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PROGRESS REPORT FOR NSDB-ASSISTED PROJECT NO. 2.235

(MARCH 8, 1971, THROUGH JUNE 30, 1972)

INLAND FISHERIES PROJECT ANNUAL TECHNICAL REPORT
FY 1971-72

ERRATA

Page i - Gaudencio Villaroman is Assistant Project Leader
References to *Clarias batrachus* (P. 2 and 36) should be *C. macrocephalus*.
Pages 26 and 27 reversed.
Pages 38 and 39 reversed.
Page 38 - (Table) No. stocked/ha (X100) should be (X1000).
Catfish used in the experiment II. C. 5 were provided by
Atty. Eufemio C. Domingo whose assistance is gratefully acknowledged.

INLAND FISHERIES PROJECT

Participating Agencies

National Science Development Board
University of the Philippines College of Fisheries
Central Luzon State University
National Food and Agriculture Council
Department of Agriculture & Natural Resources
Philippine Fisheries Commission
National Economic Council
Province of Iloilo
Municipality of Leganes, Iloilo
United States Agency for International Development

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FOREWORD

The Inland Fisheries Project (National Science Development Board Project No. 2.235) with Subprojects A - Brackishwater Fish Culture Research Station at Leganes, Iloilo and B - Freshwater Fish Culture Research Station at Central Luzon State University, Munoz, Nueva Ecija, officially started in March, 1971 when all agreements pertaining to funding, personnel, administration and operations were signed. This Technical Report of the Project covers the period during the Fiscal Year 1971-72 and includes the progress made on research activities, training and extension services.

The completion of construction of the two stations (Brackishwater and Freshwater) is highly anticipated by the Project so that research and training activities can be better organized and implemented. In spite of the lack of facilities, the Project has managed to perform research activities with private organizations and individuals, the Western Visayas Demonstration Fish Farm of the Philippine Fisheries Commission at Molo, Iloilo City, and the fish farm of the University of the Philippines College of Fisheries. Training and extension services were also done on a limited basis because of the lack of facilities.

Attempts were made to report finished experiments in a scientific manner but the results, observations and conclusions are considered to be tentative until such time further studies confirm them. On-going research and future plans of the Project are also incorporated in this report It was the intention of the Inland Fisheries Project, when it prepared this Technical Report, to give information in a substantial manner on its scientific accomplishments, endeavors and plans for the future. This report is not intended to be in the category of a scientific publication

The Project will however, welcome comments, recommendations and even criticism on the research activities being done from readers and/or institutions of aquaculture or inland fisheries It will also be highly appreciated if the Project can establish an exchange of information with scientists and institutions of other countries in order to maximize knowledge and ideas of aquaculture among scientists while minimizing repetition of research efforts.

In behalf of the staff of the Inland Fisheries Project and the University of the Philippines, I wish to extend our appreciation for the cooperation and support given to the project by the agencies participating in this project.

ROGELIO O. JULIANO
Project Director

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I. INTRODUCTION

The Inland Fisheries Project (IFP) is composed of two sub-projects: the Brackishwater Fish Culture Research Station (Brackishwater Station) in Leganes; the Freshwater Fish Culture Research Station (Freshwater Station) at Central Luzon State University (CLSU), Munoz, Nueva Ecija. The focus of the IFP is on inland fisheries, i.e., freshwater and brackishwater aquaculture of fish and other aquatic organisms in ponds.

The IFP is charged with the responsibility of:

1. Implementing research to develop technology that will substantially, consistently and economically increase the yield per hectare of pond.

2. Training of fisheries personnel including scientists, extension specialists and fish farmers in modern methods of aquaculture in order to disseminate the knowledge necessary to effect significant increases in fish production, and

3. Assisting the Philippine Fisheries Commission in extension activities including the development of resource materials and the development and implementation of result demonstrations at private fish farms as well as at the IFP stations.

This report covers the period from March 8, 1971, through June 30, 1972. The Memorandum of Agreement creating the IFP was signed on March 8, 1971. The first work of the Project began on July 28 when the Amalgamated Project Management Services officially started designs for construction of the stations. Actual construction began at the Freshwater Station (CLSU, Nueva Ecija) in March, 1972, and at the Brackishwater Station (Leganes, Iloilo) in May 1972. The first research programs were initiated in December. The first organized training programs were begun in January, 1972.

All research and training activities conducted by the IFP are herein reported. Also presented is a progress report of construction activities at the two stations.

II. RESEARCH PROGRAMS

A. Introduction

Research programs of the Inland Fisheries Project (IFP) during FY-72 were conducted at the University of the Philippines College of Fisheries (UPCF), the Western Visayas Demonstration Fish Farm (WVDFF) of the Philippine Fisheries Commission and at privately owned fish farms. The research stations of the IFP will not be ready for research before December, 1972.

The first research projects were begun in December, 1971. Three projects were completed and 15 were in progress at the end of FY-72 (June 30, 1972). The projects undertaken were more or less preliminary studies because of limited availability of physical facilities and equipment. Research emphasis was centered on pond fertilization and/or feeding of bangus (milkfish, Chanos chanos) and hito catfish (Clarias batrachus).

Research emphasis has been placed on bangus and hito because:

1) Their biological potential for culture, on the basis of production yields per culture, are among the highest known in the world;

2) Fish farmers and potential farmers have expressed far greater interest in the culture of these fishes than for any other species;

3) Both have high consumer acceptance ; retail prices in the Manila area from January through June have averaged about ₱5.00 and ₱7.00 1/ for bangus and hito, respectively;

4) About 100,000 tons of bangus are produced annually in the Philippines, which is about 99% of the total aquacultural production;

5) There is no significant commercial production of hito in ponds in the Philippines at present; however, productions of about 100 tons per ha per year are being obtained in ponds in Thailand;

1/ Peso exchange rate: ₱6.70 = US$1.00

6) Hito can be raised in ponds smaller than $10m^2$ which emphasizes the potential for "back-yard culture as well as for large-scale commercial production;

7) Hito can live in water void of oxygen and of very poor quality that would be lethal to most other fishes;

8) Hito can be held out of water alive for days, meaning that they can be transported and marketed alive insuring a quality product without the cost and problems of preservation

Essentially no Philippine producers are raising fish on an intensive scale. To intensify production, rather drastic changes in fertilization practices will be necessary, and feeds and feeding technology must be introduced At present fish feeds are not produced in the country and the only feeding practiced by fish farmers is the addition of rice bran or similar material to sustain fish weight rather than to promote growth.

Research in the use of feeds in bangus culture is secondary in priority to research in improving fertilization technology. The bangus is primarily a herbivorous fish. With a good fertilization program bangus productions of 1500 kg/ha/yr are possible without feeds, national bangus production presently averages about 600 kg/ha/yr.

Feeds will be necessary in hito culture. Lack of a suitable feed and knowledge of hito nutritional needs are major factors limiting hito culture here as well as in other Asian countries. Other factors are inadequate supply of fry and fingerlings for stocking (stocking rates as high as one million per ha are used in Thailand) and high disease incidence and mortality associated with hito culture. Solving these problems is the priority target of research to develop hito culture in the Philippines.

The immediate IFP research objectives are intended to obtain knowledge that may be directly disseminated to the private sector and which would significantly and efficiently increase fish production per unit of culture area.

Past and present research programs of the IFP are each discussed under Research Programs Completed and Research Programs in Progress.

B. Research Programs Completed

Three research projects were completed in FY-72. All were conducted at privately-owned fish farms in cooperation with the farm owners. The IFP gratefully acknowledges the cooperation and assistance of the owners and the privately-operated Philippine Fish Culture Training and Research Institute which two of the owners represented.

1. Bangus Culture in Ponds with Feed, Lab-lab[1/] and Plankton

Introduction

This report presents the results of a feeding experiment with bangus conducted in cooperation with the family of Dr. Saturnino Abesamis on their family-operated farm. The farm is located on the Masedam River about 12 km. northwest of Alaminos, Pangasinan, and is managed by Mr. Maximo Abesamis.

The object of the experiment was to compare growth rate, survival and yield of bangus in ponds with three different sources of food: supplemental feed, plankton and lab-lab.

Materials and Methods

A total of 6 ponds were used in the study. They ranged in size from 0.12 to 0.20 ha and were almost square in shape. Water depth averaged from 30 to 40 cm in all ponds. A supply canal about 2 m wide and 0.5 m deep was used in filling and draining all ponds. Treatments and numbers were assigned to ponds as illustrated in Fig. 1.01.

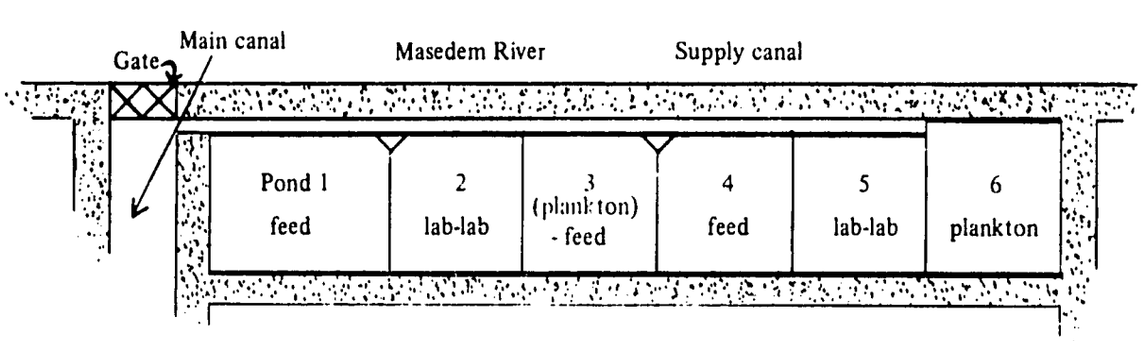

Fig. 1.01. Diagram of the study area on the Abesamis Farm showing the relationship of ponds to water supply, pond numbers and treatment received (feed, lab-lab or plankton).

1/ Lab-lab is the Tagalog word for the complex layer of plant and animal matter that forms on the bottom soil and serves as bangus food.

Important features of the experimental design are summarized in Table 1.01.

Table 1.01 - Treatment, area, number and weight of bangus stocked in each study pond.

Pond no.	Treatment	Pond area (m^2)	Bangus stocked/pond 1/ No. 2/	Kg	Avg (g)
1	Feeding	1963	1963	22.0	11.2
2	Lab-lab	1188	356	7.1	20.0
3	Phytoplankton 3/	1280	384	5.9	15.3
4	Feeding	1250	1250	19.1	15.3
5	Lab-lab	1175	351	5.4	15.3
6	Phytoplankton	1365	410	6.3	15.3

1/ Ponds 1 and 2 were stocked January 1; all others were stocked December 3.
2/ Ponds 1 and 4 were stocked with 10,000 fish/ha; all others were stocked with 3,000/ha.
3/ Began feeding pond 3 on January 14.

All ponds were drained in mid-November, 1971, to begin preparation for the experiment. Brestan insecticide was used in all ponds and the supply canal to eradicate snails and wild fish.

Preparation of ponds 2 and 5 for lab-lab production was begun November 24 by broadcasting an estimated 10 kg of 18-46-0 fertilizer over the pond bottoms. All ponds were then filled to culture depths. Ponds for phytoplankton could only be filled to about 30 cm in pond 3 and 40 cm in pond 6. Six kg of 18-46-0 fertilizer were applied in solution to each of these ponds on December 3. Ponds to receive feed (1 and 4) were not fertilized during the study. The other ponds (2 and 5) were fertilized at intervals of 2-3 weeks during the study. Fertilizer platforms approximately 0.5 m^2 were used in ponds 3 and 6 beginning December 21 and ponds 2 and 5 beginning February 17. The platforms were positioned approximately 15 cm below the pond surface beside the supply canal dike in each pond. The amounts, dates of

application and costs of fertilizer used during the experiment are presented in Table 1.02. No organic fertilizers were used in any of the study ponds during the experiment.

Table 1.02 - Amounts, dates of application and costs of 18-46-0 fertilizer used in the experimental ponds at Abesamis Farm from November, 1971, through April, 1972.

Application date	Amount (kg) applied/pond/application			
	Pond 2	Pond 3	Pond 5	Pond 6
Nov. 24	10	0	10	0
Dec. 3	6	6	6	7
Dec. 21	0	6	6	7
Jan. 2	0	6	6	7
Jan. 22	6	0	6	7
Feb. 17	3	0	3	3.5
Mar. 1	6	0	6	7
Mar. 13	6	0	6	7
Mar. 27	6	0	6	7
Total (kg)	43	18	55	52.5
Cost (₱)	36.98	15.48	47.30	45.15
Amout/ha (kg)	360	141	468	458
Cost/ha (₱)	309.60	121.26	402.48	393.88

Cost of fertilizer based on ₱0.86/kg or ₱43.00/50-kg bag.

