ECONOMICS OF AQUACULTURE, SEA-FISHING AND COASTAL RESOURCE USE IN ASIA

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RESOURCES PRODUCTIVITY IN MILKFISH CULTURE IN THE PHILIPPINES 1/

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Introduction

The total area of brackishwater ponds in operation in the Philippines is estimated at 176,000 hectares yielding approximately 100,000 metric tons of fish principally milkfish (*Chanos chanos*) or bangos. Among the objectives of the Philippines fishery development program are to attain self-sufficiency in fish and to optimize use of fish and other aquatic resources. To attain these goals government and private resources are directed toward increasing yields of production units both in capture fisheries and aquaculture; improving marketing and distribution systems; and promoting the use of appropriate technologies for aquatic resource development.

These strategies will be implemented to attain certain production targets which include a minimum of 5.5 per cent annual growth rate for the period 1977-81. Incremental production is expected to be contributed mainly by inland fisheries and aquaculture. Thus the proposed target growth rate is 10.8 per cent per year for aquaculture and 4.5 per cent for municipal or small-scale marine fisheries. A 5.5 per cent growth rate is expected for commercial marine fisheries.

Aquaculture is practiced on an extensive scale that yields per hectare had remained stable. Statistics from 1970 to the present show that increases in pond production have been due mainly to an increase in total acreage rather than an increase in productivity per unit area. While fishpond area had increased from 168 thousand ha in 1970 to 1976 thousand ha in 1973, yield per hectare had declined from 574 to 565 kilograms.

Fish farming in the Philippines dated back to hundreds of years ago and since then many researches particularly in milkfish have permeated into the industry. Yet, the

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1/ This paper is based on a research project of the author on a Socio-Economic Survey of the Aquaculture Industry in the Philippines, a joint project of the Southeast Asian Fisheries Development Center (SEAFDEC) and the Philippine Council for Agriculture and Resources Research (PCARR).

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country's average production is low compared to other countries. Research findings have evolved techniques that would increase yields up to 2,000 kilograms per hectare per year or even more. In fact, there are privately operated farms which are able to attain such high yield levels. Thus, the potential for increased production is great and efforts should be exerted to develop this potential. At present the national development plan emphasizes the improvement of existing fishponds rather than opening up new lands.

This paper would attempt to (1) assess the present technology in milkfish farms in the Philippines, (2) analyze resource productivity for various types of management, and (3) estimate costs and returns in producing milkfish.

Data were based on a survey of 1,175 sample bangos pond operators/caretakers covering 526 barrios from 40 provinces throughout the Philippines (Table 1). The largest regional sample was taken from Central Luzon which comprised 26 per cent of the total.

The Fishpond Operator and His Farm

Sex, age, and educational attainment. Almost all of the operators were male. Among the pond owners 94% were male while the corresponding proportion for caretakers was 99%. The average age of the owners was 52 years with the caretakers 6 years younger.

Majority of the operators received formal education, 96% for owners and 89% for caretakers (Table 2). On the average an owner operator reached third year high school while caretakers almost finished the elementary grade. More than one-third of the former had either reached or graduated from college and more than one-fourth had gone to high school. The proportion of owners who had no formal education was highest (9%) among small farms of less than one hectare. In fact, the years of schooling was directly proportional to the size of farm ranging from 6.1 years in small farms of less than one hectare to 11.7 years in large farms of 50 hectares or more. Further, among large farm owners 64% had gone to college and everyone had formal education. Among caretakers however, no such relationship existed. Nevertheless, caretakers managing farms larger than 10 hectares had higher educational attainment compared with those of smaller farms.

Table 1. Distribution of sample bangos fishponds by region.

Region	Size of sample		Geographical coverage of survey		
	Number	Per Cent	Provinces	Municipalities	Barrios
				number	
I. Ilocos	267	22.7	4	16	74
II. Cagayan Valley	11	0.9	1	5	9
III. Central Luzon	304	25.9	4	23	120
IV. Southern Luzon	119	10.1	6	19	56
V. Bicol	53	4.5	3	10	32
VI. Western Visayas	184	15.7	6	31	118
VII.. Central Visayas	87	7.4	2	15	40
VIII. Eastern Visayas	16	1.4	3	7	10
IX. Western Mindanao	42	3.6	3	5	23
X. Northern Mindanao	38	3.2	3	11	21
XI. Southern Mindanao	54	4.6	4	14	23
Philippines	1,175	100.0	40	156	526

Table 2. Educational attainment of the respondents.

Item	Pond-owner		Caretaker		Both	
	Number	Per cent	Number	Per cent	Number	Per cent
Did not study	32	4	42	11	74	6
Primary	109	14	120	31	229	20
Intermediate	138	18	102	26	240	20
High School	215	28	96	24	311	27
College	289	36	32	8	321	27
Average years of schooling		8.7		5.1		7.5

The Farm. Although more than one-half of the sample fishponds appeared after 1960, some were already operating before 1945 with the earliest starting in 1908 in Central Luzon. In Ilocos, about 11% were already operating before 1945. Within the decade of the 1960's 30% of the fishpond studies was developed and almost an equal proportion after 1970. In terms of total fishpond area, 3,872 hectares were operated after 1970. A little more than 4,000 hectares were developed during the 1960's and over 2,000 hectares during the 1950's. Only 725 hectares were operated before 1945.

Bangos fishponds were either owned, leased or both. Private ownership could be through purchase or inheritance while leasing could be from government or from a private individual. Among the sample farms, fifty-one per cent were owned, 46 per cent leased and 3 per cent was a combination of the two with an average proportion of 52% owned and 48% leased. Except for Bicol all regions in Luzon had more privately-owned fishponds than leased with the largest proportion of 91% in Cagayan Valley followed by Southern Luzon with 71%. In contrast, 77% of Bicol fishponds was leased. In Central and Eastern Visayas and in Western and Northern Mindanao more fishponds were leased than owned. In particular, 94% of fishponds in Eastern Visayas was leased.

