ICLARM CONFERENCE PROCEEDINGS 12

Philippine Tilapia Economics

Edited by
I. R. Smith, E. B. Torres and E. O. Tan

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INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT

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Proceedings of a PCARRD-ICLARM
Workshop
Los Baños, Laguna, Philippines
10-13 August 1983

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IAN R. SMITH
ENRIQUETA B. TORRES
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Printed in Manila, Philippines

Published by the Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna, Philippines and the International Center for Living Aquatic Resources Management, MC P.O. Box 1501, Makati, Metro Manila, Philippines.

Publication was made possible by grants from Planters Products Inc. and San Miguel Corporation.

Smith, I.R., E.B. Torres and E.O. Tan, editors. 1985. Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Cover: Tilapia fishfarmers stocking fingerlings in a pond in Sto. Domingo, Bay, Laguna, Philippines. Photo by Jose Noel A. Morales.

ISSN 0115-4435
ISBN 971-1022-18-4

ICLARM Contribution No. 254

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Preface

The Philippine Council for Agriculture and Resources Research and Development (PCARRD) and the International Center for Living Aquatic Resources Management (ICLARM) co-sponsored a workshop, 10-13 August 1983, on Philippine Tilapia Economics. The workshop brought together Philippine researchers who, with partial financial support from PCARRD and ICLARM during 1982-1983, had conducted an economic analysis of tilapia operations. This volume contains the proceedings of the workshop; which include 18 papers presented, working group reports, discussions and recommendations of the workshop.

The workshop was held at the Continuing Education Center on the campus of the University of the Philippines, Los Baños. Opening remarks for the workshop were given by Dr. Ramon V. Valmayor, Executive Director of PCARRD.

On behalf of PCARRD and ICLARM we would like to express our thanks to all of those individuals who contributed to the success of the workshop. These include not only the researchers and other participants, but also those who assisted behind the scene with workshop logistics, rapporteur notes and other administrative matters. As a group we are especially thankful to all of those private tilapia farmers, government officials and middlewomen who so kindly provided much of the information upon which most of the research papers were based. We would also like to acknowledge with thanks the financial support of Planters Products, Inc. and San Miguel Corporation towards publication costs of these proceedings.

It is our hope that this workshop proceedings will contribute to an understanding of the Philippine tilapia industry so that its current growth and economic vitality can be maintained and nurtured to the ultimate benefit of producers and consumers alike.

IAN R. SMITH
ENRIQUETA B. TORRES
ELVIRA O. TAN

Introduction

Tilapias (*Oreochromis* and *Tilapia* species) are becoming increasingly important as food fish in the Philippines. The industry is growing rapidly as tilapia have become more accepted by consumers. As recently as the mid-1970s, tilapia (primarily *O. mossambicus* at that time) were generally regarded as a nuisance fish by producers and as a low quality product by consumers. In fact, these attitudes still prevail in certain parts of the country. However, elsewhere consumer demand for tilapia has increased dramatically, due in part to the recent availability of more attractive species, especially *O. niloticus.* In many areas of the country, particularly Luzon, the product currently commands prices in retail markets that are comparable to those of other prominent food fish such as milkfish. In response to this consumer demand, the industry is in a dynamic growth stage wherein rapid changes in production techniques and organizational structure of production and marketing are occurring.

Tilapia production systems appear to be well-suited for adoption by small-scale producers because the initial capital investment, especially for cage culture, is not high. Because of declining catch and catch per effort of numerous inland lake fisheries, large numbers of small-scale fishermen have been attracted to cage culture systems and even to small land-based hatcheries where the investment required is comparable to that of a small motorized fishing boat *(banca)* and gear. Larger-scale producers are also increasingly drawn to the industry and several ponds larger than 100 ha are under development.

The increased production resulting from all this enthusiasm will have impacts on marketing systems and perhaps on prices. Depending upon economies of scale in production, small producers may face future difficulties in competing with larger-scale operators. Even in lakes where cages are suitable there is a tendency for numbers to proliferate to the eventual detriment of all producers as overcrowding occurs. Several small lakes in the country (e.g., San Pablo Lakes) have passed through several cycles of profits, overcrowding, withdrawal by marginal producers, profits and overcrowding again.

Because of the industry's potential for providing income to small-scale producers and protein to consumers, an economic analysis was needed to document the industry's current structure and the response of producers to potential profits and of markets to recent increases in production. Possible constraints to further expansion of the industry needed to be identified, whether they were in the form of input (feed and seed) supply limitations and costs, deteriorating quality of broodstock, overcrowding of available production areas, distribution bottlenecks or limited market absorptive capacity.

Both the Bureau of Fisheries and Aquatic Resources (BFAR) and the Philippine Fish Development Authority (PFDA) collect secondary data on production and prices that are useful as background to an economic analysis of the industry. However, for more complete documentation, an in-depth analysis of selected production and marketing systems based on data provided by private input suppliers, producers and marketing intermediaries was necessary. This information is especially important to guide government agencies such as the Ministry of Human Settlements which through its Kilusang Kabuhayan at Kaunlaran (KKK) Program is encouraging private investment by small-scale producers in tilapia production, particularly in cage culture systems.

To fulfill this need for an understanding of the industry, during 1982-1983 PCARRD and ICLARM invited individuals from a number of institutions around the country to participate in a nationwide economic analysis of tilapia production and marketing. Several separate, though complementary research projects were initiated during this period, and results were presented at a workshop in August 1983.

The various research studies undertaken fall into two broad categories:

1) national or regional industry status reports, and
2) economic analysis of selected input supply, production and marketing systems, including problems and successes with extension and technology transfer.

Since production of tilapia is widespread in the Philippines, it was not possible, given the very limited resources available, to undertake an in-depth economic analysis in every region of the country. Therefore, the research activities were concentrated upon selected regions (Central Luzon, Southern Tagalog, Bicol, Western Visayas and Southern Mindanao) and selected production systems within those regions (Fig. 1).

The economic analyses presented at the workshop provided an extremely encouraging picture of this dynamic industry. Fueled by increased consumer acceptance of tilapia, most participants in the industry, including small-scale hatchery operators, grow-out farm

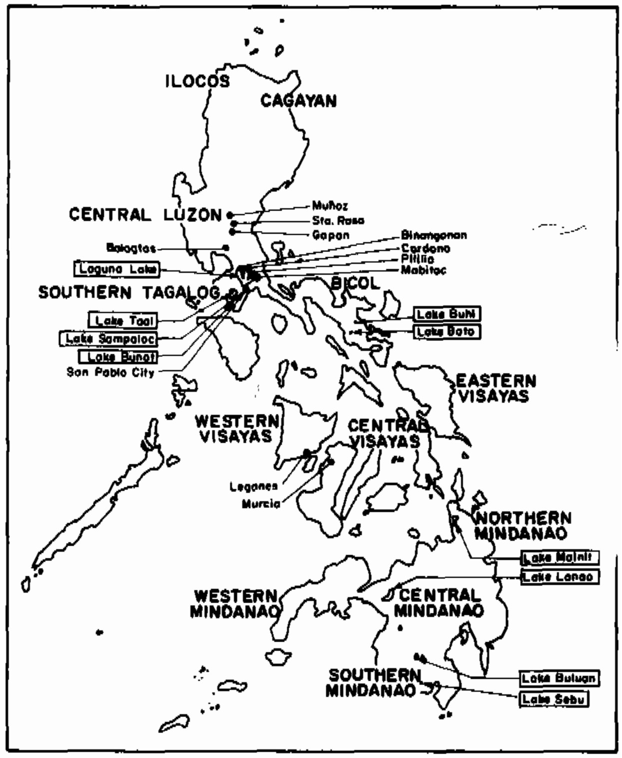

Fig. 1. Map of the Philippines showing areas of tilapia culture studied.

and cage operators and marketing intermediaries earn high profits. Nevertheless, several serious problems face the industry. Paramount among these is deterioration of broodstock and consequently poor quality fingerlings in several locations. Lack of appropriate feed for cage culture is a further constraint. Also overcrowding of some small lakes with tilapia cages has occurred and poaching remains a serious problem in some locations. High consumer demand prevails primarily on the northern island of Luzon in the Philippines and production is somewhat limited in the southern part of the country.

The workshop participants unanimously endorsed the establishment of a National Tilapia Broodstock Center which would seek to maintain and genetically improve tilapia broodstocks in the country. Also recommended was improvement in the national aquaculture statistics. More complete details on the various sectors of the industry can be found in the working group reports at the end of these proceedings.

Session 1: Overview

Tilapia Farming in the Philippines: Practices, Problems and Prospects

RAFAEL D. GUERRERO III

Aquatic Biosystems
Bay, Laguna
Philippines

GUERRERO, R.D. III. 1985. Tilapia farming in the Philippines: practices, problems and prospects, p. 3-14. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

Tilapias are important food fish cultured in developing countries. In the Philippines, in terms of annual production these fish are second only to milkfish in importance. Various farming techniques are applied by the industry for commercial tilapia production in fresh and brackishwater ponds, and cages and pens in lakes. Several factors contributed to the successful development of the tilapia industry including the energy crisis which favored aquaculture over capture fishing, improved technology made available by researchers and the ingenuity of Filipino fishfarmers. Total tilapia production is estimated to exceed 50,000 tonnes annually.

Culture methods for producing fingerlings and market-size fish are discussed in detail. The critical issues that need to be addressed for further expansion of tilapia farming to proceed are the need for improvement of broodstock, commercial production of economical feeds and development of market strategies. On the whole, however, the future outlook for tilapia farming in the Philippines is very encouraging.

Introduction

Tilapias are warmwater foodfish cultured in over 30 developing countries. These fish are suitable for farming because they can be bred easily, and are hardy and high-yielding. In 1979, the world production of tilapias and other cichlid fishes was 368,316 tonnes (t) (FAO 1980).

Culture of tilapia began in the Philippines with the introduction of the Mozambique tilapia *(Oreochromis mossambicus)* in 1950 from Thailand. Since then, three other species and several hybrids have been introduced. A total of 16 known introductions is recorded in Table 1, but complete details on the introduction of *Tilapia zillii* to the country are not known.

Because of improper management, the growing of *O. mossambicus* in backyard ponds in the early 1950s did not flourish. Overcrowding of ponds due to excessive breeding of the species resulted in small fish and disappointment of farmers. Much worse, the low-valued fish invaded brackishwater ponds and became a scourge to culturists for some time because they competed for space and feed with the higher-priced milkfish *(Chanos chanos)* traditionally grown in these ponds.

Renewed interest in tilapia culture came about in the country with the introduction of the Nile tilapia *(Oreochromis niloticus)* in 1972. This fish was better accepted by farmers and consumers alike because of its faster growth and lighter color. From that date, the growth of the tilapia farming industry in the Philippines has been dynamic and phenomenal.

Several factors have contributed to the successful development of the tilapia industry. One significant factor was the energy crisis in the 1970s that shifted the emphasis of the government and the interest of the private sector from marine fishing to aquaculture. Technical innovations developed by researchers and scientists for the improved pond management of tilapias also encouraged fishfarm operators to take a second look at the fish. The ingenuity of the Filipino fishfarmer who is credited with initiating the commercial cage and pen culture of tilapia was also a major contribution.

There are several dimensions to the current commercial production of tilapia in the

Table 1. Tilapia introductions in the Philippines (1950-1982).

Species	Year	Origin	Agency
Oreochromis mossambicus	1950	Thailand	BFAR[a]
O. hornorum x *O. mossambicus*	1971	Singapore	Private sector
O. niloticus (Uganda)	1972	Israel	LLDA[b]
O. niloticus (Egypt)	1972	Thailand	BFAR
Tilapia zillii	1973(?)	Taiwan (?)	?
O. aureus	1977	USA	CLSU[c]
O. niloticus (Ghana)	1977	Israel	CLSU
O. niloticus (Ghana)	1977	Singapore	BFAR
O. aureus (Israel)	1977	Singapore	BFAR
O. aureus (Israel)	1978	Singapore	SEAFDEC[d]
O. niloticus (Ghana)	1979	Singapore	SEAFDEC
Red tilapia (hybrid)	1979	Taiwan	SEAFDEC
Red tilapia	1981	Taiwan	Private sector
O. aureus (Israel)	1982	Israel	Private sector
O. niloticus (Ghana)	1982	Israel	Private sector
Red tilapia	1982	Taiwan	Private sector

[a]Bureau of Fisheries and Aquatic Resources.
[b]Laguna Lake Development Authority.
[c]Central Luzon State University.
[d]Southeast Asian Fisheries Development Center.

country. Foremost are the pond and cage culture sectors that produce fingerlings and market-size fish, and the emerging pen culture sector. The Nile tilapia is the most common species being farmed in these sectors. Gaining popularity among consumers, particularly in the plush Chinese restaurants of Metro Manila, is the red tilapia.

The tilapia ranks second only to milkfish in terms of fish production from aquaculture in the country. While no reliable statistics are available, it is strongly believed that the volume of tilapia produced from Philippine inland waters is quite substantial, probably over 50,000 t annually (Table 2).

Tilapia Hatchery/Nursery Systems

Fingerlings are necessary inputs for stocking ponds, cages and pens. The various hatchery and nursery systems applied by industry may be categorized into: (1) land-based systems and (2) lake-based systems.

Land-based systems

The bulk of tilapia fingerlings is produced from freshwater ponds of the Bureau of Fisheries and Aquatic Resources (BFAR) and private hatchery operators. In 1982, the 31 freshwater fishfarms of the BFAR in the 12 regions of the country produced about 34.8 million fingerlings (Table 3). The private sector could easily have produced half this amount, for a total production of more than 50 million fingerlings.

Small-Scale Breeding/Nursery Ponds. Manually-dug backyard ponds with areas of 200-400 m^2 and depths of 1-1.5 m are used as breeding ponds by small-scale hatchery operators in Bay, Laguna Province (Comia 1982). The ponds are fertilized with chicken manure at the rate of 1,000 kg/ha and stocked with 200 breeders, weighing 50-100 g each and having a sex ratio of 1:4 (male to female). Supplemental feeding of breeders is done by giving rice bran or pollard (wheat bran) at 1-1.5% of fish body weight twice a day.

Two weeks after stocking of breeders, schooling fry are scooped from the pond daily in the morning and transferred to rearing *hapas* (inverted mosquito nets). The fry are kept in the net enclosures at a density of 500-1,000/m^2 for about one week with feeding of rice bran. Fingerlings from the hapas are sorted according to size and sold or stocked in nursery ponds for further rearing at

Table 2. Estimates of tilapia production from Philippine inland waters.

Production system	Area (ha)	Average yield (kg/ha/yr)	Annual harvest (t)
Aquaculture			
Brackishwater ponds	182,000	100[a]	18,200
Freshwater ponds	12,000	1,000	12,000
Cages/pens	1,000	10,000	10,000
Open-water fishing			
Lakes and reservoirs	200,000	50	10,000
		Total	50,200

[a]Primarily a by-product of brackishwater production of milkfish and shrimps. Currently only a small number of brackishwater pond operators deliberately stock tilapia fingerlings.

Table 3. Freshwater fingerling production of BFAR fishfarms in 1982 (BFAR Extension Division).

Region	Fishfarm	Fingerling production ('000)
I (Ilocos)	San Isidro Fishfarm	2,419
	Batac Fishfarm	808
	Laoag Fish Nursery	302
	Paoay Lake Fish Nursery	522
	Pasuquin Fishfarm	703
	Sta. Rita Fishfarm	365
	Vigan Fish Nursery	395
	Natividad Fishfarm	922
	Bolinao Fishfarm	653
	La Trinidad Fish Nursery	689
II (Cagayan)	Lal-lo Fishfarm	67
	San Mateo Fishfarm	628
	San Pablo Fishfarm	303
	Banawe Fishfarm	38
III (Central Luzon)	Magsaysay Memorial Fish Nursery	1,089
	Marataf Project Fishfarm	79
	BFAR-USAID Fish Hatchery	3,000
IV (Southern Tagalog)	Butong Fishfarm	1,247
	Los Baños Fishfarm	1,725
	Bay Fishfarm and Nursery	6,550
	Sta. Cruz Fishfarm and Nursery	287
V (Bicol)	Buhi Fishfarm	2,400
	Bato Fish Hatchery	2,086
VI (Western Visayas)	Western Visayas Fishfarm	502
VII (Central Visayas)	San Francisco Fishfarm	424
VIII (Eastern Visayas)	Leyte Fish Hatchery	1,916
IX (Western Mindanao)	Calarian Fish Hatchery	9
X (Northern Mindanao)	Kitcharao Fishfarm	2,606
XI (Southern Mindanao)	Nabunturan Fishfarm and Nursery	706
XII (Central Mindanao)	Tacurong Fishfarm and Nursery	1,138
	Marantao Fishfarm and Nursery	238
	Total	34,816

a density of 200-400/m^2. The same fertilization and supplemental feeding practices applied in breeding ponds are usually also done for nursery ponds.

Fry production per female averages about 250 per spawning, with 50% of the breeders expected to spawn each month. A 200-m^2 breeding pond can produce 16,000-20,000 fry in a month.

After approximately a month of breeding activity, the ponds are drained by gravity or pump and the remaining fingerlings collected. The ponds are refilled with irrigation water or shallow well water to a depth of about 50 cm, fertilized and then restocked with breeders for the next production cycle. Breeders are generally replaced when they attain sizes of 250-350 g each.

The fingerlings sold are graded by means of nets of different mesh sizes. In 1983, the prices for the fingerlings, depending on size, ranged from ₱0.06 to ₱0.16 (US$0.005-0.015)[1] (Table 4).

Medium-Scale Breeding/Nursery Ponds. In the private commercial tilapia hatcheries of Halayhayin and Quisao in Pililia, Rizal Province, two different methods of producing and nursing young Nile tilapia are practiced. These two methods are the open-pond method and the *hapa*-in-pond method.

[1] In June-August 1983, US$1 = ₱11.

The open-pond method of breeding tilapia in Pililia is similar to the method practiced by the small-scale hatchery operators in Bay. A higher production of fry per unit area, however, is obtained from the Pililia ponds. The breeding ponds in Pililia are supplied with free-flowing underground water. Ponds are fertilized with chicken manure at the rate of 1,000 kg/ha. Water depth is maintained at 0.5-0.75 m. Breeders are stocked at a density of 4/m^2 with a sex ratio of 1:3 (male to female) and fed with a diet consisting of 25% fish meal and 75% fine rice bran at the rate of 2% biomass per day (Taduan, pers. comm.).

Collection of fry with dipnets is done six times a day at two-hour intervals starting at 7:00 a.m. Production of 7-8 fry/m^2/day is obtained from 200-m^2 ponds in 45-60 days compared to 3 fry/m^2/day in the Bay ponds. The higher production of the Pililia ponds can be attributed to the higher stocking rate of breeders, better water quality, improved feeding and more frequent collection of fry.

Newly collected fry are transferred to fine-mesh *hapas* at 500-1,000/m^2 and fed with a diet of 40% fish meal and 60% fine rice bran for 1-2 weeks. Following this period and after being graded by size, they are stocked in 100-m^2 nursery ponds at a density of 200-400/m^2 and reared with supplemental feeding for 1-2 weeks. Feeding rates of the fry and fingerlings are 8% and 6% of biomass per day, respectively. Some hatchery operators use broiler mash (23% crude protein) as feeds.

Table 4. Standard measurements, age and 1983 price of tilapia fingerlings in Bay hatcheries.[a]

Net size (No.)	Mesh size (mm)	Average total length (cm)	Weight (g)	Age (weeks)	Unit price (Pesos)
32	3	1.6	0.06-0.1	2	0.06
24	4	2.1	0.2 -0.4	3	0.10
22	6	2.6	0.5 -1.0	4	0.12
17	9	4.7	1.1 -1.5	5	0.14
14	11	5.7	2.0 -3.5	6	0.16

[a] Data provided by Mr. Orlando Comia of the BFAR Demonstration Fishfarm, Sto. Domingo, Bay, Laguna.

The *hapa*-in-pond method for breeding Nile tilapia is primarily practiced by Mr. Ludovico Tibay of Pililia, Rizal (Lampa 1981). By 1983, Mr. Tibay's Tiger Farm was producing 11 million fingerlings annually using five hundred 3x3x1.5-m fine-mesh *hapas* for breeding. Each *hapa* is stocked with 7 males and 50 females (1:7). Poultry mash is used for feeding breeders and fry are collected every 2-3 weeks by lifting the *hapas* and emptying their contents. An average production of 60 fry per spawner per month has been reported for this hatchery (Bautista 1983).

Large-Scale Breeding/Nursery Ponds. The 10-ha Freshwater Fish Hatchery of the BFAR-USAID (United States Agency for International Development) in Muñoz, Nueva Ecija Province, produced 3 million fingerlings of Nile tilapia in 1982. Breeding ponds (0.45 ha each) are stocked with tilapia breeders (50-450 g) at 200-400 kg total biomass per hectare. A 1:3 male to female sex ratio of breeders is used. Ponds are fertilized with chicken manure and inorganic fertilizer (ammonium phosphate) at the rates of 750 kg/ha/week and 25 kg/ha/week, respectively. The chicken manure is broadcast on the pond while the inorganic fertilizer is applied using underwater platforms. No supplementary feeding is practiced, which contrasts sharply with management methods currently practiced by the private hatchery operators.

Fingerlings are harvested monthly from the breeding ponds by using a seine. The average production from six 0.45-ha (total area = 2.7 ha) ponds during a 150-day period was 147,000 fingerlings/ha/month. The fingerlings had a mean weight of 2.4 g. Larger-sized fingerlings (15-25 g) are produced by stocking the smaller fingerlings in rearing ponds at 250,000-300,000 pieces/ha (Broussard et al. 1983).

Breeding of Tilapia in Concrete Tanks. The breeding of tilapia in concrete tanks is done by only a few commercial operators. Bautista (1983) recommends the use of tanks with 20-t water capacity, area of not less than 40 m^2 and water depth 0.5-0.75 m. The tanks are stocked with 4-6 females/m^2. The male: female sex ratio of breeders is 1:7. Feeding of the broodfish is with broiler starter crumbles or commercial fish pellets at a rate of 2.5% of biomass twice a day (morning and afternoon). The average fry/fingerling production per spawner from this system is 80-100/month.

Lake-based system

In Laguna de Bay, a 90,000-ha freshwater lake on the outskirts of Manila, net enclosures installed in areas with relatively calm waters such as coves are used for tilapia fry and fingerling production. In 1981, the Laguna Lake Development Authority (LLDA) established a lake-based hatchery/nursery facility at Looc, Cardona, Rizal (Garcia and Medina 1983). Double-net cages consisting of an inner coarse mesh (30 mm) net cage measuring 10x2x1 m enclosed by an outer fine-mesh net cage (12x4x1.5 m) facilitate collection of fry and replacement of breeders.

Breeders are stocked at a density of 4/m^2 with a male:female sex ratio of 1:3 and fed with fine rice bran at 3% of body weight per day (Guerrero and Garcia 1983). A 0.2-ha lake-based hatchery can produce 200,000 fry in four months. After collection the fry are stocked in rearing *hapas* measuring 10x2x1.5 m each, at densities of 500-1,000/m^2. Feeding with fine rice bran at 6-8% of biomass per day is done for two weeks. After two weeks in the rearing hapas, the fingerlings are transferred to B-net cages (6.5 mm mesh) at 250-500/m^2 for further growth. Feeding in the fingerling cages is with fine rice bran at 4-6% of body weight per day.

Industry Practices for Improvement of Tilapia Broodstock and Production of Quality Fingerlings

Concomitant to the mass production of tilapia fingerlings is the need for quality control to ensure fast-growing stocks. Poor growth of fingerlings attributed to inbreeding depression has already been reported in some fishfarms in Laguna de Bay (Anon. 1982). In attempts to avoid these problems, private tilapia hatchery operators in the Philippines practice several methods for improving their broodstock and producing quality fingerlings. These methods are crossbreeding of different strains, hybridization and sex reversal.

Fingerlings produced from the cross between the *O. niloticus* from Thailand and the *O. niloticus* from Singapore grow to sizes of 150-180 g each in 70-90 days during the months of April to July in cages at a density of $15/m^2$ without supplemental feeding (Bautista 1983). Some operators use the female or male breeders of another hatchery to crossbreed with their stocks in an attempt to avoid inbreeding.

In pond experiments, Guerrero et al. (1980) found the performance of the male *O. aureus* x female *O. mossambicus* hybrid better than those of the male *O. niloticus* x female *O. mossambicus* and male *O. aureus* x female *O. niloticus* hybrids. Bautista et al. (1981) found the hybrid of male *O. niloticus* x female *O. aureus* to have grown significantly faster than the hybrid of the reciprocal cross in cages. Guerrero (1983) compared the growth of *O. niloticus* and the hybrid male *O. niloticus* x female *O. aureus* in net cages and found the hybrid to be faster growing than the purebreed.

A private group in Sta. Rosa, Nueva Ecija, is currently engaged in the commercial culture of the tilapia hybrid, male *O. aureus* x female *O. niloticus.* Pure strains of the parent stocks were obtained from Israel in 1982. The F_1 progenies of such cross attain sizes up to 440 g in six months and have a percentage of males higher than 85% (Cohen, pers. comm.).

The commercial production of sex-reversed fingerlings of Nile tilapia is being applied by another private company, the TOL Aquatic Resources in San Pablo City, Laguna. In 1982, the firm produced 500,000-700,000 fingerlings (90-95% males) which had been treated with 40 ppm methylestosterone in the diet for 3-4 weeks. The fry were treated in indoor tanks where they were stocked at a rate of $1{,}000/m^2$. Growth of the sex-reversed tilapia in cages is reported to be 25% faster than the untreated fish (Tocino, pers. comm.).

The commercial production of red tilapia fingerlings is done by at least two groups in the country. These private firms are Bio-Research and the Hantex Aquaculture Center. Breeding of tilapia in aquaria and concrete tanks is practiced by these companies; no details on their production are available, however.

Grow-Out Systems for Tilapia

Tilapia is grown to market-size in ponds, cages and pens. For pond culture, brackish-water and freshwater ponds are used while tilapia culture in cages and pens is a rapidly expanding industry in various freshwater lakes.

Pond culture

In brackishwater fishponds, the Mozambique tilapia is the predominant species. While not deliberately stocked in most cases, the fish invades ponds stocked with milkfish. With its propensity for breeding, the tilapia multiplies and is harvested along with the main crop. To rid the pond of competitors of the milkfish, eradication of the tilapia is normally attempted during pond preparation. Chemicals such as Gusathion are used for this purpose, but tilapia still get into the ponds when they are filled prior to milkfish stocking. Production of tilapia as a byproduct of milkfish is estimated to be 50-200 kg/ha/year.

The culture of Nile tilapia in brackishwater ponds has been tried by only a few operators. For example, a farmer in Balagtas, Bulacan stocked 9,500 fingerlings (2 g average weight) in a 1.2-ha brackishwater fishpond in December 1972 and harvested 8,200 fish weighing about 100 g each after five months of culture. The pond was fertilized with chicken manure and inorganic fertilizer with the recommended rates of 1 t/ha/crop and 50 kg/ha/2 weeks, respectively. No reproduction of the fish was found at salinities up to 22 ppt (Barrera, pers. comm.).

Studies conducted at the Brackishwater Aquaculture Center in Leganes, Iloilo (Dureza, pers. comm.) indicate that survival of Nile tilapia young is adversely affected by salinities higher than 15 ppt. However, growth and survival of fingerlings are not affected at salinities up to 30 ppt, if proper acclimation is done. Brackishwater culture of Nile tilapia has not yet caught on with the private sector, however.

BFAR statistics show that in 1981, the area of privately owned freshwater ponds in ten regions of the country was 12,288 ha. These ponds produced an estimated 10,634 t of fish (mostly tilapia). The three top-producing provinces are Nueva Ecija (5,828 t), Pampanga (4,514 t) and Pangasinan (1,064 t), all in Central Luzon.

Commercial culture of Nile tilapia in freshwater ponds was stimulated in the mid-1970s by technologies generated by the Freshwater Aquaculture Center of Central Luzon State University in Muñoz, Nueva Ecija Province. One of the more successful fishpond operators in Central Luzon is Mr. Magno Velayo of Gapan, Nueva Ecija. From a 20-ha fishfarm, he harvests 60-200 kg of Nile tilapia daily (Ruiz 1980). Velayo stocks his ponds with 20,000-30,000 fingerlings/ha. Fertilization is applied using 20 bags of chicken manure and one bag of ammonium phosphate (16-20-0) per ha. The fish are fed with a ration consisting of 66% dried broiler manure and 33% fine rice bran twice a day. Selective harvesting of the fish is done after four months of culture, with complete harvest of the fish after five months. An average production of 2 t/ha/crop is obtained.

Monoculture of Nile tilapia in freshwater ponds is the practice of most commercial operators. The Puyat fishfarm in Sta. Rosa, Nueva Ecija, however, uses shrimp, *Macrobrachium rosenbergii*, with the tilapia hybrid of male *O. aureus* x female *O. niloticus* (Delos Santos, pers. comm.).

Integrated animal-fish farming is undertaken by a few operators on a commercial scale. The Montelibano farm in Murcia, Negros Occidental Province, has 7.6 ha of fishponds fertilized with hog manure daily. Red tilapia and Nile tilapia fingerlings are stocked at 20,000 fingerlings/ha. With two crops a year, the farm has an average production of 3 t/ha/year (Montelibano, pers. comm.). According to Hopkins et al. (1981), a net fish yield of 3,549 kg/ha/180 days can be obtained with 103 pigs/ha and 20,000 fish/ha. This latter estimate is based upon experimental data.

Cage culture

Cage culture of Nile tilapia in Laguna de Bay was first demonstrated in the early 1970s by Delmendo and Baguilat (1974). It was not until 1976, however, that commercial production of tilapia in cages was first reported in Lake Bunot, San Pablo City (Radan 1977). The industry further spread to nearby Lake Sampaloc and Laguna de Bay in 1977-78. Currently, there are about 100 ha of fish cages in Laguna de Bay (Garcia, pers. comm.) and an estimated 22 ha of tilapia cages in other lakes and freshwater bodies. Apart from Laguna de Bay, the other lakes with high concentrations of tilapia cages are Lake Buhi (7.9 ha), Lake Buluan (7.5 ha), Lake Bato (7.1 ha) and Lake Mainit (4.0 ha).

Cage culture has provided an innovative approach for fish production in lakes and other inland waters. It is relatively easier to manage and has better protection against typhoons and poachers than fishpens (Lampa 1981). It has also democratized the use of natural resources by increasing the number of small-scale operations that can use this technology. As of June 1983, there were 1,685 beneficiaries of government fish cage culture projects throughout the country with more in the pipeline.

Two types of cages are used for tilapia culture: the floating type and the fixed type. The former is used in deep lakes such as Lake Sampaloc and Lake Taal. The latter is generally the type found in shallow lakes such as Laguna de Bay, Lake Bato, Lake Buhi, Lake Buluan and Lake Mainit.

Tilapia Culture in Floating Cages. These cages vary in size from 10 x 10 m to 20 x 30 m with depths of 5.5-8.5 m. They are made of floating frames from which the net cages are suspended. The net cages (polyethylene, nylon, etc) have a mesh size of 12.7 mm or larger. The cages are anchored by means of concrete weights tied to nylon ropes.

Stocking density of the floating cages varies with the size of cage. In the Lake Sampaloc cages, the density ranges from 14 fingerlings/m^2 to 18 fingerlings/m^2 (Table 5). Nile tilapia fingerlings weighing 12.5 to 16 g each are stocked. Artificial feeding is normally not practiced.

Two growth periods are observed: from February to July (six months), the fish grow to sizes of 200-250 g each; from August to April (nine months), sizes of 250 to 350 g each are attained. The growth rate of the fish in cages is largely dependent on primary production in the surrounding waters and the management practices applied such as the size of the cage, density of fish and the spacing between cages. In Lake Sampaloc, for example, Aquino and Nielsen (1983) reported that congestion of cages in one area of the lake resulted in poor growth of tilapia.

In lakes and reservoirs with low productivity such as Lake Taal and Pantabangan Reservoir, supplemental feeding has been found to be advantageous for hastening fish growth, particularly at high stocking densities. Floating cages (10 x 5 x 3 m) in Lake Taal stocked with 7,500 fingerlings of "Gintong Biyaya" (a local Philippine red tilapia) produced harvestable size fish (100 g each) in four months with artificial feeding (Cas, pers. comm.). Feeding with fine rice bran only at the rate of 5% of fish biomass per day gave significantly better growth of *O. niloticus* than the control (no feeding) with both groups stocked at 200 fingerlings/m^2 in 2 x 2 x 1 m cages in Pantabangan Reservoir (Guerrero et al. 1982).

Tilapia Culture in Fixed Cages. The use of fixed cages for tilapia culture is more extensive than that of floating cages. Fixed cages are appropriate in shallow lakes that are generally more productive than deeper ones. These cages are cheaper to construct and easier to manage than floating cages. Fixed cages are common in Laguna de Bay, Lake Bato, Lake Buhi, Lake Buluan and Lake Mainit.

The fixed cage is made of polyethylene net with 1-2 cm mesh. It varies in size from 5 x 5 x 3 m to 20 x 20 x 3 m. Bamboo poles driven into the mud substratum are used for holding

Table 5. Size, stocking rate and yield of floating cages used in Lake Sampaloc (Austria, pers. comm.).

Cage size (m)	No. fingerlings stocked per cage	Density (no./m^2)	Yield (kg/cage)
10 x 10 x 9	1,800	18	1,200
20 x 10 x 9	3,500	17.5	1,300
25 x 20 x 9	7,000	14	2,600

the cage in place. It may or may not be covered and the bottom of the cage may or may not be in contact with the substratum. When covered, the net cage may be positioned underwater by adjusting its attachments to the bamboo poles to minimize damage caused by floating objects, such as water hyacinth, during typhoons.

The use of nursery cages for rearing small fingerlings to larger size is commonly practiced by cage operators. Stocking density of Nile tilapia fingerlings in fixed cages ranges from 15 to 50 fingerlings/m^2. The culture period lasts from 4 to 12 months depending on the time of the year, stocking density, management practices and location in the lake. The slow growth of tilapia in cages located in the Cardona side of Talim Island in Laguna de Bay has been attributed to poor water circulation and lack of natural food (Garcia and Medina 1983). Without supplemental feeding, 5-cm fingerlings stocked at 15 fingerlings/m^2 can attain sizes of 150 to 180 g from April to July in Laguna de Bay (Bautista 1983). Operators stocking at 50 fingerlings/m^2 with supplemental feeding of rice bran or commercial feeds incur operating costs 5-8 times higher than those stocking at 20 fingerlings/m^2. The profitability of supplementary feeding will depend upon prevailing prices of feeds and market-size tilapia. Fish harvests from fixed cages vary from 3-6 kg/m^2 (Garcia and Medina 1983).

In Lakes Bato and Buhi in the Bicol Region of Luzon, the fixed cages with sizes of 10 x 5 x 3 m and 6 x 5 x 3 m, respectively, are stocked at 30 fingerlings/m^2. The fish attain a size of 100 g each after four months (Panisales, pers. comm.). In Lake Buluan, fingerlings stocked at 30 fingerlings/m^2 in 10 x 5 x 3 m cages grow to 250 g each in four months without supplemental feeding (Bayani, pers. comm.). Growth rates thus appear to be very dependent upon the lake environment and the extent of cage culture in the vicinity.

Tilapia Culture in Fishpens

With the increasing market demand for tilapia and recent difficulties encountered in the culture of milkfish in pens, several fishpen operators have shifted to tilapia culture. The sizes of fishpens recommended for tilapia culture are much smaller than those used for milkfish and range from 0.5-1 ha. The same materials and methods as in the construction of milkfish pens, however, are applied. Stocking rates for Nile tilapia vary from 20 to 50 fingerlings/m^2. With the higher density, supplemental feeding with rice bran or pollard (wheat bran) at 2-3% of fish biomass per day is done (Bautista 1983).

In a 1.5-ha fishpen of the Laguna Lake Development Authority (LLDA) in Cardona, Rizal, stocked at 20 fingerlings/m^2, the fish grew to sizes of 170 to 250 g in 4-6 months without supplemental feeding. Difficulty in harvesting, however, was experienced; a recovery rate of only 15% was reported, although it was evident that most of the fish were still in the pen (Garcia, pers. comm.). The Nile tilapia is known to elude conventional harvesting gear such as seines by burrowing into the mud bottom.

In the 5-ha demonstration module of the LLDA in Casa Real, Mabitac, Rizal, one million fingerlings of Nile tilapia were stocked in July 1982. Sampled fish in June 1983 weighed 350-500 g each. A recovery rate of only 25% was expected, also because of inefficient harvesting techniques. The use of drag nets was not found to be economical. A private operator in Talim Island had no better luck. He recovered only 30% of his stocks from a 1-ha fishpen using seines and gill nets simultaneously for one week.

Tilapia growth in pens is faster than in cages. The problem of harvesting, however, will have to be dealt with more efficiently to ensure the viability of the culture system (Garcia, pers. comm.).

Problems and Prospects of the Tilapia Farming Industry

Three major areas of concern are critical for the further development of the tilapia farming industry in the Philippines. These are: (1) the need for improvement of tilapia broodstock for the production of high quality fingerlings, (2) the commercial production of economical feeds for intensive culture and (3) development of market strategies.

The deterioration of fish stocks due to lack of broodstock management is evident in many tilapia hatcheries, both government and private. Unless these hatcheries embark on practical programs such as upgrading of strains, hybridization or sex-reversal, the problem of slow-growing stocks will continue to worsen.

Intensification of tilapia culture in cages, pens and ponds will be the trend in the near future because of the higher yields that can be achieved. Application of intensive culture systems will depend on the availability of commercial feeds, however. While some commercial fish feeds are being tested in the market today, the economic viability of these intensive systems remains to be documented.

In many areas of the country, particularly where fish cages have proliferated, such as in lakes of Bicol and Mindanao, the problem of oversupply of tilapia in the local market has been reported. This problem can perhaps be tackled by diversifying product lines. Aside from fresh fish, processing of the product (e.g., smoking, drying and canning) should be looked into. Commercial production of other tilapia species and/or hybrids may also help.

Despite these problems, the future outlook for tilapia farming in the Philippines is very encouraging. As our human population continues to increase in the years to come, there will always be a pressing need for producing animal protein foods such as fish at low cost for our people. With the availability of a domesticated animal like the tilapia for which its environment can be completely controlled, attaining the national goal of self-sufficiency in fish seems achievable.

References

Anon. 1982. Experts warn against ill effects of inbreeding. Philipp. Farmer's J. 24(3): 27.

Aquino, L.V. and B.H. Nielsen. 1983. Primary production and growth rate of *Oreochromis niloticus* in cages in Sampaloc Lake, Philippines, p. 453-463. *In* L. Fishelson and Z. Yaron (comps.) International Symposium on Tilapia in Aquaculture, Nazareth, Israel, 8-13 May 1983, Tel Aviv University, Tel Aviv, Israel.

Bautista, A.M. 1983. Cage and pen farming management and maintenance in lakes. Aquaculture Department, Southeast Asian Fisheries Development Center, Binangonan, Rizal.

Bautista, A.M., B. Orejana and P. Valera. 1981. Culture of *Tilapia aurea* and *Tilapia nilotica* hybrids in cages in Laguna de Bay. Southeast Asian Fisheries Development Center, Binangonan Research Station, Binangonan, Rizal, 8 p.

Broussard, M.C., R. Reyes and F. Raguindin. 1983. Evaluation of hatchery management schemes for large scale production of *Oreochromis niloticus* fingerlings in Central Luzon, Philippines, p. 414-424. *In* L. Fishelson and Z. Yaron (comps.) International Symposium on Tilapia in Aquaculture, Nazareth, Israel, 8-13 May 1983, Tel Aviv University, Tel Aviv, Israel.

Comia, O.Z. 1982. Tilapia breeding--a profitable backyard industry. Fish. Newsl. 11(1): 70-73.

Delmendo, M.N. and T.B. Baguilat. 1974. Experiments on lake fish culture techniques. First Annual Tech. Report NSDB-LLDA Project No. 7301-Ag. 14 p.

FAO. 1980. 1979 Yearbook of fishery statistics, Vol. 48. Food and Agriculture Organization of the United Nations, Rome, Italy.

Garcia, A.M. and R.T. Medina. 1983. The state of development on cage culture in Laguna Lake. Paper presented at the Seminar Workshop on the State of Development of Laguna Lake. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna, Philippines.

Guerrero, R.D. III. 1983. A comparative study on the cage culture of *Tilapia nilotica* and male *T. nilotica* x female *T. aurea* hybrid in Laguna de Bay. Paper presented at the 5th Annual Meeting of the National Science Technical Authority, Bicutan, Metro Manila. 6 p.

Guerrero, R.D. III and A.M. Garcia. 1983. Studies on the fry production of *Oreochromis niloticus* in a lake-based hatchery, p. 388-393. *In* L. Fishelson and Z. Yaron (comps.) International Symposium on Tilapia in Aquaculture, Nazareth, Israel, 8-13 May 1983, Tel Aviv University, Tel Aviv, Israel.

Guerrero, R.D. III, A.G. Cagauan and T.A. Abella. 1980. Pond evaluation of three tilapia hybrids. CLSU Sci. J. 1(1): 15-18.

Guerrero, R.D. III, R.C. Sevilleja and A.M. Tolentino. 1982. Studies on the cage culture of *Tilapia nilotica* in Aya Reservoir and Laguna de Bay, Philippines. Paper presented at the Regional Workshop on Limnology and Water Resources Management in Developing Countries of Asia and the Pacific, Kuala Lumpur, Malaysia.

Hopkins, K.D., E.M. Cruz, M.L. Hopkins and K-C. Chong. 1981. Optimum manure loading rates in tropical freshwater fishponds receiving untreated piggery wastes, p. 15-29. *In* The ICLARM-CLSU integrated animal-fish farming project: poultry-fish and pig-fish trials. ICLARM Technical Reports 2, 29 p. International Center for Living Aquatic Resources Management, Manila, and the Freshwater Aquaculture Center, Central Luzon State University, Nueva Ecija, Philippines.

Lampa, R.D. 1981. Raising tilapia in a big way. Greenfields 11(10): 6.

Radan, R.R. 1977. The floating fish cages of Lake Bunot. Greenfields 7(4): 20-24.

Ruiz, L.R. 1980. Magno Velayo: tilapia king of Nueva Ecija. Greenfields 10(2): 28.

Session 2: Tilapia Hatcheries

Economics of Private Tilapia Hatcheries in Laguna and Rizal Provinces, Philippines

LUZ R. YATER

AND

IAN R. SMITH

International Center for Living Aquatic Resources Management (ICLARM)
MC P.O. Box 1501, Makati, Metro Manila
Philippines

YATER, L.R. AND I.R. SMITH. 1985. Economics of private tilapia hatcheries in Laguna and Rizal Provinces, Philippines, p. 15-32. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

This paper provides the results of a late-1982 survey of 80 privately operated tilapia hatcheries in Laguna and Rizal Provinces of the Philippines. Sample hatcheries represented approximately 20% of the total enumerated hatcheries in these two provinces. The "experimental" nature of fingerling production practices is documented, particularly variability in broodstock management, supplementary feeding and rates of fertilizer application. Average costs and returns are reported for various hatchery sizes, all of which reported positive net revenue. The average hatchery in these two provinces in 1982 was 3,900 m^2 in size, produced 488,200 fingerlings and earned a total revenue of ₱66,170. After deducting all costs of ₱31,390 (including that of feeds which made up 39% of variable costs), the average hatchery earned a residual return to operator's own and family labor, capital, management and risk of ₱34,780 or approximately ₱890/100 m^2. (₱11.00 = US$1.00).

In the near term, these high returns can be expected to continue to attract both small-scale and large-scale investors into the business. Coupled with problems of inadequate broodstock quality control among the hatcheries surveyed, however, this increased competition is going to make it difficult for the Rizal and Laguna hatcheries to maintain their present competitive advantage and high rates of return. The paper concludes with a recommendation for intensified public sector efforts in the areas of research, extension and information dissemination to improve broodstock management practices and reduce production costs.

Introduction

Fish fry and fingerlings are as essential to fishfarmers as rice seeds are to paddy farmers. They are the basic input which enables repitition of the production cycle and regular supply of high quality fish seed is necessary to support any viable aquaculture industry. Fishfarmers must either produce their own seed supply or depend upon hatchery specialists or supply from the wild.

Increased consumer acceptance of tilapia has prompted rapid growth in the Philippine tilapia industry and consequently increased demand for seed (fry and fingerlings) for stocking in cages, pens, ponds and rice paddies (Guerrero 1982). As the industry grew during the 1970s, much of this needed seed was supplied free of charge or for a nominal fee by hatcheries of the Bureau of Fisheries and Aquatic Resources (BFAR). Beginning in the late 1970s, however, private entrepreneurs began to specialize in tilapia hatchery operations and numerous small hatcheries were established in Rizal and Laguna Provinces, primarily to supply the growing number of cage operators of nearby Laguna de Bay (Lampa 1981). The nearby Metro Manila market has been the primary outlet for these Laguna de Bay producers.

As Guerrero (1982) points out, however, it was not until the availability for culture of Nile tilapia *(Oreochromis niloticus)* that the industry's recent expansion occurred. Earlier introductions of *O. mossambicus* had not been commercially successful because the fish was not attractive to consumers and bred with such frequency that fishponds quickly became overcrowded. Fishfarmers viewed tilapia as pests and eradicated them when possible. Recent advances in monosexing and particularly cage culture where overcrowding does not occur, coupled with the availability of the more attractive *O. niloticus*, have resulted in a complete turnaround in both producer and consumer attitudes regarding tilapia. Currently, tilapia sells in Metro Manila markets at prices comparable to other first-class fish such as milkfish *(Chanos chanos)*. Both BFAR and private hatcheries have therefore concentrated upon producing *O. niloticus* fingerlings.

However, a review of the literature on Philippine tilapia production (e.g., PCARR 1976; Radan 1979; Guerrero 1980; Guerrero 1981b) indicates that seed supply may still be an important constraint to further development of the industry. The major problems identified by these authors were: (1) supply shortage, (2) high mortality of fingerlings related to handling and transporting and (3) poor quality of broodstock. An in-house report of the Ministry of Agriculture (1976) showed "lack of fingerlings" as the primary problem facing the users of rice-fish technology and Guerrero (1981b) mentions the shortage of fingerlings as one of the major problems affecting tilapia cage culture in the Philippines.

It appears, however, that the seed shortage problem is very location-specific. Producers in the vicinity of Metro Manila, such as cage operators in San Pablo Lakes, apparently have no difficulty obtaining fingerlings due to the proximity to the many hatcheries of Laguna Province (Sevilla 1981). Nevertheless, elsewhere in locations where the hatchery technology has not yet been applied, fingerling supply problems may still exist for the short term.

Considering that seed costs can range from 35-70% of total variable costs for tilapia production in cages or fishponds, the ability of hatcheries to produce low cost, high quality fingerlings is an important element for the continued future success of the industry. In many other countries with tilapia industries, there is a trend towards the establishment of large-scale centralized hatcheries which, in addition to providing potential advantages of economies of scale, appear to be designed primarily to allow for the maintenance of high quality broodstock (Lovshin 1982; Mires 1982; Pullin 1982). In the Philippines, the only such large hatchery is that of the Bureau of Fisheries and Aquatic Resources (BFAR) on the campus of the Central Luzon State University in Nueva Ecija Province. The BFAR also has numerous small hatchery-cum-demonstration stations throughout the country. Privately operated hatcheries in the Philippines tend to be small, even backyard operations. These can offer potential advantages of being decentralized in proximity to tilapia grow-out operations and hence lower fingerling mortality in transport. It is of interest to the future of the industry and to the government's desire to develop rural employment and entrepreneurial activities whether the small-scale backyard hatcheries can coexist with the larger centralized government-run hatcheries.

As of mid-1982, almost 450 land-based private hatcheries were operating in the provinces of Laguna and Rizal, near the 90,000-ha freshwater Laguna de Bay (Fig. 1). These hatcheries were enumerated by the authors to construct the sample frame for the economic analysis which is the subject of this paper. If historical growth rates have been maintained as indicated for the sample in Fig. 2, the number of private hatcheries probably exceeded 600 by August 1983. In addition to these land-based hatcheries, lake-based hatcheries are also operated in Laguna de Bay itself and in other nearby lakes in San Pablo.

Despite the rapid growth of tilapia hatcheries over the past five years, no economic analysis has been conducted of their operation to determine their contribution to the industry as a whole or to identify potential problems that may arise in the future regarding seed supply and quality. The purpose of this study was to conduct such an economic analysis of private land-based hatcheries in Rizal and Laguna Provinces.

In addition to compiling a demographic and managerial profile of hatchery operators, this paper also describes management practices, including such aspects as extent of

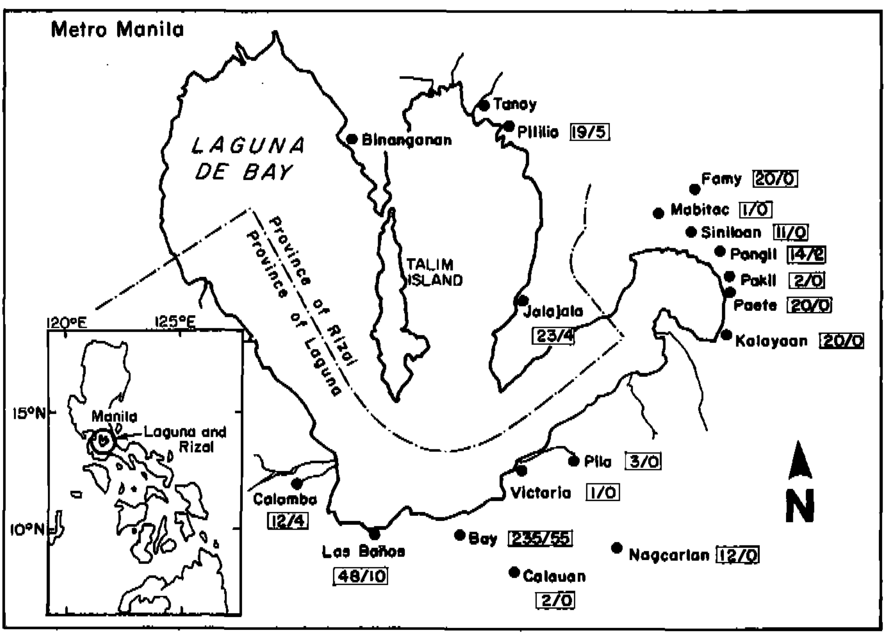

Fig. 1. Laguna and Rizal Provinces showing the distribution of private hatcheries as of mid-1982 and sample hatcheries. Total number of hatcheries in the area was 443, of which 80 were selected for interviews. First number in the box after each location is number of hatcheries in the area; second number is the number of those hatcheries in the sample.

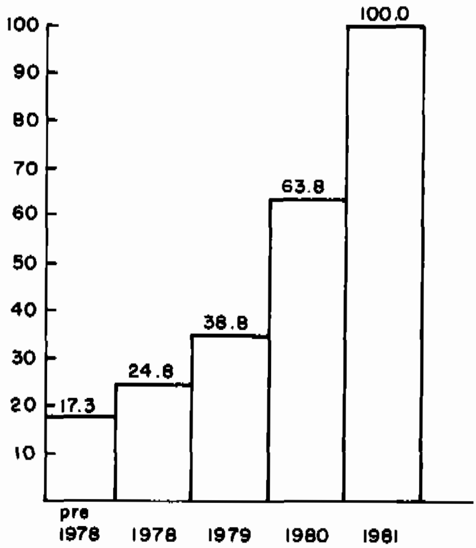

Fig. 2. Cumulative percentage of sample hatcheries in Laguna and Rizal Provinces in operation by year (n = 80).

family labor involvement, sources of broodstock and broodstock replacement practices, quality control, use of supplementary inputs (e.g., feeds), marketing arrangements, operators' attitudes regarding their industry and potential problems limiting its expansion or sustainability. The potential for a continued role for small-scale producers was also of particular interest; consequently, this paper also examines costs and returns by farm size.

The data for this study were drawn from interviews of 80 randomly selected private hatcheries in selected municipalities of Rizal and Laguna Provinces (Fig. 1). Sixty-nine (86%) of these respondents were from Laguna Province and eleven (14%) from Rizal Province. The original sampling plan had called for a 30% sample of hatcheries in each municipality around Laguna de Bay; however, at the time of interviews (September-November 1982) this approach was revised and total sample size reduced to include only those hatcheries which had been in operation for the preceding 12 months or more. Hatcheries which had been established since October 1981 (which included the majority of those in Rizal Province) were therefore not included in this study.

By total farm size, the distribution of the 80 hatcheries in the sample fell into four discrete groups that are used here for reporting purposes:

- $< 1{,}250$ m^2: backyard part-time operations, typically owner operated and requiring only household labor (n = 46).
- 1,250-4,999 m^2: also househould operated but more likely to occupy the full-time involvement of the owner (n = 24).
- 5,000-9,999 m^2: too large for only household operation and most often run by caretakers (n = 5).
- 10,000 m^2 or more: large-scale business operations with significant levels of hired labor (n = 5).

