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

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A SOCIO-ECONOMIC STUDY OF FISH PEN AQUACULTURE IN LAGUNA LAKE, PHILIPPINES

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Introduction

There are about 70 lakes and impoundments in the Philippines covering an area of 200 thousand hectares and yielding an estimated fish production of almost 100 thousand metric tons per year. However, with the evolution of modern and mechanized fishing gears some of these lakes have been depleted of their natural resources. One way to rehabilitate these natural resources as well as to conserve the productivity of the lakes is to make use of certain portions of the lakes intensively, e.g. fish culture through fish pens.

The principle involved in fish production in pens is the utilization by the fish of the available food organisms in an enclosed area of the lake. It has been demonstrated that as much as 1.5 to 4.0 metric tons can be harvested from one hectare of pen per year or 10 times the open water fish catch.

From the 1970's to date, fish pens had proliferated in Laguna Lake which is the biggest lake in the country. In 1973, there were 993 fish pens in the lake ranging from less than a hectare to more than 100 hectare with a total area of 4,802 hectares. The Laguna Lake Development Authority (LLDA), a government agency which pioneered in fish pen culture of milkfish in Laguna Lake, claims that the industry can grow to perhaps 15,000 to 20,000 hectares. This would mean a lake fishery production of about 80,000 metric tons annually. However, this growth could only be achieved if fish pen investors observe and maintain recommended practices for optimum production. Otherwise, any ecological imbalance in the lake due to mismanagement could result to massive adverse effects not only for fish pens but for the lake in general. Consequently, fishermen in the lake could be affected. Ecological, biological, and socio-economic considerations need to be taken into account in decisions to expand fish pen operations.

This study therefore aims to assess the present technology of fish pen culture, its level of productivity and profitability as well as the social conditions of fish pen operators and caretakers.

In the Philippines, fish pens are operated mainly in Laguna Lake, and in some of the small lakes of San Pablo City, both in Southern Luzon. This paper, however, deals only

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with fish pens located in Laguna de Bay (or Laguna Lake). Laguna de Bay lies east and generally south of Manila. The lake has an area of 91,136 hectares, an average depth of 2.8 meters and is somewhat brackish. The northern portion of the lake is in the province of Rizal and the southern portion in Laguna. Out of the 993 fish pens in 1973, 793 or 80% was located in Rizal and 200 in Laguna.

A sample of 174 fish pen operators comprising 17.5% of the fish pens located in the lake were surveyed. Data presented in this study refer to the period 1974-1975.

Characteristics of the Fish Pen Operators

Since fish pen owners were usually residing elsewhere almost three-fourths of the respondents were caretakers. On the average an operator was male and 43 years old with owners slightly older than caretakers. He reached second year high school but was not able to finish it. Moreover 5% were not able to study. It was observed that operators with higher education tended to work in other occupation in addition to fish pen operations. Owners spent almost one-half of the 12 months potential time on fish pen operations, 6.4 months in other occupations, and only a little less than one-half month idly. Caretakers, on the other hand, were employed almost all throughout the year. Forty-three per cent of fish pen operators had other occupation the most popular of which were engaging in business, fishing, and farming. These other occupations, earned them an annual income of ₱10,049.

Fish pen as a method of fish culture in lakes was introduced only recently hence, the respondents were relatively new in the operation, 2.6 years of experience in fish pen operation.

The household of a fish pen operator is composed of about 7.2 members with only one other member being able to help in the fish pen and/or contributed to family income. This member had about 10 years of schooling and spends his time as follows: 1.7 months in the fish pen, 9.2 months in other occupation and one month not gainfully employed.

Growth in Number and Area of Fish Pens

Fish pen aquaculture in Laguna de Bay was introduced in 1970 by the Laguna Lake Development Authority (LLDA) when it constructed a pen at Looc, Cardona, Rizal. During the same year three of the respondents for this study started their fish pen operation with a total area of 12 hectares or about 4 hectares per operator. Fish pens did not proliferate until 2 years later, in 1972, when 15% in Rizal and 17% in Laguna started cultivating fish in pens (Table 1). The greatest influx in Rizal came in 1973 and one year later for Laguna. By 1974, 55 of the sample fish pens with a total area of 414.5 hectares were just starting their operations.