The average farm area ranged from 4.9 hectares in Ilocos to 41 hectares in Western Mindanao and an average of 16 hectares for the country as a whole. However, portions of the farms still remained undeveloped. The non-operational area varied among regions with the smallest, 0.26 hectare per farm in Central Luzon and the largest, 44 hectares, in Eastern Visayas; an average of 2.66 hectares (17% of the farm) for the whole Philippines. The operational area ranged from 4.22 hectares in Ilocos to 38.92 hectares in Northern Mindanao. In addition the latter region had the biggest single operational area of 700 hectares.

By size group, about one-third of the fishponds had an operational area of 1-5 hectares, 15 per cent had one hectare or less (Table 3). Only 5 per cent had more than 50 hectares.

In the Philippines, operational area per farm averaged 13.39 hectares of which 11.32 hectares or 85% was used as rearing ponds, 1.41 hectares or 11% as transition ponds, 0.59 hectares, or 4% as nursery ponds and 0.07 or 1% as catching ponds. Six respondents, 3 in Central luzon, 1 in Southern Luzon and 2 in Eastern Visayas reported having feed ponds. Catching ponds were present in all samples averaging about 0.125 hectares per compartment. Percentage-wise there were more fishponds with catching pond in the

larger sized farms. In some regions, the fishpond water supply canals were used secondarily as catching ponds particularly in Western Visayas.

Table 3. Operational area of milkfish ponds.

Farm Size (has.)	Number	Per cent	Average Area (has.)
1.0 & below	178	15	0.62
1.0 – 5.0	392	34	2.83
5.0 – 10.0	192	16	7.59
10.01 – 20.0	201	17	14.56
20.01 – 50.0	153	13	31.11
More than 50	59	5	90.97
All Sizes	1,175	100	13.39

Cultural Practices

Pond Preparation. Regular checking of dikes for leaks and seepages, repair of gates and other accesories in the pond, cleaning, drying and levelling of pond bottom are among the various activities in preparing the pond for fish culture. These activities are done primarily to get rid of pests, predators and other nuisances, enhance the fertility of the soil to ensure luxuriant growth of natural fish food, and to effect free flow of water in and out of the fishpond system. Pond plowing is also an important activity in pond preparation for it brings the sub-surface nutrients to the surface, making it available for microbenthic organisms. Predators and other nuisances are also eliminated in this manner. General pond repair was usually done only when deemed necessary. It took about a month for a farm to undertake these activities.

Pest eradication. All sample fishponds reported having pests and predators of which fishes, lizard, water snakes, snails, frog, birds and astray animals were the most common species. Almost all (98%) operators practiced pest eradication. Of these, 73 per cent used pesticides either single or in combination. The most common pesticides used were Endrin, Brestan, Gusathion Aquatin and Tobacco dust. Endrin, Gusathion and Aquatin were used widely at the rate of 7.4, 9.5 and 12.4 ounces per hectare respectively, on the other hand, Brestan was used at the rate of 0.7 kg. per hectare while tobacco dust was used at the rate 126 kg. per hectare. On the average, treatment with pesticides lasted from 8 days (for Gusathion) to 12 days (for tobacco dust). Generally, ponds were treated only once per rearing period usually prior to stocking.

Fertilization practices Application of fertilizers was practiced by two thirds (67%) of the sample fishponds. Of these, 81 per cent used inorganic type while 47 per cent used the organic type of fertilizers. Fertilizers were used singly or in combination (Table 4).

Table 4. Use of fertilizer in bangos fishponds by region.

Region	Applied Fertilizer				Proportion Using		
	Yes		No		Organic	Inorganic	Combination
	Number	Percent	Number	Percent	Fertilizer	Fertilizer	
I. Ilocos	186	70	81	30	4	82	14
II. Cagayan Valley	8	73	3	27	38	24	38
III. Central Luzon	240	79	64	21	26	42	32
IV. Southern Luzon	45	38	74	62	40	42	18
V. Bicol	30	57	23	43	73	17	10
VI. Western Visayas	162	88	22	12	8	40	52
VII. Central Visayas	45	52	42	48	13	76	11
VIII. Eastern Visayas	3	19	13	81	33	67	–
IX. Western Mindanao	14	33	28	67	57	29	14
X. Northern Mindanao	12	32	68	26	58	25	17
XI. Southern Mindanao	39	72	15	28	8	74	18
Philippines	784	67	391	33	19	53	28

The organic fertilizers used were chicken, stable and hog manure, guano, compost, rice bran, night soil, mudpress (refuse from sugar mollasses) and Sagana 100. Of these, chicken droppings was most widely used in all regions except in Bicol where hog manure and guano were more predominantly used. Compost and Sagana 100 were used in only two regions: compost in Ilocos and Western Visayas and Sagana 100 in Ilocos and Central Luzon. Rice bran was used in Cagayan Valley and Southern Mindanao while night soil and mudpress were used only in Western Visayas.

On the average, the quantity of chicken droppings used per hectare was 31 sacks (Table 5). It ranged from 2 sacks per hectare in Cagayan Valley to 115 sacks per hectare in Southern Mindanao. Stable and hog manure was used at the rate of 13.5 sacks per hectare and guano at 5.1 sacks per hectare. Sagana 100 which was available commercially from fertilizer dealers was used in three regions only, namely: Ilocos, Central Luzon and Southern Mindanao applied at an average rate of 67 kg. per hectare.

