492-11-180-266
4920266 (1)
PD-AAQ-544-B1

AID 1025-1 (7-71) (FACE SHEET)
NONCAPITAL PROJECT PAPER (PROP)

I. PROJECT IDENTIFICATION

1. PROJECT TITLE

Aquaculture Production
[Aquaculture Research and Extension]

APPENDIX ATTACHED: ☒ YES ☐ NO

2. PROJECT NO. (M.O. 1095.2) 492-11-180-266

3. RECIPIENT (specify)
☒ COUNTRY Philippines
☐ REGIONAL ☐ INTERREGIONAL

4. LIFE OF PROJECT
BEGINS FY 1975
ENDS FY 1978

5. SUBMISSION
☒ ORIGINAL Feb., 1974 DATE
☐ REV. NO. DATE
CONTR./PASA NO. 44p

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

A. FUNDING BY FISCAL YEAR	B. TOTAL $	C. PERSONNEL (1) $	C. PERSONNEL (2) MM	D. PARTICIPANTS (1) $	D. PARTICIPANTS (2) MM	E. COMMODITIES $	F. OTHER COSTS $	G. PASA/CONTR. (1) $	G. PASA/CONTR. (2) MM	H. LOCAL EXCHANGE CURRENCY RATE: $ US 6.5 (U.S. OWNED) (1) U.S. GRANT LOAN	(2) COOP COUNTRY (a) JOINT	(2) COOP COUNTRY (b) BUDGET
											Millions Pesos	Millions Pesos
1. PRIOR THRU ACTUAL FY												
2. OPEN FY												
3. BUDGET FY 75	278	138		100		40		132			2,005	7,440
4. BUDGET FY 76	177	144		-		33		138			1,415	7,845
5. BUDGET FY 77	137	106		10		21		100			945	8,225
6. BUDGET FY 78	117	110		-		7		104			945	8,750
7. ALL SUBSEQ. FY												
8. GRAND TOTAL	709	498		110		101		474			5,310	32,260

9. OTHER DONOR CONTRIBUTIONS

(a) NAME OF DONOR	(b) KIND OF GOODS/SERVICES	(c) AMOUNT
World Bank	Loan	$4.6 Million

10. CERTIFICATION OF PNA CLEARANCE

1. DRAFTER Richard J. Delaney / Nora Schultzman — TITLE Asst. Program Officer / High Biologist — DATE 2/20/74
2. CLEARANCE OFFICER Arthur J. Bourne / John [illegible] — TITLE Program Officer / Acting Director, USAID/Phil — DATE 2/20/74

IV. PROJECT AUTHORIZATION

1. CONDITIONS OF APPROVAL

2. CLEARANCES

DUR/OFF.	SIGNATURE	DATE	DUR/OFF.	SIGNATURE	DATE
	Frank W. Sheppard, Jr. AD/AD	2-24-74			

3. APPROVAL AAs OR OFFICE DIRECTORS
SIGNATURE DATE
TITLE

4. APPROVAL A/AID (See M.O. 1025.1 VI C)
SIGNATURE DATE
ADMINISTRATOR, AGENCY FOR INTERNATIONAL DEVELOPMENT

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SUMMARY

AQUACULTURE PRODUCTION

The purpose of the project will be to strengthen aquaculture research and extension capabilities in the Philippines in order to almost triple aquaculture production and thereby increase the total amount of protein available to the Philippine people. Protein deficiency is a major and chronic problem confronting the Philippines with an estimated 70% to 80% of the total population receiving less than the recommended allowance of 50 grams per day. The vast majority of this protein deficient group falls into the low income category. The protein impact of the project should be viewed against the following backdrop: a population growth rate which produces each year more consumers than protein supply can cope with; spiraling feedgrain costs which have resulted in decreased consumption of beef, pork, and poultry; decreasing ability of the commercial and municipal fish sectors to meet the total projected demand for fish protein in the future.

Production efforts will focus initially on milkfish (bangus) since the necessary technology for significantly increasing yields and lowering production costs has been developed through research. The principal task now to be addressed will be extension to fish farmers of this known and tested technology, which will be accomplished through strengthening of the Bureau of Fisheries extension service. Production emphasis will begin to shift to species such as carp and tilapia as research for these species results in improved practices which can be imparted to fish farmers. Freshwater and brackishwater research will be carried out respectively at the Freshwater Research Station in Manos, Nueva Ecija, and at the Brackishwater Research Station in Leganes, Iloilo.

A major objective of the research component of the project will be to develop and perfect technology to permit the raising of aquaculture species together with the growing of rice. This so-called rice-paddy aquaculture is expected eventually to benefit a large percentage of the nation's small rice producers both in terms of increased income (directly through the sale of the fish produced and indirectly through savings from meeting themselves a part of their fish consumption requirements) and improvement in their diets as a result of increased consumption of fish protein.

The AID contribution to the project will consist of three contract advisors (two in research and one in extension), as well as participant and commodity support designed to specifically address weaknesses or deficiencies in aquaculture research and extension.

By 1978 when the project ends, viable research and extension programs responsive to the needs of fish farmers should exist and aquaculture production should total approximately 327,300 tons (300,000 tons milkfish production, 300 tons rice-paddy production, and 27,000 tons freshwater production) as against a figure of 120,000 tons in 1973. Of equal importance, a base will have been established for still further gains in overall production to tap the impressive aquaculture potential in the country.

AQUACULTURE PRODUCTION PROJECT

LOGICAL FRAMEWORK

Sector Goal

The overall USAID/Philippine goal to which this project will contribute is improved nutrition for the Philippine consumer. This technical assistance project will specifically contribute to this goal by increasing the availability of fish protein through expanded production and lowered production costs of aquaculture species. The expanded production and lowered production costs will be attained by strenthening the aquaculture research and extension capabilities of the Philippine Government agencies responsible for these functions.

Measure of Goal Achievement

Availability of pond-raised fish in the Philippines will increase from 3.0 kg. per capita per year (1.6 g. protein per capita per day) in 1973 to 6.4 kg. per capita per year (3.5 g. protein per capita per day) in 1978. This is an increase of over 100 per cent and will occur as protein availability from other meat and fish sources declines. Municipal and commercial fisheries in the future will likely be unable to maintain average annual production increases of the past. Consumption of beef, poultry, and pork actually declined in 1973 and will continue to do so in the face of higher prices of animal feed.

The figure of 3.0 kg. of availability assumes 1973 fishpond production of approximately 120,000 tons and a population of 40 million. The figure of 1.6 g. protein assumes 1 kg. milkfish equals 0.2 kg. of protein. The figure of 6.4 kg. of availability assumes fishpond production of 300,000 tons in 1978 and a population of 46.7 million (Bureau of Census median projection which assumes a slightly declining birth rate).

Verification of Goal Achievement

1. NFAC Consumption Surveys (annual).

2. Bureau of Fisheries estimates of fishpond production and productivity per hectare (annual) and "Fisheries Statistics of the Philippines" (annual).

3. NEDA Food Balance Sheet (annual).

Basic Assumptions of Goal Achievement

Increased aquaculture production and stationary (or even lower retail prices will result in increased consumption of aquaculture fish species by Filipinos of all economic levels.

Project Purpose

To create viable aquaculture research and extension services for increasing aquaculture fish production and simultaneously reducing production costs. Efforts will focus initially on milkfish where improved technology is ready for extension to fish farmers, and later on such species as carp and tilapia as improved practices are developed and tested.

Conditions Expected at End of Project

1. Fish farmers are using improved technology developed at aquaculture research stations and advanced by extension to increase milkfish production from approximately 120,000 tons in 1973 to 300,000 tons by the end of 1978.

2. Yields for milkfish will have increased from an average of 570 kg/ha in 1973 to 1300 kg/ha in 1978; production costs for milkfish will have decreased from ₱2.25/kg in 1973 to ₱1.00/kg by the end of 1978 (figures are based on 1973 costs).

3. Freshwater pond production composed primarily of species of tilapia, carp, and catfish will increase from 1971 (latest data available) to 1978 as follows:

	1971	1978
Total Area under Production	6,000 ha.	21,000 ha.
Yield/ha.	580 kg.	1,300 kg.
Production	3,500 tons	27,000 tons

4. Fish production in combination with rice in paddies (primarily tilapia, carp, and catfish) will increase from negligible and incidental amounts in 1973 to production in 1978 and 1980 as follows:

	1973	1978	1980
Total Area	-	3,000 ha.	100,000 ha.
Yield/ha.	-	100 kg.	125 kg.
Production	-	300 tons	12,500 tons

5. Research projects are completed and findings published as technical and extension literature; new programs are underway with competent staff.

6. Extension workers are effectively applying the "extension method"; literature is in the hands of farmers; new demonstrations and field trials with individual farmers are being set up and carried out as old ones are terminated; training programs are underway

for extension workers to keep them abreast of the most modern fish farming techniques.

Verification of Purpose Achievement

1. Through sample surveys, determine extension services being performed, and fish farmer production techniques and production.

2. Yield and cost studies; official annual "Statistics of the Philippines".

3. Formal evaluation of institutional capability and performance.

Basic Assumptions of Purpose Achievement

1. An effective credit system is functioning for fishpond operators.

2. An effective marketing system to handle increased aquaculture production exists.

3. Production inputs such as fertilizer are in adequate supply.

4. Rice variation not requiring insecticides or pesticides are being used extensively by rice farmers.

5. Research and extension programs receive timely and adequate release of funds from GOP.

Project Outputs

Outputs	Output Indicators
1. Bureau of Fisheries (BF) providing adequate extension services to fishpond operators.	
a. Bureau of Fisheries extension staff completed special training.	a. 250 extension workers will have received intensive in-service training by end 1978, and 250 will have received refresher training by end of 1978.
b. Viable and effective extension plans and programs.	b. Extension programs developed for all provinces in country with aquaculture potential by July, 1977.
c. Equipment, materials, and literature for BF extension teams.	c. All extension teams adequately equipped by July, 1977.