Demographic and Managerial Profile of Hatchery Operators

The majority of the land-based hatcheries in Rizal and Laguna Provinces are owner-operated establishments though this declined somewhat as farm size increased (Table 1). Especially for the smallest backyard type hatcheries, additional household income is earned from farming, fishing or other agricultural employment such as working as laborers at the International Rice Research Institute (IRRI) in Los Baños. Forty-five percent of all operators considered their hatchery to be a secondary occupation only and relied upon other family members for assistance in their hatcheries. Indeed, the majority of small hatcheries were developed either in corners of ricefields or in the foreshore area of Laguna de Bay near residences where they could be easily monitored by family members. Average household size of hatchery operators was 6.6 members and household heads averaged 46 years of age. The youngest operator was 19 years old and the oldest was 76.

Table 1. Managerial and demographic profile of private hatchery owners in Laguna and Rizal Provinces, by farm size (1982).

Characteristic	Farm size < 1,250 m^2 (n = 46)	1,250-4,999 m^2 (n = 24)	5,000-9,999 m^2 (n = 5)	10,000+ m^2 (n = 5)	All farms (n = 80)
% owner operated	96	79	20	60	84
% whose sole occupation is hatchery operation	13	50	20	20	29
% of owners completing some high school education or more	57	33	40	60	49
Ave. years of experience in hatchery operation	2.8	2.9	2.2	5.0	2.9
% who began hatchery business within past 2 years	70	54	80	60	65
% receiving formal training in hatchery operation	13	8	0	0	10
% learning hatchery techniques from BFAR technicians	28	46	0	20	31
% who experienced major flooding problem during September 1982 typhoon	17	25	60	0	21

As a group, tilapia hatchery operators are relatively well-educated compared to other rural residents (Castillo 1979), 46% having completed at least some high school. Fully 25% of operators have either completed some college or graduated therefrom; 7.5% have completed masters degrees. This high level of education is perhaps indicative of the attractiveness of hatchery operation as a business proposition.

While formal education has undoubtedly helped hatchery operators master the technical details of their work, as a group they are still very inexperienced in aquaculture methods and farm management. Two-thirds of all operators began their businesses within the previous two years and their average length of experience is only 2.9 years. Only 10% have received any formal training in tilapia hatchery management practices although almost one-third have benefitted from consultations with BFAR technicians. Such contact tends to be location-specific, however, and confined primarily to the smaller hatcheries in the vicinities of the BFAR experimental stations in the municipalities of Los Baños and Bay. The majority of operators have acquired their skills from other family members and neighbors and in good measure are "learning by doing." An indication of inexperience that led to poor pond siting and inadequate dikes, is the number of hatcheries that were adversely affected by flooding in September 1982 in the aftermath of a relatively minor typhoon. Most of those affected believed that future problems could be avoided for the most part through better pond construction techniques and use of temporary perimeter nets around their ponds or *hapas* (inverted mosquito nets) for broodstock storage.

Hatchery Management

This infant-industry or "experimental" nature of hatchery operations is also evident in the diversity of management practices followed. While the majority of hatcheries are very similar in design (i.e., earthen, excavated ponds, approximately 1-m deep, with water supplied from irrigation canals), there is a variety of practices followed with regard to labor utilization, feeding, fertilizing and broodstock management. Pond sizes also vary considerably, ranging from < 100 m^2 to almost 1 ha in size.

Constructing earthen excavated ponds for hatchery purposes is a labor-intensive activity and requires only simple tools such as hoes and other sharp implements to loosen the soil. Pond construction is commonly accomplished by hiring laborers on a daily or a contractual basis or through an exchange arrangement with neighboring pond operators. Rates for hired labor in 1982 averaged ₱19/day in Rizal and ₱18/day in Laguna. Depending upon the skill level involved and whether or not the individual was a close relative, the daily wage in the two provinces ranged from ₱10-25, not including an approximate ₱5 daily value of food provided to each laborer. Smaller farms which are to be operated solely as a household enterprise tended to depend more upon family labor or upon exchange or ***bayanihan*** arrangements with other prospective hatchery operators. Under the latter arrangement which is also practiced by rice farmers, individuals gave of their time to others with the expectation of reciprocity at a later date. Those receiving "free" labor in this way provide food during the pond digging and, if they choose, may fulfill their obligations by delegating their obligation to another family member.

Operators of larger hatcheries, where timeliness of completion of pond construction may be more important, relied more heavily upon contractual labor. Small groups of laborers who specialize in pond construction have evolved in the two provinces and in some cases are contracted to work in places as far away as Pampanga and other provinces to the north of Manila where extensive brackishwater milkfish ponds are located. However, local specialist groups, armed now with additional experience gained over the past two to three years, are increasingly competitive with these outside groups whose fare and lodging expenses add to their cost. In late 1982, contract pond digging costs were ₱3.00-3.25/m^2 for a 1-m deep pond. Under such an arrangement, a 550-m^2 pond (the average size of the approximately 560 ponds operated by the 80 respondents) would cost just over ₱1,700 to excavate. Since the majority of ponds are much smaller than this (the average pond size of the two smallest categories of hatcheries was only 188 m^2), the costs for hatchery expansion, if land can be obtained, are modest. Only a very small number of hatcheries, and none in the sample, were experimenting with concrete tanks for broodstock holding to minimize land costs.

A typical hatchery consists of a broodstock area and a nursery area. Two major distinctions are between (1) those hatcheries which stock broodstock in ponds and daily gather fry from around the pond edges and stock them either in *hapas* or different ponds and (2) those hatcheries which maintain their broodstock in *hapas* and remove the fry to ponds on a regular basis. The former method is much more common than the latter.

The vast majority of hatchery operators (94%) obtained their initial broodstock from other private farms or from BFAR (Table 2). However, over three-quarters of

Table 2. Broodstock management practices by farm size of hatchery operators in Laguna and Rizal Provinces, 1982.

	Farm size				
	< 1,250 m^2	1,250-4,999 m^2	5,000-9,999 m^2	10,000+ m^2	All farms
1. Source of initial broodstock (%)					
BFAR	37	67	40	80	49
SEAFDEC	0	4	0	0	1
Private farms	59	25	40	20	45
Own fingerlings	4	4	20	0	5
2. Source of current broodstock (%)					
BFAR	7	0	0	0	4
Private farms	22	8	0	0	15
BFAR and private farms	2	4	0	20	4
Own fingerlings	69	88	100	80	77
3. Changing of broodstock (%)					
Changing female breeders after one year's use	48	54	60	60	51
Changing male breeders after one year's use	48	54	60	40	50

operators interviewed obtained their current broodstock from their own fingerlings, thus losing any potential benefit that might be derived from continuously depending upon a reliable source of high quality broodstock. Original stocks were thought to be *O. niloticus,* but personal observations by the authors indicate that considerable contamination has occurred. Broodstock management as practiced departs from recommended techniques in other ways also. For example, Guerrero (1980) recommends stocking breeders at a density of one/2 m^2 (or 5,000/ha) with a sex ratio of one male to four females. While the initial stocking practices of private hatcheries approximated the recommended sex ratio, respondents claimed to initially stock at a density of one breeder/m^2 or twice the density recommended by Guerrero. This higher density, however, has been recommended by Comia (1982). Over time, operators have tended to decrease the male to female sex ratio to a current average of 1:5 and to increase stocking density to two breeders/m^2.

On average, breeders are changed every 21 months and there is little difference among hatcheries in this regard except for those in the 5,000-9,999 m^2 size category which claimed to change their breeders every 15 months. The largest category of hatcheries change their female breeders 10% more often than males. Apart from this aspect of broodstock management, there is considerable variation in prevailing practices, and operators often stated that they were no longer certain of their current exact stocking ratios and densities given their dependence upon their own fingerlings as the primary source of broodstock. It thus became impossible with industry data to relate broodstock densities, sex-ratios, and replacement practices to fingerling production in any meaningful way.

Private hatchery operators were also experimenting with different types of feeds and fertilizers and rates of application. Here, too, exact quantification proved difficult. The most common feeds used were chicken starter mash, broiler pellets, rice bran and *trigo* or pollard (a coarse wheat flour), but egg yolk, skimmed milk, fish meal and *kangkong* (a leafy green vegetable) also found their way into breeders' and fingerlings' diets. Because of the varied price per kg of these feeds,[2] hatchery operators claimed to be seeking various means to reduce their feed costs, which as discussed in the next section of this paper, were approximately one-third of their annual costs of operation.

Rates of application of organic fertilizers (mostly chicken manure) also showed much variation, ranging from none at all in several cases including the largest hatcheries to an average of 8.3 $kg/m^2/yr$ for those hatcheries between 5,000 and 9,999 m^2 in size. To some extent, it appears that some hatchery operators were attempting to substitute regular organic fertilizer applications (which cost approximately ₱0.20/kg) for the more expensive supplementary feeds. However, several hatchery operators complained about irregular supply of organic fertilizers.

Before sale, fingerlings are graded by size through the use of nets of various mesh size (Fig. 3). The larger fingerlings (known as sizes 22, 17 and 14) naturally command higher prices (see Table 3) due to their longer rearing periods. Since Laguna and Rizal hatcheries sell primarily to tilapia cage operators in Laguna de Bay, San Pablo Lakes and Lakes Buhi and Bato in Bicol, the majority of fingerlings sold are between sizes 22 and 14. Hatchery operators were asked to estimate their break-even prices for fingerlings of given sizes and the average of their responses is also shown in Fig. 3. As will be discussed in the next section on costs and returns, these estimates are on average only slightly less than that derived from the survey data (₱0.65/piece), though neither include returns to owned inputs. Still, the apparent margin between estimated production costs and then prevailing prices was considerable.

Due to strong demand for fingerlings and need for large quantities of stocking materials by individual pond and cage culturists, a network of specialist fingerling middlemen is developing. Respondents reported only a limited number of different buyers during the preceding six months, averaging only 1.4 buyers. Small hatcheries in particular sell on a regular basis primarily through *agente* or commissionmen, many of whom are large hatchery operators who make bulk sales particularly to the government livelihood program, Kilusang Kabuhayan at Kaunlaran (KKK). The usual commission is ₱0.02-₱0.04/piece.

If selling on credit, which 31% of hatchery operators do on occasion, a surcharge of ₱0.015/piece is usually added to the selling price. Counting is usually based on the *takal* method which entails first counting and weighing a sample (say 1,000 pieces) of fingerlings of a given size, then matching this weight for subsequent quantities to determine the desired number of pieces. Packing fingerlings for shipping entails placing them in double plastic bags containing oxygenated water, the plastic bags then being placed in woven *pandan* bags to protect them from puncture. Quantities packed per bag depend upon the size of fingerlings involved (Fig. 3) and upon the distance over which they are to be shipped and expected time in transport.

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[2]As of late 1982, selected feed costs were as follows: rice bran (₱1.20-1.30/kg); broiler mash (₱2-3/kg); broiler pellets (₱2-3/kg); skimmed milk (₱8/kg) and *trigo* (approximately ₱2/kg).

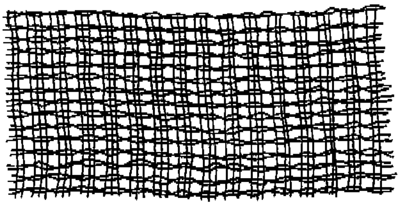
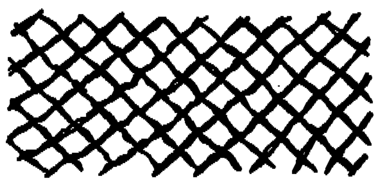
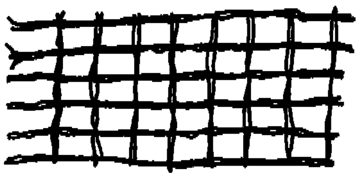
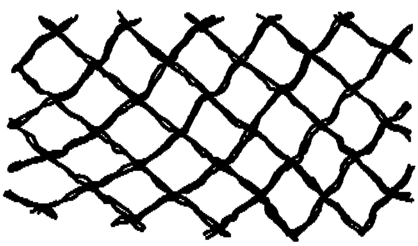
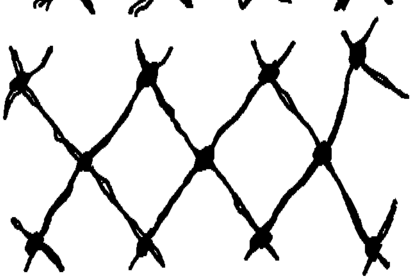
Mesh used to categorize	Size and age	Producers' estimates of break-even price per piece	Prevailing prices per piece	Ave. no. packed per bag for shipping
	Fry 1-3 days	–	–	5,000
	Size 32 4-6 days	–	₱0.07	4,800
	Size 24 7-10 days	₱0.03	₱0.08	1,300
	Size 22 11-15 days	₱0.035	₱0.09	825
	Size 17 16-30 days	₱0.05	₱0.11	430
	Size 14 30-45 days	₱0.066	₱0.14	390
	Size 12	₱0.076	–	250

Fig. 3. Fingerling sizes and ages, producers' estimates of break-even prices, average prevailing prices in Laguna and Rizal Provinces (August 1981 to October 1982) and average number packed per bag for shipping.

Table 3. Weighted average price in pesos of fingerlings in Laguna/Rizal Provinces by size and by month.

Month	Size 14	17	22	24	32
1981					
September	0.15	0.10	0.10	0.08	0.08
October	0.14	0.11	0.09	0.06	0.07
November	0.13	0.10	0.09	0.10	0.06
December	0.17	0.10	0.09	0.10	0.08
1982					
January	0.13	0.11	0.09	0.10	0.07
February	0.14	0.10	0.10	0.10	0.10
March	0.13	0.12	0.09	0.09	0.07
April	0.15	0.11	0.10	0.09	0.07
May	0.14	0.12	0.10	0.08	0.05
June	0.13	0.12	0.09	0.08	0.10
July	0.12	0.13	0.09	0.08	0.06
August	0.13	0.12	0.09	0.09	0.08
September	0.12	0.12	0.08	0.06	0.06
October	0.12	0.11	0.09	0.06	0.07
Simple average price September 1981-October 1982:	0.14	0.11	0.09	0.08	0.07

Fingerlings being transported to nearby fish cages are often transported simply in freshwater in the bottom of hand-paddled boats known as *pituya.*

It is common practice for sellers to offer buyers an extra allowance or *pasobra* to cover the expected mortality that may occur in shipping. This allowance ranges from 5% extra for the large farms to 10% for the smallest farms. For all transactions of the 80 sample respondents during the period September 1981-October 1982 the *pasobra* averaged 5.6%. No information is available to determine how closely this *pasobra* approximates actual mortality in shipping nor to what extent it may represent in part a factor to compensate for differential quality of fingerlings between small and large hatcheries.

Costs and Returns

While it is relatively easy during a recall survey to collect reliable data on production practices, asset ownership and acquisition costs, it is far more difficult to achieve reliability in data on variable costs and on returns. This is especially true for a business like hatcheries where supplementary feeding is practiced on a continuous basis and expenses for some other inputs (e.g., hired labor) are incurred at irregular intervals during the production cycle. Moreover, sales of fingerlings occur throughout the year, so it is difficult for the respondent to recall these figures with much accuracy. Consequently, during the course of this study, a conscious effort was made to thoroughly review and assess all data provided on costs and earnings and to eliminate those questionnaires which were deemed to be unreliable. This screening produced a reduced sample of 43 hatcheries, the costs and returns data from which are the basis of this section of the report.

Another variable input that is extremely difficult to measure from a survey is household labor. Results presented here show net revenue as the residual return to owned inputs including household labor. Some independent estimates of labor inputs, which have been collected from a separate one-year record-keeping activity initiated by ICLARM in late 1982, are introduced to add to the discussion. These more reliable estimates indicate that survey respondents consistently overestimated the levels of own and family labor actually applied to their hatchery operations. This viewpoint is consistent with the earlier opinion of Chong et al. (1982) that survey respondents often provide information on labor available and not on labor actually utilized.

Initial capital expenditures for tilapia hatcheries include those for equipment and pond development. Although a complete complement of equipment and facilities for the larger hatcheries might include nets, *hapas*, pumps, oxygen tanks, aerators, caretaker's house, storage sheds and vehicles such as tricycles or jeeps, the majority of hatcheries made do with much less (Table 4). Most of the major items such as pumps and vehicles can be borrowed or rented as necessary. Consequently, the initial capital outlay for the

Table 4. Asset ownership, capital investment and pond development costs, 1982, by farm size.

	Farm size				
	<1,249 m^2	1,250-4,999 m^2	5,000-9,999 m^2	10,000+ m^2	All farms
Ave. farm size (m^2)	658	2,112	9,300	26,450	3,900
Assets (equipment) owned per farm (ave. no. of units)					
Pump	0.24	0.40	2.00	2.00	0.50
Net	2.00	3.00	2.20	4.20	2.25
Hapa	2.30	6.00	8.00	8.00	4.00
Oxygen tank	0.04	0.25	0.00	0.20	0.11
Aerator	0.00	0.00	0.00	0.20	0.01
Caretaker's/laborers' house	0.28	1.00	1.40	2.00	0.61
Storage shed	0.04	0.10	0.00	1.00	0.10
Vehicle	0.04	0.20	0.20	1.00	0.15
Ave. capital investment costs (₱) per farm for equipment	2,300	3,900	27,250	75,400	10,700
Ave. pond development costs (₱) per farm (i.e., pond digging at 1982 rates)	2,050	6,590	29,000	82,500	12,150
Ave. initial investment per farm (₱)	4,350	10,490	56,250	157,900	22,850

majority of hatcheries (i.e., those < 5,000 m^2) was not high; in fact it was less than that required for a motorized outrigger fishing boat and gear.

Annual costs and earnings for the four different sizes of hatcheries reveal that all earned positive net revenue (as calculated below) for the 12-month period ending September 1982 (Table 5). In fact, the "average" hatchery easily recovered its initial investment in one year's operation. Only those hatcheries in the 1,250- to 4,999-m^2 category experienced low returns during this period and this is perhaps traceable in part to their lower feed and/or fertilizer expenditures per m^2 than any other hatchery category. Note that although the average hatchery area of this group is over three times as large as the average hatchery area in the smallest group, fingerling production was only 78% higher and total revenue only 50% higher. This group therefore either sold smaller fingerlings or received a lower price; given the lower rates of feed and fertilizer application, the former possibility seems the more likely.

For the hatcheries in the smallest category, the added monthly income is probably more important to the operator than the high rate of return derived from investment in this business. These small hatcheries provided almost ₱400/month in supplementary income, not an insignificant amount considering that for most operators in this category, hatcheries were but a secondary occupation. Such an income also compared favorably with the opportunity wage for labor (₱15-20/day) then prevailing in Laguna and Rizal Provinces.

From the ICLARM record-keeping activity for tilapia hatcheries which was initiated in late 1982, the average labor inputs can be determined. The 10 hatcheries participating in the record-keeping activity had an average farm size of 2,760 m^2 and an average monthly labor input of 39 man-days or 1.41 man-days/100 m^2. This labor input includes operator's own, family and hired labor. With this information as a basis and using labor opportunity wage of ₱18.50/man-day (the prevailing wage for pond-digging during 1982) and opportunity cost of capital of 9% (the rural bank savings deposit rate in 1982), it is possible to determine if the net revenue for the average farm reported in Table 5 exceeded the opportunity costs of owned inputs. The calculations are as follows:

- Average farm size = 3,900 m^2, implying total labor requirements of 55 man-days/month or 660 man-days/year. At ₱18.50/day, total annual labor costs would be ₱12,208, of which ₱5,952 has already been paid on the average farm to hired labor and caretakers, including food. Unpaid labor costs are therefore ₱6,256. Adding the opportunity cost of capital invested (₱22,850 x 9% = ₱2,057) gives ₱8,313 opportunity costs of owned inputs. Since net revenue for the average farm is ₱34,781, the average hatchery operator earned approximately ₱26,468 return to his management and risk.
- Similar calculations for the hatcheries in the smallest category result in a return to management and risk of ₱2,754. These small hatcheries require 111 man-days of labor per year, equivalent to 2 1/2 hours/day. If anything, this return above labor and capital opportunity costs may be overstated because some of this labor is family labor, even of children, whose opportunity wage is undoubtedly less than ₱18.50/day.

The major point to stress here is not so much the exact level of the returns but the fact that tilapia hatcheries certainly appear to provide potential for income generation above that from many alternative rural employment opportunities. The rapid rate of entry into this business within the past several years seems to confirm the attractiveness of this business opportunity.

One final aspect of interest is to what extent small hatcheries can compete with larger hatcheries. While the largest hatcheries

Table 5. Average annual costs and earnings of tilapia hatcheries in Laguna and Rizal Provinces, 1982, by farm size.

	Farm size				
	< 1,250 m² (n = 24)	1,250-4,999 m² (n = 13)	5,000-9,999 m² (n = 2)	10,000+ m² (n = 4)	All farms (n = 43)
Farm characteristics					
Ave. area (m²)	658	2,112	9,300	26,450	3,900
Ave. no. of ponds	4	9	20	10	7
Ave. capital investment (equipment)	2,300	3,900	27,250	75,400	10,700
Fingerling production ('000s)					
Sold (including own use)	75.1	133.5	881.5	3,664.0	464.1
Pasobra allowance	6.6	8.3	37.7	177.2	24.1
Total production	81.7	141.8	919.2	3,841.2	488.2
Gross revenue (₱)					
Fingerling sales	7,866	12,400	101,450	439,450	53,737
Broodstock sales	721	1,041	6,924	29,700	3,801
Other (commissions)	1,142	1,151	0	82,209	8,633
Total revenue	9,729	14,592	108,374	551,359	66,171
Costs (₱)					
Fixed costs					
Depreciation	374	761	2,986	15,513	2,020
Licenses/fees	17	15	0	197	32
Land rental	86	317	1,395	4,000	581
Interest on debts	14	174	0	1,400	191
Total fixed costs	491	1,267	4,381	21,110	2,824
Variable costs					
Feeds	2,428	3,631	28,566	78,558	11,090 (39% of variable costs)
Hired laborers	347	1,648	2,400	26,548	3,273 (11%)
Caretaker	291	699	2,400	8,160	1,244 (4%)
Food for laborers	125	938	420	12,600	1,545 (5%)
Organic fertilizers	315	558	16,200	3,619	1,435 (5%)
Inorganic fertilizers	0	3	0	0	1 –
Water	42	56	3,600	1,480	345 (1%)
Electricity	6	0	0	4,560	428 (1%)
Fuel	157	259	868	10,800	1,211 (4%)
Equipment rental	48	227	800	0	133 –
Broodstock	433	855	0	25,240	2,848 (10%)
Maintenance/repairs	0	185	0	16,875	1,626 (6%)
Marketing costs incl. bad debts	609	2,459	11,492	20,225	3,499 (12%)
Total variable costs	4,801	11,518	64,346	208,665	28,565
Total costs (₱)	5,292	12,785	68,727	229,775	31,390
Annual net revenue (₱) or residual return to operator's own and family labor, capital, management and risk	4,437	1,807	39,647	321,584	34,781

Continued

Notes on annual costs/earnings (Table 5)

1. *Pasobra* allowance for "all farms" category is weighted average of total fingerlings produced (less those for own use), not weighted average by farm. Smaller farms generally must give a higher *pasobra* to buyers than do the largest farms. The *pasobra* given to buyers ranges from 10% for small farms to 5% for large farms and averages 5.6%.

2. Other commission income represents earnings from acting as broker in large quantity sales of fingerlings. The larger farms, for example, often use several ponds for temporary storage of others' fingerlings, charging a commission (e.g., ₱0.02/piece) on the sale.

3. Land rental at ₱0.15/m^2 represents opportunity cost of land used for hatchery purposes. For those hatchery operators not owning the land where their hatchery is located, this is payment in-kind (e.g., cavans of rice) from their rice harvest to their landlord which must still be made for the land used for hatchery purposes.

4. Depreciation ranges from 11-21% of capital cost (equipment) depending upon operator's estimates of expected life of equipment.

5. Marketing costs include "bad debts" or annual sales for which payment is not collected in full.

6. Maintenance/repairs represent primarily an additional labor cost. These were generally undertaken by the operator or family members on smaller farms and by hired labor on the larger farms.

appear to have a slight competitive edge over the smallest hatcheries in terms of lower production cost per fingerling as shown in Table 6, this is a rather crude measure of relative efficiency. Because various sizes of fingerlings are sold, these efficiency measures would be truly comparable only if the various categories of farms sold the same size-composition of fingerlings. The data in this study, which focused on numbers of fingerlings and fingerling sales rather than weight of fingerlings sold, unfortunately do not permit a more precise comparison. Nevertheless, the net revenues per fingerling indicate that, all other things being equal, the smallest hatcheries (< 1,250 m^2) can remain competitive as long as fingerling prices do not drop more than ₱0.04/piece on average. However, hatcheries in the 1,250- to 4,999-m^2 category need to take steps immediately to increase their production and fingerling growth rates, possibly through increased supplementary feed and fertilizer usage, so as to reduce their average fingerling production costs.

Problems and Future Prospects

The foregoing analysis of costs and returns notwithstanding, private hatcheries of Rizal and Laguna do face problems with sustaining and expanding their share of the industry. Some of these problems have been identified by the hatchery operators themselves; others have become apparent to the researchers during the course of this study.

Even though they identify problems of obtaining land, capital and high quality water supply as major problems, hatchery operators are uniformly optimistic about the future of the tilapia industry and about their own future participation (Table 7). The vast majority of all categories of hatchery operators expect still to be involved in the industry in five years' time.

Operators acknowledge the necessity for a high level of technical expertise if one is to be successful in hatchery operations. Despite the high profits currently being earned by most hatcheries, several authors (PCARR 1976;

Table 6. Relative physical and economic efficiency of tilapia hatcheries in Laguna and Rizal Provinces, 1982, by farm size.

	Farm size				
	<1,250 m^2	1,250-4,999 m^2	5,000-9,999 m^2	10,000+ m^2	All farms
Ave. area (m^2)	658	2,112	9,300	26,450	3,900
Ave. pond size (m^2)	165	235	465	2,645	557
Total annual fingerling production per farm	81,700	141,800	919,200	3,841,200	488,200
Production per 100 m^2	12,416	6,714	9,884	14,522	12,518
Gross revenue per 100 m^2 (₱)[1]	1,306	636	1,165	1,774	1,474
Fixed costs per 100 m^2	75	60	47	80	72
Variable costs per 100 m^2	730	545	692	789	732
feed expenditure per 100 m^2	369	172	307	297	284
fertilizer expenditure per 100 m^2	48	27	174	14	37
Net revenue per 100 m^2 (₱)[1]	501	31	426	905	670
Ave. production cost per fingerling (₱)					
fixed cost	.006	.009	.005	.005	.006
variable cost	.06	.08	.07	.05	.06
total cost	.065	.09	.075	.06	.064
Net revenue per fingerling (₱)[1]	.04	.005	.04	.06	.05

[1]Does not include income from commissions.

Cabero 1980; Dureza et al. 1980; Guerrero 1980, 1981a; Comia 1982) who report on experimental results or on data from the more advanced private hatcheries, indicate that fingerling production and profits could be even higher. What is striking about these reports and that of Mires (1982) is the extreme variability in production reported elsewhere. As Van Gorder and Strange (1981) point out, "to become familiar with the tilapia family requires a review of a seemingly endless variety of situations in which they have been cultured." Fingerling production everywhere is certainly far from scientific and experimental approaches will undoubtedly continue in private hatcheries for some time to come. Although improved hatchery management techniques will evolve, there are several factors at work which will make it difficult for Laguna and Rizal hatcheries to sustain their present high levels of profitability.

First, the existence of these high profits will attract others into the business, adding to overall fingerling supply and possibly reducing prices. Based on the average production data in this study of 488,200 fingerlings produced per farm, the 443 Laguna and Rizal hatcheries would have produced almost 225 million fingerlings in 1982. The popular press was

Table 7. Attitudes of hatchery operators towards their business and the future (Laguna and Rizal Provinces, 1983).

% in agreement with following statements:	Farm size <1,250 m²	1,250-4,999 m²	5,000-9,999 m²	10,000+ m²	All farms
1. Conditions of entry					
The capital required is high	89	79	80	80	85
Obtaining land is difficult	83	75	40	60	76
Obtaining high quality broodstock is difficult	49	54	40	40	49
High level of technical expertise required	83	83	60	60	80
2. Business operation					
Water supply is unreliable	50	21	60	0	39
Poaching of broodstock is a problem	15	17	40	20	18
Poaching of fingerlings is a problem	17	17	40	20	16
High level of technical expertise necessary	83	83	0	60	80
Buyers complain about poor quality fingerlings	2	4	0	0	3
Reliable buyers are difficult to find	41	58	0	0	41
Collecting payment from buyers is difficult	30	50	40	0	35
3. Business prospects					
I am selling less fingerlings now than one year ago	63	63	60	40	61
The price of fingerlings now is lower than one year ago	46	71	40	20	51
I am planning to expand the size of my hatchery	54	42	60	80	53
I expect to be in the hatchery business five years from now	85	79	100	100	85

filled during 1983 with news of new hatcheries being established around the country; small-scale operators, millionaire businessmen, BFAR and universities now all produce *O. niloticus* fingerlings for sale or free dispersal so it is not unreasonable to assume that total production from these two provinces would increase over the next few years. Already by late 1982, hatchery operators in Laguna and Rizal were observing that reliable buyers were becoming difficult to find and that both prices and quantities sold were declining compared to the same time a year earlier (see Table 7).

Second, discriminating buyers with experience of using fingerlings from various sources could be expected to be willing to pay premium prices for reliable high quality fingerlings. Here, the private hatchery operators, particularly the small-scale backyard operators, will be at a disadvantage compared to the larger facilities, such as those of BFAR which provide for better broodstock control (see Broussard et al. 1983). It is apparent from the survey reported in this paper that the majority of private hatchery operators, though claiming to produce *O. niloticus* fingerlings, are not at all certain about the true identity of their stocks. Contamination with *O. mossambicus* is bound to slow average growth rates and rebound to the future disadvantage of fingerling sellers.

To date, the Philippine government has become actively involved in the tilapia industry as fingerling producer (BFAR), production research and demonstration (BFAR and universities), extension (BFAR), information dissemination (PCARRD) and as buyer of fingerlings (KKK). If the role of private hatcheries is to be sustained in this industry, intensified efforts in extension and information dissemination are necessary to complement continuing efforts by researchers to identify improved management practices that assure better broodstock quality control and reduce the average costs of fingerling production.

To a certain extent the ongoing experimentation by private operators in feeding, fertilizing and other management aspects will help them meet the above challenges, but they can be assisted in many ways by support and advice from the public sector. The potential of tilapias to add significantly to domestic protein supply and to rural producer incomes is too great to allow these opportunities for contributing to sustained growth to be missed.

Acknowledgements

The authors would like to thank Ma. Cristina Sevilla who participated in the data collection phase of this study and of course the 80 respondents who cheerfully answered many questions. During the writing of this paper, the authors have benefitted from discussion with Emma Escover.

References

Broussard, M.C. Jr., R. Reyes and F. Raguindin. 1983. Evaluation of hatchery management schemes for large-scale production of *Oreochromis niloticus* fingerlings in Central Luzon, Philippines. Paper presented to the International Symposium on Tilapia in Aquaculture, 8-13 May 1983, Nazareth, Israel.

Cabero, A.D. 1980. Tilapia raising in Rizal. Greenfields 10(11): 4, 6, 8, 10 & 12.

Castillo, G.T. 1979. Beyond Manila: Philippine rural problems in perspective. IDRC-116e. International Development and Research Centre of Canada, Ottawa.

Chong, K.C., M.S. Lizarondo, V.F. Holazo and I.R. Smith. 1982. Inputs as related to output in milkfish production in the Philippines. ICLARM Technical Reports 3, 82 p. Bureau of Agricultural Economics, Fishery Industry Development Council, and International Center for Living Aquatic Resources Management, Manila.

Comia, O.Z. 1982. Tilapia breeding–a profitable backyard industry. General Information Series Vol. V, No. 2. Bureau of Fisheries and Aquatic Resources, Manila.

Dureza, L.A., V.L. Corre, Jr. and C. Gempis. 1980. Mass production of tilapia seeds. Paper presented to the Seminar Workshop on Brackishwater Aquaculture, UPV-BAC, 1 October-19 November 1980, Leganes, Iloilo.

Guerrero, R.D. 1980. How to produce fingerlings of Nile tilapia. Modern Agriculture and Industry–Asia 3(2): 4-5.

Guerrero, R.D. 1981a. Bay town cashes in on tilapia bonanza. Asian Farms and Gardens (February): 14.

Guerrero, R.D. 1981b. Introduction to fish culture in the Philippines. TRC Series. Technology Resources Center, Manila.

Guerrero, R.D. 1982. An overview of tilapia culture in the country. Philipp. Farmer's J. 24(3): 28, 29, 31, 35.

Lampa, R.R. 1981. Raising tilapia in a big way. Greenfields 11(10): 6-14.

Lovshin, L.L. 1982. Tilapia hybridization, p. 279-308. *In* R.S.V. Pullin and R.H. Lowe-McConnell (eds.) The biology and culture of tilapias. ICLARM Conference Proceedings 7, 432 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Ministry of Agriculture. 1976. Internal report (untitled) on tilapia use in rice-fish culture (mimeo).

Mires, D. 1982. A study of the problems of the mass production of hybrid tilapia fry, p. 317-330. *In* R.S.V. Pullin and R.H. Lowe-McConnell (eds.) The biology and culture of tilapias. ICLARM Conference Proceedings 7, 432 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

PCARR. 1976. The Philippines recommends for tilapia. Philippine Council for Agriculture and Resources Research. Los Baños, Laguna, Philippines.

Pullin, R.S.V. 1982. General discussion on the biology and culture of tilapias, p. 331-358. *In* R.S.V. Pullin and R.H. Lowe-McConnell (eds.) The biology and culture of tilapias. ICLARM Conference Proceedings 7, 432 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Radan, R.R. 1979. Tilapia: from nilotica and mossambica to a mutant called flamingo. Greenfields 9(10): 24-40.

Sevilla, Ma. C.L. 1981. An economic analysis of tilapia floating cage culture in San Pablo City, Laguna. 1981. Undergraduate thesis, University of the Philippines in Los Baños, Laguna.

Van Gorder, S. and D.J. Strange. 1981. Tilapia: production and spawning methods. Aquaculture project, Organic Gardening and Farming Research Center, Rodale Press Inc., Kutztown, Pennsylvania.

Cost Analysis of a Large-Scale Hatchery for the Production of *Oreochromis niloticus* Fingerlings in Central Luzon, Philippines

MERYL C. BROUSSARD, JR.
Department of Wildlife and Fisheries Sciences
Texas A&M University
College Station, Texas
U.S.A.

CECILIA G. REYES
Bureau of Fisheries and Aquatic Resources
Muñoz, Nueva Ecija
Philippines

BROUSSARD, M.C., JR. AND C.G. REYES. Cost analysis of a large-scale hatchery for the production of *Oreochromis niloticus* fingerlings in Central Luzon, Philippines, p. 33-43. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

Operations of the Bureau of Fisheries and Aquatic Resources (BFAR) hatchery at Muñoz, Nueva Ecija are analyzed from the economic point of view. Cost analysis of fingerling production using open pond spawning indicates that fingerlings can be produced at a relatively low cost at a large hatchery complex if production systems are properly managed. Cost estimates from this facility could be relevant for large private hatcheries. Additional costs to private producers would include interest on loans and operating capital, and higher cost for water. However, capital investment for facilities and pond construction should be substantially lower for a private hatchery.

Production during the first year of operation was approximately 33% of capacity because of the multiple uses of the facility and down-time during initial operations, but during the second year should approach capacity.

An important component of any large centralized hatchery is fingerling dispersal. Inability to disperse fingerlings is a primary limiting factor for marketing of fingerlings produced by small- to medium-scale (1-5 ha) private hatcheries in Central Luzon. Since small farmers are the target recipients of the BFAR hatchery-produced fingerlings and individual orders are relatively small, dispersal is a large problem.

Hatchery budgets and pricing schemes for government tilapia operations should be reviewed. Cost of such operations can be partially supported by revenues from fingerling sales. If the government intends to encourage fingerling production from private hatcheries, government facilities should not undersell private producers. In areas where private hatcheries can meet fingerling requirements, government sales of fingerlings could be phased out.

Introduction

The culture of the Nile tilapia, *Oreochromis niloticus,* is an expanding industry in the Philippines. Associated with this expansion is an increase in the number of tilapia hatcheries both private and government. Although the technical aspects of fry and fingerling production in the Philippines have been documented (PCARR 1976; Guerrero 1979, 1983; Guerrero and Garcia 1983; Broussard et al. 1983), little information is available on the economics of fingerling production. Cost analyses have been conducted for various tilapia culture methods used in the Philippines such as rice-fish, fishponds and integrated farming systems (Sevilleja and McCoy 1979; Dela Cruz 1980; Hopkins and Cruz 1982).

The purpose of this study was to conduct a cost analysis for tilapia fingerling production from a large government hatchery located in Central Luzon, Philippines. Cost analysis was based on actual hatchery production during the first year of operation (May 1982-May 1983). Production facilities and methods are described and cost of fingerling dispersal is also analyzed.

Background

The Bureau of Fisheries and Aquatic Resources (BFAR) operates the Freshwater Fish Hatchery and Extension Training Center (FFH-ETC) in Muñoz, Nueva Ecija. The center is part of the BFAR-USAID Freshwater Fisheries Development Project designed to increase freshwater fish production and consumption in Central Luzon. The target beneficiaries of the project are small-scale freshwater fishfarmers. The 20-ha site consists of a tilapia fingerling hatchery, a training center and extension support facilities. The center is manned by a well-trained technical staff and necessary support personnel.

Previous constraints to freshwater aquaculture development in the region, which provided the rationale for the Center's activities, were inadequate supply of fingerlings and lack of appropriate extension programs. The hatchery component is designed to produce and disperse approximately 8-10 million *Oreochromis niloticus* fingerlings per year. Through extension outreach programs it is planned that an additional 40 million fingerlings will be produced by private hatcheries in the region. Extension workers have been trained in aquaculture technology and extension methodology, and by mid-1983 over 50 demonstration farms had been established.

Although all support facilities were not yet completed, the pond system for the hatchery was completed in May 1982. As of mid-1983, the hatchery produced and dispersed between 100,000 and 200,000 fingerlings per week.

Farmers are charged for fingerlings, but free delivery is provided for buyers in the region. A broodstock improvement program has begun to assure production of good quality fingerlings. Broodfish from performance tested lines are dispersed on a limited basis.

The Hatchery Facility

The actual production area of the hatchery is approximately 9.3 ha consisting of 58 excavated earthen ponds as follows: twelve 4,500 m^2, sixteen 1,300 m^2 and thirty 600 m^2. The primary water supply is a National Irrigation Administration (NIA) irrigation canal. Water from the canal flows to two 1-ha excavated earthen reservoirs. From the reservoirs, water flows by gravity to all ponds through an underground PVC water supply line. The secondary water source is a deep well with a capacity of 1,000 liters/min. An additional deep well has been developed with an expected capacity of 2,000 l/min. The secondary water supply is used only during canal shutdown. All ponds have concrete catch basins and can be completely drained by gravity through an underground reinforced concrete drain line. Road dikes permit vehicular access to most production ponds.

There are several support facilities that will complement pond production facilities. An indoor holding facility with 20 concrete raceways and a 375-m^2 hatchery room have been completed. An outdoor fingerling holding facility consisting of 18 concrete raceways will facilitate fingerling harvest and dispersal and was expected to be completed in late 1983. A storage and maintenance building and an administration building are used for hatchery purposes. Staff housing for project technical staff was also under construction at the time of writing.

Production Methods

Hatchery production can be divided into the following three phases: broodfish production, fingerling production and advanced fingerling production. In all of these systems, ponds receive a basal application of dried chicken manure at a rate of 2,000 kg/ha and inorganic fertilizer (NPK: 16-20-0) at a rate of 100 kg/ha. Dried chicken manure and inorganic fertilizer are also applied weekly at rates of 3,000 kg/ha/month and 100 kg/ha/month, respectively. No supplemental feeding is used.

Broodfish are produced in 600-m^2 and 1,300-m^2 ponds. Fingerlings (1-10 g) are stocked at a rate of 2-3/m^2 and reared to harvest size (50-80 g) in 90-150 days. Production of broodfish in these ponds ranges from 8-15 kg/ha/day. At harvest, fingerlings are also recovered from this system in quantities as high as 400,000/ha. Broodfish are produced to meet the needs of the hatchery and are not routinely produced for dispersal. In the early development of the hatchery a large percentage of the facility was allocated to broodfish production. Broodfish can be used for 2-3 years without replacement. If sex ratios of 1 male to 3 females are used, an excess of adult males is produced and these can be sold.

Fingerlings are produced using open pond spawning. Broodfish are stocked into 4,500-m^2 and 1,300-m^2 ponds at a rate of 100-400 kg/ha at a sex ratio of 1 male to 3 females. Ponds are harvested with a 6-mm mesh bag seine 60 days after stocking broodfish and every 30 days thereafter. At each harvest, fish are graded and sampled. Broodfish are returned to the pond and fingerlings are conditioned for dispersal. Conditioning consists of holding fingerlings in *hapas* (inverted mosquito net cages) for a period of three days prior to dispersal. Initial production data showed that while the number of fingerlings harvested decreased with time, the total kilograms of fingerlings harvested remained relatively constant (Broussard et al. 1983). Therefore, in order to optimize the number of fingerlings produced from this system, ponds should be reconditioned 150-180 days after stocking. If this practice is followed, annual fingerling production should approach 1.2 million/ha. Average weight of fingerlings produced from this system is approximately 4 g.

Advanced fingerlings (10-20 g) are produced by transferring fingerlings (1-5 g) to 1,300-m^2 or 600-m^2 ponds. Ponds are stocked at rates of 20-30 fish/m^2. Advanced fingerlings can be harvested in 60-90 days. Production in these ponds can be as high as 56 kg/ha/day.

Cost Analysis

Capital cost for fingerling production

Facilities: Costs of the hatchery facilities are presented in Table 1. The total hatchery cost was approximately ₱8,530,770 (US$775,500).[1] The pond system represents approximately 44% of the total cost. Facilities not yet completed or not yet utilized are included in this capital cost estimate. Cost of facilities shared by other components of the project were estimated based on the percentage of each item allocated to the hatchery compo- State University (CLSU) at no cost, its market value would be approximately ₱25,000/ha. The hatchery facility occupies approximately 15 ha of the 20-ha site.

[1]In mid-1983, ₱11.00 = US$1.00.

Equipment: The cost and economic life of hatchery equipment utilized for fingerling production are presented in Table 2. The costs in this table represent actual cost to the BFAR. The economic life of each item was estimated by the hatchery staff based on experience. The total cost of hatchery equipment used in fingerling production is approximately ₱560,560. The farm tractor, the largest single item, represents 45% of the equipment cost.

Operational cost for fingerling production

During the first year of operation a large portion of the facility was used for broodstock production, broodstock evaluation, training of hatchery staff and pond testing. Because of the multiple uses of the hatchery facility, direct production cost analysis for

Table 1. Cost (in pesos) of hatchery facilities for the Freshwater Fish Hatchery and Extension Training Center, Muñoz, Nueva Ecija, Philippines. (₱11 = US$1 in mid-1983)

Item	Cost (₱)
Pond system (excluding land)	3,736,400
Deep well 1 (50%)	92,650
Deep well 2*	210,000
Hatchery and laboratory building (50%)	1,428,150
Outdoor holding tanks*	770,740
Security and storage building* (50%)	353,540
Administration building* (33%)	270,290
Perimeter fencing*	939,590
Electrical distribution line	354,410
Land purchase (value)	375,000
Total	8,530,770

Notes:

% Indicates percentage of item allocated to hatchery use.

* These items not completed during the first year of operation.

Table 2. Cost (in pesos) and economic life of equipment used in fingerling production at the Freshwater Fish Hatchery and Extension Training Center, Muñoz, Nueva Ecija, Philippines. (₱11 = US$1 in mid-1983)

Equipment	No. of units	Economic life (yrs)	Cost (₱)
Jeep – pick up	1	5.0	100,000
Farm tractor	1	10.0	250,000
Hand tractor	1	5.0	25,000
Deep well pump 30 hp #1	(50%)	10.0	40,000
Deep well pump 30 hp #2	1	10.0	80,000
Seine-harvest 60 m	1	2.5	3,480
Seine-harvest 25 m	1	2.5	1,400
Seine-harvest 20 m	1	2.5	1,200
Grading *hapa*	2	2.0	2,400
Holding *hapa*	25	2.0	3,000
Filter socks	112	5.0	8,960
Tubs	20	3.0	1,600
Scales 50 kg	2	5.0	2,100
Scales 10 kg	2	5.0	700
Fertilizer platforms	70	3.0	4,270
Dip nets	10	2.0	500
Sprayer	1	5.0	350
PVC welder	1	5.0	4,100
Generator	1	5.0	6,000
Digging blades	5	10.0	500
Grass cutters	4	5.0	25,000
Total			560,560

the entire hatchery operation would not accurately reflect cost of fingerling production for the systems used at the hatchery. Therefore, the annual operational expenses for the entire hatchery were estimated assuming a fully operational pond system of 10 ha regardless of actual use (Table 3). The total annual operational expense for the hatchery was estimated at ₱763,549 or approximately ₱76,355/ha. This estimate was then used to determine the cost of each fingerling production system separately under actual production conditions. Cost estimates were prepared on a per ha basis. Annual operational expenses were adjusted for the length of each production period with 15 days added to the actual production period to allow for pond down time.

Expenses were divided into fixed and variable costs. Fixed costs consist of depreciation on facilities and equipment, calculated using the straight line method. All buildings were depreciated over 25 years and deep wells over 20 years. Earthwork for the pond system was not depreciated as pond dikes are maintained by the labor force. However, drainage and water supply lines for the pond system (43% of capital cost of pond system) were depreciated over 25 years. Facilities not yet completed or not yet utilized were included in these estimates. The total fixed cost was ₱322,894 with depreciation on facilities representing 76% of the fixed cost.

Variable costs are expenses related directly to fingerling production. The total variable cost was ₱440,655. Personal services represent the single largest variable cost (33%) and include the salaries for the hatchery manager, pond manager, fingerling production manager, records officer, secretary and 15 laborers.

Table 3. Summary of annual operational expenses for the Freshwater Fish Hatchery and Extension Training Center, Muñoz, Nueva Ecija, Philippines, assuming a fully operational 10-ha pond system. (₱11 = US$1 in mid-1983)

Operational expenses	Cost (₱)
Fixed costs	
Depreciation on facilities	244,064
Depreciation on equipment	78,830
Subtotal	322,894
Variable costs	
Personal services	145,300
Chicken manure	75,789
Inorganic fertilizer	26,400
Diesel and gasoline	48,300
Maintenance (vehicle and equipment)	40,600
Feeds	18,000
Pumping	1,500
Pesticide	1,424
Miscellaneous supplies	10,000
Administrative cost (20% of variable costs)	73,442
Subtotal	440,655
Total	763,549

Chicken manure and inorganic fertilizer are critical inputs and represent 23% of the variable cost. Costs of chicken manure and inorganic fertilizer were based on a 12-month period at a cost of ₱8 per 38-kg bag for chicken manure and ₱110 per 50-kg bag for inorganic fertilizer. Diesel and gasoline costs were based on actual quarterly allotment for the hatchery. Maintenance for vehicles and motorized equipment was estimated at 10% of the original capital cost. Although supplemental feeds are not used in the ponds, fish are fed during conditioning prior to dispersal. The feed formulation used at the hatchery cost approximately ₱3/kg. The deep well pump was used 100 hours for the entire year at an estimated hourly cost of ₱15. Water from the NIA canal was obtained free of charge. Pesticide was applied at a rate of 0.5 l/ha at a cost of ₱95/l after each production cycle.

Broodfish production

Two broodfish production periods were evaluated. In the first production period five 600 m^2 ponds were stocked with fingerlings at a rate of $2/m^2$. Although manuring rates varied, the average manuring rate was approximately 3,000 kg/ha/month. Ponds were harvested on the 100th day. The average daily production of broodfish was 8.9 kg/ha. Also, approximately 400,000 fingerlings/ha (61% of the total production by weight) were produced during this period.

In the second production period, four 1,300 m^2 ponds were stocked with fingerlings at a rate of $3/m^2$. Standard manuring rates were used. All ponds were harvested on the 150th day. The average daily production of broodfish was 12.1 kg/ha. Fingerlings were produced in this second period but the exact number produced was not determined.

A summary of production cost for broodfish for both of the above production series (including 15 days of pond down time) is presented in Table 4. The cost/kg for broodfish production was ₱29.30/kg for the first period and ₱20.30/kg for the second period. At the higher stocking density used in the second period, there was less fingerling production and higher broodfish production. This accounts for the differences in unit cost for broodfish production in each system. Under hatchery conditions, however, excess fingerling production would be viewed as an asset rather than a problem. In the first production period, 400,000 fingerlings/ha were produced valued at approximately ₱32,000 (₱0.08 each). This exceeded the total cost of production by ₱6,000/ha.

Fingerling production

The following cost analysis for fingerling production is based on data presented by Broussard et al. (1983). Open pond spawning was evaluated in six 0.45-ha earthen ponds over a 265-day production period. The average fingerling harvest from the six ponds was 658,900 fingerlings/ha or 2,833 kg of fingerling/ha for the 265-day production period. A summary of production costs (excluding broodfish costs or sale value) is presented in Table 5. Broodfish gained an average 150% in weight during the production period representing a corresponding increase in their value. Broodfish were stocked at a rate of 300 kg/ha and could have been sold for ₱7,440 at the end of the production period instead of

Table 4. Summary of broodfish production costs (in pesos) in earthen ponds for two production periods. (₱11 = US$1 in mid-1983)

	Production period	
	1	2
Broodfish produced/ha (kg)	890	1,815
Length of production period (days)	115	165
Operational expenses/ha	24,433	34,360
Cost of fingerlings stocked/ha (@ ₱0.08)	1,600	2,400
Total cost/ha	26,033	36,760
Cost/kg of broodfish	29.3	20.30
Value of fingerlings produced (@ ₱0.08)	32,000	undetermined

Table 5. Summary of production costs (in pesos) for fingerlings in six 0.45-ha earthen ponds over a 265-day production period.[1] (₱11 = US$1 in mid-1983)

Number of fingerlings produced/ha	658,000
Fingerlings produced/ha (kg)	2,833
Length of production period (days)	265
Cost/ha	55,739
Cost/fingerling produced	0.08
Cost/kg	19.67

[1]Excluding initial cost of broodstock and broodstock value at the end of production period.

held for the next fingerling production period. Excluding these broodfish costs and potential revenues, the average production cost/fingerling was ₱0.08 and production cost/kg was ₱19.70.

Advanced fingerling production

Cost of production for advanced fingerlings was calculated from production data presented by Broussard et al. (1983). Fingerlings (2.6 g each) were stocked into fifteen 600-m^2 earthen ponds at stocking rates from 15-35 fingerlings/m^2 (average 25/m^2). All ponds were harvested on the 90th day. Average production was 43 kg/ha/day and average weight of fingerlings at harvest was 18.3 g. A summary of advanced fingerling production costs is presented in Table 6. Including initial cost of ₱0.08 per fingerling stocked, the average production cost per advanced fingerling was ₱0.17 and average production cost/kg was ₱9.30.

Fingerling Dispersal Cost

Operational expenses were estimated for fingerling dispersal during the first year of the hatchery operation. Capital cost and economic life for dispersal equipment are presented in Table 7. The total cost for dispersal equipment was ₱292,600. A summary of operational expenses for dispersal is presented in Table 8. These expenses are divided into fixed

Table 6. Summary of advanced fingerling production costs (in pesos) from fifteen 600-m^2 earthen ponds over a 115-day production period. (₱11 = US$1 in mid-1983)

Number of fingerlings produced/ha	250,000
Fingerlings produced/ha (kg)	4,550
Length of production period (days)	115
Operational expenses/ha	22,143
Initial cost of fingerlings stocked/ha (@ ₱0.08)	20,000
Total cost/ha	42,143
Cost/advanced fingerling produced	0.17
Cost/kg	9.30

Table 7. Cost (in pesos) and economic life of equipment used in fingerling dispersal at the Freshwater Fish Hatchery and Extension Training Center, Muñoz, Nueva Ecija, Philippines. (₱11 = US$1 in mid-1983)

Equipment	No. of units	Economic life (yrs)	Cost (₱)
Delivery truck	2	5	140,000
Pick-up truck	1	5	130,000
Hauling boxes	10	5	7,600
Agitators	15	5	9,000
Regulators	4	5	3,000
Scale 30 kg	2	5	1,700
Scale 10 kg	2	5	900
Tubs	5	3	400
Total			292,600

Table 8. Annual operational expenses for dispersal of fingerlings at the Freshwater Fish Hatchery and Extension Training Center, Muñoz, Nueva Ecija, Philippines. (₱11 = US$1 in mid-1983)

Operational expenses	Amount (₱)
Fixed cost	
Depreciation on equipment	58,573
Variable costs	
Personal services	48,400
Diesel	42,240
Administrative cost (20% of variable costs)	27,763
Maintenance of vehicles	27,000
Travel	11,256
Miscellaneous supplies	5,000
Salt	3,000
Oxygen	1,920
Subtotal	166,579
Total	225,152

and variable costs with depreciation on equipment based on the straight line method being the only fixed cost. Personal services represent the largest variable cost (29%) and include salaries for the dispersal manager, dispersal assistant, two drivers and two laborers. The dispersal trucks averaged 32,000 km/year each. Diesel fuel cost was estimated based on a consumption rate of 5 km/l at a cost of ₱3.30/l. Maintenance cost estimates of these vehicles was based on 10% of original capital cost. Travel represents per diem (₱18.75/day) for drivers and staff while making deliveries. The total operational cost for fingerling dispersal was ₱225,152 of which variable cost represented 74% of the total cost. Cost of dispersal was ₱3.50/km. One additional truck would be needed to accommodate fingerling volume produced by a fully operational hatchery; as a result, annual operational cost for dispersal should increase to approximately ₱308,459 during the second year of operation.