Fish Pen Permits

Construction of fish pens in all inland waters is regulated by the government. Anyone wishing to engage in fish pen aquaculture must apply to the Bureau of Fisheries and Aquatic Resources for a license to operate a fish pen. An annual license fee of ₱100 per hectare or a fraction thereof, must be paid in advance.

From the survey, it appeared that a number of permits have to be obtained in order to construct and operate a fish pen. Usually a municipal permit is obtained as indicated by 89% of Laguna Lake pens, only 12% secured a permit from BFAR. A few paid for Mayor's and barrio permits. On the average a license fee amounted to ₱186 per hectare varying from ₱104 to ₱400 per hectare.

Table 1. Number and area of fish pens operated by starting year of operation (area in hectares).

Location	Year of Start					Total
	1970	1971	1972	1973	1974	
Rizal						
Number	3	2	22	80	43	150
Per cent	2	1	15	53	29	100
Total area	12.00	15.50	116.15	566.5	363.0	1,073.15
Area per pen	4.00	7.75	5.28	7.08	8.44	7.15
Laguna						
Number	—	—	4	8	12	24
Per cent	—	—	17	33	50	100
Total area	—	—	50.00	41.00	51.50	142.50
Area per pen	—	—	12.50	5.12	4.29	5.94
Laguna Lake						
Number	3	2	26	88	55	174
Per cent	2	1	15	50	32	100
Total area	12.00	15.50	166.15	607.50	414.50	1,215.65
Area per pen	4.00	7.75	6.39	6.90	7.54	6.99

Permits were granted for an average of two years although six respondents reported having 5-year permits. Seven operators had permits covering bigger lake area than was actually operated in 1974. They cited unavailability of fingerlings and lack of capital as factors contributing to the extent of non-operational areas.

Characteristics of the Pens

Milkfish was the predominant species cultured in fish pens in Laguna Lake, 96% cultured pure milkfish, while 2% had milkfish with other species like tilapia and carp. The former had an average of 6.64 hectares while the latter had 4.33 hectares. Three pens cultured purely tilapia in an average area of 2.33 hectares.

In 1974, an individual was allowed a maximum area of 10 hectares and 50 hectares for corporations, associations, partnerships or cooperatives. These maximum areas, however, could be increased or decreased by the Secretary of Natural Resources for reasons of public interest such as: (1) the financial capacity and/or qualifications of the applicant; (2) the socio-economic importance of the project; (3) the existence of other applicants in the place where the area applied for is located.

The size of fish pens vary from less than 1 hectare to more than 100 hectares. In a 1973 report of the LLDA, the median size of fish pens was 5 to 10 hectares in Laguna. Rizal fish pens were concentrated in the 10 to 20 and 20 to 50 hectare brackets reflecting larger investments in fish pens per unit of ownership in Rizal. Based on the sample for this study, almost 50% of the pens in Laguna Lake had areas ranging from 1 to 5 hectares. In Laguna, pen areas ranged from 1.0 to 30 hectares or an average of 5.52 hectares. In Rizal, pen areas ranged from 0.16 to 45 hectares averaging 6.65 hectares.

In general, the principal materials used in constructing a fish pen were bamboo and nets. One pen in Rizal used chicken wire and bamboo.

Before stocking, nurseries were temporarily constructed in a small portion of the pen area. The nursery makes possible the rearing of fry or fingerlings to suitable sizes or for acclimatization. It therefore affords close supervision of the fingerlings during the initial stage of their growth until such time that they are big enough for release to the entire pen. More than three fourths had nurseries. Rizal having a larger area, 4, 300 sq. meters with a capacity of 219 thousand pieces than the latter which had 1,800 sq. meters and a capacity of 166 thousand pieces of fingerlings.

Rearing pens were subdivided into smaller compartments mainly for more effective management and to minimize the risk of great losses. The study showed that the number of rearing compartments and area per compartment increased with total pen size. In this regard Rizal pens differed from the Laguna pens. In Rizal, the number of rearing compartments did not increase proportionately with farm size. Rather, the area per compartment was enlarged to cope up with the increase in farm area. The area of rearing compartments in Laguna did not vary much with farm size but rather the number compartments was increased to cope up with bigger farms. Thus, the average number of compartments in Laguna was twice that in Rizal while the average compartment area in the former was less than one-half that of the latter.