Majority of the operators preferred the incomplete type of inorganic fertilizer specially the nitrogenous – phosphorus to the complete type. Nitrogenous fertilizer was applied at the rate of 3 kg. of N per hectare in Cagayan Valley to 36 kg. in Eastern Visayas or an average of 24 kg. The nitrogen – phosphorus type was applied at 11 and 16 kg. per hectare respectively. Complete fertilizer on the other hand, was applied at 40 kg. of nutrients per hectare distributed as follows: 13N, 20P and 7K. Note that nitrogenous fertilizer was applied at a higher rate than either phosphorus and potassium despite the finding of the U.P. Inland Fisheries Project that phosphate deficiency and not nitrogen is the limiting factor for the growth of natural food in fishpond [3]/ However, in the nitrogen-phosphorus type, phosphorus was applied at a higher rate than nitrogen. Agricultural lime is primarily used as a soil conditioner. Applied in the right proportion, lime corrects the acidity and prevents pH fluctuation in fishponds.[4]/

3/"Bangos: King of the Fishponds". Greenfields vol. 3, no. 6, pp. 10-11.

4/The Philippines Recommends for Bangos, 1976, p. 8. Lime also prevents the build-up of excessive magnesium, sodium and potassium ions toxic to aquatic life and promotes the release of nutreints. When applied in ponds with water, it precipitates suspended materials which hamper light penetration, noxious ions in soiutions and other putrescible organic matter. It also reduces incidence of diseases.

Table 5. Rate per hectare of fertilizer used in bangos fishpond, Philippines, 1974.

Type of fertilizer	REGION I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Phil.
Number reporting	186	8	240	45	30	162	45	3	14	12	39	784
Organic												
Chicken manure (sack)	16	2	32	32	10	36	11	11	6	28	115	31
Stable and hog manure (sack)	10	2	13	2	8	18	77	–	–	–	–	11
Guano (sack)	2	–	20	3	9	2	13	–	13	53	–	5
Rice bran (kg.)	–	–	345	–	–	–	–	–	–	–	–	345
Sagana 100 (kg.)	9	–	100	–	–	–	–	–	–	–	95	67
Inorganic (kg.)												
Nitrogen (N)	16	3	21	37	12	30	32	36	–	11	16	24
Phosphorus (P)	14	–	–	9	–	–	–	–	–	–	40	13
Nitrogen-Phosphorus												
N	13	8	5	10	12	13	9	–	2	10	18	11
P	16	10	7	13	15	21	17	–	3	12	22	16
Nitrogen-Potassium												
N	7	–	–	–	–	–	–	–	–	–	–	7
K	7	–	–	–	–	–	–	–	–	–	–	7
Complete (N-P-K)												
N	6	–	14	2	–	14	8	–	11	a/	11	13
P	6	–	14	–	–	23	7	–	11	a/	22	20
K	6	–	14	–	–	8	7	–	11	a/	4	7
Agricultural Lime	–	–	–	–	–	2,600	–	142	–	–	–	878

a/ Less than 0.5 kilogram.

The Philippines Recommends for Bangos 1976 reports that the platform method is the most efficient and effective method of applying fertilizers. This method saves from 20-40% of fertilizer compared with broadcasting or spreading method. However, only 2% of the fishponds used this method. The most common practice of fishpond operators was to spread the fertilizer on watered or wet pond surface as reported by 60% of the fishponds. Broadcasting was practiced by 46%.

Feed growing. There are different ways of growing fish food as there are different types of feed (lab-lab, lumut and plankton) grown in fishpond. However, good pond preparation is a pre-requisite for obtaining good growth of fish food.[5/] It was found that majority of the operators (18%) did not renew water during feed growth. Only 19% changed water in the pond during this period. It is interesting to note that the present practice of bangos fishpond operators of maintaining a 19-cm. water level during feed growth was almost the same as the recommended level for growing lab-lab. It was only in Cagayan Valley which had exceptionally deep water level being more than the national average.[6/]

5/For lab-lab growing ponds, water just enough to cover the pond bottom should be allowed in the pond at the beginning till lab-lab develops and thickens. The water should then be gradually increased to about 20 cms. and maintained at that height. An abrupt increase in water level cause lab-lab to lose attachment from the pond bottom. Lumut and plankton-growing fishponds on the other hand, need a deeper water than lab-lab. Water freshening is a recommended practice to obtain a luxuriant growth of fishfood.

6/The type of food grown in fishpond was not determined during the survey.

Finally, before stocking, it is necessary to determine the sufficiency of natural food in the pond to ensure a good start for the young bangos. Most of the respondents determined the sufficiency of natural food in their ponds by mere ocular inspection. Secchi disc (an instrument for measuring the thickness of plankton in water) water) was used by only two respondents for this purpose, specifically in Western Visayas. Nonetheless, nine per cent did not know or just did not bother determining whether natural food was sufsufficient or not.

Supplementary feeding. Supplementary feeding is a necessity whenever (1) the pond runs short of natural food supply, (2) accelerated growth of the fish is desired, and (3) when the fry are still unable to utilize the food available in the pond.

Twenty six per cent supplemented the natural food in the pond. The practice was most predominant (64%) in Cagayan Valley. Bicol on the other hand, had the least proportion, 6%. Most of the larger sized farms practiced supplementary feeding.

The most common supplementary feed used in bangos fishponds was rice bran (Table 6). Rice and corn bran were fed at the rates of 191 and 137 kg. per hectare, respectively. Breadcrumbs were fed at the rate of 235 gantas per hectare while egg yolk (for fry in nursery pond) was fed at the rate of 16 pieces per hectare. A few others used other types of feeds such as copra meal, hogmash, powdered milk, dried lumut, gulaman, rice straw, ipil-ipil leaves and chicken manure. Moreover, 3 respondents used mixtures of feeds. The first used rice bran-aurofac combination at 2:1 by weight; the second used one tablespoon of acepelyn (a vitamin concentrate in powdered form) to 4 kerosene cans of rice bran; and the third used equal volumes of rice bran and chicken manure.