IFP-1 was used in ponds 1 and 4 beginning December 3, the date of stocking. Feeding rates were changed at intervals during the study. Rates were adjusted downward from approximately 5% to 3% body weight from beginning to end of the study. The feeding schedule including costs is given for each pond in Table 1.03.

The fish were fed daily. Each day's ration of feed was divided into halves with one half fed in the early morning, the other in the late afternoon. The feed was broadcast from the dike separating the ponds from the supply canal.

All ponds were stocked with bangus fingerlings on December 3. Ponds 1 and 4 were stocked with 10,000 fish/ha; the other ponds received 3,000/ha. The fingerlings averaged 15.3 g and 115.3 mm (length range from 84-153 mm) at stocking.

Table 1.03 – Amounts, dates of application and costs 1/ of pelleted feed (IFP–1) used in the experimental ponds at the Abesamis Farm from December 3, 1971, to April 18, 1972.

Feeding Period		Pond 1 2/ Amount (kg)		Pond 3 Amount (kg)		Pond 4 Amount (kg)	
Dates	Days	/day	/period	/day	/period	/day	/period
12/3 – 12/12	10	0	0	0	0	1.1	11.0
12/13– 12/22	10	0	0	0	0	1.1	11.0
12/23– 1/1	10	0	0	0	0	1.6	16.0
1/2 – 1/11	10	1.8	18.0	0	0	2.2	22.0
1/12– 1/13	2	1.8	3.6	0	0	2.2	4.4
1/14– 1/21	8	3.0	24.0	1.3	10.4	3.1	24.8
1/22– 1/31	10	4.2	42.0	1.8	18.0	4.0	40.0
2/1 – 2/10	10	5.2	52.0	2.2	22.0	5.0	50.0
2/11– 2/20	10	6.4	64.0	2.8	28.0	5.8	58.0
2/21– 3/1	10	4.8	48.0	2.1	21.0	3.5	35.0
3/2 – 3/11	10	6.2	62.0	2.1	21.0	4.0	40.0
3/12– 3/21	10	7.2	72.0	2.5	25.0	4.8	48.0
3/22– 3/31	10	8.0	80.0	3.0	30.0	4.2	42.0
4/1 – 4/10	10	9.0	90.0	3.3	33.0	4.6	46.0
4/11– 4/18	8	9.0	72.0	3.3	26.4	4.6	36.8
Total/pond (kg)	–	–	627.6	–	234.8	–	485.0
Cost/pond (₱)	–	–	564.84	–	211.32	–	436.50
Total/ha (kg)	–	–	3211	–	1838	–	3880
Cost/ha (₱)	–	–	2889.90	–	1654.20	–	3492.00

1/ Cost of feed based on ₱0.90/kg or ₱36.00/40-kg bag.
2/ Amount fed in pond 1 does not include the amount fed before restocking January.1.

Fish stocked were yearlings that had been held under crowded conditions in a nursery pond. Prior to stocking the fish were seined from the nursery catch-pond and held in a net enclosure. A random sample of 75 fish was netted from the enclosure, anaesthetized in quinaldine solution and measured to the nearest 1.0 mm to determine mean total length. Another sample of 85 fish, treated similarly, was weighed en masse to the nearest 1.0 g to determine mean weight.

Samples of fish were taken from each pond at approximately 30-day intervals throughout the study. The samples consisted of approximately 40 fish which were seined at random, anaesthetized in quinaldine solution, and individually weighed and measured before being returned to the pond. Usually additional fish were weighed en masse from each pond at each sampling. The samples were taken to determine growth rate and to adjust feeding rates. Length-weight data were collected for analysis as part of a separate study. On each sampling date observations considered pertinent to the project were recorded.

The experiment was terminated with all ponds drained and harvested on April 19, 1972, after 138 days in culture. Fish from each pond were individually counted and weighed en masse. Length-weights of 40 fish selected at random from each pond were also taken.

Two adjustments in experimental design were necessary during the study. First, the Brestan residue caused a total kill in pond 2 and a partial kill in pond 1 immediately after stocking. These ponds were restocked by the owner on January 1. He restocked pond 1 and pond 2 with fish averaging 11.3 and 20.0 g , respectively. Second, establishing a phytoplankton bloom in pond 3 was not accomplished. Therefore, a feeding program in pond 3 was begun on January 14 and continued until the expriment ended.

Results and Discussions

Plotted empirical growth curves (Fig. 1.02) of fish in all ponds were essentially straight lines or linear rather than the expected sigmoid curves. Slopes of the curves varied considerably within as well as between treatments. Additional data is needed to explain the almost linear rather than sigmoid growth curves. For example, weight gain per fish was greatest in pond 5 and lowest in pond 2, both ponds with lab-lab treatment. Pond 6 with plankton produced the second greatest weight gain per fish and the ponds with feeding collectively ranked third in net weight gain per fish.

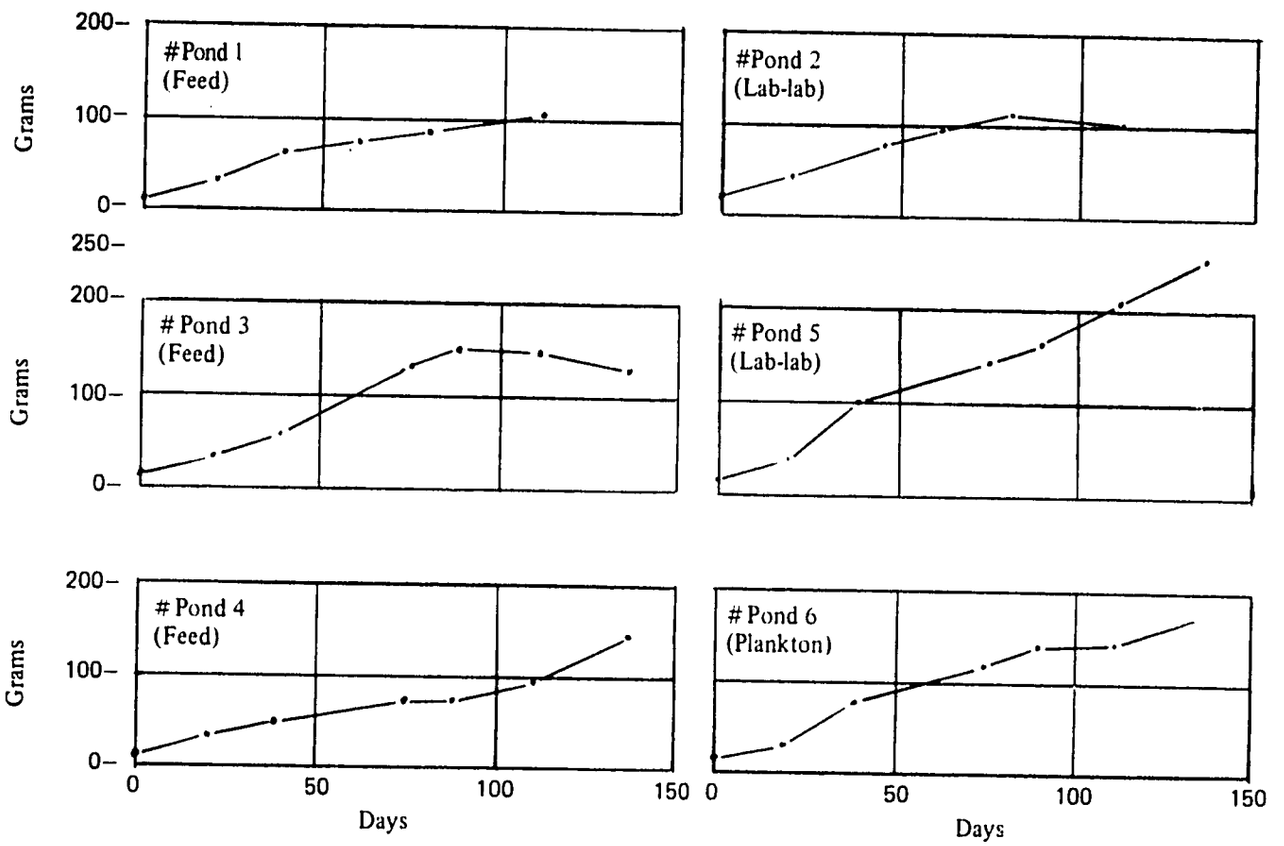

Fig. 1.02. Empirical growth curves of *bangus* raised in study ponds at Abesamis farm with feed, *lab-lab* and plankton (points indicate mean weights at dates sampled).

Table 1.04 - Average weight increase per fish per pond for each treatment.

Treatment	Pond no.	Mean weight (g) Stock	Mean weight (g) Harvest	Net increase (g) Total/fish	Net increase (g) Fish/day
Feed	1	11.3	104.6	93.4	0.86
	4	15.3	138.7	123.4	0.88
	3	15.3	133.0	117.7	0.83
Plankton	6	15.3	181.5	166.2	1.19
Lab-lab	2	20.0	105.1	85.1	0.79
	5	15.3	249.2	233.9	1.68

Growth rates in the 3 ponds with feeding (ponds 1, 3 and 4) did not vary greatly when comparing net weights gained and final weights, but Fig. 1.02 shows that fish in pond 3 did not grow and actually lost weight during the final 50 days of culture while fish in ponds 1 and 4 steadily increased in weight. Natural foods appeared to be as abundant throughout the study in ponds 1 and 3 as in any of the other ponds. Very little natural foods were ever observed in pond 4; the pond was turbid with silt in January and February. Flushing was necessary during mid-February because of apparent low oxygen. Pond 1 was in culture only 108 days while ponds 3 and 4 were both in culture 138 days. Pond 3 contained only 3,000 fish per ha while ponds 1 and 4 contained 10,000 per ha.

Pond 3 was originally designed for plankton production, but since phytoplankton could not be developed in the shallow water, a feeding program was begun. This left pond 6 as the only pond with phytoplankton. Pond 6 was also shallow (about 40 cm depth) but a phytoplankton bloom was established about 30 days after the study began. Lab-lab grew for the first month before being replaced by the phytoplankton. Pond 6 was heavily contaminated with *Tilapia mossambica* and *Poecilia* (*Mollienesia*) *latipinna* from beginning of culture.

Growth of *bangus* in the lab-lab ponds, 2 and 5, varied greatly. Pond 2 was in culture 108 days while pond 5 was in culture for 138 days. However, negative growth was being experienced in pond 2 but not in pond 5 at termination. Pond 5 was turbid with silt during January but was cleared with fertilization. The lab-lab growth had been depleted, but it recovered as the silt settled.

Fish in pond 1 were only 57% as large as those in pond 2 at restocking in January (11.2 and 20-0 g, respectively). However, at termination 108 days later, mean weights were 105 g in both ponds. This represents mean weight increases of 926% in pond 1 at 10,000 density/ha and 526% in pond 2 at 3,000/ha. Pond 1 received feed and pond 2 was a lab-lab pond. Growth had ceased in pond 2 by termination.

Production yields for each pond are presented in Table 1.05. The highest total and net productions of bangus were produced in supplementally fed ponds. However, the highest total fish production was attained in pond 6 with phytoplankton.

Table 1.05 - Bangus production in ponds with feeding, phytoplankton and lab-lab.

Treatment	Pond no.	Stocked (kg/ha)	Produced (kg/ha) Total	Produced (kg/ha) Net	Net gain (kg) /ha/day
Feed	1	112.1	897.6	785.5	7.27
	4	153.0	1312.0	1159.0	8.40
	3	46.0	233.0	187.0	1.36
Plankton	6	46.0	504.1 1/	458.1	3.32/11.97 2/
Lab-lab	2	59.7	139.6	79.9	0.74
	5	46.0	564.3	518.3	3.76

1/ A total of 1193.6 kg/ha (162.9 kg/pond) of tilapia were harvested from pond 6 giving a total standing crop of 1697.7 kg/ha at harvest.

2/ Mean net gain was 3.32 kg/ha/day for bangus only and 11.97 kg for both bangus and tilapia.

Survival varied greatly between ponds ranging from 45.2 to 94.6% (Table 1.06). Survival in ponds 1 and 2 was measured from time of restocking and not from the original stock that was lost to Brestan poisoning. Approximately 30 bangus were observed in the supply canal of March 22. Since pond 4 had previously been flushed repeatedly, the owner assumed the fish had escaped from the pond during flushing and, therefore, returned them to the pond. No evidence of disease or dead fish was noticed in any pond during the study. Oxygen stress was apparent in pond 4 for "several" consecutive mornings during mid-February, but no loss of fish was observed.

