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FISHERIES DEVELOPMENT PROJECT
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MILKFISH CULTURE IN PENS: AN ASSESSMENT OF ITS CONTRIBUTION TO
OVERALL FISHERY PRODUCTION OF LAGUNA DE BAY

by

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ASEAN/UNDP/FAO Regional Small-Scale Coastal Fisheries Development Project
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MILKFISH CULTURE IN PENS: AN ASSESSMENT OF ITS CONTRIBUTION¹ TO OVERALL FISHERY PRODUCTION OF LAGUNA DE BAY

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1. INTRODUCTION

Laguna de Bay, a 90 000 ha lake near Manila, is now more popularly known for its fishpens. It has become an industry within a span of 10 years from its introduction in 1971. Figures 1 and 2 show the Laguna lake region and the geographic location of the pilot fishpen. The high productivity levels per unit area compared to the conventional brackishwater culture in the country make the milkfish culture in pens a unique and highly profitable fish farming operation in the area.

The high production of fishpen is due to the natural productivity of the lake which is not fully utilized by the native lake fish populations.

The fishery of the lake is the single aquatic resource that has been exploited since time immemorial which provides food and livelihood of fishermen households around the area. Fish catches on the lake consist of the Therapon plumbeus (perch) and the Glossogobius giurus (white goby) which represent about 93% of the open water fish harvests (Delmendo & Gedney, 1974). None of these species consume algae. About 2/3 of the lake fish population is omnivorous and 1/3 are predators. These species consume approximately 7% of the primary production of the lake (Delmendo, 1968; ADB, 1984).

With the introduction of milkfish culture in pens, a more efficient utilization of the primary productivity, mostly algae and diatoms, came about.

The development of fishpens was premised on the natural productivity of the lake which was then not fully used by the existing fish populations. It was also an attempt to lessen fishing intensity by shifting the activities of fishermen to farming to rehabilitate the overfished condition of the lake fishery resources.

2. EXPANSION OF FISHPEN OPERATIONS

From 1971 onwards the expansion of fishpen operations in Laguna de Bay was rapid. The area increased from 40 ha in 1971 to about 30 000 ha in 1983.

¹ Lecture given in the SEAFDEC Aquaculture Training Course, Tapao, Binangonan, Rizal, 30 September 1987

This stabilized from this period but reached a maximum area of 29 011 ha in 1985(Fig. 3). Due to socio-economic conflicts between the fishermen and fishpen operators, the government decided to reduce the area in fishpens to 10 000 ha only (PCLL, 1987). However, as of February 1987, there are still 14 377 ha of fishpens in operation in Laguna de Bay. Table 1 shows the growth of fish-pen operations in the area.

Table 1. Expansion of fishpen operations in Laguna de Bay^{1/}

<u>Year</u>	<u>Area</u>
1971	40 (pilot area)
1973	4 800
1976	7 000
1979	no data
1980	10 420
1981	15 270
1982	15 000
1983	28 907
1984	28 907
1985	29 011
1986	19 903
1987	14 377 *

¹ Source: BFAR; * PCLL The ownership of fishpens is broken down as follows: (Source: ADB, 1984)

<u>Type of Ownership</u>	<u>Number of Operators</u>	<u>Area Registered</u>	<u>Surveyed Hectarage</u>
Corporations	427	17 967.70	21 794.35
Partnership	73	1 969.21	2 094.70
Association	15	185.00	153.55
Individual	851	4 290.57	5 038.87
Undetermined	2	5.0	6.0
Totals	1 368	24 418.48	29 087.47

The distribution by size of fishpens is shown below: (Source: ADB, 1984)

<u>Category (ha)</u>	<u>Number of Operators</u>	<u>Surveyed Hectarage</u>
0- 5	636	2 334.18
6-10	219	1 697.30
11-15	59	767.30
16-20	35	660.50
21-25	18	416.70
26-30	19	546.00
31-35	21	705.10
36-40	30	1 153.25
41-45	20	848.50
46-50	102	5 075.70
51-55	30	1 578.80
56-60	28	1 621.85
61-70	56	3 538.70
71-80	57	4 281.50
81-90	13	1 097.80
91-100	15	1 464.60
Over 100	10	1 299.00
Totals	1 368	29 087.47

From the above information it is observed that the largest number of operators have 5-10 ha of fishpen; more than 100 individuals operate 46-50 ha and 10 operators have more than 100 ha of fishpens.