Outputs	Output Indicators
d. New and revised extension literature covering all aspects of aquaculture.	d. By July 1974, literature prepared covering all existing technology. Thereafter, literature will be developed as freshwater and brackish-water research progresses.
e. Effective aquaculture field-testing and demonstration farms.	e. All 21 BF demonstration fishfarms programmed to carry out field-testing and demonstrations as needed.
2. Conducting of research in freshwater fish culture in subjects listed below at the Freshwater Station at Central Luzon State University, Munoz, Nueva Ecija, with results published in actual research reports.	
a. Rice-fish culture production	a. Tilapia species and/or common carp production at 100 to 500 kg/ha/yr at a cost of 25 centavos /kg by 1976.
b. Mono and polyculture production	b. Single and combination production of species of carps and tilapias and mudfish at 1500 to 3000 kg/ha/yr at a cost of ₱1.00 per kg by 1976 or 1977 (Based on 1973 cost figures).
c. Monoculture production.	c. Milkfish production at 1500 to 2000 kg/ha/yr at a cost of ₱1.00/kg by 1976.
d. Artificial spawning and hatchery techniques for mass production of fry.	d. Accomplished for species of carps, catfishes, and tilapias by 1976 or 1977.
e. Optimum fertilizers selected and fertilization techniques developed.	e. Accomplished for all the above species by 1976 or 1977.
f. Identification of disease organisms and development of technology for their control.	f. Accomplished for all the above species by 1976 or 1977.

Outputs	Output Indicators
g. Pest identification and control	g. Accomplished for all the above species by 1976.
h. Optimum pond construction techniques developed.	h. Accomplished for all the above species by 1976.
3. Conducting of research in brackishwater fish culture at the Brackishwater Station in Leganas, Iloilo, with results published in actual research reports.	
a. Artificial spawning and hatchery techniques for mass production of fry.	a. Accomplished for milkfish by 1977.
b. Decrease in mortality rate of wild milkfish at all stages of handling from fry collecting from the ocean to harvest of marketable fish.	b. Decreased from 70% in 1973 to 30% by 1976.
c. Establish production ranges for milkfish production based on the three major foods (lumut, lab-lab, plankton) and develop optimum management-production techniques for each.	c. Accomplished by 1975.
d. Identification and testing of polyculture production possibilities for milkfish, species of mullets, tilapias, shrimps, and sea bass. (No significant polyculture exists in Philippines at present).	d. Accomplished by 1977 or 1978.
e. Identification and selection through test culturing of species of molluscs (clam and oyster species) for possible small operator, "backyard" production (for consumption and local sale by operators).	e. Accomplished by 1977.
f. Same as 2 (e) for all the above species.	f. 1976.
g. Same as 2 (f).	g. 1977.
h. Same as 2 (g).	h. 1976.
i. Same as 2 (h).	i. 1976.

Project Inputs

U.S. Inputs

	$000/FY				
	75	76	77	78	Total
Technical Assistance					
Direct Hire (1 @ 1/4 time)	6	6	6	6	24
Extension Advisor (1)	40	42	44	46	172
Research Advisor (1 for 4 yr; 1 for 2 yr)	80	84	44	46	254
Short-term advisors (3mm/yr)	12	12	12	12	48
Sub-Total	138	144	106	110	498
Participants					
Extension:					
Graduate degree (18 mo)	36	0	0	0	36
Aquaculture - 2					
Pathology - 1					
Non-degree (6 mo)	40	0	0	0	40
Pond construction - 2					
Aquaculture - 2					
Extension methodology - 2					
Nutrition - 1					
Pathology - 1					
Research:					
Graduate degree (18 mo)	24	0	0	0	24
Aquaculture - 1					
Fish processing/tech - 1					
Non-degree (6 mo)	0	0	10	0	10
Aquaculture - 2					
Sub-Total	100	0	10	0	110

	$000/FY				
	75	76	77	78	Total
Commodities					
Extension:					
Jeeps ($350 ea for 85 total)	12	12	7	0	31
Information-education (camera, projector, megaphone, other)	3	3	3	0	9
Field equipment (balance, chemicals, other)	3	3	3	0	9
PURA (tires, other)	5	5	5	5	20
	(23)	(23)	(18)	(5)	(69)
Research:					
Jeeps ($350 ea for 6 total)	1	0	1	0	2
Vehicles (carry-all -2; pick-up - 2)	6	6	0	0	12
Lab. equipment	9	3	1	1	14
PURA	1	1	1	1	4
	(17)	(10)	(3)	(2)	(32)
Sub-Total	40	33	21	7	101
TOTAL	270	177	137	117	709

GOP Inputs	$000/FY				
	75	76	77	78	Total
Extension (Bureau of Fisheries)					
Extension service operations	3,300	3,500	3,700	4,000	14,500
Training	1,260	1,280	1,320	1,400	5,220
Surveys	700	735	765	800	3,000
Demonstration farm operations	2,000	2,100	2,200	2,300	8,600
Leasing	220	230	240	250	940
Sub-Total	7,440	7,845	8,225	8,750	32,260
Research (University of the Philippines College of Fisheries, Central Luzon State University, and National Science Development Board)					
Operation Costs of stations	580	650	770	820	2,820
Equipment/Supplies	25	35	45	45	150
Facilities					
Experiment Station					
Dormitory/Classroom	300	150	50	0	500
Staff housing	50	0	0	0	50
Staff apartment	100	0	0	0	100
Ponds and other physical facilities	120	300	0	0	220
Maintenance	10	10	10	10	40
Freshwater Station					
Dormitory/Classroom	400	100	0	0	500
Staff housing	50	50	0	0	100
Staff apartment	150	150	0	0	300
Ponds and other physical facilities	150	100	0	0	250
Maintenance	20	20	20	20	80
Sub-Total	1,955	1,365	895	895	5,110
Participants (Philippine Council for Agricultural Research)					
Scholarships (10/yr)	50	50	50	50	200
TOTAL	9,445	9,260	9,170	9,695	37,570

Other Donor Project Inputs

No inputs have been committed or promised by other donors other than a $4.6 million loan from IBRD/WB in 1973 for fishfarm development. However, the Rockefeller Foundation and possibly similar institutions will also be requested to support certain specific research projects (e.g., research in artificial spawning of milkfish). Rockefeller Foundation will be requested to assist UPCF in establishing a graduate degree program.

The Philippine Government through Mindanao State University is implementing the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC)1/. The project focuses upon crustacean (primarily shrimp) production for the commercial market. The Department is operating with a budget of $1,673,000 for FY-1974 with $573,750 provided by the Philippines and the remainder from member nations, primarily Japan.

1/ Under the SEAFDEC program emphasis is on crustacean production while emphasis in the project presented herein is on fin fish, therefore, there is no duplication or competition in the two programs.

AQUACULTURE PRODUCTION PROJECT

GENERAL RATIONALE

1. Project Goal

The goal of the Aquaculture Production Project is to increase the total amount of animal protein available to the Filipino people. Nutrition improvement has been a major priority and component of USAID/Philippine and Government of the Philippine programs for some years. This emphasis reflects the widespread belief that the health and energy of the individual are important factors in the development process. Stated another way, malnutrition is seen as a major obstacle to development.

The state of nutrition among Filipinos is below desirable nutritional standards. Malnutrition is a serious affliction and daily companion of the majority of Filipinos and particularly those in the lower economic classes (especially infants, preschool children, and pregnant and lactating women). Their diet is deficient both in terms of calories and protein. Average daily per capita consumption of protein in the Philippines in 1970 was less than 47 grams compared to the recommended dietary allowance (RDA) of 50 grams. It is estimated that between 70% and 80% of the total population receives less than the RDA for protein.

2. Fish as Nutritional Source

Fish in general provide more nutrition per unit of weight than red meats. While beef has a net protein utilization (percent of total protein that the human body can actually utilize) of 70, that for fish is 80. On a moisture-free basis, protein in fish averages around 80% whereas red meat provides only about 50%. After rice, fish is the most important source of total protein in the diet of low income Filipinos. It is the single most important source of animal protein in their diet, and ranks ahead of pork, beef, poultry and eggs. It should also be noted that fish is a more desireable and higher quality source of protein than rice or corn. Vegetable protein is usually very low in the essential amino acids lysine and methionine.

According to a survey conducted in May 1973, among the very lowest income group of Filipinos (less than ₱600 per capita per annum), fish provides about 20% of total protein intake and makes up 61% of animal protein (Table 1). Milkfish, the principal pond-cultured species at present, alone accounts for up to 2% of total and 6% of animal protein. One survey (Table 2) indicates average daily per capita consumption of milkfish protein is 0.70 g, which is equivalent to 256 g of protein or 1.3 kg of fresh milkfish per year[1/]. Note that milkfish is the tenth most important source of protein and provides essentially as much protein as chicken.

1/ These data are based on consumption surveys which give figures of per capita consumption of milkfish ranging from 1.3 to 5.4 kg/annum. A per capita consumption of approximately 3.0 kg/annum is most consistent with production data.

Table 1 - Major food protein sources consumed by Filipino income groups 1/.