Pricing of Fingerlings

The pricing scheme for fish sold from the hatchery was as follows: 1-5 g fingerlings – ₱0.08 each, 6-10 g fingerlings – ₱0.15 each, 11-20 g fingerlings – ₱0.20 each. Fish above 20 g were sold as breeders at ₱15/kg. This scheme was based upon the projected direct operational expenses of the hatchery and market value of fingerlings in the area in late 1981. Low prices of fingerlings and free deliveries were used as incentives at the beginning of the project to encourage nearby farmers to develop freshwater aquaculture. Receipts from the sale of fingerlings were not intended to fully cover operational expenses of the hatchery. The operational budget of the hatchery cannot be easily changed and is not related to receipts. Receipts were deposited in the national government's general fund. During the first year of operation, only 66% of the total number of fingerlings dispersed were sold with the remainder going to government projects at no charge. Fingerlings were also delivered free of charge during this first year. Actual dispersal from the hatchery during the first year of operation was 3,167,777 fingerlings at an average weight of 4.6 g and 160,000 breeders averaging 26 g. This represents approximately 33% of annual capacity of a fully operational hatchery of this size and pond layout devoted to fingerling production.

Discussion

Cost analysis of fingerling production using open pond spawning indicates that fingerlings can be produced at a relatively low cost at a large hatchery complex if production systems are properly managed. Ponds must remain in a fingerling production mode and should not be idle or used for holding. Operational inputs such as labor and fertilizer must be supplied in a timely manner. Cost estimates from this facility could be applied to large private hatcheries. Additional cost to private producers would include interest on loans and operating capital and higher cost for water. However, capital investment for facilities and pond construction should be substantially lower for a private hatchery.

Production during the first year of operation at this government hatchery was approximately 33% of capacity because of the multiple uses of the facility and down time during initial operations. Actual annual operating expenses were somewhat lower than those presented in Table 3. Production during the second year should approach capacity. In order to utilize additional facilities such as the hatchery buildings and outdoor holding tanks, additional inputs will be required. Use of these facilities would increase efficiency of production and could also increase production above the rated capacity.

An important activity of any large centralized hatchery is fingerling dispersal. Inability to disperse fingerlings is a primary limiting factor for marketing of fingerlings produced by small- to medium-scale (1-5 ha) private hatcheries in Central Luzon. Since small farmers are the target beneficiaries of the Center, dispersal becomes a larger problem because individual orders are relatively small. Nevertheless, it is doubtful that free deliveries can be continued because of budgetary constraints. Dispersal cost can be passed on to the farmers in the form of delivery charges based on distance or can be incorporated into the price of the fingerlings.

Hatchery budgets and pricing schemes for government-managed operations should be reviewed. Costs of such operations can be supported by revenues from fingerling sales, and operational budgets should be based on rational estimates of actual operational expenses. Hatchery facilities should be carefully constructed based on available operational funding because overbuilding of facilities that cannot be operated later due to inadequate funding represents a loss to government.

Some small hatchery operators in Central Luzon have complained of low fingerling prices at the BFAR hatchery and claim they cannot compete with government facilities. If the government intends to encourage fingerling production from private hatcheries, government facilities should not undersell or compete in any form with private producers. In areas where private hatcheries can meet fingerling demand, government sales of fingerlings could be phased out.

Large capital-intensive government hatcheries could be more effective if used for the production of good quality broodstock. Improved performance-tested strains of breeders produced under controlled conditions could be sold to private hatcheries. The large demand for fingerlings could then be met by the private hatcheries. A national broodstock development program should be undertaken to assure that high quality breeders are available to the public. Research institutions, government hatcheries and private producers must work together if such a program is to be successful.

References

Broussard, M.C., R. Reyes and F. Raguindin. 1983. Evaluation of hatchery management schemes for large-scale production of *Oreochromis niloticus* fingerling in Central Luzon, Philippines, p. 414-424. *In* Proceedings of the International Symposium on Tilapia in Aquaculture, 8-13 May 1983, Nazareth, Israel.

Dela Cruz, C.R. 1980. Integrated agriculture-aquaculture farming systems in the Philippines, with two case studies on simultaneous and rotational rice-fish culture, p. 209-223. *In* R.S.V. Pullin and Z.H. Shehadeh (eds.) Integrated agriculture-aquaculture farming systems. ICLARM Conference Proceedings 4, 258 p. International Center for Living Aquatic Resources Management, Manila and the Southeast Asian Center for Graduate Study and Research in Agriculture, College, Los Baños, Laguna, Philippines.

Guerrero, R.D. 1979. Cage culture of tilapia in the Philippines. Asian Aquaculture 2(11): 6.

Guerrero, R.D. 1983. Pond culture of the Nile tilapia. Modern Fish Farming (Philippines) 1: 20-22.

Guerrero, R.D. and A.M. Garcia. 1983. Studies on the fry production of *Sarotherodon niloticus* in a lake-based hatchery, p. 388-393. *In* Proceedings of the International Symposium on Tilapia in Aquaculture, 8-13 May 1983, Nazareth, Israel.

Hopkins, K.D. and E.M. Cruz. 1982. The ICLARM-CLSU integrated animal fish farming project: final report. ICLARM Technical Reports 5, 96 p. International Center for Living Aquatic Resources Management, Manila, and the Freshwater Aquaculture Center, Central Luzon State University, Nueva Ecija, Philippines.

PCARR. 1976. The Philippines recommends for tilapia. Philippine Council for Agriculture and Resources Research, Los Baños, Laguna, Philippines.

Sevilleja, R.C. and E.W. McCoy. 1979. Fish marketing in Central Luzon, Philippines. Research and Development Series No. 21. International Center for Aquaculture, Agricultural Experiment Station, Auburn University, Auburn, Alabama, 23 p.

The Adoption of Tilapia Farming and Its Impact on the Community of Sto. Domingo, Bay, Laguna, Philippines
(An audiovisual presentation)[1]

MA. CORAZON B. GAITE

JOSE NOEL A. MORALES

OLGA CRISELDA R. ORILLA

BERNARDINE B. PILI

Department of Communications
Ateneo de Manila University
Quezon City
Philippines

GAITE, M.C.B., J.N.A. MORALES, O.C.R. ORILLA AND B.B. PILI. 1985. The adoption of tilapia farming and its impact on the community of Sto. Domingo, Bay, Laguna, Philippines, p. 44-49. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

Transforming traditional agriculture into a highly productive and profitable sector of the economy is a task that continues to challenge development efforts today. One rice farming community that has been transformed by adoption of tilapia culture is the village of Santo Domingo, Bay, Laguna, Philippines. The community's success is ascribed to the right combination of available technology, community leadership, economic incentive and institutional support from the Bureau of Fisheries and Aquatic Resources (BFAR). By late 1982, over one-third of the community's 300 households were involved in backyard tilapia hatchery operations.

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[1]This audiovisual is based upon a research study and survey conducted by the authors in fulfillment of their undergraduate thesis requirements. The authors' thesis is deposited with the libraries of Ateneo de Manila University and ICLARM.

This paper is the text of an audiovisual presentation describing the tangible change that has occurred in the community as the tilapia industry has grown. Change has occurred not only in terms of physical possessions and improvements to housing, but also in terms of reduced unemployment of household heads and more hopeful attitudes towards the future. Insecurity of land tenure, lack of quality control over broodstock and increased competition from fingerling producers elsewhere contribute to some uncertainty regarding the future of the community's tilapia farms but experience to date indicates that some of these problems can be overcome if the community receives continued support from government agencies. The community's experience shows that small farmers can be active participants in the upliftment of their own socioeconomic conditions.

Tilapia Farming and Change in Sto. Domingo

An audiovisual presentation

Narrator: In recent times the contributions of small farmers and producers to sustain food production and supply in the light of high population growth have become increasingly important.

Rural transformation and growth holds forth promises of better quality of life, increased rural employment opportunities and increased, if not more equitable distribution of incomes.

Transforming traditional agriculture into a highly productive and more profitable sector of the economy is a task that continues to challenge development efforts today.

In the Philippines one possible alternative of increasing rural income or employment is aquaculture. While increasingly food imports have been judged necessary to meet the country's nutritional requirements, much hope is also placed on aquaculture, to help not only fill the gap of insufficient fish production but also to provide alternative income sources for traditional farmers and fishermen.

One community that has taken the path of aquaculture transformation is Barrio Sto. Domingo of Bay, Laguna. And their choice of alternative income activity is tilapia hatcheries.

Milkfish or *bangus* has long been the premiere aquaculture product of the Philippines but lately, another species has been gaining attention from producers and consumers alike.

Tilapia is now the second most important cultured fish in the Philippines.

(Market sounds . . . woman's voice: "Tilapia! Bili na kayo ng tilapia!") (Buy tilapia now!)

Narrator: Because of the increasing consumer demand for tilapia, culture of this species is now attracting considerable government and especially private investment by many small-scale entrepreneurs.

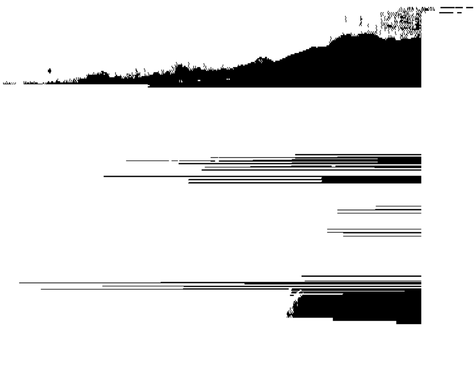
This growing and dynamic industry includes hatchery specialists, cage, pond, and pen culturists and an extensive marketing network.

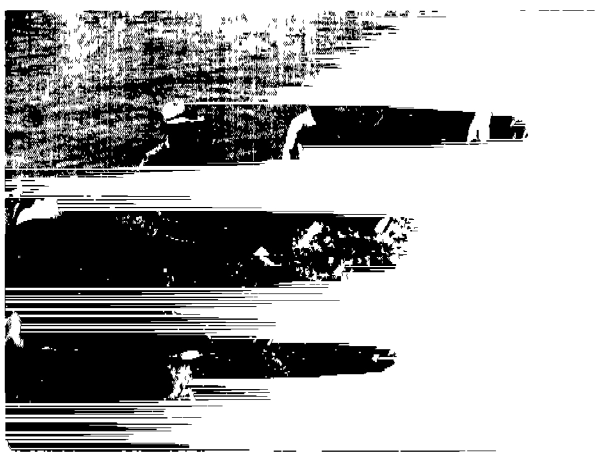
While tilapia was introduced in the Philippines thirty years ago, it was only in the last decade that it became popular for food and profit.

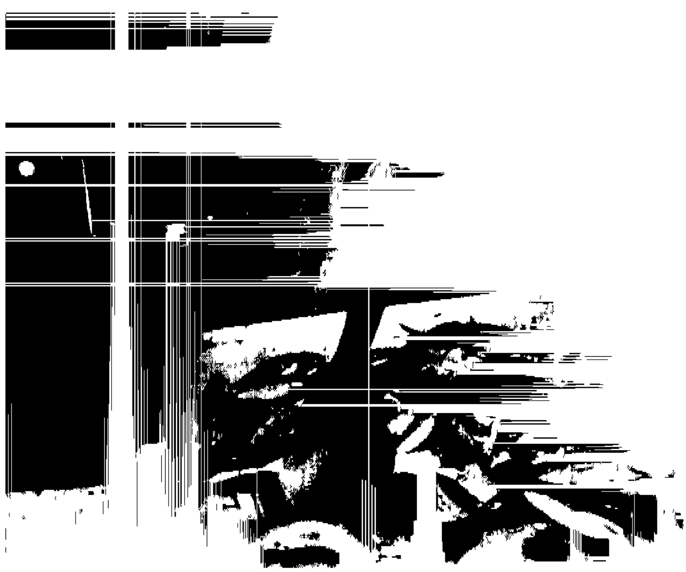
According to Dr. Rafael Guerrero, noted aquaculturist and tilapia expert, the tilapia industry offers many advantages and opportunities in terms of profitability.

Aside from ready marketability tilapia production can be undertaken on a small-scale basis. The fish can be easily bred. It is a hardy species which feeds on plankton.

It can withstand harsh environmental conditions such as low oxygen level, wide range of salinities and temperature and poor water quality.







Dr. Guerrero: The first introduction of tilapia in the Philippines was made by the late Deogracias Villadolid of the former Philippine Fisheries Commission, and the species introduced was *T. mossambica.* This came from Thailand in 1950. The introduction of the species was unfortunate because no studies were made on its management. The fish easily overcrowded ponds because of its ability to mature early and breed frequently and so its introduction to brackishwater ponds caused a lot of problems with respect to milkfish culture.

Tilapia became a very strong competitor of the milkfish for food. So with that bad experience, people became wary and started to despise the fish.

It was not until 1972 when we introduced another species of tilapia, *Tilapia nilotica,* when the attention of people again became more keen on tilapia.

This was because *T. nilotica* compared to *T. mossambica* had better features particularly its whiter color, its bigger size and faster growth.

Narrator: Today the tilapia industry is in a dynamic stage where rapid changes in production techniques and organizational structure of production and marketing are occurring. Because tilapia can be economically grown in small-scale operations, rural households have joined in the industry, and their involvement has brought about additional income and progress to their communities.

How does change occur in such communities? Where? By whom? And how extensive is the practice and adoption of a new source of income? What are the factors that contribute to the successful transformation of such communities?

Laguna Province is currently the site of more than 500 tilapia hatcheries, over 200 of which can be found in the municipality of Bay.

More than half of these are located in Sto. Domingo where one-third of the barrio's households operated their own backyard hatcheries as of late 1982.

The transition of Sto. Domingo from a heavy dependence on tenant rice farming, fishing and casual employment to substantial income from tilapia hatcheries has occurred within a short five-year period.

In 1978 it would have been difficult to predict these changes because, like many other rural communities, Sto. Domingo was characterized by a largely traditional agriculture, dependent upon the grace of the landlord who allowed residents to farm nearby land for free.

The transition of this lakeside barrio shows that community development is as dependent on how effectively people work together as it is on the natural resources with which they begin.

Technical, economic and institutional factors have combined with community leadership to bring about material change and new hope for the future in Sto. Domingo.

A former barrio captain, Mr. Pascual Navallo, was the first local resident to develop his own backyard hatchery. He picked up the idea from the local Bureau of Fisheries station where he worked as a security guard.

Mang Pascual was encouraged by his fellow employees at the fisheries station to operate his own hatchery. After preparing his ponds in his spare time, he stocked them with tilapia breeders, some of which he purchased from Talim Island.

Two months later in January 1978, he reaped his first harvest of 27,000 fingerlings which he sold for over ₱2,000.00. Observing Mang Pascual's success and benefitting from his advice, his relatives and neighbors soon began hatcheries of their own.

In addition to Mang Pascual's initiative, another contributing factor to the rapid growth in numbers of hatcheries in Sto. Domingo is the presence of the experimental fishfarm of the Bureau of Fisheries and Aquatic Resources.

This station provided free breeders and technical advice. It appears that an effective support institution is one thing a community needs to successfully embark on a new venture.

Mr. Orlando Comia, BFAR Fisheries Officer: "My personnel from the farm and myself are giving them technical assistance in the form of giving techniques on the proper construction of the pond, the system of preparation of the pond, the system of feeding. Aside from that, we come and see the operator and by seeing the project itself, we could identify other problems."

Narrator: People find operating a hatchery relatively easy. The initial investment cost is low and the techniques of pond preparation, fertilization, stocking, feeding, fingerling harvesting and pond draining can be readily learned.

These small hatcheries which have an average of three ponds can be easily operated as a family business. The labor input required is less than four hours a day primarily for feeding and maintenance.

Many farmers have not fully abandoned rice farming but have converted part of the land they till into tilapia hatcheries. For many residents, their tilapia hatcheries remain a secondary occupation. Those not involved cited lack of access to land as their major reason.

Community cooperation is evident when heavy tasks such as pond digging and repair or harvesting and draining are often collectively performed. Farmers frequently turn to friends or relatives for assistance. Hired labor is also used.

Marketing of fingerlings is done either by direct negotiations with buyers or through an agent. A major outlet for Sto. Domingo fingerlings is the cage culture industry of nearby Laguna de Bay.

Buyers come from as far away as Bicol. When major buyers, such as the KKK government livelihood program, require hundreds of thousands of fingerlings, agents assemble these quantities from many operators.

Indeed, Sto. Domingo hatcheries have become known throughout Central and Southern Luzon and the whole community has experienced progress as a result.

Comments/Testimonials of Barrio Residents . . . (in Tagalog) . . .

Narrator: Throughout Sto. Domingo there is much tangible evidence of the changes brought about by the increased income from tilapia hatcheries. In terms of consumer durables owned and type of housing material, hatchery operators are significantly better than non-operators.

Two-thirds of hatchery operators have improved the structure of their homes since 1978 while less than one-third of the non-operators have done the same.

Hatchery operators are more likely to own refrigerators, television sets, transistor radios, sewing machines, gas stoves and household furnishings than are non-operators. The majority of these items have been purchased since 1978. Hatchery operators also have more savings and less debts than non-operators.

Seventy percent of the hatchery operators say their life and standard of living has improved since the first hatcheries appeared in the community. Less than 30% of the non-hatchery operators believe their life to be better now than five years ago. However, almost 60% of the non-operators say they are planning to enter the hatchery business soon.

Perhaps, most important of all since 1978, there has been a significant decline in the percentage of household heads who are unemployed. Attitudes of the residents about the future have become more hopeful and determined both for themselves and their children.

The development and progress brought about by the tilapia hatcheries in Sto. Domingo may appear to have been achieved easily. However, it was only possible because of the right mixture of available technology, economic incentives, community initiative and institutional support.

With the initiative and willingness to invest shown by the residents and with the support extended by the local fisheries station, much has been accomplished. But the continued success of the barrio's industry is dependent upon several factors, only some of which are within the community's control.

One factor is the vague issue of land use and ownership. Most of the hatchery operators do not own the land they are using and worry that the owner may convert it to a housing subdivision and resort complex.

Another problem is the lack of quality control over the broodstock used in the hatcheries. Most of the community's current broodstock is no longer pure *Tilapia nilotica* and there is already evidence that growth rates of fingerlings have suffered as a result of this contamination with other species such as *T. mossambica.*

Finally, there is the inevitable threat of competition from hatcheries elsewhere. Since the technology is relatively easy to apply anywhere in the country where adequate fresh water is available, Sto. Domingo and other Laguna hatcheries may find their markets restricted to Laguna de Bay cage operators and thus a reduced demand for their fingerlings.

Despite these potential problems and threats, however, the experience of Sto. Domingo is significant in many points. First, it adds to the observation that traditional Filipino farmers are willing and receptive to change. Second, it shows that when a community works together, the process of agricultural transformation can be accelerated. And that the small farmers or small producers can be active participants in the upliftment of their own socioeconomic conditions. Third, that if the efforts of the people are complemented with continued institutional support, new income generating activities are more likely to be sustainable.

It appears that Sto. Domingo's success can be duplicated in other communities of the country if these lessons are kept in mind.

Agricultural transformation is a complex and dynamic process. Attention must be paid to the economic, institutional, technical and human factors that make it possible.

Session 3: Cage Culture Systems

The Economics of Tilapia Cage Culture in Bicol Freshwater Lakes, Philippines

EMMA M. ESCOVER*

AND

RODRIGO L. CLAVERIA

Ateneo de Naga
Naga City, Philippines

ESCOVER, E.M. AND R.L. CLAVERIA. 1985. The economics of tilapia cage culture in Bicol freshwater lakes, Philippines, p. 50-65. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

This paper analyzes the economics of cage culture of 70 tilapia cage operators in Lake Buhi and Lake Bato, both located in Camarines Sur Province of the Philippines.

Data showed that tilapia cage culture, although recently adopted, has made considerable contribution to the annual household income of operators in the two study areas. On the average, a tilapia cage operator in Bicol had five cages totalling 192 m^2. The cages were usually family-operated and utilized mostly the available fingerlings from the two lakes. Average investment for all farm sizes was ₱3,579.

In terms of production, Lake Bato cage operators had higher volume of production. The average production for all farms was 401 kg per cropping, 87% of which was sold, 6% was consumed at home and 7% was given away.

Net cash incomes for all farms were positive. However, including an imputed value for labor results in all farm sizes showing negative net income because of very high labor input in guarding tilapia cages.

Natural calamities, e.g., typhoons and sulphur upwelling, poaching and lack of capital were the major problems encountered in tilapia cage culture.

*Current address is c/o ICLARM, MC P.O. Box 1501, Makati, Metro Manila, Philippines.

Introduction

For some time now, inland fisheries have been attracting the attention of different sectors. The recent introduction of tilapia culture has further enhanced its attraction and today, inland fisheries are growing at a rapid rate. Despite this accelerated growth, inland fisheries (including brackishwater aquaculture) contribute only 10% of the total Philippine fish catch, with 90% produced by marine fisheries (BFAR 1982). Although contributing a small fraction of the total fish supply, inland fisheries make a more important contribution to the supply of relatively cheap protein for human cosumption.

Because the country's population is growing fast, the government has to continuously stimulate increased food production. After attaining self-sufficiency in rice production in the late 1970s, the government is currently concentrating on fish in hopes of duplicating this achievement. It has launched numerous programs geared towards optimum development and exploitation of the country's fisheries and aquatic resources.

Recent studies (Alvarez 1981; Cabrero 1981) have documented the growing popularity of fish culture in various freshwater bodies. One of these was tilapia culture. In the Bicol region alone, particularly the municipalities of Buhi and Bato, both in Camarines Sur Province, a renewed interest in freshwater fish production (including capture fisheries) has resulted in the grant of ₱7.7 million by the national government to the needy inland fishermen under the Kilusang Kabuhayan at Kaunlaran (KKK) program (Ministry of Human Settlements (MHS), Naga City, pers. comm., 1982). These loans are being used by local residents to set up tilapia fish cages in Buhi and Bato Lakes. With the setting up of these fish cages, the fish farmers expect increased production of fish, thereby boosting their income.

The initial success of tilapia culture around Lake Buhi and Lake Bato generated intense interest and the number of fish cages mushroomed. However, Bureau of Fisheries and Aquatic Resources (BFAR) technicians in the two municipalities revealed that various problems beset the tilapia fish farmers in these two lakes; principally, unscientific production practices and marketing constraints. To help solve these problems, both fishery planning and implementing agencies, as well as tilapia fish farmers, need more specific information. This study therefore attempts to provide this information by documenting the different production and marketing practices of tilapia fish farmers in the two lakes.

Objectives of the Study

The primary objective of the study was to determine the economics of tilapia cage production in Lake Buhi and Lake Bato. The specific objectives were:

- to identify the production practices of cage operators;
- to identify and estimate the different inputs used;
- to estimate the volume and value of production;
- to estimate the costs and returns of tilapia cage operations; and
- to determine the problems encountered by cage operators.

Methodology

To construct a sample frame, names of cage operators in the two municipalities of Buhi and Bato were obtained from the local office of the Ministry of Human Settlements and from key informants. Random sampling with replacement was used in selecting sample respondents. Respondents were distributed as follows:

Lake Buhi = 50 cage operators
Lake Bato = 20 cage operators

The Lake Bato sample was small because of the unfavorable peace and order condition prevailing in the area during September-November 1982, the time of the survey.

The respondents were interviewed using a structured questionnaire. Related information was collected from the BFAR, the National Census and Statistics Office, municipal offices and key informants. Collected data were compiled and summarized at the Research and Service Center of the Ateneo de Naga. Frequency distributions, means and proportions and costs and returns analyses were applied in this study.

The Tilapia Cage Operators

Ninety-six percent or 67 of the 70 tilapia cage operators included in the study in the municipalities of Buhi and Bato were males and 99% were married (Table 1). Average age

Table 1. Background information on 70 cage operators in Lake Buhi and Lake Bato, 1982.

Characteristic	Lake Buhi (n = 50) %	Lake Bato (n = 20) %	Both lakes (n = 70) %
1. Age (years)			
30 and below	6	5	6
31-36	26	20	24
37-42	22	15	20
43-48	30	20	27
49-54	8	20	11
55 and above	8	20	11
Ave. (years)	42	50	43
2. Sex			
Male	96	95	96
Female	4	5	4
3. Civil status			
Single	2	–	1
Married	98	100	99
4. Educational attainment			
None	2	–	1
Elementary	56	30	49
High school	32	60	40
College	10	10	10
5. Years engaged in cage culture			
1-3	90	85	89
4-6	10	15	11
Ave. (years)	2.3	2.4	2.3
6. Extent of involvement			
Part-time	70	85	74
Full-time	30	15	26
7. Nature of involvement			
Owner-operator	90	90	90
Owner-non-operator	–	5	1
Non-owner, supervisor	10	5	9

was 43 years. Forty-nine percent of the operators had completed elementary education, 40% had attended secondary education, 10% had taken some college education, while only 1% was reported to have no formal education.

Ninety percent of the respondents owned their tilapia cages, 9% were caretakers and 1% was an owner but not directly managing the farm. While the cage operators in Lake Buhi and Bato on average had been engaged in fishing activities for the past 17 and 20 years, respectively, the majority of them only started their tilapia cage operations two years ago.

Twenty-six percent of the tilapia operators reported to be fully employed in their cage culture while 74% were only partially involved because they were either engaged in capture fishing, farming or have business/trade and/or employment elsewhere. Cage operators derived almost 40% of their total annual household income from fishing activities, and over half of this was derived from cage culture (Table 2). Salaried employment, business/trade and farming were the major contributors to the household annual income of the cage operators included in this study.

Adoption of Tilapia Cage Culture

Any new technology introduced in a locality would draw interest, more so if it promises good economic prospects. Tilapia cage culture is a good example of a technology which attracted such enthusiasm. The first set of cages was constructed in 1976 in Lake Bato and in 1978 in Lake Buhi and adoption of cage culture had been rapid. By 1982, literally thousands of tilapia cages were found in both lakes.

Varied reasons were given by operators as to why they adopted cage culture. Fifty-seven percent of the respondents engaged in cage culture because they were certain of its profitability. Ten percent of the respondents who were not fully convinced in the first instance of its profitability, started their cage operation to test whether it was really a profitable venture. Moreover, the prolific nature of tilapia also encouraged fishermen to adopt this system. They said that a hundred-thousand fish could easily be produced in short periods. Those who reported to have other sources of income adopted the system because it is a good source of additional

Table 2. Source of annual household income (by percentage) of tilapia cage operators in Lake Buhi and Lake Bato, 1982.

Source	Lake Buhi (n = 50)		Lake Bato (n = 20)		Both lakes (n = 70)	
1. All fishing activities:	41		37		39	
Cage operation		20		23		22
Other fishing activities		21		14		17
2. All non-fishing activities:	59		63		61	
Salaried employment		25		23		23
Business/trade		21		28		26
Farming		13		12		12
Total	100		100		100	

household income. Low hired labor requirements, ready availability of tilapia fingerlings from their own *baklad* (fixed fish traps) and low capital requirements for cage construction were the other important reasons cited for the adoption of the tilapia cage culture system (Table 3).

Tilapia cage operators learned about the culture system from the Bureau of Fisheries and Aquatic Resources (BFAR) technicians, from friends and relatives, and from attending one- to two-day seminars sponsored by the local offices of the Ministry of Human Settlements under the Kilusang Kabuhayan at Kaunlaran programs.

Tilapia Cage Operation

Number of cages, type and size of operation

Sixty-three farms had cages for grow-out tilapia only while seven or 20% had both grow-out and hatchery cages. Only grow-out operations were analyzed in this study.

On the average, the tilapia fish farmers in both lakes had five cages of the fixed type, thus a different system from the floating cages in Laguna Lake (see Aragon et al., this volume). Only 7% of the total respondents had 10 cages or more (Table 4). In general, Lake Buhi and Lake Bato cage culture is made up of relatively small-scale operations.

The cages are usually rectangular. Cages in Lake Buhi were smaller, having dimensions of 2 x 3.5 m to 22 x 3.5 m. Average depth was 2.5 m. Cages in Lake Bato were bigger, ranging from 6 x 3 m to 10 x 8 m and had an average depth of 3 m (Table 5).

For this study, cage culture farms were classified as follows: small farms (< 99 m^2); medium farms (100 to 199 m^2); and large farms (200 m^2 or more). On average, Lake Bato farms were larger in area than those in Lake Buhi although the average number

Table 3. Reasons for the adoption of tilapia cage culture in Lake Buhi and Lake Bato, 1982.

Reason in rank order	Lake Buhi (n = 50) No.	%	Lake Bato (n = 20) No.	%	Both lakes (n = 70) No.	%
1. Profitable business	40	57	13	57	53	57
2. Wanted to test whether cage culture is profitable	7	10	2	9	9	10
3. Tilapia very prolific	7	10	2	9	9	10
4. Additional source of income	5	7	1	4	6	7
5. Requires lesser labor input	3	4	1	4	4	4
6. Available fingerlings from own *baklad*	3	4	1	4	4	4
7. Low capital requirement	2	3	–	–	2	2
8. Miscellaneous reasons	3	4	3	13	6	6
Total	70[a]	100	23[a]	100	93[a]	100

[a]Exceeds total number of respondents due to multiple responses.

Table 4. Number of cages per operator in Lake Buhi and Lake Bato, 1982.

No. of cages	Lake Buhi (n = 50) %	Lake Bato (n = 20) %	Both lakes (n = 70) %
1-3	34	45	37
4-6	44	40	43
7-9	18	--	13
10-12	2	10	4
13 and above	2	5	3
Total	100	100	100
Ave. no. of cages	5	5	5

Table 5. Type, size of farm and stocking density of tilapia culture systems in Lake Buhi and Lake Bato, 1982.

Item	Lake Buhi (n = 50)		Lake Bato (n = 20)		Both lakes (n = 70)	
	No.	%	No.	%	No.	%
1. Type of farm						
Grow-out only	44	88	19	95	63	90
Grow-out and hatchery	6	12	1	5	7	10
Total	50	100	20	100	70	100
2. Size of farm (m^2)						
Small: < 99 m^2	28	56	3	15	31	44
Medium: 100-199 m^2	12	24	7	35	19	27
Large: > 199 m^2	10	20	10	50	20	29
3. Stocking density (no. of fingerlings) by size of farm						
			Per farm			
Small	2,531		7,333		2,996	
Medium	2,851		9,737		5,388	
Large	3,073		8,224		5,648	
Weighted average	2,716		8,620		4,403	
			Per m^3			
Small	14		40		16	
Medium	6		22		12	
Large	3		73		38	
Weighted average	10		50		32	

of cages operated were the same in both locations.

Species, stocking density and source of fingerlings

The tilapia species used by these lake operators depends upon the availability of its supply and its price. Many cage operators who have also *baklad* used fingerlings taken from the lake for their cage operations. The species taken from the lake was usually a crossbreed between *O. mossambicus* and *O. niloticus* locally called "natural". Out of the 70 respondents, 90% used this crossbreed tilapia. This species was preferred because of its availability and abundance. Moreover, the fingerlings taken from the lake are also cheaper, ₱0.04 to ₱0.06/piece, as compared to a pure breed *O. niloticus* which costs ₱0.20/piece in the Bicol region. A few of the larger cage operators (10% of total respondents) with more readily available capital preferred to stock *O. niloticus* because of its faster growth.

Stocking density of tilapia cages varied according to both location and size of farm. On the average, tilapia cages in Lake Buhi had a stocking density of $10/m^3$, while those in Lake Bato had $50/m^3$ (Table 5).

Fingerlings were obtained from different sources. They were either bought, caught from the lake or bred by the producers themselves. Fifty percent of those interviewed caught their fingerlings from the lake, while 14% bought them either from local land-based hatcheries or from *baklad* operators (Table 6). Twenty-seven percent of the respondents obtained half of their fingerlings from the lake and the remaining half from other sources. Others who bred their own fingerlings but had insufficient quantities by this means, obtained additional fingerlings from other supplies or from their own *baklad*. There were only two producers who relied totally on their own fingerlings for their operation. Fingerlings purchased from *baklad* operators were cheaper than those purchased from private hatcheries in Antipolo, Buhi and Baao, Camarines Sur. The price difference was primarily due to the purer strain of *O. niloticus* offered by the private hatchery. Lake caught fingerlings were almost certainly heavily contaminated with *O. mossambicus* genes.

Capital investment and source of funds

Total investment increased with the size of farm. Capital investments of cage operators included expenses for boat, engine, nets and bamboo posts. For most small and large farms, a guard house was also necessary. Only large farm operators reported owning *bañeras* or metal tubs used for marketing the harvest. Total investment for small farms was ₱1,580;

Table 6. Source of fingerlings obtained by cage operators in Lake Buhi and Lake Bato, 1982.

Sources	Lake Buhi %	Lake Bato %	Both lakes %
Bought	10	25	14
Lake caught	50	50	50
Breed their own	2	5	3
Bought/lake caught	30	20	27
Bought/breed	6	–	4
Lake caught/breed	2	–	1
Total	100	100	100

for medium farms was ₱2,456; and for large farms was ₱5,962 (Table 7). Average investment cost was ₱3,579 per farm.

The study showed that of the 70 cage operators interviewed, only five availed of loans to start their cage operations. Two borrowed from banks while three borrowed from their relatives. High collateral requirements and interest rates were the explanations given why the majority of the cage operators did not avail of any loans.

In mid-1982, however, after they had already begun their cage operations, 40 out of the 50 respondents in Lake Buhi were able to avail of the short-term loans extended by the government through the Tilapia Cage Project of the Kilusang Kabuhayan at Kaunlaran (KKK) livelihood project. Borrowers obtained on average ₱2,423, a large portion of which was given in kind, i.e., netting material, fingerlings and bamboo posts. The cash portion was allotted for feeds and labor for cage construction and installation. KKK loans were released in installments.[1]

Management Practices

Site selection

Prospective cage culture sites were selected primarily for their accessibility. Fifty percent of the respondents chose a site because of its proximity to their residence or *baklad*, while 14% considered physical safety from typhoon and strong currents and from the seasonal sulfur upwelling in Lake Buhi, locally known as *kanuba* to be important (Table 8). Ten percent showed preference for sites with abundant supply of plankton which would reduce expensive supplementary feed costs. Other reasons cited for the selection of cage sites were: the area was declared as part of the Lake Buhi's tilapia cage belt (Fig. 1); the site was recommended by a BFAR technician; or they were the only sites available.

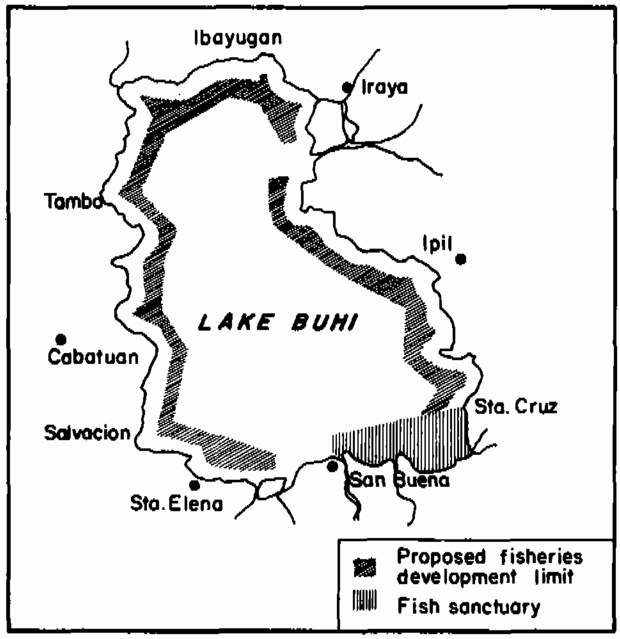


Fig. 1. Map of Lake Buhi showing the proposed fisheries development limit (fish cage belt).

Construction of fish cages

The cage is constructed from 2-4 cm mesh size synthetic (polyethylene) netting attached around an enclosed frame of the desired size, using monofilament as thread and polyethylene rope to hold the net to the bamboo posts. Bamboo posts of selected sizes are staked to the bottom at all four corners with approximately eight posts supporting each stationary cage. Extra bamboos are used at the surface to enclose the entire cage area and at the same time serve as a catwalk for laborers and caretakers. The top portion of net is tied to the bamboo posts one foot above the lake's water surface.

[1]Editors' note: Lake Buhi was hit by a typhoon in late 1983 which destroyed large numbers of tilapia cages. This damage and subsequent delays in release of KKK funds made it extremely difficult for cage operators to repay the first release received under these KKK loans. Lake Bato operators, however, have been able to repay most of their obligations.

Table 7. Capital investment (in pesos) by size of farm, 70 cage operators, Lake Buhi and Lake Bato, 1982. (₱8.50 = US$1.00 in mid-August 1982)

Farm size	Ave. capital investment							
	Small farms (n = 31)		Medium farms (n = 19)		Large farms (n = 20)		All farms	
Item	Capital cost	% of total cost	Capital cost	% of total cost	Capital cost	% of total cost	Capital cost	% of total cost
Boat engine	498	32	1,020	42	1,736	29	1,085	30
Fish nets	265	17	477	19	902	15	548	15
Boat	295	19	479	20	802	13	525	15
Bamboo for cage	115	7	127	5	918	15	387	11
Ipil-ipil[1] post	37	2	125	5	265	4	142	4
Rope/filament	33	2	124	5	139	2	99	3
Weighing scale	51	3	74	3	36	1	54	1
Tub *(bañera)*	0	0	0	0	31	1	31	1
Guard house	273	17	0	0	1,075	18	674	19
Others	14	1	30	1	58	1	34	1
Total	1,580	100	2,456	100	5,962	100	3,579	100

[1] Scientific name: *Leucaena leucocephala.*

Table 8. Reason(s) for selecting present location of cages, 70 cage operators, Lake Buhi and Lake Bato, 1982.

Reason	Lake Buhi	Lake Bato	Both lakes
		Number reporting[a]	
1. Proximity to residence or *baklad*	29	11	40
2. Safe from typhoon, strong currents and sulphur upwelling	10	4	14
3. Abundant supply of plankton	7	3	10
4. Declared as tilapia cage belt	3	2	5
5. Recommended site of BFAR	1	3	4
6. Only available site	4	–	4
7. Offered by a friend	1	–	1
Total	55	23	78

[a] Some respondents gave several reasons.

Maintenance of cages

After initial stocking of fingerlings, regular inspection of cages is necessary to ensure that loose rope connections or gaps do not allow fingerlings to escape. Frequency of cage inspection for this purpose varied from once a day to once a month (Table 9). Since the top portion of the cage is constantly exposed to sunlight, deterioration frequently occurs on this section. The net becomes weak and grown tilapia may thus be able to jump out of the cage. During the culture period, the operators or hired laborers also dive and inspect the condition of the underwater netting and other materials to check for damaged nets and to avoid losses of fish stock. The majority of operators inspected their cages at least weekly.

Cages are cleaned thrice a week to once a year. Cages were cleaned to remove fouling organisms from the netting and weeds thriving around the cage that may hamper water movement and thus fish growth. Surprisingly, a large number (almost 40%) did not practice cage cleaning, reasoning that the accumulated organisms could serve as food for their tilapia.

Feeding practices

The most widely used feed consisted of rice bran only (Table 10). A somewhat smaller number of operators mixed rice bran with small freshwater fish *(irin-irin)* and/or dried freshwater shrimps. Other feeds used were grated coconut meat refuse mixed with either rice bran and/or corn. Of the eight respondents not practicing supplementary feeding, seven were from Lake Bato. They believed that abundance of plankton in the lake supplies the needed feeds.

Feeding was done once to thrice a day, three to seven times a week or once or twice a month, depending upon the producer's discretion. Normally, feeds were broadcast on the surface water of the cages by the operator during his periodic visits; others preferred to add water to the feed mixture and form it into balls. Operators who practiced this latter method claimed it saved on feed expenses because the feed mixture is not easily carried away from the cage by currents or wind, unlike dried rice bran which can easily be blown away by a strong wind.

Rice bran was purchased from local markets or rice mills at an average price of ₱0.70/kg while *irin-irin* and dried shrimp could be caught from the lake or bought from local fishermen.

Harvesting practices

On average two crops of tilapia can be grown each year (Table 9). Forty-one operators practiced selective harvesting while the rest harvested the whole crop at once. Harvesting techniques employed were similar in the two sample areas. Harvesting was done by untying first the bottom support rope of the cage. After untying, a long bamboo was slipped under the bottom portion of the cage and with the support of the bamboo, the harvesters, usually the operator and his family, drove the entire catch into its open top corner. A scoop net was used in catching the fish which are then transferred to boats or sometimes to a bamboo container that can accommodate 30 to 40 kg of tilapia.

After harvesting, the cage operators usually practiced grading based on fish sizes. The harvest was sold or marketed immediately due to its perishable nature.

Labor input

Tilapia cage farms, particularly the small-sized farms, are usually family-operated. Hired labor was usually employed by small and medium farms only for net preparation and cage installation to ensure that they were properly done. In addition to these tasks, large farms also employ hired laborers to guard their cages 24 hours a day. Intensive guarding, especially when tilapia reach market size, is very necessary.

On the average for all farm sizes, the total labor input per farm per four-month crop was

Table 9. Management practices, 70 tilapia cage operators, Lake Buhi and Lake Bato, 1982.

Item	Lake Buhi %	Lake Bato %	Both lakes %
1. Frequency of cleaning cages			
Thrice a week	10	0	7
Weekly	16	20	17
Biweekly	2	0	1
Monthly	16	10	14
Every harvest	18	15	17
Yearly	0	5	1
Depends on accumulated fouling	4	0	3
Do not clean	34	50	39
Total	100	100	100
2. Frequency of inspecting cages			
Daily	30	35	31
Every other day	26	10	21
Twice a week	14	20	16
Weekly	30	25	29
Monthly	–	10	3
Total	100	100	100
3. Method of feeding			
a. Broadcast (dry feeds)	64	35	56
b. Broadcast (wet feeds)	24	30	26
c. Combination of a and b	10	–	7
d. Do not feed	2	35	11
Total	100	100	100
4. Frequency of feeding by those who practice feeding			
Once a day	24	0	19
Twice a day	29	15	26
Thrice a day	2	0	2
Once a week	8	15	10
Twice/thrice a week	31	46	34
Four-ten times per week	6	8	6
Once or twice a month	0	15	3
Total	100	100	100
5. Type of harvesting			
Selective/partial	54	70	59
Complete	46	30	41
Total	100	100	100
6. Ave. stocking duration (no. of months)	4.2	3.9	4.1
7. Ave. no. of harvests per year	2.1	2.4	2.2

182.8 man-days (Table 11). The most labor-intensive activity, requiring 87.3 man-days, was guarding the cages. Maintenance of the cage utilized 31.6 man-days while net preparation required 25.2 man-days per crop. Feeding, installation of cages and procurement of fingerlings were the other labor-intensive activities in tilapia cage operations.

Tilapia Production

In general, harvesting is done after rearing the tilapias for approximately four months. There were respondents, however, who harvested small (> 10 pieces/kg) tilapias because of their immediate need for cash (Table 12). Another reason cited by several respondents for harvesting small tilapia even after four months was poor growth rate, which may be attributed to insufficient feeding and poor quality fingerlings.

Total volume harvested per farm was higher in Lake Bato than in Lake Buhi for all farm sizes. On average in both lakes, small farms produced 234 kg, medium farms produced 340 kg and the large farms produced 755 kg/crop (Table 13). For all farm sizes, the average production was 401 kg/crop.

Costs and Returns

Tilapia harvested from the lake cages were either sold, consumed at home, or given away. Of the 409 kg total production per farm per crop, 87% (356 kg) was sold; 6% (24 kg) was consumed at home; and the remaining 7% (29 kg) was given away.

Prices received by cage operators ranged from ₱4.50 to ₱10.00 and averaged ₱7.43/kg. Price primarily varied according to size of tilapia sold, with larger fish fetching higher prices. The total value of tilapia per crop was ₱1,792 for small farms; ₱2,573 for medium farms and ₱5,448 for large farms (Table 14). This total value includes the imputed value of fish consumed or given away. The average total cash and non-cash return per crop for all farm sizes was ₱3,040.

Table 10. Number of cage operators using different feeds by size of farm in Lake Buhi and Lake Bato, 1982.

Type	Small farms (< 99 m^2)		Medium farms (100-199 m^2)		Large farms (> 199 m^2)		All farms (n = 70)	
	Buhi	Bato	Buhi	Bato	Buhi	Bato	Buhi	Bato
				Number reporting				
Rice bran only	16	0	6	4	1	5	23	9
Rice bran and dried shrimp	4	0	3	1	7	1	14	2
Rice bran and *irin-irin*[a]	4	0	2	0	1	0	7	0
Rice bran and coconut meat refuse *(sapal)*	3	0	0	1	1	0	4	1
Rice bran, corn and *irin-irin*	0	0	1	1	0	0	1	1
No feeding	1	3	0	0	0	4	1	7
Total	28	3	12	7	10	10	50	20

[a]*Irin-irin* is the local term for *Vaimosa dispar.*

Costs of production per season include cash and non-cash costs. Cash costs include direct expenses needed in the production of tilapia, such as fingerlings, feed, hired laborers, fuel and oil, and municipal licenses. Total per farm cash costs averaged ₱1,890 per crop, with fingerlings comprising approximately 50% of these expenses.

Non-cash items included depreciation of materials and equipment, unpaid family labor

Table 11. Labor input (man-days) per farm per crop by activity and by size of operation and location, Lake Buhi and Lake Bato, 1982.

Activity	Small (< 99 m^2) Buhi (n = 28)	Small (< 99 m^2) Bato (n = 3)	Medium (100-199 m^2) Buhi (n = 12)	Medium (100-199 m^2) Bato (n = 7)	Large (> 199 m^2) Buhi (n = 10)	Large (> 199 m^2) Bato (n = 10)	Both lakes (n = 70)
1. Procurement of materials	3.9	1.5	1.7	1.3	1.5	4.3	3.8
2. Preparation of nets	7.5	5.3	8.2	5.3	30.7	18.5	25.2
3. Installation of nets	1.8	3.0	5.5	1.8	6.4	8.7	9.0
4. Procurement of fingerlings	3.9	3.0	2.6	7.0	5.7	4.2	8.7
5. Inspecting, cleaning, maintenance	23.9	23.6	6.6	10.4	18.4	12.0	31.6
6. Feeding	6.1	0.1	18.4	1.4	5.2	0.8	2.9
7. Harvesting	1.1	0.9	0.9	1.1	3.8	11.8	14.3
8. Security	70.7	18.8	88.2	65.1	107.8	159.0	87.3
Total	118.9	56.2	132.1	93.4	179.5	219.3	182.8

Table 12. Tilapia harvests: average number of pieces per kg, 70 cage operators, Lake Buhi and Lake Bato, 1982.

No. pieces/kg	Lake Buhi %	Lake Bato %	Both lakes %
Less than 5	6	5	6
5-9	24	25	24
10-14	24	25	24
15 and above	26	45	31
Do not use weighing scale	20	–	14
Total	100	100	100

Table 13. Average volume (kg) of tilapia harvested per farm per crop by size of farm, 70 cage operators in Lake Buhi and Lake Bato, 1982.

Size of farm	Lake Buhi (n = 50)	Lake Bato (n = 20)	Both lakes (n = 70)
Small (< 99 m^2)	199	389	253
Medium (100-199 m^2)	256	462	315
Large (> 199 m^2)	695	810	728
Ave. all farms (kg)	307	636	401

(excluding the owner-operator) and losses of tilapia. Average total non-cash costs per crop for all sizes of farms amounted to ₱1,664; unpaid family labor represented approximately two-thirds of these non-cash costs.

Total cash and non-cash costs of production for all farm sizes averaged ₱3,553 per crop and average net cash income was ₱793. Imputing a value for the operator's own labor valued at ₱10/day results in a negative net farm income for all farm sizes. Nevertheless, the more important aspect as far as most cage operators were concerned was that all farm sizes returned a positive net cash farm income *plus* returns to family labor. For the average farm, total returns to the household per crop were valued at ₱2,250 per crop, representing ₱358 for fish consumed or given away, ₱1,099 return to unpaid family labor and ₱793 cash. Since most of the tilapia cage farms were operated as secondary sources of income, this total return is quite attractive given the low levels of income prevailing in the Bicol region.

Problems

Tilapia producers reported various problems in their cage operation (Table 15). Both Buhi and Bato operators ranked natural calamities as the major problem. In the case of Buhi, producers were concerned with periodic sulphur upwellings, during which fish are forced to the surface to gulp air due to low dissolved oxygen in the lake. In Bato, sulphur upwelling does not occur, but producers there were bothered by strong currents caused by either typhoons or strong winds.

Theft was another serious problem reported. Producers not able to carefully guard their cages constantly incurred losses of fish stocked, especially when fish were near market size. Even guard houses erected in the middle of the production areas were to no avail unless somebody could be stationed 24 hours daily.

Lack of capital and credit assistance was also a problem. In addition, those who were given KKK loans reported that loans were not always released on time. After stocking the fingerlings, succeeding loan releases were apparently delayed. Thus, recommended supplementary feedings were not applied by these operators.

Finally, proliferation of cages, though few respondents reported production problems emanating from overcrowding, is worthwhile mentioning. The mushrooming of cages caused increased competition between small and large fish cage operators. All 70 respondents reported that there were more small cage operators than large ones and that competition exists between them not only for space but also for a share of the market. Large fish cage operators can influence the price of tilapia by withholding from or flooding the market with large volumes of tilapia. Small operators who did not coordinate their harvesting in any way, were unable to influence market prices and claimed to be

Table 14. Costs and returns per farm per crop in pesos by size of farm, 70 cage operators in Lake Buhi and Lake Bato, 1982. (₱8.50 = US$1.00 in mid-August 1982)

Item	Small (< 99 m^2) n = 31	Medium (100-199 m^2) n = 19	Large (> 199 m^2) n = 20	All farms n = 70
Returns: (₱)				
Ave. price received/kg	7.66	7.48	7.21	7.43
Cash returns				
Fish sold	1,680	2,200	4,696	2,683
Non-cash returns				
Fish given away	40	151	424	180
Fish consumed	72	192	328	178
Gross returns	1,792	2,543	5,448	3,040
Costs: (₱)				
Cash costs				
Fingerlings	443	645	1,950	928
Feeds	109	142	368	192
Hired labor	145	203	867	367
Fuel & oil	264	392	403	338
Licenses	5	19	54	23
Others[a]	48	34	37	41
Total	1,014	1,435	3,679	1,890
Non-cash costs				
Depreciation cost	228	442	626	400
Losses[b]	80	160	300	165
Unpaid family labor	995	1,145	1,217	1,099
Total	1,303	1,747	2,143	1,664
Total costs (₱)	2,317	3,182	5,822	3,553
Net cash farm income (₱)	666	765	1,017	793
Net farm income[c] (₱)	(525)	(639)	(374)	(513)

[a]Includes batteries, meals, cigarettes and liquors.
[b]Losses were due to typhoon, poaching and sulphur upwellings.
[c]Represents net cash farm income less the imputed value (₱1,306) of the owner-operator's labor. Opportunity cost of invested capital is not included in the above calculations; not only is it low, but it would normally be considered as 'paid for' from the net farm income.

Table 15. Problems encountered by tilapia cage operators, Lake Buhi and Lake Bato, 1982.

	Problem	Lake Buhi %	Lake Bato %	Both lakes %
1.	Poaching	24	30	25
2.	Bad weather	20	28	22
3.	Sulphur upwelling *(kanuba)*	18	–	14
4.	Lack of capital	11	12	11
5.	Intentional destruction of cages	8	6	8
6.	Poor/slow growth of fingerlings	5	6	5
7.	Lack of fingerlings/expensive fingerlings	3	4	4
8.	Polluted water	–	8	2
9.	Lack of feeds/bamboo and *ipil-ipil* posts	3	–	2
10.	Insecurity of access to present location of cages	3	–	2
11.	Low price of tilapia	1	6	2
12.	Proliferation of cages	1	–	1
13.	Disruption by Lake Buhi irrigation and dam project	2	–	1
	Total	100	100	100

[a]Exceeds number of respondents because of multiple responses.

adversely affected by the action of the large cage operators whose marketing plans they did not know. Controlling and regulating the entry of fish cage operators could be done by the local government through ordinances governing the maximum area of operation. Buhi has designated a tilapia cage belt, but as yet this attempt at regulation neither generates much income for the municipality nor effectively governs actual placement of tilapia cages within the lake. Bato has no such regulation.

Acknowledgements

The authors would like to thank the following agencies and individuals who extended various assistance in the conduct of this study: ICLARM, PCARRD, Research and Service Center of Ateneo de Naga, Dr. Ian Smith of ICLARM, Mr. Orestes Salon, Ms. Luz Yater, Mr. Carlos Asor, Mrs. Virginia Claveria, and most especially the 70 tilapia cage operators in Buhi and Bato.

References

Alvarez, R. 1981. Growing tilapia in floating cage. Greenfields 11(10): 6-14.

BFAR. 1982. 1980 Fisheries Statistics. Bureau of Fisheries and Aquatic Resources, Quezon City, Manila.