Table 1.06 - Survival of bangus cultured in ponds with supplemental feed, phytoplankton and lab-lab.

Treatment	Pond no.	Stocked 1/	Harvested 2/	% Survival
Feed	1	1963	1689 (3)	85.2
	4	1250	1182 (1)	94.6
	3	384	224 (1)	58.6
Plankton	6	410	379 (0)	92.4
Lab-lab	2	356	158 (3)	45.2
	5	351	266 (12)	79.2
Total/pond		4714	3898 (20)	83.1

1/ Ponds 1 and 4 were stocked with 10,000 fish/ha; all other ponds were stocked with 3,000/ha.

2/ Numbers in parenthesis represent the known number of bangus removed from the corresponding pond during the study and are considered as part of the harvest.

Observations on abundance of natural foods present in each pond were recorded at each sampling and are presented in Table 1.07. Except for pond 3 which received feed, growth curves (Fig. 1.02) generally reflected abundance of natural foods present. In pond 3 there was a high abundance of natural food in addition to daily supplemental feeding, but the fish lost weight during the last 50 days of culture. However, in the other fed ponds growth was positive to the end of the study even though both had 333% greater stocking density than pond 3, and pond 4 had essentially no observed natural foods present during the study.

Table 1.07 - Observations of natural food (plankton and lab-lab[1/]) abundance recorded monthly for each experimental pond.

Date	Food	Pond number and treatment					
		Feed	Lab-lab	Feed	Feed	Lab-lab	Plankton
		Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6
12/20	Plankton	0	0	0	0	0	0
	Lab-lab	0	very good	poor	0	very good	poor
1/13	Plankton	0	0	0	0	0	poor
	Lab-lab	good	good	poor	0	very good	0
2/16	Plankton	poor	0	poor	*	*	good
	Lab-lab	very good	very good	very good	0	0	0
3/22	Plankton	0	0	0	*	*	poor
	Lab-lab	very good	poor	very good	0	good	0
4/18	Plankton	0	0	0	*	*	poor
	Lab-lab	good	very good	very good	poor	very good	0

* pond silty
0 none observed
1/ Lumut algae was present in some ponds but was not differentiated from lab-lab

Inorganic fertilizer (18-46-0) was sufficient to induce and maintain lab-lab and phytoplankton growth without the use of any organic fertilizer. Periodic fertilizer applications on submerged platforms sufficiently supported vegetation growth with standing crops at 1698 kg of bangus and tilapia in the plankton pond (pond 6) and 564 kg of bangus in one lab-lab pond (pond 5).

Table 1.08 gives the amounts and costs of fertilizer used during the study.

Table 1.08 - Amounts and costs of 18-46-0 fertilizer used/ha in the experimental ponds (From Table 1.02).

Treatment	Pond no.	Fertilizer/ha Amounts (kg)	Cost (₱)
Feed	3	141	121.26
Plankton	6	458	393.88
Lab-lab	2	278	239.08
	5	468	402.48
Total	-	1345	1156.70

A total of 1360 kg of feed was to have been fed during the study; however, a 460-kg surplus was on hand after harvest which means that only 900 kg (64.4%) of the feed was actually fed. It is not known how this discrepancy occured, but it is assumed to have been caused by inaccurate weighing. Table 1.09 shows both the recorded and corrected amounts of feed used in each pond as well as conversion and costs for those amounts.

Table 1.09 - Amounts, conversions and costs of feed used to produce bangus in the experimental ponds (From Table 1.03).

Pond no. 2/	Net production (kg/ha)	Amount (kg/ha)	Total cost (₱)	S 3/	Cost (₱) /kg fish	Corrected 1/ Amount (kg/ha)	Total cost (₱)	S 3/	Cost (₱) /kg fish
1	785.5	3197	2877.30	4.07	3.66	2059	1853.10	2.62	2.36
4	1159.0	3880	3492.00	3.35	3.02	2498	2248.20	2.16	1.94
3	187.0	1836	1652.40	9.82	8.84	1104	993.60	5.91	5.32

1/ Assuming only 64.4% of the recorded feed amount was actually fed in each pond.
2/ No feed was used in ponds 2, 5 and 6.
3/ Conversion "S" is calculated by dividing the total amount of feed used in a pond by total net gain of fish in that pond.

Feed conversions were poor regardless of whether the recorded or corrected feed quantities were used. Economics generally determines conversion-rate acceptability. With current wholesale prices for bangus at approximately ₱4.00/kg, conversions as high as 3.0 (₱2.70) may be acceptable. However, conversions of 2.0 or less are generally considered as acceptable for most fishes. The high conversion rates obtained in this study can most likely be attributed to poor feed availability and acceptability.

The maximum amount of feed fed/ha/day in ponds 1, 4 and 3 were 45.8, 46.1 and 25.8 kg, respectively. A total of 36 or more kg of feed/ha was fed in pond 1 daily during the final 38 days of culture. Oxygen stress occured in pond 4 during mid February when 46 kg/ha/day were being fed. This amount of feed may be above the "safe" level of feed to apply/ha/day.

Feed was not as effective as lab-lab or plankton in increasing individual fish weight at the densities stocked - 10,000 fish/ha with feed and 3,000 fish/ha for lab-lab and plankton. Except for the pond 2 population, the cost of feed in producing fish was much greater (about 225%) than the cost of fertilizer to produce an equal weight of fish (Table 1.10).

Table 1.10 - Costs of feed and fertilizer used in producing fish in each experimental pond.

Treatment	Pond no.	Net production (kg/ha)	Fertilizer (kg) total/ha	Feed (kg) total/ha	Cost (₱) of fertilizer and/or feed	
					Total	/kg net prod
Feed	1	785.5	0	2059	1853	2.36 3/
	4	1159.0	0	2498	2248	1.94 3/
	3	187.0	141	1104	1119	5.98 3/
Plankton	6	458.1 1/ / 1651.7 2/	458	0	394	0.86 1/ / 0.24 2/
Lab-lab	2	79.1	278	0	239	3.02
	5	518.3	468	0	402	0.76

1/ Weight of *bangus* only.
2/ Weight of *bangus* and *tilapia*.
3/ Corrected feed values given in Table 7.

A combined net total per ha of 1945 kg of bangus was produced in ponds 1 and 4 with feed. The amount of feed used was 4557 kg at a cost o ₱4101.00. The S conversion of 2.34 resulted in a feed cost of ₱2.11/kg of bangus produced in those two ponds. Fertilizer costs for net productions of bangus in pond 5 (lab-lab) and pond 6 (plankton) were ₱0.76 and ₱0.86/kg, respectively. In pond 6 fertilizer cost for the combined production of bangus and tilapia was only ₱0.24/kg.

Average net production was 973 kg/ha in ponds 1 and 4 at a feed cost of ₱2053. The average net production of bangus in fertilized ponds 5 and 6 were 488 kg/ha at a cost of ₱398. The difference in mean net productions between fed and fertilized ponds were 485 kg/ha at a cost differential of ₱1655. The cost of feed to produce 485 kg/ha above productions with fertilization only was ₱3.41/kg. This is costly production.

Only 2 pond populations, those in ponds 2 and 3 were demonstrating negative growth at harvest. Sub-lethal levels of Brestan residue could be responsible. Both ponds 1 and 2 experienced fish kills immediately following the initial stocking and had to be restocked a month later. At restocking, pond 2 received fish almost twice the size of those in pond 1 and only one-third as many, however, at harvest mean weights of individual fish were the same in both ponds. Greater food (feed) abundance in pond 1 could explain this phenomenom since pond 1 was being fed and pond 2 was not fed. Furthermore, the bangus had nearly depleted the natural foods in pond 2 by harvest date. The fact that lab-lab increased in amount in pond 1 during the experiment in spite of the heavy stocking rate, suggests the fish preferred the artificial feed over the available lab-lab. However, the pond 3 population had shown negative growth for approximately 50 days even though feed was being given daily and an abundance of natural foods was present. During the 50-day period, fish in pond 3 were being fed at a higher rate than in pond 4, but pond 4 fish were increasing in weight although almost no natural foods were observed.

Low survivals in ponds 2 and 3 of 45% and 59%, respectively, also indicate poison residue, especially since survivals in the other ponds ranged from 79% to 95%.

The possibility of mycotoxin poisoning from the feed was considered as a contributer to poor conversions and low survival. However, gross examination of the livers and internal organs of 5 fish from each of the fed ponds at harvest showed no evidence of lesions, tumors or other abnormalities.

Summary of Results

There was a lack of good quantitative technique and adequate replications in the study. However, some results and observations obtained, although inconclusive, are worthy of being repeated:

1. Brestan toxin was probably responsible for fish kills in ponds 1 and 2, and at sublethal levels was an apparent cause for poor production in ponds 2 and 3.

2. A standing crop of 564 kg bangus/ha was produced in a pond with lab-lab in 138 days.

3. Plankton produced a standing crop of 504 kg bangus/ha and 1194 kg tilapia/ha for a total of 1698 kg fish/ha at the end of 138 days.

4. Pelleted feed of the IFP formula produced a standing crop of 1312 kg bangus/ha of pond at the end of 138 days. Feed conversions were poor.

5. Periodic fertilizer applications on submerged platforms sufficiently supported growth of plankton in ponds to produce a standing crop of 1698 kg of bangus and tilapia/ha. The same supported growth of lab-lab sufficient to produce a standing crop of 564 kg bangus/ha. (Fertilizer platforms were successfully used in maintaining lab-lab in ponds 0.12 ha in area.)

6. Inorganic fertilizer (18-46-0) did sufficiently induce and maintain lab-lab and phytoplankton growth in bangus ponds without the use of any organic fertilizer.

7. Supplemental feeding did not appear to be advantageous where lab-lab was abundant although the fish apparently preferred the feed to the lab-lab.

8. Supplemental feeding appeared to permit lab-lab to become reestablished following near depletion by bangus.

9. Feed conversions were poor (range from 3.16 to 5.91) which resulted in feed costs/kg of net gain of fish ranging from ₱1.94 to ₱5.32.

2. Bangus Culture in Ponds with Feed and Lab-lab - with and without Lime

Introduction

This report presents results of an experiment in bangus production by the IFP in cooperation with Mr. Jose R. Legarda. The Legarda Fish Farm is located approximately 10 km northeast of Orani, Bataan on the Matunas and Balos Maragul Rivers. The Bataan-Pampanga provincial boundary crosses the farm.

The primary objective of the study was to compare bangus production parameters between pond populations receiving supplemental feed and those with lab-lab. The secondary objective was to measure the effect of agricultural lime on production of bangus in the above treatments.

Materials and Methods

The portion of the Legarda Fish Farm used in the study was originally a swamp covered by mangrove and nipa palm. The dikes and pond soils are high in organic matter content that is composed primarily of roots and other woody materials. When dry the dikes can be set afire, and will burn similar to the burning of sawdust. Water in the ponds is dark brown in color similar to dilute coffee. The odor of hydrogen sulfide is strong when the bottom soils are disturbed.

The owner stated that he had never been successful in producing an optimum growth of lab-lab in the ponds since their construction in 1966.

Eight ponds were selected for the study. All were rectangular in shape and ranged in size from 0.76 to 0.94 ha. Water depth averaged approximately 25 to 30 cm throughout the culture period. The supply canal used to service the ponds was connected directly to the Balos Maragul River (Fig. 2.01 A).

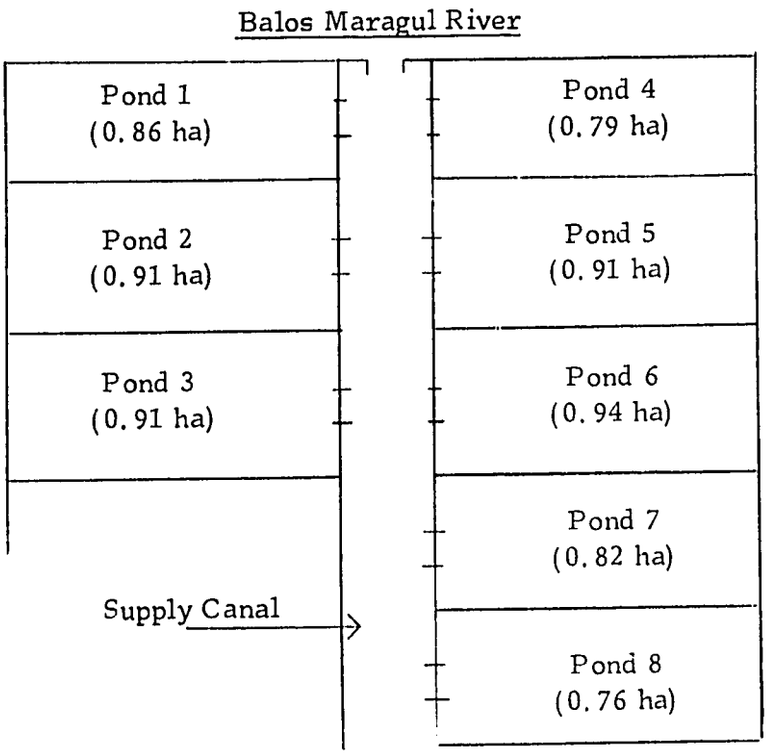

Fig. 2.01 Diagram of the study area on the I egarda Farm showing pond numbers, areas and the relationship of ponds to water supply.