Food Sources	Daily per capita protein consumption per income group									
	Less than ₱400		₱400-799		₱800-1499		₱1500-over		All Groups	
	R	G	R	G	R	G	R	G	R	G
Rice, milled	1	20.4	1	21.8	1	22.2	1	23.0	1	-21.6
Corn (grits)	2	6.1	5	4.3	9	2.5	10	2.2	6	4.3
Fish (fresh)	3	4.7	2	6.2	2	7.3	4	7.5	2	6.2
Fish (dried)	4	4.6	3	4.9	5	5.3	5	5.3	3	4.9
Wheat (bread)	5	2.9	4	4.6	4	6.2	3	8.3	4	4.8
Pork	6	2.2	6	4.1	3	6.5	2	8.8	5	4.7
Mongo/beans	7	1.1	10	1.6	11	1.6	11	1.8	10	1.5
Beef	8	1.1	7	1.9	6	3.2	6	4.8	7	2.3
Poultry	9	1.0	8	1.7	7	2.8	7	4.3	8	2.1
Eggs	10	0.9	9	1.7	8	2.7	8	3.5	9	1.9
Other	-	1.5	-	3.4	-	4.6	-	5.3	-	3.4
Total		47.1		56.2		64.9		74.8		57.7
Plant Origin		31.0		32.8		33.1		36.0		32.7
Animal Origin		16.1		23.4		31.8		38.8		25.0
% animal		34.1		41.7		49.0		52.0		43.4
% animal from fish		61.0		52.0		44.0		38.0		48.0

R - rank (NFAC Marketing Research Unit Reports No. 73-8, May, 1973)
G - grams

1/ These consumption data are considered to be representative of relative consumption or trends, though the actual values are probably biased high.

Table 2 - Average protein consumption in the Philippines per capita per day.

Source	Rank	Protein consumption Grams	% of total
Rice	1	19.80	41.7
Corn	2	4.85	10.2
Wheat	3	2.15	4.5
Anchovy	4	1.78	3.8
Pork	5	1.37	2.9
Beef	6	1.06	2.2
Mongo bean	7	1.04	2.2
Milk	8	1.00	2.1
Chicken	9	0.71	1.5
Milkfish	10	0.70	1.5
Other	-	13.04	27.4
Total		47.5	100.0

(Nutrition Surveys, FNRC, NISM, NCHS, 1959-1968)

Fish is also superior to red meat in that it contains unsaturated low cholesterol fat as opposed to saturated, high cholesterol fats in meats. In addition, greater amounts of calcium and other minerals are consumed per unit of weight from fish than from meats.

3. Fish Production Potential vs. Meat Production Potential

The higher consumption among low income groups of fish over animal meats reflects the fact that fish is produced at lower cost. From the standpoint of the consumer, it is not realistic to consider animal meat production alternatives given the comparative advantages which fish have and are likely to continue to have in the future, especially given the increasingly high cost of feedgrains required to produce meats, particularly pork and poultry. In well-managed environments, 2000 kg of fish/ha can be produced per year while the maximum figure for cattle

is only 500 to 700 kg. Feedgrains are necessary for large-scale production of poultry and swine but are not required for large-scale fish production. In the Philippines feedstuffs necessary for commercial livestock production are not locally available and must be imported at increasingly higher prices.

Fish inherently are more efficient in converting food to flesh than land-based animals, primarily because they are cold-blooded and live in an aquatic environment. Land-based culture animals are warm-blooded and require a great deal of energy in maintaining a constant temperature; fish being cold-blooded take on the temperature of the environment and do not need to use energy to maintain a body temperature. Land-based animals expend a great deal more energy in supporting themselves against gravity than fish since fish adjust their specific gravity to zero in water.

Average prices paid for fish and meats per capita by income group are presented in Table 3, and costs per gram of protein for fish and other selected foods by income groups are presented in Table 4. Note that dried and fresh fish rank first and fourth as the cheapest sources of protein to the lowest income group.

Table 3 - Average price paid per kilo of selected foods in Feb-Mar 1973.

Source	Per capita income group				
	Less than P400	P400 to 788	P800 to 1499	P1500 & above	All Groups
Fish (fresh)	2.20	2.63	2.73	3.23	2.66
Chicken (alive)	5.34	4.68	4.75	5.38	5.12
Pork (carcass)	5.20	4.84	6.74	6.04	5.80
Chicken (dressed)	6.00	6.02	6.13	6.03	6.03
Beef (carcass)	4.17	5.58	5.92	8.22	6.25

Data from February-March, 1973 prices.

Table 4 - Cost per gram of total protein for selected foods.

Source	Price paid (₱) per capita income group				
	Less than ₱400	₱400 to 788	₱800 to 1499	₱1500 & above	All Groups
Corn (grits)	0.75	0.71	0.65	0.65	0.71
Fish (dried)	0.70	0.79	0.78	0.78	0.76
Rice (milled)	1.47	1.49	1.52	1.62	1.51
Chicken	2.40	2.14	2.27	2.46	2.41
Fish (fresh)	2.36	2.82	2.93	3.44	2.80
Eggs	3.69	3.53	3.70	3.20	3.54
Milk, condensed	3.66	2.93	3.60	3.77	3.68
Milk, evaporated	3.67	3.93	4.06	4.09	4.03
Pork (carcass)	3.66	3.52	4.82	4.36	4.12
Beef (carcass)	2.80	3.76	3.88	5.41	4.21

Data from BAHR-NFAC Research Report 73-8.

4. Aquaculture Potential vs. Municipal and Commercial Fish Potential

The fisheries industry in the Philippines is commonly classified into three sectors: commercial, municipal, and inland fisheries. Both commercial and municipal involve capture fishing while inland fisheries represents "fish farming". Commercial fishing is that conducted on the open seas by ocean-going vessels weighing more than 3 GRT (gross tons) and operating in waters deeper than 7 fathoms (mostly beyond the three-mile limit). About 39% of total national fisheries production derives from the commercial fisheries sector. This sector is expected by the Philippine Government in the future to be the source of major fish exports such as shrimp and tuna.

Municipal fishing is essentially sustenance fishing carried out by small craft weighing up to 3 GRT and operating in waters no deeper than 7 fathoms (usually within the three-mile limit). Most of the craft are non-mechanized. This sector is responsible for 51% of total fish output but operates at a low level of efficiency and productivity. The bulk of production is for subsistence and local consumption.

The inland fishing or aquaculture sector includes both freshwater and brackish-water fish farming and accounts at present for about 10% of total fish output.

The majority of fishponds are brackishwater. In 1970 approximately 162,000 hectares were brackishwater and 6,000 freshwater. At present, the milkfish is by far the major species raised in ponds, accounting for approximately 90% of total fishpond production.

Between 1960 and 1970, total fish production increased from 445,000 metric tons to 989,000 metric tons for an overall growth rate per annum of about 8.47% (Table 5).

Table 5 - Source of fish output and growth rates.

Fishing Sector	Output by source (%) 1960	1965	1970	Annual growth rate (%) 1960-65	1965-70	1960-70
Commercial	27.0	45.0	38.6	20.1	4.9	12.3
Municipal	59.5	45.5	51.6	2.8	10.9	6.8
Fishforming	13.5	9.5	9.8	1.0	8.8	4.9
All sectors	100.0	100.0	100.0	8.5	8.2	8.4

Taken from the Fisheries Statistics of the Philippines, 1960, 1965 and 1970.

From 1960 to 1970, the average per annum growth rate of commercial fisheries output was 12.3%. However, it was 20.1% for the first half of the decade and only 4.9% for the second half. Over the past decade the trend in vessel size has been toward an increase in the number of vessels 70 tons or more and a decrease in vessels 10 tons or less. Over 90% of fish are harvested using purse seines, otter trawls and bagnets, and average production per vessel using these gears declined 4%, 12%, and 14%, respectively, between 1968 and 1970. The overall growth rate for fisheries was maintained at over 8% during the 1965-70 period by acceleration of fishpond activity and municipal fishing, according to the IBRD Sector Survey (Annex 5, Para. 9, p. 2).

The annual growth rate for municipal fishing from 1960 to 1970 was 6.8%. However, productivity is not high. In 1970 one man engaged in municipal fisheries could account for one metric ton of output whereas one man in commercial fisheries accounted for 12 metric tons of production.

Inland fisheries had only a 4.9% annual growth rate from 1960 to 1970, but from 1965 to 1970 the growth rate was 8.8%, compared to 4.9% for commercial and 10.9% for municipal. Area, yields, and production have all increased significantly.

Table 6 - Area, yield, and production of fishponds.

Year	Area of ponds (ha)	Yield (kg/ha)	Production (tons)
1960	123,300	478	60,000
1965	137,200	460	63,000
1970	168,000	574	96,500

Fisheries Statistics of the Philippines, 1970, 1965 and 1960.

The FAO/UNDP/SF Deep Sea Fishing Development Project estimates the potential annual catch within Philippine territorial waters at about 1.65 million tons, which is almost double the actual catch in 1970 (Table 7). The potential consists of 650,000 tons for municipal and 1,000,000 tons for commercial fisheries. According to these estimates, the municipal catch in 1970 represented 79% of the potential in the waters dominated by this sector, the commercial catch about 38% of the potential and about 54% was the figure for the total capture fisheries potential.

Table 7 - Potential and actual fisheries catch in Philippine territorial waters.

Sector	Potential catch	Actual catch 1970	Actual catch % of potential
Commercial	1,000,000 tons	382,000 tons	38%
Municipal	650,000 tons	511,000 tons	79%
Total	1,650,000 tons	893,000 tons	54%

Municipal fishing is obviously approaching the limit of its potential catch. At the present intensity of fishing in waters covered by this sector, it will become increasingly difficult to absorb more fishermen without adversely affecting the livelihoods of existing fishermen.