In terms of area used, the category of 46-50 ha operations cover the largest water area; this is followed by the 71-80 ha category which covers the second largest water surface area of the lake.

In the light of the present demolition campaign of the government, perhaps these need a closer look in addition to those operating more than 100 ha of fishpen areas.

3. LAGUNA DE BAY, PRIOR TO THE FISHPEN DEVELOPMENT

The lake had been the subject of limnological studies in the late 1950s up to the early 1970s. The physical and biological aspects of the lake were investigated, the results of which have been reported and published in international publications. Fishery evaluation was likewise undertaken to determine the number of fishermen and fish catches.

The first evaluation of the lake fisheries was carried out in 1963 (Delmendo, 1966). This was followed by a general fishery survey of Laguna de Bay in 1968 (Shimura and Delmendo, 1969). On the basis of this survey, a sample survey was undertaken by the Laguna Lake Development Authority in 1973, after the fishpen was successfully demonstrated (Tech. Pap. No. 1, LLDA, 1974).

Prior to the fishpen development in the lake, fishery production was high in terms of volume but poor in quality (Rabanal, et al, 1964). The bulk of fishery catches were made up of snails, representing 247 770 mt or 71% of the total production; fish consisted of 82 882 mt or 24% and shrimps 19 096 mt or 5%. The total open water fish catches were 921 kgs/ha/yr in 1963; 434 kg in 1968; and 243 kg in 1973.

The open water fish catches before and after the fishpen development consist of the following species:

	1968	In Percent (%)	1973
<u>Therapon plumbeus</u>	65.7)	
<u>Glossogobius giurus</u>	25.9)	
<u>Arius manilensis</u>	4.6)	
<u>Cyprinus carpio</u>	1.8)	51.9
<u>Clarias macrocephalus</u>	0.6)	
<u>Trichogaster pectoralis</u>	0.2)	
<u>Tilapia mossambica</u>	0.6)	
<u>Miscellaneous species</u>	0.6)	
<u>Chanos chanos</u>	0.0		48.1
	100.0		100.0

As shown above, the dominant species caught in Laguna de Bay was composed of the Therapon plumbeus (perch) followed by the white goby, Glossogobius giurus and the catfish, Arius manilensis. These 3 major species made up more than 96% of the total fish catches in 1968; these species including the minor but desirable species altogether composed 51.9% of the fish catches in 1973 while the milkfish made up 48.1% after the fishpen developed.

Fishing operations in Laguna de Bay are carried out 24 hours a day with various types of fishing gears. A fisherman operates more than one type of fishing gear, the net mesh sizes of which vary to enable the fishermen to catch fish. These are not regulated although there are rules and regulations to be observed on fishing gears. Fishing in the

lake is not licensed, hence, fishermen catch all that the gears could harvest. If not for human consumption, the catches are used for animal feeds.

The number of fishermen, types and number of fishing gears used and the number of duck farms are shown in Table 2 below.