Preparation of the study ponds began December 10, 1971. Prior to that the ponds had stood dry except for a small pool of water at the gate of each pond. Fertilizers and lime were broadcast over the dry pond soils from December 10 to 13 as prescribed by the treatment for each pond (Table 2.01).

Treatments were assigned to ponds as follows:

Ponds	Treatment
1 and 7	Fertilizers for lab-lab (no lime or feed)
4 and 8	Fertilizers and lime for lab-lab (no feed)
2 and 6	Feed and lime (no fertilizers)
3 and 5	Feed (no lime or fertilizers)

The fertilizers used consisted of chicken manure and 16-20-0 and 14-14-14 inorganic fertilizers. The lime applied was ground agricultural limestone. Neither fertilizer nor lime were used after the preparation applications in mid-December. The fertilizers used were the kinds and amounts normally used by the pond manager.

Table 2.01 – Amounts and dates applied of fertilizers and lime used in the preparation of study ponds at the Legarda Fish Farm[1/].

Material	Pond 1		Pond 2		Pond 4		Pond 6		Pond 7		Pond 8	
	Kg	Date	Kg	Date	Kg	Date	Kg	Date	Kg	Date	Kg	Date
Chicken manure	1450	12/13	0	–	1450	12/10	0	–	1500	12/10	1400	12/13
16–20–0	200	12/13	0	–	200	12/13	0	–	200	12/13	200	12/13
14–14–14	100	12/13	0	–	100	12/13	0	–	100	12/13	100	12/13
Lime	0	–	2320	12/13	2280	12/10	2360	12/10	0	–	1920	12/11

1/ No fertilizer or lime was applied to ponds 3 and 5.

Table 2.02 – Amounts, dates applied and costs[1/] of pelleted feed used in the study ponds from December 17, 1971, to April 6, 1972.

Period	Pond 2 Amount (kg)			Pond 3 Amount (kg)		Pond 5 Amount (kg)		Pond 6 Amount (kg)		All Ponds Total kg
	Days	/day	/period	/day	/period	/day	/period	/day	/period	
12/17 – 1/5	20	2.0	40.0	2.0	40.0	2.0	40.0	2.1	42.0	–
1/6 – 1/15	10	3.2	32.0	3.2	32.0	3.2	32.0	3.3	33.0	–
1/16 – 1/25	10	6.2	62.0	6.2	62.0	6.2	62.0	6.4	64.0	–
1/26 – 2/4	10	8.4	84.0	8.4	84.0	8.4	84.0	8.7	87.0	–
2/5 – 2/24 2/	20	11.5	219.0	11.5	219.0	11.5	219.0	11.8	226.0	–
2/25 – 2/28	4	11.8	47.2	11.8	47.2	11.8	47.2	12.4	49.6	–
2/29	1	6.0	6.0	6.0	6.0	6.0	6.0	6.4	6.4	–
3/1 – 3/7	7	3.0	21.0	11.8	82.6	3.0	21.0	3.0	21.0	–
3/8	1	3.0	3.0	6.0	6.0	(harvest)	–	(harvest)	–	–
3/9 –3/13	5	12.0	60.0	12.0	60.0	–	–	–	–	–
3/14	1	6.0	6.0	6.0	6.0	–	–	–	–	–
3/15 – 3/17	3	0.0	0.0	0.0	0.0	–	–	–	–	–
3/18 – 4/4	18	12.0	216.0	12.0	216.0	–	–	–	–	–
4/5	1	6.0	6.0	6.0	6.0	–	–	–	–	–
Total/pond (kg)			802.2		866.8		511.2		529.0	2709.2
Cost/pond (₱)			721.98		780.12		460.08		476.10	2438.28
Total/ha (kg)			881.6		952.4		561.8		562.9	–
Cost/ha (₱)			793.44		857.16		505.62		506.61	–

1/ Cost of feed based on ₱0.90/kg.
2/ The full ration/day was not fed on all days during this period.

IFP - formula feeds were used in ponds 2, 3, 5 and 6 beginning December 17, the day following stocking. Feeding rates were adjusted at intervals during the study. The feeding schedule, including feed amounts and costs, is given for each pond in Table 2.02. The fish were fed on a daily schedule with half of each day's ration fed in the morning and the other half in the afternoon. The feed was broadcast along the entire length of the same dike of each pond at each feeding.

All ponds were stocked on December 16. Ponds that received feed were stocked with 10,000 bangus/ha; the fertilized ponds were stocked with 3000 bangus/ha (Table 2.03).

The fingerlings used for stocking were seined from a nursery pond and held temporarily in a net enclosure. The fish were then counted individually into groups of 1000 and stocked at random until the desired amount had been stocked into each of the 8 ponds.

Mean weight and length of the fish stocked into all ponds were 2.9 g and 74.5 mm, respectively. Mean weight was determined by weighing en masse 3 samples of fish and taking the average. The samples collectively numbered 212 fish that weighed 622.g. Mean length was determined by measuring to the nearest 1.0 mm total length each of 195 fish selected at random from the group being stocked.

Table 2.03 - Treatment, area, number and weight of bangus stocked in each study pond.

Pond no.	Treatment	Pond area (ha)	Bangus stocked/pond No.	Kg.
1	Lab-lab	0.86	2580	7.5
2	Feed/lime	0.91	9100	26.4
3	Feed	0.91	9100	26.4
4	Lab-lab/lime	0.79	2370	6.9
5	Feed	0.91	9100	26.4
6	Feed/lime	0.94	9400	27.3
7		0.82	2460	7.1
8	Lab-lab/lime	0.76	2280	6.6
Total		6.90	46,390	134.6

The culture period began in all ponds with stocking on December 16, and ended with harvest on March 8 in pond 5. March 9 in pond 6, March 10 in ponds 4, 7 and 8, April 6 in ponds 2 and 3 and April 24 in pond 1

The feeding programs began in the fed ponds on December 17 and continued through March 7 in ponds 5 and 6 through April 5 in ponds 2 and 3.

Each pond population was sampled at approximately 30-day intervals throughout the study. Each sample consisted of approximately 40 fish that were seined at random, anesthetized in quinaldine solution, and individually weighed and measured before being returned to the pond. Additional fish from each pond were usually weighed en masse at each sampling The sample results were used to determine growth rates and to adjust feeding rates. Length-weight data were collected for a separate study. Observations on environmental conditions and other notes were recorded at each sampling date on chemical and physical properties of the pond waters. Results and observations of each sampling are presented.

The ponds were harvested at different dates from March 8 to April 24. All fish from each pond were individually counted. Sample weights were taken to determine mean weight per fish and total weight per pond.

Results

Growth rate varied greatly within as well as between treatments. For example mean weights of the 2 populations in ponds with lab-lab and without lime (ponds 1 and 7) were 64 g and 29 g, respectively, on the 61st day of culture. The 64 g mean weight was the highest at day 61; the lowest was only 16 g in pond 4 (lab-lab and with lime). Slopes of plotted empirical growth curves (Fig 2.02) were linear rather than sigmoid in 7 of the 8 populations. The exception was the population of pond 1.

The phenomenal growth-rate potential of bangus was demonstrated in pond 1 (Table 2.04). In the first 12 days after stocking the fish increased in weight by 179% for an average of 15% increase in body mass per fish per day. In 61 days the fish increased from 2.9 g to 64.4 g - an increase of over 2000%. A general rule-of-thumb in freshwater-warmwater fish culture is that most agencies will double in weight every 30 days. The bangus in pond 1 were doubling their weight about every 10 days during the first 30 days of culture in spite of the fact that the observed abundance of natural food in the pond did not appear to be adequate for optimum growth.

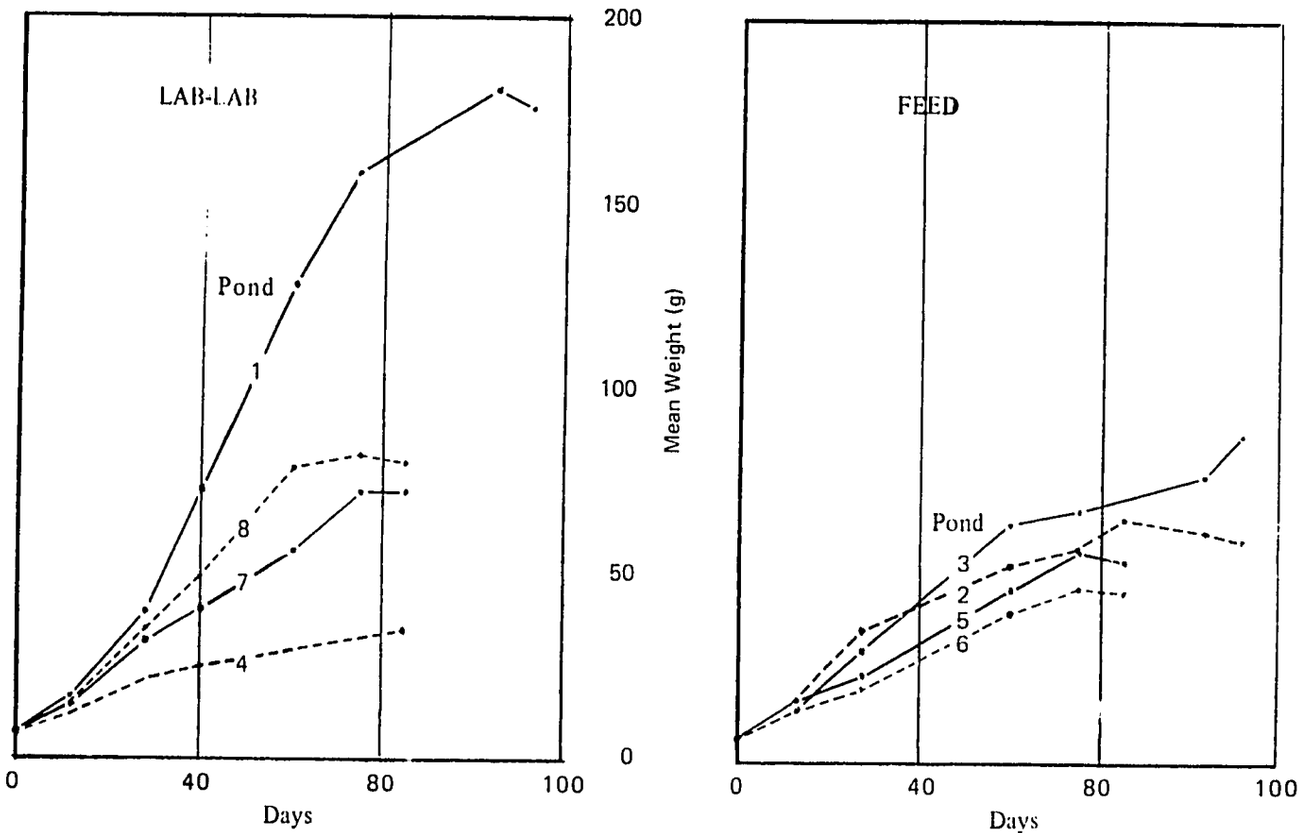

Fig. 2.02 - Empirical growth curves of bangus raised in study ponds at Legarda farm with feed and lab-lab (points represent mean weights at dates sampled; numbers written into the curves represent pond numbers).

Table 2.04 - Mean % increase per bangus per culture day in pond 1 from December 16 to March 28.

Culture day 1/	Mean weight /fish (g)	Culture period (days)	% increase /period	% increase /day/period
0	2.9	0	0	0
12	8.1	12	179	14.9
27	20.3	15	151	10.1
61	61.4	34	217	6.4
75	78.8	14	22	1.6
103	90.6	28	15	0.5
Total	-	103	3024	29.4

1/ December 16 and March 28 were culture day 0 and 103, respectively.

Total production in the ponds with feed averaged approximately 2.5 times greater than production in the ponds with lab-lab. Net gain averaged 253.2 kg/ha in the ponds with feed and 107.3 kg in the ponds with lab-lab (Table 2.05).

Table 2.05 - Comparison of bangus production between ponds with feed and ponds with lab-lab.