Majority (61%) of fish pens in Laguna Lake were managed by single proprietors, 22% and 17% were owned by partners and corporations, respectively. One cooperatively-owned fish pen was in operation in Rizal. This cooperative was located in Binangonan, Rizal with an area of 5.0 hectares.

Cultural Practices

Idling of fish pens. After harvesting, pens are laid idle to wait for the next stocking period. The fish pen site has to be laid at least one month a year so that excess food and other organic matters have been completely decomposed before stocking with new fingerlings.^{2/} Three fourths laid their pens idle for an average period of 15 weeks mostly in November, December, January or February.

Pen preparation. This includes checking and repairing of the pen and nursery structures, cleaning and elimination of predators. Fish pens, being constantly subjected to various environmental hazards in the lake like inclement weather would naturally require period changes and repairs depending on the quality and durability of material used. Many of the fish pen structures were relatively new, hence, about three-fourths had not been changed. For those who did, 9% in Laguna Lake changed their pens every year, the rest from 2 to 3 years at most. Checking of pens above and below water is a daily routine as indicated by more than one-half of the operators. The rest checked every other day to weekly. Although checking of the pens was done almost daily, general pen repair was done less frequently.

Pest/Predator eradication. All the pens sampled cultured either milkfish, tilapia, carp or combinations of these species. Others present in the pen were considered pests/predators since they would prey or compete on food with the cultured species. The most common pests/predators reported were dalag, biya, bid-bid, carp, tilapia (locally called "tilapiang tigre"), ayungin, bulan-bulan, bird, water snake, kanduli and even man.

To eliminate these, undesirable fish species they were caught and either killed or eaten. If elimination of predators is done before stocking sometimes "electric shock" was employed.

Fertilizer use. The dangerous effect of fertilizers either in organic or inorganic applied in fish pens has recently been emphasized by LLDA. According to them, "there must not be any addition of any kind of chemicals or organic fertilizer or animal wastes such as chicken droppings. Such wastes can trigger or support the occurrence of algae bloom which can very seriously affect water quality and can lead directly to fish mortality". Contrary to this, 3 fish pen operators in Rizal used chicken droppings intensively applying approximately 0.64 sack per day throughout the rearing period of the fish.

^{2/} Felix, Sergio S. "Bangos Culture in Fish Pen". Bureau of Fisheries and Aquatic Resources, May 1975 (mimeo).

Stocking practices. Sources of stock for Laguna Lake pens were predominantly (98%) from purchased fingerlings/coming mostly from Dampalit, Malabon, Rizal. One operator purchased fry, another one purchased both fry and fingerling. In Rizal, the average quantity of fingerlings purchased per pen was 179 thousand pieces compared with 95 thousand in Laguna. On a per hectare basis, Rizal Operators bought 25 thousand pieces while Laguna purchased 16 thousand pieces. About two-thirds purchased fingerlings only once a year which was usually timed when fingerlings were abundant. From the source, stock were commonly transported in a large motorized banca (boat) locally called "pituya". The fingerlings were directly placed in this boat which was then filled with pond water, thus acclimatizing the fingerling during transport. Fresh water from the lake gradually goes in and out of the banca thru its bottom inlet and outlet. Thus, water circulation is maintained. When other means of transportation, e.g., bus and jeeps, were used, fingerlings were placed in plastic bags with water and oxygen. The plastic bag was placed in a pandan bag. Average mortality rate of fingerlings in transit ranged from 3.5 to 3.6% or an average of 7.3% that is, 73 out of 1,000 fingerlings die on the way from the source until they are finally stocked in the pens. Mortality rate is directly related to the distance of the source. Acclimatization of stock was practiced by 90% of the Laguna Lake operators extending from 5 hours in Rizal to 6 hours in Laguna

Rearing practices. It seemed that natural food from the lake was not sufficient and thus has to be supplemented with artificial feeds. Eighty eight per cent of the fish pens used supplementary feeds, the most common of which was bread crumbs given at the rate of 249 gantas per hectare. Rizal had a higher rate of feeding bread crumbs than Laguna. In the latter a higher rate of feeding rice bran was noted. For both provinces rice bran was given at the rate of 176 kg. per pen. Broken cones were also used as supplementary feed although this practice was observed only in Rizal. Other feeds used were terramycin egg yolk, fish meal, lumot, ipil-ipil leaves, and kangkong. Mortality rate from stocking to harvesting was reported at an average of 37%. Pens located in Rizal had a higher rate of mortality compared with those in Laguna.