Table 2. Number of fishermen and fishing gears used

	<u>1963¹</u>	<u>1968²</u>	<u>1978³</u>
Total number of fishermen	<u>13 000</u>	<u>9 813</u>	<u>5 128</u>
Full-time	6 511	7 654	4144
Part-time	6 489	2 159	984
Total number of fishing boats	<u>7 149</u>	<u>7 155</u>	<u>4 487</u>
Motorized	2 559	3 305	2 863
Non-motorized	4 590	3 850	1 624
Total number of fishing gears used	<u>51 463</u>	<u>116 131</u>	<u>48 369</u>
Snail dredge	1 005	738	442
Fish corral	825	765	1 463 (all types)
Motorized push net	1 010	1 496	485 (includes non- motorized)
Manual push net	1 067	737	-
Gill net	1 720	37 867	3 373
Long line	477	7 997	385
Shrimp brush shelter	44 952	21 936	-
Drive-in-net	240	197	67 (drag seine)
Motorized seine	16	9	-
Mudfish seine	91	37	-
Therapon seine	60	11	-
Pole and line	-	16 390	10 112 (handline)
Cast net	-	151	-
Frame net	-	221	-
Fish shelter	-	956	17 302
Fish trap	-	17 268	7 152 (fish pot)
Shrimp trap	-	7 999	-
Spear	-	160	872
Hoop net	-	-	5 245
Other gears	-	1 196	1 471
Total number of duck farms	4 324	3 796	2 369 ⁴
Total number of ducks kept	536 690	734 445	446 787
Average number of ducks per farm	124	193	188

¹ Delmendo, 1966

² Shimura and Delmendo, 1969

³ Mercene, 1980 (unpublished report)

⁴ Mercene, 1987

From the above survey data it will be noted that the number of full-time fishermen increased in 1968 but the number of part-time fishermen decreased. This may be due to specialization of occupation during the 1963-68 period as a result of industrial developments which took place in the lake region. From the period 1968-1978 there was a general decline in number of fishermen in both categories. This may be due to the development of fishpens on the lake in which fishermen obtained alternative employment in construction, caretaking, harvesting and related economic activities such as transport of fishpen supplies, marketing, etc.

It will also be noted that each fisherman uses an average of 4 units of fishing gears in 1963; 12 units in 1968 and 9.5 in 1978. There are at least 20 different types of fishing gears used for fishing in the lake.

While the number of fishermen decreased from 1963, the number of fishing gears used increased over the years. The fishing operations do not generate revenues to the government inasmuch as the boats and fishing operations carried out are not licensed. The lake fishery has remained an open access resource without success in the attempts to regulate fishing activities. The introduction of the fishpen was intended to lessen fishing intensity by shifting activities of fishermen to farming. However, this did not fully materialize but the fishermen and their families also benefited indirectly.

4. FISHPEN PRODUCTION OF LAGUNA DE BAY

The contribution of fishpens to the overall fishery production of the lake has been disputed by certain quarters without examination of available fishery production data on Laguna de Bay. The Haribon Foundation in its White Paper No. 2 reported that the fishpen did not contribute to the overall production of Laguna de Bay. The Presidential Committee on Laguna de Bay (PCLL) also shared the same view on the matter.

Prior to the development of the fishpen, fishery production of the lake had been continuously declining (Table 3). From 1963 to 1968, there was a decrease of 53% or slightly over 10% per year during the 5-year period. In the subsequent 5-year period, 1969-1973, there was a decline of 47% or an average of 9.4% a year. During the decade, 1964-1973, the percentage contribution of the open water fish catches to the overall fishery production of the lake decreased from 24% to 15%. With the advent of the fishpen in 1971, fish production in 1973 constituted 14% from fishpens and 15% from open water fishing, thus increasing the total fish production in that year to 29%. While the fishpen withdrew a total area of 4 800 ha from open water fishing operations of fishermen, the production per unit area of fishpen was 4.0 tons/ha in contrast to .243 tons/ha of the open water fish catch in 1973.

From Tables 3 and 4, it is seen that the contribution of the open water fish catch increased by 5% in 1976 but declined sharply in 1979 to 8% of the total fish production over a 3-year period. From 1980 onwards, the quantity of open water fish catches fluctuated from a low level of 4% in 1983 to a high level of 14% in 1986 or an average of 8.75% of total fish production per year from 1979 to 1986.

On the other hand, the contribution of fishpen production to the total fish output of Laguna de Bay ranged from 17% to 27% during the 1980-86 period, or an average of 22.14% per year.