Ponds with lab-lab				Ponds with feed			
	Weight (kg)/ha				Weight (kg)/ha		
Pond no.	Stock	Harvest	Net gain	Pond no.	Stock	Harvest	Net gain
1	8.7	216.7	208.0	2	29.0	264.2	235.2
4	8.7	41.5	32.8	3	29.0	393.0	333.1
7	9.4	113.2	103.8	5	29.0	247.9	218.9
8	8.7	93.4	84.7	6	34.3	260.0	225.7
Avg	8.9	116.2	107.3	Avg	30.3	281.3	253.2

Growth and production were poor in all ponds of all treatments. The reasons for the poor performance can only be speculated.

In all ponds there is a possibility that a sub-lethal level of Gusathion persisted at least long enough to adversely affect growth The bangus were stocked only 5 days after the Gusathion treatment. Sub-lethal levels could have had an adverse effect on the physiology of the fish as well as an adverse effect on the abundance of fish food organisms.

In all ponds apparent low quality of water and soil conditions most likely contributed to poor production. This is only assumed based on apparent acid conditions (coffee-colored water and high amounts of woody material in the soil), hydrogen sulfide odor when the bottom muds were disturbed and the owners past difficulty in producing lab-lab.

In the ponds with feeding low availability and accessibility of the feed pellets were at least partially responsible for poor production. Also, the feed was designed as a supplemental feed, not as a nutritionally complete feed. However, the expected plankton growth never materialized in the fed ponds. Consequently, the fish at 10,000/ha were probably not receiving adequate nutrition from the incomplete feed and available natural foods.

In the fertilized ponds the failure to produce a suitable lab-lab growth obviously affected production. Failure to produce suitable lab-lab has been the history in the ponds likely because of unfavorable water-soil conditions. In the study lab-lab did not have sufficient time to become established before the bangus were stocked. Preparations for lab-lab began on December 10; the fish were stocked December 16. At densities of 3000 fish/ha, the fish probably eliminated the lab-lab as rapidly as it developed.

There was no observed difference in survival of bangus between treatments (Table 2.06). Survival was approximately 85% in each treatment.

Table 2.06 - Comparison of survival of bangus between ponds with lab-lab and ponds with feed.

Ponds with lab-lab				Ponds with feed			
Pond no.	No. fish stocked	No. fish harvested	Survival %	Pond no.	No. fish stocked	No. fish harvested	Survival %
1	2580	2114	81.9	2	9100	7933	87.2
4	2370	1840	77.6	3	9100	7438	81.7
7	2670	2600	97.4	5	9100	8235	90.5
8	2280	1780	78.1	6	11113	10580	95.0 1/

1/ In pond 6 a total of 9400 fish were to have been stocked; however, 10,580 were recovered at harvest. A survival of 95% was assumed which resulted in an adjusted stocking density of 11,113 rather than 9400.

The application of ground agricultural limestone to half the study ponds prior to stocking had no apparent positive effect on bangus production. The opposite was the observed response. The average values of mean weight attained, net gain per ha and % survival (Table 2.07) were superior in ponds without limestone added.

Table 2.07 - Comparison of mean weight attained, net gain and survival between ponds with and without agricultural limestone.

	With limestone			Without limestone		
	Mean weight (g)	Net gain (kg/ha)	% Survival	Mean weight (g)	Net gain (kg/ha)	% Survival
	17.8	32.8	78	88.2	208.0	82
	39.9	84.7	78	35.7	103.8	97
	30.3	235.2	87	44.3	333.0	82
	23.1	225.7	-	27.4	218.9	91
Avg	27.8	144.6	81	48.9	215.9	88

No sound explanation can be given for the results obtained between the liming and non-liming treatments. A knowledge of the physio-chemical conditions in each pond would be necessary for an explanation. Not having even basic information on the water-soil conditions was a serious weakness in the study.

In the 4 ponds with feeding, an average of 2.92 kg of feed was required to produce each 1.0 kg net gain of bangus (Table 2.08) The feed cost was ₱2.63/kg of fish produced. In the 4 ponds with fertilizer, an average of 16.8 kg of chicken manure, 2.3 kg of 16-20-0 and 1.2 kg of 14-14-14 were required to produce each 1.0 kg net gain of bangus (Table 2.09). The fertilizer cost was ₱3.65/kg of bangus produced.

The cost of production both for feed and for fertilizer are too high to be economical. The extremely high cost of fertilizer production (average of ₱3.65/kg net production of bangus) resulted from the inability to establish growth of lab-lab and other natural foods.

Table 2.08 - Amounts and costs of feed used in the 4 feed study ponds at the Legarda Fish Farm.

Pond no.	Net gain (kg)	Feed used/ha Amount (kg)	Feed used/ha Cost (₱)	S 1/	Cost/kg net gain (₱) 2/
2	235.2	881.6	793.44	3.74	3.37
3	333.1	952.4	857.16	2.86	2.57
5	218.9	561.8	505.62	2.57	2.31
6	225.7	562.9	506.61	2.49	2.24
Avg	253.2	739.7	665.73	2.92	2.63

1/ S = feed conversion = kg net gain of fish divided by the total kg feed fed.

2/ Cost based on ₱ 0.90/kg of feed.

An analysis of water salinity in each study pond on February 2 revealed a salinity range from 7.8 ppt (pond 8) to 8.6 ppt (pond 2). The average salinity was 8.3 for the 8 ponds.

3. Bangus Culture in Ponds with Feed and Lab-lab

Introduction

A study in bangus production was conducted in cooperation with Mr. Jose Batungbacal. The Batungbacal Fish Farm is located in Orani, Bataan.

Table 2.09 - Amounts and costs of fertilizers used in the 4 fertilized study ponds at the Legarda Fish Farm.

Pond no.	Net gain (kg) of fish	Fertilizer						Total cost (₱)	Cost (₱) kg net gain
		Manure		16–20–0		14–14–14			
		kg	₱	kg	₱	kg	₱		
1	208.0	1686	151.74	233	144.46	116	70.76	366.96	1.76
4	32.8	1835	165.15	253	156.86	127	77.47	399.48	12.18
7	103.8	1829	164.61	244	151.28	122	74.42	390.31	3.76
8	84.7	1842	165.78	263	163.06	132	80.52	409.36	4.83
Avg/pond	107.3	1798	161.82	248	153.76	124	75.64	391.22	3.65
Avg/1.0 kg of fish	-	16.8	1.51	2.3	1.42	1.2	0.72	3.65	3.65

1/ Cost based on ₱0.09/kg for chicken manure, ₱0.62/kg for 16-20-0 and ₱0.61/kg for 14-14-14 (prices per unit of item as given by the owner).

The objective of the study was to compare bangus production in ponds with lab-lab only, lab-lab and artificial feed and artificial feed only.

Materials and Methods

A total of 6 ponds were used in the study. They ranged in area from 0.18 to 0.27 ha and each had a water depth of approximately 30 cm. A supply canal approximately 2.5 m wide and 1.0 deep was connected directly to the Orani River.

Prior to beginning preparation for the study, the ponds were dry except for small puddles of water in each pond. Fertilizer in the form of rice bran and 16-20-0 were broadcast over ponds 1, 2, 3 and 4 on December 7. No fertilizers were used in ponds 5 and 6. A mixture of 110 kg of 16-20-0 and 600 kg of rice bran was used per hectare in each fertilized pond.

After the initial fertilization treatment prior to stocking, no fertilizers were used in the ponds during the study

Immediately after broadcasting the fertilizer, Gusathion and endrin were applied to the supply canal and to water puddles in all ponds. The poisons, in unmeasured amounts, were used to eradicate snails and wild fishes. Controlled flooding of the ponds began on December 7.

All the study ponds were stocked with bangus on December 17. Prior to stocking, the fish were seined and held in a net enclosure. They were then counted into groups of 100 and placed in plastic bags filled with approximately 1 part water and 4 parts oxygen gas. The fish were then transported to the ponds and stocked into designated ponds selected at random. Lengths and weights were obtained from bangus samples taken prior to and during stocking. The fish were anesthetized in a quinaldine solution, individually measured to near- [illegible] and weighed en masse to the nearest 0.1 g. A total of 238 fish were sampled from the 13,760 bangus stocked. Mean length was 94.1 mm (range of 73 to 180 mm) and mean weight was 7.0 g.

Ponds 2 and 3 were restocked on December 28 with bangus averaging 6.1 g.

A feeding program using IFP-formula pellets was begun on December 17 in ponds 5 and 6 and December 28 in ponds 2 and 3. Feeding rates averaged approximately 3% body weight over the culture period.

The bangus in all ponds were sampled at intervals of approximately 30 days. At each sampling fish were seined and anesthetized in a quinaldine solution. About 40 fish were individually measured to nearest 1.0 mm and weighed to the nearest 0.1 g. Additional fish were weighed en masse to the nearest 0.1 g.

The study was terminated with the draining of all ponds on March 8. The bangus were removed by seining as the ponds were drained. The fish from each pond were all counted individually. Samples of fish were taken at random during draining. Individual fish were measured and weighed, and groups of fishes were weighed to determine average sizes and standing crops.

Results

Results of this project are summarized in Tables 3.01 through 3.04.

Table 3.01 - Bangus production in ponds with lab-lab only, lab-lab and feed, and with feed only.

Treatment	Pond no.	Stocked (kg/ha)	Produced (kg/ha) Total	Produced (kg/ha) Net	Net gain (kg)/ ha/day
Lab-lab	1	70.4	58.3	-12.1	-0.15 1/
	4	70.4	157.8	87.4	1.06
Lab-lab and feed	2	61.1	136.8	75.7	0.92
	3	61.1	93.9	32.8	0.40
Feed	5	84.1	238.2	154.1	1.88
	6	82.2	247.2	165.0	2.01

1/ Negative production occurred in pond 1 where 70.4 kg/ha were stocked and only 58.3 kg/ha were recovered.

Table 3.02 - Survival of bangus cultured with lab-lab only, lab-lab with feed and with feed only.

Treatment	Pond no.	Bangus number Stocked	Bangus number Harvested	% Survival
Lab-lab	1	2300	1812	78.8
	4	2700	2564	95.0
Lab-lab and feed	2	2200	1790	81.4
	3	1800	1136	63.1
Feed	5	2650	2520	95.1 1/
	6	2110	2007	95.1 1/
Total/pond	-	13760	11829	86.0
Total/ha	-	10585	9099	86.0

1/ Ponds 5 and 6 contained more fish at harvest than were supposedly stocked; to correct for this a 95% survival was assumed and the stocking density was increased proportionately.

Table 3.03 - Feed efficiency and cost for bangus production.

Pond no.	Kg net gain/ha	Amount (kg)	Cost (₱)	S 1/	Cost/kg net gain (₱)
2	75.7	569.9	512.91	7.53	6.78
3	32.8	643.3	578.97	19.61	17.65
5	154.1	650.8	585.72	4.22	3.80
6	165.0	672.7	605.43	4.07	3.66

1/ S = feed conversion net weight gain (kg) of fish divided by total weight (kg) of feed used.

Table 3.04 - Feed and fertilizer costs for bangus production in ponds at the Batungbacal Fish Farm.

Treatment	Pond no.	Kg net gain/ha	Cost (₱) of fertilizer	Cost (₱) of feed	Total cost (₱) feed & fertilizer	Total cost (₱) kg/net gain
Lab-lab	1	-12.1	308.82	0.00	308.82	-
	4	87.1	308.82	0.00	308.82	3.53
Lab-lab and feed	2	75.7	308.82	512.91	821.73	10.86
	3	32.8	308.82	578.97	887.79	27.07
Feed	5	154.1	0.00	585.72	585.72	3.80
	6	165.0	0.00	605.43	605.43	3.66
Total	-	502.9	1235.28	2283.03	3518.31	7.00

Figures calculated from Tables 3.05 and 3.06.

All ponds were contaminated with wild fishes. Tilapia and Poecilia (Mollienesia) were the most abundant, but Elops and Megalops were also present. Ponds 3 and 6 contained the greatest numbers and weights of wild fish, but no attempt was made to determine the actual measure of contamination in any pond.

The application of Gusathion and endrin on December 7 did kill snails, but the treatment was not effective in eliminating them. Snail density was great in all ponds throughout the study.

The fish kill that occurred in ponds 2 and 3 after stocking on December 16 was thought to be caused by residue of endrin and Gusathion. Sublethal levels of pesticide residue was probably partly responsible for poor production in all ponds and especially in ponds 1, 2 and 3.

A satisfactory lab-lab growth was not established in the fertilized ponds. Immediately after flooding, a plankton bloom developed in ponds 1 and 2. Poor growths of lab-lab and/or plankton had developed in ponds 1, 2, 3 and 4 by December 16, the day of stocking. The observed abundance of natural food organisms (lab-lab) never developed to a satisfactory level. Some important reasons for the lack of development are:

1) Snail contamination,
2) High stocking density (10, 000 bangus/ha),
3) Insufficient time for development between fertilization on December 7 and stocking on December 16, and
4) Lack of subsequent fertilizer applications after the initial treatment on December 7.