Commercial fishing has apparently reached its potential on present fishing grounds, and the production gains resulting from use of larger vessels have been realised. Exploitation of the remaining potential for commercial fisheries will require moving into deeper and more distant waters at higher costs. Commercial fishing beyond Philippine territorial waters is not likely on a significant scale

given the costly investment and highly skilled manpower required and the existing intensive fishing pressure exerted in the western Pacific by other nations, particularly Japan, Taiwan, and South Korea.

As an indication of the inland fish potential, in 1970 total aquaculture production was 96,500 tons. As shown in Table 6, this figure was attained with an average yield of 574 kg/ha and total cultivation area of 168,000 hectares. Research results from trial testing by the Inland Fisheries Project and Bureau of Fisheries demonstrate the possibility of yields as high as 3,000 kg/ha/yr. Average national yields of at least 1,200 to 1,500 kg/ha/yr at the fertilization level of management should easily be realized in the next four years. In Taiwan average yields of approximately 1,800 kg/ha are attained in only a seven-month growing season -- temperatures are too low for milkfish culture during the other five months. However feeds are required to achieve these high yields, whereas in the Philippines because of favorable climate and other conditions high yields are possible without using feeds and perhaps with only phosphate fertilizer. The technology for achieving the high production is simple and inexpensive to apply.

An additional 496,000 ha. of swamp lands, consisting of 370,000 ha. of brackishwater and 126,000 ha of freshwater areas, are estimated to be available for fishpond production. This land, unsuitable for agriculture, at present serves little or no significant economic function. Table 8 shows the distribution of present fishpond area and productivity by fishing region and the swamplands available for development. Some 64% of the area and over 70% of output are concentrated in Regions XII (Bulacan, Cavite, Pampanga) and V (Iloilo, Capiz, Negros Occidental) where yields rank high. More than half of the swamplands available for development are in Regions VI and VIII where present yields are among the lowest (particularly Northern Samar in Region VI and Agusan del Sur and Davao del Norte in Region VIII). There is also considerable room for expansion in Region III (Zaloman, Quezon, Pampanga).

Table 8 - Fishpond area and production in 1970

Region	Area (1,000 ha)	Production (1,000 tons)	Yield (kg/ha)	Area Available for development: Fresh Water (1,000 ha)	Area Available for development: Mangroves (1,000 ha)	Area Available for development: Total (1,000 ha)
I	12.4	8.7	706	2.5	6.3	8.8
II	0.5	0.1	200	2.9	13.4	16.3
III	56.9	41.9	737	23.5	58.8	82.3
IV	10.8	3.8	348	-	38.3	38.3
V	42.8	27.9	652	-	33.8	33.8
VI	14.4	4.3	297	9.7	141.6	151.3
VII	18.3	5.9	322	1.0	45.4	46.4
VIII	12.1	3.9	322	86.6	32.3	118.9
Total	168.1	96.5	574	126.2	370.1	496.3

Fisheries Statistics of the Philippines 1970.

The aquaculture potential is clearly reflected in the Government's Expanded Fish Production Program (FY 1974-75) being implemented by the Bureau of Fisheries. Whereas the projected incremental production increases for the commercial and municipal sectors are 37% and 15% respectively, that for fish farming is 48%, or almost equivalent to the combined percentage increases of the other two sectors. In fact, fish farming is targeted to yield about 50% of total annual production increases over the next several years, and by 1980 is expected to account for 21% of total fish production.

Freshwater fishponds are targeted by the Government to produce almost 42% of the incremental production from the inland fisheries sector in 1975. This target is probably too high and not likely to be attained for a number of reasons. However, the future of freshwater pondproduction is very good and yields per input cost could in time easily exceed that from brackishwater ponds.

The fisheries section (Annex 5) of the IBRD Sector Survey[1/] (May 2, 1973) also underlines the potential of the inland fisheries sector and supports the other findings contained in this PAOP. Paragraph 4 on p. 1 states that: "This component (inland fisheries) has a very large potential for increasing output both by improving technology of existing fishpond culture and by development of extensive swamp areas throughout most of the Philippines". Paragraph 32 on p. 10 makes note of the limited potential of both municipal fishing and commercial fishing. Paragraph 69 is quoted in its entirety below and is taken from the concluding section of the Annex dealing with "development strategy":

"Development Strategy. Given the uncertainty as to the extent of marine resources, the element priority relates to improving fish farming as rapidly as possible -- both the yields of existing fishponds and the development of new fishpond areas. Most of the increase in demand for fish in the next 10 years could be met by a program to develop [illegible] half of the available swampland area (25,000 ha per year) and by a program to double yields per hectare by extensive use of fertilizers and other improved practices in fishpond culture. Such activities have much to offer in development of lagging regions, since large swampland areas are particularly available in Mindanao, Samar, Bohol, and Palawan. Much of these latter areas have very limited access, and a coordinated program of roads and market facilities would be required for their development."

1/ Annex 5 of the IBRD survey and the Aquaculture Production Project are in such close accord that much of the data and information contained in this PAOP comes from the Annex itself, especially the PAOP section on aquaculture potential.

5. Projected Low Income Consumer Benefits from Increased Aquaculture Production

Aquaculture, as previously noted, consists almost exclusively of milkfish production at present. That was estimated in 1973 at 120,000 tons. Average yield per hectare in 1973 was approximately 570 kg. Production costs were ₱2.25 kg. of milkfish. (Carandang, F.L. and L.B. Darrah, "Bangus Production Costs", Marketing Research Unit, NFAC-DANR, 73-10, May 1973).

The project objective is to increase aquacultural production to 300,000 tons by the end of 1978. This will be accomplished by: (a) increasing hectarage under production from 180,000 ha. in 1973 to 230,000 ha. by end-1978, and (b) increasing average yield per ha. to 1300 kg. Secondly, the program objective is to decrease production costs to ₱1.00/kg (this and other cost figures are based on 1973 levels).

Targets for other aquaculture species (tilapia, carp, catfish) are indicated under the purpose section of the logical framework. For the analysis which follows below, in the interest of simplicity, only the effects of increased milkfish production on consumers in the lowest income bracket are treated. However, the beneficial consequences of expanded production of non-milkfish species should be taken into account in considering the impact of the project on this low income group. In addition, as noted earlier, the protein deficient group in the Philippines is a considerable one, accounting for between 70% and 80% of the total population. It is much larger than the very lowest income group treated in the analysis. Moreover, the majority of the protein deficient group fall into the low income category. These factors also need to be considered in gauging the total effect of the project. In other words, the analysis tends to understate that effect in discussing just a portion of the beneficiaries of the project.

The final objective or "goal" in PROP terminology is to increase the amount and decrease the cost of protein available to the consumer, particularly the low income consumer. What will be the estimated effects on lowest income consumers of: (1) an increase in milkfish production, and (2) a decrease in milkfish production costs?

Milkfish is probably the most favored fish by all classes of Filipinos, with an income-quantity elasticity of demand of 0.67, as compared to that for all fish and first class fish of 0.26 and 0.51, respectively. For the poorest one-third of Philippine families, milkfish normally comprises 8-10%, by weight, of all sea food purchased, and furnishes about 2% of total protein intake and 6% of animal protein intake.

Pre-1972 flood milkfish production was approximately 120,000 tons annually, or 3.2 kg. per capita, with the lowest income class (the poorest one third) consuming approximately half the overall per capita average, or 1.6 kg. per capita. Increasing production to 300,000 tons annually by 1978 will increase per capita availabilities to 6.4 kg., an increase of 100%.

Cost of production of milkfish in 1973 was about ₱2.25/kg., and retail price was about ₱5.00/kg. If production costs fall to ₱1.00/kg by 1978, price should then fall by at least 1.25 ÷ 5.00 x 100 = 25%, and possibly more due to small profit margins (concommitant with higher volume of sales). This price fall and an assumed annual rate of growth of real per capita income of 4% for the 1972-1978 period imply an increase in annual per capita demand for milkfish of 40% from 3.2 kg. in 1971 to 4.5 kg. in 1978, using an income elasticity of .67 and price elasticity of .6 from the Marketing Research Unit of the GOP National Food and Agriculture Council. Since income-quantity elasticity of demand for milkfish for the low income class is about the same as the overall coefficient, and since income for this class grows as fast as total personal income, demand for milkfish by this class can be assumed to grow by at least 40%.

There is still another consideration in estimation of demand for milkfish: the substitution of milkfish, and fish in general, for other animal products. Some of the recent meat price increases may reflect 1972 flood damage, but a large part is due to high feed prices (world-wide), which are expected to continue. A sample of price increases in the Philippines from May-June, 1971, to February-March, 1973 shows that: pork prices increased 32%, beef and carabao 27%. In the same period per capita consumption of meat other than sea food fell by 23%, in weight terms. Per capita consumption of seafood fell by 10% over the same period, most of which was caused by flood damage to milkfish fishponds.

Data is not available on the extent to which people substitute fish for other animal products when their price changes, but if we assume people attempt to replace the decrease in other animal products consumed with even half of the same weight increase in fish consumed, then the 25% drop in per capita consumption of other meat products would lead to an increased per capita demand for fish of about 4 kg. annually, a large part of which demand would be for the soon-to-be cheaper milkfish. Families in the low income class will tend to substitute fish for meat at a greater rate than higher income classes.

The increased demand for milkfish due to income increases, decreased price of milkfish, and increased price of other animal products should thus match the projected increase in production of 3.2 kg. per capita annually.