Assuming that the fishpen did not come about in 1971, the 4 800 ha in fishpens in 1973 would have been available for open water fishing. At a fish production level of 433 kg/ha in 1968, the total fish output from this source would have given an incremental production of 2 078 tons or a total of 22 801 tons instead of 20 723 tons as reported in that year. The fishpen output from the same area was 19 204 tons which was almost equal the total open water fish production from 85 200 ha.

From 1976 onwards, the area of the lake in fishpens increased from 7 000 ha to 29 011 ha in 1985 (BFAR, 1985). This is almost 1/3 of the total lake area. The quantity of fish produced from this source ranged from 14 to 40% of the total fish output of the lake (Tables 3 and 4) as against 8.14% total fish production from 60 000 ha of open water fishing area.

The total contribution of fishpen production to the overall national aquaculture output in 1984 was 19% (Table 5).

A comparative fish production per unit area of open water fishing and fishpen operations from 1976 to 1986 showed an increasing trend in the former and decreasing in the latter. However, volumewise, the fishpen production per unit area is still higher as shown in Table 6.

Table 3. Total fishery production of Laguna de Bay (in metric tons)

Source	1963	1968	1973	1976	1979	1980	1981	1982	1983	1984	1985	1986
1. Open water fishing (capture)												
Fish	82,882 ¹	39,055 ²	20,723 ³	27,359*	15,434*	14,426*	20,424*	19,216*	13,346*	29,591*	25,515*	34,793*
Shrimps	19,096	27,552	23,597	16,002	7,780	7,361	4,325	3,800	992	8,302	7,913	16,121
Snails	247,770	96,683	77,560	36,228	159,388	179,726	158,401	193,560	207,231	192,052	164,834	149,697
2. Culture	—	—	19,204 ¹	47,020 ¹	No Data	37,184	56,255	60,555	82,442	81,846	51,634	41,005
a.			(4,800) ⁴			(10,420)	(15,270)	(15,000)	(28,907)	(28,907)	(29,011)	(19,903)
Fishpens			(7,000) ⁴									
b.							5,841	4,404	3,454	4,488	5,461	4,505
Fishcages												
							(113.47)	(97.00)	(92.67)	(92.67)	(158.67)	(167.33)
Totals	349,748	163,290	141,084	126,609	182,602	238,697	245,246	281,535	307,465	316,279	255,357	246,121

¹ Delmendo, 1966

² Shimura and Delmendo, 1968

³ Delmendo and Gedney, 1974

⁴ ADB, 1984

* BFAR

() Area in hectares

Table 4. Percentage contribution of major fishery products in the overall production of Laguna de Bay (in %)

	1963	1968	1973	1976	1979	1980	1981	1982	1983	1984	1985	1986	
1. Total fish catches													
a. Open water		24	24	15	20	8	10	8	7	4	9	10	13
b. Fishpens		—	—	14	40	no data	20	23	21	27	26	20	17
c. Fishcages		—	—	—	—	—	2	2	1	1	2	2	
2. Total snails production	71	59	55	30	88	70	65	69	68	61	65	61	
3. Total shrimps production	5	17	16	10	4	-	2	1	-	3	3	7	

Table 5, Fish production of aquaculture, 1984*

Type of aquaculture and product	Quantity (metric tons)	Percent of total	Value (thousand pesos)
TOTAL	477 887	100%	7 265 913
Marine	177 011		538 792
Oysters	14 617	1%	95 010
Mussels	20 306	4%	162 448
Seaweeds	142 088	30%	281 334
Freshwater	89 036		1 443 470
Fishpens	81 966	19%	1 357 357
Fishcages	7 070	1%	86 113
Fishpond	211 840		5 283 651
Brackishwater	198 729	42%	5 116 683
Freshwater	13 111	3%	166 968

* Source: BFAR Statistics, 1984

Table 6. Fish production per hectare of lake area (in MT)