Table 3.05 - Amounts and costs of fertilizers used in the study ponds at the Batungbacal Fish Farm on December 7, 1971.

Pond no.	Amount (kg) 1/ and cost (₱) 2/ of fertilizers: Rice bran Kg	Rice bran ₱	16-20-0 Kg	16-20-0 ₱	Total cost (₱)
1	138	55.20	26	16.12	71.32
2	132	52.80	24	14.88	67.68
3	108	43.20	20	12.40	55.60
4	162	64.80	30	18.60	83.40

1/ The amounts of fertilizers/ha of ponds were 600 kg of rice bran and 110 kg of 16-20-0.

2/ Costs were based on ₱ 0.40/kg of rice bran and ₱ 0.62/kg of 16-20-0.

Table 3.06 - Amount and cost of pelleted feed (IFP-formula) used in the study ponds at the Batungbacal Fish Farm from Decmeber 17, 1971 to March 7, 1972.

Feeding Period		Amount of feed used (kg)/pond				
Date	Days	Pond 2	Pond 3	Pond 5	Pond 6	Total (kg)
12/17 - 12/26	10	0.0	0.0	12.0	10.0	-
12/27 - 1/5	10	10.2	8.5	12.0	10.0	-
1/6 - 1/15	10	12.0	10.0	12.0	10.0	-
1/16 - 1/25	10	16.0	13.0	16.0	13.0	-
1/26 - 2/4	10	20.0	17.1	20.0	17.1	-
2/5 - 2/14	10	27.0	23.0	27.0	23.0	-
2/15 - 2/24	10	29.0	25.0	29.0	25.0	-
2/25 - 3/5	10	10.2	8.2	14.2	12.2	-
3/5 - 3/7	2	1.0	1.0	1.0	1.0	-
Total/pond (kg)	-	125.4	115.8	143.2	121.1	505.5
Cost/pond (₱)[1/]	-	112.86	104.22	128.88	108.99	454.95
Total/ha	-	569.9	643.2	650.8	672.7	2536.6
Cost/ha (₱)[1/]	-	512.91	578.88	585.72	605.43	2282.94

1/ Cost based on ₱ 0.90/kg of feed.

C. Research Programs in Progress

A total of 15 research projects initiated during FY-72 remained in progress on June 30, 1972, the final date in the reporting period. The majority of those will be completed in the first half of FY-73, but others will be continued indefinitely. The projects could be grouped into one of 3 areas of research, namely: feeds and feeding, fertilization and bio-physio-chemical surveys. The projects in progress are discussed in the above general groupings and order.

1. IFP - Special Formula Fish Feed

A special formula fish feed is being used in the IFP research studies conducted in the private sector, at the UPCF and at the WVDFF of the PFC. The feed was formulated by the IFP staff and prepared by B-Meg Feed Company of the San Miguel Corporation. Three different batches of feed were prepared with each being slightly modified in composition. The three batches and modifications were designated IFP-1, IFP-1a, and IFP-1b (Table 1.01). IFP-1 and 1a were formulated as supplemental feeds. Vitamins were added to IFP-1a to form a nutritionally complete feed (IFP-1b) that can be fed in situations where natural foods are lacking or absent.

Table 1.01 - Composition of IFP-1 feed and its modifications.

Ingredient	% of Ingredient	
	IFP-1	IFP-1a and 1b 1/
Fish Meal (60-66% protein)	40	40
Copra Meal (20% protein)	20	20
Brewer's Dried Grains (16% protein)	20	20
Rice Bran (12% protein)	16	16
Bentonite (binder)	4	0
Corn Grits (8% protein)	0	1
Total	100	100

1/ IFP-1b had the same composition as IFP-1a except with a vitamin supplement added.

The feed was prepared in pelleted form, 5 mm wide and 7 mm long. The pellets were begged at 40 kg/sack for transporting and storing. The feed costs were ₱35.50/bag (₱0.89/kg) for IFP-1 and 1a and ₱36.50/bag (₱0.91/kg) for the vitamin fortified IFP-1b.

Proximate analyses were conducted on feed samples from each batch (Table 1.02). The analyses were made by laboratories at B-Meg (Mr. Prudencio R. Falcon); Laboratory Services Division, Bureau of Animal Industry (Mrs. Rosita B. Sadueste-Domingo); and the Department of Fisheries and Allied Aquaculture, Auburn University, Alabama, U.S.A. (Dr. R. T. Lovell).

Table 1.02 - Proximate analysis on a dry-weight basis of samples from each batch of IFP feed as reported by three different laboratories. 1/

	IFP-1			IFP-1a		IFP-1b	
Nutrient	B-M	BAI	AU	BAI	AU	BAI	AU
Crude protein	39.4%	37.7%	39.0%	37.5%	36.0%	35.5%	35.7%
NFE	26.0	31.8	25.5	30.7	28.5	35.7	32.0
Crude ash	14.0	13.5	13.3	15.7	15.6	11.9	11.7
Crude fat	11.2	10.2	10.8	8.6	12.1	9.2	9.2
Crude fiber	9.4	6.8	11.4	7.5	7.8	7.7	11.4
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

1/ The laboratories were B-Meg Feed Co. (B-M), Bureau of Animal Industries (BAI) and Auburn University (AU).

The B-Meg laboratory reported the caloric value of IFP-1 feed to be 2,068 kcal/kg of finished feed. This was the only analysis for caloric value made on the feeds.

The IFP feed was formulated with intentions of obtaining a feed with approximately 33% crude protein, 10% crude fat and 2,200 kcal/kg of dry-weight pellets.

Samples of each batch of feed were given a water stability test by Auburn University. The stability test was performed by placing the pellets on a 1/8-in hardware cloth screen; the screen was then placed in water for 10 min; the screen was removed and the feed dried. The weight of absolute dry matter remaining on the screen was the measure of water stability. The first batch (IFP-1) had poor but acceptable stability at 88%. IFP-1a and 1b had water stability at only 65% and 63%, respectively.

IFP-1, the most stable pellets, contained 4% bentonite which is generally considered to be a poor binding agent. The pellets showed poor stability under field conditions. Also, much loose feed material was present with the bagged pellets. To improve pellet stability and reduce the amount of loose feed in IFP-1, bentonite was replaced with corn grits (starch) in IFP-1a and 1b. Also, in the latter batches the ingredients were to be finely ground with processing temperatures being raised to 180°F for starch gelatinization. It was thought that fine grinding and gelatinizing of the starch would improve the water stability of the pellets. However, it was evident the ingredients were no more finely ground in IFP-1a and 1b than in IFP-1. Perhaps the gelatinization temperature of 180°F was not reached either. At any rate the IFP-1a and 1b pellets were much inferior to IFP-1 in water stability. This fact was confirmed by observations of field use as well as the laboratory testing.

A sample of IFP-1 feed was given to Dr. R. W. Engel (Nutrition Specialist, USAID/Manila) for mycotoxin analysis. The feed was found to contain 25 ppb B_1, and 8 ppb B_2 toxin. Although the feed was prepared December 1, 1971, the mycotoxin analysis was not made until April 1, 1972. A superficial examination was made on 10 bangus that had received IFP-1 feed daily for 138 days; the examination revealed no apparent adverse effects on the fish including the liver and other internal organs.

In the research projects with bangus completed prior to June, 1971, the IFP-feed did not perform as well as expected. Conversions (S) were in excess of 2.0, and were considered too high for practical application

Two apparent reasons for poor feed conversions were low availability and low acceptability to the bangus. Low feed availability was a direct result of poor pellet stability in the water. Since the pellets did not hold together, feed particles became dispersed and, hence less available for consumption. On the other hand, the suspended feed particles appeared to be more acceptable to the bangus than did the feed pellets. Fine particles of feed floating on the surface were taken directly by the bangus. Pellets as such did not appear to be taken at all. However, feed particles in the mid-water appeared to be taken. Although the fish were not observed taking pellets off the bottom, they swam back and forth over the disintegrating pellets apparently creating water currents which forced the feed particles up into the mid-water where they were consumed This behavior was observed in ponds at experiments in both Bataan and Pangasinan

The feeding behavior of bangus on the prepared feeds is not surprising, for basic morphology indicates that the bangus is a mid-water, filter feeder rather than a bottom feeder. The fish has on each gill arch a pair of extremely fine gill rakers. The rakers are attached on the proximal end to the arch and on the distal end to rakers of an adjacent arch; this forms a

filtering device capable of straining very fine particles. The fish also has a terminal mouth that contains no teeth. These features and the long intestinal tract indicate the bangus is basically a planktophagic herbivore.

The morphological features and the feeding behavior of bangus suggest that artificial feeds in the form of floating meals or perhaps floating pellets would perhaps be more efficient than sinking pellets. Feeds of varying physical characteristics are being tested for bangus acceptability. No conclusive results have been obtained.

IFP-1b feed is being fed to hito catfish (Clarias batrachus) in high-density cultures where a complete feed is required. Preliminary results indicate that the feed is nutritionally complete; no signs of nutritional deficiencies were evident after 91 days of culture where the hito were being fed exclusively with IFP-1b feed. It is believed at this point that the IFP feed-formula composition is satisfactory.

2. Screening of Feed Stuffs

Some fish farmers are using composted materials such as mixtures of chicken manure, rice straw, bran sweeping and grass to feed fish. The practice has created considerable interest among fish farmers, and many have made inquiries to the IFP staff wanting information on the feasibility of using composts. A compose considered to be one of the most promising had the following composition·

Chicken manure	68% by weight
Bran sweepings	22
Grass	6
Subsoil	2
Molasses	2

A Japanese commercial produc called BYME (the letters represent bacteria, yeast, molds and enzymes) is added at a rate of 10 g BYME to 600 kg of the mixture. The BYME is added about 1 week after the mixture is composed. Its purpose is to promote fermentation thereby increasing the level of protein in the decaying mixture. Samples of mixtures before and after the addition of BYME were taken for proximate analysis. The following table is the resulting analysis of a sample taken

from a recently prepared mixture (sample 1); a sample taken just after a mixture had stood for one week and at the time for mixing in the BYME (sample 2); and a sample that had stood for "several" weeks after the addition of BYME (sample 3):

Nutrient	Sample 1	Sample 2	Sample 3
Protein*	24.3%	24.4%	22.5%
Fat	4.1	2.5	0.9
NFE	29.8	25.4	21.4
Fiber	12.3	15.4	11.2
Ash	29.5	32.3	14.0
Total	100.0%	100.0%	100.0%

- The samples were taken from different mixtures.

- The analyses were made by the Laboratory Services Division, Bureau of Animal Industry (Mrs. Rosita B. Sadueste-Domingo).

* Protein is based on total nitrogen with no allowances given to the non-protein nitrogen present in chicken manure.

The proximate analysis results indicate that this particular compost was not worth the cost and effort to prepare it. However, composts do have potential in aquaculture and some will likely be tested in the future.

3. Bangus Feeding Behavior on Artificial Feed (Iloilo)

A project was started in May to determine through observed feeding behavior the physical properties of artificial feeds most suitable for bangus culture. Physical properties of the feeds being tested are form (pellets, crumbles and meals), specific gravity (floating or sinking) and particle size. The different feeds are being tested on fish of different size groups. The project is expected to be terminated in September, 1972.

4. Bangus Production in Ponds with Lab-lab and Supplemental Feed (Bataan and Iloilo)

This study is composed of 2 projects being conducted at 3 different locations. Two are located in Orani, Bataan, on fish farms of Mr. Jose Batungbacal and Mr. Jose Legarda. The third is at the WVDFF Iloilo City.

5. Hito Production in Ponds at Four Densities (Quezon City)

This study is being conducted in four ponds of the UPCF, Quezon City. It is preliminary to more extensive studies in hito culture. The objectives are to determine optimum stocking density, rate of growth and feed conversion using IFP-1b pelleted feed.

The ponds are small, averaging 23.4 m^2 (range from 22.0 to 25.2 m^2) and with normal water depths of 50 cm.

Hito fingerlings averaging 28.9 g were stocked on February 28 as follows:

Pond no.	Area (m^2)	No. stocked /pond	No. stocked /m^2	No. stocked /ha (X100)	Kg stocked /pond	Kg stocked /m^2	Kg stocked /ha
1	25.2	252	10.0	100	7.1	0.3	2890
2	22.0	385	17.5	175	11.2	0.5	5058
3	23.2	580	25.0	250	16.8	0.7	7225
4	23.2	754	32.5	325	21.9	0.9	9393
Avg	23.4	493	21.3	213	14.3	0.6	6142

The fish are being fed daily with each day's ration divided into 2 equal portions: one portion is fed in the morning, the other in the afternoon.