Stocking practices. In the Philippines, ponds are stocked with fry, fingerlings or both. Seventy one per cent stocked fry while only 36 per cent used fingerlings. Five regions: Cagayan Valley, Central and Eastern Visayas and Western and Southern Mindanao reported having all sample ponds stocked with fry. Nevertheless, more farms in Central and Southern Luzon stocked fingerlings, having 81 and 58 per cent, respectively. These are the regions where many of the nursery ponds are located.

To a little extent, the choice of whether to stock fry or fingerlings depended on farm size. More of bigger farms had to stock fingerlings for stocking.

Ninety four per cent of the fishponds purchased fry or fingerlings (Table 7). Of these, 68% purchased fingerlings and the rest purchased both. Others who did not purchase stock either gathered their own fry or that fry entered the pond with tidal water. Sources of fry were mostly from other provinces as reported by 41%. Four sources were manifested in Eastern Visayas and Central Luzon. On the other hand, the usual sources of stock in Bicol, Ilocos, and Central Visayas were within the provinces.

The amount of fry stocked in the farm was about 70 thousand pieces equivalent to 6.21 thousand per hectare of rearing area. Two-fifths of the farm stocked fry at a rate of 1,000 to 4,000 pieces per year while one-fourth used a rate of 5,000 to 9,000.

The quantity of fry/fingerlings that can be stocked depends on food, carrying capacity of the ponds, and the size of fish desired by farmers. Variations were therefore expected in the stocking density. On the average, a farm required more than 46 thousand fingerlings per year, 3.91 thousand per hectare.

Table 6. Types and rate of supplementary feeding in bangos fishponds, 311 fishponds.[a/]

		No. of fish-ponds	Rice Bran			Bread Crumbs			Eggs			Corn Bran			Others[b/]
			Rate (kg.)			Rate (ganta)			Rate (pcs.)			Rate (kg.)			
			Per-cent	Per pond	Per ha.	Per-cent	Per pond	Per ha.	Per-cent	Per-pond	Per pond	Per-cent	Per pond	Per ha.	Per-cent
13															
I.	Ilocos	31	90	282	215	–	–	–	–	–	–	–	–	–	13
II.	Cagayan Valley	7	100	300	125	–	–	–	–	–	–	–	–	–	14
III.	Central Luzon	112	81	1,669	178	21	2,951	249	–	–	–	–	–	–	3
IV.	Southern Luzon	40	88	537	273	8	217	60	–	–	–	–	–	–	12
V.	Bicol	31	100	867	1,429	–	–	–	–	–	–	–	–	–	–
VI.	Western Visayas	60	77	292	244	5	321	161	5	32	21	12	243	102	3
VII.	Central Visayas	12	58	301	215	8	560	80	17	8	3	25	283	2,225	9
VIII.	Eastern Visayas	2	50	25	33	50	20	13	–	–	–	–	–	–	–
IX.	Western Mindanao	14	57	104	120	–	–	–	21	8	17	–	–	–	–
X.	Northern Mindanao	17	65	266	249	–	–	–	–	–	–	6	14	9	–
XI.	Southern Mindanao	13	69	163	138	–	–	–	23	19	127	15	25	90	16
	Philippines	311	79	828	191	10	2,260	235	4	18	16	4	201	137	3

a/ Total percentage may not equal 100 since some respondents used more than 1 type.

b/ Includes copra meal, hogmash, powdered milk, dried lumot, gulaman, rice straw, ipil-ipil leaves, aurofac, chicken manure.

Rearing practices. Bangos fry is stocked in nursery ponds for about 45 to 60 days, after which fingerlings should be thinned out or transferred to a bigger pond with deeper water to provide the fish with greater water space and sufficient amount of natural food. This pond may be a transition pond or rearing pond. Transition pond may serve as a reserved pond ("bansutan") for stunting fingerlings needed for the next rearings or as a transitory pond ("impitan") as an intermediary pond for gradual conditioning of fingerling to rearing pond.

Table 7. Sources of stock in fishpond by region, Philippines.[a/]

Region	Number of farms	Gathered own fry		Purchased		Free Entrance		Given	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent
I. Ilocos	267	11	4	255	96	2	1	2	1
II. Cagayan Valley	11	3	28	8	73	–	–	–	–
III. Central Luzon	304	8	3	297	98	–	–	–	–
IV. Southern Luzon	119	5	4	110	92	4	3	2	2
V. Bicol	53	7	13	47	89	1	2	2	4
VI. Western Visayas	184	9	5	179	97	1	1	2	1
VII. Central Visayas	87	11	13	74	85	2	2	–	–
VIII Eastern Visayas	16	–	–	14	88	2	12	–	–
IX. Western Mindanao	42	2	5	39	93	1	2	–	–
X. Northern Mindanao	38	6	16	32	84	–	–	4	11
XI. Southern Mindanao	54	4	7	51	94	–	–	–	–
Philippines	1,175	66	6	1,106	94	18	1	12	–

[a/] Total percentage may not equal 100 since some respondents reported more than 1 source.

Of the farm having transition ponds, 36% maintained it for stock transfer ("bansutan"), the remaining used it as "impitan". The post fingerlings or "garongin" are finally transferred to rearing ponds where they grow to marketable sizes. The average depth of water maintained during the rearing period ranged from 0.8 m. in Bicol to 1.2 meters in Central Visayas with an overall average of 0.9 m. In all compartments the water should be freshed to ensure good water quality suitable for growth of natural food consequently good growth of fish. In rearing ponds, the frequency of changing water ranged from one to more than ten times. However, a few operators reported that they did not change the water during the entire rearing period.

A rough estimate of mortality rate of fry from source to harvesting was about 45%, the highest rate was 74% and the lowest, was 26%. On the other hand, fingerlings had an average mortality rate of 39% from source to harvesting, highest at 67% and lowest at 21%.