To gauge the nutritional impact of this program we must consider the probable course of events without the project. In this case we assume no increased productivity (or lowered costs), but that hectares under fishponds expands at a rate of 1.7% per year, as occurred in the 1968-71 period; thus production will expand 1.7% each year. But with population increasing roughly 3% annually, this rate of production increase means a decrease in per capita availability totalling about 6.5% by 1978. This decrease combined with a fall-off in meat production would probably not be made up in the short run from other high protein foods, except to some extent by increased imports. In terms of per capita availability of protein, if milkfish production is increased from a 3.2 kg to a 6.4 kg. annual

per capita level with the project, as opposed to falling to a 3.0 kg per capita level without the project, then the difference, 3.4 kg per capita, is an amount of high protein food that would not otherwise be produced in the country. This translates into 2 g. of protein per capita per day. This is in addition to what would be produced without the project.

How important is this 2 g of protein? Recommended daily consumption is 50 g. and actual average intake is 47 g., but for the lowest income class, average daily intake can be estimated to be about 42 g. Since the low income class can less afford imports and more expensive local meat, and since income increase-induced changes in demand should be relatively as great for the low income group, this group's share of the additional protein available from the project should be somewhat more than its present share of fish or other protein, say 1.3 g per capita or 2.4 kg milkfish annually. Thus, the protein produced by this project would be equal to 3% of the protein consumed by low income families, and 10% of animal protein consumed by such families. Because of the high quality of fish protein, this amount would represent a highly important element of protein nutrition for the low income consumer, particularly since such diets are usually high in starch root crops of low protein value.

An additional factor to be weighed in considering the nutritional impact of increased aquaculture production is the diminishing capability of the commercial and municipal fish sectors to meet the projected demand for fish over the next several years. The IBRD Annex on fisheries suggests a likely gap between fish supply and demand in the future (para. 26, p.8). The annex states that the increases required to meet projected demand -- 56,000 tons in 1970-75 and 66,000 tons a year in 1975-80 -- are substantially above the output increments of recent years. Most of the increased output since 1968 has been from municipal fisheries; yet, para. 32, p.10 of the annex notes that "municipal fishing is approaching its potential catch." We have previously pointed out the limitations connected with efforts to expand the commercial catch. Consequently, if the fish protein intake of the low income Filipino is to be even maintained at its present inadequate level, aquaculture production will have to shoulder a major share of the burden of increased fish production.

To recapitulate, the increased aquaculture production deriving from this project is required if only to maintain present poor levels of nutrition because of: (a) expanding population, (b) decreased availability of animal meat protein, (c) the diminishing ability of commercial and municipal fisheries to increase their production as they approach total potential catch. Without the national aquaculture production program and this accompanying project, low income nutrition will deteriorate. With them, at worst present nutritional standards will be maintained; at best these standards will improve.

6. Project Strategy

Extension Emphasis:

The objective of the extension element in the project is simultaneously to increase production and decrease production costs. Research conducted under the present Inland Fisheries Project has demonstrated that significantly higher yields are possible, accompanied by lowered production costs. What must now occur is an effective program of information-dissemination of known technology to milkfish producers together with a strengthening of GOP extension capability. Extension effort will focus almost exclusively on milkfish production for the first two years or until extendable technology is developed for other freshwater and other brackishwater species through applied research.

The Bureau of Fisheries (BF) of the Department of Agriculture and Natural Resources will be responsible for extension activities under the project. The extension service will be directly linked to aquaculture research stations with extension workers stationed at each to obtain backstopping from the station staffs and to advise in what research will be undertaken at the station. An essential element of the extension component of the project will be a strengthening of the capacity of BF to provide effective extension services to aquaculture producers. The implementation section of the PROP discusses the extension component in greater detail.

Research Emphasis:

While major emphasis for milkfish production will be accorded to extension of known technology and research findings, additional research efforts on milkfish will be necessary in such areas as artificial spawning and hatching techniques, suppressing mortality rate of wild milkfish fry, standardizing production techniques, and the establishment of production figures for different milkfish production techniques. Research in these areas will help to further increase potential yields and decrease costs of production. Research on milkfish will be conducted primarily at the Brackishwater Station in Leganes, Iloilo, which is operated by the University of the Philippines College of Fisheries (UPCF).

With respect to non-milkfish species, the objective will be to develop basic production knowledge not existing now which can be extended to producers. Priority will be given to rice-fish culture production; mono and polyculture production of species of carps, tilapias, catfishes and mudfish; freshwater monoculture of milkfish; artificial spawning and hatchery techniques for mass production of fry of various fishes; fertilization, pest management, disease control, and pond construction techniques. The Freswater Station at Munoz, Nueva Ecija, which is jointly operated by Central Luzon State University (CLSU) and UPCF, will carry out research in the above areas. The Brackishwater Station in Leganes will conduct research into the possibilities of

culture production of species of mullets, tilapia, shrimps, and sea bass and for mollusc culture (clam and oyster species).

A primary objective for the research efforts at Leganes and Munoz is to establish a base of basic production information and technology which will permit pond-culture production on a significant scale for species other than milkfish.

The end objective is to add to the total fish and protein supply available to Filipino consumers. The implementation plan provides additional details on research activities to be carried out under the project and specific targets for these.

Education and Administrative Support:

Additional academic or educational programs are not needed to achieve the immediate, specific purpose and goal of this project. However, meaningful undergraduate and graduate programs are essential to the long-range development of the aquacultural industry. The subject is addressed in the implementation section, although USAID will not contribute direct assistance to the educational service.

Administrative support refers to services such as infrastructure development, market improvement, credit and similar areas not covered by extension, research and education. Other than to illustrate its position in the total system of public sector services and to describe actions being taken therein, administrative support will not be discussed in the PROP as they are being addressed by the GOP, other donors, and the private sector.

7. Small Producer v. Large Producer

There are close to 20,000 fish farmers at present in the Philippines with incomes ranging from low to the upper brackets for a relatively few. Generally speaking their income levels are above those of, say, rice or corn farmers. This is due in large part to the nature of fish farming which involves a more highly sophisticated technology than rice farming and requires a higher level of management on the part of producers. Moreover, it is not a traditional pursuit which has been practiced for centuries as is the case with rice farming. It is a relatively new science in the world and particularly to the Philippines. Knowledge of fish farming thus has not been passed down from generation to generation as with rice farming. Finally, most fish farming requires a greater capital outlay than that required for rice production. Thus fish farming (particularly brackishwater) because of economic and technological requirements has been carried out in the main by the entrepreneur with an above average educational level and capital availability. Unless these basic facts are modified, there is limited opportunity in large scale fish farming for low-income, poorly-educated producers. As pond productivity and hectarage increases new employment opportunities will be created.

Consequently, the case for an Aquaculture Production Project rests primarily on its benefits to the large numbers of Filipinos (estimated at 70% to 80% of the total population) whose daily intake of protein falls below recommended allowances. The proposition made herein is that this benefit justifies AID support to this project. New technology is available, and it is deemed advisable to accelerate its use to help solve a food problem even if some of the benefits may accrue to an "entrepreneural" class of producers. Nonetheless, as the research segment of the project progresses, there will be a significant benefit to the small producer and, happily, the small rice producer. This will take place as in the following manner.

Until the late 1940s when the practice began of using chlorinated hydrocarbon-based insecticides, some fish producing along with each rice crop was common throughout the rice growing areas of the world. The amount of fish produced was usually incidental, but the fish provided the farmers with fish for the table and also helped control insect damage to their rice crop. However, fish production essentially ceased when the use of insecticides became a standard rice management practice. Insecticides, especially chlorinated hydrocarbons, are lethal to fish at very low concentrations.

Recently, the International Rice Research Institute (IRRI) has developed a variety of rice --IR 26-- that is resistant to most insects and diseases, and, therefore, the application of insecticides is not a necessary management practice with this variety. This opens the door again for fish to be raised along with rice, providing two crops instead of one. However, instead of incidental production of fish, as was the case before the practice of using insecticides, yields of fish in the range of 100 to 500 kg/ha/yr. are expected to be attained without lowering rice yields.

The opportunity to raise fish with rice presents many possibilities. Animal protein could then be produced in the "back yards" of large numbers of rice farmers in the Philippines and in the entire rice-growing world. Not only would the fish provide subsistence protein to the farmers, but would indirectly and directly provide income--indirectly, through saving on fish purchase and, directly, through fish sales. Costs of fish production should be minimal with essentially the only cost being seedlings for stocking. The land, dikes, water management facilities, fertilizer and weed control are costs charged to rice production. In essence, the rice farmers manage their rice crop for maximum yields and receive the fish crop as an added benefit at an insignificant cost.

The technology for rice-fish culture is yet to be perfected, but this will precisely be a major priority of freshwater research to be carried out under the project at the Freshwater Station in Munoz. In fact the research is already underway.