Year	Open water fishing production	Fishpen production	Fish cage production
1963	.920	0.00	0.0
1968	.433	0.00	0.0
1973	.243	4.00	0.0
1976	.329	6.71	0.0
1979	.186*	no data	0.0
1980	.181	3.56	0.0
1981	.240	3.68	51.0
1982	.256	4.04	45.40
1983	.218	2.85	37.54
1984	.484	2.83	48.26
1985	.418	1.78	34.00
1986	.496	2.06	26.92

*Area in fishpens assumed the same as 1976

The increasing trend in open water fish catches may be attributed to the effects of fishpen structures which serve as sanctuary of fish species. The Manila catfish, which was practically extinct before the fishpen developed, recovered and the catfish fishery is now back as a common catch of open water fishing. Furthermore, the damages brought about by typhoons every year on the fishpen structure released fish stocks into the open. The decline in fish-pen productivity was due to overstocking which resulted in poor growth of milkfish. The unusual flood in 1985 and the campaign for fishpen demolition by the government is responsible for the reduction in area of fishpens. Fishpen operators were also reluctant to invest further due to uncertainty of policies on Laguna lake.

A more remarkable performance is shown by fishcage production. The average production of tilapia in cages in the lake ranged from 26.97 tons to 51.0 tons. Cage size varies from 50 m² to 200 m² per unit. Stock density per cage of 200 m² size is 15 000 to 20 000 tilapia which can produce 1.5 to 3.0 tons in 4-5 months of rearing.

5. THE SNAIL FISHERY

Many people believe that the snail fishery of the lake was completely wiped out by the fishpen. As shown in Tables 3 and 4 the snail production of Laguna de Bay has remained the largest aquatic output of the lake. Its lowest level of production was in 1976 when snails contributed only 30% of the total fishery production, representing 36 228 tons. This increased to 87% in 1979 and stabilized from 1980 onwards at an average contribution of 55.43% of the total fishery output per year. This maintains the

duck farming industry around the lake. There was a decline in the number of duck farms by 12.2% from 1963 to 1968 and 37.6% in 1978. Duck farming is a highly fluctuating business due to several factors like diseases and the cost of feeds and demand for duck eggs and meat. Fishing households engaged in duck farming often go in and out of this activity depending on the behavior of the market.

6. SOCIO-ECONOMIC IMPACT OF THE FISHPEN

There has been no socio-economic assessment of the impact of the fishpen in Laguna de Bay. However, the physical changes that have taken place in the construction materials of houses and new dwellings, the furniture and electrical appliances found in the fishing households after the advent of the fishpen in the lake are indicators of economic benefits obtained by the lake-shore communities. These amenities were not common in the fishing households prior to the development of the fishpen in Laguna de Bay. The amount of investments brought in by the fishpen generated backward and forward linkages in the region and over the entire country. These are manifested in the following activities:

6.1 Milkfish fry and fingerling production

In view of the higher stock density in fishpens, nursery operators expanded their fry and fingerling output. Fry gatherers are encouraged to collect more in view of the high market demand. These activities generated increased employment opportunities.

6.2 Trucking of fishpen construction materials

There were increased business activities in the manufacture of netting materials, ropes, twines, sinkers and bamboos. All these increased employment opportunities in urban and rural areas.

6.3 Construction of fishpens

Employment of fishermen in the construction of fishpens at the height of its development took place. Even the young children after coming from schools found part-time employment in the cleaning of bamboos.

6.4 Employment as security guards and caretakers in fishpens gave the fishermen alternative occupations.

6.5 Custom labor in harvesting of fishpen stocks was also another alternative occupation opened to groups of fishermen.

6.6 Transportation of fishpen supplies including fingerlings and marketable fish became a permanent business of several entrepreneurs in the lake area.

6.7 Marketing and distribution of fish harvest gave economic activities to some groups of fishermen and their families.

6.8 On-shore businesses such as food shops, sale of ice, fish containers and fish landing and unloading work at landing sites are daily job opportunities opened to short-term job hunters.

