy to write that Pirapitinga (Mylossoma bidens) broodstock, 3 1/2 years old, are ready to be spawned. A ripe female weighing 3.5 Kg was sacrificed and the ovaries removed. The fully ripe ovaries weighed 419 g and contained an estimated 348,308 eggs. A number of males were captured that had free flowing sperm. The author and Brazilian counterparts will attempt to spawn Pirapitinga in two weeks using injections of fresh Curimatã (Prochilodus corunbata) pituitaries. If the authors can succeed in artificially spawning Pirapitinga, it will be the first time in the world that this fish has ever been artificially spawned.

Tambaquí (Colossoma bidens) was also captured and observed. Broodstock of 4 1/2 years of age and weighing between 8 and 10 Kg. were observed for spawning condition. Several males had free flowing sperm, but no gravid females were found. However, the author has high hopes that gravid females will still be found within the next couple of months.

Channel Catfish (Ictalurus punctatus) were imported from the U.S. in October of 1972. Two lots of 250 fish each with an average weight of 3 g were stocked into 2, 1/2 hectare earthen ponds. Using chemical fertilizer and utilizing shrimps and Tilapia for forage, the Channel Catfish now weigh between 500 g and 1.5 Kg after 15 months of growth.

In the U.S., Channel Catfish do not reach sexual maturity and spawn until 2 to 3 years of age. The author estimates

that the Channel Catfish at Pentecoste are about 19 months old, thus, spawning most likely will not begin until at least June of this year.

Tilapia hybrids — Ten earthen ponds are now in Tilapia hybrid production. Over the past six months, an estimated 20,000 hybrid fingerlings have been produced and are now available for stocking in private ponds or for experimental work.

Trip to Japan and Philippines — The author and two Brazilian biologists, Osmar Fontenele and William Bezerra, both working for DNOCS, went to Tokyo, Japan to attend the world wide FAO technical conference on fishery products held Dec. 4-11. The conference dealt with the latest developments in fishery products, handling and preservation, and processing in the developed and developing countries. Sessions were also devoted to Tropical fish and aquaculture, Product development, marketing, training of fishery technologists, and International cooperation. The conference presented excellent opportunities to view some of Japans large and modern fishery industries, make contacts with other fishery workers around the world, and gain much insight into the coordination and running of an international conference. All three participants considered the conference an invaluable experience and returned with the newest ideas available in fish preservation and products for tropical areas.

After the FAO conference, the three participants flew to Manila, Philippines to visit the USAID/Auburn University fisheries technical assistance project. The participants were guided by Dr. Rudy Schmittou, Chief-of-Party for the Auburn University team, and visited the freshwater research station in Munoz, Nueva Ecija, the government fishery laboratory and research ponds in Manila, and a number of private milk fish farms in the Manila area. The participants were unable to visit the brackishwater research station in Leganes, Iloilo because of transportation difficulties. The participants were able to view extensive commercial fisheulture enterprises which are almost unknown in Brazil. This was of great value, for the Brazilians have seen very little fishculture outside of Brazil and it was a chance for them to see that given the proper incentive, fish farming can be an important and money making business.

All in all, the trip was very worthwhile for all concerned and many new contacts were made and new ideas brought back to Brazil.

Participant Training — Two DNOCS biologists are now studying for MS degrees in fisheries at Auburn University. They have been studying at Auburn for 8 months and appear to be progressing well. A third participant trainee was received on the Auburn campus in January and enrolled in a one year special program which will emphasize fish nutrition. This one year

program will allow the trainee to iniciate a research program in fish nutrition and help train other Brazilians interested in fish nutrition.

A fourth trainee received a 45 day intensive course in fish taxonomy under the guidance of the fish taxonomist in the Auburn University Fishery Department.

The trainee spent 45 days identifying and classifying Brazilian fish sent by USAID to Auburn. He returned to Brazil with the knowledge to classify the fishes found in the Northeast of Brazil and to act as curator of the DNOCS fisheries museum.

At present, a DNOCS biologist has gained permission to relinquish his normal duties and is studying English full-time in preparation to leave for Auburn University to start studying for an MS degree in fisheries. It is hoped that this participant will be able to begin studying in June, 1974.

Table 5 shows the DNOCS personnel that has been trained in the U.S. since 1969 and their field of training.