Cabrero, A. 1981. Tilapia raising in Rizal. Greenfields 11(10): 6-14.

Economics of Tilapia Cage Culture in Laguna Province, Philippines

CORAZON T. ARAGON

MIGUELITO M. DE LIM

GERARDO L. TIOSECO

College of Development Economics and Management
University of the Philippines at Los Baños
College, Laguna
Philippines

ARAGON, C.T., M.M. DE LIM AND G.L. TIOSECO. 1985. Economics of tilapia cage culture in Laguna Province, Philippines, p. 66-82. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

This study was conducted to determine the profitability of tilapia cage culture in San Pablo City and Los Baños, Laguna, Philippines. Primary data were gathered from 29 producers engaged in tilapia cage culture in Los Baños and 63 producers in San Pablo City.

On the average, the total capital investment of tilapia farmers in Los Baños for their small-scale grow-out operation was ₱2,460 per farm. Average capital investment in farms in San Pablo City ranged from ₱7,022 to ₱66,462 for their grow-out operations. Large farms in the area which were engaged in both grow-out and hatchery operations had a total capital investment amounting to ₱70,735. Fish nets represented the largest item of capital investment, comprising more than 30% of the total capital investment in both locations. (₱8.50 = US$1.00 during the study)

Findings of the study indicate that tilapia cage culture is a profitable business venture in San Pablo City but that there were significant differences in mean total labor use, production, total cost, gross return and net farm income among the three farm size groups.

Net farm income from tilapia cage culture in San Pablo City was also found to be directly related to farm size. Large farms engaged in both grow-out and hatchery operations in the area received the highest net farm income per season (₱230,000) followed by large farms engaged in grow-out operation only (₱151,000). On the other hand, the tilapia producers in Los Baños had a net average loss of ₱2,800. This was due to the high non-cash labor cost. Because of the poaching problem in the area, the tilapia producers spend much time in guarding and inspecting the cages thereby increasing the non-cash labor cost. However, the tilapia producers still continue to operate since the average net cash farm income from tilapia cage culture is ₱1,570.

Introduction

Tilapia, which was once regarded as a nuisance fish by producers, is now produced widely in the provinces near Metro Manila. In 1980 and 1981, tilapia was second to snails in volume produced from freshwater (BFAR 1980, 1981).

A recent development in the tilapia industry of the Philippines is the cage culture of tilapia. The first experiments in the Philippines were conducted in Lake Bunot in San Pablo City, south of Manila, after which commercial production of tilapia in floating cages began (MNR 1982). Because of initial successes in tilapia cage culture in the area and its low initial capital requirement, both small- and large-scale fishermen have been attracted to fish cage culture. Tilapia culture in fish cages has now become a popular business not only in San Pablo City but also in many parts of the country.

So far, only a few studies have been conducted either to determine the profitability of tilapia cage culture or to analyze possible constraints to further expansion of the tilapia industry in the Philippines (Avansado 1979; Sevilla 1982). This study, therefore, was conducted to determine the profitability of tilapia cage culture in Los Baños and San Pablo City, Laguna.

Methodology

A complete list of fishermen practicing tilapia cage culture in Los Baños and San Pablo City, Laguna, was prepared. Twenty-nine tilapia producers in Los Baños and 63 producers in San Pablo City were interviewed using a pre-tested interview schedule. Because of the limited number of tilapia producers engaged in cage culture in Los Baños, complete enumeration was done during the survey. Sample tilapia producers in San Pablo City were selected using stratified random sampling, classified according to their level of initial capital investment. Small farms were those whose capital investment was below ₱10,000 while medium farms were those farms with a capital investment ranging from ₱10,000 to ₱19,999.[1] Large farms were those whose capital investment exceeded ₱20,000. The sample size in each stratum was determined using proportional allocation. The sample size for small, medium and large farms was 25, 16 and 22, respectively. All Los Baños cage operations were small farms.

Data collected from the sample fishermen included production practices in tilapia cage culture, size of operation, source of feeds, volume of production per season, operating expenses, labor input by activity, capital investment, sources of credit, prices received for their catch, marketing outlets and problems encountered in the production and marketing of tilapia. Interviews were conducted in early 1983 and covered the 1982 season.

Primarily descriptive analysis was used in this study. Costs and returns analysis was conducted to determine the profitability of tilapia cage culture. The t-test was also used in determining significant differences in mean levels of gross income, costs and net farm income among tilapia farms with different sizes of operation in San Pablo City.

[1]₱8.50 = US$1.00 at time of this study.

Characteristics of the Tilapia Producers

On the average, the tilapia producers engaged in cage culture in Los Baños and San Pablo City were 49 and 40 years old, respectively (Table 1). The level of education of the tilapia producers was generally low, although the majority of the respondents in both locations had elementary education. It was observed that operators with higher education were more likely than the less educated ones to work in other occupations such as business, farming and fishing in addition to cage operations. The average monthly income from these other occupations was ₱945 and ₱958 for Los Baños and San Pablo tilapia producers, respectively.

All the tilapia producers interviewed in Los Baños were owner-operators and were engaged in grow-out operation only. On the other hand, 84% of the 63 sample respondents in San Pablo City were owner-operators. Only one producer in the area was a lessee while 8 and 6% were share tenants and caretakers, respectively. Eleven percent of the respondents in San Pablo City were engaged in both grow-out and hatchery operations. These were composed of large tilapia producers only. The majority of the sample respondents in the area (89%) were only engaged in grow-out operation.

In Laguna de Bay, tilapia cage culture was first introduced by employees of the Laguna Lake Development Authority in 1974. The first commercial production of tilapia in cages was reported in Lake Bunot, San Pablo City in 1976. Production of tilapia in cages further spread in Laguna de Bay and other lakes in San Pablo, such as Lake Sampaloc, Lake Palakpakin, Lake Calibato and Lake Mohicap in 1977-1978.

Since tilapia cage culture as a method of fish culture in lakes was introduced only in the 1970s in both areas, the respondents were relatively new in the operation. The sample tilapia producers from Los Baños and San Pablo City had, on the average, only four and three years of experience, respectively, in cage culture at the time of the survey.

The majority of the respondents mentioned that they decided to practice tilapia cage culture because they thought that it was a profitable business venture. They were motivated to practice tilapia cage culture by either their friends or neighbors and relatives.

All the sample respondents from San Pablo City mentioned that they learned of this new fish culture by reading publications dealing with cage culture. Fifty-two percent of the tilapia producers interviewed in Los Baños, however, had undergone formal training in tilapia cage culture for two weeks while the remaining 48% of the respondents mentioned that although they did not have any formal training in tilapia cage culture, they gained their knowledge from friends. Aside from tilapia cage culture, some of the respondents in both locations also operated other production systems such as fishpen and pond culture.

On the average, the household of a tilapia cage operator in Los Baños and San Pablo City was composed of about seven and six members, respectively, with only two other members helping in tilapia cage operations and one member assisting in marketing tilapia.

Characteristics of Tilapia Farms

All the tilapia cage farms included in this study were owned by single proprietors. On the average, large tilapia cage farms in San Pablo City had a total farm area of 2,499 m^2 while the medium and small farms had average areas of 848 m^2 and 420 m^2, respectively (Table 2). The small farms in Los Baños had an average farm size of 532 m^2.

Two types of cages are used for tilapia culture: the floating type and the fixed type. The former is used in San Pablo lakes which are deep lakes while the latter is found in Laguna de Bay which is a shallower lake.

The highest number of tilapia cages per farm that was reported was 33 and the least

Table 1. Socioeconomic characteristics of 92 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Socioeconomic characteristics	Los Baños %	San Pablo City %
Age (years)		
21-30	3	10
31-40	10	48
41 and above	87	42
Ave. age (years)	49	40
Educational attainment		
None	7	–
Elementary	65	51
High school	21	49
College	7	–
Ave. years of schooling	6.1	6.6
Tenure status		
Owner	100	84
Lessee	–	2
Share tenant	–	8
Overseer/caretaker	–	6
Extent of involvement		
Full-time	58	84
Part-time	42	16
Years in tilapia cage culture business		
1-5	86	86
6-10	14	14
Ave. no. of years in tilapia cage culture business	4	3
Type of operation		
Grow-out	100	89
Hatchery	–	–
Grow-out and hatchery	–	11
Sources of family income		
Tilapia production only	58	84
Tilapia production and other sources[1]	42	16
Ave. monthly income from other sources (₱)	945	957.5
Household size		
1-5	20	44
6-10	66	46
11 and above	14	10
Ave. household size	7	6
No. of family members assisting in tilapia cage culture		
None	66	–
1-2	24	81
3-4	10	16
5 and above	–	3
Ave. no. of family members assisting in tilapia cage culture	2	2
No. of family members assisting in marketing tilapia		
None	45	–
1-2	55	83
3-4	–	16
5 and above	–	1
Ave. no. of family members assisting in marketing tilapia	1	1

[1]Includes storekeeper, driver, seller, business manager, photographer, farmer, teacher, government employee.

Table 2. Farm characteristics, 92 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Farm characteristics	Location: Los Baños	Location: San Pablo City
Ave. farm area (m^2)		
Small farms	532	420
Medium farms	–	848
Large farms	–	2,499
Ave. no. of cages		
Small farms, grow-out operation	2	2
Medium farms, grow-out operation	–	3
Large farms, grow-out operation	–	7
Large farms, hatchery operation	–	15
Ave. size of cage (m^2)		
Small grow-out farms	266	280
Medium grow-out farms	–	314
Large grow-out farms	–	320
Large hatchery farms	–	54
Ave. depth of cage (m)	3	6

number was one. On the average, the tilapia producers from Los Baños had two fixed type cages while those from San Pablo City had five floating cages. Not surprisingly, the number of tilapia cages in San Pablo City was also found to be directly related to farm size.

The tilapia producers constructed either square or rectangular cages. Dimension of cages varied (e.g., 10 m x 20 m, 20 x 35, 15 x 20, 10 x 30, 5 x 10, 20 x 20, 10 x 10, 5 x 20, 10 x 25, 11 x 20, 20 x 30). Usually, cage size varied depending on the amount of capital available to the tilapia operators. On the average, large farms in San Pablo City had larger grow-out cages (320 m^2) than those of the medium and small farms which had average grow-out cage sizes of 314 and 280 m^2, respectively. The average size of grow-out cages of small farms in Los Baños was 266 m^2. The average depth of the floating tilapia cages in San Pablo City was 6 m, falling within the recommended depth range for such cages. Coche (1982) reported that a depth of 5 to 10 m is recommended for floating cages to reduce parasitism and disease outbreaks. In contrast, the average depth of grow-out cages in Los Baños was only 3 m.

The size of cages was also found to vary for different operations. Breeding and fingerling production cages were smaller than grow-out cages. The average size of nursery cages was 54 m^2 and the depth ranged from 3 to 6 m.

Capital Investment in Tilapia Cage Culture

The total capital investment in tilapia cage culture varied depending upon the number of cages and the type of materials used in the construction of cages. Table 3 shows that the average capital investment in grow-out operation was ₱7,022, ₱14,363 and ₱66,462 for

Table 3. Capital investment (in pesos) per farm by size and type of operation, 63 tilapia producers, San Pablo City, Laguna, 1982. (₱8.50 = US$1.00 in 1982)

Capital item	Size of operation												All farms	
	Small farms		Medium farms		Large farms									
					Grow-out only		Both grow-out and hatchery				Total			
							Grow-out		Hatchery					
	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%
Net cage	3,651	52	8,099	60	44,681	67	38,174	67	9,546	69	47,720	67	20,950	66
Bamboo poles	1,587	23	2,828	20	9,865	15	8,428	15	2,107	15	10,535	15	4,963	16
Nylon cord	1,032	15	1,989	14	10,064	15	8,598	15	2,150	16	10,748	15	4,767	15
Lead sinker	133	2	210	2	799	2	748	2	–	–	748	1	472	2
Cement	57	1	97	1	398	1	372	1	–	–	372	0.5	231	–
Miscellaneous[1]	562	7	533	3	655	1	612	1	–	–	612	1	593	2
Total investment	7,022	100	14,363	100	66,462	100	56,932	100	13,803	100	70,735	100	31,976	100

[1]Includes metal tubs, weighing scale, wire, wood, iron, sand and nails.

small, medium and large farms in San Pablo City, respectively. Generally, the large tilapia producers had more cages and used more durable or stronger materials in constructing their cages. Large farms engaged in both grow-out and hatchery operations in the area had a total capital investment of ₱56,932 for grow-out operation and ₱13,803 for hatchery operation. On the average, the total capital investment of the tilapia cage producers in Los Baños (Table 4) was considerably lower (₱2,460) than that of the tilapia operators in San Pablo City. Los Baños operators invested their capital on bamboo poles, net cages, weighing scales, metal tubs, boats and guard houses. The largest investment was on the net cage which represented more than 30% of the total value of capital investment in both locations.

Management Practices in Tilapia Cage Culture

Cage preparation. The floating cages in San Pablo City were made of floating frames from which the net cages were suspended. The structures were anchored by means of concrete weights tied to nylon ropes. The tops of the cages were open.

The fixed cages in Los Baños were made of polyethylene nets and bamboo poles which were driven into the mud substratum were used to hold the cages in place. To minimize damage caused by floating objects in Laguna Lake during typhoons, those net cages which had covers were positioned underwater by adjusting their attachments to the bamboo poles. Some cages, however, were not covered.

Cages being constantly subjected to various environmental hazards in the lake like inclement weather would naturally require periodic changes and repairs depending on the quality and durability of materials used. Checking of cages is a daily routine although some operators checked their cages every other day. The producers also frequently inspected the condition of the net and other materials submerged underwater to avoid losses of fish stocks.

Cleaning of cages was done regularly by some producers to remove decayed materials, filamentous algae, water lilies and other materials that might affect fish growth, as well as possibly damage the cages. It is noteworthy to mention, however, that 38% of the 63 sample respondents in San Pablo City did not clean their cages at all. The main reason given by those who did not practice cage cleaning was that since tilapia ate the filamentous algae

Table 4. Average capital investment, 29 small tilapia farms, Los Baños, Laguna, 1982.

Capital item	Value (₱)	%
Net cage[1]	765	31
Boats	755	31
Bamboo poles	621	25
Guard house	207	8
Weighing scale	82	3
Bañera	30	1
Total	2,460	100

[1]This includes fish nets and other materials used in the installation of the cage.

growing on the sides of the cages, cleaning was not necessary.

Stocking practices. Tilapia fingerlings used for grow-out were either bought, taken from the lake or bred by the producers themselves. The majority of the producers in both locations bought their fingerlings. Most of the producers who purchased their tilapia fingerlings considered the Demonstration Fish Farm of the Bureau of Fisheries and Aquatic Resources (BFAR) in Bay, Laguna as their best source of fingerlings because the fingerlings sold by this farm were of good quality and uniform size. Moreover, the farm has an adequate supply of fingerlings and is accessible.

Those who used the fingerlings they produced on their own farm for their grow-out operations mentioned that their fingerlings were not of uniform size. Some producers bought their fingerlings from hatcheries in the towns of Calauan, Calamba, Los Baños and also from other producers engaged in hatchery operations in San Pablo City. *Oreochromis niloticus* was the species used by all the respondents in both locations. It was preferred because it grows faster and attains a heavier weight than other species such as the *O. mossambicus.* The producers in Los Baños who caught their fingerlings from Laguna de Bay included these in their cages along with purchased *O. niloticus* fingerlings to augment their income. The tilapia cage operators generally used larger fingerlings (sizes 14, 17 and 22[2] which commanded higher prices than sizes 26 and above). The average price of fingerlings varied by fingerling size: ₱0.12/piece for size 22; ₱0.14 for size 17 and ₱0.16 for size 14.

The stocking density of the cages in the study area was rather uniform (Table 5), averaging 38 fingerlings/m^2 regardless of cage size and depth.

The 15 San Pablo City tilapia hatchery operators stocked breeders at an average density of one breeder/m^2 with a male to female sex ratio of 1:3 to 1:5. On the average, the hatchery operators changed their breeders every 20 months. The broodstock were kept in *hapas*[3] breeding continuously. The fry produced were sorted by size and then grown on to fingerling size in other *hapas.* The fingerlings were reared until ready for transfer to grow-out cages for further growth.

The male tilapia in general grows faster than the female and Guerrero (1979) has

[2]The size of fingerling was based on the mesh size of the net. See Yater and Smith (this volume) for further details.

[3]A *hapa* is a fine-mesh net enclosure, usually made of mosquito netting supported by poles at the corners.

Table 5. Average stocking density per cage of tilapia fingerlings by size of operation and by location, 92 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Farm type	Stocking density[1] Los Baños Fish/cage	Fish/m^2	San Pablo City Fish/cage	Fish/m^2
Small	3,292	12	10,430	37
Medium			11,853	38
Large			13,573	42
All farms		12	11,725	38

[1]Los Baños cages average 3-m depth; San Pablo City cages average 6-m depth.

advocated monosex male culture to give faster growth and increased production. However, none of the sample respondents practiced monosex male culture because they lacked knowledge of hybridization and manual sexing.

Feeding practices. Adequate feeding is essential for growth and survival of tilapia. In the Laguna de Bay cages of Los Baños, feeding was done by the majority of the tilapia cage operators by broadcasting the feeds over the water surface of the stocking cages twice every day. San Pablo City cage operators broadcast the feed or put it in a basin submerged in the cage. The majority of these producers fed their tilapia once daily. Exact quantification of feeding rates proved extremely difficult because most tilapia producers experimented with different types of feeds and feeding rates.

The type of feed given to the tilapia generally depended on the age of the fish. During the first two months after stocking, wheat pollard, rice bran or broiler mash was used by the Los Baños tilapia producers for their grow-out operation. However, after two months, a wider variety of feeds was given. Algae, vegetable leaves (e.g., *kangkong*), wheat pollard and rice bran were fed by the majority of the producers. Other kinds of feeds given consisted of decayed waterlily, shrimps, leftover food from the producer's own table, chicken manure, pig manure, pellets, and ipil-ipil *(Leucaena leucocephala).* Algae, shrimps and waterlilies were taken from the lake while *kangkong* was gathered along the shore. Wheat pollard, rice bran, broiler mash and pellets were purchased by the producers.

In the lakes of San Pablo City, naturally available food was insufficient due to the proliferation of cages in the study area. For this reason, fish in grow-out cages were given pellets and rice bran as supplementary feeds during the first two months. After two months, however, no supplementary feeding was done.

Harvesting practices. Grow-out periods ranged from 6 to 14 months from stocking to harvesting, and averaged 10 months in both locations. Hence, for most producers only slightly more than one crop per year was possible. The majority of the producers in both study areas reported that they harvested tilapia once a year due to lack of natural food in the lakes which lengthened the production period. Size of fish primarily determined the date of harvesting. Other factors considered were market demand and weather conditions.

Harvesting of market-size tilapia was more commonly done by releasing the net cage from the bamboo enclosure and then lifting it until the tilapias were within reach. A scoop net was used to transfer the tilapias from the cage to a metal tub *(bañera)* or boat. Tilapia was harvested in a selective manner; those of marketable size were sold while smaller ones were left for another month or two in the cages until they reached the desired market size. The average production of market size tilapias per harvest per farm in Los Baños was only 370 kg (Table 6). The average production of market size tilapia in San Pablo City was much higher than that obtained in Los Baños and was found to be directly related to farm size (Table 6). Yields per m^2 were not significantly different among the San Pablo City farms, however, ranging from 6.1-7.2 kg/m^2 per crop. Los Baños producers had very low yields per m^2.

The large farms in San Pablo City, that also operated as hatcheries, harvested the fingerlings using a scooping net without lifting. Those that were scooped were then sorted or graded by means of nets of different mesh sizes. On the average, the total production of fingerlings per farm per year was 702,000.

Labor utilization and labor payment in tilapia cage culture

Farm labor in tilapia cage culture was supplied by the operator, his family and hired

Table 6. Tilapia production per crop and disposal, 92 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Method of disposal	San Pablo City Small farms Grow-out (kg)	San Pablo City Medium farms Grow-out (kg)	San Pablo City Large farms[1] Grow-out (kg)	Los Baños Small farms Grow-out (kg)
Fish sold	2,512	5,560	17,835	363
Fish given away	30	39	145	4
Fish consumed at home	21	23	90	3
Total production	2,563	5,622	18,070	370
Production per m^2	6.1 kg	6.6 kg	7.2 kg	0.7 kg

[1]Excluding fingerlings sold or produced and used by these producers in their own grow-out operations.

workers. Of the total labor requirement for grow-out cage operations in San Pablo City, hired labor represented 40, 39 and 45% for small, medium and large farms, respectively, although hired labor was utilized only in the installation of the cages and in harvesting operations. In contrast, hired labor constituted only 1% of the total labor input in tilapia cage culture in Los Baños. This may be attributed to their smaller size of operation and lower production level (Table 7).

Regardless of the exact nature of the work involved, hired laborers were paid an average of ₱20/day in Los Baños. In San Pablo City, 78% of the tilapia producers paid their laborers on a wage rate basis while 22% paid on a contractual basis. The average wage rate per person per day in San Pablo City was ₱25 while the contractual cost for cage installation varied by size of cage, ranging from ₱350/cage for a cage dimension of 10 x 20 m or 15 x 20 m to ₱600/cage for a cage dimension of 10 x 30 m.

On the average, it took a total of 178 man-days per cropping cycle to perform the different operations in tilapia cage culture in Los Baños (Table 7), of which security measures accounted for the highest percentage (64%). This may be attributed to the poaching problem which was considerable in the area. In addition to security measures, other operations which accounted for a large percentage of the total labor utilization were feeding and inspection of cages.

In San Pablo City, total labor use per season in grow-out operation was found to be directly related to farm size (Table 7). It can be noted that small farms had the least total labor requirement with an average of 54.1 man-days per season as compared with the medium and large farms with a total labor use of 55.6 and 78.9 man-days per season, respectively. Repair of cages and nets, feeding and cage preparation were the major laboring operations in tilapia cage culture in the area and represented 73, 74 and 75% of the total labor requirement for the small, medium and large farms, respectively.

For hatchery operation, the total labor requirement was 31.2 man-days (Table 7) of which 28% was used for repair of cages, 22% for feeding and 17% for cage preparation.

Table 7. Labor utilization (man-days per cropping cycle) in tilapia cage culture by operation, 92 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Fishing operation	Los Baños Small farms Grow-out	San Pablo City Small farms Grow-out	San Pablo City Medium farms Grow-out	San Pablo City Large farms Grow-out	San Pablo City Large farms Grow-out	San Pablo City Large farms Hatchery
			man-days per season			
Cage preparation and stocking	2.8	10.9	12.0	14.6	13.6	5.4
Feeding	42.3	12.1	13.5	20.1	17.3	6.9
Repair of cages and nets	17.7	16.4	15.8	24.7	21.9	8.7
Cleaning of cages		1.9	2.5	3.7	3.2	4.9
Checking and guarding of cages	113.2	9.9	8.6	11.1	10.5	3.2
Harvesting and hauling	1.9	2.9	3.1	4.7	5.2	2.1
Total	177.9	54.1[a]	55.6[a, b]	78.9[b]	71.7	31.2

[a, b]Means with the same letter in the same row are not statistically different at the 5% level using the t-test.

Costs and returns in tilapia cage culture

The financial performance of any farm business can be best judged through an analysis of its expenses and receipts. A comparative analysis of costs and returns per farm per season in tilapia cage culture among farm size groups and between locations is presented in Tables 8 and 9.

Cash and non-cash costs. Expenses in tilapia cage culture consisted of cash and non-cash costs. As shown in Table 8, cash, non-cash and total costs incurred in grow-out operations in San Pablo City increased with farm size. The differences in mean cash, non-cash and total costs incurred in grow-out operation among the three farm size groups were statistically significant at the 5% level of significance. By item of cash expenditure, the cost of fingerlings comprised the bulk of total cash cost constituting about 56, 66 and 71% of the total cash cost for small, medium and large farms, respectively. This was followed by interest on capital and hired labor cost (20 to 31%). In contrast to these grow-out operations, a large portion (60%) of the total cash outlay for hatchery operations in the area went into interest payment on loans.

Likewise, the cost of fingerlings represented the highest percentage of total cash cost (54%) for grow-out operations in Los Baños (Table 9). This was followed by interest on capital (22%) and the cost of feeds (18%).

Non-cash costs for all farm types and sizes in San Pablo City were accounted for largely by depreciation of tools and equipment.

Table 8. Costs and returns (in pesos) per farm per season in tilapia cage culture by farm size and type of operation, 63 tilapia producers, San Pablo City, Laguna, 1982. (₱8.50 = US$1.00 in 1982)

Item	Small grow-out operation	Medium grow-out operation	Large[1] grow-out operation	Large[2] Grow-out operation	Large[2] Hatchery	Total
			Size of operation			
Costs						
Cash costs:						
Fingerlings bought	2,812[a]	6,863[a,b]	20,099[b]	18,816		18,816
Hired labor	732[a]	933[a,b]	3,283[b]	3,235	258	3,493
Interest on capital	798[a]	1,529[a,b]	2,536[b]	2,120	578	2,698
Feed supplies	228[a]	574[a,b]	1,788[b]	1,767	135	1,902
Other costs[3]	434[a]	452[a,b]	469[b]	439		439
Total cash costs	5,004[a]	10,351[a,b]	28,175[b]	26,377	971	27,348
Non-cash costs:						
Fingerlings other than bought				15,724		15,724
Unpaid operators' labor	422[a]	444[a,b]	628[b]	600	376	976
Unpaid family labor	395[a]	396[a,b]	453[b]	455	238	693
Broodstock other than bought					30,660	30,660
Depreciation[4]	2,456[a]	5,052[a,b]	23,841[b]	23,719	1,644	25,363
Total non-cash costs	3,273[a]	5,892[a,b]	24,922[b]	40,498	32,917	73,416
Total costs	8,277[a]	16,243[a,b]	53,097[b]	66,875	33,888	10,076
Returns						
Cash returns:						
Fish sold	30,144	66,720	201,179	188,338		188,338
Fingerlings sold					124,704	124,704
Total cash returns	30,144	66,720	201,179	188,338	124,704	313,042
Non-cash returns:						
Fish consumed at home	246	270	1,019	954		954
Fingerlings used by the producers					15,724	15,724
Fish given away	356	472	1,631	1,527		1,527
Total non-cash returns	602[a]	742[a,b]	2,650[b]	2,481	15,724	18,205
Gross returns	30,746[a]	67,462[a,b]	203,829[b]	190,819	140,428	331,247
Net cash farm income[5]	25,140[a]	56,369[a,b]	173,004[b]	161,961	123,733	285,694
Net farm income[6]	22,469[a]	51,219[a,b]	150,732[b]	123,944	106,540	230,484

[1]Includes farms engaged in grow-out operation only.
[2]Includes farms engaged in both grow-out and hatchery operations.
[3]Consists of wire, wood, iron, nails and sand.
[4]Consists of depreciation of bamboo poles, fish net, sinkers, nylon cord, weighing scale and metal containers.
[5]Net cash farm income = total cash returns minus total cash costs.
[6]Net farm income = gross returns minus total costs.
[a, b]Means with the same letter in any given row are not significantly different at the 5% level using the t-test.

On the other hand, the imputed value of operator's labor accounted for the largest percentage of non-cash expenses in Los Baños. In this location, a large percentage of the operator's time was devoted to security measures to counteract the poaching problem.

Table 9. Costs and returns (in pesos) per farm per season in tilapia cage culture, 29 tilapia producers, Los Baños, Laguna, 1982. (₱8.50 = US$1.00 in 1982)

Item	Value (₱)		
Costs			
Cash costs:			
Fingerlings bought	923		
Interest on capital	369		
Feeds bought	302		
Hired labor	40		
Other costs[1]	63		
Total cash costs		1,697	
Non-cash costs:			
Unpaid operator's labor	3,120		
Unpaid family labor	403		
Depreciation	838		
Total non-cash costs		4,361	
Total costs			6,058
Returns			
Cash returns:			
Fish sold	3,267		
Total cash returns		3,267	
Non-cash returns:			
Fish consumed at home	36		
Fish given away	37		
Total non-cash returns		63	
Gross returns			3,330
Net cash farm income[2]			1,570
Net farm income (loss)[3]			(2,758)

[1]Includes wire, wood, iron, nails and sand.
[2]Net cash farm income = total cash returns minus total cash costs.
[3]Net farm income (loss) = gross returns minus total costs.

A comparison among total costs of the three farm size groupings in San Pablo City also reveals that large farms had incurred the highest total cost per farm per season amounting to ₱53,097 for farms engaged in grow-out operation only and ₱100,764 for those engaged in both grow-out and hatchery operations. The total cost in grow-out operations, on the average, was ₱8,277 and ₱16,243 for small and medium farms in San Pablo City, respectively. The differences in total cost can be attributed to the greater number of cages operated by the large tilapia producers as compared with those of the medium and small producers. In Los Baños, the total cost of production in grow-out operations amounted to ₱6,138 per season.

Gross and net returns. Gross returns include both cash and non-cash returns. As shown in Table 8, there is a direct relationship between gross returns, net cash farm income and net farm income derived from tilapia cage culture in San Pablo City and farm size. Large farms had the highest gross returns per farm per season with an average of ₱203,829 for those engaged in both grow-out and hatchery operations; medium and small farms had gross returns of ₱67,462 and ₱30,746, respectively. This significant variation in gross returns might be attributed to the difference in production levels among the three farm size groups, which was, in turn, dependent on the capital resources of the tilapia producers.

Average gross returns from tilapia cage culture in Los Baños, on the other hand, amounted to only ₱3,330 per season.

Net cash farm income per season received by large tilapia producers in San Pablo City, on the average, was significantly higher (₱173,004 for those engaged in grow-out operation only and ₱285,694 for those engaged in both grow-out and hatchery operations) than those obtained by medium and small farms which amounted to ₱56,369 and ₱25,140, respectively. Net cash farm income derived from tilapia cage culture in Los Baños which amounted to ₱1,570 was considerably lower than those obtained in San Pablo City. The positive net cash income received by tilapia producers in both locations indicates that they can go on operating their farm businesses since total cash costs were covered by total cash income.

Net farm income was derived by deducting total costs (cash and non-cash) of production from gross returns. A comparison of net farm income by farm size and type of operation in San Pablo City reveals that large farms engaged in both hatchery and grow-out operations received the highest net farm income per season (₱230,484) followed by large farms engaged in grow-out operation only (₱150,732). Net farm income derived by small and medium farms engaged in grow-out operation in the area averaged ₱22,469 and ₱51,219 per season, respectively. The positive net farm income derived for all types of operations and farm size groups indicates that tilapia cage culture is a profitable farm business in San Pablo City. In contrast, the tilapia producers in Los Baños had a net loss amounting to ₱2,808, primarily due to the considerable amount of operator's and family labor used for security measures.

Credit practices

Seventy-three percent of the respondents from San Pablo City and 66% of the tilapia producers from Los Baños obtained loans for their tilapia operations from formal or non-formal credit sources (Table 10). The majority of the borrowers from both locations borrowed from non-formal sources such as friends and relatives. Too much paper work, high interest charges, inadequate amounts released and delays in the release of loans by banks were the main reasons cited by the borrowers for their preference for non-formal sources. Payment of loans from friends and relatives after each harvest was either in the form of cash, fish or both without any interest charged.

Table 10. Sources of credit by location, 82 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Source of credit	Los Baños Number	%	San Pablo City Number	%
Formal and non-formal sources				
Relatives/friends	12	41	35	56
Banks	7	24	7	11
Government agencies	–	–	4	6
None	10	34	17	27
Total	29	100	63	100

Local banks and the Ministry of Human Settlements through its Kilusang Kabuhayan at Kaunlaran (KKK) program were the formal sources of loans. The average amount of loans borrowed from these formal sources of credit amounted to ₱3,785 at 13% interest rate for Los Baños tilapia producers and ₱17,636 at 10 to 12% interest rate for tilapia producers from San Pablo City. Seventy-one percent of the borrowers from Los Baños said they were unable to repay their loans due to their low tilapia production as a result of typhoons, poaching and cage damage.

Some of the respondents who did not obtain loans mentioned that they did not borrow because they were afraid that they would not be able to pay their debts on time while others claimed that they had no intention to borrow because they had sufficient capital.

Problems in tilapia cage culture

Table 11 summarizes the major problems encountered in culturing tilapia in cages in Los Baños and San Pablo City. Overcrowding due to proliferation of cages and pens in the lake was mentioned as the most important problem in tilapia cage culture in San Pablo City. This was brought about by the non-requirement of a license for cage culture in the past. However, even though a license is now required, this is not strictly implemented.

Table 11. Problems in tilapia cage culture, 82 tilapia producers, Los Baños and San Pablo City, Laguna, 1982.

Problem[1]	Los Baños Number	%	San Pablo City Number	%
Proliferation of cages and pens	–	–	49	70
Slow fish growth	12	41	31	49
Unfavorable water condition	–	–	23	36
Lack of capital or credit assistance	14	48	19	30
Net destruction	25	86	17	27

[1]Most of the tilapia producers reported more than one type of problem.

Thus, those who wanted to construct floating cages would go ahead without securing a license from the municipal government. As a result of overcrowding or proliferation of cages, the tilapia producers reported the following secondary problems: slow fish growth due to competition for natural food in the lake, longer production period due to slower growth rate of the tilapias and conflict among tilapia cage operators.

The overcrowding problem, however, was not encountered by tilapia producers from Los Baños, where net destruction which resulted in fish losses was reported as the most important problem. Poaching was cited by the producers as one of the causes of net destruction. This problem, however, was less serious in San Pablo City due to lesser incidence of poaching in the area. Some producers also reported typhoon damage as one of the causes of net destruction while others mentioned damage to underwater sections of their cages due to predators such as the fish *ayungin*.

Slow fish growth is another major problem that the producers in both locations encountered. This could not be solely attributed to overcrowding of cages in San Pablo City. Other factors which might have caused slow fish growth in both locations were insufficient feeds given to the fish or feed losses through the cage walls due to strong water currents.

Lack of capital and credit assistance was also cited as one of the main problems in tilapia cage culture in both locations. Due to limited capital, many of the small producers operated only one or two cages.

Poor water quality during the cold months of December and January was also reported as a major problem by tilapia operators in San Pablo City. Low dissolved oxygen appears during this critical period as a periodical feature of the lymnological cycle of the water body. Thus, to avoid risk of high fish mortality, some of the tilapia producers discontinued cage culture during this critical period.

Conclusions and Recommendations

The study shows that tilapia cage culture in Laguna Province is a profitable business venture. However, several problems in tilapia cage culture must be overcome to ensure that the tilapia producers will continue practicing this new fish culture.

To avoid proliferation of cages, a survey of each lake's capacity for cage culture should be conducted, guidelines for the siting/operation of the cages should be set and licensing of legitimate tilapia operators should be strictly implemented.

To solve the poaching problem and to ensure the security of commercial operations, the cages should be located close to the residence of the producers or full-time watchmen should be employed.

Credit assistance and adequate extension service should be provided to encourage the tilapia producers to adopt improved management practices. In addition, information on improved breeding practices should be provided to the hatchery operators so that they can produce better quality fingerlings.

The slow fish growth problem can be solved through efficient feeding programs. Research should be conducted to develop or formulate low-cost feeds that will promote rapid growth of tilapias.

Acknowledgements

The authors wish to express their sincere appreciation to the following: ICLARM and PCARRD for the financial support which made this study possible; the College of Development Economics and Management, U.P. at Los Baños for all the facilities made available to the authors during the conduct of the study; Mrs. Milagros Acosta for her help in the data tabulation; and lastly, all the respondents in Laguna for their cooperation during the data collection phase of this study.

References

Avansado, A. 1979. Oliveros fish farm: a case study. Special Problem Report submitted for the Degree of Bachelor of Science in Agricultural Business, College of Development Economics and Management, University of the Philippines in Los Baños, College, Laguna.

BFAR. 1980. 1980 Fisheries statistics of the Philippines. Vol. 30. Bureau of Fisheries and Aquatic Resources, Quezon City.

BFAR. 1981. 1981 Fisheries statistics of the Philippines. Vol. 31. Bureau of Fisheries and Aquatic Resources, Quezon City.

Coche, A.G. 1982. Cage culture of tilapias, p. 205-246. *In* R.S.V. Pullin and R.H. Lowe-McConnell (eds.) The biology and culture of tilapias. ICLARM Conference Proceedings 7, 432 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Guerrero, R. 1979. Cage culture of tilapia in the Philippines. Asian Aquaculture 30(11): 6.

MNR. 1982. The culture of tilapia. MNR Instructional Series No. 1. Ministry of Natural Resources, Quezon City, Philippines. 22 p.

Sevilla, M. 1982. An economic analysis of tilapia floating cages culture in San Pablo City, Laguna. College of Agriculture, University of the Philippines at Los Baños, College, Laguna. M.S. thesis.

Economics of Tilapia Cage Culture in Mindanao, Philippines

LYDIA P. OLIVA

Southern Mindanao Agricultural Research Center
University of Southern Mindanao
Kabacan, North Cotabato
Philippines

OLIVA, L.P. 1985. Economics of cage culture in Mindanao, Philippines, p. 83-106. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

The economics of cage culture in three lakes of Mindanao, namely: Lakes Buluan, Sebu and Lanao, are compared.

Average production cost per farm was highest in Lake Buluan (₱2,487,125 for a farm of 1,100 floating cages operated by the Southern Philippines Development Authority), followed by Lake Lanao (₱7,898 for an average farm size of four cages). Lake Sebu incurred the least production cost (₱7,395 for an average farm size of six cages). All produce of the tilapia cage operators in Lake Buluan was sold. Lakes Sebu and Lanao cage operators sold 92.6% and 83.2% of their total produce, respectively, with the remainder either used at home or for other purposes. The rates of profit of cage operators in Lakes Buluan, Sebu and Lanao varied, with the operator in Buluan realizing the highest (₱2,739 per cage per cropping), followed by the operators in Lake Lanao (₱1,611) and Lake Sebu (₱896). (₱11.00 = US$1.00 during the survey)

The four major problems identified by cage operators in the three lakes were: overcrowding, lack of capital, poaching and lack of technical know-how in tilapia cage culture.

Introduction

Based on the per capita fish requirement recommended by the Food and Nutrition Research Institute and on the supply situation of fish in 1979, three regions of Mindanao (Regions X, XI and XII) were identified as among the fish deficient regions in the Philippines. On the other hand, Region IX also in Mindanao was found to be a fish surplus region producing over 200% of its fish requirement. This surplus may suffice in meeting the deficiency of the three other regions. However, considering distribution problems due to the perishability of fish, difficulty of handling, and high transport costs, it is perhaps a better option for the deficient regions to reduce their own deficiency in fish by tapping their vast water resources. A good number of lakes are found in these three regions; in fact, three of these lakes are considered among the major lakes in the Philippines.

Tilapia is one fish which may fill the need. This fish has been gaining social acceptability not only among poor consumers but also among those of the middle and upper class. Moreover, this fish had been found to be suitable for fish farming because of its high yield potential and hardiness (Devamkez 1964; Cabero 1980; Wohlfarth and Hulata 1981). Tilapia can be cultured through different systems, i.e., in ponds, pens or cages.

Tilapia cage culture is now gaining popularity among small-scale fish producers. This method has been identified to be among the more viable fish production ventures in recent years (Radan 1977; Cabero 1980; Alvarez 1981). In terms of the well-being of the many inhabitants along the coastal areas of the lakes, cage culture may substantially add to their income.

Significance of the study

Tilapia cage culture has been identified to be a profitable fish venture. However, proliferation of cages could result in overcrowding of lakes and may become detrimental to small-scale producers. Thus a knowledge of the existing cage culture system in the lakes of Mindanao is imperative. Moreover, with an economic analysis of the cage culture in the areas, current profitability may be determined.

While a good number of economic studies have been conducted on cage culture, most of these were conducted in Luzon. Available studies in Mindanao mainly focused on the culture, biology or on the technical aspects, and not much on the economic aspect. Furthermore, environmental as well as economic conditions in Mindanao may be quite different from those in Luzon. It is important that data to be used by planners in the regions of Mindanao should be Mindanao-based so that more realistic programs or plans could be formulated, especially in attempts to assist the fishermen in the lakes of Mindanao. Moreover, data for tilapia project feasibility studies such as those required by the Kilusang Kabuhayan at Kaunlaran (KKK) government livelihood program in Mindanao may be more realistic if based on Mindanao data than if based on data from studies conducted in areas outside Mindanao.

Objectives of the study

The primary purpose of the study was to determine the economics of tilapia cage culture in selected lakes in Mindanao. Specifically, the study conducted in Lake Buluan, Sebu and Lanao aimed to:

1. identify and compare the production practices of tilapia cage operators;
2. determine and compare the inputs and costs incurred by tilapia cage operators;
3. describe and compare the production and nature of disposal of the fish cage operators' produce;
4. assess the profitability of cage culture; and
5. identify the production problems encountered by cage operators.

Methodology

Sample area

There were three lakes involved in the study, two of which are among the major lakes in the Philippines, i.e., Lake Buluan with a total area of 5,880 ha and Lake Lanao with 34,304 ha (Fig. 1). Lake Sebu, the third lake in the study, which is classified as a minor lake in the Philippines, has an area of 964 ha.

Fish cages in Lake Buluan are located in the municipalities of Tenok and Maslabeng. In Lake Sebu, residents of almost all the coastal barangays have established fish cages, while in Lake Lanao, the municipalities identified to have fish (tilapia) cages were Marantao, Balindong, Bubong, Tugaya, Masiao, Poon and Bayabao. Of these municipalities, only Bubong, Balindong, Marantao and Tugaya were included in the study.

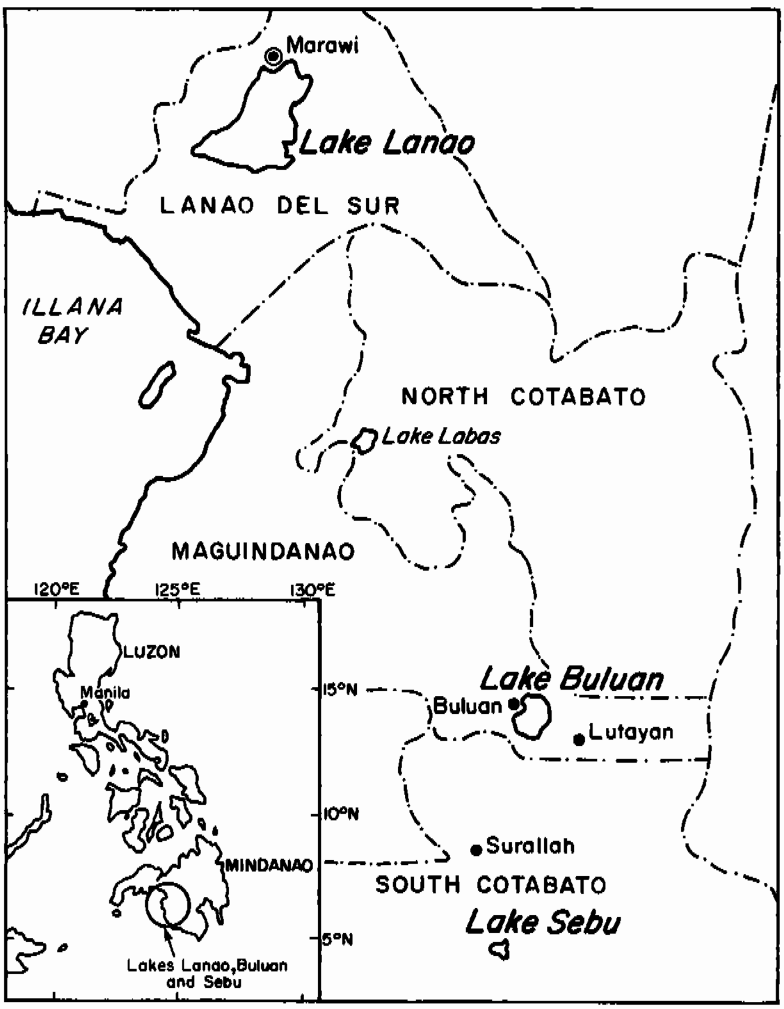


Fig. 1. Location of Lakes Lanao, Buluan and Sebu in Mindanao, Philippines.

Sample respondents

Since only one entity, the Southern Philippines Development Authority (SPDA), is operating fish cages in Lake Buluan, the assistant manager of the SPDA project served as the only respondent for this lake. Among some 400 fish cage owners in Lake Sebu, 60 randomly selected respondents were included in the study. Sixty fish cage/pen/pond owners of Lake Lanao were also included (Table 1).

Data collection

Data from the cage operators were obtained through a survey questionnaire which was administered through personal interview. In addition, secondary data and information relevant to the study were collected mainly from the SPDA, Region XII office of the Bureau of Fisheries and Aquatic Resources (BFAR) and partly from other sources. The study was carried out in 1983.

Method of analysis

All pertinent data gathered were collated by the enumerators and tabulators. Analyses used were mainly descriptive in nature such as frequency distribution and costs and returns tabulations.

Results and Discussion

Location of the study

Lake Buluan is located southeast of Buluan and northwest of Lutayan. It abounds with natural beauty and resources because the poor peace and order condition has protected the area from exploitation. This situation, however, may not last long because of the rapid development of fish cages and pens in the lake.

In contrast, Lake Sebu is about 24 km uphill from Surallah, South Cotabato. It is a small lake with a good number of fish cages fixed along the sides of the lake. While Lake Buluan was dominated by the traditional Maguindanao fishermen, Lake Sebu was historically used by the T'bolis, a tribal minority. Only a few of this group, however, have fish cages in the lake.

Lake Lanao is a beautiful body of water near the Mindanao State University in Marawi. It is one of the largest lakes in the country and a good number of Lanao del Sur municipalities surround the lake. Fishermen and fish cage operators in this lake are Maranaos.

The respondents

The study included 121 sample respondents from the three lakes under consideration. About 53% were between 31 and 40 years

Table 1. Distribution of respondents of the Mindanao lakes tilapia economics survey, 1983.

Lake	No. of respondents	% of sample
Buluan[1]	1	1
Sebu	60	49.5
Lanao	60	49.5
Total	121	100

[1]Only the Southern Philippines Development Authority (SPDA) farms tilapia in Lake Buluan.

old, 15% were younger and about one-third were over 40 years old. Almost all the respondents were male and married (Table 2).

Demographic characteristics

Educational Attainment: All respondents from Lakes Buluan and Sebu were literate and on the average may be considered highly educated (over 75% were between high school and M.Sc. level). In Lake Lanao, about 17% had no formal schooling while the remaining 83% had formal education, ranging from primary to college level. The majority (about 77%) of the respondents in the three lakes being studied achieved education levels between high school and M.Sc. level, on the average a very well educated group of respondents (Table 3).

Occupation: About one-third of the respondents in the lakes depended solely on tilapia culture as their source of income. The rest were farmers, employees or businessmen engaged in tilapia culture on a part-time basis (Table 4).

Membership in Organizations: About 400 cage operators in Lake Sebu were members of the Lake Sebu Fish Cage Operators Association. Of the 400 members, 58 were among the respondents of the study. Only three of the Lake Sebu respondents were non-members of the association (Table 5). In Lake Lanao, less than one-half of the respondents were affiliated with any tilapia-related organization. This may be so because the individual fishfarmers were widely dispersed and the peace and order condition of the area was relatively unstable.

Length of Years in Residence and Tenure Status: A majority of the respondents occupied their present residence for over 10 years. All respondents in Lake Sebu owned the cages they operated; 95% of the respondents in Lake Lanao also owned their cages while only 5% were merely caretakers (Tables 6 and 7).

Table 2. Age, sex, civil status of respondents of the Mindanao lakes tilapia economics survey, 1983.

Item	Lakes Buluan (n = 1) %	Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Age				
Below 30	–	12	18	15
31-40	100	45	60	53
41 and above	–	43	22	32
Total	100	100	100	100
Sex				
Male	100	98	100	99
Female	–	2	–	1
Total	100	100	100	100
Civil status				
Single	100	–	–	1
Married	–	100	100	99
Total	100	100	100	100

Table 3. Educational attainment of respondents of the Mindanao lakes tilapia economics survey, 1983.

Educational attainment	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
None	–	–	17	8
Primary	–	10	–	5
Elementary	–	13	13	13
High school	–	25	27	26
College (B.A. or B.Sc.)	–	50	43	46
M.Sc.	100	2	–	2
Total	100	100	100	100

Table 4. Occupations of respondents of the Mindanao lakes tilapia economics survey, 1983.

Occupation	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Employee-fishfarmer	100	43	38	41
Fishfarmer only	–	14	30	22
Farmer-fishfarmer	–	33	21	27
Businessman-fishfarmer	–	10	11	10
Total	100	100	100	100

Table 5. Membership in tilapia-related associations of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Organization	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
None	–	5	52	29
Lake Buluan Development Program (LBDP)	100	–	–	1
Samahang Nayon (SN) Pre-cooperative	–	–	11	5
Lake Sebu Fish Cage Operators Association (LASEFOA)	–	95	–	47
Lake Lanao Fish Cage Cooperative-Southern Philippines Development Authority (LLFCC-SPDA)	–	–	37	18
Total	100	100	100	100

Table 6. Length of years in present residence of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Years	Lakes Buluan (n = 1) %	Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
10 or less	100	23	17	20
11-20	–	35	5	20
Since birth	–	42	78	60
Total	100	100	100	100

Table 7. Tenure status of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Tenure status	Lakes Buluan (n = 1) %	Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Owner	100	100	95	98
Caretaker	–	–	5	2
Total	100	100	100	100

Experience in tilapia culture

Table 8 indicates that a good number of respondents in all the lakes had only a few years of experience in tilapia culture, implying that a majority of the respondents were still new in the business.

Most (93%) respondents were cage operators. Some of these operators were also operating fish pens or ponds while a few operated fish pens or ponds only (Table 9).

Assistance Received: It was evident that among formal institutions, the Bureau of Fisheries and Aquatic Resources (BFAR) played a very active role in the development of the tilapia cage venture in the three lakes. In Lake Sebu, 95% of the cage operators were being assisted by BFAR as were 60% of the respondents in Lake Lanao. Some respondents were also assisted to a lesser extent by other government agencies such as the Ministry of Human Settlements (MHS)

Table 8. Number of years as fishfarmers of the respondents of the Mindanao lakes tilapia economics survey, 1983.

No. of years	Lakes Buluan (n = 1) %	Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
5 years or less	100	72	80	76
6-10 years	–	20	12	16
11 and above	–	8	8	8
Total	100	100	100	100

Table 9. Types of fish culture practiced by respondents[1] of the Mindanao lakes tilapia economics survey, 1983.

Types	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Fishpond	–	–	33	17
Fishpen	100	2	3	4
Fish cage	100	98	97	93

[1]Some fish cage owners also owned ponds or pens.

or the Southern Philippines Development Authority (SPDA). Forms of assistance obtained from these sources included technical, management, financial and social advice on tilapia culture (Tables 10 and 11). The majority of the respondents entered the business in order to improve their incomes or standards of living (Table 12).

Choice of Site and Rights of Access to Location: The SPDA had chosen Lake Buluan

Table 10. Agencies/individuals assisting respondents of the Mindanao lakes tilapia economics survey, 1983.

Agency/Individual	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Bureau of Fisheries and Aquatic Resources (BFAR)	–	95	60	76
Neighbor	–	25	25	25
Relative	–	17	7	12
Southern Philippines Development Authority (SPDA)	100	–	15	8
Ministry of Human Settlements (MHS)	–	–	10	5

Table 11. Forms of assistance obtained by respondents of the Mindanao lakes tilapia economics survey, 1983.

Forms of assistance	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Technical	100	95	99	97
Management	100	90	70	80
Financial	100	95	3	50
Social[1]	100	–	15	8

[1]The Southern Philippines Development Authority provides social assistance to fishfarmers in the form of advice on community, organizational and marketing matters.

Table 12. Reasons for deciding to venture into tilapia culture of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Reasons	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Livelihood	–	33	74	53
Business	–	42	10	25
Consumption	–	17	3	10
Recreation	–	–	3	2
Fast growing species	100	8	10	10
Total	100	100	100	100

for its large fish cage project mainly because the lake was not overcrowded. Among the Lake Sebu respondents, the main reason for choosing their site was the location which fronted or was adjacent to their residence. Almost half of the Lake Lanao respondents chose the location because they owned the land adjacent to where their cages could be placed. Their access or right to the location was either through ownership, rental, inheritance or membership in an organization (Tables 13 and 14).

Degree of Progress of Their Project: About two-thirds of all the respondents considered their fishfarming project to progress moderately well and only 3% considered it very slow. This result implies that the fishfarmers were generally content with their business to date (Table 15).

Extent of Involvement: The majority of respondents considered their involvement to be on a part-time basis (62% from Lake Sebu and 74% from Lake Lanao) while the minority were involved on a full-time basis (Table 16).