The pond soils are rather porous and full water depth must be maintained by pumping from a deep well. However, the pump broke down on March 10 and has functioned for only one week from March 10 through June 30. Municipal water has been used during the period, but water depth has averaged only about 10 to 15 cm and on June 22 water depth was only 5 to 8 cm in the ponds.

The fish are being sampled at 30-day intervals to measure growth rate and for adjusting feeding rates. Limited analyses of water quality are being made.

After 120 days in culture the average weight of hito was only 69 g with no apparent difference in growth rate that could be attributed to treatment (density) effects. The fish have appeared to grow steadily throughout the culture. Condition has been good and no signs of disease have been observed. Feed conversion has been poor, but the feed is evidently nutritionally complete.

The project will likely be terminated in August.

Results of previous experiments indicate that supplemental feeding of newly stocked bangus fingerlings is not beneficial when lab-lab is abundant. It also appears that supplemental feeding could permit lab-lab to become reestablished following near depletion by bangus. This study was initiated to test these observations.

A total of 17 ponds are being used in the study. The study consists of 3 treatments:

1) Lab-lab as the only food source,
2) Lab-lab plus supplemental feed beginning soon after stocking bangus,
3) Lab-lab plus supplemental feed beginning after the lab-lab has been depleted (about 4 weeks after stocking). All ponds were prepared for production of lab-lab. After lab-lab was established, all ponds were stocked with bangus fingerlings at either 2000 or 5000/ha.

Specific information for projects at each location is summarized as follows:

Batungbacal Farm

1) 6 ponds ranging in size from 0.18 to 0 27 ha,
2) 2 replications of each treatment,
3) Stocked April 15 with fingerlings averaging 14.4 g, and
4) Stocked 5000/ha in ponds to receive feed, 2000/ha where no feed is to be used.

Legarda Farm

1) 5 ponds ranging in size from 0.76 to 0.94 ha,
2) 1 replication only of treatment for feeding beginning immediately after stocking - 2 replications each of other treatments,
3) Stocked April 15 with fingerlings averaging 12.2 g,
4) Stocked 5000/ha in ponds to receive feed, 2000/ha where no feed is to be used.

Western Visayas Demonstration Fish Farm

1) 6 ponds approximately 0.11 ha each,
2) 2 replications of each treatment,
3) Stocked May 11 with fingerlings averaging 6.7 g,
4) Stocked 5000/ha in each pond.

The study will be continued with monthly sampling for 120 to 150 days (August to October).

6. Bangus Production in Ponds with Plankton (Bataan)

The bangus is a filter-feeding fish and is probably planktophagic in its natural habitat. However, lab-lab (primarily benthos) is the principal food of bangus at most fish farms. A few farmers use lumut (filimentous algae) as bangus food, while even fewer farmers use plankton (deep-water method) as bangus food. Many farmers have reported trying the plankton or deep-water method of raising bangus, but were not satisfied with the results.

This experiment was originally designed to compare bangus production between ponds with phytoplankton and lumut as the primary food. However, after the project was underway, the lumut failed to become established and the experimental design was altered to compare two different stocking densities of bangus in ponds with plankton as the food source.

A total of 5 ponds ranging in area from 0.10 to 0.17 ha were provided for the study by Mr. Jose Legarda near Orani, Bataan. One pond was stocked on April 11 with 1000 fingerlings/ha; the other 4 ponds were stocked on May 28 with 1000 fish/ha in each of 2 ponds and 2000 fish/ha in the other 2 ponds.

The study will be continued until fish reach harvestable size or stop growing as determined by monthly sampling. Results will be used to design further experiments in the value of plankton to bangus production.

7. Bangus Production with Lab-lab Produced by Inorganic Fertilizers (Pangasinan)

Few fish farmers in the Philippines are using exclusively inorganic fertilizers to produce fish food in ponds. Probably no farmers are using phosphate only fertilizer. It is probable that inorganic fertilizer, and perhaps phosphate only, can be used as effectively as organic or organic-inorganic combination fertilizers for raising bangus in ponds.

This experiment is designed to compare an incomplete inorganic fertilizer (16-20-0) with phosphate only (0-20-0) and with a no-fertilization control. The farmer, Mr. Abesamis near Bani, Pangasinan, uses 16-20-0 or 18-46-0 fertilizer as a standard practice. The only organic fertilizers he has used in recent years has been grass cut from the pond dikes.

A total of 6 ponds ranging in size from 0.12 to 0.20 ha were selected for the study. Two ponds are fertilized with 16-20-0, 2 with 0-20-0 and 2 are receiving no fertilizer. Fertilizer was applied 2 weeks before stocking and at each subsequent 2-week interval at a rate of 45 kg/ha/application. After the initial application, which was broadcast

over the pond, all applications have been on platforms. The ponds were each stocked on May 16 with 3000 fingerlings/ha; the fish averaged 32.8 g each.

Fish in all ponds were sampled on June 14. The experiment is scheduled for termination about July 13.

8. Lab-lab Production with Individual and Combination Organic and Inorganic Fertilizers (Iloilo)

Pond fertilization in the Philippines, although practiced extensively, has not truly progressed past the trial-and-error stage. Fertilization practices may be grouped on a regional basis although each farmer seems to have his own preferred method. This study was designed to compare the lab-lab production effects of rice bran, chicken manure, 16-20-0 individually and in combinations.

Twelve cylindrical concrete tanks about 1 m^2 (m^3) are being used. Soil was taken from fishponds, dried, composited and packed into the tank bottoms to a depth of about 10 cm.

Fertilizers were applied singly or in combination at rates of 2000 kg/ha chicken manure, 600 kg/ha rice bran and/or 100 kg/ha 16-20-0 during the preparation period in mid-May. Six treatments with 2 replications each were prepared:

1) chicken manure only,
2) rice bran only,
3) 16-20-0 only,
4) chicken manure and rice bran,
5) chicken manure and 16-20-0, and
6) rice bran and chicken manure.

Daily observations of lab-lab growth are being recorded and periodic samples for qualitative and quantitative analyses are being made.

The experiment will continue for approximately 1 year (until about May, 1973). As one test is completed a new one will begin either repeating the previous test or starting a new one. Various fertilizers and their combinations will be tested. Different rates of fertilization will also be tested.

9. Determination of Length-Weight Relationships of Bangus and Other Fishes

Length-weight measurements are to be taken during fish-population sampling to establish a standard for comparing relative condition between populations. Collection of length-weight data began in December, 1971, and collecting is continuing. Approximately 5000 measurements have been collected on bangus, mostly on fingerling-sized fish. About 800 measurements have been recorded on hito.

The computer facilities at the University of the Philippines will be used to generate a length-weight regression formula for all the fish sampled. This formula will then be used to compute the typical weight of a fish at different lengths. The computer will also permit separate analysis of the length-weight relationship and relative condition factors for each sample of fish in each experiment, thus facilitating analysis. The computer program will receive additional samples as they are made.

10. Survey of Aquacultural Chemicals (Iloilo)

Aquacultural chemicals of various types are being used by fish farmers to control unwanted fishes, snails and other pests in fishponds. The farmers have little knowledge about which chemicals are most effective, what concentrations should be used or what after effects the chemicals might cause. For example many fish farmers are using endrin as an all-purpose pesticide without realizing that sub-lethal residual levels to fish may persist and adversely affect the fish population for an indefinite period.

A survey was begun in May to screen aquacultural chemicals to determine which chemicals would be most effective in controlling various pest organisms and what concentrations would be required. Also, the duration of residual toxicities are being measured by their effects on fishes, the pests and on fish-food organisms over time. Until now all the screening has been conducted under laboratory conditions using bio-assays. Final screening will be conducted in ponds under field conditions. Preliminary results have been obtained on the following:

1) Gusathion A (Bayer) - insecticide used as a molluscicide,
2) Lannate (DuPont) - insecticide used as an all-purpose pesticide,
3) Du-Ter (Philips-Dephar) - fungicide used as a molluscicide.

This project will continue indefinitely at various levels of activity.

11. Reaction of Bangus to Changes in the Physio-Chemical Conditions of Its Environment (Iloilo)

Bangus are subjected to numerous and varied changes in their environment during the period from collection in the sea to final harvest from the culture ponds. The environment is in constant change and while most of the changes are gradual some may be very rapid. Some examples are: the evaporation of water from culture ponds concentrating salts which may increase salinities to as much as 60 ppt in 3 to 4 months; on the other hand, a hard rain may dilute salinity by more than one-half in an hour or so; also, when stocking fish, a farmer may transfer fish directly from water of 35 ppt salinity to a pond of 70 ppt. Such changes in salinity, or similar changes in temperature, pH or other conditions, are sure to stress fish and may directly or indirectly result in fish kills or poor production.

Very little is known about the effects of environmental change in bangus. This study is designed to determine the tolerance range of various environmental factors. Bangus behavior will be studied to determine stress conditions. Acclimation periods to different environmental factors will be determined. Bioassays will be used for the studies.

Studies on bangus reaction to changes in salinity were begun in May. Preliminary results indicate that change from low to high salinity is more critical than change from high to low. Obvious stress was observed on bangus directly transferred to salinities 20 ppt above or below salinity of sea water (35 ppt).

This project will be in progress through FY-73.

12. Physio-Chemical Survey of Bangus Ponds and Other Selected Waters (Iloilo)

The physio-chemical conditions of the water have definite effects, directly or indirectly, on the biological productivity of ponds. These conditions are themselves affected by various factors such as soil, source of water, size and shape of ponds, water depth, meteorological conditions, density of fish and quality and quantity of vegetation. This dynamic interplay is difficult to define and often produces occurrences in ponds that are difficult to explain (i.e., fish kills, disease infestations and poor growth of fish and vegetation). Invariably, changes in water quality are looked upon for possible explanations.

The present study aims to accumulate, as extensively as possible, data and observations about the physio-chemical nature of water in ponds and their surrounding environment. The work initially consists of periodic field analyses of water salinity, pH, dissolved oxygen, free carbon dioxide, alkalinity, hardness, temperature, turbidity and rainfall.

This study began in March, 1972, and data collecting will be almost daily through March, 1973. Information on the physical and chemical conditions from day to day through this base year will be valuable in management and research planning.

13. Biological Survey of Ponds and Natural Waters (Iloilo)

Bangus culture as presently practiced in the Philippines depends on the natural organisms to provide food to fishes in ponds. The chemical and physical conditions of the environment dictate what organisms will be present. Culture practices also influence to a great extent the types and amounts of organisms produced in bangus ponds. This large group of organisms are described and referred to, in such gross terms as lab-lab, lumut, filamentous or non-filamentous algae, microscopic or macroscopic organisms, plankton and benthos. A pressing need exists for a more exact and scientific method of categorizing these food organisms.

A study was begun in April at the WVDFF to identify fish food organisms occurring in ponds, and also to study the different environmental conditions that bring about their occurrence and abundance. The study is designed to measure the efficiency of the organisms as food materials for bangus. Accumulated data may also reveal information relevant to studies on pond fertilization and other aspect of pond management.

At present, the work is being undertaken in connection with a pond experiment on the efficiency of benthic or lab-lab type of fish food and that of supplemental feeds in promoting bangus production. Activities involved are mainly periodical qualitative and quantitative assessments of fish food organisms in treated ponds. Similar observations shall be undertaken in ponds and natural waters at various localities in the vicinity of Iloilo City.

III. TRAINING PROGRAMS

A. Participants Training in the United States

Four participants were enrolled in the Graduate School of Auburn University in FY-72 to work toward a Master of Science in Aquaculture. Three of the students, Romeo D. Fortes and Arsenio S. Camacho of the University of the Philippines College of Fisheries, and Catalino dela Cruz of Central Luzon State University, began their graduate work in September, 1971. Rafael Guerrero, III, also of Central Luzon State University, enrolled in January, 1972. These four participants are expected to join the IFP staff by the end of FY-73.

B. Training Activities of the IFP Staff

A general seminar series on "Principles of Aquaculture" was presented by Dr. Schmittou at the UP College of Fisheries. Seven weekly meetings, open to students, staff and interested public, began January 17. Each seminar had an average attendance of about 45 participants (20 students, 15 staff and 10 private fish producers). Besides general material, special topics covered included different systems of aquaculture, yield trials, feeds and fertilizers. Because of interest, two additional get-togethers were held with members of the private sector to further explain aquacultural concepts. About 20 individuals attended each of the sessions.

A series of five seminars on research methods in aquaculture was conducted by Dr. Grover with the UP Institute of Fisheries staff. The seminars met weekly starting Janaury 31, and had an average attendance of 12. The requirements of good research were presented and model research proposals were developed.