It took about six months from stocking to harvesting, hence, the number of rearing ranged only from one to two per year. Size of fish primarily determined the date of harvesting. Other factors considered were demand for stocking, weather condition, and availability of natural food. Harvesting in Laguna Lake was more commonly done by seining, hence, fishes were harvested totally.

Stocking and Cropping Patterns

Stocking Pattern

Milkfish. Extensive stocking of bangos fingerlings was done in Laguna Lake pens from January to May. Approximately, three-fourths of the total requirement of the sample fishpens was stocked during these months. In quantity terms, stocking was heaviest in May and least in November and December. More than three-fourths of the pens were stocked from January to May gradually diminishing towards the end of the year. The annual stocking rate of bangos fingerlings was about 241 thousand pieces per pen or 36 thousand per hectare with an almost equal stocking density for Rizal and Laguna (Table 2). A direct relationship existed between stocking rate per pen and farm size, that is the amount of stock per pen increased as the pen area increased (Table 3). On the other hand, an inverse relationship between stocking rate per hectare and farm size was observed. This means that large farms are stocked less intensively than small farms.

Table 2. Annual quantity of bangos fingerlings stocked in fish pens by size of pens, Laguna Lake.

Farm Size	Per Pen	Per Hectare
<i>hectares</i>		<i>thousand pieces</i>
1.0 and below	36.36	43.10
1.01 – 5.0	138.65	46.09
5.01 – 10.0	300.56	34.79
10.01 & above	762.76	31.16
All Sizes	241.27	35.56

Table 3. Annual cropping rate of bangos in Laguna Lake fish pens, 148 pens.

Location	Number or pens	Per Pen	Per Hectare
			<i>kilos</i>
Rizal	127	27,940	4,005
Laguna	21	14,292	2,353
Both	148	26,015	3,798

Other species. Only 5 out of 174 fish pens studied in Laguna Lake cultured tilapia. Of these, 3 were cultured alone and the other 2 in combination with bangos or carp. No discernible pattern of stocking seemed to exist in tilapia pens. The largest volume of fingerlings was stocked in March and April representing 43% of the total quantity stocked, during the year. On the average 32.2 thousand fingerlings per hectare was stocked in one year.

Yields

An average fish pen in Laguna Lake harvested about 26 thousand kilos of bangos or 3,798 kilos per hectare (Table 3). Rizal fish pens were found to be more productive than Laguna pens with the former having a productivity per hectare/which was 70% greater than the latter. Compared with ordinary fishponds, yield per hectare in fish pens was 6.5 times greater.^{3/}

The annual production per pen increased with farm size but at a decreasing rate. Thus productivity per hectare decreased as the pen area increased. Highest production per hectare was obtained by fish pens with 1-5 hectare area (Table 4).

The unique characteristic of rearing fish in pens in Laguna Lake is that the fish obtain their food from sources naturally available in the lake. Thus supplementary feed-

^{3/} See A.R. Librero, Resource Productivity in Milkfish Culture in the Philippines, Paper presented at the second Biennial Meeting of the Agricultural Economics Society of Southeast Asia, 3-6 November, 1977.

ing is not necessary ^{4/} Nonetheless, majority (87%), particularly the large farms supplemented the natural food in the lake. This practice did not do much to increase yields. In fact the quantity of milkfish harvested from pens with supplementary feeds was lower by about 1,269 kg./ha. than those with no supplementary feeding (Table 5). This does not mean, however, that the low yield resulted from the use of supplements. Rather, the low yield could be due possibly to other factors. As mentioned earlier, supplementary feeding was generally practiced in bigger-sized pens which obtained lower yields.

Table 4. Annual cropping rate of bangos in Laguna Lake fish pens by pen size, 148 pens (quantity in kilograms and value in pesos).