The fish cages

Almost 50% of the respondents in Lake Sebu started their fishfarms between 1977 and 1980 while about one-third did the same in Lake Lanao. Tilapia cage culture was established in Lake Buluan much later than in

Table 13. Reasons for choice of location of fish cages of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Reasons	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
Fronting the residence	–	70	17	43
Owned nearby land area	–	7	48	27
Natural feeds are available	–	7	28	18
Not too overcrowded	100	16	7	12
Total	100	100	100	100

Table 14. Methods of obtaining access/right to location of fish cages of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Methods		Lakes		
	Buluan (n = 1)	Sebu (n = 60)	Lanao (n = 60)	All lakes (n = 121)
	%	%	%	%
Owned the nearby land	100	38	52	45
Rented the nearby land	–	62	35	48
Inheritance of rights	–	–	12	6
Membership in association	–	–	1	1
Total	100	100	100	100

Table 15. Degree of progress of individual fishfarming activities of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Progress		Lakes		
	Buluan (n = 1)	Sebu (n = 60)	Lanao (n = 60)	All lakes (n = 121)
	%	%	%	%
Very fast	100	–	12	7
Fast	–	17	8	12
Moderately fast	–	65	68	66
Slow	–	17	7	12
Very slow	–	1	5	3
Total	100	100	100	100

Table 16. Extent of involvement in fishfarming of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Time involved		Lakes		
	Buluan (n = 1)	Sebu (n = 60)	Lanao (n = 60)	All lakes (n = 121)
	%	%	%	%
Full-time	100	38	26	33
Part-time	–	62	74	67
Total	100	100	100	100

Lakes Sebu and Lanao. The recent introduction of tilapia cage culture to Lake Buluan (under the auspices of SPDA in 1981) may be the reason why no local residents had yet engaged in such ventures at the time of the survey (Table 17).

Type of Operation: All the SPDA fish cages in Lake Buluan were of the floating type (Table 18). Lake Sebu respondents had more of the fixed type (71%), while about 70% of the fish cage owners in Lake Lanao had floating cages. One reason for the prevalence

Table 17. Year of establishment of tilapia cages/pens/ponds of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Item	Buluan (n = 1) %	Lakes Sebu (n = 60) %	Lanao (n = 60) %	All lakes (n = 121) %
1977-earlier	–	7	5	6
1978	–	12	8	10
1979	–	35	12	23
1980	–	42	30	36
1981	100	3	38	21
1982-present	–	1	7	4
Total	100	100	100	100

Table 18. Type of cages and systems of fish cage operators in the Mindanao lakes tilapia economics survey, 1983 (n = 113).[1]

Item	Buluan (n = 1) %	Lakes Sebu (n = 58) %	Lanao (n = 54) %	All lakes (n = 113) %
Type of cages				
Fixed	–	71	30	55
Floating	100	29	70	45
Total	100	100	48	100
Type of system				
Grow-out only	–	100	94	96
Hatchery and grow-out	100	–	6	4
Total	100	100	100	100

[1]In this and remaining tables, fish pen/pond owners excluded from the tabulation.

of floating cages in Lake Lanao and Lake Buluan is the depth of the water where the fish cages were located.

The SPDA operation in Lake Buluan had both hatchery and grow-out cages, while all respondents in Lake Sebu and about 94% of the respondents in Lake Lanao had grow-out cages only. The majority of the private cage owners thus bought fingerlings for stocking their cages.

Size and Area Operated: The average size of the SPDA fish cages in Lake Buluan was only 50 m^2 or a dimension of 5 x 10 m (Table 19). In Lake Sebu, two-thirds of respondents were operating fish cages that averaged 250 m^2 or more while more than four-fifths of respondents in Lake Lanao were operating fish cages less than 150 m^2 in average size. The larger Lake Sebu cages were generally of the fixed type, while cages in Lakes Lanao and Buluan were of the floating type.

The Lake Buluan respondent was operating 1,100 fish cages for tilapia culture with a total area of 5.5 ha. Ninety percent of the respondents coming from Lake Sebu were operating one-fourth ha or less and almost all respondents (98%) in Lake Lanao were operating equally small fish farms (Table 20).

Stocking Rate, Size of Fingerlings and Grow-out Period: The stocking rate of SPDA at Lake Buluan was 2,500 fingerlings per cage (50/m^2). In Lake Sebu, the most common stocking rate was between 2,001 and 3,000 fingerlings per cage (25-30 fingerlings/m^2); in Lake Lanao (39%) the most popular stocking rates were between 4,001 and 5,000 (40-50 fingerlings/m^2) (Table 21). Fish cages

Table 19. Size of individual fish cages of the respondents[1] of the Mindanao lakes tilapia economics survey, 1983.

Average size (m^2)	Buluan (n = 1) %	Lakes Sebu (n = 58) %	Lanao (n = 54) %	All lakes (n = 113) %
50	100	–	48	24
100-149	–	9	35	21
150-199	–	9	5	7
200-249	–	15	4	10
250-299	–	31	4	18
300 or more	–	36	4	20
Total	100	100	100	100
Average size (m^2)	50	250	105	179

[1]Fish pond/pen operators excluded.

Table 20. Area per farm (m^2)[1] of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Area (m^2)	Buluan (n = 1) %	Lakes Sebu (n = 58) %	Lanao (n = 54) %	All lakes (n = 113) %
1-500	–	12	73	41
501-1,000	–	34	15	25
1,001-1,500	–	25	6	16
1,501-2,000	–	10	2	5
2,001-2,500	–	10	2	5
2,501 or more	100	10	2	7
Total	100	100	100	100
Average farm area (m^2)	55,000	1,638	462	1,548

[1]Fish pond/pen operators excluded.

Table 21. Stocking rate per cage for grow-out cages[1] of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Stocking rate no. fingerlings (per cage)	Buluan (n = 1) %	Lakes Sebu (n = 58) %	Lanao (n = 54) %	All lakes (n = 113) %
1,000-2,000	–	14	15	15
2,001-3,000	100	53	16	35
3,001-4,000	–	31	15	23
4,001-5,000	–	–	39	19
5,001 or more	–	2	15	8
Total	100	100	100	100
Average stocking rate/m^2	50	25-30	40-50	32-40

[1]Fish pond/pen operators excluded.

in Lakes Buluan and Lanao tended to have higher stocking rates than fish cages operated in Lake Sebu.

In Lake Buluan, the grow-out period for tilapia was only four to six months. *Oreochromis niloticus* was the species used and on the average, five to six pieces of tilapia per kg were obtained at harvest. Four respondents from Lake Sebu and two from Lake Lanao were also using the same grow-out period and species and were harvesting almost the same sizes as those harvested from Lake Buluan. However, 15 respondents from Lake Lanao were harvesting much smaller tilapia over the same grow-out period (nine respondents harvesting 7 to 8 pieces/kg, four respondents with 9-10 pieces/kg, and two respondents with 11 or more pieces/kg) (Table 22).

A majority of cage owners in both Lakes Sebu and Lanao were using either *O. mossambicus* or mixed stocks of *O. mossambicus* and *O. niloticus.* Grow-out periods ranged from 4 to 12 months, with most respondents having longer stocking duration and smaller harvest in Lake Lanao than in Lake Sebu.

Table 23 shows that in Lake Buluan, the average size of *O. niloticus* fingerlings at stocking was about 4 cm. They were kept in cages for about five months and by harvest time averaged 200 g (5 pieces/kg).

In Lake Sebu, the average size of *O. niloticus* fingerlings stocked was 4.75 cm. The average grow-out period was about 5.75 months and when harvested the fish reached an average of 167 g (6 pieces/kg). For *O. mossambicus,* the fishfarmers used fingerlings averaging 3.84 cm length, which were kept in cages for a duration of 6.5 months and reached an average about 143 g (7 pieces/kg) at harvest time.

Finally, for mixed stocks or hybrids, the average length of fingerlings used was 3.05 cm with an average grow-out period of 6.8 months. These fish reached 167 g (6 pieces/kg) when harvested. This experience of the fishfarmers indicates that *O. niloticus* in Lake Sebu grew fastest followed by the hybrids or mixed stocks, and *O. mossambicus,* the slowest.

On the other hand, fishfarmers in Lake Lanao used on the average smaller fingerlings, longer average grow-out periods and produced smaller fish at harvest (125 g for *O. niloticus* and about 110 g for *O. mossambicus*) than in Lakes Buluan and Sebu. The almost two months' difference in grow-out period in Lake

Table 22. Grow-out period and average number of pieces harvested per kg by species of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Lake	Species	Grow-out period (months)	Average no. pcs./kg 5-6	7-8	9-10	11-up
Lake Buluan			(n = 1)			
	O. niloticus	4-6	1	–	–	–
Lake Sebu			(n = 32)	(n = 23)	(n = 3)	
	O. niloticus	4-6	4			
	O. mossambicus	4-6	3	4		
		7-8	9	8	1	
	Both	4-6	2	4	1	
		7-8	12	7	1	
		9-12	2			
Lake Lanao			(n = 8)	(n = 21)	(n = 19)	(n = 6)
	O. niloticus	4-6	2	9	4	2
		7-8	–	2		
		9-12	4			
	O. mossambicus	4-6	–	–	–	1
		7-8	–	1	2	1
		9-12	2	3	6	–
	Both	4-6	–	4	3	1
		7-8	–	–	2	1
		9-12	–	2	2	–

Table 23. Average size of fingerlings, grow-out period to harvest and size of harvested tilapia by species of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Item	Species *O. niloticus*	*O. mossambicus*	Mixed/Cross
Lake Buluan	(n = 1)		
Ave. size of fingerlings (cm)	4	–	–
Ave. grow-out period (months)	5	–	–
Ave. size of harvested fish (g)	200	–	–
Lake Sebu	(n = 4)	(n = 25)	(n = 29)
Ave. size of fingerlings (cm)	4.75	3.84	3.05
Ave. grow-out period (months)	5.8	6.5	6.8
Ave. size of harvested fish (g)	167	143	167
Lake Lanao	(n = 23)	(n = 16)	(n = 15)
Ave. size of fingerlings (cm)	3.88	3.69	4.04
Ave. grow-out period (months)	7	9.6	7.4
Ave. size of harvested fish (g)	125	110	110

Lanao was insufficient to match the final harvested weights of cultured tilapia obtained in the other two lakes.

Based on the foregoing results, Lake Lanao appears less favorable to tilapia growth than the other two lakes perhaps due to other natural constraints. Despite these seemingly lower growth rates, the majority of fishfarmers from Lakes Sebu and Lanao preferred stocking *O. mossambicus* or an *O. mossambicus/O. niloticus* mixture than using exclusively *O. niloticus.* One of the observed reasons was that consumers prefer the taste of *O. mossambicus* to that of *O. niloticus.*

Production practices

All respondents in Lakes Lanao and Sebu were practicing regular feeding and maintenance while the Lake Buluan respondent provided no feed due to the abundance of natural food in the lake (Table 24).

Kind and Amount of Feeds Used: Almost all of the 54 respondents (96%) from Lake Lanao were feeding their tilapia with rice bran; almost two-thirds gave fish meal and only a few respondents gave wheat pollard, copra meal, *ipil-ipil (Leucaena leucocephala)* and household left-overs (Table 25). On the

Table 24. Production practices in tilapia fish cage culture of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Item	Lakes Buluan (n = 1) %	Sebu (n = 58) %	Lanao (n = 54) %	All lakes (n = 113) %
Feeding				
Regular	–	100	100	99
No feeding	100	–	–	1
Total	100	100	100	100
Checking farm structures				
Monthly	–	–	6	2
Once a year	–	5	50	27
After harvest	100	47	33	41
As necessary	–	48	11	30
Total	100	100	100	100
Inspecting cages				
Daily	100	100	74	87
Weekly	–	–	26	13
Total	100	100	100	100
Cage cleaning				
Monthly	–	50	11	30
Yearly	–	14	11	13
After harvest	100	33	61	48
As necessary	–	3	17	9
Total	100	100	100	100

Table 25. Types of supplementary feeds for tilapia cage culture in Lakes Sebu and Lanao[1] of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Feeds used	Lakes: Sebu (n = 58) %	Lanao (n = 54) %	Both lakes %
Rice bran	8	96	50
Wheat pollard	0	2	1
Copra meal	17	2	10
Ipil-ipil leaf meal	41	20	31
Fish meal	12	56	33
Tiki-tiki[2]	100	0	51
Left-overs	9	16	13
No feeding	0	0	0

[1]No supplementary feeds were used by the fishfarmer (SPDA) in Lake Buluan.
[2]Coarse rice bran and broken rice particles.

other hand, all the respondents in Lake Sebu were providing their tilapia culture with *tiki-tiki* (coarse rice bran and broken rice particles) and over one-half gave *ipil-ipil* leaves and a few gave rice bran, fish meal, copra meal and left-overs. Fishfarmers in the two lakes were using different feed rations mainly because of the difference in the degree of availability of natural food in the lake.

Table 26 shows the daily amount of feeds in kg given by cage owners in the first month and in subsequent months to the tilapia in their cages. Lake Sebu respondents provided less feed to the tilapia than those in Lake Lanao regardless of cage size. The average feeding rate in Lake Lanao was about twice that in Lake Sebu, which corresponds to the relative stocking rates in the two lakes.

Method and Frequency of Feeding: All the fishfarmer respondents in Lakes Lanao and Sebu fed their tilapia by broadcasting the feeds (Table 27). About 65% of the respondents in Lake Lanao practiced feeding three to four times daily while in Lake Sebu, over 81% practiced only once or twice daily feeding.

Labor Requirement: Table 28 shows the average man-days of labor utilized by fish cage owners per activity or production operation per farm and per cage. Installation of cages in Lake Buluan (about 1,100 cages) required 6,600 man-days or an average of 6 man-days per cage (each cage averaged 50 m^2 in size). This was done entirely by hired laborers. On the other hand, Lake Lanao fish cage owners used an average of 20.6 man-days (11.3 and 9.3 man-days of operator/family labor and hired labor, respectively) per farm for cage installation or an equivalent of 5.1 man-days per floating cage of 105 m^2 average size. In Lake Sebu, an average of 11.4 man-days was spent in each farm (4.8 from operator/family labor and 6.6 man-days of hired labor) or an average of 1.7 man-days per cage (0.7 and 1.0 man-days for operator-family labor and hired labor, respectively). The lower average man-days of labor required in the establishment of cages in Lake Sebu may be attributed to the longer experience of cage owners in the business and the fact that most of the cages though averaging 250 m^2 in size were not of the floating type but of the fixed type.

Stocking, transporting, maintenance (e.g., inspecting, cleaning) harvesting and hauling (e.g., supplies and marketing) operations in all the lakes under consideration required minimal man-days of labor. However, it should be noted that of the total man-days required per farm and per cage in all the lakes, by far the greatest proportion was spent in providing security measures for the cages during growout. While the fishfarmer in Lake Buluan did not spend time for feeding, the second most important labor-using activity in Lakes Lanao and Sebu was feeding.

On the whole, the average man-days required per 50 m^2 cage in the tilapia fish cage operation in Lake Buluan was 90.6

Table 26. Average quantity of feeds (kg) per day by size of cage and by age of fingerlings used by respondents of the Mindanao lakes tilapia economics survey, 1983.

Cage dimension (m)	Age of fingerlings	Lakes Sebu (kg)	Lanao (kg)	Both lakes (kg)
10 x 5	Less than 1 month	.25	0.9	0.5
	More than 1 month	.50	1.9	1.0
10 x 10	Less than 1 month	1.4	1.6	1.5
	More than 1 month	1.8	3.8	2.8
10 x 15	Less than 1 month	1.5	2.2	1.8
	More than 1 month	1.9	4.4	3.1
10 x 20	Less than 1 month	2.2	2.8	2.5
	More than 1 month	2.5	4.5	3.5
10 x 25	Less than 1 month	2.3	3.5	2.9
	More than 1 month	2.8	6.2	4.5
10 x 30	Less than 1 month	3.0	4.1	3.6
	More than 1 month	5.0	7.3	6.1
Average	Less than 1 month	1.8	2.5	2.1
	More than 1 month	2.4	4.7	3.5

Table 27. Method and frequency of feeding of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Item	Lakes Sebu (n = 58) %	Lanao (n = 54) %	Both lakes (n = 112) %
Method of feeding			
Broadcasting	100	100	100
Frequency of feeding/day			
1-2 times	81	35	59
3-4 times	19	65	41
Total	100	100	100

Table 28. Average man-days of labor (per farm and per cage) utilized by fishfarmers by source (operator, family or hired) and by activity of 113 respondents of the Mindanao lakes tilapia economics survey, 1983.

Lake	Cage installation O&FM[1]	Cage installation Hired	Stocking & transport O&FM	Stocking & transport Hired	Maintenance O&FM	Maintenance Hired	Security O&FM	Security Hired	Feeding O&FM	Feeding Hired	Harvesting O&FM	Harvesting Hired	Hauling O&FM	Hauling Hired	Total all activities O&FM	Total all activities Hired	Total man-days	Approx. man-days per 100 m^2
Buluan																		
Per farm	0	6,600	0	344	0	22,000	0	69,625	0	0	0	1,070[2]	0	0	0	99,639	99,639	181
Per cage	0	6.0	0	0.3	0	20.0	0	63.3	0	0	0	1.0	0	0	0	90.6	90.6	
Percent[3]	0	6.6	0	0.3	0	22.2	0	69.8	0	0	0	1.1	0	0	0	100	100	
Sebu																		
Per farm	4.8	6.6	1.2	0.5	2.1	0.3	89.4	7.9	16.4	3.6	1.3	0.3	2.0	0.2	117.2	19.4	136.6	11
Per cage	0.7	1.0	0.2	0.1	0.3	0.04	13.0	1.2	2.4	0.5	0.2	0.04	0.3	17.1	2.9	20		
Percent[3]	3.5	4.8	0.9	0.4	1.5	0.2	65.4	5.8	12.0	2.6	1.0	0.2	1.5	0.1	85.8	14.2	100	
Lanao																		
Per farm	11.3	9.3	2.0	2.7	5.2	0.7	106.1	7.8	25.3	1.8	1.5	0.5	1.6	0.6	153	23.4	176.4	34
Per cage	2.8	2.3	0.5	0.7	1.3	0.2	26.3	1.9	6.3	0.4	0.4	0.1	0.4	0.1	38	5.7	43.7	
Percent[3]	6.4	5.3	1.2	1.6	2.9	0.4	60.2	4.4	14.3	1.0	0.8	0.3	0.9	0.3	86.7	13.3	100	

[1] Operator and family labor.
[2] Harvesting and hauling combined.
[3] Percent of total man-days labor.

man-days. This was all hired labor and considerably more per unit area than for the other two lakes. In the case of Lake Sebu, the average labor input per cage was 19.9 man-days, about 86% of which was contributed by the operator and/or family, and only 14% by hired labor. The average labor required per cage in Lake Lanao was about 43.7 man-days, about 87% of which was provided by the operator or family and the remaining 13% by hired labor. In both Lakes Sebu and Lanao tilapia cage culture was essentially a family venture.

Some aspects of business analysis

Production and Disposal: On a per farm basis, the single respondent in Lake Buluan had the highest production, all of which was sold (Table 29). Lake Sebu followed with an average of 3,191 kg per farm, about 93% of which were sold and the remainder used at home and other purposes. Lake Lanao had the least production with only 1,900 kg average per farm, 83.2% of which was sold, 12.2% consumed and the remainder given away. On a per unit area basis, however, the smaller farms of Lake Lanao were more productive than the larger farms of Lake Sebu (Table 30).

Cost of Production: The production costs incurred by the sole operator of the 1,100 fish cages in Lake Buluan reached over ₱2 million, while Lakes Sebu and Lanao respondents had only an average of ₱7,395 and ₱7,898 per farm, respectively (Table 31). On a per cage basis, Lake Sebu operators had the lowest production cost followed by Lake Buluan; the highest per cage costs were incurred in Lake Lanao.

Considering the components of these costs, it could be noted that in Lake Buluan, almost 60% of the total costs were spent for hired labor followed by "others" (i.e., payment of interest on loans, etc.) and the least, for depreciation. In the case of Lake Sebu, almost 40% of the average total costs were spent for labor, (if the cost of family and operator's labor were given an imputed value), followed by the cost of fingerlings, feeds and marketing costs. Lake Lanao fishfarmers spent about 36% of the total costs for fingerlings; hired and imputed value of own/family labor was about the same. The least was spent on marketing of the produce.

Costs and Returns: The average costs and returns per crop for tilapia cage culture in the three lakes are presented in Table 32. On a per farm, per cage and per m^2 basis, the SPDA in Lake Buluan had the highest net return followed by fishfarmers in Lake Lanao and then by those in Lake Sebu. This result appears to be due to two factors: the price of produce from Lakes Buluan and Lanao is approximately double that of Lake Sebu and on the average, fish farms

Table 29. Average production in kg per farm of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Lakes	Ave. production	Sold		Nature of disposal Used at home		Others[1]	
	Kg	Kg	%	Kg	%	Kg	%
Buluan	550,000	550,000	100	0	0	0	0
Sebu	3,191	2,955	92.6	188	5.9	48	2.5
Lanao	1,900	1,581	83.2	232	12.2	87	4.6

[1]E.g., given away.

Table 30. Summary input and production data from tilapia cage operations of the respondents of the Mindanao lakes tilapia economics survey, 1983.

	Lake Buluan (n = 1)	Lake Sebu (n = 58)	Lake Lanao (n = 54)
Production unit type	floating	fixed	floating
Ave. size of cage (m^2)	50	250	105
Ave. area of farm (m^2)	55,000	1,638	462
Ave. no. of cages	1,100	6.6	4.4
Stocking			
Ave. stocking rate (pieces/m^2)	50[1]	25-30	40-50
Species	*O. niloticus*	*O. niloticus* and *O. mossambicus*	*O. niloticus* and *O. mossambicus*
Feeding (supplementary)	No	Yes	Yes
Labor input			
Ave. no. of man-days/farm	99,639	137	176
Ave. no. of man-days/100 m^2	181	11	34
Production per cropping cycle (g)			
Ave. size of fish at harvest (grams)	200[1]	143-167	110-125
Ave. production/farm (kg)	550,000[1]	3,191	1,900
Ave. production/100 m^2 (kg)	1,000[1]	193	411

[1]Editors' note: data on stocking rate, average size of fish at harvest and average production obtained from the SPDA fishfarm and reported here implies 100% survival rate. SPDA believed survival rate to be approximately 95%; therefore, the average size of fish at harvest (on which these calculations are based) is probably only a rounded off figure of a range of 175-200 g.

in the former two lakes have higher stocking rates per m^2 than the latter. On average, fishfarms in all three lakes were profitable.

Comparing these averages, the implication is that between Lake Lanao and Lake Sebu, Lake Lanao cages tended to profit more per crop. However, on average only one crop per year is obtained in the cage operations of Lake Lanao, while Lake Sebu respondents harvested two crops per year on average. Hence, on an annual basis the Lake Sebu fishfarmers received higher net return per farm than did those of Lake Lanao (their annual net return/m^2 was still the lowest among the three lakes, however).

On the whole, the net return for tilapia cage culture in the three lakes is indeed encouraging. This does not, however, mean that there is no limit to this venture. Supply and demand considerations and their effect on prices and the possibility of overcrowding the lakes should be taken into consideration.

Production problems

Tilapia cage owners, in spite of the seemingly profitable business they have, are not spared from numerous problems in the production of tilapia. In spite of the availability of highly trained technical manpower of SPDA, mortality during grow-out was still considered a problem, aside from a new social problem with fishermen in the lake.

Table 31. Average annual production costs (in pesos) per farm[1] of the respondents of the Mindanao lakes tilapia economics survey, 1983.

Item	Buluan (n = 1)[2] Value	%	Lakes Sebu (n = 58)[2] Value	%	Lanao (n = 54)[2] Value	%	All lakes (n = 113)[2] Value	%
Labor								
Unpaid family/operator's labor	0	0.0	2,848	38.5	2,121	26.8	1,014	3.6
Hired labor	1,485,575	59.7	138	1.9	415	5.4	13,416	47.7
Fingerlings	275,000	11.1	1,907	25.8	2,860	36.1	4,779	17.0
Feeds	0	0.0	634	8.6	1,260	15.9	928	3.3
Marketing costs	170,500	6.9	314	4.3	111	1.5	1,723	6.1
Depreciation	136,092	5.5	816	11.0	1,132	14.3	2,164	7.7
Others	419,958	16.8	730	9.9	0	0.0	4,091	14.6
Total	2,487,125	100	7,387	100	7,899	100	28,115	100

[1]At the time of this study (1983), ₱11.00 = US$1.00.

[2]n = number of respondents from whom complete production costs were obtained.

Table 32. Average costs and returns (in pesos) per crop for tilapia cage culture of the respondents of the Mindanao lakes tilapia economics survey, 1983. (₱11.00 = US$1.00 in 1983)

Item	Buluan[1] (n = 1)	Lakes Sebu (n = 58)	Lanao (n = 54)	All lakes (n = 113)
Ave. farm size	55,000 m^2	1,638 m^2	462 m^2	1,548 m^2
	Per farm (₱)			
Ave. gross returns (net sales)	5,500,000	13,763	15,929	63,349
Ave. total costs	2,487,125	7,387	7,899	28,115
Ave. net returns	3,012,875	6,376	8,031	35,234
	Per cage (₱)			
	(C = 1,100)[2]	(C = 380)[2]	(C = 238)[2]	(C = 1,718)[2]
Ave. gross returns (net sales)	5,000	2,100	3,614	4,166
Ave. total costs	2,262	1,128	1,792	1,849
Ave. net returns	2,739	972	1,822	2,317
	Per m^2 (₱)			
Ave. gross returns (net sales)	100.00	8.40	34.48	40.92
Ave. total costs	45.22	4.51	17.10	19.11
Ave. net returns	54.78	3.89	17.38	21.81
Net returns/₱ spent	1.21	0.86	1.02	1.14

[1]Fish cages in Lake Buluan are operated by SPDA and average total costs reflect only the man-days of hired labor, excluding management and administrative staff.
[2]Total number of fish cages.

In Lake Sebu, the problem of overcrowding ranked first, followed by poaching, lack of capital and lack of technical knowhow. One reason why overcrowding was considered the main problem may be attributed to the rather limited area of Lake Sebu which is only 964 ha. With the existing fish cages in operation, the area allowable by law for fish cage operation in the lake may have already been reached or perhaps even exceeded.

Lake Lanao respondents identified the most number of problems, with lack of capital ranking first, followed by lack of technical knowledge, overcrowding, high interest rates and social problems (with fishermen).

Operators' future plans

Of the 121 respondents, the majority (90 respondents or 74%) intended to expand their projects (Table 33). Forty-two percent of the 45 respondents in Lake Sebu who planned for expansion were contemplating to add one to three cages while 31% planned to add four to six cages. Meanwhile, 27% intended to expand their venture to commercial scale requiring hired labor (seven cages or more). The majority of the 44 respondents from Lake Lanao who wanted to expand intended to add only one to three cages while a minority would add four or more cages.

Table 33. Proposed expansion and capital requirements (in pesos) of the fish cages of the respondents of the Mindanao tilapia economics survey, 1983. (₱11.00 = US$1.00 in 1983)

	Lakes							
No. of cages to be added	Buluan (n = 1)		Sebu (n = 58)		Lanao (n = 54)		All lakes (n = 113)	
	No.	%	No.	%	No.	%	No.	%
1-3	–	–	19	42	25	57	44	49
4-6	–	–	14	31	9	20	23	25.5
7 or more	1	100	12	27	10	23	23	25.5
Total	1	100	45	100	44	100	90	100
Expected capital requirements								
₱1,000-6,000		–		46		51		48
6,001-11,000		–		34		10		23
11,001 or more		100		20		39		29
Total		100		100		100		100

Recommendations

While tilapia cage culture in both Lakes Sebu and Lanao is fast expanding due to the present viability of the venture in the area, the observed problem of overcrowding indicates the need to limit the extent of cage culture to an appropriate level. Thus it is recommended that further encouragement of cage culture be limited to the optimum number to preclude the bad experiences of fish farms in some lakes in Luzon due to overcrowding (Radan 1977; Alvarez 1981).

While there now exist a good number of tilapia cages in Lake Buluan, some portions of the lake may still be tapped by a number of private fishfarmers. Moreover, to equitably distribute the resources of the lake to the greatest number of fishermen in the area, the sole operator should now give way to the other fishermen to tap the remaining allowable area of the lake. This will minimize the social problem. Areas that may be tapped by government funded projects include the Butayan portion of the lake, i.e., southwest of the lake.

Acknowledgements

The author wishes to extend gratitude to ICLARM and PCARRD for providing financial assistance; to Drs. Corazon Aragon, Ian Smith and Elvira Tan who had been mainly responsible for the inclusion of the study in their project; to Asst. Director Sani Macabalang (BFAR, Region XII) and Cesar Pagdilao (PCARRD) for their helpful comments and suggestions; and to Ellyn, Sylvia, Nul, Sugra and Mapiamama for helping in the data collection and collation.

References

Alvarez, R.C. 1981. Growing tilapia in floating cages. Greenfields 11(2): 8-10.

Cabero, A.D. 1980. Tilapia raising in Rizal. Greenfields 10(11): 4-12.

Devamkez, L.C. 1964. *Tilapia mossambica* Peters. Current Affairs Bulletin. Indo-Pacific Fisheries Council, FAO-UN, Bangkok, Thailand. 41 p.

Radan, R.R. 1977. The floating cages of Lake Bunot, San Pablo, Laguna. Greenfields 7(4): 46.

Wohlfarth, G.W. and G.I. Hulata. 1981. Applied genetics of tilapias. ICLARM Studies and Reviews 6. 26 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Financial and Economic Analyses of Grow-Out Tilapia Cage Farming in Laguna de Bay, Philippines

JOVENAL F. LAZAGA

SEAFDEC Aquaculture Department
Ortigas Ave., Mandaluyong, Metro Manila
Philippines

LEONARDO L. ROA

Ateneo de Manila University
Quezon City
Philippines

LAZAGA, J.F. AND L.L. ROA. 1985. Financial and economic analyses of grow-out tilapia cage farming in Laguna de Bay, Philippines, p. 107-114. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

A survey of grow-out tilapia cage farming in Laguna de Bay, Philippines, was conducted in two towns in Rizal Province. The resulting analyses indicate low financial performance and poor economic viability of grow-out tilapia cage farming in this part of the lake during the 1980-1982 seasons. Overcrowding of cages in limited areas, poaching and typhoon damage were the major reasons for poor performance.

Introduction

The fishery industry in Laguna de Bay consists of two major activities: fish capture in open waters and fish culture in pens and cages. Notably, two kinds of fish are cultured—milkfish in pens and tilapia in cages.

The recent interest in tilapia cage farming was brought about mainly by the introduction of *Oreochromis niloticus*. It was generally believed that *O. niloticus* was a "miracle fish" which promised high financial returns, not only for its marketability but also for its fast growth in the lake at high stocking densities even without supplemental feeding. Moreover, tilapia cage farming involves simple technology and requires low capital investment, hence is adoptable by low-income groups.

But is there really a steady demand for tilapia which offers reasonable profits and income to its producer? Does tilapia grow fast enough in cages such that production costs can be minimized with maximizing output? Is tilapia cage farming a simple technology that could be easily learned by marginal fishermen to augment their income? More significantly, is tilapia cage farming financially and economically viable?

A multidisciplinary study is required to answer these questions adequately. As a prelude to such a study, this paper aims to evaluate the financial and economic viability of tilapia cage farming in selected areas of Laguna de Bay.

Review of Literature

Four species of tilapia have been introduced in the country for local adaptation: *O. mossambicus, O. niloticus, O. aureus* and *T. zillii.* In 1970, *O. niloticus* was introduced in the Philippines for experimental study (Ronquillo and Garcia 1976). However, as of 1979, only *O. mossambicus* was reported to be grown on commercial basis (Guerrero 1981). *O. mossambicus* did not gain widespread acceptance among consumers, hence its commercial production was very limited.

Several studies have been conducted on Laguna de Bay's capture fishery as well as the management aspects of pen and cage culture but few, if any, have examined the economics of tilapia farming in cages. This could be attributed to the fact that tilapia cage farming in the lake became widely practiced only in the last two to three years.

For example, a socioeconomic survey of tilapia farming in the Philippines was conducted by Tidon and Librero (1978). The survey covered 131 tilapia fishponds nationwide but made no mention of tilapia cage farming in the lake. Presumably, at the time the survey was made, the number of tilapia cage farms in the lake was negligible despite early efforts to introduce this technology there.

Tilapia cage farming in Laguna Lake involves both pens and cages. In 1963, the Bureau of Fisheries and Aquatic Resources (BFAR) planned a pilot project for the culture of tilapia, milkfish and goby using bamboo cages (Blanco 1963). The project was implemented in 1965 in the municipalities of Cardona, Baras, Tanay and Binangonan (Felix 1974); however, it did not spread widely in these areas, let alone in other lakeshore towns. In 1973, the Laguna Lake Development Authority (LLDA) introduced net cages for tilapia culture in Cardona.

Fish cage culture is the raising of fish from juvenile stage to commercial size in a volume of water enclosed on all sides, including the bottom, while permitting the free circulation of water through the cage (Coche 1979). Fish cages are distinguished from fishpens in that the latter are constructed at the culture site and made up of closely arranged wooden or bamboo poles stuck in the lake bottom with side netting but no horizontal netting at the bottom.

Experiments on tilapia cage farming under lake conditions have been undertaken since 1977 by the Binangonan Research Station of the Southeast Asian Fisheries Development Center (SEAFDEC). Initial studies focused on stocking density, feeding and production of high quality fingerlings. A tilapia cage farming demonstration project was set up in 1980 in four barangays (SEAFDEC-BRS 1981). A technology verification project was launched jointly with the Technology Resource Center in early 1981, involving the establishment of small-scale farms in five municipalities around the lake (SEAFDEC 1981). Since then, no study has been conducted on the financial and economic performance of tilapia cage farming in Laguna de Bay.

Methodology

Area of study and data collection

This study was conducted in two towns in Rizal Province representing two different water zones of Laguna Lake. For the West Bay, Binangonan was selected and for the Central Bay, Cardona (Fig. 1).

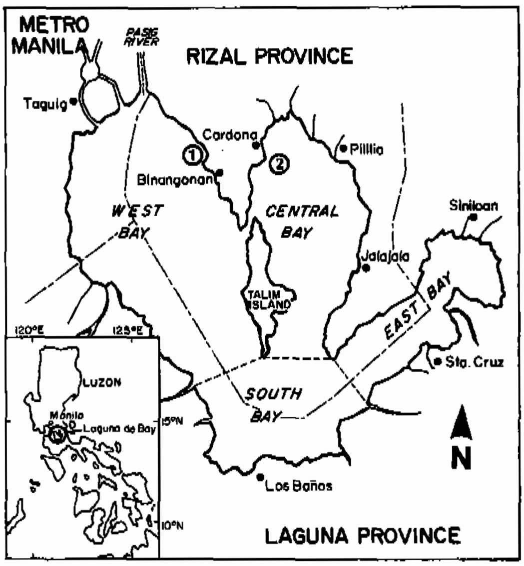


Fig. 1. Map of Laguna de Bay showing the two sampling sites in Binangonan and Cardona.

Tilapia cage farming consists of three types of activities: 1) hatchery/nursery; 2) grow-out farming; and 3) integrated hatchery/nursery and grow-out system. This paper deals with tilapia farms which were engaged solely in grow-out operations.

The data were collected through personal interviews during October and November 1982 and covered the 1980-1982 period. Total enumeration was done in both sampling sites because there were fewer operational cage farms than the targeted samples, many operators having abandoned their cage farms due to various reasons (e.g., typhoon damage, rampant poaching, slow fish growth and poor financial returns). Selected stocking and production information is shown in Table 1. Capital investment data are shown in Table 2.

Benefit-cost analyses

Financial Analysis: A simple benefit-cost (B/C) ratio was employed to evaluate the financial performance of tilapia cage farming. The financial B/C ratio was computed for each cage farm in both sample sites and is presented in Table 3 along with effective farm area, total discounted benefits and costs. The discount rate used was 18% because this was the lending rate of the local banks. The pricing of inputs and outputs was based on actual prices prevailing for the cage farmers under market conditions (Gittinger 1978). Using data obtained from field survey, the useful life of the cage farms was estimated at two years.

The average B/C ratio was obtained for the two sampling sites to allow comparison of the financial efficiency of cage farmers belonging to the two distinct lake zones. On average, little difference between the two sites was found.

Economic Analysis: The procedure used to compute an economic benefit/cost (B/C) ratio was similar to that employed in the financial analysis, but with some modifications. First, the total benefits and costs were discounted at 15% instead of 18% because this was the opportunity cost of capital in the locality, e.g., interest rate charged by local banks. Second, all labor including operators' own and family labor was priced at its opportunity cost.

The economic B/C ratios obtained for the two sampling sites are presented in Table 4.

Results and Discussions

Profile of the sample farms

Due to inadequate number of usable samples obtained from the two sample sites,

Table 1. Stocking density, culture period and fish size at harvest of 21 tilapia cage farms in Binangonan and Cardona, 1982.

Farm no.	Effective area (m^2)	Stocking density (fingerlings/m^2)	Culture period (months)	Fish size at harvest (pieces/kg)
Binangonan				
1	148	32	–	12.0
2	260	46	5	8.5
3	392	46	8	8.0
4	600	48	6	8.5
5	800	12	7	5.5
6	1,440	22	7	8.5
	$\bar{x}$ = 623	34	6.6	8.5
Cardona				
1	200	20	8	10.0
2	240	62	5	10.0
3	288	42	6	12.0
4	300	50	6	10.0
5	400	62	8	10.0
6	400	50	–	7.0
7	400	40	3.5	8.0
8	500	–	8	10.0
9	512	39	–	12.0
10	600	15	–	7.0
11	765	34	–	6.5
12	1,600	28	7	7.0
13	1,700	6	6	7.5
14	2,300	34	5	4.0
15	2,900	30	–	5.5
	$\bar{x}$ = 874	37	6.3	8.4

statistical inferences cannot be derived from the available data. However, judgmental observations were made as follows:

Farm Size: Sizes of tilapia cage farms in Binangonan ranged from 248 to 1,440 m^2, while those in Cardona ranged from 148 to 2,900 m^2 (Table 1). In both sites, the distance between two neighboring farms ranged from 10 to 50 m.

Stocking Density: The average stocking density used by tilapia farms in Binangonan was 34 fingerlings/m^2, while that in Cardona was 37/m^2 (Table 1).

Supplemental Feeding: Tilapia farmers in Binangonan and Cardona provided minimal and irregular supplemental feeding to their fish. Most farmers reported that they had limited cash resources to buy even the cheaper feeds such as rice bran and stale bread.

Financial analysis

The financial B/C values obtained for tilapia cage farmers in Binangonan range from 0.20 to 1.29, while for Cardona the said

Table 2. Capital investment in establishing tilapia cages in Binangonan and Cardona.

Farm no.	Effective area (m^2)	Total capital investment* (₱)		Ave. investment (₱/m^2)
Binangonan				
1	248	5,714		23.04
2	260	5,000		19.23
3	392	6,306		16.09
4	600	8,738		14.56
5	800	7,616		9.52
6	1,440	11,268		7.83
	Σ = 3,740		Farm average:	15.05
			Weighted average/m^2:	11.94
Cardona				
1	200	2,516		12.58
2	240	3,634		15.14
3	288	5,160		17.92
4	300	4,366		14.55
5	400	4,662		11.66
6	400	5,367		13.42
7	400	6,712		16.78
8	500	9,746		19.49
9	512	7,205		14.07
10	600	7,692		12.82
11	765	12,060		15.76
12	1,600	20,545		12.84
13	1,700	29,906		11.71
14	2,300	21,793		9.48
15	2,900	26,606		9.18
	Σ = 13,105		Farm average:	13.83
			Weighted average/m^2:	12.05

*Investment is based on actual procurement prices in 1980 to 1982 and includes costs in establishing fish cages and caretaker's hut.

values range from 0.25 to 1.52 (Table 3). The average per farm financial B/C values among tilapia cage farms in Binangonan and Cardona are 0.79 and 0.81, respectively, indicating that tilapia cage farming in both sites was not financially viable (Tables 3 and 4). Weighting these B/C values by farm size shows improved, but still unattractive values of 0.96 (Binangonan) and 0.92 (Cardona).

The low financial performance of tilapia cage farming in both sampling sites could be attributed to a number of factors. First, many fishfarmers reported heavy losses due to rampant poaching and typhoon damage. Second, slow fish growth was possibly due to inadequate natural food entering the net enclosures or to the degeneration of the quality of the juveniles stocked. Third, the

Table 3. Summary of effective farm area, total discounted benefits and costs and financial B/C ratios of six grow-out tilapia cage farms in Binangonan, Rizal and 15 grow-out tilapia cage farms in Cardona, Rizal.

Farm no.	Effective farm area (m^2)	Total discounted benefits (₱)	Total discounted costs (₱)		Financial B/C
Binangonan					
1	248	3,001	14,749		0.20
2	260	7,484	10,956		0.68
3	392	10,690	16,894		0.63
4	600	21,164	16,358		1.29
5	800	9,303	13,789		0.67
6	1,440	28,468	22,659		1.26
				Farm average:	0.79
				Weighted average:	0.96
Cardona					
1	200	5,540	9,645		0.57
2	240	10,948	12,018		0.91
3	288	8,381	12,953		0.65
4	300	11,044	11,947		0.92
5	400	8,157	12,711		0.64
6	400	8,947	14,157		0.63
7	400	10,634	15,027		0.71
8	500	28,468	24,230		1.18
9	512	14,107	20,449		0.69
10	600	12,504	15,619		0.80
11	765	7,250	28,960		0.25
12	1,600	51,798	35,959		1.44
13	1,700	21,110	33,227		0.63
14	2,300	76,706	50,369		1.52
15	2,900	41,775	61,951		0.67
				Farm average:	0.81
				Weighted average:	0.92

fishfarmers may have lacked proper management skills in tilapia cage culture.

Economic analysis

The economic B/C values obtained for tilapia cage farmers in Binangonan range from 0.15 to 1.33 and 0.31 to 1.52 for Cardona. The average economic B/C values per farm among tilapia cage farmers in Binangonan and Cardona are 0.69 and 0.78, respectively, indicating that tilapia cage farming in both sites was also not economically viable (Table 4). There was little difference between the B/C values in the two locations when weighted by farm size.

The reasons cited above for the low financial performance of tilapia cage farming in both sites could also be cited for its poor economic performance. Moreover, economic B/C values were also influenced by the adjustments for price distortions such as taxes and

Table 4. Summary of effective farm area, total discounted benefits and costs and economic B/C ratios of six grow-out tilapia cage farms in Binangonan, Rizal and 15 grow-out tilapia cage farms in Cardona, Rizal.

Farm no.	Effective farm area (m^2)	Total discounted benefits (₱)	Total discounted costs (₱)		Economic B/C
Binangonan					
1	248	3,126	20,296		0.15
2	260	7,798	11,176		0.70
3	392	11,126	20,540		0.54
4	600	22,044	16,627		1.33
5	800	9,686	30,278		0.32
6	1,440	29,640	27,617		1.07
				Farm average:	0.69
				Weighted average:	0.81
Cardona					
1	200	5,771	14,471		0.40
2	240	11,378	12,335		0.92
3	288	8,734	17,145		0.51
4	300	11,503	25,885		0.44
5	400	8,497	13,007		0.65
6	400	9,318	10,892		0.86
7	400	11,071	15,236		0.72
8	500	29,640	29,957		0.99
9	512	14,688	20,944		0.70
10	600	13,014	15,919		0.81
11	765	7,570	24,124		0.31
12	1,600	54,545	35,824		1.52
13	1,700	21,972	33,733		0.65
14	1,300	79,865	53,867		1.48
15	2,900	43,452	63,268		0.69
				Farm average:	0.78
				Weighted average:	0.80

opportunity costs of resources used in tilapia cage farming.

Conclusions and Recommendations

In studying the financial and economic viability of grow-out tilapia cage farming in Laguna de Bay, there may be factors which analysts failed to consider that could affect costs and returns. This could be expected in a non-experimental survey where investigators do not have control over exogenous factors.

Data obtained in this study indicated low financial performance and poor economic viability of grow-out tilapia cage farming in Laguna de Bay.

It is therefore recommended that:

1. Tilapia farmers should be trained or train themselves on proper management

techniques for tilapia cage farming before going into commercial production in order to minimize unnecessary financial losses.

2. Continuing work should be made to develop and maintain quality stocking materials for culture.

Acknowledgements

The authors express their appreciation to the following SEAFDEC staff: Dr. Alfredo C. Santiago, Jr., for his valuable comments in the preparation of the study; Mr. Pepito Valera for assisting in preparing the questionnaire as well as in the actual interviews; Mr. Danilo Evangelista for his assistance in refining the questionnaire; Mr. Federico de los Reyes, Jr., for furnishing information on some input costs; Mr. Milian Silvestre for assisting in the interviews; Mr. Apolinario Ceñido for operating the boat which brought the authors to the various fishfarms; and Ms. Miriam Espiritu for providing the initial secretarial support.

The authors also wish to thank the tilapia cage farmers who allowed themselves to be interviewed.

References

Blanco, G.J. 1963. Prospectus: fish cage propagation pilot project. Philippine Fisheries Commission, Diliman, Quezon City. (mimeo)

Coche, A.G. 1979. A review of the cage fish culture and its application in Africa, p. 428-440. *In* T.V.R. Pillay and W.A. Dill (eds.) Advances in aquaculture, Fishing News Book Ltd., England.

Felix, S.S. 1974. Raising fish in fishpens and fish cages. UNESCO National Commission of the Philippines. Man and Biosphere National Committee. Inter-Bureau Mobile Meeting on Ecological Research Inputs in Resource Management, 16 October 1974, Manila.

Gittinger, J.P. 1978. Economic analysis of agriculture projects. John Hopkins University Press, Baltimore.

Guerrero III, R.D. 1981. Recent developments in the cage culture of tilapia in the Philippines. Paper presented at the IFS General Assembly Meeting, 12 November 1981, Chiang Mai, Thailand.

Ronquillo, I.A. and D.M. Garcia. 1974. Introduction of new species into freshwater areas. UNESCO National Commission of the Philippines. Man and Biosphere National Committee. Inter-Bureau Mobile Meeting on Ecological Research Inputs in Resource Management, 16 October 1974, Manila.

SEAFDEC. 1981. Annual Report. Southeast Asian Fisheries Development Center, Aquaculture Department. Tigbauan, Iloilo, Philippines. 72 p.

SEAFDEC-BRS. 1981. Progress Report. Binangonan Research Station, Southeast Asian Fisheries Development Center, Aquaculture Department, Binangonan, Rizal, Philippines.

Tidon, A. and A. Librero. 1978. A socio-economic study of tilapia farming in the Philippines. SEAFDEC/PCARR Research Paper Series No. 10. Los Baños, Laguna, Philippines.

Session 4: Land-Based Culture Systems

Tilapia Production in Freshwater Fishponds of Central Luzon, Philippines

RUBEN C. SEVILLEJA

Freshwater Aquaculture Center
Central Luzon State University
Muñoz, Nueva Ecija
Philippines

SEVILLEJA, R.C. 1985. Tilapia production in freshwater fishponds of Central Luzon, Philippines, p. 115-126. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

Tilapia production in freshwater ponds of Central Luzon, Philippines, is described and the economics of monoculture and polyculture systems are discussed. The culture of tilapia is shown to be economically feasible in the area with polyculture systems being slightly more profitable than monoculture systems. Land rent and feed purchases constitute the major cash expense items.

The major problems encountered by tilapia producers include the difficulty of obtaining credit, lack of technical assistance, limited management expertise and high price of inputs. Availability of fry/fingerlings and market absorptive capacity for tilapia produced were reported only as minor problems.

Introduction

Fisheries rank high in the country's national development priorities. This is so in recognition of the industry's far-reaching social and economic significance. During the past years, several long-range strategies have been initiated by the government to accelerate the development of the capture (commercial and municipal) and aquaculture sectors of the industry. Among these sectors, the major improvement and expansion in percentage terms is expected to be generated from the aquaculture sector.[1]

[1]Brackishwater and freshwater aquaculture and freshwater capture fisheries are together called 'inland fisheries' in the Philippines–(Editors' note).

In the Philippines, fish culture is becoming increasingly attractive among fishfarmers because of the bright economic potential it offers. Aquaculture is expected to play a key role in economic development in terms of providing incomes to fishfarmers, creating more job opportunities for the people and helping meet the nutritional needs of the people.

The introduction of tilapia to the country further boosted the popularity of aquaculture. According to Bardach et al. (1972), tilapia is one of the most important food fishes cultured in the world. In the Philippines, tilapia ranks second to milkfish *(Chanos chanos)* as the most important cultured fish contributing about 20% of the 1979 total yield from inland fisheries (Guerrero 1981).

The advantages that tilapia production offers favor its adoption by fishfarmers, especially the small-scale operators. The various technologies for the different tilapia production systems in the Philippines have been appropriately documented (PCARR 1976; SEAFDEC and PCARR 1979). While some of these technologies are already being practiced, others remain to be improved and refined.

Central Luzon region has extensive areas of fishpond culture. In 1976, an estimated 12,726 tonnes (t) of fish were produced from the region's freshwater areas (Sevilleja and McCoy 1978); 34,921 t were produced from brackishwater ponds (BFAR 1980). Moreover, there are vast potential resources which are not presently widely used for fish culture. According to national statistics (BFAR 1976, 1980; MNR 1979), there are about 51,990 ha of brackish and freshwater fishponds, 146,658 ha of irrigated paddy fields, 1,975 ha of communal waters and numerous tidal, estuarine and mangrove areas in Central Luzon which remain to be developed.

Although tilapia farming in the Philippines has been found to be profitable (Tidon and Librero 1978), there is still an inadequacy of up-to-date economic information which constrains effective fisheries planning and policy-making. The dynamic growth and development of the tilapia industry in the country will have numerous economic consequences and implications affecting the fisheries industry in general. At this point, therefore, an up-to-date economic analysis of the overall structure of the tilapia industry is necessary.

The general objective of this study was to determine the economics of tilapia production in freshwater fishponds of Central Luzon. The specific objectives of the study were as follows: (1) to identify and describe the existing culture systems including labor utilization, sources of fish stock and use of production inputs; (2) to determine costs and returns for alternative production systems; (3) to present a brief description of the marketing system and practices; and (4) to identify problems encountered by the tilapia producers.

Methodology

The provinces of Bulacan, Nueva Ecija, Pampanga and Tarlac comprised the study area (Fig. 1).

A list of tilapia fishfarmers, obtained from the regional office of the Bureau of Fisheries

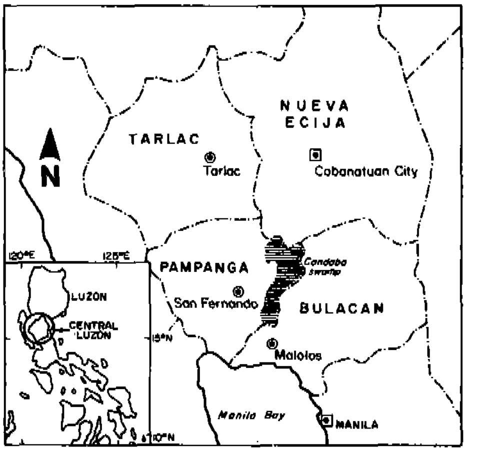


Fig. 1. Map of Central Luzon showing study areas.

and Aquatic Resources (BFAR), was used as the sampling frame. A total of 100 sample operators representing about 13% of the population was purposively established. The distribution of sample operators by province is presented in Table 1.

Data and information were obtained by personal interview during 1983 using a prepared questionnaire. Production information was obtained for the 1982 calendar year.

Results and Discussion

Profile of operators

Tilapia producers in Central Luzon had an average age of 48 years with six members in their household (Table 2). They had gone through nine years of formal schooling. Tarlac operators had the highest educational attainment with Pampanga farmers having the lowest.

Experience in fish culture ranged from three to 14 years with about four years on average having been devoted to tilapia culture. Most of their know-how in tilapia production was obtained through self-study, reading and "word-of-mouth". Only 23% of the respondents had undergone formal training on how to raise tilapia. The training consisted mainly of seminars conducted by BFAR and the Freshwater Aquaculture Center (FAC) of Central Luzon State University, Muñoz, Nueva Ecija.

Table 1. Distribution of sample tilapia operators, by province.

Province	No. of operators[a]	No. of respondents	%
Bulacan	61	15	24
Nueva Ecija	80	25	31
Pampanga	244	30	12
Tarlac	360	30	8
Total	745	100	13

[a]Information obtained from Regional Office of the Bureau of Fisheries and Aquatic Resources.

Table 2. Characteristics of sample tilapia operators, by province.

Item	Province				Central Luzon Region
	Bulacan	Nueva Ecija	Pampanga	Tarlac	
Age (years)	45	51	47	48	48
Household size (no.)	7	6	7	5	6
Years in school	9	9	7	11	9
Years experience in:					
Fish culture	14	6	5	3	6
Tilapia culture	8	4	2	3	4
Percent of income from tilapia culture	20	26	28	25	25

All respondents were part-time fishfarmers as they reported that tilapia production was not their only source of income. For the majority (92%), it was only a secondary source; only three operators reported that tilapia culture was their major income source. Other sources of income included rice farming, livestock production, white collar jobs and manual jobs. On average, only about 25% of the operators' income was obtained from tilapia culture.

Fishpond information

Tilapia farmers operated an average fishfarm area of 2.83 ha composed of about six ponds with an average depth of 1.29 m (Table 3). Nueva Ecija operators owned the largest fish farms with an average area of 4.62 ha while Bulacan operators had the smallest area of 1.40 ha. Age of ponds ranged from three to eight years.

Fishponds in 97% of farms were of the excavated type; the others were levee type. Irrigation canals were the primary source of water in 39 farms while primarily pumps were used by 32 operators. Other sources of water include surface run-off, springs and streams. In particular, Pampanga Province fish farms relied on natural water courses.