6.9 Fish vending became a common sideline activity of some housewives in their daily routine marketing trips, There are many other benefits which accrued to the local governments in terms of sales revenues and business taxes.

7. PRIVATE CAPITAL INVESTMENTS ON FISHPENS

In 1973 the cost of capital investment per hectare of fishpen was ₱8 000.00/ha. In recent years this went up to ₱50 000/ha due to the rapid increase in costs of construction materials. The demand had been on the rise over the last decade.

Based on the recent capital costs of fishpen construction, it is estimated that the total private investment on fishpens is in the order of 91.50 billion considering the total area of about 30 000 ha as of 1985.

The cost of operation per ha of fishpen averages ₱25 000. With a total area of fishpens in 1985, the total operating capital of fishpens was in the order of ₱750 million.

Altogether, private capital invested in Laguna de Bay amounted to ₱2.25 billion. At the exchange rate of ₱20 to US\$1, this is equivalent to US\$125 000 million.

8. PROBLEMS OF FISHPEN OPERATIONS

Fishpen management techniques in Laguna de Bay vary according to the operator's skill and experience. Research work on optimum stock density and species combination have not been determined despite the existence of a pilot demonstration project. The pattern of water flow and water movement of the lake has not also been determined. This is essential in the location of fishpens and the mesh size of nettings for enclosure purposes.

The Philippines suffers from an average of 18 typhoons a year. It would be useful to study the pattern, the strength of typhoons that affect the area so that fishpen locations could be more or less defined in relation to the sections of the lake that are prone to strong wind lashes during typhoon season.

Fishpen size and design also vary according to the operator's capital resources. A policy to this effect is necessary based on economic scale of operation and technical parameters appropriate for the maintenance of good water quality.

9. FISHPEN DEVELOPMENT REGULATION

There is no doubt an overexpansion of fishpens in Laguna de Bay. This was a consequence of the lack of policy guidelines with respect to water rights use allocation and the licensing procedure at the very start of the fishpen development program. There was a draft proposal setting up the mechanics of water rights and permits for the operation of fishpens. This proposal gave priority rights to bona fide resident fishermen of Laguna de Bay. The action needed on this matter did not come about for reasons not well understood. In the absence of such regulatory mechanism, proliferation of fishpens occurred. As a consequence, the fishermen complained of lack of room for their fishing operations which is a legitimate claim.

At present, the LLDA is demolishing the fishpens to accommodate the fishermen's plight. The government must be able to strike a compromise on how the investors could be allowed to get back their capital investments in the fishpen. For this purpose, the PCLL gave a 5-year period on which the existing fishpen operators should move out and give priority to small fishermen to operate fishpens.

Inasmuch as the size of fishpen operations per individual or corporation is known, it would perhaps be useful to limit fishpen operations per individual from 5-15 ha and for corporations 16-50 ha. No more than these size categories should be licensed and no overlapping corporations should be allowed to operate fishpens. The location of fishpens must be based on lake water flow pattern.

A study of the economics of operations should be based on prevailing conditions of the market and the optimum production capacity of Laguna lake should also be undertaken to determine economic size of fishpen and the level of management technique of fishpen aquaculture to maintain good water quality. Fishpen design in relation to water movement is essential.

The Laguna Lake Development Authority should be under the administration of the proposed Department of Fisheries in order to have appropriate technical support and backstopping on fishery research, management and development. This is necessary in order to monitor the fishery production situation and the quality of the aquatic environment for the benefit of generations to come.

The fishpen business is one investment which the government did not have difficulty in selling to the private sector. The government encounters problems on how to get them out of it.