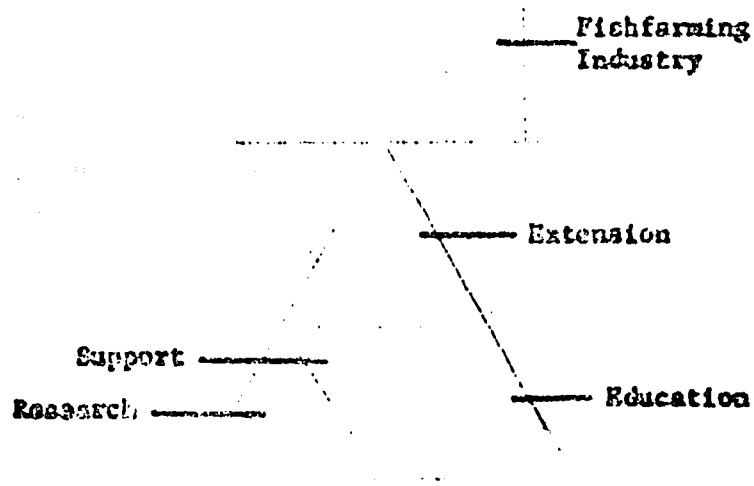
8. Employment effects of fishpond development

As fishpond productivity increases and hectarage expands new employment opportunities will be created for both laborers and full time managers of pond operations. As presently organized the typical absentee owner-investor employs a full time pond manager for his holding. This individual may receive a small salary plus a percentage share of the fish harvest. He is responsible for the day to day adjustments of water level, control of weeds and pests, upkeep of the dikes, stocking of ponds with fingerlings, application of fertilizer, and arranging and assisting with harvest. The owner-investor arranges and finances input supply (fingerlings, fertilizer, medicines when needed), decides when to harvest, selects a buyer and finances repairs after floods along with normal pond maintenance. Addition of each 8 to 15 ha of pond area will create a new employment opportunity for such a pond manager and under existing pond production patterns an owner-investor. The Philippine Government is exploring expansion of pond operation to attract additional pond managers and perhaps offer financing so that they may also perform the owner-investor role. At present some 15,000 pond managers and 18,000 pond owner-investors are engaged in aquaculture along with an additional 150,000-man part-time and full time labor force. By 1978 an estimated additional 3,500 pond managers and 4,000 owner-investors will be attracted to aquaculture production along with a labor force of about 40,000-man labor force. Both the pond manager and the owner-investors constitute the target group for extension under this project. Though presently unable to totally quantify the added manpower requirements, the increase in pond productivity will surely generate some new employment opportunities for laborers in harvesting, transporting and selling the fish. Pond construction is ordinarily performed by hand labor. It is roughly estimated that 1,000 man-hours of labor is required to bring a hectare of fishpond into production - or the estimated 50,000 hectares of new pond production will create a demand for 6.3 million man-days of labor. This construction can be performed during the dry season when crops are not ordinarily growing and will provide welcomed work for underemployed farm labor. This project will make a critical contribution toward triggering this development by perfecting production practices that will provide profitability margins to attract investors, managers and laborers to aquaculture.

NARRATIVE
RATIONALE AND IMPLEMENTATION PLAN

I. Introduction

The GOP must provide four essential services to the fish farming industry if fish production is to close the gap between production and demand and keep pace with the country's increasing demand for fish. Those services are research to generate new ideas and techniques; extension to assist fish farmers in putting into practice the products of research; education to provide trained personnel to both the private as well as the public sectors; and administrative support to implement programs such as making adequate capital available, helping create markets, developing infrastructure, making fertilizers and other inputs available in a timely manner. These essential services are figuratively expressed in the following illustration to show the relationship of one to another and to the industry they collectively support.



The services constitute the framework in which GOP efforts and USAID assistance will work to achieve and maintain the fish output of which the industry is capable. For the system of services to work efficiently on an independent basis coordination of the services will require extensive inter-agency cooperation since different GOP agencies and institutions are responsible for providing different services.

Major emphasis in the Aquaculture Production Project will be in extension and research services. (The outputs enumerated later in this section relate directly to USAID technical assistance.) Extension activities will relate to strengthening the Bureau of Fisheries Extension Service in order to disseminate existing knowledge and technology on fish production, especially milkfish production. Research activities will endeavor, first, to build on present knowledge of brackish-water fish production (in particular, to address certain remaining important production constraints for milkfish), and, second, create a body of knowledge on freshwater production which essentially does not exist at the present time in the Philippines.

2. Extension

Project activities will be aimed at strengthening the Bureau of Fisheries extension service so that it can become a more effective and efficient agent in encouraging fish farmers to adopt new technology and practices which will help them to realize gains in production and reductions in costs. An educational process is required: the classic and time-honored extension method.

Normally, before a fish farmer will accept and invest in a new practice, he must: (1) become aware of it, (2) develop an interest in it, (3) make judgement on whether it is advantageous, (4) try it out on a small scale and finally (5) adopt (or reject) the new practice. A change in his production behavior is required, and to bring this about a process of education must occur. The change is defined in terms of knowledge (e.g. [illegible] fish fertilizer to use) and in skills, both mental (e.g. the ability to plan his fish farming operation) and manual (e.g. the ability to construct fishponds). The educational process and consequently its results can only be as successful as: (1) the abilities and performance of extension workers, (2) the accuracy and quality of the information being extended, (3) the program plan of operation for extending information to fish farmers, and (4) the interest and resources of the farmers.

Abilities and Performance of Extension Workers

Fisheries has 175 extension workers (in addition to 47 U.S. Peace Corps Volunteers) assigned to 18 provinces. The effectiveness of such personnel, due to insufficient training, is not as great as it might be in terms of the needs of a modern fish farming sector. The Bureau has in the past relied primarily on non-fishery graduates and two-year fishery certificate holders to fill extension positions. Before assigning these personnel the Bureau provided a

short-term training course to prepare them for field service. However, their inadequate educational background coupled with an inadequate in-service training program resulted in an ineffective extension efforts.

Accuracy and quality of information being extended. Most extension information has in the past been based on hearsay and personal observations rather than proven research. Essentially no research results on fish culture have been published in the Philippines. Literature is not available to extension workers as an operational aid. Visual aids, demonstrations, short courses, and similar educational tools are not in standard use by extension workers. Most workers must use public transportation to get to and from the field. Field kits containing such basic items as water analysis equipment, measuring boards and weighing balances are not available to extension workers. Essentially the workers extend their own personal "technology" by word-of-mouth to individual farmers.

The program plan of operation. Operational plans for extension programs have been vague and consequently difficult or impossible to implement. Past "plans" have consisted mostly of targeted figures without a specific or detailed course of action for achieving the targets.

The interest and incentives of the farmers. In general the fish farmers are extremely responsive to efforts to assist them. They recognize the importance of technology and are enthusiastic in adopting new practices. Farmer motivation is thus not an inhibiting factor, and capital is generally available through the banking system.

Course of Action

Upgrading of Extension Workers. The Bureau of Fisheries recognizes the deficiencies in its extension workers and is taking steps to reduce those deficiencies. A total of 450 extension workers, including Peace Corps Volunteers, are scheduled for in-service training 1975. These workers will continue to receive refresher and advanced training through 1978, and an additional 100 extension workers will be added to the training program in each of the three years after 1975. Resource personnel from other agencies and institutions will be utilized in developing and implementing the training programs. The Bureau has budgeted ₱1,219,000 for training extension workers in 1975. The Extension Adviser provided by AID will spend approximately 25% of his time in this effort.

Extension worker performance will be greatly improved by the acquisition and use of necessary equipment. Jeeps will be provided each two-man extension team to facilitate transportation to the field. Basic field equipment such as water analysis kits, measuring boards and balances will be supplied to each team. Visual aids and other equipment for carrying out demonstrations and short courses will also be made available.

Extension Literature Development. The accuracy and quality of information being extended will be improved. Literature will be developed for dissemination to the private sector by extension workers. Seven separate pieces of extension literature have been developed by the Inland Fisheries Project staff, and at least three additional pieces will be prepared before July, 1974. This literature is based on research and field trial results, and all future literature will be developed on the same basis.

Improving Extension Planning and Implementation. The project will attempt to improve actual extension planning and implementation performance by demonstration. Present plans of the Bureau of Fisheries calls for extension effort to be focused on 18 provinces. The Bureau has established manpower and budgetary requirements as well as production targets for these 18 provinces. In the past there was no standard extension methodology used by extension workers nor generally were they utilizing research-proven technology. Rather they applied their personal extension techniques, and the technology they promoted was that of existing fish farmers. The workers in each province were essentially left to their own resources and resorted to improvisation in carrying out their day-to-day extension work.

Under the project with USAID assistance, in contrast, in certain designated provinces the Bureau will be guided by a carefully conceived and phase plan which will be carried out in well delineated steps. The table below shows for the plan the provinces covered and time frame for each phase as well as production and hectarage data for each province. The intention is to demonstrate the efficacity of careful planning and organization through measurable production improvements in the province where the plan is being implemented.

In the first phase covering the Island of Panay, two of the four provinces - Iloilo and Capiz - are among the Bureau's 18 targeted provinces while two are not - Antique and Aklan. During the first phase, the Brackishwater Station at Leganes will be utilized extensively to backstop and support implementation of the extension plan.

For each phase, there are four separate stages in implementation. The same four steps will be repeated in each geographical area, although details may vary depending on peculiar circumstances and experience gained from earlier phases. The four stages are: (1) data gathering, (2) training and orientation, (3) actual field implementation, and (4) evaluation.

Data Gathering. In the data gathering stage, basic information and data are collected about the provinces included in that phase: e.g., number of fish farmers, amount of land in fish production, number and location of banks and pesticide/fertilizer dealers, volume of sales of pesticides, fertilizer, fry and fingerlings, and marketing and shipping information. Data gathering will be a continuous process and will serve as one means of verifying project accomplishments.

Project extension plan - Targeted provinces with production and area data as of 1971 and projected for 1978.