Short-term Technical Assistance — With the aid of Auburn University, three short-term visits were made by fishery personnel to aid the project in specific areas of interest. Dr. William Rogers, fish parasitologist, and Dr. Thomas Lovell, fish nutritionist, of the Auburn University Fisheries Department, spent November 20 to November 27 working with DNOCS biologists in their fields of interest as well as evaluating

TABLE 5

DNOCS Biologists Trained in the United States
on USAID Participant Training Program

Name	Date	Local	Area of Study	Present Employee	Present Position
Amaury B. da Silva	Aug. 68 June 69	Auburn U.	Fishculture	DNOCS	Director of Pentecoste Research Station
Helio A. Rezende Melo	Aug. 69 July 70	Auburn U.	Limnology	DNOCS	Director of Limnology Research
Odilo F. Dourado	Aug. 69 July 70	Auburn U.	Fishery Biology	DNOCS	Director of Reservoir Mgt. Program
Joaquim Figueiredo	June 73 –	Auburn U.	Fishery Biology-MS	DNOCS	In U.S. Studying
Afonso Augusto	June 73 –	Auburn U.	Limnology-MS	DNOCS	In U.S. Studying
Jarbas Studart Gurgel	Mar. 71 Dec. 71	Kansas St.U. U.of Seattle	Fish Nutrition Fish Technology	DNOCS	Administrator of Fresh-water Fisheries in the Northeast
José Rogerio Tavares	Aug. 68 July 69	U.of Seattle	Fish Technology	U.of Ceará	Assistant Professor-Chemistry
José Valdo Freitas	Aug. 68 July 69	U.of Seattle	Fish Technology	DNOCS	Director of Fish Technology Program
Cincinato Paiva	Jan. 74 –	Auburn U.	Fish Nutrition	DNOCS	In U.S. Studying
João O. Chacon	Oct. 73 Nov. 73	Auburn U.	Fish Taxonomy	DNOCS	Fish Taxonomy
5 DNOCS Biologists	45 days		Visited various	DNOCS	

the project for Auburn University and giving timely suggestions for the improvement of research efforts.

Dr. Jack Greenfield, regional fishery economist with the National Marine Fisheries Service, spent November 20 to December 2 working with John Jensen and the DNOCS fisheries economist evaluating the economic and business potential of commercial fishculture in Ceará and aiding in planning a program that the DNOCS economist can follow to evaluate the economics and marketing potential of freshwater fish in Ceará.

All three advisors presented lectures to fishery students and DNOCS biologists at the University of Ceará in their specific fields of interest.

The author feels that the short-term visits were of great value to the project in providing help in specific areas where the author is unable to provide assistance and in bringing new ideas to the project from an outside source that is not connected directly with the project. All three advisors are writing reports concerning their visits which will be combined and published together by Auburn University. This report should be available to USAID in the near future.

USAID/Brasília — The author would like to acknowledge the fine cooperation received by USAID/Brasília in the past six months. The author can not remember one request to Brasília in the past six months that has not been immediately attended

to and fulfilled. Private English language lessons for participant trainees, secretarial help for the author, the trip to Japan and Philippines, the short-term visit to Auburn University by a DNOCS biologist for fishery training, and a great number of small requests for assistance have all been attended to. This has all made the author's job much easier as well as strengthening the project.

The author is also extremely pleased by USAID/Brasília's attempts to continue USAID and Auburn participation in the project beyond the June 1974 termination date. Visits to Fortaleza by USAID-Brazil directors and staff, a U.S. Congressman (J. Edward Roush of Indiana), and the publicity generated by Brasília have all helped to focus attention on the project in Brasil as well as in the U.S. The author hopes that these efforts will be rewarded by extending the project beyond June, 1974.

Auburn University — The author would also like to acknowledge the direction and assistance the project has received from Auburn. The coordination of the visits by short-term advisors, prompt attention to requests for materials, and timely correspondence have all made the author's job much easier. Recognition should also be given to Auburn's efforts with AID/Washington in behalf of project continuation. The author hopes that Auburn's efforts will be paid off by an extention of our Contract beyond the termination date this year.

DNOCS — The author would also like to acknowledge the cooperation and assistance received from the cooperating governmental agency, DNOCS. The project has advanced greatly in the past year because of DNOCS efforts to build a strong fisheries department. The establishment of a separate Department of Fisheries under the able direction of Dr. Adhemar Braga has greatly enhanced the planning, organization, and inter-departmental communication and morale. DNOCS has shown their interest in fisheries by steadily increasing their financial contribution (Table 6) to the project. In 1973, DNOCS provided 800,000.00 Cr to the project so that additional research ponds could be built. DNOCS reduced their contribution to the project in 1974, but still provided enough money to continue construction on a smaller scale and adequately provide for running a research station and laboratory. Other Brazilian Government agencies are also providing financial assistance as these agencies are also pleased with progress made by DNOCS in fisheries research. These agencies realize the future potential that a strong fisheries research program can have on the development of commercial fisheculture enterprises in the Northeast.