Farm Size (has.)	Number of pens	Per Pen		Per Hectare	
		Quantity	Value	Quantity	Value
1.0 & below	26	3,679	15,536	4,314	18,206
1.01 - 5.0	69	16,476	77,994	5,098	24,132
5.01 - 10.0	34	32,364	151,872	3,802	17,836
10.01 & above	19	80,675	386,932	3,161	15,158
All Sizes	148	26,015	122,929	3,798	17,948

Almost all fish pens have predators usually "dalag" (mudfish) preying on fingerlings. Operators employing some means of eradicating predators obtained a yield of 3,684 kg/ha. In contrast, those who did not eradicate pests had a yield of 2,342 kg./ha only.

Of the fish pens studied, 5 cultured tilapia which produced 4,151 kilos per farm or 1,037 kg./ha. per year.

Capital Investment and Costs and Returns in Fish Pen Aquaculture

This section discusses first, the capital investments in the fish pens, second the receipts derived and the costs of production, third some measures of profit and finally, a comparison of the costs and returns and profits for different size groups.

Capital Investments Assets in a fish pen consist of (1) the pen itself or the materials used in the construction plus the construction costs, (2) buildings which include a house/shed provided for the caretakers or workers and a shed for equipment, (3) transportation facilities including a motor boat or a banca plus other land transport facility used for the business, (4) nets, (5) container like bags, basins, baskets, and (6) others including bolos, scales, raft, etc. Six respondents reported having refrigerated facilities for their bangos catch. On the average the capital investment per fish pen in Laguna Lake amounted to P50,241 of which 80% is the value of the pen itself. Per hectare, the investment was P7,700.

^{4/} M.N. Delmendo and R. Gedney. Fish Farming in Pens A New Fishery Business in Laguna de Bay. Laguna Lake Development Authority, Technical Paper No. 2. 1974.

Table 5. Annual cropping rate by use of supplementary feeds and practice of pest/predator eradication.

Practice	Number of pens	Production (Kg.)	
		Per Pen	Per Hectare
Used supplementary feeds	129	26,171	3,545
Did not use supplementary feeds	19	25,216	4,814
Eliminated predators	16	25,801	3,684
Did not eliminate predators	118	17,102	2,342
No predators	14	35,808	4,600

Farm receipts. Cash receipts was derived almost wholly from sales of fish. Non-cash farm receipts include the value of fish consumed at home, given away as gifts or paid in-kind for services. In Laguna Lake, annual cash receipts averaged ₱15,446 per hectare while the non-cash receipts amounted to ₱134 per hectare. Total farm receipts therefore was ₱15,580 per hectare. Farm receipts obtained by Rizal operators was 63% higher than Laguna operators. One factors which could account for this is the significantly higher yield obtained by the former (4,005 kilos per hectare) compared to the latter (2,353 kilos).

Farm expenses. It took almost ₱12,000 to operate a hectare of pen in Laguna de Bay with approximately 93% in cash and 7% non-cash. The cost of fingerlings was the primary item of expenses comprising 66% and 48% of the total cost for Rizal and Laguna, respectively (Table 6). It is important to stress at this point that the big difference in the cost of stock between Rizal (₱8,012 per hectare) and Laguna (₱4,186) was due mainly to a wide discrepancy in the price paid for their fingerlings. Rizal operators paid a much higher price (₱286 per thousand) than Laguna operators (₱198), thus although the stocking rates were more or less the same, the total cost differed. The two other major items of expense were the cost of labor and equipment purchased. Other cash expenses included supplementary feeds, oil, repairs, light, handling, cost of stock, interests on loans. Non-cash expenses on the other hand included the imputed value of family labor, decrease in inventory and payments in-kind for services.

Net returns. Two measures were used to determine the profitability of fish culture in pens: (1) net cash farm income gives an indication of the cash returns from the operations, and (2) total net farm income which includes both cash and non-cash net income. A fish pen in Laguna Lake earned a net cash income of ₱29,220. With an average rearing area of 6.5 hectares, this is equivalent to ₱4,488 per hectare. Due to a higher non-cash expenses, total net farm income amounted only to ₱25,058 per pen or ₱3,489 per hectare, a rate of return of 26% over operating expenses or 50% of fixed capital investment. In terms of both net cash income and total net farm income, Rizal pens profited more than the Laguna pens. Income figures indicate that about 34 centavos is earned for every peso spent in Rizal while it was only 16 centavos in Laguna.