Phase and initiation date	Province	Area (ha) of fishponds: Developed (1971) (Brackish-water)	To be developed (1978) 2/: Freshwater	To be developed (1978) 2/: Brackishwater	Total fishpond production (tons) 3: 1971	Total fishpond production (tons) 3: 1978
I July, 1974	Aklan	3,605	*	1,410	2,163	6,770
	Antique	220	*	20	66	324
	Capiz	11,211	*	1,360	6,726	16,971
	Iloilo	17,351	*	2,775	13,098	27,170
II Jan. 1975	Camarines Sur	3,334	*	1,700	663	6,769
	Mindoro Occidental	5,335	*	470	3,770	13,304
	Mindoro Oriental	1,609	*	170	1,127	3,751
	Negros Occidental	18,557	*	815	5,279	15,352
	Nueva Ecija	*	860	*	*	1,161
	Pangasinan	9,463	360	1,210	7,570	13,544
	Quezon	15,882	*	3,760	7,941	26,517
	Zamboanga del Sur	14,496	*	*	4,346	19,556
III July 1975	Bataan	3,105	*	5	2,795	4,199
	Bulacan	16,173	*	1,410	14,555	23,737
	Masbate	3,118	*	3,350	2,183	8,732
	Misamis Occidental	778	*	1,720	234	3,372
	Pampanga	9,209	2,950	*	8,288	16,415
	Sorsogon	2,023	*	1,580	405	4,864
	Zamboanga del Norte	1,398	*	1,550	259	3,845
IV Jan. 1976	Agusan del Sur	0	4,450	*	*	6,008
	Bohol	1,827	700	3,360	731	7,947
	Cagayan	455	160	2,090	91	3,652
	Camarines Norte	1,533	*	660	307	2,961
	Cotabato	2,270	3,670	395	1,135	8,552
	Davao del Norte	1,018	300	3,650	305	6,707
	Isabela	74	135	600	15	1,092
	Leyte	3,409	265	820	1,003	6,067
July 1976 to July 1977	(All remaining provinces)	37,000	800	3,200	12,060	41,000
	Total	176,373	14,650	38,080	97,915	300,339

See footnote next page.

* No or very little production or pond area.

1/ Freshwater pond area in 1971 was only 6,000 ha or less than 4% of the total area of freshwater and brackishwater ponds.

2/ Numbers represent approximately 20% of the area available for development except for the freshwater fishponds in Phase IV and both brackishwater and freshwater ponds in Phase V which represents only about 10% of the areas available for development.

3/ Total fish production in 1978 is based on projected average yields/ha of 1,350 kg in the first four phases and 1,000 kg/ha in Phase V for an overall average of 1,300 kg/ha.

Training and Orientation. The purpose of this stage is first to fully familiarize the extension workers who will be working in the area in question with all the information and data they require to perform effectively (e.g., topography, names and locations of input dealers, bankers, government officials). Second, it is to upgrade the workers in basic extension methodology and fully bring them up to date on new technology in fish production developed through research. As part of their instruction, they will conduct field trials using the new technology. The importance of this aspect of the learning process should be underlined since the best majority of Bureau extension workers have never raised a crop of fish with or without the new technology. Finally, a seminar for local officials will be held to introduce them to the objectives and strategy of the extension plan. Approximately four to six months will be required for the data gathering and training/orientation stages.

Actual Field Implementation. The preceding two stages pave the way for actual extension activity. This stage will consist of: (a) a general introduction through slide shows and literature to large groups of fish farmers of the new technology without going into great detail or depth; (b) convening of small discussion groups (20 or fewer farmers, bankers, input dealers) at which more specific topics will be covered in depth and where discussion will be freer and more open; (c) demonstration of application of the new technology at a research station or demonstration farm together with actual records showing amount of input, yields, and cost and profit data; (d) individual assistance to fish farmers and demonstrations on ponds of successful and respected farmers of what the new technology can produce in terms of yields and cost (fish farmers are often skeptical of the results attained at government facilities, but lend high credibility to the results of fellow farmers, especially those whom they hold in high esteem); (e) follow-up with individual farmers to discern progress, problems encountered, and to inform them of new research development.

Evaluation. Baseline data will be available as a result of stage 1, and this data will be used to measure the actual performance of the project implementation efforts. It will be possible to determine whether for example yields and input sales production are increasing or whether additional hectarage is being brought under production. Evaluation reports will be prepared at three-, six-, and twelve-month intervals. If progress is not satisfactory, modifications or adjustments will be made to the implementation plan. Expected accomplishments by date for the four provinces of Panay (Phase I) are summarized below. Similar targets will be developed for the provinces of succeeding phases.

Expected accomplishments by date for evaluation and reports - Phase 1

No.	Date	Expected accomplishments
1	6/30/74	1- Prelim survey data compiled and assessed. 2- Extension personnel selected, trained and deployed in respective divisions. 3- Necessary equipment purchased and distributed. 4- Introductory visits with local officials, bankers and business people. 5- Meeting places selected. 6- Extension literature, slide presentations, etc. developed.
2	9/30/74	1-Seminar for local officials, bankers and businessmen. 2- Introductory meeting with operators, caretakers, their families and interested neighbors. 3- Subject matter meetings. 4- Demonstrations at sites set up during orientation program. 5- Group meetings. 6- Select cooperators. 7- Set-up demonstration/field trials.
3	12/31/74	1 - Assistance to individual operators and prospective operators (33% of total farms visited). 2- Demonstration with cooperators. 3- Groups become organized with leader selected for each. 4- Repeat and follow-up activities. 5- All operators and caretakers (including families), and related business people contacted through congregation, group discussion, group or individual meetings where discussions held and all given literature - all given opportunity to see demonstrations - At least 33% of farms visited. 6- Surveys brought up to date and analyzed.
4	3/31/75	1-Assistance to individual operators on at least 67% of the existing fish farms. 2- Approximately 50% of operators completed own individual feasibility trials.
5	6/30/75	1- Assistance to individual operators on 100% of existing fishponds. 2- A minimum 70% of operators completed own individual feasibility trials. 3- A minimum 25% of operators adopted new techniques.

No.	Date	Expected Accomplishments
		4-An approximate increase of 1,000/ha in total fish pond area from an estimated 33,597 ha in 1974 (32,387 ha in 1971) to 34,500 ha. 5-Results from intensive IFP research, EF demonstrations and trials of individual operators (Detailed evaluation of entire program emphasizing assessment of technology being extended, extension methodology and accomplishments). 6-Survey data compiled to date and analyzed.
6	9/30/75	1-A minimum 70% of operators have adopted new technology. 2-A minimum 80% of operators completed own individual feasibility trials.
7	12/31/75	1-Approximately 70% of operators have completed at least one culture using new technology. 2-Survey data compiled to date and analyzed.
8	3/31/76	1-Approximately 75% of operators have adopted new technology and completed at least one culture using the methods.
9	6/30/76	1-A minimum 75% of operators completed a minimum two cultures using new technology. 2-A minimum 75% of the incremental increases of 28,382 t in per annum production expected by 1978 for a production in 1976 of 44,952 mt (estimated 23,666 mt in 1974 plus 21,286 mt increase; production in 1971 was 22,853 t) 3-Average increase in per hectare yields from 700 kg. in 1974 to 1,200 kg in 1976. 4-An increase of 2,800 ha of production area to 37,300 ha which is approximately 50% of the incremental increase of 5,565 ha expected by 1978.
10	6/30/78	1-Average per annum increase in total fishpond production of 20% from an estimated 23,666 in 1974 to 51,235 t in 1978. 2-Average increase in per ha yields of 92% from an estimated 700 kg to 1350 kg in 1978. 3-Development of 5,565 ha of swamp lands into fishpond for a total production area of 37,952 ha in 1978 (an estimated 33,597 ha developed in 1974). 4-Survey data, compiled to date and evaluated.

3. Research

Tangible production results from agricultural research are often slow to materialize, and a technological breakthrough which results in production increases of one or two per cent is considered significant. However, aquaculture, unlike agriculture, is a relatively new science which has had limited impact to date on ongoing fish farming in most parts of the world, including the Philippines. Consequently, application of new technology from acaptive aquaculture research can result in production increases of several hundred per cent. Field trials in milkfish production conducted under the Inland Fisheries Project, for example, have produced yields which are many times greater than the average. These yields are being attained with only minor changes in methodologists and increases of inputs. This high and quick magnitude of return is a salient characteristic of research activity in the Philippines which the Aquaculture Production Project seeks to capitalize on.

Efficiency in the use of limited resources -- limitation of funds, shortage of trained personnel and the lack of adequate research equipment and facilities -- calls for centralizing research activities. However, regional stations positioned throughout the country to meet wide differences in climate, soil types and other physicalconditions are also required. Coordinated teamwork of all research activities must be effected to avoid duplication of effort and to facilitate finding solutions to production bottlenecks.

Research resources available to the project are adequate. Facilities and equipment include two fully equipped research stations and 21 Bureau of Fisheries (BF) demonstration farms. Trained manpower include three Ph.D graduates, 10 MS holders and several in the BS and below category. Some of the personnel will be working toward their degrees in the early months of the project. Project research funds will be solicited from the National Science and Development Board (NSDB), Philippine Council for Agricultural Research and from organizations outside of the country.

The research stations at Leganes, Iloilo, and at Central Luzon State University, Munoz, Nueva Ecija will serve as the centers of brackishwater and freshwater research, respectively. The Leganes station will be operated by the University of the Philippines College of Fisheries (UPCF) which will also provide the operating budget. The National Science Development Board (NSDB) provided funding for the construction of buildings and ponds including the operating expenses for the first three years of operation. The Munoz station, also built with NSDB funds, will similarly be operated by UPCF but in cooperation with Central Luzon State University (CLSU). At present the operating budget is funded by NSDB through UPCF, but in the future it will be a joint UPCF-CLSU undertaking.