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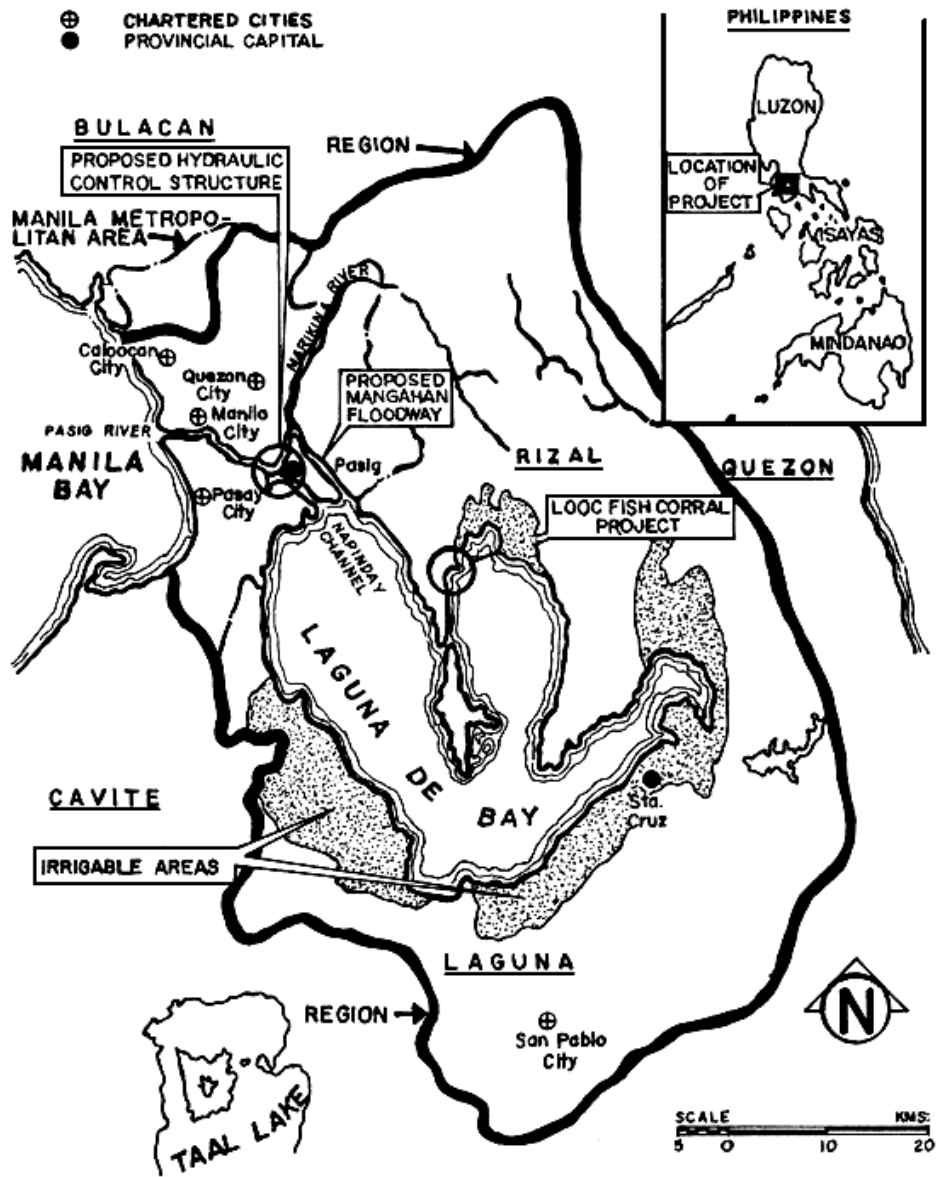