Costs and returns by farm size. By farm size, highest profit was obtained in farms with areas of 1.01 – 5.0 hectares. Both the net cash income and the total net farm income were almost twice that of the average for all farms. Moreover, about 51 centavos is returned to the operator for every peso invested to operate his pen. Net returns per hectare increased with size of pen until 5 hectares after which it started to decline. The least profit per hectare was obtained by large farms with area of more than 10 hectares.

Table 6. Annual cash farm expenses in fish production in pens in Laguna Lake.

Item	Rizal	Laguna	Both
Fingerlings	8,012	4,186	7,562
Hired labor	1,411	975	1,360
Value of commission	275	131	258
Food for laborers	128	198	137
Equipment purchased	684	1,733	807
Transportation	306	100	282
Supplementary feed	286	205	276
Ice	75	58	73
Interest	4	223	30
Miscellaneous	170	198	174
Total cash expenses	11,351	8,007	10,958

Marketing practices and prices

Marketing practices. Output in Laguna Lake pens were mostly marketed (99%). Majority (76%) of the fish pen owners sold their crop by direct wholesale. Direct retailing, consigning and contractual selling were also practiced but only to a limited extent. In contractual selling, the buyer is chosen while the fish is still being reared in the pens. Furthermore, the buying price is agreed upon before actual harvesting. The price for a kilo of bangos was highest when sold by contract. Surprisingly, the lowest price was received by directly retailing the fish in the market. In Rizal, almost an equal proportion of the operators had their harvest picked-up by the buyer or delivered to them. In Laguna however, majority preferred to have their crops picked-up from the farm by the buyers.

Market outlets. Most popular (22%) outlets among Laguna Lake operators was the Malabon Fish Terminal in Malabon, Rizal. Farmer's market in Cubao and Divisoria market in Manila were also preferred outlets particularly by Rizal operators. Fish pens located in Binangonan, Cardona and Pililla, cited Cardona as the nearest common market. Of course, the local market served also as an outlet for the the fishes reared in the locality. Aside from the local market, pens located in Laguna considered also the Calamba and San Pablo markets.

Traditional price behavior theory states that everything else equal and for undifferentiated products, an increase in the amount of a product offered for sale will lead to a lower price. Thus, the apprehension expressed by established marketers of bangos in Malabon regarding the depressing effect on prices of the added fish catch from Laguna Lake appears warranted and worthy of study..

A study^{5/} conducted was from October 29, 1973 to January 31, 1974 covering 5 major landing points in Rizal analyzed the impact of milkfish landings from these areas on milkfish prices in Malabon. Some 1043 tons of bangos were landed at the 5 major stations along Laguna Lake in Rizal. Quezon City (mostly Farmers' market) and Pangasinan were the principal destinations absorbing more than 370 tons and 212 tons, respectively. Large shipments were also made to Pangasinan. The combined shipments to Malabon and Navotas amounted to 198 tons or about 19 per cent only of all bangos landed.

^{5/} R.D. Guzman, R.D. Torres and L.B. Darrah, "The Impact of Bangos Landings from Laguna Lake (Rizal points) on Bangos Prices in Malabon". Special Studies Division, NFAC, Diliman, Quezon City.

Contrary to initial indication it appeared that these 2 markets did not absorb the bulk of the bangos landed from Laguna Lake. However, Malabon's share of the markets in Greater Manila such as Farmer's Market correspondingly shrunk with the entry of Laguna Lake bangos.

The study concluded that the price of bangos in Malabon/Navotas responded to factors other than quantity of bangos shipped from the Rizal side of Laguna Lake. The claim that bangos landed from Laguna Lake has caused a decline in bangos prices in Malabon/Navotas was not warranted. On the contrary, prices observed at the landing points were higher than Malabon/Navotas on 83 per cent of the days included in this study.