Mortality was caused by a number of factors the more prevalent of which were: (1) occurrence of typhoon, (2) presence of predators, (3) insufficiency of natural food, (4) depletion of oxygen supply due to decomposition of organic matter in the pond, (5) and overstocking. During the culture period, natural calamities such as typhoon and flood also occur, in which case precautionary measures must be employed to avoid heavy damage on the fish as well as on the fishpond. The common practice was reinforcing dikes and gates with bamboo poles staked at both sides of dikes and gates. Some opera-

tors open water outlets and inlets to equalize the pressure inside and outside the pond. Still others install bamboo screens in areas of the dike that are low and weak to prevent the fish escape.

Production Rates and Costs and Returns Analysis

This section presents the rates of production, both in physical and monetary terms for various cultural practices and factors such as size of farm and type of farm ownership. Comparison is based on averages and no statistical test of significance was made. Production covers a one-year period and refers only to milkfish, that is, even if other fishes had been produced (but not stocked purposively) those were excluded. In computing the productivity per hectare only the rearing area cropped during the year was considered.

In general milkfish production per farm is directly related to the rearing area harvested during the year. The lowest production per farm was therefore observed in the Ilocos region and the highest production in Northern Mindanao. The national average production amounted to 6,484 kilos of bangos per farm per year.

The regional ranking of productivity per hectare presents a different picture. The highest production per hectare was obtained by Western Visayas (903 kilos) followed by Ilocos (709 kilos), Central Luzon (611 kilos) and Southern Mindanao (516 kilos). Regions which may be considered of medium productivity are Cagayan Valley, Southern Luzon and Eastern Visayas and Northern Mindanao. Low productivity regions are Bicol, Central Visayas, and Western Mindanao. The national production per hectare averaged 580 kilos. 7/

Table 8. Annual cropping rate per farm and per hectare, 1,092 bangos fishponds.

Region	Number	Rearing Area	Quantity Produced	
			Per Farm	Per hectare
		has.	*kilos*	
I. Ilocos	249	3.26	2,307	709
II. Cagayan Valley	10	10.28	3,402	330
III. Central Luzon	268	17.34	10,608	611
IV. Southern Luzon	114	4.94	2,323	471
V. Bicol	52	9.21	2,391	260
VI. Western Visayas	178	13.17	11,888	903
VII. Central Visayas	81	4.87	1,407	289
VIII. Eastern Visayas	15	33.33	10,613	318
IX. Western Mindanao	37	17.28	2,921	168
X. Northern Mindanao	35	34.98	13.988	399
XI. Southern Mindanao	53	9.23	4,769	516
Philippines	1,092	11.17	6,484	580

With these yields, an average bangos fishpond realized a gross income of about ₱30,953 or ₱2,294 per hectare, 98% of which was cash and 2% non-cash (Table 9). A wide variability in total farm receipts was observed among the regions. Per farm, it varied from ₱5,723 in Central Visayas to ₱53,066 in Northern Mindanao. The latter had the biggest farm size of 38.92 hectares. Per hectare receipts ranged from ₱701 in Western Mindanao to ₱3,625 in Ilocos.

7/ This is only for milkfish. Other fishes like tilapia, shrimps, crabs, etc. have entered the ponds. An average bangos pond harvested about 65 kilos of other fishes per hectare.

Table 9. Farm receipts in bangos fishpond by region, 1974.

Item	REGION I	II	III	IV	V	VI	VII	VIII	IX	X	XI
					pesos per farm						
Cash Receipts											
Fishes stocked sold	14374	16422	51340	9273	10438	46782	5429	45432	12467	51684	27126	29762
Other fishes sold	627	1720	735	325	318	226	32	177	419	346	–	459
Other cash receipts	11	–	23	–	–	33	–	–	–	–	–	13
Sub-total	15012	18142	52098	9598	10756	47041	5461	45610	12886	52030	27126	30234
Non-cash receipts												
Value of fish used at home	181	416	175	154	194	436	76	716	339	501	327	343
Value of fish given away	117	88	165	69	124	766	94	194	107	514	339	263
Change in inventory	–	–	182	–	–	890	–	–	41	–	286	173
Other non-cash receipts	8	–	14	13	8	146	92	–	3	21	315	53
Sub-total	306	504	536	236	326	2238	262	910	490	1036	1267	719
Total receipts	15318	18646	52634	9834	11082	49279	5723	46520	13376	53066	28393	30953
					pesos per hectare						
Cash receipts *Cash receipts*											
Fishes stocked sold	3401	1599	2455	1588	971	2857	972	1261	653	1328	2288	2206
Other fishes sold	149	167	35	55	30	14	6	5	22	9	–	34
Other cash receipts	2	–	1	–	–	2	–	–	–	–	–	–
Sub-total	3552	1766	2491	1643	1001	2873	978	1266	675	1337	2288	2241
Non-cash receipts												
Value of fish used at home	43	41	8	27	18	27	13	20	18	13	27	18
Value of fish given away	28	9	18	12	11	46	17	6	76	12	29	18
Change in inventory	–	–	9	–	–	54	–	–	2	–	24	13
Other non-cash receipts	2	–	1	2	1	9	17	–	a	1	26	4
Sub-total	73	50	26	41	30	136	47	26	26	26	106	53
Total receipts	3625	1816	2517	1684	1031	3009	1025	1292	701	1363	2394	2294

a/ a less than ₱0.50.

Table 10. Expenses per hectare of bangos fishpond by region, 1974.