The number one problem facing the DNOCS Fishery Department at this time is not financial, but a lack of trained biologists to carry out research programs and answer the many inquiries for technical assistance. The Department of Fisheries is conscious of the problem and is trying to remedy the situation.

TABLE 6

FUNDS PROVIDED BY GOVERNMENT OF BRAZIL

FOR CONVENIO USAID/DNOCS/SUDENE, 1967 - 1974

YEAR	DNOCS[1]	SUBIN[2]	SUDENE[3]	TOTAL	% DNOCS
1967	50,000.00 Cr	204,000.00 Cr	—	254,000.00 Cr[4] ($ 42,333.33 US)	19.7
1968	100,000.00 Cr	200,000.00 Cr	—	300,000.00 Cr ($ 50,000.00 US)	33.3
1969	100,000.00 Cr	200,000.00 Cr	—	300,000.00 Cr ($ 50,000.00 US)	33.3
1970	121,000.00 Cr	200,000.00 Cr	—	321,000.00 Cr ($ 53,500.00 US)	37.7
1971	200,000.00 Cr	200,000.00 Cr	—	400,000.00 Cr ($ 66,666.66 US)	50.0
1972	220,000.00 Cr	200,000.00 Cr	200,000.00 Cr	620,000.00 Cr ($103,333.33 US)	35.5
1973	800,000.00 Cr	—	225,000.00 Cr	1,125,000.00 Cr ($187,500.00 US)	71.1
1974	390,000.00 Cr	200,000.00 Cr	300,000.00 Cr	890,000.00 Cr ($148,333.33 US)	43.8

[1]Departamento Nacional de Obras contra as Secas

[2]Secretaria de Cooperação Economica e Técnica Internacional

[3]Superintendência do Desenvolvimento do Nordeste

[4]$1.00 U.S. = 6 cruzeiros

The Brazilian Government, at the highest levels, has closed off direct hiring by all government agencies complicating the process greatly. Still, the Fisheries Department has hired 3 new biologists in the past 6 months by entering into a Convenio with the State of Ceará. These three biologists are paid in part by the state and in part by DNOCS. After working under this agreement for a period of a year or two, they will become permanent employees of DNOCS and will be permanently connected with the research center. Two men and one woman are now working and receiving training in fishculture and limnology respectively. This added personnel now raises the number of biologists working within the Convenio to 15.

To further reduce the manpower problem and aid in the training of fishery biologists, the Department of Fisheries has arranged through SUDENE, six small scholarships to be given to interested fishery students in the University of Ceará to work part-time in the Convenio. Fisheries students in their last year of study will be selected to work with Convenio biologists in various disciplines while continuing their studies when not working. This will greatly aid Convenio staff while giving students much needed practical experience. Those students that show the most potential and interest can then be hired by DNOCS when direct hiring is reopened in the future.

International Center for Fisheulture Training — The author firmly believes that DNOCS now has a strong foundation in facilities, trained personnel, and departmental organization to establish a much needed center for training in aquaculture. The Department of Fisheries has already received numerous inquiries from other Brazilian agencies and neighboring South American countries to provide technical assistance and trainin DNOCS gave individual training in fisheulture and related disciplines to 15 Brazilian and one foreign biologist in 1973.

With the Convenio's facilities and personnel, an international center for fisheulture training can easily be established with the aid of USAID and Auburn University. A program will have to be established with well organized training programs and defined areas of study. Instead of providing individual training programs demanding much time effort, a single well organized program can be offered once a year to interested biologists utilizing DNOCS staff and facilities. It is clear that the demandfor training in fisheulture is growingrapidlyin developing South America and that the best potential source for this training is located with DNOCS in Fortaleza. There is no better tropical fisheulture training facility to be found in South America.

The author strongly recommends that DNOCS, USAID, and Auburn do everything within their power to see that the planne center for fisheulture training becomes a reality.

Future Plans

1) Continue with research activities at the Pentecoste Research Station.

2) Continue to write up results of research activities for publication.

3) Work for the establishment of an international center of fishculture training in South America.