Management practices

There were two production systems being practiced in the region: monoculture and polyculture. As shown in Table 4, there were 48 farmers who practiced monoculture and the rest adopted a polyculture system. While monoculture farmers stocked only tilapia, there was no attempt to rid their ponds of other species of fish. To them, added fish were welcome as they were sold, thereby increasing total farm receipts.

Pond preparation: Activities in pond preparation included levelling of pond bottom, cleaning of weeds and other debris and patching up eroded pond dikes. Generally, operators practiced neither poisoning nor

Table 3. Characteristics of the sample tilapia farms by province.

Item	Province				
	Bulacan (n = 15)	Nueva Ecija (n = 25)	Pampanga (n = 30)	Tarlac (n = 30)	Central Luzon Region (n = 100)
Ave. area of fishfarm (ha)	1.40	4.62	1.93	2.99	2.83
Ave. no. of ponds	6	7	4	8	6
Ave. depth of ponds (m)	1.29	1.12	1.43	1.29	1.28
Ave. age of ponds (years)	8	6	8	3	6
Kind of pond (% of operators)					
Excavated	100	100	90	100	97
Levee type	–	–	10	–	3
Main source of water (% of operators)					
Irrigation canal	73	40	20	40	39
Pump	13	48	27	33	32
Others[a]	13	12	53	27	29

[a]Include surface run-off, springs and streams.

Table 4. Stocking practices and production information of the sample tilapia operators by system and by province.

System/Information	Bulacan	Nueva Ecija	Pampanga	Tarlac	Central Luzon Region
	Province				
Monoculture:[a]					
No. of operators	10	23	12	3	48
%	67	92	40	10	48
Stocking rate (pieces/ha/crop)	13,083	9,336	16,730	21,796	12,748
Stocking size (g/fish)	29	12	15	30	17
Harvest size (g/fish)	122	89	56	87	83
Annual production (kg/ha)					
Tilapia	1,466	714	686	1,565	917
Other species[c]	5	144	28	267	94
Polyculture:					
No. of operators	5	2	18	27	52
%	33	8	60	90	52
Stocking rate (pieces/ha/crop)					
Tilapia	5,500	8,360	15,344	26,849	20,102
Other species[c]	750	1,140	2,092	3,612	2,715
Stocking size (g/fish)					
Tilapia[b]	13	16	9	26	18
Other species[c]	4	7	7	11	9
Harvest size (g/fish)					
(Tilapia only)	164	50	54	77	76
Annual production (kg/ha)					
Tilapia[b]	823	246	404	1,936	1,229
Other species[c]	87	32	255	363	290

[a]Species cultured was *Oreochromis niloticus* only.
[b]Include *O. niloticus, O. mossambicus* and *T. zillii.*
[c]Include *O. striatus, C. carassius, C. carpio* and *C. batrachus.*

complete eradication of left-over fish in the ponds after each harvest, apparently preferring to save these for the next production cycle. This is the main reason why fishes other than tilapia were harvested by operators practicing monoculture.

Species cultured: Oreochromis niloticus was the most popular species raised in freshwater fishponds. It was reported by 77% of the farmers as their main cultured species and the only species stocked in monoculture systems. Other species of tilapia reared mainly in polyculture systems were *O. mossambicus* and *Tilapia zillii.* However, 18% of the operators did not know the species of tilapia they were culturing.

The other fish species cultured in polyculture systems were mudfish *(Ophicephalus striatus)* and carps (mainly *Carassius carassius* and *Cyprinus carpio*). Catfish *(Clarias batrachus)* were not being intentionally stocked but were occasionally found and harvested from the ponds.

Stocking practices and production: Presented in Table 4 are the stocking practices and production information for monoculture and polyculture systems. On the average, the stocking rate for monoculture was 12,748/ha/

crop at a fish stocking size of 17 g. Total annual fish production was 1,011 kg/ha with tilapia comprising about 91% of the total harvest.

On the other hand, the stocking rate for polyculture was 22,817/ha/crop with a composition ratio of 88% for tilapia and 12% for other fish species. Total annual production for tilapia and other species were 1,229 and 290 kg/ha, respectively.

Fifty-seven percent of the farmers produced their own fingerling needs. The predominant system was to collect fingerlings from their rearing ponds, usually during harvest. Only 12 operators maintained separate breeding and nursery ponds. For those who purchased their fish stock, the common sources were the BFAR-USAID hatchery and the FAC both at CLSU, other BFAR hatcheries and private fishponds which were not exclusively for hatchery purposes. The market supply of fingerlings fluctuated because fish farm operators sold only when their own needs were met. Thus, overpopulation was not considered a problem in most fish farms as "excess" fish were either used in the farm and/or sold to others.

Fertilization and feeding: Application of fertilizers was practiced by 82% of the sample fishpond operators; of these 74% applied inorganic fertilizer and the rest used organic fertilizer. The most commonly used inorganic fertilizer was urea while chicken manure was used by most of the farmers. Fertilizers were used singly or in combination.

Feeding was practiced by 52% of the producers. Of these, 92% fed rice bran while only 8% used fishmeal. The use of fishmeal was limited because of its high price. Supplemental feeds were given only in powder form.

In general, no regular pattern or schedule of fertilization and feeding was followed by the fish farm operators. The most common practice was to fertilize and feed only whenever operators "felt that there is need to do so".

The kind and amount of fertilizers and feeds given are presented in Table 5. Except in the province of Tarlac, the levels of application of these inputs by province were lower in polyculture systems than in monoculture systems. For the region as a whole, it can be generalized that with respect to fertilization and feeding, monoculture systems of tilapia production were more intensively operated. Respondents did not report any problems regarding availability of these inputs.

Harvesting practices: The majority of the sample operators did not follow a definite harvesting schedule. Among the major reasons given for harvesting were the need for money, the desire for table fish (for home consumption) and when fish attained desirable market size.

The most common harvesting system was by section of pond or by pond which was practiced by 85% of the operators. The methods used were netting (36%), partial draining and netting (31%) and total draining (18%). The last of these methods was common among farmers who practiced total harvesting.

Marketing practices

Ninety-six percent of the farmers surveyed sold their products fresh. Eighty-eight percent practiced sorting, mostly by size; only 5% packed their products before selling.

The majority of the operators (56%) sold their products through retailers/wholesalers while 42% disposed of their products through direct sale to consumers. Seventy-six percent had their products picked up at the pond site while the rest delivered them to the outlets/buyers. Payment was made on a cash basis for 96% of the operators with the selling price determined by: prevailing market price (49%); dictated by operator (31%); agreement between buyer and seller (13%); and dictated by buyer (7%). Selling arrangement was made mainly through direct contact with the buyers.

There were 77 operators who knew the final destination of their products. Of these, 84% said their market outlets were within the municipality.

Table 5. Kind and amount of fertilizers and feeds used (kg/ha/year) by province and production system of the sample tilapia operators.

Kind	Bulacan		Nueva Ecija		Pampanga		Tarlac		Central Luzon Region	
	Monoculture	Polyculture	Monoculture	Polyculture	Monoculture	Polyculture	Monoculture	Polyculture	Monoculture	Polyculture
Fertilizers										
Organic	870	660	2,910	720	360	270	2,250	2,640	1,800	1,530
Inorganic	300	350	350	250	100	100	300	400	250	300
Feeds										
Rice bran	450	450	2,200	600	450	250	700	900	1,300	600
Fishmeal	0	0	100	0	0	0	100	150	50	100

Labor utilization

A total of 62 man-days/ha/year was utilized to carry out the various operations in tilapi production (Table 6). On a provincial basis, Bulacan had the highest labor requirement with 71 man-days/ha/year followed by Nueva Ecija, Pampanga and Tarlac with labor needs of 66, 65 and 55 man-days/ha/year, respectively. The operation that required the most time was pond preparation, comprising 19% of the total. Feeding, weeding, repairs/maintenance and harvesting operations contributed 13% each of the total labor requirement.

About half of the above total labor requirements was provided by the operator and members of his family. Caretakers and hired laborers contributed 27% and 26% of the total, respectively. In most of the smaller fishfarms, the majority of the labor input was provided by the operator and members of his family.

There was negligible difference between the total labor input for monoculture systems (60 man-days/ha/year) and polyculture systems (59 man-days/ha/year).

Capital investment

The amount of capital investment (₱/ha) is presented in Table 7.[2] Land was the major investment item, followed by pond development which comprised 61% and 22% of the total investment, respectively. Other investment items include farm buildings (10%), tools and equipment (4%) and vehicles (3%). Bulacan fishfarms had the highest capital investment while Pampanga had the least. For the region, total capital investment amounted to ₱18,766/ha.

Costs and returns

Expenses in tilapia production are itemized in Table 8. Average annual costs amounted to ₱6,352/ha. Cash expenses contributed 84% to this total. Non-cash costs, composed of unpaid operator/family labor and depreciation expenses, comprised 16% of the total expenditures.

[2]At the time of study, ₱11.00 = US$1.00.

Table 6. Labor utilization (man-days of hired, own and family labor per ha/year) by task and by province of the sample tilapia operators.

Task	Bulacan	Nueva Ecija	Province Pampanga	Tarlac	Central Luzon Region (man-days)	%
Pond preparation	16	15	10	8	12	19
Stocking	3	6	5	6	5	8
Fertilization	10	5	6	5	6	10
Feeding	12	8	10	5	8	13
Weeding	6	7	10	8	8	13
Repairs and maintenance	5	10	8	7	8	13
Harvesting	11	10	8	7	8	13
Sorting/packing	2	3	5	4	3	5
Marketing	6	2	3	5	4	6
Totals	71	66	65	55	62	100

Table 7. Capital investment (₱/ha) of the sample operators for tilapia production by province. (₱11.00 = US$1.00 in 1983)

Item	Bulacan	Nueva Ecija	Province Pampanga	Tarlac	Central Luzon Region Amount	%
Land	12,760	11,517	10,500	11,976	11,536	61
Pond development[a]	6,055	6,091	1,073	4,776	4,185	22
Tools and equipment[b]	1,065	807	553	675	730	4
Farm buildings	8,456	797	605	477	1,792	10
Vehicle[c]	1,325	250	327	577	523	3
Total	29,661	19,462	13,058	18,481	18,766	100

[a]Includes pond excavation, construction of dikes, canals and watergates.
[b]Include nets, buckets, pumps and others.
[c]Computed based on percentage use in tilapia production.

Table 8. Annual expenses (₱/ha) of the sample operators in tilapia production by province. (₱11.00 = US$1.00 in 1983)

Item	Bulacan	Nueva Ecija	Province Pampanga	Tarlac	Central Luzon Region Amount	%
Cash expenses						
Land rent/lease	1,663	796	880	1,495	1,161	22
Feeds	1,483	1,603	106	1,038	966	18
Fertilizer	1,228	1,564	152	558	788	15
Fry/fingerlings	377	122	1,190	837	695	13
Interest on loan	–	–	1,021	1,188	663	13
Hired labor	802	418	516	410	502	9
Fuel/oil	1,981	403	163	118	482	9
Marketing costs	221	21	55	62	73	1
Subtotal	7,755	4,927	4,083	5,706	5,330	100
Non-cash expenses						
Depreciation[a]	2,137	298	335	542	658	64
Unpaid operator/ family labor	273	306	504	319	364[b]	36
Subtotal	2,410	604	839	861	1,022	100
Total	10,165	5,531	4,922	6,567	6,352	100

[a]Based on all depreciable capital items except land.
[b]Average imputed value of labor is ₱14/day.

Land rent/lease (or opportunity cost of land if owned) constituted the major cash expense item comprising about 22% of the total. Other major cash expense items were feed purchases (18%), fertilizer expense (15%), fry/fingerlings (13%) and interest on loans (12%).

Total annual returns averaged ₱12,585/ha with fish sales contributing 78% of the total (Table 9). Of this, tilapia contributed 86%. The value of fish used at home, which was considered a non-cash receipt, was a significant 19% of the total. This emphasizes the importance of tilapia production as a source of food especially to the small fishpond operators.

The profitability of tilapia production is shown in Table 10. In general, polyculture systems were slightly more profitable (₱6,629/ha/year) than monoculture systems with net earnings of ₱6,034/ha/year. Among polyculture farms, Tarlac operators obtained the highest net earnings while Bulacan fishfarmers were the most profitable among monoculture systems.

Problems

Tilapia producers in Central Luzon freshwater fishponds encountered several problems in their operations. Difficulty of obtaining credit was the major problem as reported by 43% of the operators. Other problems in their order of mention were lack of technical assistance, limited management expertise, high price of inputs and other problems which included natural calamities (e.g., flooding) and poaching.

Summary and Recommendations

In this study, an economic description of the culture systems in the production of tilapia in freshwater fishponds of Central

Table 9. Annual receipts (₱/ha) of the sample operators for tilapia production by province. (₱11.00 = US$1.00 in 1983)

Item	Bulacan	Nueva Ecija	Province Pampanga	Tarlac	Central Luzon Region Amount	%
Cash receipts						
Sale of tilapia	17,740	7,183	4,396	8,793	8,413	86
Sale of other fishes	309	211	1,635	2,680	1,393	14
Subtotal	18,049	7,394	6,031	11,473	9,806	100
Non-cash receipts						
Value of fish used at home[a]	1,145	1,265	1,065	5,292	2,395	86
Others[b]	810	479	368	109	384	14
Subtotal	1,955	1,744	1,433	5,401	2,779	100
Total	20,004	9,138	7,474	16,874	12,585	100

[a]Include fish consumed and amount retained for farm use.
[b]Include those given away.

Luzon was presented. This study was undertaken in response to a need for up-to-date information about this sector.

As shown from the analysis, tilapia culture in the region is economically feasible with bright prospects for further development. Although there was a wide range in productivity among the individual producers, average production for monoculture and polyculture approximate those reported by Guerrero (1976) and Guerrero and Villanueva (1979) for similar systems. This means that production and corresponding profits from many individual farms that achieved less than the

Table 10. Costs and returns (₱/ha/yr) of tilapia production of the sample operators by province. (₱11.00 = US$1.00 in 1983)

Item	Bulacan	Nueva Ecija	Province Pampanga	Tarlac	Central Luzon Region Amount	%
Monoculture						
Returns						
Cash	23,965	7,807	7,309	12,633	11,350	89
Non-cash	605	1,837	1,337	1,100	1,409	11
Total	24,570	9,644	8,646	13,733	12,759	100
Costs						
Cash	8,184	4,709	5,347	4,737	5,595	83
Non-cash	2,654	649	840	897	1,130	17
Total	10,838	5,358	6,187	5,634	6,725	100
Net cash income	15,781	3,098	1,962	7,896	5,755	95
Net non-cash income	(–2,049)	1,188	497	203	279	5
Net earnings	13,732	4,286	2,459	8,099	6,034	100
Polyculture						
Returns						
Cash	6,222	2,651	5,181	11,345	8,384	67
Non-cash	4,658	682	1,497	5,880	4,045	33
Total	10,880	3,333	6,678	17,225	12,429	100
Costs						
Cash	6,780	1,914	3,181	5,778	4,826	84
Non-cash	1,925	93	840	857	924	16
Total	8,705	2,007	4,021	6,635	5,750	100
Net cash income	558	737	2,000	5,567	3,558	53
Net non-cash income	2,733	589	657	5,023	3,121	47
Net earnings	2,175	1,326	2,657	10,590	6,679	100

average can be increased with higher levels of input application and more attention to management.

However, farmers claim to be unable to intensify their production systems because of the problems and constraints that they encountered. Although there are existing government credit schemes for fishpond operations, farmers apparently did not readily avail of these. There is also an urgent need to upgrade the present level of technical knowhow of fishfarmers. In line with this, the government can lend support to the industry by extending more technical support.

Acknowledgements

The author wishes to express his gratitude to Mr. Tereso A. Abella for his critical comments; Mr. Romeo Cabacungan, Ms. Janet Orden, Ms. Lolita Santiago, Ms. Eleanor Soriano and Mr. Bharat Sharma for their assistance in data collection and analysis.

This study was jointly supported by the Philippine Council for Agriculture and Resources Research and Development (PCARRD) and the International Center for Living Aquatic Resources Management (ICLARM).

References

Bardach, J.E., J.H. Ryther and W.O. McLarney. 1972. Aquaculture: the farming and husbandry of freshwater and marine organisms. Wiley-Interscience, New York.

BFAR. 1976. Fisheries statistics of the Philippines. Bureau of Fisheries and Aquatic Resources, Manila, Philippines.

BFAR. 1980. Fisheries statistics of the Philippines. Bureau of Fisheries and Aquatic Resources, Manila, Philippines.

Guerrero, R.D. 1976. Culture of *Tilapia nilotica* at two densities with fertilization and supplemental feeding. Fish. Res. J. Phil. 1(1): 39-43.

Guerrero, R.D. 1981. Introduction to fish culture in the Philippines. Phil. Educ. Co., Inc. Quezon City, Metro Manila.

Guerrero, R.D. and E.P. Villanueva. 1979. Polyculture of *Cristaria plicata* (leach) at two densities with *Tilapia nilotica* and *Cyprinus carpio* in fertilized ponds. Fish. Res. J. Phil. 4(2): 13-17.

MNR. 1979. Philippine natural resources profile, fisheries. Vol. III, Natural Resources Management Center, Ministry of Natural Resources, Manila, Philippines.

PCARR. 1976. The Philippines recommends for tilapia. Philippine Council for Agriculture and Resources Research. Los Baños, Laguna.

SEAFDEC and PCARR. 1979. Available technology and technology gaps in tilapia farming in the Philippines, p. 13-17. *In* Proceedings of Technical Consultation on Available Aquaculture Technology in the Philippines. Southeast Asian Fisheries Development Center and Philippine Council for Agricultural Resources Research, 8-11 February 1979.

Sevilleja, R.C. and E.W. McCoy. 1978. Fish marketing in Central Luzon, Philippines. R and D Series No. 21. International Center for Aquaculture. Auburn University, Auburn, Alabama.

Tidon, A.G. and A.R. Librero. 1978. A socio-economic study of tilapia farming in the Philippines. Research Paper Series No. 10. SEAFDEC-PCARR Research Program. Los Baños, Laguna.

Economics of Rice-Fish Culture Systems, Luzon, Philippines

ROGELIO N. TAGARINO

Center for Policy and Development Studies
University of the Philippines at Los Baños
College, Laguna
Philippines

TAGARINO, R.N. 1985. Economics of rice-fish culture systems, Luzon, Philippines, p. 127-150. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

The study was an attempt to establish the technical input-output relationships in simultaneous rice-fish culture production systems in parts of Luzon, Philippines. Individual output and composite output production functions in Cobb-Douglas functional form were estimated using cross-sectional data. On the basis of the estimated composite production functions, the economics of optimization in the use of production inputs are discussed. Costs and returns analyses were also undertaken and showed that simultaneous rice-fish culture could be a profitable venture. The study had the limitation of using farmers' recalled input-output data. It is recommended that further study on the input-output technical relationships in simultaneous rice-fish culture be undertaken with the use of more reliable farm production data.

Introduction

Economic analyses beyond feasibility studies and costs-returns analyses on any of the "rotational" and "simultaneous" rice-fish culture systems in the Philippines are only just beginning to be undertaken. This study was conducted in view of the need for more rigorous economic analysis of rice-fish culture to be able to generate more useful conclusions and recommendations. Specifically, the objectives of the study were: (a) to estimate the input-output relationships of simultaneous rice-fish culture production with the use of cross sectional data and (b) to use the estimated production function to predict the production levels of composite and individual outputs in simultaneous rice-fish culture and the marginal productivities of inputs from given levels of input application.

This paper also includes a brief review of the rice-fish culture technology development in the Philippines and presentation of the results of costs-returns analysis of the production system at the farm level. The final section of this paper discusses the policy implications of the study.

Source of data and limitation of the study

One of the original objectives for the research was to differentiate the economic performances of "rotational" and "simultaneous" rice-fish culture systems at the farm level. This objective was not achieved because, despite considerable fieldwork, a large enough sample of case farmers practicing "rotational" rice-fish culture system could not be identified.

It was originally proposed to survey some 200 rice-fish culture operators in the Central Luzon area. This targetted sample size was based on a National Food and Agriculture Council (NFAC) report (Banzon 1982) that a number of farmers in the area had already adopted the technology. In the actual field survey, however, most of those that were listed as rice-fish culture operators were not actually practicing the technology *per se;* some of them had purely fishpond culture instead, while the others had long discontinued practicing rice-fish culture. There were only a few operators that are sill practicing rice-fish culture; hence, the targetted sample size was not achieved. The sample size for Central Luzon (Table 1) is, therefore, near complete enumeration of rice-fish culture operators in the area during the year of the study. Data collection was also extended to Laguna and Albay Provinces in Southern Luzon Region.

The data for the wet and dry seasons (crop year 1981-1982) of the rice-fish culture system were obtained through personal interviews with the use of pre-tested survey instruments. Not all the sample farmers

Table 1. Average total farm size and area of rice-fish culture paddies in hectares operated by sample farmers in the selected Central and Southern Luzon Provinces, Philippines, 1981-1982 (standard deviation in parentheses).

Location	No. of farms	Ave. total area/farm (ha)	Ave. total area of rice-fish culture paddies/farm (ha)	% total farm area devoted to rice-fish culture
Central Luzon	37	3.32	0.60	18.2
Pampanga Province	9	3.36	1.02	30.5
Tarlac Province	7	3.50	0.79	22.7
Bulacan Province	4	1.63	0.25	15.4
Nueva Ecija Province	17	3.62	0.39	10.7
Southern Luzon	16	1.79	0.55	30.6
Laguna Province	7	3.13	0.69	22.0
Albay Province	9	0.75	0.44	58.6
All farms	53	2.85 (2.28)	0.59 (0.87)	20.8

interviewed had practiced rice-fish culture in both the wet and dry seasons. Generally, the farmers interviewed did not keep farm records; thus, the data that were analyzed in this study were farm information as recalled by the farmers. Furthermore, most of the farmers were not able to indicate the exact species of tilapia which they had grown and harvested. As a consequence, the attempt to estimate production functions by species of fish was not possible.

An Overview of the Rice-Fish Culture Technology Development in the Philippines

There are numerous published literature and bibliographies on rice-fish culture technology (e.g., Hora and Pillay 1962; Coche 1967; Temprosa and Shehadeh 1980). It can be deduced from these that the Philippines is not unique in practicing fish culture in lowland ricefields. The practice is known worldwide, particularly in the irrigated rice producing areas of the tropics. An excellent paper concerning rice-fish culture in Southeast Asia (Khoo and Tan 1980) describes the different methods of fish culture in the paddy field and the different factors, such as heavy farm use of agricultural chemicals that may have caused the decline of rice-fish culture production in some countries of the region. It also discussed the potential benefits of rice-fish culture such as increased rice yields, reduction in the cost of production of rice and increased supply of relatively cheap animal (fish) protein for human consumption.

Rice-fish culture technology generation

In the Philippines, a program for research and development of rice-fish culture technology was conceived and proposed by P. Manacop to the International Rice Research Institute (IRRI) in the early 1960s but it was not carried out then (Manacop 1960). A review of literature further revealed that no other attempt was initiated for the development of the technology until 1974 when the researchers of Central Luzon State University (CLSU) and University of the Philippines College of Fisheries (UPCF) conducted an exploratory trial of culturing fish with a rice crop in Iloilo Province (Anon. 1974). Hence, more than a decade elapsed before the concept of rice-fish culture technology was actually applied.

The CLSU-UPCF in collaboration with IRRI, the National Science and Development Board (NSDB), the United States Agency for International Development (USAID) and other institutions subsequently initiated formal research and development programs on rice-fish culture technology. The program that was launched had the immediate objective to develop "low-cost appropriate technology" for fish production on rice farms. Its ultimate long-term goal was to increase availability of animal protein supply and thereby improve the nutrition of the people in landlocked areas (Dela Cruz 1980).

The development of workable methodologies for simultaneously and rotationally culturing fish with rice crops in the paddy fields was then the priority task in the established research program. The major subject matter of rice-fish culture research that was undertaken at CLSU-FAC included paddy field carrying capacity, fish species and rice varieties compatibility studies, polyculture, supplemental feeding and fertilization. In recent years research gave emphasis to screening commercial pesticides.

The technological package that was evolved in the experimental fields was then tested under actual farmers' field conditions. *Oreochromis niloticus* and *O. mossambicus* were the major species of fish used in the field test and both showed promising results.

Technology transfer

The package of rice-fish culture technology was introduced nationwide in the late 1970s and its extension became one of the important government policies on food and nutrition. The objective was to further increase income of *Masagana 99* farmers thru maximum land utilization by growing fish simultaneously with rice in paddy fields and to provide fresh fish as a cheap supply of protein for the low income group and those in the rural hinterlands (Banzon 1982). A national rice-fish culture program coordinating body was formed to carry out effective implementation of the food policy. Various agencies of the national government were involved to provide the necessary support services for an effective implementation of the nationwide rice-fish culture program.

The program implementation strategy included provision of recommended technical inputs (e.g., seeds of high-yielding variety rice, fish stocking materials), credit support, training of both production technicians and farmers, and other support services. Monitoring and evaluation of rice-fish culture and farm business operations have been important aspects of the program implementation strategy. However, the monitoring and evaluation activities being carried out still need to be improved so that a more comprehensive picture of the technology's impact and progress, and other relevant information will be made available as a guide to policymaking.

Production Techniques and Net Returns

Rice-fish culture paddy development cost

Based on the sample survey, the average total area of rice-fish culture paddies per farm is 0.59 ha. This is about 21% of the total area of farm operated by an average farmer (Table 1). The rice-fish paddies were originally used primarily for rice production. Information about physical characteristics of rice-fish paddies is shown in Table 2, along with estimates of the development cost of a hectare of rice-fish culture paddy.

Development costs of rice-fish culture paddies are those expenses incurred in the improvement of physical layout of lowland rice paddy so as to accommodate the growing of fish stocked. Rice paddy improvements include construction of trenches, installation of irrigation water control devices, increasing the height of dikes, installation of wire screens in water gates and other fencing materials not only to prevent entry of predators but also to prevent the stocked fish from going astray. Development costs also include the cost of physical materials used. On the average, the estimated total cost of developing a hectare rice paddy into a rice-fish culture paddy amounted to ₱2,000. The imputed value of unpaid operator and family labor services in construction constituted more than 75% of this total cost per hectare.

Management practices for simultaneous rice-fish culture

The recommended technological package for simultaneous rice-fish culture system is summarized in Table 3. However, a majority of the operators interviewed did not strictly follow these recommended practices. Not all of them applied 5 kg/ha zinc sulfate as recommended. The rice varieties that were predominantly planted by the operators were not the pest resistant varieties such as IR-32 and IR-42. Basal and top dressing methods of inorganic fertilizer application were generally followed by the operators, but they did not strictly apply the recommended quantity and quality of fertilizer.

The "ordinary wet bed" and *"dapog"* methods of growing seedlings were practiced by most operators, while some of the operators directly seeded their main rice-fish culture paddies. The rice seedlings were transplanted at an average age of 25 to 30 days. Paddy fields were stocked with fingerlings just a few days (about 5 to 7 days on average) after transplanting.

Management practices during the growing period of rice and fish crops included, among others, insect pest control through spraying, supplemental feeding and maintenance of adequate water supply. Three operators in Central Luzon reported to have mistakenly used agricultural pesticides which are toxic to fish and thus they had no fish harvest in their wet season cropping.

Harvesting of fish was generally done prior to harvesting the rice crops, by draining the paddy and allowing the fish to congregate

Table 2. Physical characteristics and average per ha development cost of rice-fish culture paddy fields as surveyed in Central and Southern Luzon, Philippines, 1982 (n = 53). (Figures in parentheses are standard deviations.)

I. Physical characteristics	
Area of rice-fish paddies/farm (ha)	0.59 (0.87)
Ave. area/rice-fish culture paddy (ha)	0.22 (0.28)
No. of rice-fish culture paddies/ha	4 to 6
Ave. dimensions of rice-fish culture paddy dikes (m)	
Base	1.50
Top	0.88
Height	1.14
Types of trenches (n = 53) (%)	
Peripheral	60
Central	23
Combination	6
No trenches	11
No. of farms with fish breeding ponds	32 (60%)
Ave. area of fish breeding pond (ha)	0.023 (0.021)
II. Development cost (₱/ha)*	
Labor services in construction	1,585 (1,969)
Water control devices installed	260 (252)
Wire screens	195 (449)
Fish nets and other fencing materials	351 (645)
Ave. total cost/ha	2,000 (1,937)

*₱8.50 = US$1.00 in 1982.

in the trenches. For the whole sample, average production of fish and rice per hectare during the wet and dry seasons were similar, though there was variation among provinces (Table 4). About 80% of the harvested fish were consumed by the operator's family, while the remaining portion were either given away and retained for farm use.

In general, the cultural and management practices required for simultaneous rice-fish culture are similar to those required for rice culture, except for the addition of some specific activities that became necessary due to the inclusion of fish crops in the system.

Costs and returns of simultaneous rice-fish culture

Table 5 presents the average per hectare costs and returns of simultaneous rice-fish

Table 3. Recommended technological package for simultaneous rice-fish culture production system.[1]

I. Technical Inputs of Production

Kind	Recommended quality and quantity of application
Rice seeds	– IR-36, IR-42 and other pest resistant varieties; to be transplanted at a distance of 20 x 20 cm between hills
Fish stocking material	– *Oreochromis niloticus* (Nile tilapia) – 5,000 fingerlings/ha or common carp – 2,000 to 3,000 fingerlings/ha
Inorganic fertilizer	– Urea (45-0-0) – 75 kg/ha Complete (14-14-14) – 200 kg/ha Zinc sulfate – 5 kg/ha
Pesticides and weedicides	– Carbofuran 1-3 bags/ha. 2-4-D IPE weedicides 25 kg/ha Insecticides at 0.01% concentration such as Furadan 3G, Azodrine 202, etc.

II. Schedule of Production Activities
Days after preparation

0	– prepare and fertilize seedbed
1	– soak rice seeds
3	– broadcast germinated rice seeds on seedbed
5	– treat growing seedlings with recommended insecticides
10-24	– prepare the rice-fish paddies–plowing, harrowing, clearing and improving dikes, trenches, etc.
	– basal fertilization and pesticide application
24	– pull rice seedlings
25	– transplant rice seedlings
28-39	– irrigate paddy fields, 3-5 cm water depth
29	– apply recommended herbicides
32	– stock the paddies with fingerlings
	– increase irrigation water, 7 to 10 cm deep
75	– reduce irrigation water depth to 5 cm, apply fertilizer top dressing
76-95	– irrigation water level must be increased to 10-15 cm deep
96-124	– increase irrigation water depth to 20 cm
125-130	– drain the paddies and harvest the fish
131-135	– harvest and thresh rice crops

[1]Source: NFAC-MA. n.d. Use of brandnames does not imply endorsement of any particular product.

Table 4. Average per ha production of simultaneous rice-fish culture as surveyed in selected Central and Southern Luzon Provinces, 1981-1982.

Location	Wet season, 1981			Dry season, 1982		
	No. of farms reporting	Rice (cavans)[1]	Fish (kg)	No. of farms reporting	Rice (cavans)	Fish (kg)
Central Luzon	35	87	175	14	91	214
		(33)	(146)		(38)	(218)
Pampanga Province	9	64	160	3	58	164
Tarlac Province	7	85	123	2	139	196
Bulacan Province	4	72	150	–	–	–
Nueva Ecija Province	15	105	215	9	101	235
Southern Luzon	13	122	309	14	94	292
		(59)	(207)		(32)	(250)
Laguna Province	5	144	242	6	77	257
Albay Province	8	109	350	8	107	319
All samples	48	97	211	28	96	253
		(44)	(173)		(34)	(234)

Note: Figures within parentheses are standard deviations.
[1] 1 cavan = 50 kg.

culture production as surveyed in selected Central and Southern Luzon provinces. The harvested rice crop accounted for a major portion of the gross returns in simultaneous rice-fish culture system. The harvested fish stock accounted for 26% and 30% of the gross returns in the wet and dry seasons, respectively.

The average per hectare cost of rice-fish culture production was estimated to be ₱4,625 and ₱4,477 for the wet season and dry season croppings, respectively, for all samples. These estimates did not include the opportunity cost of land and unpaid operator and family labor and management inputs. Detailed information on the costs incurred for simultaneous rice-fish culture (including imputed value of unpaid operator and family labor) is presented in Table 6. The cost of fish stocking material (i.e., fish fry/fingerlings) amounted to about 30% of the total cost of production including the non-cash (own labor) cost. For all locations the total of cash and non-cash costs of simultaneous rice-fish culture was estimated to be ₱5,904 and ₱5,205/ha for the wet and dry seasons, respectively. There were no significant differences in the per hectare total cost of production between the two survey locations covered by this study.

It can be concluded from Table 5 that growing fish with rice under the simultaneous culture system was a profitable venture. This is indicated by positive residual net earnings after deducting the costs of production from gross returns. The average residual for all farms surveyed during the dry season (₱4,623) was higher than during the wet season (₱5,516), or a difference of ₱893/ha.

Composite Production Function Model

The use of a composite production function model in the input-output analysis of simultaneous rice-fish culture can be justified because of the nature of the production technology itself. The question of input allocation between the two outputs is not too relevant; that is being done internally in the production system. However, the application of a technical input that is specifically intended for use for a particular output would also affect other outputs in the system. Hence,

Table 5. Average per ha costs and returns (in pesos) of simultaneous rice-fish culture by season as surveyed in selected Central and Southern Luzon Provinces, Philippines, 1981-1982.

Location	No. of farms reporting	Returns Rice	Returns Fish	Returns Total	Costs[1]	Residuals[2]
		Wet season, 1981				
Central Luzon	35	6,492	2,240	8,733	4,112	4,621
		(4,337)	(1,106)	(5,106)	(2,348)	(4,665)
Pampanga Province	9	4,095	2,305	6,400	3,659	2,740
Tarlac Province	7	7,137	1,715	8,853	3,779	5,073
Bulacan Province	4	3,835	1,687	5,522	2,618	2,904
Nueva Ecija Province	15	8,339	2,594	10,933	4,883	6,051
Southern Luzon	13	7,719	2,918	10,637	6,006	4,631
		(3,556)	(1,819)	(3,811)	(3,520)	(4,023)
Laguna Province	5	8,559	2,183	10,742	3,426	7,316
Albay Province	8	7,193	3,378	10,571	7,618	2,953
All samples	48	6,825	2,424	9,248	4,625	4,623
		(4,140)	(1,804)	(4,827)	(2,809)	(4,458)
		Dry season, 1982				
Central Luzon	14	7,372	2,959	10,330	3,445	6,634
		(3,416)	(3,384)	(4,247)	(2,106)	(4,815)
Pampanga Province	3	4,026	2,182	6,208	4,095	2,112
Tarlac Province	2	13,469	2,773	16,242	2,303	13,939
Bulacan Province	–	–	–	–	–	–
Nueva Ecija Province	9	7,132	3,259	10,391	3,873	6,518
Southern Luzon	14	6,794	3,150	9,943	5,508	4,397
		(2,809)	(3,185)	(4,928)	(3,097)	(3,727)
Laguna Province	6	5,350	2,301	7,651	3,597	4,054
Albay Province	8	7,877	3,786	11,663	7,008	4,655
All samples	28	7,083	3,054	10,137	4,477	5,516
		(3,083)	(3,226)	(4,519)	(2,863)	(4,376)

Note: Figures in parentheses are standard deviations.

[1]Does not include the opportunity cost of land and unpaid operator and family labor and management inputs.

[2]Represents returns (net earnings) to owned inputs.

Table 6. Itemized breakdown of costs (in pesos) in simultaneous rice-fish culture by season as surveyed in selected Central and Southern Luzon Provinces, Philippines, 1981-1982. (₱8.50 = US$1.00 in 1982)

	Central Luzon				Southern Luzon				All locations			
	Wet season, 1981		Dry season, 1982		Wet season, 1981		Dry season, 1982		Wet season, 1981		Dry season, 1982	
Input item	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%	Cost	%
Material input	(2,745)	(48)	(2,186)	(48)	(4,611)	(70)	(4,019)	(69)	(3,250)	(55)	(3,103)	(60)
Rice seeds	125	2	204	4	135	2	192	3	128	2	198	4
Fingerlings	1,603	28	1,115	25	1,894	28	1,645	29	1,681	28	1,380	26
Inorganic fertilizer	485	8	438	10	1,562	24	1,523	26	777	13	980	20
Supplementary feeds	395	7	313	7	635	10	435	7	458	8	374	7
Chemical pesticides and weedicides	140	3	117	2	385	6	224	4	206	4	171	3
Labor input	(2,492)	(44)	(1,806)	(40)	(1,388)	(21)	(1,275)	(21)	(2,193)	(37)	(1,540)	(30)
Hired (cash)	950	17	732	16	819	12	893	15	915	15	812	16
Unpaid operator and family labor (non-cash)	1,542	27	1,074	24	569	9	382	6	1,279	22	728	14
Miscellaneous operating costs[1]	(417)	(8)	(527)	(12)	(576)	(9)	(596)	(10)	(460)	(8)	(562)	(10)
Total per ha costs[3]	5,654 (4,112)	100	4,519 (3,445)	100	6,575 (6,006)	100	5,890 (5,508)	100	5,904 (4,625)	100	5,205 (4,477)	100

[1]Miscellaneous operating costs comprise repair and maintenance, depreciation expenses, interest charges on production loans, etc.
[2]Figures in parentheses are subtotals of each input category.
[3]Figures in parentheses are total per ha costs excluding opportunity cost of land and unpaid operator and family labor and management inputs.

multiple output responses are involved. Even if each of the individual output responses to various levels of input application are estimated, "value aggregation" of indivudal output responses would still be necessary to make production optimization decisions. Another reason for using the composite production function model was to simplify the analysis of a complex production system so that practical interpretations of results could be done more easily.

Theoretical model

Theoretically, the composite output of a simultaneous rice-fish culture system could be defined as $Q = \Sigma P_{y_i} Y_i$; where Y_i is the level of production of output i; P_{y_i} is the price of output i, and i = 1 and 2 representing the rice and fish yields that are being aggregated into composite commodity, Q. By this definition, Q could also be thought of as a "value aggregate" of various commodities (Mundlak 1962). The usual procedure in aggregating multi-outputs of a given production system is to use the output prices (P_{y_i}) as weights. This procedure assumes that the output prices are fixed, and hence, the composite output would have the usual properties of a single commodity. This is consistent with Hick's Theorem on Value and Capital which states that "if the relative prices within a group of commodities are fixed, the value aggregate of such commodities would behave as if it were a separate intrinsic commodity" (Hicks 1946).

It would follow that the optimization procedure normally used with single output production functions would also hold true with composite production functions. The economic analysis however, must be carried out with the clear understanding that the composite production function is not a single-valued function of inputs and its parameters (i.e., the technical coefficients) depend on the composition of output and the prices which were used as output weights (Mundlak 1962). Theoretically, it would mean that the estimated composite output elasticity with respect to a given input is expected to be a weighted linear combination of the individual output elasticities with respect to the same inputs (corresponding elasticities) as well as of the other individual output elasticities (non-corresponding elasticities).

The functional relationship between inputs and composite output can be expressed in the generalized form:

$$Q = f(X_1, X_2, \ldots X_n) \quad (1)$$

where:

$Q = \Sigma P_{y_i} Y_i$ = composite output is the price weighted value of rice (Y_1) and fish (Y_2) yields in the simultaneous rice-fish culture system

X_i's = are quantities of input i's combined together in the production process; i = 1, 2, . . . n; and n is the number of inputs being used.

The equation states that the quantity of composite output Q which can be produced depends upon the quantities of inputs which are applied in the rice-fish paddy field. Graphically, a composite production function curve for simultaneous rice-fish culture production can be derived from the vertical summation of the individual output response curves.

The economically optimum input level and combination can be said to occur in the single-output case when the marginal product (MP_i) is equal to the input-output price ratio ($\frac{P_i}{P_y}$); that is, when the value of marginal product of input (VMP_i) is equal to price of input (P_i). In case of composite outputs the condition for economic optimum will be that level of input application where the "numeraire value" of the composite marginal product of the input is equal to the price of the input so specified. Mathematically, this relationship can be derived as follows:

$$Q = f(X_1, X_2, X_3 \ldots X_n) \quad (1)$$

$$\frac{\partial Q}{\partial X_i} = f'(X_1, X_2, X_3 \ldots X_n) = CMP_{x_i} \quad (2)$$

$$CMP_{x_i} = P_{x_i} \quad (3)$$

where:

CMP_{x_i} = composite marginal product of input X_i;
P_{x_i} = price of input (e.g., fertilizer)

The "numeraire value" of the composite marginal product can be directly used without the need to multiply it by output prices, since Q was originally defined in terms of the output prices. Theoretically, as long as the output prices that were used as weights hold true, the "numeraire value" of CMP_{x_i} would be exactly equal to the value aggregate of the input's marginal product for each individual output as if they were estimated individually; that is,

$$CMP_{x_i} = \sum_{i=1}^{2} P_{y_i} (\partial Y_i / \partial X_i)$$

where

$\partial Y_i/\partial X_i$ = the marginal product of X_i in output Y_i.

Specification of the model

As earlier discussed the composite production function would have the usual properties of a single-output production function. Thus, any functional form that may be applicable in estimating single-output production functions could also be applicable to composite production functions. There are several functional forms which can be used in the estimation of production functions but there is no one form that has all the desired features (Fuss et al. 1978).

The decision in this research to use the Cobb-Douglas production function form was not entirely arbitrary but rather was selected because the production system that is being analyzed is complex and thus justifies the use of a relatively simple functional form in order to avoid further complication in the interpretation of results. The simultaneous rice-fish composite production function model specified in this research was of the following Cobb-Douglas functional form:

$$Q = A X_1^{\beta_1} X_2^{\beta_2} \ldots X_8^{\beta_1} \varepsilon \quad (4)$$

transformed in logarithmic linear form as:

$$Q = \ln A + \beta_1 \ln X_1 + \ldots + \beta_8 \ln X_8 + \varepsilon \quad (5)$$

where:

Q = composite output (P) of the simultaneous rice-fish culture system, earlier defined as $\sum_{i=1}^{2} P_{y_i} Y_i$

X_1 = area of rice-fish culture paddy (ha);
X_2 = quantity of rice seeds planted (kg);
X_3 = quantity of tilapia fingerlings stocked (pieces);
X_4 = inorganic fertilizer (bags, 50 kg/bag);
X_5 = supplementary feeds (pesos);
X_6 = chemical pesticides (pesos);
X_7 = labor (man-days);
X_8 = average size of tilapia fingerlings stocked (cm);
A, β_i = technical coefficients to be estimated; and
ε = error term distributed with mean zero and constant variance.

This functional form is a power function which is linear in logarithmic form and thus computationally simple. The elasticities of production under the Cobb-Douglas form are easy to obtain and interpret. Hence, the estimated regression coefficients are themselves the estimates of the elasticities of production. The sum of the estimated regression coefficients ($\Sigma\beta_i$) can be interpreted as the economies of scale of production.

The explanatory variables

In this study of the production function of simultaneous rice-fish culture system, it is hypothesized that the variability of production of the composite output, as well as the individual output components, is explained by the variables shown in equation (5) above and in Table 7.

The different inputs of the rice-fish culture production system can be categorized as either 'output-specific' and 'non-output-specific' inputs. Inputs such as rice seeds and fish fingerlings are said to be 'output-specific inputs' in the sense that their application in the production process is specifically

Table 7. Survey means of the explanatory variables (X_i) of simultaneous rice-fish culture production and input prices (P_{X_i}) for all survey locations by season, 1981-1982. (Figures in parentheses are standard deviations.)

Variables		Wet season 1981	Dry season 1982	Both seasons 1981-1982
No. of farms reporting	(n)	48	28	76
Area harvested (ha)	X_1	0.54	0.64	0.58
		(0.84)	(1.07)	(0.93)
Rice seeds (kg)	X_2	64.27	104.75	79.18
		(216.40)	(283.75)	(242.32)
– Rice seed price (pesos)*	P_{X_2}	1.65	1.80	1.71
Tilapia fingerlings stocked (pcs.)	X_3	2,861.00	1,954.00	2,527.00
		(3,482.00)	(1,818.00)	(2,997.00)
– Fingerling price (pesos)	P_{X_3}	0.22	0.17	0.21
Inorganic fertilizer (bags @ 50 kg/bag)	X_4	2.06	2.40	2.19
		(2.64)	(4.29)	(3.32)
– Fertilizer price (pesos)	P_{X_4}	115.04	121.93	117.53
Supplementary feeds (pesos)	X_5	123.82	134.65	127.81
		(200.54)	(310.03)	(244.61)
Chemical pesticides (pesos)	X_6	37.85	46.34	40.98
		(61.10)	(70.25)	(64.29)
Labor (man-days)	X_7	38.34	43.14	40.11
		(40.85)	(58.14)	(47.63)
– Labor cost (pesos)	P_{X_7}	17.62	17.03	17.40
Ave. size of tilapia fingerlings stocked (cm)	X_8	2.53	2.21	2.41
		(1.34)	(1.32)	(1.33)

*₱8.50 = US$1.00 in 1982.

intended to produce the targetted outputs of rice and fish, respectively. In contrast, the 'non-output-specific' inputs such as irrigation water and inorganic fertilizer are factors of production jointly utilized by the different outputs of the system. The above method of input classification does not ignore the usual method of classifying inputs of production by whether they are applied in fixed or variable quantities.

Simultaneous Rice-Fish Culture Production Function Results and Discussions

The individual output and composite output production functions for simultaneous rice-fish culture system for all survey locations by season were estimated on a per farm and per ha basis. The different production functions were estimated through the general least square (system regression) estimation procedure. The prices that were used as individual output weights in the estimation of the composite production functions were the average output prices received by the sample farm operators during the period of the study (Table 8).

Fit of the model

The estimated per farm and per ha composite production functions for simultaneous rice-fish culture by season for all survey locations are summarized in Table 9. In general, the Cobb-Douglas specification seemed to fit the data well as indicated by significant F-values of the estimated functions.

The signs of the estimated technical coefficients of the production functions were not generally consistent in every case with those which were hypothesized. Except variable X_6 (pesticides), all the explanatory variables were expected to have positive influences on the level of production. The technical coefficient of variable X_6 was expected to be negative, considering that pesticides in general are toxic to fish and thus, it was hypothesized that it can do more harm than good in the simultaneous rice-fish culture production. Variables X_2 (rice seeds) and X_5 (supplemental feeds) were hypothesized to have positive influence on the level of composite output, but this was not the case in some of the estimated production functions. The technical coefficient of X_5 was negative rather than positive as hypothesized. This would imply that the application of X_5 during the dry season would

Table 8. Average output prices (pesos per unit) used as weights in the estimation of composite production functions for simultaneous rice-fish culture for all survey locations by season, Philippines, 1981-1982. (Figures in parentheses are standard deviations.) (₱8.50 = US$1.00 in 1982)

Season	Rice (cavans)	Fish (kg)
Wet season, 1981	69.39	12.11
	(24.55)	(2.83)
Dry season, 1982	73.64	11.99
	(18.76)	(2.84)
Both seasons, 1981-1982	70.96	12.06
	(22.42)	(2.83)

Table 9. Estimated composite production functions for simultaneous rice-fish culture by season for all survey locations, 1981-1982.

Variables and description	Expected signs	Wet season, 1981		Dry season, 1982		Both seasons, 1981-82	
		Per farm	Per ha	Per farm	Per ha	Per farm	Per ha
Intercept (constant)		3.123	6.289	2.311	6.665	3.197	6.459
X_1	+	0.547	–	0.879**	–	0.741*	–
X_2	+	0.121	–0.089	–0.381**	–0.316*	0.067	–0.126
X_3	+	0.344*	0.205*	0.417*	0.246*	0.322*	0.233*
X_4	+	0.114	0.130**	0.057	0.093	0.106	0.097**
X_5	+	–0.010	0.003	–0.153**	–0.115*	–0.039	–0.044**
X_6	–	0.002	0.003	0.059	0.047	0.016	0.007
X_7	+	0.366*	0.201**	0.921*	0.293	0.421*	0.193**
X_8	+	0.142	0.149	0.697*	0.623*	0.250**	0.251**
Economies of scale ($\Sigma\beta_i$)		1.63	0.60	2.49	0.87	1.88	0.61
R^2		0.91	0.40	0.95	0.58	0.91	0.37
Adjusted R^2		0.89	0.30	0.93	0.44	0.90	0.31
F-value		52.25*	3.83*	45.91*	3.97*	89.59*	5.78*
DW statistics		2.01	1.83	1.93	1.57	1.94	1.81
Autocorrelation		–0.01	0.06	0.03	0.19	0.02	0.07

*Significant at 1%.
**Significant at 10%.

decrease composite output production. This result may be due to the water quality effects of the supplementary feed (X_5) in the paddy.

The values of R^2 (coefficient of determination) are high for the estimated per farm composite production functions but, as expected, are relatively lower when these production functions were estimated on a per ha basis.

It was also expected that there would be increasing returns to scale of input application in simultaneous rice-fish culture production. The estimated economies of scale, which are the sum of the input technical coefficients of the per farm production functions, confirmed this expectation.

The estimated composite production functions

Referring again to Table 9, of the eight explanatory variables hypothesized to explain variation in the levels of production, four in the per farm and five in the per ha specification were significant in the estimated "all seasons" (i.e., the average annual) production function. Common to both specifications are fish stocking rate (X_3), labor inputs (X_7) and average size of fingerlings at stocking (X_8).

The area harvested (X_1) is a significant variable in explaining the variability of the composite output production. The estimated production coefficient for X_1 is 0.74 which would imply that for every 1% increase in area of rice-fish culture paddy, a 0.74% increase in the level of composite output can be expected, *ceteris paribus*. Similarly, fish stocking rates (X_3) were found to be significant in explaining the composite output of simultaneous rice-fish culture. The composite output of the system is expected to increase by 0.32% for every 1% increase in stocking rate. The average size of fingerlings (X_8) at stocking was found to be one of the significant explanatory variables in the estimated composite production function for all seasons. This result is obviously expected, because the larger the size of fish fingerlings being stocked in the paddy the higher the level of fish production expected. The estimated elasticity of production with respect to variable X_8 is 0.250 and 0.251 for the per farm and per ha production functions, respectively.

The insignificant variables are those which have coefficients not significantly different from zero; that is, increases in the quantity of these inputs will have no significant impact on the level of production. The variables X_2 (rice seeds) and X_6 (pesticides) are insignificant in the per ha specification of the all seasons composite production function.

Table 9 also presents the estimated per farm and per ha composite production functions by season. In terms of the number of significant variables as well as the estimated economies of scale of production, the estimated composite production functions for the wet and dry seasons are numerically different or distinct from one another.

Attempts to distinguish between the input-output responses according to wet or dry season were also made through the use of a dummy variable (D_2). The estimated coefficient of dummy variable (D_2), where D_2 = 1 for dry season, wet season being the benchmark, is positive though insignificant (Tables 10 and 11). This result suggests that there are no significant differences between the wet and dry seasons' input-output relationships of simultaneous rice-fish culture production.

The differences in productivity of simultaneous rice-fish culture between Central and Southern Luzon were also estimated through the use of a dummy variable (D_1). The results are presented in Tables 12 and 13 for per farm and per ha specifications of the wet season production function and in Tables 14 and 15 for the per farm and per ha specifications of the dry season production function. Significant differences in productivity between the two survey locations were found only during the wet season cropping (see D_1 values in Tables 12 and 13). It suggests that the productivity of simultaneous rice-fish culture during the wet season in Southern Luzon was significantly higher than in Central Luzon.

The individual output response functions

The individual product responses to the application of inputs in simultaneous rice-fish culture system were also estimated to gain more insights into the internal structure of the production system. Because of the nature of the production system, all the explanatory variables considered in the composite production function were also used in estimating each of the individual output functions. In doing this, it was assumed that those inputs which are specific to a particular output also affect the level of production of the other output of the system. This is particularly true in the case of variable X_3 (fingerlings), which is also a significant explanatory variable of rice yield (Y_1), though X_3 is specifically applied for fish (Y_2) production (see Tables 10 to 15).

Each of the individual output production functions was estimated along with the composite production function so that the individual outputs which have contributed

Table 10. Estimated average annual composite and individual output production functions showing differences in productivity by season and marginal productivity of inputs in simultaneous rice-fish culture, Central and Southern Luzon Provinces, Philippines, 1981-1982.

Variables and description	Input geometric mean ($\bar{X}$)	Rice: Technical coefficient	Rice: ($\hat{Y}_1$) & $\partial Y_1/\partial X_i$ at ($\bar{X}$)[1] (cavans)	Fish: Technical coefficient	Fish: ($\hat{Y}_2$) & $\partial Y_2/\partial X_i$ at ($\bar{X}$)[1] (kg)	Composite output: Technical coefficient	Composite output: ($\hat{Q}$) & $\partial Q/\partial X_i$ at ($\bar{X}$)[1] (pesos)
Intercept (constant)		−0.824	(5.61)	−1.880	(18.74)	3.045	(606.58)
X_1	0.43	0.918*	11.976	0.391	17.040	0.754*	1,063.63
X_2	17.66	0.009	0.003	0.099	0.105	0.034	1.17
X_3	1,165.00	0.231*	0.001	0.618*	0.009	0.335*	0.17
X_4	1.30	0.049	0.212	0.042	0.605	0.099	46.19
X_5	33.81	−0.080**	−0.013	0.061**	0.034	−0.041	−0.74
X_6	9.90	0.011	0.006	0.018	0.034	0.019	1.16
X_7	22.74	0.558*	0.138	−0.017	−0.014	0.449*	11.98
X_8	2.15	0.214	0.588	0.362*	3.155	0.271**	76.45
D_2		0.237		0.143		0.130	
Economies of scale ($\Sigma\beta_i$)		1.91		1.57		1.92	
R^2		0.89		0.87		0.92	
Adjusted R^2		0.87		0.86		0.90	
F-value		60.14*		51.17*		80.34*	

Note: D_2 = dummy variable representing dry season, wet season being the benchmark

*Significant at 1%
**Significant at 10%

[1]Expected levels of production (figures in parentheses) and marginal productivities of inputs.