Participant hours of formal training amounted to about 623 hours (248 staff-, 210 student- and 165 private sector- participant hours, respectively).

Dr. Schmittou was invited to speak to the Phi Sigma Society at the University of the Philippines. His topic, presented January 28, was "World Aquaculture and Its Relation to the Philippines."

On February 17, a half-day meeting was held with U.S. Peace Corps fisheries trainees in Dagupan City, where the IFP staff answered technical questions about fish culture. Subsequently, there has been informal exchange with the Peace Corps Volunteers working as fisheries extension specialists with the Philippine Fisheries Commission (PFC).

A two-day short course in aquacultural techniques was outlined for presentation by the IFP staff to PFC regional staffs. No dates for this have yet been set.

Staff members have visited fish-raising facilities around the country to keep in touch with current practices and offer their advice. During the reporting period, visits were made to the PFC demonstration fish farms at Molo, Tanay, Los Banos, Bay, Sta Cruz and Sabalo. Various private operations in eight provincial areas (Bataan, Bulacan, Iloilo, Mindoro Oriental, Nueva Ecija, Pampanga, Pangasinan and Zamboanga) were visited. Fish development activities in and around the areas of Lake Naujan, the Candaba Swamp, Laguna de Bay and Lake Sampaloc were also visited.

Special meetings were held with bankers and feed mill operators to explain the prospects for improved aquacultural methods.

A news release about participant training in the US was prepared and given to the press. A file of photographs showing project activities and construction progress was started for use in future publications and reports. Color slides were also made for use in seminars and classes.

IV. PROPOSED RESEARCH, TRAINING AND EXTENSION PLANS - JULY THROUGH DECEMBER, 1972

This proposal contains the planned research, training and extension activities of the Inland Fisheries Project (IFP) for the period from July 1 through December 31, 1972. The Brackishwater Fish Culture Research Station (Leganes, Iloilo) and the Freshwater Fish Culture Research Station (Central Luzon State University (CLSU), Munoz, Nueva Ecija) are referred to in this report as the Brackishwater Station and the Freshwater Station, respectively. Neither station will be ready for operation, but both will have working staffs in the areas of the stations at the beginning of the period. The staff of the Brackishwater Station will be based on the campus of the University of the Philippines, Iloilo, and the Western Visayas Demonstration Fish Farm of the Philippine Fisheries Commission, Iloilo City. The staff of the Freshwater Station will be based on the campus of Central Luzon State University.

A. Research Plans

The majority of research projects listed as proposed will actually be in progress on July 1. A total of 15 active projects were carried over from FY-72. Additional projects will be initiated as facilities are made available. Until the stations are functional, research projects will be limited to facilities used in cooperation with the public and private sectors.

Research facilities available beginning July 1 on three farms in the private sector include 15 ponds in Bataan and 6 ponds in Pangasinan. Those available in the public sector include 4 ponds at the University of the Philippines, Quezon City, 6 ponds and 28 concrete tanks at the Western Visayas Demonstration Fish Farm (Iloilo) of the Philippine Fisheries Commission, and a laboratory at the University of the Philippines, Iloilo. Other facilities are expected to be made available in the private sector for result demonstration projects that will serve purpose of extension as well as research.

Research emphasis will continue to be centered on pond fertilization and/or feeding of bangus (milkfish) and hito catfish. Research in the use of feeds in bangus culture will be secondary in priority to research in improving fertilization technology. Three major problems that must be solved before hito can be commercially cultured include:

1) Lack of know-how in reproduction and the raising of fry to stocking size;

2) Lack of a suitable feed and knowledge of hito nutritional needs; and

3) High disease incidence and mortality associated with the culture.

However, research projects on hito biology and culture have not been designed. A report entitled "A Literature Review on the Biology and Culture of Hito" was begun in May and is expected to be completed in September. In addition to this, Dr. John Grover will make a first-hand study of the cultural practices of hito in Thailand in July. Results of these reports will be used to design projects on such factors as reproduction, fry production, food habits, growth rates and parasite-disease control. The Institute of Fisheries Research and Development has achieved measurable success in hito reproduction. It is likely that studies replicating or expanding the Institute's studies, plus additional studies toward the development of hito culture, will be initiated in facilities at the Freshwater Station in October or November.

The following research projects will be conducted during the July-through-December period. Titles of the individual projects are presented under subject headings. Station staffs responsible for the projects are given in parenthesis as BS (Brackishwater Station) and FS (Freshwater Station). The dates of expected activity are also given in parenthesis.

Fertilizer and Fertilization

The standard practice of fish farmers is to apply a large initial amount of organic and/or inorganic fertilizers to the bottom soils to induce lab-lab growth, and not use any subsequent treatments to sustain growth. Research studies will be conducted to improve the standard practice with intentions of making fertilization more efficient, practical and productive. The studies include testing the feasibility of:

1) Replacing organic fertilizer entirely or in part by inorganic forms,

2) Using only phosphate fertilizer rather than other elements or combinations,

3) Reducing the initial application and making subsequent periodic applications throughout the culture,

4) Using platforms for all or some of the applications rather than apply the fertilizer directly onto the soil,

5) Inducing plankton rather than lab-lab as the primary food source for bangus.

The following list of resea·ch projects will be conducted during the July through December period:

1) Bangus Production with Lab-lab Produced by Inorganic Fertilizers (0-20-0 and 16-20-0) (FS, May to Dec.)

2) Lab-lab Production with Individual and Combination Organic and Inorganic Fertilizers (BS, May to Dec.)

3) Bangus Production in Ponds with Plankton (FS, Apr. to Aug.; BW, Jul. to Dec.)

It is anticipated that projects similar to each of the above will also be initiated at 1 or 2 additional farms in the private sector in Bataan and Iloilo.

Feeds and Feeding

The greatest yields of fish per unit area are necessarily achieved with feeds. Feeds are being developed and tested that can be used to supplement or to completely meet the dietary needs of pond fishes. Completed experiments toward this goal have contributed much to the knowledge of feeding bangus and hito. However, much is yet to be accomplished in developing an efficient and economical feed from locally available feed stuffs. The primary objective is to develop a base feed and then perfect its nutritional and physical quality from an economic-efficiency standpoint. This is a long-range goal. A base feed has been developed that is apparently nutritionally acceptable, but it is relatively expensive and its physical qualities have not been satisfactory, at least for bangus. The following studies will be in progress during the period:

1) IFP - Special Formula Fish Feed (BS and FS, Dec. 1971 through Dec. 1972)

2) Screening of Feed Stuffs (BS and FS, May through Dec.)

3) Bangus Production in Ponds with Lab-lab and Supplemental Feed (FS, Apr. to Aug.; BS, May to Aug.)

4) Bangus Feeding Behavior on Artificial Feed (BS, Jun to Nov.)

5) Hito Production in Ponds at Four Densities (FS, Mar. to Aug.)

Additional studies will be initiated in September after an evaluation of the above projects that terminate in August.

Biology of Aquacultural Species

Scientific knowledge on the biology of bangus and hito is incomplete, and the literature is vague and contradictory on many points pertinent to developing bangus and hito culture. Two disputed subjects concerning bangus that are very important in its culture are its basic feeding habits and its tolerance to various environmental factors.

Biological studies on bangus programmed for the six-month period are:

1) Reaction of Bangus to Changes in the Physio-Chemical Conditions of the Environment (BS, Jun through Dec.)

2) Determination of Length-Weight Relationships of Bangus and Other Fishes (BS and FS, Dec. 1971 through Dec. 1972)

3) Laboratory Study on the Feeding Habits of Bangus (BS, Aug. through Dec.; this study is independent of the project already mentioned entitled Bangus Feeding Behavior on Artificial Feed).

Similar studies are planned for hito.

Environmental Surveys

Surveys were begun in May to gather data on the bio-physio-chemical conditions in ponds and natural waters in Iloilo. The data is to be used as a basis for making future management decisions as well as for designing experiments. The projects are:

1) Physio-Chemical Survey of Bangus Ponds and Other Selected Waters

2) Biological Survey of Ponds and Natural Waters

3) Tidal Observations at the Brackishwater Station

The projects will continue indefinitely but at least until June, 1973, so that environmental conditions for a full year will be known.

Chemical Screening

Many different kinds of aquacultural chemicals, primarily pesticides, are being used by fish farmers. Little is known about the relative effectiveness, costs or possible adverse effects of the chemicals being used. One project will be in progress during the period to screen different chemicals with the objective of standardizing kinds and amounts of chemicals used. Criteria for selecting pesticides will include effectiveness, cost, residual and selectiveness. The project is: Survey of Aquacultural Chemicals (BS, May through Dec.)

Disease Studies

Disease is a major limiting factor to the production of all aquatic organisms in all culture environments. Controlling or preventing disease epizootics is a constant problem for farmers of some fishes. Consequently, the technology in disease control has developed to sophisticated levels for some cultures including those of trout and channel catfish in Europe and America. Nevertheless, disease continues to be a major factor limiting culture of these fishes in spite of the highly technical state of disease control. The cultures of hito and bangus are affected by disease. In hito culture in Thailand, disease causes an estimated average mortality of 40% per culture. Disease is much less serious in bangus culture. A survey of literature on bangus culture revealed no mention of disease. However, evidence of disease has been observed on bangus in ponds in Pangasinan, Bataan, Bulacan and Iloilo.

A survey of ecto- and endoparasites of bangus, hito and tilapia will begin in August. Also, a detailed study of epizootics occurring in fishponds will be made whenever possible to determine the organisms responsible. This study will include epizootics caused by bacteria as well as parasites. The projects are:

1) Survey of Ecto-and Endoparasites of Bangus, Hito and Tilapia (BS and FS, Aug. through Dec.)

2) Study of Bacterial and Parasitic Epizootics Occurring in Fishponds (BS and FS, Aug. through Dec.)

B. Training and Extension Plans

Training: No further attempts will be made to organize formal training activities until facilities at the stations become available. In the interim training sessions will be conducted about twice weekly with the technical staffs of both stations. Also, periodic training sessions will be held with the private sector.

Participants: Four participants are scheduled to begin graduate programs in the U.S. in September, 1972. These four will raise to eight the number of students working toward graduate degrees in aquaculture. A third set of four participants for graduate aquacultural training will be selected during FY-73 for enrollment in September, 1973.

Extension: No formal extension activities will be programmed for the period, but visits to fish farms will be made as frequently as possible. Cooperation with individual farmers through research projects will continue.

V. PROGRESS REPORT OF STATION CONSTRUCTION

The Amalgamated Project Management Services (APMS) officially began the design developments and other planning activities for construction of both stations on July 28, 1971. It was decided that development of each station would be divided into 3 phases with each phase constructed independent of the others. The primary reasons for this decision were the insufficient funds available to cover construction cost of the total facility, and to expedite construction in order that part of the stations could be put into operation at the earliest possible date. Working closely with the IFP staff the AFMS completed plans for the first phase of construction in early January, 1972. Advertisements for bids for drilling of the well and phase-one construction of each station were published on January 6 and 25, respectively.

A. Brackishwater Fish Culture Research Station (Leganes, Iloilo)

Well: Drilling of the 250-ft well began in May, and was completed in June without reaching water. Clearances were given to continue drilling for an additional 85 ft.

Construction: Phase one of the construction program began in May, but essentially nothing was accomplished until June 19. Beginning on that date, a labor force of approximately 200 men were engaged in excavation work on the 41 units of 500 m^2 ponds By June 30 these ponds were approximately 30% complete. The project engineer expects that excavation will begin on the 1000 m^2 ponds in mid-July and construction on one main gate (gate no. 2) by early August.

B. Freshwater Fish Culture Research Station (Central Luzon State University, Muñoz, Nueva Ecija)

Well: Drilling of the 500-ft well began in late March, 1972. Drilling was completed and permanent casing was installed in May. Grouting was completed in June. The well was ready for test pumping at the end of June. Water was first encountered at 16 ft. and water level in the finished well was also at 16 ft. The well is expected to supply the 400 gpm capacity that was desired.

Construction: Phase one of the construction program officially got underway on March 14, 1972. By the end of June the reservoir, the 33 units of 500 m^2 ponds and the 27 units of 1000 m^2 ponds were reported by the project engineer to be 80% complete. The drainage canals were 40% complete. Scheduled completion

dates for construction of phase one are programmed as follows:

Date	Item
Jul 25	Reservoir
Aug 9	500 m^2 ponds
Aug 24	1000 m^2 ponds
Aug 24	Canals
Oct -	Plumbing installations
Nov. 7	Pond trimming

The monsoon rains could alter the target dates.

Designs of phases two and three are complete but have not been programmed.