Figure 1. Laguna Lake Development Authority Region

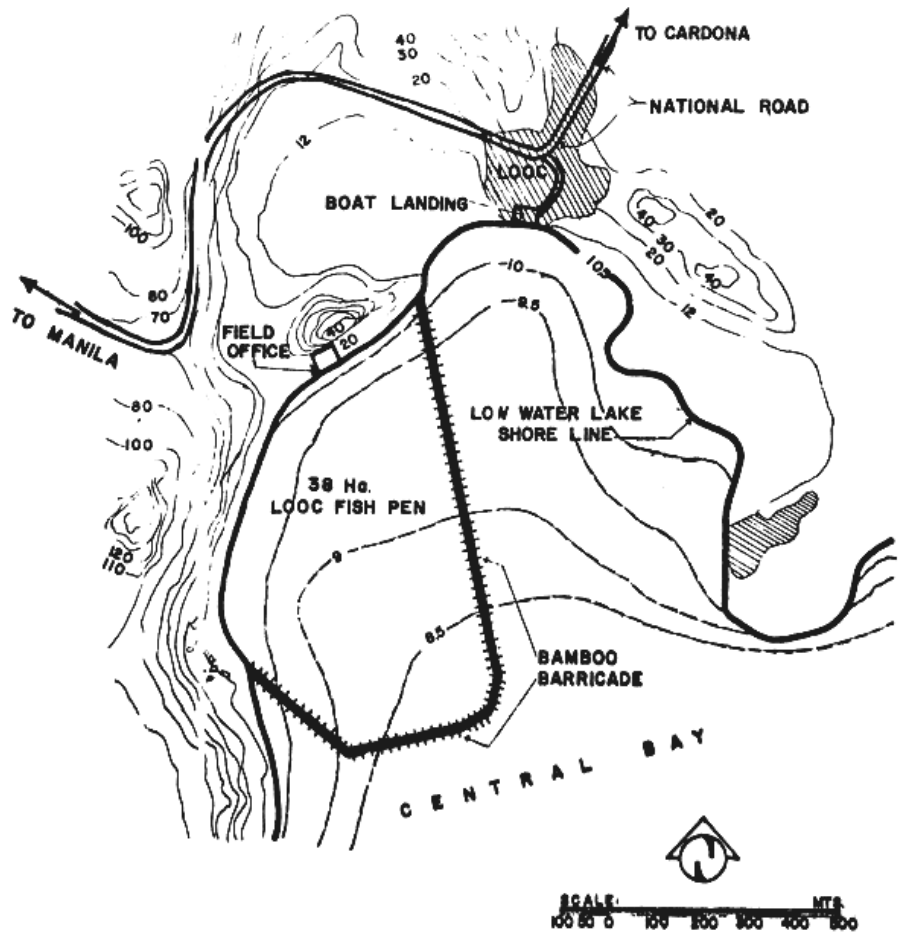


Figure 2. Looc fishpen



Figure 3. Existing fishpens in Laguna de Bay¹

¹ Source: From ADB, 1984

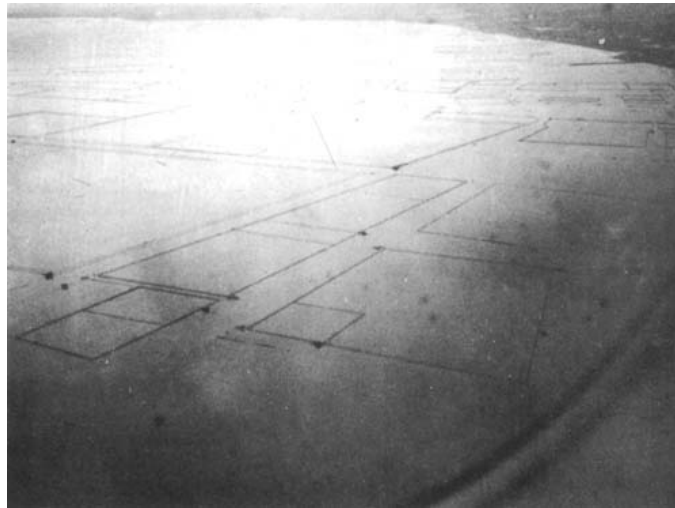


Figure 4. Fishpen in Laguna de Bay

**PUBLICATIONS AND DOCUMENTS OF THE
ASEAN/UNDP/FAO REGIONAL SMALL-SCALE COASTAL FISHERIES
DEVELOPMENT PROJECT**

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