Table 11. Estimated per hectare composite and individual output production functions showing differences in productivity by season and marginal productivity of inputs in simultaneous rice-fish culture, Central and Southern Luzon Provinces, Philippines, 1981-1982.

Variables and description	Input geometric mean $(\bar{X})$	Rice		Fish		Composite output	
		Technical coefficient	$(\hat{Y}_1)$ & $\partial Y_1/\partial X_i$ at $(\bar{X})^1$ (cavans)	Technical coefficient	$(\hat{Y}_2)$ & $\partial Y_2/\partial X_i$ at $(\bar{X})^1$ (kg)	Technical coefficient	$(\hat{Q})$ & $\partial Q/\partial X_i$ at $(\bar{X})^1$ (pesos)
Intercept (constant)	–	2.737	(71.51)	–0.895	(132.60)	6.363	(7,226.79)
X_1	0.43	–	–	–	–	–	–
X_2	74.87	–0.153	–0.146	–0.118	–0.209	–0.157**	–15.15
X_3	5,501.00	0.120	0.002	0.709*	0.017	0.241*	0.32
X_4	4.32	0.055	0.910	–0.041	–1.258	0.087	145.54
X_5	130.79	–0.081*	–0.044	0.020	0.020	–0.044**	–2.43
X_6	24.01	0.010	0.029	0.004	0.022	0.011	3.31
X_7	94.97	0.278*	0.209	–0.033	–0.046	0.212*	16.13
X_8	2.16	0.229	7.521	0.369**	22.652	0.273**	913.38
D_2		0.249*		0.269**		0.149	
Economies of scale $(\Sigma\beta_i)$		0.46		0.91		0.62	
R^2		0.26		0.63		0.40	
Adjusted R^2		0.17		0.58		0.32	
F-value		2.89*		14.00*		5.49*	

Note: D_2 = dummy variable representing dry season, wet season being the benchmark

*Significant at 1%
**Significant at 10%

[1] Expected levels of production (figures in parentheses) and marginal productivities of inputs.

to the variability in composite output as a result of input application could be identified. For instance, in Table 11, the variability of composite output as explained by variable X_3 could be attributed mainly to fish (Y_2) inasmuch as variable X_3 is not significant in the estimated rice yield (Y_1) response function. Also in Tables 12 and 13, variable D_1 is significant in the estimated composite production function indicating that there is significant difference in productivity between locations during the wet season. This significant difference in productivity of simultaneous rice-fish culture system by locations could be attributed mainly to rice (Y_1), since D_1 is not significant in the estimated fish (Y_2) yield response function.

The expected level of production and marginal productivity of input use

Tables 10-15 also present the expected levels of production (figures in parentheses) and marginal productivities of inputs from given levels of application which were predicted with the use of the estimated production functions. The estimated numeraire value of composite marginal productivity of a particular input can be used to determine whether the level of input application is at the optimal level to achieve maximum profits. Levels of input application are said to be optimal when the numeraire value of composite marginal product of input is equal to the price of the input. Thus, if the numeraire value of composite marginal product of input is greater (or less) than the input price, the levels of input application should accordingly be increased (or decreased) until the above optimization criterion is achieved.

An inspection of the estimated composite marginal product of inputs indicated that the level of application of some of the inputs was either less than or more than the profit maximization level. For instance, the estimated value of composite marginal product of X_3 (fingerlings) in Tables 13 and 15 is still greater than the price of fingerlings (i.e., ₱0.31 for the former versus fingerling prices of ₱0.22 and ₱0.17 for wet and dry seasons, respectively). Thus, net earnings from simultaneous rice-fish culture can still be increased by increasing the stocking rates of fingerlings. Based on the estimated per ha composite production functions and the given prices of fingerlings, the optimum level of fingerling stocking rate/ha is estimated to be 8,946 and 11,716 pieces of fingerlings for the wet and dry seasons, respectively, given *ceteris paribus* conditions.

Summary and Implications

The preceding sections focused on three aspects of rice-fish culture technology in the Philippines: review of the technology development; farm level costs and returns analyses; and input-output relationships of simultaneous rice-fish culture.

The history of rice-fish culture technology development in the country indicates that it took more than a decade before the concept of rice-fish culture technology proposed in 1960 began to be seriously evaluated by researchers. Formal research and development of the technology was initiated at the Freshwater Aquaculture Center of Central Luzon State University in 1974. The technology that was developed began to be introduced nationwide in the late 1970s. Numerous government agencies were involved in technology transfer. There is a need for a closer look into the activities of agencies supporting rice-fish culture programs in the Philippines so as to avoid duplication of functions.

Farm level costs and returns analyses showed that growing fish simultaneously with rice crops could be a profitable venture. The profitability of the production system could however, be further improved if certain constraints were resolved. The constraints include risks of pesticide contamination,

Table 12. Estimated per farm composite output and individual output production functions showing differences in productivity by location and marginal productivity of inputs in simultaneous rice-fish culture system, wet season, 1981.

Variables and description	Input geometric mean ($\bar{X}$)	Rice		Fish		Composite output	
		Technical coefficient	$(\hat{Y}_1)$ & $\partial Y_1/\partial X_i$ at $(\bar{X})$[1] (cavans)	Technical coefficient	$(\hat{Y}_2)$ & $\partial Y_2/\partial X_i$ at $(\bar{X})$[1] (kg)	Technical coefficient	$(\hat{Q})$ & $\partial Q/\partial X_i$ at $(\bar{X})$[1] (pesos)
Intercept (constant)		–1.049	(10.37)	–1.202	(7.53)	2.881	(859.54)
X_1	0.41	0.451	11.407	1.090**	20.019	0.457	958.07
X_2	15.54	0.159	0.106	0.049	0.024	0.167	9.24
X_3	1,224.00	0.271**	0.002	0.508*	0.003	0.354*	0.25
X_4	1.31	–0.006	–0.047	0.123	0.707	0.024	15.75
X_5	38.74	–0.051	–0.014	0.090**	0.017	–0.021	–0.46
X_6	10.13	–0.022	–0.023	0.007	0.005	–0.025	–2.12
X_7	23.60	0.510*	0.224	–0.058	–0.018	0.419*	15.26
X_8	2.27	0.069	0.315	0.307**	1.018	0.136	51.49
D_1		0.334**		0.183		0.333**	
Economies of scale ($\Sigma\beta_i$)		1.38		2.12		1.51	
R^2		0.89		0.90		0.92	
Adjusted R^2		0.87		0.88		0.91	
F-value		37.21*		39.23*		51.14*	

Note: D_1 = dummy variable representing Southern Luzon, Central Luzon being the benchmark

*Significant at 1%
**Significant at 10%

[1]Expected levels of production (figures in parentheses) and marginal productivities of inputs.

Table 13. Estimated per ha composite output and individual output production functions showing differences in productivity by location and marginal productivity of inputs in simultaneous rice-fish culture system, wet season, 1981.

Variables and description	Input geometric mean ($\bar{X}$)	Rice		Fish		Composite output	
		Technical coefficient	($\hat{Y}_1$) & $\partial Y_1/\partial X_i$ at $(\bar{X})^1$ (cavans)	Technical coefficient	($\hat{Y}_2$) & $\partial Y_2/\partial X_i$ at $(\bar{X})^1$ (kg)	Technical coefficient	($\hat{Q}$) & $\partial Q/\partial X_i$ at $(\bar{X})^1$ (pesos)
Intercept (constant)		2.420	(78.59)	0.465	(132.80)	5.959	(7,272.81)
X_1	0.41	–	–	–	–	–	–
X_2	66.46	–0.086	–0.102	–0.080	–0.159	–0.062	–6.78
X_3	5,789.00	0.143	0.002	0.514*	0.011	0.243*	0.31
X_4	4.23	0.045	0.836	0.050	1.569	0.054	92.84
X_5	167.87	–0.046	–0.021	0.076**	0.060	–0.016	–0.69
X_6	25.26	–0.004	–0.012	–0.011	–0.057	–0.015	–4.32
X_7	102.96	0.262**	0.200	–0.094	–0.121	0.222*	15.68
X_8	2.27	0.044	1.523	0.385**	22.523	0.137	438.93
D_1		0.304**		0.282		0.322**	
Economies of scale ($\Sigma\beta_i$)		0.36		0.84		0.56	
R^2		0.30		0.58		0.47	
Adjusted R^2		0.15		0.49		0.36	
F-value		2.07**		6.86*		4.35*	

Note: D_1 = dummy variable representing Southern Luzon, Central Luzon being the benchmark

*Significant at 1%
**Significant at 10%

[1] Expected levels of production (figures in parentheses) and marginal productivities of inputs.

Table 14. Estimated per farm composite output and individual output production functions showing differences in productivity by location and marginal productivity of inputs in simultaneous rice-fish culture system, dry season, 1982.

Variables and description	Input geometric mean ($\bar{X}$)	Rice: Technical coefficient	Rice: ($\hat{Y}_1$) & $\partial Y_1/\partial X_i$ at ($\bar{X}$)[1] (cavans)	Fish: Technical coefficient	Fish: ($\hat{Y}_2$) & $\partial Y_2/\partial X_i$ at ($\bar{X}$)[1] (kg)	Composite output: Technical coefficient	Composite output: ($\hat{Q}$) & $\partial Q/\partial X_i$ at ($\bar{X}$)[1] (pesos)
Intercept (constant)		–1.456	(3.33)	–3.199	(38.22)	2.148	(528.54)
X_1	0.45	1.166**	8.628	–0.116	–9.852	0.802**	941.98
X_2	21.96	–0.414**	–0.063	–0.294	–0.511	–0.406**	–9.77
X_3	1,070.00	0.255**	0.001	0.818*	0.029	0.408*	0.20
X_4	1.28	0.029	0.075	–0.142	–4.240	–0.047	–19.41
X_5	26.75	–0.212**	–0.026	–0.012	–0.017	–0.172*	–3.39
X_6	9.51	0.082	0.028	0.050	0.201	0.065	3.61
X_7	21.33	0.999*	0.156	0.520	0.932	1.010*	25.03
X_8	1.97	0.796*	1.345	0.470	9.118	0.753*	202.02
D_1		0.307		0.143		0.287	
Economies of scale ($\Sigma\beta_i$)		2.70		1.29		2.41	
R^2		0.93		0.88		0.96	
Adjusted R^2		0.89		0.82		0.94	
F-value		27.21*		14.58*		44.62*	

Note: D_1 = dummy variable representing Southern Luzon, Central Luzon being the benchmark

*Significant at 1%
**Significant at 10%

[1]Expected levels of production (figures in parentheses) and marginal productivities of inputs.

Table 15. Estimated per ha composite output and individual output production functions showing differences in productivity by location and marginal productivity of input in simultaneous rice-fish culture system, dry season, 1982.

Variables and description	Input geometric mean ($\bar{X}$)	Rice: Technical coefficient	Rice: ($\hat{Y}_1$) & $\partial Y_1/\partial X_i$ at $(\bar{X})^1$ (cavans)	Fish: Technical coefficient	Fish: ($\hat{Y}_2$) & $\partial Y_2/\partial X_i$ at $(\bar{X})^1$ (kg)	Composite output: Technical coefficient	Composite output: ($\hat{Q}$) & $\partial Q/\partial X_i$ at $(\bar{X})^1$ (pesos)
Intercept (constant)	–	2.739	(51.36)	–2.819	(119.51)	6.014	(5,859.55)
X_1	0.45	–	–	–	–	–	–
X_2	92.31	–0.322**	–0.179	–0.398**	–0.515	–0.341**	–21.64
X_3	4,994.00	0.098	0.001	0.875*	0.021	0.270*	0.31
X_4	4.46	0.097	1.117	–0.169	–4.528	0.039	51.24
X_5	84.73	–0.165*	–0.100	–0.040	–0.056	–0.132*	–9.13
X_6	21.90	0.054	0.127	0.052	0.283	0.042	11.24
X_7	82.26	0.395	0.247	0.413	0.600	0.415**	29.56
X_8	1.97	0.739**	19.266	0.584**	35.428	0.699*	2,079.10
D_1		0.307		0.258		0.243	
Economies of scale ($\Sigma\beta_i$)		0.90		1.32		0.99	
R^2		0.39		0.78		0.63	
Adjusted R^2		0.14		0.68		0.47	
F-value		1.55		8.27*		4.02*	

Note: D_1 = dummy variable representing Southern Luzon, Central Luzon being the benchmark

*Significant at 1%

**Significant at 10%

[1]Expected levels of production (figures in parentheses) and marginal productivities of inputs.

higher management requirements, biased management practices toward rice as the primary crop, the problem of poaching, and the non-adherence of adoptors to recommended practices.

A composite production function model was used as a way of simplifying the analyses of the complex input-output relationships of simultaneous rice-fish culture. The model, however, is only very useful if and only if the sole objective of production is to maximize profit without regard to the output mixture. The data used in estimating the relevant production functions were only farmers' recalled information on their respective rice-fish culture. Because of the need for more reliable data, the reported production functions should be considered only preliminary estimates of the true input-output relationships of simultaneous rice-fish culture under actual field conditions of farmers. The estimated functions do provide, however, some important information toward improving the technology. The various estimated production functions indicate which of the inputs are critical in simultaneous rice-fish culture. For example, it was found out that the stocking rates of fingerlings were far from the optimum level.

Finally, the study implies that there is a need for (a) support of the existing technology verification program; (b) intensified operation and closer monitoring of demonstration farms for integrated rice-fish culture; and (c) evaluation of the economic viability of recommended technologies and assessing the extent of technology adoption.

Acknowledgements

The author would like to acknowledge the Philippine Council for Agriculture and Resources Research and Development (PCARRD) and the International Center for Living Aquatic Resources Management (ICLARM) for the financial support of this study. Acknowledgement and special thanks go to the Center for Policy and Development Studies Executive Director Dr. Ramon L. Nasol and staff members Agnes Recto, Lorna Escueta, Evelyn Garcia and Rolando Corcolon for their invaluable contributions. Deep gratitude and appreciation is accorded to Dr. Aida R. Librero of PCARRD for her constructive suggestions on the original version of this manuscript. The author retains full responsibility of the views expressed herein.

References

Anon. 1974. Exploratory trial on rice-fish culture. Progress Report of the Freshwater Aquaculture Center. Central Luzon State University, Muñoz, Nueva Ecija. Philippine NSDB-Assisted Project No. 7103.

Banzon, M.A. 1982. Status of the rice-fish production program. National Food and Agriculture Council, Diliman, Quezon City. 8 p. (mimeo)

Coche, A.G. 1967. Fish culture in ricefields: a worldwide synthesis. Hydrobiologia 30(1): 1444.

Dela Cruz, C. 1980. Integrated agriculture-aquaculture farming systems in the Philippines with two case studies on simultaneous and rotational rice-fish culture, p. 209-223. *In* R.S.V. Pullin and Z.H. Shehadeh (eds.) Integrated agriculture-aquaculture farming systems. ICLARM Conference Proceedings 4, 258 p. International Center for Living Aquatic Resources Management, Manila and the Southeast Asian Center for Graduate Study and Research in Agriculture, College, Los Baños, Laguna, Philippines.

Fuss, M., D. McFadden and Y. Mundlak. 1978. A survey of functional forms in the economic analysis of production, p. 219-268. *In* Fuss, M. and D. McFadden (eds.) Production economics: a dual approach to theory and applications. Contribution to Economic Analysis. Vol. 2. North-Holland Publishing Co., Amsterdam.

Hicks, J. 1946. Value and capital. Clarendon Press, Oxford.

Hora, S. and T. Pillay. 1962. Handbook on fish culture in the Indo-Pacific region. FAO Fish. Biol. Tech. Pap. 14, FAO, Rome, 204 p.

Manacop, P. 1960. A proposal: program of research on rice-paddy-fish culture for the International Rice Research Institute. IRRI, Los Baños, Philippines. 16 p.

Mundlak, Y. 1962. Specification and estimation of multiproduct production functions. J. Farm Econ. 45: 433-443.

NFAC-MA. n.d. Rice-fish culture: Part I. Paddy culture of rice-fish and Part 2. Production of tilapia fingerlings in net enclosures and rice paddies. National Rice-Fish Culture Coordinating Committee. National Food and Agriculture Council, Ministry of Agriculture, Diliman, Quezon City.

Khoo, K.H. and E.S.P. Tan. 1980. Review of the rice-fish culture in Southeast Asia, p. 1-14. *In* R.S.V. Pullin and Z.H. Shehadeh (eds.) Integrated agriculture-aquaculture farming systems. ICLARM Conference Proceedings 4, 258 p. International Center for Living Aquatic Resources Management, Manila and Southeast Asian Center for Graduate Study and Research in Agriculture, College, Los Baños, Laguna, Philippines.

Temprosa, R. and Z.H. Shehadeh. 1980. Preliminary bibliography of rice-fish culture. ICLARM Bibliographies 1, 20 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

The Introduction of Integrated Backyard Fishponds in Lowland Cavite, Philippines

FRANK FERMIN

International Institute of Rural Reconstruction
Silang, Cavite
Philippines

FERMIN, F. 1985. The introduction of integrated backyard fishponds in lowland Cavite, Philippines, p. 151-164. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

This paper describes the process of re-introducing backyard fishponds in lowland Cavite in the Philippines, through an integrated approach to rural reconstruction known as the People's School System. This paper describes (1) the training process of Barangay Scholars at the People's School; (2) the adaptation of the technology by the Barangay Scholars and other adaptors in the village; and (3) a study on the economic returns and the impact of the technology on six small-scale fishfarmers. Patterns of adaptation by the Barangay Scholars and other farmers in the village are discussed, together with recommendations for future project expansion. Although typhoons and flooding affected some of the fishponds, the 14 Barangay Scholars were successful in involving an additional 45 farmers in family-operated integrated backyard fishponds. Water and manure supply are the major problems faced by the farmers. Although the program is still in its early stages, the economic prospects for the backyard fishponds and their contributions to household nutrition appear quite favorable.

Introduction

Backyard fishponds were introduced by the Philippine Government in the early 1950s to augment the meager income of farming families. This effort failed however, due to two factors: the use of an inferior tilapia species *(Oreochromis mossambicus)*, and the lack of sound technical know-how in tilapia culture. More than three decades have passed, yet the stigma of the backyard fishpond campaign in the 1950s has never been forgotten by farmers. In spite of this obstacle, two staff of the International Institute of Rural Reconstruction (IIRR) and four selected farmers from Dasmariñas and General Trias municipalities underwent a four-day training at the Freshwater Aquaculture Center (FAC) of the Central Luzon State University (CLSU) in May 1981 as a preliminary step to re-introducing backyard fishponds in lowland Cavite. This training was jointly conducted by the International Center for Living Aquatic Resources Management (ICLARM) and FAC-CLSU.

The four farmers who trained at the FAC tried out what they had learned on their own farms. This was done to provide demonstration sites for the planned Barangay (village) Scholar (BS) training, to share first-hand experiences in adapting a new technology and to identify and address location-specific problems.

The livelihood staff of the IIRR had previously identified potential in small-scale fish farming and had discussed this with a number of active Barangay Scholars in various livelihood disciplines. By sending a team of six people to the special training at FAC, IIRR gained new knowledge and skills to share with other farmers. Subsequently, a People's School (PS) training on fish farming was planned and then implemented by IIRR (see Flavier (1980) and Pernito (1980) for further details of the People's School concepts).

Before the PS training course in Inland Fish Culture was conducted, the following criteria were set for the program:

1. Training would be done with the active involvement of the local office of the Bureau of Fisheries and Aquatic Resources (BFAR) to insure long-term follow-up and the availability of inputs required to implement the technology.
2. The training curriculum would be approved by the training staff and a training manual would be developed. This was to insure that the training content was compatible with the objectives, that the content addressed the needs of the participants, and that the content and methodologies were appropriate to the educational levels and experiences of the participants.
3. Training would be scheduled at an appropriate time for application of the technology by the farmers when inputs such as fingerlings were available.
4. Orientation/training of trainors would be conducted to equip Barangay Scholars with capabilities and skills in imparting their knowledge to other farmers and Barangay Scholars.

In August 1982, the PS training on Inland-Fish Farming was conducted at IIRR; 13 people attended of which 10 were Barangay Scholars from Dasmariñas and General Trias. By the time the training was offered, a certain amount of dissemination of the new technologies had already taken place through the influence of the farmers trained at FAC-CLSU.

After the training, it was decided to revise and finalize the training manual for future PS training activities and for similar courses to be conducted by the BFAR. IIRR facilitators have also regularly visited and guided the BS to monitor and evaluate their own projects for improvement and so that IIRR could generate valuable information for sharing with other agencies.

Project Details

The IIRR inland fish farming project aims to help small farmers to supplement their meager income while at the same time provide fish for family consumption to address the nutritional need for protein. This paper describes three phases of the project, namely: (1) the training process of Barangay Scholars at the People's School, (2) the adaptation of the technology by the Barangay Scholars and other adaptors in the village, and (3) a study on the economic returns and the impact of the technology on six small-scale fish farmers.

The People's School Approach is used in the training process of Barangay Scholars. This approach is based on the principle that "outsiders can help but insiders must do the job". The People's School trains farmers and villagers as paraprofessionals. The trained villagers then become the diffusers of technology that are relevant to the needs of the village. In this type of training, the technology is simplified and adapted to suit the needs of farmers and their villages.

People's School Training

Pre-training activities

Promotional materials about the training on tilapia culture at the People's School were distributed to the village leaders in the 18 villages covered by the IIRR program. This was followed up by individual and group meetings with the village leaders to further explain the requirements for the training and to discuss appropriate criteria in the selection of the Barangay Scholars.

A training manual was prepared in consultation with FAC-CLSU and BFAR. Trainors were given orientation and training on how to become effective teachers. Resource persons were also recruited. Training fields were prepared and the commitment of BFAR to provide tilapia fingerlings after the Scholars were trained was obtained. Finally, the recruitment of the Scholars was completed.

The training

The Scholars were trained for a period of five days. During this training, 75% of the time was spent in the field at the fishponds and 25% in classroom instruction. The principle of "teach by showing, learn by doing" was adopted for this training. Three of the Scholars earlier trained in the FAC served as trainors together with the staff of FAC, BFAR and two IIRR specialists. The Scholars were taught not only about tilapia technology but were also provided knowledge and skills on how to become effective teachers in training other farmers.

The youngest Scholar was 16 years old while the oldest was 58; the majority of them were in the 30-37 years age bracket. Only one had previous experience in fish culture. Two were single and the rest were married. Their average landholding was 2.44 ha; only two owned their land. Five of the Scholars had only 3-7 years of schooling; five had 8-10 years and the remaining five had 11-14 years.

Adaptation of the technology by the scholars

After the Barangay Scholars completed their training at the People's School, they built their own fishponds in their own farms. They applied the knowledge and skills learned from the training to varying degrees. Realizing the need for team work and team spirit, they also organized themselves into the Cavite Fish Raisers Association (CFRA).

Project Site

The project areas were in two municipalities in Cavite: General Trias and Dasmariñas (see Fig. 1).

The villages in these two municipalities generally have similar characteristics:

Terrain	– almost level to gently rolling
Land use	– 80% planted to rice – 20% planted to secondary crops
Tenancy rate	– 70%-80% tenants
Source of water	– irrigation
Crop grown	– major crop: rice; secondary crops: corn and vegetables
Major source of income	– farming

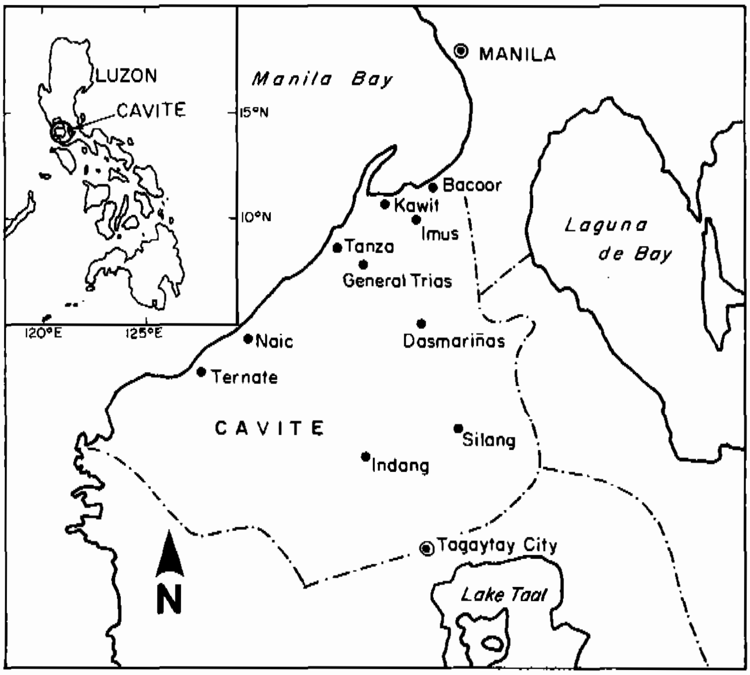


Fig. 1: Map of Cavite and its municipalities.

Pond Construction and Location: Most of the ponds were constructed in low areas near irrigation canals to facilitate water supply and to minimize water seepage. The ponds were constructed by first plowing the area. After plowing, the Scholars used their hands and a harrow to excavate the ponds and erect the dikes until the desired depth of the pond was reached. The depth of water in the ponds averaged about 0.5 m (Table 1). Working together or *Bayanihan* was practiced in the construction of all the ponds.

Preparation of the Pond: Of the six Scholars, only one fertilized his pond with chicken manure before the fingerlings were stocked. The others were not able to apply manure because their ponds were constructed only a day before the fingerlings were distributed.

The amount of manure applied by the Scholars averaged 100 kg for each 450 m^2.

Size of Ponds: The size of the Scholars' ponds ranged from 200 to 626 m^2, within the range of ideal size for backyard ponds of 100-1,000 m^2.

Water Supply: The source of water supply was from irrigation canals, with the system of water distribution on a rotational basis, weekly and bi-weekly, depending on the amount of water available. It was only during the rainy season that sufficient water supply was readily available. However, under normal weather conditions when there is no long dry season or drought, water shortage will not usually be felt until the month of February.

In general, therefore, there is usually enough time to raise tilapia in a period of six months if the ponds are stocked with fingerlings during the month of August.

Source of Fingerlings: The fingerlings were provided free by BFAR so that the Scholars

Table 1. The Barangay Scholars' (BS) pond size, depth of water, stocking rate, mortality rate, farm inputs, culture period and yields.

Item	Barangay Scholars						
	BS_1	BS_2	BS_3	BS_4	BS_5	BS_6	Average
Pond size (m^2)	350	450	200	624	626	513	460.5
Depth of water (cm)	36	46	36	45	44	48	42.4
Stocking rate/m^2 (no. of pieces)	2.85	2.22	2.5	2.56	2.39	2.92	2.6
Mortality rate (%)	7	.6	10.6	10	14	4.73	7.8
Total quantity of rice bran feeds (kg)	298	65	13	52	70	72	95
Kind of fertilizer and total amount applied (kg)							
14-14-14	6	–	–	–	5	–	1.8
16-20-0	4	–	–	–	–	–	0.7
Chicken manure	5.5	450	60	30	25	124	115.8
Hog manure	8	–	–	84	369	136	99.5
Carabao manure	8	–	–	–	–	–	1.3
Culture period (days)	205	134	120	194	150	194	166.2
Total yield							
Tilapia (kg)	71	99.5	27.5	80	93	98	78.2
No. of pieces	700	900	430	780	830	971	768.5
Snakehead (kg)	8	2	–	15	2	6	5.5
No. of pieces	44	1.5	–	49	7	28	21.6
Yield (kg/m^2)	0.23	0.23	0.14	0.15	0.15	0.20	0.18

could immediately start their projects after completing their training. It was estimated by the Scholars that the average size of fingerlings stocked was 30 mm. All Scholars stocked tilapia, *O. niloticus.*

Stocking Rate: The stocking density practiced ranged from 2.2 to 2.5 fingerlings per m^2. The main reason for the different stocking density was the inaccurate estimates made by the Scholars on the size of their ponds. The estimate was done prior to the construction of the pond which was their basis of determining the number of fingerlings ordered. Although they were aware of the lower recommended rate of stocking per m^2, the Scholars decided to keep extra fingerlings in their ponds to provide an allowance for the predators and for mortality.

Unfortunately after the training, four of the fishponds owned by the Scholars were washed out by a typhoon in early September 1982, less than two months after the tilapia fingerlings were stocked in the fishponds. Three other fishponds dried up due to the long drought in early October of the same year. As a result of these unexpected calamities, only six fishponds remained for growout and study purposes.

The fishponds of the Scholars were located at:

	No. of scholars
General Trias	
Buenavista	2
Pasong Camachile	1
Navarro	1
Dasmariñas	
San Jose	1
Paliparan	1
Total	6

Pond Fertilization: Chicken and hog manure were used by all the Scholars after stocking the fingerlings. One scholar applied carabao manure; two applied inorganic fertilizer (14-14-14 and 16-20-0) in addition to chicken and hog manure.

The rate of manure applied per m^2 varied from one pond to the other within the range 0.8 to 1.0 kg/m^2 and averaged 0.47 kg/m^2 for the total area of the six ponds (2,763 m^2). The two Scholars who used commercial fertilizer applied it at the rate of 1.0-1.7 kg/month.

Feeding: Rice bran was used for supplemental feeding of the tilapia. The amount of feed given per feeding by the Scholars ranged from 0.5 to 1.7 kg; feeding frequency also varied: once a day, weekly and twice a week. It was very seldom that the fish were fed twice a day. The time of feeding was usually in the early morning. The recommended quantity of feeds per feeding was from 1 to 2 handfuls of rice bran for every 400 fish. Three Scholars also experimented with *Azolla* as an additional feed supplement. However, they experienced that a certain period is reached when the fish start to dislike the *Azolla.* When that happened, the uneaten *Azolla* multiplied very quickly and covered the entire pond, reducing the oxygen supply in the pond. For this reason the Scholars did not continue to feed their fish with *Azolla.*

Harvesting and Marketing: The Scholars practiced either partial harvesting or complete draining of the pond. In partial harvesting, a net was used to catch the fish, with only the big fish selected for home consumption and for sale. Those Scholars who drained their ponds did so when tilapia buyers had been contacted. *Bayanihan* or helping one another was practiced, especially during complete drainage when more labor inputs were needed.

The ponds were harvested from 120 to 205 days after stocking, averaging 166 days culture period (Table 1) for the six ponds. The average yield for all six ponds was 78.2 kg of tilapia and 5.5 kg of snakehead *(Channa striata* known locally as *dalag).* The total number of tilapia fingerlings produced that were given away to others was 10,830. Most of the fingerlings were collected before harvesting so that the problem of overpopulation in the pond was minimized, though other fingerlings were also collected during harvest time.

Most of the tilapia that were not consumed at home were sold in the village; marketing of tilapia was not a problem.

Adaptation of the technology by other farmers

The knowledge and skills acquired were shared with village mates through the demonstration fishponds of the Barangay Scholars. Farmers who had trust and confidence in the Scholars and who foresaw a potential in backyard fish farming started the project at the same time as the Scholars. In order not to dampen the enthusiasm of the other farmers, the Scholars increased their fingerling orders to share some of the fingerlings they obtained from BFAR. Barely three months after the Scholars had stocked their ponds, other farmers started asking for fingerlings from them as they started digging their own fishponds. This happened in the villages where the ponds were not so much affected by typhoons and floods. The Scholars also made periodic visits to other adaptors and provided some technical advice. The farmers were also invited by the Scholars to attend their monthly meetings.

An additional 45 farmers were influenced by the Scholars (Table 2), although one Scholar was not able to influence a single farmer. One reason was that the farmers did not see any sign of success as the Scholar's pond had been flooded and only a few fingerlings were left. Another reason could have been that this particular Scholar was very young, only 16 years old. On the other hand, another Scholar was able to influence 12 other farmers.

Follow-up activities of IIRR facilitator & BFAR

The Scholars and other adaptors were visited at least twice a month. The visitations were done with enough time for each Scholar and other adaptors to:

- study their problems and personal difficulties and assist in their solution;
- keep their spirits high;
- provide additional technical guidance;
- provide assistance in record keeping.

Meetings were usually held in the villages of Barangay Scholars on a rotation basis. In these meetings, the following were taken up:

- visit the Scholar's project and those of other adaptors to provide the opportunity for them to see each other's projects, learn some insights and provide advice whenever necessary;
- provide technical information;
- discuss progress/status of project;

Table 2. Number of Scholars trained at IIRR in relation to number of farmers influenced by them to engage in backyard fishponds and the average pond size of those influenced.

Villages	No. of scholars	Other farmer adaptors	Average size of ponds (m^2)
General Trias, Cavite			
Buenavista	3	8	413
Navarro	1	1	200
Pasong Kawayan II	1	0	
Pasong Camachile	1	2	350
Tinungan	1	12	100
Andingan	1	2	270
Subtotal	8	25	
Dasmariñas, Cavite			
San Jose	1	4	300
Paliparan	3	12	241
Burol	1	2	155
Subtotal	5	18	
Amadeo (upland area)			
Pangil	1	2	100
Total	14	45	

- permit open discussion of views/ideas, experiences, difficulties, success and failures for the shared benefit of all BS.

Evaluation of the Projects

Technical matters

One problem encountered by the Scholars was the lack of chicken and hog manure; another problem was the transporting of manure to the fish farm. This was experienced by Scholars whose ponds were located away from the village. Among these six Scholars, only one raised pigs. In most of the villages, very few families have pigs that feed on commercial feeds. There are other families raising one or two pigs fed purely with rough rice bran, sometimes cooked with sweet potato leaves. The Scholars seemed to be reluctant to use the manure because they were of the belief that such manure has little or no effect at all in inducing the growth of plankton in comparison with the manure of pigs fed with commercial feeds. This belief was also true for carabao or cow manure although it too was available.

It was experienced by some of the Scholars that even if they had agreement with pig owners to collect the manure, the owners would clean the pigpens if the Scholar was late in collecting it. The Scholars appeared convinced that chicken and hog manure can encourage the growth of plankton, but chicken manure was quite difficult to obtain. Only very few villages have poultry (broiler) projects where manure can be collected; only one or two families raised from 50-100 birds. Consequently, chicken manure had to be obtained from other towns or villages. The problem of the lack of manure was more serious in villages where demand increased as other farmers were also motivated to grow tilapia in backyard fishponds. In spite of the fact that the recommended quantities of manure per m^2 were not applied, the Scholars were still able to raise marketable size of tilapia. A 65% average survival rate was obtained, and fish averaged 102 g at harvest (Table 1).

Another major problem encountered by the Scholars was the lack of water from the irrigation network. They started experiencing this problem during the month of October 1982 and it became more and more serious through the tilapia culture period. The water shortage was attributed to the longer than usual dry season that year. The problem of water supply not only affected the maintenance of the desired depth of pond water (0.5 m), but also forced some Scholars to harvest their ponds earlier than they would have done otherwise.

Nevertheless, the project benefited the Scholars and other farmers in terms of fish for their emergency needs, since they had insufficient cash for baptisms and birthdays of their children and could now serve fish. It was also observed that tilapia was becoming a delicacy in some of the villages; during social gatherings, tilapia was the primary food served.

The fish culture project appears also to have contributed to an increase in the protein intake of the Scholars and their families. Of the six Scholars, three either consumed or gave away their fish and thus had no cash income. In an indirect way, the project also contributed to the increase in the protein intake of the community since approximately 90% of the tilapia were sold to co-villagers for home consumption. The project not only provided fish for the family but also further strengthened neighborhood ties, unity and cooperation, as Scholars gave away fish and fingerlings and held tilapia feasts especially during harvest time.

The early diffusion of the technology even when the project was still in the trial stage may be attributed to the influence of the Scholars and also to the *gaya-gaya* (imitate) attitude in the village. Of the 14 Scholars, eight were still engaged in the project in July 1983 while the rest, although still interested, could not start their projects due to lack of water. Of the 45 adaptors over 40% were undertaking tilapia projects as of the same date, while the others were still interested, though up to this time they still had no water.

Backyard fish farming is relatively cheap and simple, especially if family labor and other farm inputs (resources) are utilized. Some farmers claim that fish farming is better than pig and poultry raising. A major factor in success is the application of animal manure in proper amounts. In sum, then, tilapia culture seems to be simple and practical; however, the lack of technical know-how, and more importantly the lack of inputs, can result in the failure of the project in any community where it is being implemented.

Economic Analysis

The Barangay Scholars incurred both cash and non-cash expenses to raise their tilapia. The major cash expenses were for feeds, land rental and *bayanihan* meals for those who provided labor. The major non-cash expense was the labor input of the Scholar and his family. The quantities and value of these major inputs are shown for each fishpond in Tables 3 and 4. The average labor input for initial pond construction and the first grow-out cycle (average length of 166 days) was 11 man-days per fishpond. At an imputed value of ₱15/day, average labor cost per fishpond was ₱165.

Fingerlings were provided free by BFAR; organic fertilizers were obtained from the Scholars' or neighbors' farms free also. Total cash expenses per fishpond were ₱194. Income foregone (opportunity cost) of operating capital for the 166-day period was ₱6. Thus, total cash and non-cash expenses for the average fishpond were ₱365 for a single grow-out cycle.

The fishponds on average produced 78.2 kg of tilapia fingerlings (1,805 pieces) and snakehead (*Channa striata,* 5.5 kg), the bulk of which were either consumed by the Scholar and his family or given away (Table 5). On average, the Scholars realized ₱310 from sale of tilapia; the imputed value of the fish either consumed or given away was three times as high.

These expenses (cash and non-cash) and income (cash and in kind) are summarized in Table 6. Not only was net cash income positive (₱106), for the single production cycle but more importantly, the average fishpond yielded a total cash and non-cash income above cash expenses of more than ₱1,100. This amount represents the net return to the inputs (labor and capital) of the Barangay Scholar and his family. Even if one imputed value to labor (at ₱15/man-day) and to capital (9% interest foregone), the pure economic profit from the average pond was ₱951.

Finally, if the Scholars had paid cash for the average 1,183 fingerlings stocked (valued at ₱118), the pure economic profit would still have been ₱833. This is primarily due to the value of fish consumed and given away, however; their net cash income would have been negative (minus ₱12).

All in all, then, the experience of these six Barangay Scholars indicates that tilapia farming, though not without problems, can still provide positive cash income and positive returns to the fish farmers' own labor and capital inputs. Tilapia farming is also attractive because the initial capital expense and operating capital requirements are not substantial. Supply of fertilizers and irrigation water remain major problems, however.

Conclusions and Recommendations

Tilapia fishfarming appears to be valuable not only for the added cash income it produces, but also for the added fish protein that

Table 3. Labor input (by fishpond in pesos) for pond construction and first grow-out cycle based on Barangay Scholar records. Labor cost imputed at ₱15/man-day. (₱8.50 = US$1.00 in 1982)

Barangay scholar	Pond construction		Stocking		Pond maintenance		Feeding		Hauling and fertilizing		Harvesting		Irrigation		Total labor		*Bayanihan* meal expenses[1]	Total labor expenses
	Days	Cost	Days	Cost	Days	Cost	Days	Cost	Days	Cost	Days	Cost	Days	Cost	Days	Cost		
No. 1	3.0	45.00	0.02	0.31	1.00	15.00	2.00	30.00	3.00	45.00	1.50	22.50	1.50	22.50	12.0	180.31	37.50	217.81
No. 2	5.0	75.00	0.02	0.30	2.00	30.00	0.42	6.25	2.69	40.42	1.50	22.50	2.50	37.50	14.1	211.97	10.00	221.97
No. 3	2.0	30.00	0.02	0.26	0.08	1.25	0.14	2.03	1.67	25.00	1.00	15.00	0.12	1.87	5.0	75.42	20.00	95.42
No. 4	6.0	90.00	0.02	0.30	2.00	30.00	0.33	5.00	3.33	50.00	2.00	30.00	6.00	90.00	19.7	295.30		295.30
No. 5	2.0	30.00	0.01	0.10	0.54	8.12	0.32	4.76	0.96	14.39	2.50	37.50	0.08	1.25	6.4	96.12	50.00	146.12
No. 6	5.0	75.00	0.01	0.16	0.33	5.00	0.42	6.37	0.27	4.01	2.50	37.50	0.17	2.50	8.7	130.54		130.54
Average	3.8	57.50	0.02	0.24	1.0	15.00	0.6	9.00	2.0	30.00	1.8	27.50	1.7	25.94	11.0	164.94	19.58	184.53

[1] Meals for neighbors and friends who provided free labor.

Table 4. Non-labor inputs (by fishpond in pesos) for first grow-out cycle based on Barangay Scholar records. Cash cost for inorganic fertilizers and feeds. Organic fertilizers obtained free from the farm or neighbors; fingerlings obtained free from BFAR. (₱8.50 = US$1.00 in 1982)

	Fertilizer				Feeds				Fingerlings			Other expenses		
Barangay Scholar	Kind	Quantity (kg)	Unit price	Cost	Own or purchased	Quantity (kg)	Unit price	Cost	Quantity (pcs)	Unit price	Cost	Irrigation fee	Land rentals	Total cost
No. 1	16-20-0	4	2.00	8.00	Own	298	1.00	298.00	1,000			8.93	42.00	368.93
	14-14-14	6	2.00	12.00										
	Chicken	5												
	Hog	8												
	Carabao	16												
No. 2	Chicken	450			Purchased	65	1.00	65.00	1,000			11.47	54.00	130.47
No. 3	Chicken	60			Purchased	13	1.00	13.00	500				24.00	37.00
No. 4	Chicken	30	free		Purchased	52	0.61	31.72	1,600	free		15.91	74.88	122.51
	Hog	84												
No. 5	Chicken	25			Purchased	70	1.00	70.00	1,500			15.96	75.12	171.08
	Hog	369												
	14-14-14	5	2.00	10.00										
No. 6	Chicken	124	free		Purchased	72	1.95	140.40	1,500			13.08	61.80	215.28
	Hog	136												
Average cash cost of non-labor inputs:				5.00				103.02				10.89	55.30	174.16

Table 5. Value of total production (in pesos) from the six Barangay Scholar fishponds (single grow-out cycle only) showing cash income from tilapia sales (if any) and non-cash value of fish and fingerlings either given away or consumed. (₱8.50 = US$1.00 in 1982)

	Tilapia sales				Tilapia given away/consumed				Snakeheads given away/consumed				Fingerlings given away			Value subtotals		Value of
Barangay Scholar	Pieces	Quantity (kg)	Price/ kg	Amount (sales)	Pieces	Quantity (kg)	Price/ kg	Total value	Pieces	Quantity (kg)	Price/ kg	Total value	Pieces	Price/ piece	Total value	Sales	Given or consumed	total production
No. 1	283	29	12.00	348.00	417	42	12.00	504.00	44	8.0	20.00	160.00	1,800	0.10	180.00	348.00	844.00	1,192.00
No. 2					900	99.5	13.00	1,293.50	2	1.5	20.00	30.00	1,200	0.10	120.00		1,443.50	1,443.50
No. 3					430	27.5	12.00	330.00					1,600	0.10	160.00		490.00	490.00
No. 4	570	59	15.00	885.00	210	21	15.00	315.00	49	15.0	20.00	300.00	1,500	0.10	150.00	885.00	765.00	1,650.00
No. 5					830	93	13.00	1,209.00	7	2.0	20.00	40.00	2,500	0.10	250.00		1,499.00	1,499.00
No. 6	470	48	13.00	624.00	501	50.5	13.00	656.50	28	6.0	20.00	120.00	2,230	0.10	223.00	624.00	999.50	1,623.50
Average	220	22.7		309.50	548	55.6		718.00	22	5.4		108.33	1,805		180.50	309.50	1,006.83	1,316.33

becomes available. Several insights have been gained from this Barangay Scholar project:

1. Technical resource persons disseminating technology (e.g., tilapia culture) to the rural people should not only be equipped with theoretical knowledge, but they should also have first-hand practical experience in fishpond operation.

Table 6. Economic analysis for the average Barangay Scholar tilapia fishpond; one grow-out cycle averaging 166 days. (₱8.50 = US$1.00 in 1982)

	₱
Gross income	
• cash: value of fish sold	310
• noncash: value of fish consumed by household or given away (tilapia, tilapia fingerlings and snakehead)	1,006
Total cash and non-cash income	1,316
Expenses	
• cash expenses	
– feeds	103
– land rental	55
– *bayanihan* meals	20
– irrigation fee	11
– fertilizers	5
– fingerlings	free from BFAR
Subtotal	194
• non-cash expenses	
– imputed (opportunity) value of own and family labor	165
– opportunity cost of operating capital (9% prorated over 166 days)	6
Subtotal	171
Total cash and non-cash expenses	365
Net cash income	
Cash income minus cash expenses	116
Net return to own inputs (labor and capital)	
Total cash and non-cash income minus cash expenses	1,122
Pure economic profit	
Total cash and non-cash income minus total cash and non-cash expenses	951

2. Development of a curriculum should not only focus on the technical aspects but also on the practical side with consideration for constraints (e.g., fertilizer shortage) likely to be faced by the fishfarmers.
3. Training should be short, simple and practical but emphasizing the most essential components of tilapia culture.
4. Follow-up training is an important aspect.
5. Collaboration of different agencies is essential.
6. The trained Barangay Scholars under the People's School system can effectively play the role of an extension worker in disseminating their newly acquired technology to other farmers in their village.

The following recommendations should be considered:

1. Further in-depth study of the project for the following reasons:
   a. This is the first crop of Barangay Scholars and also the first time that they adopted the technology.
   b. The sample size used in the study is quite small.
2. As the project was found to be profitable that:
   a. the project be adopted in areas with abundant and good supply of water to further test the viability and the economic results of the project.
   b. the project be continued with the Scholars in Cavite in the villages where water is not so much a problem to generate more knowledge and skills on backyard fishpond technology.
3. Loans be extended to the adaptors to finance their piggery or poultry projects. This could minimize the problem of inadequate source of animal manure for the fishponds.
4. Farmers be encouraged to utilize carabao, cow and other organic fertilizers suitable for use in fishponds.
5. Record keeping be a primary concern; a sense of its importance needs to be understood by farmers.

Acknowledgements

Acknowledgement is extended to Lyn Capistrano for editing the report; to Dr. John Batten for finalizing the project proposal; to Kamal Malhotra, Dr. Ed Reed, Bobby Kasala, Ed Calayag and Johnny Jasa, Jr. for helping in the economic analysis of the project.

The author highly appreciates the inspiration, support and encouragement extended by Dr. Juan M. Flavier, Dr. Tony A. de Jesus and Mr. Menandro S. Pernito of the International Institute of Rural Reconstruction; Dr. Dennis R. Labayen of Outreach International; and all those who helped in the preparation of the paper.

References

Flavier, J.M. 1980. A people's school in the Philippines. Rural Reconstr. Rev. 2: 2-5.

Pernito, M.S. 1980. The people's school system: an integrated approach to rural reconstruction. Rural Reconstr. Rev. 2: 6-10.

Status, Potential and Needs of Tilapia Culture in Panay Island, Philippines

VALERIANO L. CORRE, JR.

University of the Philippines in the Visayas
College of Fisheries
Brackishwater Aquaculture Center
Leganes, Iloilo
Philippines

CORRE, V.L. JR. 1985. Status, potential and needs of tilapia culture in Panay Island, Philippines, p. 165-173. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

There are three tilapia species cultured in Panay Island, Philippines: *Oreochromis mossambicus, O. niloticus* and red tilapia. The industry is in its infancy. The total area under tilapia culture on Panay Island is 102 ha (for freshwater ponds and rice-fish farms) but there is potential for the expansion of tilapia culture in the developed brackishwater fishponds of Panay Island which total 41,534 ha. The total tilapia production in 1982 was about 21 tonnes, while production of fingerlings exceeded one million in 1982. However, seed production is very crude and traditional and there are as yet no specialist hatchery operators.

Large tilapia (> 100 g) are sold in the major city markets on the island while the smaller fish produced from rice fields are seldom sold in the market. Limited consumer acceptance of tilapia and lack of regular supply of fingerlings are some of the main problems constraining the expansion of tilapia culture on Panay Island at the present time. Also, use of insecticides and multiple cropping of rice which shortens the growing period have limited the adoption of rice-fish culture.

Introduction

The first recorded tilapia *(O. mossambicus)* introduction to the Philippines was in 1950 but the fish did not gain wide acceptance until recently when *O. niloticus* became available. Today tilapia is highly recognized as a table fish and even commands a market price higher than milkfish, the traditional cultured fish of the Philippines. Among aquaculturists in this country today, especially in the Luzon area, tilapia is emerging as one of the most important cultured fish species in the freshwater environment. Because tilapia eat vigorously and feed well on natural aquatic food or supplemental feeds and at the same time are low in the food chain, their culture in ponds, pens and cages is very promising.

In Panay Island, which comprises the four provinces of Aklan, Antique, Capiz and Iloilo (Fig. 1), the brackishwater fishpond industry is well developed and tilapia is regarded as nuisance fish. Milkfish and shrimp are the main species for culture and tilapia is only a subsidiary crop separated after harvest. Tilapia culture is confined to freshwater environments of the island, i.e., either ponds or rice paddies.

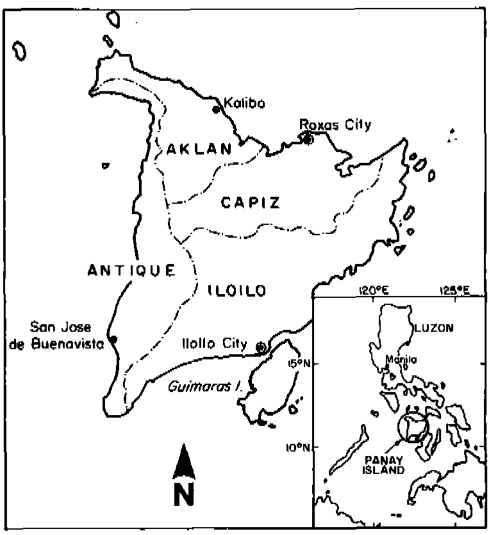


Fig. 1. Map of Panay Island showing its four provinces–Aklan, Capiz, Antique and Iloilo.

This paper reports on an attempt to determine the status and potential of tilapia culture on the island of Panay. The paper also identifies the important problems and needs of the Panay tilapia industry. Data were gathered through a series of personal interviews by the author and from the regional office of the Bureau of Fisheries and Aquatic Resources (BFAR).

Area Under Tilapia Culture

Brackishwater

The total area of brackishwater fishponds in Panay Island in operation (privately owned or government leased) covered a total area of 41,534 ha which is about 20% of the total productive fishponds in the Philippines (Table 1). This area is primarily devoted to milkfish, prawn or shrimp culture and tilapia is only an additional crop during harvest.

At least one private fishpond operator has cultured tilapia *(O. mossambicus)* in brackishwater; while at the Brackishwater Aquaculture

Table 1. Area of brackishwater fishponds in operation and total production in the provinces of Panay Island.[1]

Province	Privately owned (ha)	Government leased (ha)	Total (ha)	Production (t/yr)	Production (kg/ha)
Aklan	1,070	9,724	10,794	12,679	1,175
Antique	517	363	880	546	620
Capiz	12,833	2,332	15,165	21,540	1,420
Iloilo	10,914	3,781	14,695	24,555	1,671
Panay Island total	25,334	16,200	41,534	59,320	1,428

[1]Based on Region VI Fisheries Statistics (1982), Bureau of Fisheries and Aquatic Resources (BFAR), Iloilo City.

Center (BAC) of the University of the Philippines in the Visayas (UPV), Leganes, Iloilo, *O. niloticus* was grown to harvestable size (> 100 g) in 90 culture days in this same environment (Biona 1981; Corre 1981; Camacho et al. 1982). Therefore, while commercial tilapia (i.e., *O. mossambicus* and *O. niloticus)* culture in brackishwater is almost nil, it appears promising.

Freshwater

Tilapia is deliberately cultured only in freshwater areas of the island. Fishponds and rice paddies (rice-fish farms) are used in its culture. The total area of developed freshwater fishpond is only about 40 ha (Table 2), with half of this area in Iloilo Province. There are approximately 62 ha of rice-fish farms, with over half located in Antique Province.

Culture Systems

The culture of tilapia on the island is thus concentrated in freshwater ponds and rice paddies. Production in these systems is highly seasonal: culture is only done during the rainy season. These ponds and rice paddies are usually dry during summer (April-June) except in those areas where large water impoundments exist. The tilapia being cultured are the following: *O. mossambicus, O. niloticus* and red tilapia (taxonomy presently unclear). Monoculture of tilapia with little supplemental feeding (i.e., rice bran and other agricultural by-products) is the culture technique being used by most fishfarmers, although one fishfarmer in Batan, Aklan, is doing polyculture of *O. mossambicus,* Thai catfish and mudfish. A listing of these and other tilapia farms by province is shown in the appendices to this paper.