Item	REGION											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Phils.
	pesos per hectare											
Cash expenses												
Stock of fry/fingerling bought	470	120	651	321	90	473	113	159	83	242	274	447
Fertilizers bought	293	50	138	86	26	638	90	15	4	38	230	220
Chemicals	31	17	16	14	2	94	15	2	15	4	47	32
Supplementary feeds	21	37	38	23	2	4	3	a/	1	1	1	18
Hired labor	238	326	271	195	146	270	226	124	56	169	667	250
Value of commission	967	46	239	245	125	116	40	171	92	30	145	179
Food for laborers	14	57	7	13	6	16	18	1	8	7	7	10
Ice	15	—	1	6	1	10	5	2	—	—	14	5
Equipment purchased	37	8	32	12	13	108	18	6	21	17	73	44
Lease	133	—	282	64	11	53	10	7	6	5	15	135
Interest on borrowed capital	125	17	16	4	—	30	1	3	6	10	6	16
Miscellaneous	74	32	76	18	34	178	25	38	18	10	127	81
Sub-total	1718	710	1767	1001	456	1990	564	528	328	533	1606	1437
Non-cash expenses												
Fry gathered/given free	3	8	a/	2	3	6	12	1	1	4	2	2
Unpaid family labor (exchange)	50	103	7	11	24	10	63	a/	19	8	3	15
Change in inventory	8	51	—	16	3	—	2	8	—	1	—	—
Other non-cash expenses	2	a/	1	2	1	9	17	—	a/	1	27	4
Sub-Totals	64	162	8	32	31	25	94	9	20	14	32	21
Total expenses	1782	872	1775	1033	487	2015	658	537	340	547	1638	1458

a/ Less than ₱0.50.

Table 11. Annual costs and returns per bangos fishpond by region, 1974.

Item	REGION I	II	III	IV	V	VI	VII	VIII	IX	X	XI	Phils.
						pesos per farm						
Farm receipts												
Cash	15012	18142	52098	9598	10755	47041	5461	45610	12886	52030	27126	30234
Non-cash	306	504	536	236	326	2238	262	910	490	1036	1267	719
Total	15318	18646	52634	9834	11082	49279	5723	46520	13376	53066	28393	30957
Farm expenses												
Cash	7261	7286	36947	5846	4904	32598	3150	19008	6114	20746	19059	19390
Non-cash	272	1672	162	186	338	402	528	298	380	558	387	280
Total	7533	8959	37109	6032	5242	33000	3678	19306	6494	21304	19437	19670
Net cash farm income	7751	10856	15151	3751	5851	14443	2311	26601	6773	31284	8076	10844
Non-cash farm earnings	34	(-1168)	374	50	(-11)	1836	(-266)	613	109	478	880	439
Net farm earnings	7885	9688	15525	3802	5840	16279	2045	27214	6882	31762	8956	11283
						pesos per hectare						
Farm receipts												
Cash	3552	1766	2491	1643	1001	2873	978	1266	675	1337	2288	2241
Non-cash	73	50	26	41	30	136	47	26	26	26	106	53
Total	3625	1816	2517	1684	1031	3009	1025	1292	701	1363	2394	2294
Farm expenses												
Cash	1718	710	1767	1001	456	1990	564	528	320	533	1606	1437
Non-cash	64	162	8	32	31	25	94	9	20	14	32	21
Total	1782	872	1775	1033	487	2015	658	537	340	547	1638	1458
Net Cash Farm Income	1834	1056	724	642	545	883	414	738	355	804	682	804
Non-cash farm earnings	9	(-112)	18	9	(-1)	111	(-47)	17	6	12	74	32
Net farm earnings	1843	944	742	651	544	994	367	755	361	816	756	836

To operate a bangos fishpond an annual cash operating capital of ₱19,390 per farm or ₱1,437 per hectare is needed (Table 10) On the whole the four major items of expense were the cost of stock - 31%, hired labor - 17% fertilizer -- 15%, and value of commission 12% of the total cost. Among the regions, fishponds in Western Visayas were the most capital intensive requiring about ₱2,015 per hectare for one year. Thus, it costs about ₱2,23 to produce a kilo of bangos in this region For all regions it costs about ₱2.51 to produce a kilo of bangos.

The cash profit earned was ₱10,844 per farm of ₱804 per hectare per year (Table 11). The non-cash income, in comparison was small amounting only to ₱439 per farm or ₱32 per hectare. Net income which represents the difference between gross income and gross expenses, amounted to ₱11,283 per farm or ₱836 per hectare. In other words, a bangos in Ilocos was high. it ranked second only to Western Visayas. Even with the pond.

The per hectare net cash income and total earnings obtained by the Ilocos farmers were exceptionally high compared to the other regions. Although the average yield of bangos in Ilocos was high, it ranked second only to Western Visayas Even with the high highest yield, Western Visayas obtained a total net income of only ₱994 per hectare al most one-half that of the earnings in Ilocos Price received for bangos could be one of the major factors which explain lower gross receipts in Western Visayas Ilocos operators could easily avail of market in Metro Manila which offer better prices for bangos

Low income levels were obtained in Bicol, Central Visayas and Western Mindanao Correspondingly these were the 3 regions with the lowest yield

The net farm earnings per hectare of the 1 148 fishpond operators were grouped into 9 income classes The distribution of operators among income classes was skewed to the right with more than one third concentrated in the 1,000 and below income class Fifteen per cent and 16% had incomes of ₱1,999 to ₱1,999 and ₱2,000 to ₱3,999 respectively Several operators obtained net profit of ₱4,000 per hectare or more of which the highest amounted to ₱25,283 per hectare in Central Luzon

Productivity Comparison by Use of Purchased Inputs

Variation in yields was noted in fishponds among regions and within regions This variation could probably be explained by differences in inputs used and management Thus, Tables 12 and 13 try to compare the yields costs and returns for farms using and not using purchased inputs such as fertilizer supplementary feeds and chemicals

By use of fertilizer. On a per farm basis an average fertilizer-using farm harvested 8,322 kilos of milkfish during the year compared with non-users who obtained only 2,850 kilos or one-third of the former (Table 12) The fertilizer-users however have two hectares more area than the non-users. On a per hectare basis, fertilizer-users obtained higher yields, 686 kilos compare to 308 kilos for the non-users. It seemed that those applying both organic and inorganic types realized higher yields (844 kg./ha.) than those using only one type Those using inorganic fertilizers produced 623 kilos while it was 570 kilos for organic fertilizer

It is evident that the use of fertilizer pays off Fertilizer using farms profited by about 46% more than those which did not apply fertilizer The additional cost of fertilizer was more than compensated by a greater production and therefore, income.