Labor utilization

Fish pen culture is a more labor intensive endeavor than either fishpond farming or crop farming. What makes it different is the constant surveillance that is required to lessen the risk of loss of stock and therefore of income. In Laguna Lake, it took about 949 mandays to operate an average fish pen. Safeguarding the pen required the most labor accounting for about 69% of the total labor requirement. Replacement of split bamboos and repairing of torn nets required more time than the actual construction of the enclosure. Care of the stocks was not as time consuming as the other preparations. Around 21 mandays was spent in harvesting the stock.

Labor requirement of bigger farms were of course higher than in small farms. In fact, the amount of labor days increased as the farm size increased. The amount of labor use per hectare, however had an inverse relationship with farm area indicating that labor was more intensively used in smaller farms than in bigger farms. Furthermore, it suggests that labor may be more efficiently used in the latter than the former.

In Laguna Lake, the amount of labor involved did not differ much whether the species cultured was bangos or tilapia. Rearing bangos involved about 140 mandays per hectare while tilapia required 159 mandays. Moreover, it seemed that polyculture of say, bangos-tilapia or bangos-carp required more labor than monoculture of a species in fish pens. This observation was of course, limited to only a small sample.

Sources of labor. Most of the operational activities in the fish pen were provided by hired personnel notably by a caretaker. He provides about 55% of the total labor requirement while about 42% was done by other hired helpers. Only about 3% was contributed by the owner and his family.

The amount of labor provided by the caretakers and other hired laborers increased with farm size. The owners on the other hand, get less involved with the actual operation as the fish pen area increased.

Farm personnel. Caretakers in fish pen function as overall in-charge of the operations in lieu of the operator himself. Hiring of caretakers was a fairly common practice by owners of fish pens in Laguna Lake. One hundred forty eight out of 174 pens reported hiring from 1 to 13 caretakers averaging about 1.56. Smaller fish pens were usually operated by the owners themselves. Caretakers were commonly paid a monthly salary averaging ₱280 or ₱3,030 a year. Others were paid a commission or a daily wage. Caretakers being paid by commission received the highest remuneration for his labor among the four modes of payment.

In addition to caretakers, laborers/helpers were hired. In Laguna Lake about 9 laborers were hired as help in the pens. Three-fourths of the laborers were paid with a fixed daily wage averaging ₱10.30. Some operations were usually done by contractual laborers or locally termed as "pakyawan." Contracting parties were composed of about 14 persons paid depending on the operation to be done and the agreement with the

owners. For construction/installation of the fence, payment could either be ₱0.97/bamboo pole (locally called "tulos" or "pelote") or about ₱62.50/banatan of netting installed or approximately ₱710 per hectare of fence constructed.

In six fish pens, security guards paid on monthly basis were hired.

Credit Practices

Most (89%) of the fish pen owners in Laguna Lake did not experience any shortage of operating capital. Of those who did, 3 reported using mainly borrowed capital to operate his fish pen while 9% augmented his own with some borrowed capital the proportion of which was 47% owned and 53% borrowed.

Six out of the 15 Laguna Lake borrowers chose the rural bank as their source of credit. Another 6 borrowed from relatives or friends while 5 others borrowed from big credit institutions other than the rural bank. The amount of loan averaged ₱55,200. Thirteen out of 15 operators reported that their loans were used to finance their operations. Two other acquired the loan for the development of the pen structure.

Problems in the Industry

In any budding industry like the fish pen industry problems are likely to occur. Adverse weather condition posed as the biggest problem in Laguna Lake as reported by 52% of the operators. This, however, should be treated more as a risk than a problem. Precautionary measures should therefore be employed to lessen the risk in the business. Other problems cited were: insufficient technical support from the government, irregular supply of stock, and where supply was available dishonesty in counting was prevalent, exorbitant prices of stock in some places, theft and pilferage of stock and unavailability of credit for pen construction. In Laguna about 3/4 of the sample operators were visited by extension workers compared with about one-third in Rizal. Visits of extension workers concerned mostly with damages after typhoon. Other assistance included the acquisition of a DBP loan and stocks from BFAR nurseries.

Correspondingly, it was suggested that the government, in line with its intensive food production program could lend support to the industry by implementing a price support program for the primary inputs of the industry and extending technical support, likewise, a government credit scheme for fish pen was suggested by some operators. It was added that the government should take charge of the distribution of fingerlings.