The BF will field-test technology developed at the research centers and do other adaptive research at the various BF demonstration farms. The research station personnel will assist the BF demonstration farms staff in setting up

and modifying technology as requested by the EF. In addition, a 5-60-10 ha station will be developed and operated in or near the Candaba Swamp by the EF and research activities will be jointly handled by EF and the Freshwater stations (Munoz station) personnel. The Candaba station will function as a facility for adaptive research hatchery and/or extension demonstration depending on need.

Freshwater Research Objectives

The overall objective of USAID and counterpart GOP agencies will be to develop cultures of various individual and combinations of fishes to extendable levels. Specific objectives for research through FY 1978 include:

1. To develop for commercial application technology for combined rice-fish culture in small paddies.

2. To develop through transfer and applied research technology for application of monoculture and polyculture of various combinations of tilapias, mudfish mudfish, Indian and Chinese carps.

3. To develop basic technology for hatchery production of predominantly male seedlings of tilapia species.

4. To develop technology for culture of milkfish in freshwater ponds.

5. To develop basic technology for artificial spawning and hatchery techniques for mass production of seedlings of Indian and Chinese carps and catfish (Clarias) species.

6. To determine the most effective and efficient types of fertilizer and rates of application in raising each species and combination of species.

7. To identify parasitic and other disease organismsof each cultured species and develop technology for their control.

8. To identify fishpond pests and develop technology for their control.

9. To develop design and engineering technology for inland fishponds that will facilitate management practices.

10. To assess economic consequences of various combinations of production practices.
practices.

Brackishwater Research Objectives

Primary research objectives will be to develop and perfect technology of milkfish production for a potential national average of at least 2000 kg/ha/yr at the fertilization level of management. Major objectives also include development of cultural techniques for other fishes and animals such as molluscs in combination with and independent of milkfish culture. Specific objectives through FY 1976 include:

1. To develop technology for artificially reproducing milkfish and develop effective hatchery techniques for the mass production of fry.

2. To determine means of reducing the high mortality rates of milkfish during handling and culturing.

3. To determine various milkfish production figures resulting with the three food types - plankton, lumut, and lab-lab.

4. To determine the most effective and efficient types of fertilizer and rates of application in producing each type of food and each species and combination of species.

5. To determine the most effective and efficient stocking rates, including manipulations, of milkfish for ponds with each type food.

6. To develop technology for polyculture of milkfish in various combinations with species such as shrimp, mullet, tilapia and sea bass.

7. To develop technology for monoculture of tilapia and mullet and polyculture of mullet, tilapia and sea bass and tilapia with sea bass.

8. To begin selection of species of oysters and clams for culture and testing different cultural techniques.

9. To determine safer, more effective means of controlling pond pests than are now being employed.

10. To identify parasitic and other disease organism and develop technology for their control.

11. To develop improved designs and engineering technology for coastal fishponds that will facilitate management practices.

12. To assess profitability of various combinations of production practices and their impact upon aquaculture investment incentives.

4. Purpose and Use of U.S. Inputs

Technical Assistance

1. One direct-hire Project Manager will be provided on a one-quarter time basis to assist and backstop the project contract team. His primary responsibility will be to handle the non-technical, "office responsibilities" permitting the specialized technical advisors to devote their primary attention to field activities. He will coordinate directly with the contract team leader. He will be located in AID/AD.

2. One contract Extension Advisor will be provided for the duration of the project to work directly with the Bureau of Fisheries (BF) in their aquacultural extension program. He will serve as team leader of the contract team. His responsibilities will include:

   a. Assisting the BF and the GOP Inland Fisheries Project (IFP) in coordinating their extension and research activities.

   b. Acting as an advisor to the BF on matters of aquaculture extension such as:

      1) Planning and programming,

      2) Implementation of plans and programs,

      3) Preparation of extension literature, and

      4) Evaluation and reporting.

   c. Assisting the Director and other BF administrators in other related matters where his expertise can be utilized.

   d. Assisting the Research Advisors and IFP staff in their research, planning, programming and evaluation.

   e. Coordinate with the AID Project Manager and GOP project level administrators in evaluating progress reports, identifying possible constraints or bottlenecks related to capital and other areas of project management.

   f. Recommend programs and activities to alleviate constraints or to improve performance of the extension, research, education and administrative support services.

He will be based at the BF Central Office in Manila.

3. Two contract Research Advisors will work directly with the IFP staffs at the two research stations. One advisor will be based at each station for the first two years of the project (until the end of FY 1976). Beginning in FY 1977, only one Research Advisor will remain with the project; he will be based at the Brackishwater Station, but will assist the Freshwater AStation staff on a one-fourth time basis). General responsibilities of the Research Advisors will include:

   a. To act as technical advisors to the IFP administrators and the station staff advising in research matters such as;

      1) Planning and programming,
      2) Implementation of plans and programs,
      3) Evaluation of research and preparation of research publications and progress reports.

   b. To assist in other functions of the IFP including those which may be requested by other agencies or organizations.

   c. To assist in BF extension activities, especially in training programs and backstopping field extension activities.

Commodities

1. A total of 91 jeeps are required, of which 85 will go to the BF for use in carrying out the extension program. Provision of these vehicles will increase the mobility and hence effectiveness of extension workers significantly. Six of the jeeps are to be divided among the two stations for use by research and station-assigned extension personnel in supporting or backstopping the field extension workers.

2. Four vehicles -- 2 campmiles and 2 pickups, are required to support the expanded role of the staff posted at the two research stations.

3. Information-education equipment such as cameras, slide projectors and megaphones will be used in carrying out the fishfarmer education programs of the extension workers.

4. Field equipment kits containing water analysis chemicals, weighing balance and other items will be utilized for conducting field trials and demonstrations and determining information for advising farmers on such subjects as pond productivity, causes of fish mortality and general management procedures.

5. Essential laboratory equipment items are required to supplement or replace equipment at the two IFP stations.

5. Long-Term Human Resources Planning

An additional aspect of the implementation plan deserves mention because of its long-term implications for the success or failure of GOP efforts to realize the full potential of inland fisheries. Education or academic training programs will not be critical in terms of the 1978 project production and cost objectives, but essential in the long-run if the project is to be viable after 1978.

There is a need for well-trained and qualified aquaculturists both in the private and public sectors. Until recently, university programs in the Philippines were adequate to meet these private and public sector demands. However, progressive fish culture has now become a technical and highly complex science which increasingly requires greater numbers of aquaculturists at the B.S. and M.S. levels and a shift in emphasis in the content of instruction. In the absence of this, the GOP goal of increasing national per annum inland fish production by over 200 percent before 1980 will be seriously jeopardized.

Specifically: researchers are required at the Brackishwater and Freshwater Research Stations; well-trained graduates who can move directly into extension without the need for lengthy and costly re-training are required if the Bureau of Fisheries extension service is to be a long-term positive force in promoting change in the private sector; aquacultural managers competent in both biological (fish farming) and business management are required by the private sector; and well-qualified teachers are needed for aquacultural training at all educational levels.

At the bachelor's degree level more than 100 graduates per year could be gainfully employed in government or private work. The Bureau of Fisheries now employs about 200 junior fishery biologist to work in the inland fisheries area. There are also approximately 90 U.S. Peace Corps Volunteers assisting the Bureau of Fisheries in inland fish activities. Their work must eventually be absorbed by Filipinos. Merely to maintain the number of junior biologists, assuming a 20% loss to promotion or other employment each year, would consequently require more than 60 graduates per year. The Bureau of Vocational Education's 56 vocational schools could absorb at least 10 BS graduates per year. The private sector is also seeking graduates, and it is reasonable to assume some of these would go into business for themselves. The private sector requirement is thus on the order of 30 B.S. graduates annually.

A M.S. level graduate program is essential to building minimum capability in the research, education and extension aspects of aquaculture. M.S. level education is a prerequisite for research personnel who are able to generate new ideas and technology, for extension specialists who backstop the less specialized extension agents, and instructors who teach under-graduates and graduate courses. As an illustration, the Bureau of Fisheries now probably employs more than 200 senior biologists. Assuming half of these require training in fish culture and a 5% replacement rate from outside the Bureau,

there would be a sustained need for 5 new MS degree holders in fish culture each year. Universities, research groups and vocational schools could absorb an equal number. Graduate students doing research also provide manpower for the research stations.

Clearly then, the number of B.S. and M.S. aquaculture graduates being produced each year is inadequate in terms of sustaining aquaculture production over the long-haul. In addition, course content needs to develop a greater orientation toward the practical aspects, as opposed to the theoretical ones, of fish culture. If the Philippines is not to rely indefinitely on foreign training sources, it will have to both expand its own university-level facilities and modify or re-orient curricula. At the present time only the University of the Philippines and Mindanao State University offer aquaculture specialization at the bachelor's degree level and neither offers any type of post-graduate training. Both schools together produce not more than 6 to 8 B.S. graduates per year, and emphasis at both schools tends toward the academic.

As initial steps, the University of the Philippines College of Fisheries should upgrade its undergraduate program and initiate a graduate degree program while Central Luzon State University should develop an undergraduate curriculum. The University of the Philippines College of Fisheries and Auburn University will develop the graduate degree program through a direct relationship with anticipated support from an outside source such as the Ford or Rockefeller Foundations. The educational programs of both universities should be linked together in a cooperative agreement and should be built solidly around two research stations.

AID will not be directly involved in these efforts because of limited resources, but they are mentioned in this IMOP in order to call attention to their importance.