The use of inorganic fertilizers generated more income compared with the organic or both types of fertilizers. However, among these three farm groups, highest gross return was reported in the latter amounting to ₱2,914 per hectare Coupled with the high gross returns was high operating expenses resulting in a low rate of return (37%) to operating capital.

By use of supplementary feeds and pesticides. Supplementary feeding was practiced by 30% of the respondents. These farms obtained a higher production of 653 kilograms per hectare than those who did not use supplementary feeds (540 kilos) (Table 13). The two groups of farms differed by about 118 kilos.

Table 12. Yield, costs and returns per hectare of milkfish farm by use of fertilizer.

Category	Number of farms	Yield	Gross Receipts	Gross Expenses	Net Returns
		kilos		*pesos per hectare*	
Did use fertilizer	725	686	2,668	1,755	913
Organic	129	570	2,358	1,760	598
Inorganic	394	623	2,628	1,473	1155
Both types	202	844	2,914	2,123	791
Did not use fertilizer	366	308	1,270	646	624
All Farms	1,091	580	2,294	1,458	836

Table 13. Yield, costs and returns per hectare by use of supplementary feeds and pesticides.

Item	Number of farms	Yield ha.	Receipts	Expenses	Net Returns
			pesos per hectare		
Use of supplementary feeds					
Used	323	658	2,711	1,744	967
Did not use	769	540	2,067	1,304	763
Use of pesticides					
Used	729	664	2,514	1,726	788
Did not use	313	379	1,802	854	948

It is apparent from Table 13 that supplementing the natural food by artificial feeds subtantially increased fish production and consequently the income generated. Users of supplementary feeds obtained a net income of ₱967 per hectare, 27% higher than that of the non-users.

The use of pesticides to eradicate pests substantially increased the level of production as indicated by the yields of farms using pesticides which was 688 kilos/ha., a difference of 338 kilos over farms not using chemicals. However, the marginal increase in yield was lower than the incremental change in operating costs. Thus, the earnings of farms using pesticides was lower by 17% compared to the non-users. Those using pesticides spent about ₱2.60 to produce a kilo of fish while it was ₱2.20 without the use of these chemicals.

The use of pesticides resulted in a higher profit in most regions except in Cagayan Valley, Central Luzon, and Bicol. In Cagayan Valley and Bicol, the use of manual labor ("catch and kill") rather than pesticides to eradicate pests and predators proved to be more effective in terms of both production and profit. In Central Luzon, on the other hand, users of pesticides incurred high operating cost so that the resulting higher receipts did not do much to increase the net income.

Productivity by type of stock The farms were classified into three catagories according to type of seeds used, that is, fry, fingerlings, or both fry and fingerlings. Productivity of ponds stocked with fry was only 8 kilos per hectare larger than those stocked with fingerlings (Table 14). However, fingerlings stocked farms obtained the highest gross returns amounting to ₱35,357 per farm of ₱2,250 per hectare. This was higher by ₱368 and ₱383 per hectare of the returns from fry and both fry and fingerling stocked farms. This could probably be explained by the fact that rearing period is shorter when fingerlings are used thus more rearings could be had in one year.

Fingerlings required a bigger amount of capital than fry to raise then to marketable size. A farm stocked with pure fingerlings needed about ₱26,264 per farm or ₱1,907 per hectare cash operating capital. The least expenditure was incurred by pure fry stocked farms, ₱1,215/ha. more than one-third lower than in fingerling-stocked farms. Thus the former also received the highest net returns among the three groups.

The annual quantity of bangos fry stocked per hectare of fishpond ranged from less than one thousand to more than 15 thousand. Among farms stocking pure fry, 9% had less than 1,000 pieces, 42% had 1-4 thousand; and 11% had more than 15,000. Gross receipts and expenses generally increased with an increased in the quantity of stock (Table 15). With receipts increasing faster than expenses, net returns likewise increased.

Productivity by size of farm A direct relationship existed between yields per farms and size of farm. On the Other hand, yield per hectare was inversely related to farm size for farms five hectares and above (Table 16). The highest yield per hectare was derived from farms with sizes of 5 to 10 hectares.

The total receipts, expenses, and net income per farm generally increased with farm size. However, on a per hectare basis, these measures increased from the smallest to the farm size group of 5-10 has. then started to decline as the farm becomes larger.

The annual receipts per farm among farm size groups increased at an increasing rate from 1 ha. and below to 5-10 has., then continued increasing but at a decreasing rate. Thus, although the highest total receipts per farm of ₱179,570 was realized in the biggest farm size group, its gross return per hectare was the lowest amounting only to ₱1,968. This was even 14% lower than the national average. Correspondingly, these farms had the lowest annual production of bangos per hectare among the six farm size groups

Comparatively, the operational expenses per hectare were higher in the three smaller size groups than in the bigger farms. It costs more to operate a hectare of a small farm than a big farm.

Highest net return was obtained by farms of 5 to 10 hectares.

Table 14. Yield, costs and returns per hectare by type of stock.

Type of Stock	Number of farms	Yield/ Ha.	Receipts	Expenses	Net Returns
Fry	713	585	2,179	1,215	964
Fingerlings	305	619	2,550	1,907	643
Both	73	544	2,167	1,683	484

Table 15. Costs and returns per hectare by fry stocking density.

Quantity of Fry Stocked/ Hectare	Yield/ Ha.	Gross Receipts	Gross Expenses	Net Returns
thousand pieces	*kilos*		*pesos per hectare*	
Less than 1	134	527	548	21
1 – 4	334	1,929	764	1,165
5 – 9	828	2,970	1,570	1,400
10 – 14	827	2,989	1,961	1,028
15 & above	1,899	4,356	2,896	1,960

Table 16. Yield, costs and returns per hectare by size of farm.

Size of Farm	Number of Farm	Yield/ Ha.	Receipts	Expenses	Net Net Returns
hectares		*kilos*	*pesos per hectare*		
1.0 and below	171	647	2,727	1,905	822
1.01 – 5.0	356	630	2,570	1,705	865
5.01 – 10.0	181	741	2,933	1,877	1,056
10.01 – 20.0	189	621	2,425	1,426	999
20.01 – 50.0	140	594	2,315	1,448	867
More than 50	55	495	1,968	1,317	651

Marketing and Prices

In general bangos pond operations are market oriented. Small backyard farm operators, constituting one per cent of all ponds studied used all output for home consumption. An average fishpond in the Philippines produced about 580 kilos of bangos per hectare of which 98% went to the market. This ranged from 95% in Central Visayas to almost 100% in Central Luzon. The rest of the output was used for home consumption, given to friends, or paid to creditors and hired laborers. The proportion of the annual production sold to the market increased with farm size.

Most bangos fishpond operators sold their produce directly to wholesalers. The average price received varied from 3.23 to 5.88 pesos per kilo of bangos with an average of 4.86 pesos per kilo. Compared with the other selling arrangements wholesalers' price was lowest, although in Central Visayas this was higher than the price received from retailers.

Direct retailing of freshly harvested bangos was practiced in all regions in the country although only 14 per cent of sample operators reported to have sold their products by this method. The averaged price received varied from ₱3.82 to ₱5.69 per kilo of bangos averaging ₱5.05 per kilo.

Selling by consigment was practiced in 6 of the 11 regions in the country with the majority coming from Central Luzon. For the country as a whole, one-fourth sold their bangos in this manner receiving a price ranging from ₱3.78 to ₱5.72 per kilogram or a national average of ₱4.96. The larger sized farms tended to sell more by consignment.

Of the 1.126 farms who sold their output 60 per cent delivered the bangos to their buyers. Delivery cost was estimated at ₱384 per farm per year. On the other hand, 42% of the fishpond operators had buyers who picked-up the bangos right on the farm. Bangos were marketed approximately 51 kilometers from the farm. The fishpond in Western Visayas had the farthest delivery point averaging about 179 kilometers.

Although most farms sold their fish within the provincial location of their pond, there is still wide variation in distances of outlets. Only 10% reported selling within the same barrio as the fishpond site while 38% sold their crop within the same municipality. An almost similar proportion subscribed to markets of other municipalities but within the same province.

About 17% marketed their produce outside the provincial location of their ponds. Big markets in the provincial capital were usually preferred in all regions. Bangos produced in Luzon were also disposed in big traditional markets such as Divisoria, Baclaran and the fish terminal in Malabon. For the Visayas fishponds, Manila, Iloilo City and Cebu City were three of the favored markets. Notwithstanding the distance and the big cost in transporting the fish, two operators in Mindanao chose Manila as the market for their produce.

Extension and other Services

Except for Cagayan Valley, only a small portion of the fishponds was reached by extension workers of the government. As a whole, one-fourth of the sample operators reported having been reached by technicians. Considering that there is less than 500 government extension workers for fisheries — 185 for fishpond development, 120 for municipal fisheries, 6 for commercial fisheries and 68 for fish processing — the number reached by extension workers is already high.

For those who were reached by these technicians questions were asked on what information were provided to them and whether the recommendations were followed. There were 284 fishpond operators who were asked these questions. One half received information on cultural practices particularly on the use of fertilizer, production and use of plankton, and improve care of fingerlings. One-fourth was given information on the availability of fry at the Bureau of Fisheries and Aquatic Resources. Still 9 per cent reported that extension workers conducted seminars on fishpond operations.

Fishpond operators seem to be receptive to improve techniques as shown by the 67% out of the 284 operators who followed the recommendations extended to them. This was particularly evident in Northern and Southern Mindanao where 82 to 94 per cent of the operators reported following the recommendations. The corresponding proportion for Cagayan Valley, Southern Luzon and Bicol were 75 to 78 per cent.

Probably because of the lack of extension assistance, fishpond operators tended to become observant of other operators. In some areas neighboring fishponds may be far but 59% of the sample operators studied followed what they consider as better methods used by others. The practices which were followed dealt mainly with the "right" quantities of fertilizer that need to be applied and the use of chemicals to control pests and predators. Other practices involved type and amount of supplementary feeds to give and the methods for enhancing the production of lumot or lablab.

Despite fish farmers being observant, only a few fishermen's organization exist. Of the 1.175 sample fishpond operators, only 134 or 11% were members of an organization. Of this number, two thirds reported that they actually did not get any benefit from the association. For the others, benefits derived were enumerated as follows: (1) implementation of a fry allocation scheme (22%); (2) assistance in the purchase of fertilizer and other inputs (15%); (3) conduct of seminars or classes on improved techniques in fishpond operations (15%); (4) assistance in marketing the crop (13%); and (5) others (12%).

Thus, it was not surprising to find that 87% of the operators suggested that the fishpond industry needs government assistance. According to them, the primary assistance the government can give to improve the industry is on credit, that is, loans should be extended to them as suggested by 32% of the operators. A second important suggestion was the control of prices of inputs as well as the output. Another aspect in which the government can assist the industry is the provision of technical support through fielding technicians and launching of government programs geared at increasing production. These needs are also reflected in the problems which operators encountered some of which may not have any direct solution, e.g. the unpredictability of the weather. Other problems enumerated were the high cost of inputs which may be related with insufficient capital and unavailability of credit; unavailability of technical support; lack of proper infrastructure, and unfavorable price structure.

About 9% or 104 operators reported having no problems in their operations.