Based on BFAR data, production from these systems varies considerably. In Antique rice paddies, the annual tilapia production ranged from 35 kg/ha to 400 kg/ha and in Aklan, from 100 kg/ha to 500 kg/ha. No production records exist for Iloilo and Capiz Provinces. For Aklan freshwater ponds, annual tilapia production ranged from 15 kg/ha to 2,000 kg/ha and in Capiz from 150 kg/ha to 1,250 kg/ha. No production records exist for Iloilo and Antique Provinces.

Brackishwater culture of Nile tilapia *(O. niloticus)* is still in the experimental stage. Culture of this fish at an experimental facility for 90 days, given supplemental feeds and stocked at a density of 10,000/ha yielded an average of 1,000 kg/ha (Biona 1981; Corre 1981). Pen and cage techniques are also being tested by BAC.

Tilapia Hatcheries

Tilapia hatcheries are centrally located in areas where culture of this fish is developed. The estimated annual fingerling production from these hatcheries exceeds 1,000,000 (Table 3). According to the owners of these

Table 2. Freshwater fishponds and rice-fish farms in operation by province.

Province	Fishpond (ha)	Rice-fish farms (ha)
Aklan	5	10
Antique	11	37
Capiz	2	13
Iloilo	21	3
Panay Is. total	39	63

hatcheries, the breeders (Nile and red tilapia) were initially supplied by the BFAR Region VI Demonstration Farm at Molo, Iloilo City, Iloilo. Others were brought directly from Luzon (from Central Luzon State University, Muñoz, Nueva Ecija, or from tilapia growers in Laguna de Bay).

All of the hatcheries visited, except the BFAR Region VI Demonstration Farm and BAC, Iloilo, used the traditional pond method. The tilapia breeders are stocked in ponds at various male to female ratios and no specific stocking density. After a month or so, the fry or fingerlings are collected from time to time using a seine dragged across the pond. The fry or fingerlings collected are placed in *hapas* (small net enclosures) for further culture, or sometimes for holding purposes only. With this method, the age and sizes of the fingerlings vary considerably. The fish are also often damaged during seining.

At the BFAR Region VI Demonstration Farm, the *hapa* method is used for tilapia fingerling production. The size of the *hapa*

Table 3. Location of hatcheries and estimated *Tilapia nilotica* fingerling production in Iloilo Province (1983).

Owner	Location	Type of ownership	Area (ha)	Estimated annual fingerling production (pieces)
Perry Monfort	Barasan, Pototan	Private	4.50	40,000
Atty. Angel Salcedo	Sara, Iloilo	Private	4.00	500,000
Sulficio Estares	Linao, Btac. Nuevo	Private	1.00	50,000
Vivencio de los Santos	Agkuwayan, Btac. Nuevo	Private	1.00	25,000
Myron Cenazora	Tuburan, Pototan	Private	0.50	65,000
Gregorio Parra	Somkon Ilawod, Pototan	Private	0.10	20,000
Miguel Callado	San Miguel, Iloilo	Private	0.10	Undetermined
Cornelio Gavieta	Lubacan, Guimbal	Private	0.10	60,000
BFAR Region VI Demonstration Farm	Molo, Iloilo City	Government	0.05	85,000
Eugenio Torrento	Buyuan, Tigbauan	Private	0.05	15,000
Oscar Garin	Sta. Rosa, Guimbal	Private	0.05	Undetermined
Tomas Geal	Sta. Rosa, Guimbal	Private	0.05	Undetermined
Rizal Elem. Sch.	Rizal, Pototan	Government	0.05	60,000
Tuburan Elem. Sch.	Tuburan, Pototan	Government	0.04	Undetermined
UPV-BAC	Leganes, Iloilo	Government	0.01	Undetermined
Total			11.6	≈1 million

usually measures 2 x 1 x 1 m or 2 m^3, with the size of the mesh depending on the size of the broodfish held inside the *hapa*. Tilapia breeders are stocked at a 1:3 male to female ratio at a maximum of 16 breeders/m^3. The fry are collected early in the morning and placed in separate *hapas* or nursery ponds for further rearing to fingerling size. In this method, fingerlings produced are uniform in age and size.

Tilapia fingerlings are produced at BAC using three methods, namely, *hapa*, pen and pond culture. Sex ratios for these three methods are maintained at 1:3 male to female. Stocking density for breeders ranges from 16 to 20/m^3 *(hapa)*, 1/m^2 (pen) and 2/m^2 (pond), respectively.

Markets and Estimates of Prevailing Prices

Marketing channels

The locations of fish markets on Panay Island are shown in Table 4. Iloilo City (Iloilo Province) and Roxas City (Capiz Province) are the main outlets for fish on Panay Island. The two cities have sufficient transport and preservation facilities to service all of the fishpond operators. The fish (mostly milkfish) is channeled through brokers, then transferred to other brokers, to wholesalers and finally to retailers. For tilapia, producers sell their fish directly to wholesalers, who sell to retailers. Finally the product is sold to consumers in the marketplace.

Prevailing prices

The price of tilapia per kg varies with the size of the fish. In 1982-1983, bigger tilapia (> 100 g) retailed for ₱8-12/kg regardless of the season. Smaller fish (< 50 g) are very seldom sold in the market but are consumed by the producer or the family. Panay Island consumers generally prefer and are willing to pay more for marine fish and milkfish.

Problems and Needs of the Industry

Several problems have contributed to the slow development of tilapia culture. The main

Table 4. Location of fish markets in Panay Island by province.

Iloilo	Capiz	Antique	Aklan
Iloilo Central Market	Poblacion Pilar	Poblacion San Jose	Poblacion New Washington
Iloilo Supermarket	Poblacion Pres. Roxas	Poblacion Anini-y	Poblacion Kalibo
La Paz Public Market	Pontevedra	Semirara	Poblacion Numancia
Arevalo Public Market	Panay	Poblacion Tibiao	Poblacion Batan
Molo Public Market	Ivisan	Poblacion Pandan	
Oton Public Market	Roxas City	Poblacion Libertad	
Tigbauan Public Market	Mambusao	Poblacion Lawa-an	
Guimbal Public Market	Dumarao	Poblacion Patnongon	
San Joaquin Public Market	Dumalag	Poblacion Bugasong	
Miag-ao Public Market	Jamindan	Poblacion T. Fornier	
Zarraga Public Market	Maayon	Poblacion Barbaza	
Leganes Public Market	Sigma	Poblacion Belison	
Dumangas Public Market		Poblacion Hamtic	
Barotac Nuevo Public Market		Poblacion Sebaste	
Barotac Viejo Public Market			
Ajuy Public Market			
Binon-an Batad Public Market			
Estancia Public Market			
Balasan Public Market			
Carles Public Market			

problems revealed by producers and other observers during the survey were:

1) the lack of a regular and reliable supply of tilapia fingerlings;
2) the adverse effects of advanced technology in rice production, such as the application of pesticides, herbicides and fungicides necessary with the use of high yielding varieties;
3) the concept of multiple cropping in rice cultivation which leaves little time for fish culture because of the shorter time that there is water in the rice fields;
4) the lack of suitable technology for tilapia culture either in freshwater or brackishwater environment; and
5) problems in marketing and acceptability of the fish by the people.

To solve the problems mentioned and to overcome constraints to development of tilapia culture on Panay Island, the following steps are recommended:

1) increase the number of hatcheries to increase fingerling supply;
2) conduct research on effects of pesticides on fish flesh (e.g, is it accumulated?);
3) provide more information on recommended stocking practices;
4) increase the contact that extension sources have with prospective and current tilapia farmers.

In conclusion, tilapia culture in Panay Island is in its infant stage only.

References

BFAR. 1982. Fisheries Statistics for Region VI. Bureau of Fisheries and Aquatic Resources, Iloilo City, Philippines.

Biona, H.D. Sr. 1981. The effects of stocking density on the growth, survival and reproduction of intensively fed Nile tilapia in brackishwater ponds. University of the Philippines in the Visayas, Iloilo City. M.S. thesis.

Camacho, A.S., V.L. Corre, Jr. and E.S. Tubongbanua. 1982. Use of agricultural by-products for tilapia production III. Evaluation of the levels of fiber for fish pellets. Technical report. Brackishwater Aquaculture Center, University of the Philippines in the Visayas, College of Fisheries, Iloilo City.

Corre, V.L. Jr. 1981. Culture of Nile tilapia in brackishwater fishponds using supplemental feeds containing various levels of protein. University of the Philippines in the Visayas, Iloilo City. M.S. thesis.

Appendix Table 1. Operator, location, farm area, species cultured and production of freshwater fishponds in Antique (1983).

	Name of operator	Location	Area (ha)	Species cultured	Ave. annual production (kg)
1.	Dominador Gimotea	Esperanza, Culasi	1.00	*O. niloticus*	350
2.	Jose Dy	Esperanza, Culasi	3.00	*O. niloticus*	1,050
3.	Paking Magdaug	Jalandoni, Culasi	0.03	*O. niloticus*	12
4.	Juanito Escaner	Sinaja, Belison	0.52	*O. niloticus*	82
5.	Paterno Ardeño	Sinaja, Belison	0.06	*O. niloticus*	21
6.	Delima Elem. School	Delima, Belison	0.03	*O. niloticus*	12
7.	Mr. Solis	Poblacion, Belison	0.05	*O. niloticus*	175
8.	Rodolfo Gentica	Bagumbayan, San Jose	0.06	*O. niloticus*	21
9.	Lilia Yasay	Badiang, San Jose	0.50	*O. niloticus*	175
10.	Luis Garfin	Sibalom, Antique	0.50	*O. niloticus*	175
11.	Florencio Tandug	Bunglo, Sibalom	0.50	*O. niloticus*	175
12.	Roman Vidad	Buljo, Sibalom	2.00	*O. niloticus*	70
13.	Aurelio Gamad	Buljo, Sibalom	2.00	*O. niloticus*	70
14.	Loreto Mascaso	Danao, Sibalom	3.00	*O. niloticus*	1,050
15.	Rustico Tebañosa	Poblacion, Sibalom	2.00	*O. niloticus*	70
16.	Manuela Mamales	Katinggan, Sibalom	1.00	*O. niloticus*	35
17.	Eustaquio Olivaros	Lanag, Hamtic	1.50	*O. niloticus*	525
18.	Ruding Haro	La Paz, Hamtic	4.00	*O. niloticus*	1,400
19.	Eugenio Tungua	Badiang, San Jose	1.00	*O. niloticus*	35
20.	Benjamin Manano	Batbat, Pandan	1.00	*O. niloticus*	35
21.	Roque Cordero	Igdaquit, Sibalom	0.04	*O. niloticus*	13
22.	Vicente Mabaquiao	Buang, Hamtic	3.00	*O. niloticus*	1,050
23.	Atty. Estoya	Sebaste, Antique	0.50	*O. niloticus*	175
24.	Isidro Padilla	Sebaste, Antique	0.50	*O. niloticus*	175
25.	Sevelino Bot	Poblacion Patnongon	0.50	*O. niloticus*	175
26.	Cresencio Brajo	Beri, Barbaza	0.25	*O. niloticus*	87
27.	Godofredo Espartero	Beri, Barbaza	0.25	*O. niloticus*	87
28.	Mamerto Marquez	Beri, Barbaza	0.25	*O. niloticus*	87
29.	Vicente Lantican	Ipil, Barbaza	0.50	*O. niloticus*	175
30.	Daniel Ganza	Valdevarrama	1.00	*O. niloticus*	35
31.	Rosendo Bahaw	Natividad, Tibiao	1.00	*O. niloticus*	35
32.	Edison Mariano	Bugo, San Remegio	1.00	*O. niloticus*	35
33.	Vevencio Mostacho	Bugo, San Remegio	1.00	*O. niloticus*	35
34.	Carlos Botyong	Bugo, San Remegio	1.00	*O. niloticus*	35
35.	Nelson Singco	Cubay, Bugasong	1.00	*O. niloticus*	35
36.	Mario Arguelles	Talisay, Bugasong	0.50	*O. niloticus*	175
37.	Cornelio Odi	Cubay, Bugasong	1.00	*O. niloticus*	35

Appendix Table 2. Operator, location, farm area, type of ownership, species cultured and production of freshwater fishponds in Aklan (1983).

Name of operator	Location	Area (ha)	Type of ownership	Species cultured	Ave. annual production (kg)
1. Conrado Fernandez	Silakat, Nonoc Leso	1.00	Private	*O. niloticus*	Undetermined
2. Jose Rimano	Navitas, Malinao	1.00	Private	*O. niloticus*	Undetermined
3. Moises Villegas	Rosario, Malinao	0.25	Private	*O. niloticus*	Undetermined
4. Madalag Elem. School	Poblacion, Madalag	0.01	Government	*O. niloticus*	200
5. Rodolfo Laurenio	Bakyang, Madalag	1.00	Private	*O. niloticus*	200
6. Dante Laurenio	Alaminos, Madalag	1.00	Private	*O. niloticus*	200
7. Alexander Nadura	Poblacion, Madalag	1.00	Private	*O. niloticus*	150

Appendix Table 3. Operator, location, farm area, species cultured and production of freshwater fishponds in Capiz (1983).

Name of operator	Location	Area (ha)	Species cultured	Ave. annual production (kg)
1. Erero Agusto	Cadingle, Dumarao	0.04	*O. mossambicus*	50
2. Sergio Calizo	Poblacion, Ilawod, Dumarao	0.02	Red tilapia	No record of harvest; recreational purposes only
3. Antonio Chiefe	Dumarao, Capiz	1.00	*O. mossambicus*	200
4. Enrique Bello	Tapaz, Panit-an	0.50	*O. niloticus*	75

Appendix Table 4. Operators, location, area, species cultured and annual fish production of rice-fish farms in Aklan (1983).

Name of operator	Location	Nature of operation	Area (ha)	Species cultured	Ave. annual production (kg)
1. Vicente Reforen	Felicano, Balete	Rice-fish (monoculture)	2.00	*O. niloticus*	No harvest
2. Estrellino Bantique	Lalab, Batan	Rice-fish (polyculture)	1.00	*O. mossambicus* Catfish Mudfish	500
3. Engr. Bartolome Rasco	Cerrudo, Banga	Rice-fish (monoculture)	2.00	*O. niloticus*	200
4. Labrado Mercado	Palo, New Washington	Rice-fish (monoculture)	0.50	*O. niloticus*	100
5. Benedicto Venus	Pinamuc-an, New Washington	Rice-fish (monoculture)	0.25	*O. niloticus*	50

Continued

Appendix Table 4. (Continued)

Name of operator	Location	Nature of operation	Area (ha)	Species cultured	Ave. annual production (kg)
6. Linabuan Norte Elem. School	Linabuan Norte, Kalibo	Rice-fish (monoculture)	0.02	*O. niloticus*	No harvest
7. Moises Villegas	Rosario, Malinao	Rice-fish (monoculture)	0.50	*O. niloticus*	50
8. Numancia Elem. School	Numancia	Rice-fish (monoculture)	0.33	*O. niloticus*	400
9. Joel Oquendo	Estancia, Kalibo	Rice-fish (monoculture)	3.00	*O. niloticus*	400

Appendix Table 5. Operators, location, farm area, species cultured and annual fish production of rice-fish farms in the province of Capiz (1983).

Name of operator	Location	Area (ha)	Species cultured	Annual production
1. Augusto Arorio	Cadingle, Dumarao	0.040	*O. mossambicus*	Undetermined
2. Sergio Calizo	Poblacion Ilawod, Dumarao	0.003	Red tilapia	Undetermined
3. Lorenzo Degala	Salocon, Panit-an	0.025	*O. niloticus*	Undetermined
4. Manalo Regalado	Dinaguig, Pontevedra	0.069	*O. mossambicus*	Undetermined
5. Tranquilino Tupas	Bgy. Fe, Jamindan	5	*O. mossambicus*	Undetermined
6. Eleuterio Lumaque	Jagnaya, Jamindan	7	*O. mossambicus*	Undetermined
7. Agustin Quirao	Pinagbunitan, Sigma	5	*O. niloticus*	Undetermined

Appendix Table 6. Operators, location, farm area and species cultured of rice-fish farms in Iloilo (1983).

Rice-fish farmers	Location	Area (ha)	Species cultured
1. R. Magnero	Batad, Iloilo	0.50	*O. niloticus*
2. M. Oñate	Acao, Cabatuan	0.10	*O. niloticus*
3. FSDC	Cabatuan	Undetermined	*O. niloticus*
4. Leonardo Tacuyan	Dumangas	0.25	*O. niloticus*
5. FSDC	Poblacion, Dingle	0.10	*O. niloticus*
6. C. Oragones	Poblacion, Dingle	0.25	*O. niloticus*
7. Caligany	Poblacion, Dingle	0.01	*O. niloticus*
8. M. Gulmayo	Poblacion, Dingle	0.10	*O. niloticus*
9. F. Catalan	Sto. Niño, Duenas	0.03	*O. niloticus*
10. F. Geranao	Guimbal, Iloilo	0.10	*O. niloticus*
11. F. Gayoba	Cabasi, Guimbal	0.05	*O. niloticus*
12. L. Genevea	Particion, Guimbal	0.01	*O. niloticus*
13. Gaudencio Edjan	Igbaras	Undetermined	*O. niloticus*
14. R. Provido	Poblacion, Pototan	0.03	*O. niloticus*
15. C. Dayot	Poblacion, Pototan	0.05	*O. niloticus*
16. G. Parra	Somkon Ilawod, Pototan	1.00	*O. niloticus*

Transfer of Fish Culture Technology in Central Luzon, Philippines

WESTLY R. ROSARIO

Freshwater Fish Hatchery and Extension Training Center
Bureau of Fisheries and Aquatic Resources
Muñoz, Nueva Ecija
Philippines

ROSARIO, W.R. 1985. Transfer of fish culture technology in Central Luzon, Philippines, p. 174-179. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

The state of the extension activities of the Philippine Bureau of Fisheries and Aquatic Resources (BFAR) in Central Luzon is presented. The two groups of extension people, the BFAR Regional/District office and the BFAR Freshwater Fish Hatchery and Extension Training Center (FFH-ETC), that extend assistance in this area are compared. There are 21 freshwater extension technicians who are inadequately equipped. The FFH-ETC has five full-time extension staff fully equipped and prepared with sufficient transport facilities to ensure mobility. The two groups have different criteria to measure accomplishment; the BFAR Regional extension staff consider farm area (size) while the FFH-ETC consider number of visits. The Pampanga district with seven BFAR extension workers rendered 31 extension visits while the FFH-ETC with five extension agents rendered 140 extension visits in April 1983. From January to June 1983, the FFH-ETC established 43 demonstration projects on rice-fish culture, fishpond, backyard fishpond, small-scale tilapia nursery and fish cage culture. At least five fishfarmers are recorded to have benefited from each of the demonstration projects using backyard fishponds of cooperating owners at strategic locations.

Introduction

Agricultural extension is the diffusion of useful and practical information on agriculture and farm living and the encouragement of the effective application of the same (Chang 1964). According to Pfannstiel (pers. comm.), extension education is the process of bringing about changes in the skills, knowledge and attitudes of the clientele. Extension tries to bridge the gap between the research laboratory and the farmer's field (Krishan 1968; Pili 1973). Benor and Harrison (1977) said that extension service lessens the backlog of research findings which already exist but have not yet reached the farmers. Also it gives continuous feedback to research from the fields so that research institutions will not lose touch with the real problems farmers face.

Promotion of fish culture is an essential step to facilitate development of an effective inland fisheries program throughout Central Luzon.

The purpose of this paper is to present the status and some problems of the Bureau of Fisheries and Aquatic Resources (BFAR) extension activities in Central Luzon. Focus is given to the operation of the BFAR Freshwater Fish Hatchery and Extension Training Center (FFH-ETC). Partial results of FFH-ETC demonstration projects are presented.

Present BFAR Extension Function

The extension function of BFAR has been gaining success. Pfannstiel (pers. comm.) has stated that while progress has been made, there is still a tremendous opportunity for BFAR to improve the social and economic conditions of limited income families in Central Luzon through its extension function.

At present, there are 21 BFAR extension agents for freshwater projects in the six provinces of Central Luzon (Region III). The number of extension agents per province, as shown in Table 1, is too small to meet the demand for extension services in every municipality. Because of the large number of producers, it will remain impossible for BFAR to reach all producers directly. The task is made even more difficult since the extension service usually lacks vehicles to ensure adequate mobility. This makes it impossible to achieve the close regular contact between the extension worker and the farmers which is essential for successful extension.

Table 1. Number of BFAR freshwater extension agents in Central Luzon by province as of July 1983.

Province	No. of freshwater extension agents
Nueva Ecija	3
Bulacan	2
Tarlac	4
Bataan	1
Zambales	3
Pampanga	
District office	5
Regional office	3
Regional total	21

For a poorly paid and inadequately trained extension agent, programs are often poorly defined and inadequately supported. Extension goals that are set are often unrealistic and bear little relevance to the local situation. Agents of District Offices are given goals based on area of farms contacted and not in terms of truly educational goals such as the changes in behavior to be brought among specified clientele. Pfannstiel (pers. comm.) stated that extension education is concerned with people and not with things. Stressing per hectare contacts and goals (see Table 2) encourages the extension agents to concentrate only on the large farms as they cannot reach all farms in their area.

Table 2. Accomplishment targets (ha) of BFAR Region III freshwater extension agents for 1983.

Province	Rice-fish farms	Freshwater pond improvement	New freshwater pond
Bulacan	46	0	0
Nueva Ecija	30	275	135
Pampanga	44	819	620
Tarlac	30	130	30
Bataan	0	0	0
Zambales	0	0	0
Regional total	150	1,224	755

Extension personnel cannot devote all their time exclusively to professional extension work. They have statistical, regulatory and administrative work. Such assignments divert the attention of the extension agents from their primary task. Extension agents should spend more time in reaching producers. Pfannstiel (pers. comm.) suggested that extension work has to be carried out where the people are.

In April 1983, the BFAR District Office in Pampanga had the highest number of extension visits among all provincial offices in the region. There were 31 technical service visits for the month. The estimated direct cost per visit was ₱48.00.[1]

The Freshwater Fish Hatchery and Extension Training Center (FFH-ETC)

In addition to the above extension service activities, BFAR has established the Freshwater Fish Hatchery and Extension Training Center (FFH-ETC) in Nueva Ecija Province as a special project. The project has two major objectives: a) to augment the income of small fishfarmers and rice-fish farmers and b) to increase the protein consumption of the people by producing more fish through rice-fish culture and freshwater fishpond development and improvement. At present, the FFH-ETC is capable of delivering to producers 100,000 *Oreochromis niloticus* fingerlings and breeders per week.

In addition to the production of fish seed which are sold at a nominal price, the FFH-ETC also extends technical services to fishfarmers who are willing to engage in fish culture. Tested aquaculture technologies are brought to the farmers through various educational programs which include: conduct of barangay (village) or farmers' meetings and field trips; establishment of method and result demonstration projects; providing technical services; campaigns through mass media and distribution of printed materials. The FFH-ETC aims to serve 3,000 cooperator farmers annually.

FFH-ETC extension function

The FFH-ETC has educated, well-trained and experienced Extension Specialists in rice-fish culture, pond and hatchery management, extension outreach, pond construction, fish health management, extension communication and aquaculture economics. The specialists are ready to render technical assistance to any farmer who wishes to avail of help on specified subject matters. The goal

[1]In 1983, ₱11.00 = US$1.00. This figure excludes salary costs.

of the operation is to develop a modern professional service capable of giving farmers sound technical advice.

The FFH-ETC organized the Field Extension Team (FET) to fully accelerate the fundamental revitalization of the BFAR extension service in Central Luzon. The FET is composed of an extension outreach specialist, a pond and hatchery management specialist/rice-fish culture specialist, two pond construction specialists, four extension agents and two support personnel. The group is equipped with two jeeps, three motorcycles, complete engineering and pond management equipment.

The FET is capable of reaching more than 60 new fishpond, hatchery and rice-fish culture cooperators per month (Fig. 1). For the month of April 1983, the FET was able to render 140 extension visits (Fig. 2). The travelling expenses such as gasoline, per diems, etc. combined amounted to ₱5,213.15. It means therefore, that the FFH-ETC spends about ₱37.25 for every technical assistance that it renders, not counting staff salaries and capital (e.g., jeep) costs.

FFH-ETC extension demonstration projects

To reach more fish farmers effectively, great effort is exerted to establish group contacts such as meetings, field trips and demonstrations. Because of the large number of producers, reliance is placed on indirect influence so that those directly involved in such get togethers can share information with their community.

The FFH-ETC extension agents concentrate also on demonstration projects to spread tested fish culture practices to most farmers in the area. At present, effort is focused on improvement of existing fish culture projects rather than development of new ones so as to use available aquatic resources to their fullest potential at less cost and time.

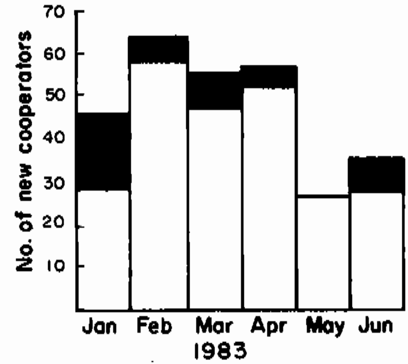


Fig. 1. FFH-ETC assisted fishpond, hatchery and rice-fish culture cooperators, January to June 1983. (□ fishpond and hatchery; ■ rice-fish culture).

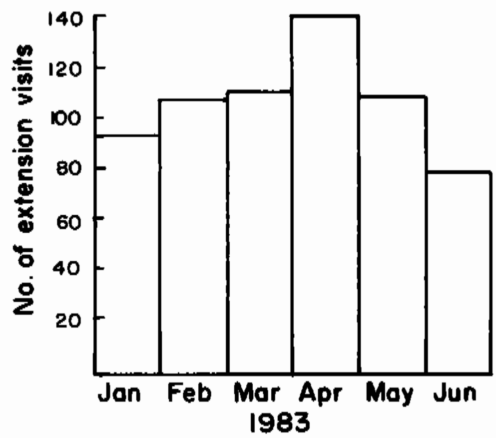


Fig. 2. Monthly extension visits rendered by FFH-ETC, January to June 1983.

Farmer leaders are usually selected as demonstration cooperators. They must follow recommendations from BFAR extension agents and agree to spread the technology to the public. In return, the cooperator is given a maximum of 10,000 *O. niloticus* fingerlings free and special technical assistance. He or she can also participate in training, field days and other activities conducted free at the

FFH-ETC. At present, there are 43 demonstration projects comprised of rice-fish culture, fishpond, backyard fishpond, small-scale tilapia nursery and fish cage culture established by the FFH-ETC.

Partial result of extension demonstration projects

Extension demonstration projects are providing excellent results. Tables 3 and 4 are examples showing net cash and in-kind income that can be derived from backyard fishponds. They indicate that for every m^2 of a backyard fishpond, a farmer can have a return above cash costs of about ₱3.00. Compared to a maximum profit of ₱1.00/m^2 in rice culture, backyard fish farming can be a more profitable project for a farmer with a good source of water.

Diffusion of technology was felt only a few weeks after the establishing of demonstration projects. A minimum of five fish farmers were directly benefited by each of the projects described in Tables 3 and 4. Also, farmers are proud of what they have achieved and are increasingly asking the extension agents for more help.

Conclusions

Statistics provide an incomplete indication of what has been achieved by extension in Region III. The BFAR Extension Service needs to be revitalized so it can improve and expand the transfer of fish culture technology in Central Luzon.

Significant production gains can be achieved by using available resources more efficiently with effective promotion of improved fish culture methods. It was observed that in large

Table 3. Result of a backyard fishpond extension demonstration project.

Cooperator	:	Macario Salvador				
Location	:	Talavera, Nueva Ecija				
Pond area	:	0.013 ha				
Treatment	:	Stocking rate	:	20,000 tilapia fingerlings/ha		
		Fertilization rate	:	3,000 kg/ha/mo chicken manure 100 kg/ha/mo inorganic fertilizer (16-20-0)		
Date stocked	:	24 November 1982				
Date harvested	:	3-31 March 1983				
Gross income (₱)[a]						502.00
Value of fish sold (27.5 kg)					330.00	
Value of fingerlings produced (2,150 fingerlings)					172.00	
Expenditure[b] (₱)						73.80
Fingerlings (260)					20.80	
Chicken manure (111 kg)					15.00	
Inorganic fertilizer (16-20-0) (16.5 kg)					38.00	
Net income (₱)						428.20

[a]₱11.00 = US$1.00 in 1983.
[b]Pond constructed by the Salvador family; material cost negligible; cost of irrigation water also negligible.

Table 4. Result of a backyard fishpond extension demonstration project.

Cooperator	:	Victor Agagni		
Location	:	Sto. Niño II, San Jose City		
Pond area	:	0.1039 ha		
Treatment	:	Stocking rate	:	30,000 tilapia fingerlings/ha
		Fertilization rate	:	3,000 kg/ha/mo chicken manure
				100 kg/ha/mo inorganic fertilizer (16-20-0)
Date stocked	:	27 December 1982		
Date harvested	:	18 March-18 May 1983		

Gross income (₱)[a]		4,550.00
Value of fish sold (178 kg)	2,670.00	
Value of fingerlings sold (1,750 fingerlings)	140.00	
Value of fingerlings given free (21,750 fingerlings)	1,740.00	
Expenditure[b] (₱)		417.36
Fingerlings (3,117)	249.36	
Chicken manure (185 kg)	50.00	
Inorganic fertilizer (16-20-0) (50 kg)	118.00	
Net income (₱)		4,132.64

[a]₱11.00 = US$1.00 in 1983.
[b]Pond constructed by Agagni family; cost of materials and water negligible.

commercial fishpond operations, the economic pressures involved make the adoption of modern technology risky to a fish farmer. On a small scale, however, many of the economic and technological aspects of fish culture become manageable, even by a lay person. Research in this direction may make backyard fish culture more practical and profitable.

The cost of the improved extension services per beneficiary is relatively smaller than for the old system. Moreover, the results are highly visible and bolster the farmers' confidence and pride in their work. Such initial success has generated enthusiasm for the new system and continuing efforts are required to ensure that the system maintains its momentum.

References

Benor, D. and J.Q. Harrison. 1977. Agricultural extension: the training and visit system. World Bank, Washington D.C.

Chang, C.W. 1964. Extension education for agricultural and rural development. FAO, Rome.

Krishan, R. 1968. Agricultural demonstration and extension communication. Asia Publishing House, New York.

Pili, F. 1973. The principles of extension work. Fish. Newsl. July-September: 22-25.

Session 5: Tilapia Marketing

Tilapia Marketing in Central Luzon and Metro Manila, Philippines

ENRIQUETA B. TORRES

College of Development Economics and Management
University of the Philippines at Los Baños
College, Laguna
Philippines

EMELINE R. NAVERA

NACIDA Region V
Bureau of Agricultural Economics-National Cottage Industry Development Authority
Legaspi City, Philippines

TORRES, E.B. AND E.R. NAVERA. 1985. Tilapia marketing in Central Luzon and Metro Manila, Philippines, p. 180-191. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

The marketing channels through which tilapia passes are relatively short on Luzon Island, Philippines. This may be due to the fact that the geographical location of the production area and the trading activities are relatively close in most localities. Another reason is the relatively small supply compared to other fish species.

The seasonality of supply affects to a large extent the price of tilapia. However, size and freshness are also factors that affect the price. The quality of the fish that reach the market also affects the demand as indicated by consumer preferences.

That there are no overwhelming problems in the marketing of tilapia implies that prospects for its culture as a source of income and a help to augment food protein availability in the country are indeed bright.

Introduction

In the past, people had a low regard for tilapia due to the undesirable features of the species *(O. mossambicus)* that were first introduced in the country. The recently introduced species *(O. niloticus)*, however, has many attributes that encourage its culture. It shows excellent growth rates on low protein diets, tolerates wide ranges of environmental conditions, has little susceptibility to diseases and is amenable to handling and captivity (Pullin and McConnell 1982). In addition, it has desirable market characteristics that appeal to consumer's tastes, such as soft flesh, large size and palatability.

The introduction of cage culture has helped boost tilapia production. However, tilapia is still considered a minor product among fishpond operators. In a study of fishponds in Quezon province, for example, de la Cruz and Lizarondo (1978) reported that on the average milkfish *(Chanos chanos* or *bangus)* production was 1,292 pieces/ha, shrimp *(P. monodon* or *sugpo)* 1,985 pieces while 600 pieces or only 150 kg of tilapia per ha were produced. In addition, only one among 95 respondents reported the deliberate stocking of tilapia in his fishpond.

Because of the relatively late entry of tilapia production in the Philippines, few studies have been done on the subject. Fewer still have been the studies done on marketing aspects.

This paper discusses tilapia production and price trends, marketing flow and trading practices of tilapia in the Luzon area. The data are based on available secondary data and on a study conducted among fish wholesalers and retailers handling tilapia in Metro Manila and Central Luzon, specifically San Fernando market in Pampanga, and Cabanatuan and San Jose markets in Nueva Ecija.

Production and Prices

Trends

The increasing trend in tilapia production is evident from the data on fish landings reported by the Philippine Fish Marketing Authority from various ports in Luzon (Table 1).

As Table 1 indicates, there has been a steady increase of tilapia unloaded in the various parts of Luzon. In Navotas, Rizal, for example, tilapia unloaded averaged 2,419 kg/month in 1978. But by 1982, this increased to 26,338 kg. In Dalahican, Quezon, the average monthly tilapia unloaded in 1978 was 2,682 kg, but by 1981 the volume had quadrupled. Another fast increasing tilapia production area is Zambales; the Magsaysay fish landing area in the province recorded an average of tilapia unloadings of 5,605 kg/month in 1977. In 1982, the volume had increased to a very high 39,676 kg.

There have also been places where a reduction in the volume of tilapia landed has occurred. Pangasinan port, for example, had an average monthly landing of 6,972 kg in 1981, but volume decreased to 4,863 kg in 1982. In Atimonan, Quezon, average tilapia landed was about 1,400 kg/month in 1981 but only 152 kg in 1982. No direct analysis has been undertaken to explain the reduction of tilapia production in these two areas. This could be due to the fact that Pangasinan and Atimonan, Quezon, are primarily milkfish *(Chanos chanos)* producing areas.

Where price trends of tilapia are concerned, prices increased even as production increased. Fig. 1 shows the trends in tilapia market supply and price from 1978 to 1982. The price shown is the wholesale price per tub of 50 kg each that passed through the Navotas fishing landing port. While statistics are not complete for other parts in Luzon, the price trends indicated in Fig. 1 could be reflective of the price trends in the various tilapia producing areas of Luzon.

The increase in prices, despite increases in production, can be attributed to two reasons: the inflationary effect, which has not been offset by increased supply, and the appearance in the market of bigger fish and better quality tilapia both of which command higher prices.

Table 1. Monthly volume of tilapia (kg) unloaded at various fish landing ports in Luzon.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
NAVOTAS (1978-1982)													
1978[a]													2,419.3
1979	7,182	7,255	17,242	6,612	12,832	19,513	17,661	2,510	1,020	2,305	11,820	3,915	9,155.6
1980	6,930	4,095	2,655	3,330	7,110	12,780	63,000	9,810	4,635	12,060	5,490	17,460	12,446.25
1981	9,045	8,055	9,180	6,030	1,350	8,235	51,930	67,050	34,560	39,195	27,810	25,380	23,985
1982	23,310	28,035	16,335	9,810	11,970	27,000	67,905	–	–	–	–	–	26,337.9
Ave.	11,616.75	11,860	11,353	6,445.5	8,315.5	16,882	50,124	26,456.7	13,405	17,853.3	15,040	15,585	
MAGSAYSAY (1978-1982)													
1978	–	–	–	–	–	–	–	–	–	5,509.1	8,153	3,152	5,604.7
1979	5,623	5,596	5,202	4,265	4,743	5,648	5,714	1,979	5,202	5,099	6,279	8,270	5,301.7
1980	3,201	3,256.5	12,853	13,635	17,455	25,770	10,692	9,722	7,823	7,829	5,684	6,879	10,399.96
1981	7,787	12,540	15,341	23,507	29,202	22,655	10,741	24,291	53,810	44,643	35,505	30,861	26,406.92
1982	32,395	37,038	47,130	42,141	–	–	–	–	–	–	–	–	39,676
Ave.	12,251.5	14,607.6	20,131.5	20,887	17,133.3	18,024.3	11,049	11,997.3	22,278.3	15,770.03	13,905.25	12,290.5	
DIVISORIA (1981-1982)													
1981	–	–	–	–	–	–	–	3,040	3,125	3,280	4,650	7,220	4,263
1982	3,607	4,540	4,970	–	–	–	–	–	–	–	–	–	4,372.3
PANGASINAN FISH LANDING (1981-1982)													
1981	5,895	2,765.0	8,377	7,150	6,958	8,593	10,039	7,808	7,023	8,981	5,520	4,549	6,971.5
1982	4,499	4,258	5,831	–	–	–	–	–	–	–	–	–	4,862.7
ATIMONAN FISH LANDING (1981-1982)													
1981	–	–	3,365	3,545	1,174	223	70	–	–	–	–	35	1,402
1982	175	105	175	–	–	–	–	–	–	–	–	–	151.7
DALAHICAN FISH LANDING (1978-1982)													
1978	–	–	–	–	–	635	3,985	3,659	3,170	1,355	2,212	3,760	2,682.3
1979	2,520	2,870	2,535	4,389	4,130	3,395	6,780	14,570	12,297	11,256	7,707	6,790	6,603.3
1980	8,660	11,010	9,985	9,527	7,492	6,479	10,964	3,487	8,493	7,580	9,265	11,363	8,692.1
1981	9,025	5,218	5,711	8,465	9,330	13,875	8,540	8,235	6,945	9,095	8,155	7,095	8,307.4
1982	–	–	–	–	–	–	–	–	–	–	–	–	–
Ave.	6,735	6,366	6,077	7,460.3	6,984	6,096	7,567	7,488	7,726	7,321.5	6,835	7,252	

[a]No monthly breakdown for 1978, but total volume unloaded for the year is 29,032 kg.

Source: Philippine Fish Marketing Authority.

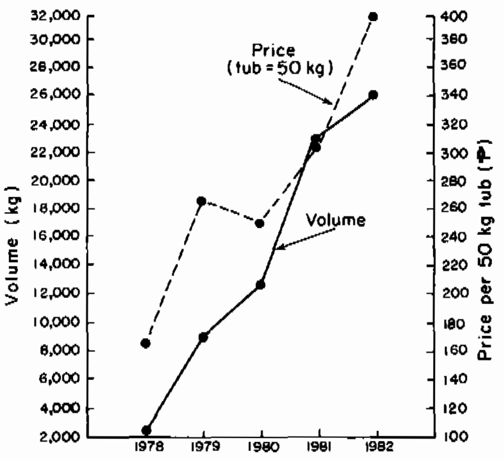


Fig. 1. Tilapia volume and price trends (1978-1982), Navotas Fish Landing Port and Fish Market.

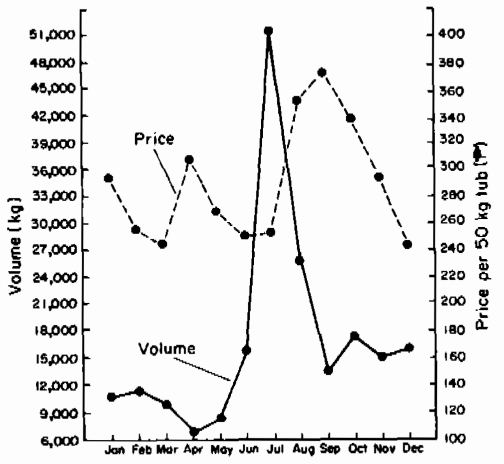


Fig. 2. Average seasonal (monthly) volume and prices for tilapia (1978-1982), Navotas Fish Landing Port and Fish Market.

With a much more attractive product, demand for tilapia may rise at the same time as supply.

Seasonal price variation

While the annual average price trend may be rising, an analysis of monthly prices covering the same period (1978-1982) shows that seasonal price fluctuations are quite pronounced (Fig. 2). Prices were low in the months of March, June, July and December and were especially high from August to October. The exceptionally high prices in these months could be due to the fact that typhoons are usually prevalent in this period. Changes in climate and weather conditions were noted by Rondon (1979) as the primary reasons for seasonal price fluctuations of other types of fish in the country. Likewise, the high volume in July can probably be explained by the tendency of tilapia producers (especially cage operators) to harvest their fish prior to the onset of the typhoon season.

The wholesale monthly price levels of tilapia at various fish landing ports for 1978 to 1982 are shown in Appendix Tables 1 to 4.

Marketing Channels

Most Filipino consumers, particularly in Luzon, when buying freshwater fish want them to be as fresh as possible--even alive--and tilapia is no exception. Accordingly, the marketing channels through which tilapia passes are very short: from producers to wholesalers then to retailers and finally to consumers (Fig. 3). There are also many instances where producers, especially cage culture operators, sell directly to retailers.

In Metro Manila, the number of retailers supplied directly by producers was about the same as those supplied by wholesalers. The shortness of the trade route can be explained by the relative proximity of the sources to the traders and markets. The suppliers were from towns of Rizal Province around Laguna lake particularly Cardona, Binangonan, Taguig and Muntinlupa. Bulacan producers in Obando and Hagonoy also supplied Metro Manila traders as did Malabon near the Rizal/Bulacan provincial border. The proportion of supplies from Pampanga towns (i.e., Guagua, Masantol, Candaba and Mabalacat) were almost the same as those from Laguna provincial towns

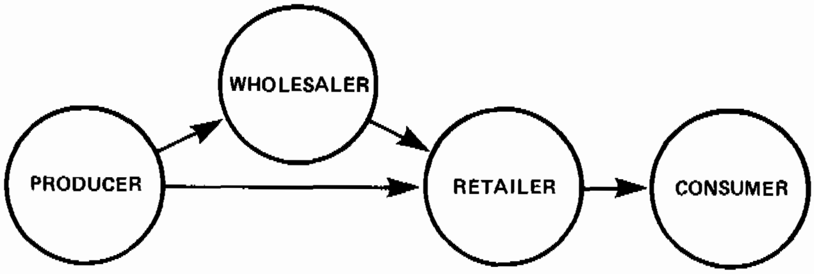


Fig. 3. Marketing channels for tilapia.

of Calamba, Sta. Cruz and San Pablo City. Tanza town was the only source reported from Cavite Province.

Retailers in Pampanga Province obtained their supply of tilapia from Bataan and Pampanga. Wholesalers in Pampanga operated on a consignment basis, i.e., they did not buy the fish outright but paid the producers after the fish had been sold in the market.

In Nueva Ecija, the most frequently mentioned source of supply was Orani town in Bataan. Because of the distance of Bataan, practically all tilapia that reached Nueva Ecija passed through the wholesalers or *viajeros*.

Scale of Marketing Operations

To obtain an idea of the scale of operations in tilapia marketing in the Luzon area, the study classified the retailers according to volume of tilapia handled per week. Those classified as small were those who handled less than 100 kg/week. This group predominated in Nueva Ecija, handling anywhere from 5 to about 20 kg/day. Medium-sized retailers were those handling between 100 and 500 kg/week; this group comprised the majority of retailers in Metro Manila. Large retailers were those who handled more than 500 kg/week; these were found only in Metro Manila (Table 2). Wholesalers, who comprised only about 9% of total respondents, were too small a group to classify in this manner.

As Table 2 shows, tilapia trading in Central Luzon (Nueva Ecija and Pampanga Provinces) lies mainly in the hands of small-scale retailers. This may be due to the fact that being a relatively new species in the country, tilapia is still regarded as a minor product. Most retailers also sold other types of fish with milkfish *(Chanos chanos)* as the most popular species sold alongside tilapia.

Table 2. Distribution of tilapia traders by size of operations, 1982-1983.

Location	Retailers (No.) Small (<100 kg/wk)	Medium (100-500 kg/wk)	Large (> 500 kg/wk)	Wholesalers (No.)
Metro Manila	30	69	16	9
Nueva Ecija	40	9	–	5
Pampanga	4	5	–	3
Total	74	83	16	17

The types of tools and equipment used by retailers indicated that tilapia trading is not a capital-intensive operation. Among the more common equipment used were weighing scales, containers (either *banyera* or *bilao*) and icebox or freezer. Cold storage facilities were not used by small-scale operators especially in Pampanga and Metro Manila. However, freezers or iceboxes seemed important to Nueva Ecija retailers probably because of their distance from the source of the fish.

Trading Volume Handled and Gross Margins

Based on the survey conducted among respondent retailers, tilapia sold in the market did not seem to undergo any processing. No slicing or filleting was undertaken by the retailers and tilapia were sold in the form in which they were harvested.

The wholesalers in Pampanga claimed that during the peak harvest they traded an average of 1,708 kg/day while in the lean months they traded only about 200 kg/day. In Nueva Ecija and Metro Manila the volume handled weekly by wholesalers ranged from 120 kg in the lean months to 10,000 kg per week during the peak harvest months.

In general (except Pampanga), small-scale retailers have a higher gross margin per kg than the larger operations. This can be explained by the fact that the former have small volume and have to charge more in order to increase total earnings whereas large retailers can earn more even if they charge a lower per unit margin (Table 3).

Marketing and Labor Costs

The total cost of marketing tended to be directly related to volume handled as shown in Table 4.

In Metro Manila and Pampanga, transport expenses for tilapia retailers were relatively small compared to transport expenses of Nueva Ecija retailers. This again could be attributed to the proximity of the source for Metro Manila traders. However, transport expenses for Nueva Ecija traders were a major item of expense since the supply of tilapia came from outside the province.

Table 3. Volume handled and gross margin of tilapia retailers, 1982-1983. (₱11.00 = US$1.00 in 1983).

Item	Average volume handled/week (kg)	Buying price (pesos/kg)	Selling price (pesos/kg)	Gross margin (pesos/kg)
Nueva Ecija				
Small-scale	20	9.60	12.90	3.30
Medium-scale	174	7.83	9.22	1.39
Pampanga				
Small-scale	48	9.50	11.75	2.25
Medium-scale	160	5.90	10.00	4.10
Metro Manila				
Small-scale	50	7.70	11.23	3.53
Medium-scale	451	8.30	11.06	2.76
Large-scale	1,277	8.50	11.50	3.00

Table 4. Monthly operating cost, in pesos, for tilapia traders, 1982. (₱11.00 = US$1.00 in 1983).

Operating cost	Size of operation Retailers Small (< 100 kg/wk)	Medium (100-500 kg/wk)	Large (> 500 kg/wk)	Wholesalers
Metro Manila				
Hired labor	–	24	62	–
Transport	65	68	91	125
Supplies[a]	46	103	101	153
Market fees	9	12	23	81
Utilities	21	48	49	76
Others	2	6	24	6
Total	143	261	350	441
Nueva Ecija				
Transport	282	179	n/a	1,800
Supplies[a]	278	246		951
Utilities	2	–		–
Market fees	54	13		160
Others	37	53		45
Total	653	491		2,956
Pampanga				
Transport	–	61	n/a	97
Supplies[a]	124	128		125
Utilities	–	–		–
Market fees	41	20		66
Others	–	–		13
Total	165	209		301

[a]Wrapping materials, salt and ice.
n/a = not applicable.

Wrapping materials, salt and ice were also major items of expense for all traders. Expenses for ice were quite high among wholesalers while expenses for wrapping materials were considerable among retailers.

Labor has not been given any valuation for several reasons: (1) labor is a noncash cost and respondents were not quite sure how to value their labor input since they or their family members usually did the tasks themselves; (2) they had other fish species being handled, in addition to tilapia; and (3) time devoted to tilapia trading was highly variable depending on supply and availability (tilapia supply was irregular).

Price Variation

Price levels of tilapia depended upon fish size, seasonality and supply-demand conditions. In general, respondents identified July to September as the peak months and December to March as the lean period for the supply of tilapia.

Table 5 shows the average price differences between the peak and lean periods. Since the

Table 5. Average price levels, in pesos, as reported by retailers in Metro Manila and Central Luzon, 1982. (₱11.00 = US$1.00 in 1983).

Location	Average price level (₱/kg) Peak month	Lean month
Nueva Ecija	8.60	10.45
Pampanga	8.22	12.55
Metro Manila	11.77	14.42

price differences have been averaged, the figures do not truly reflect the price variations as respondents gave price ranges for each period. Within a given peak or lean period, prices also fluctuate. For example, in Metro Manila the price within the peak month can go as low as ₱5/kg to as high as ₱15/kg. Then, during the lean months the prices could range from ₱7 to ₱16/kg.

The price fluctuation in both Metro Manila and Nueva Ecija averaged 22% between the peak and lean months while the fluctuation was much wider in Pampanga with a price difference of approximately 53% (Table 5).

The association of dead and frozen fish with "poor quality" is probably the reason why the majority of the retailer respondents in Pampanga and Metro Manila did not know of tilapia being processed for sale in the market. However, in Nueva Ecija, practically all retailers reported tilapia being sold either salted or dried. Perhaps because of the lack of local supply in Nueva Ecija the retailers had to rely on fish processing to store them longer.

Fish sizes also determined the price level. Retailers graded and sorted because smaller-sized tilapia commanded lower prices than the bigger ones.

Finally, the degree of freshness also influenced the selling price. This was true not only for tilapia but for all types of fish. Central Luzon fish consumers were willing to pay a premium for fresh, even live fish since they claimed that fresh or live ones had superior taste.

Consumer Preference

The study also sought to obtain from tilapia retailers information on what they perceived as consumer preferences with regard to tilapia. The majority of the respondents (75%) indicated that consumers primarily look for good quality and low prices in fish. The other 25% of retailer respondents observed that consumers take into account fish size and weight, with bigger and fatter fish becoming more popular than before. Given the introduction of tilapia species (e.g., *O. niloticus*) that grow faster and bigger, it is not surprising that weight and size are also given importance.

Most of the respondents reported that in general consumers look for good quality fish. The criteria for good versus poor quality fish are shown in Table 6.

Only three respondents in Metro Manila reported seeing processed tilapia being sold but they had no experience in processing tilapia themselves.

Problems in Tilapia Marketing

The retailer respondents cited the limited supply of tilapia as one of their major problems in marketing (Table 7). This seemed to

Table 6. Number of respondents reporting various criteria of good and poor quality tilapia, Metro Manila and Central Luzon, 1982.

Characteristics	Nueva Ecija	Location Pampanga	Metro Manila
Good quality			
Fat, fresh	33	11	74
Rounded body, big	32	3	32
Alive	2	–	17
Female	9	–	15
Poor quality			
Thin, small	41	8	44
Not fresh, frozen	10	5	47
Dead	2	–	–
Male	9	–	34

Table 7. Number of respondents reporting problems in tilapia marketing, Central Luzon and Metro Manila traders (1982) according to frequency of citation.

Problems	Nueva Ecija	Location Pampanga	Metro Manila
Buying			
1) not enough fish to sell	16	1	56
2) poor quality of fish	16	–	46
3) erratic source of supply	13	–	34
4) source is far	1	–	23
Selling			
1) lack of cold storage facilities	15	–	13
2) low demand	10	1	22
3) low selling price	6	4	10

indicate that there is a growing demand for tilapia among the retailers and that supply is lagging behind.

The second important problem cited was the poor quality of fish available which had low demand and low selling price. Respondents may be referring primarily to the small tilapia that were traded in the markets even if large species were already available.

The distance of the source of supply was also a problem particularly for Nueva Ecija retailers who had to get tilapia from Bataan.

Respondents also claimed that "imported" species of tilapia which had different colors from the usual ones are not saleable. Unfamiliarity with these species could have made buyers apprehensive about their taste.

That there are no overwhelming problems cited by respondent retailers where selling tilapia is concerned indicates that traders did not complain at all about their earnings from tilapia. In fact when asked why they engaged in tilapia trading, the responses given were: profitability; consumer's demand; availability; and good source of additional income.

Acknowledgements

The authors would like to acknowledge the help of Mr. Rene Verzola and the other researchers at the Bureau of Agricultural Economics for their help in the gathering of the data.

References

De la Cruz, Z.S. and M.S. Lizarondo. 1978. Fishpond operations and marketing practices in Quezon province 1977. BAEcon. Res. Rep. Ser. 9: 9.

Pullin, R.S.V. and R.H. Lowe-McConnell, editors. 1982. The biology and culture of tilapias. ICLARM Conference Proceedings 7, 432 p. International Center for Living Aquatic Resources Management, Manila.

Rondon, M.V. 1979. Seasonal price variations of selected fish species in the Philippines, 1970-1977. Phil. Ag. Econ. Rev. 2(1): 27-33.

Appendix Table 1. Monthly average wholesale price (₱/50 kg tub) at Navotas Fish Port and Fish Market from 1978 to 1982. (₱8.50 = US$1.00 in 1982)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1978	175	179	155	182	120	110	–	–	–	–	220	165	163.25
1979	415	155.60	182.50	425	120	158	165	450	437	420	164.16	175	272.27
1980	200	220	160	260	155	230	220	195	415	250	435	253.33	249.44
1981	250	250	272.50	272.50	230	380	250	350	300	335	374	371	302.92
1982	435	438	458	435	300	345	356	410	347.50	352	–	–	387.65
Ave.	295	248.5	245.6	314.9	270	244.6	247.75	351.25	374.9	339.25	298.29	241.08	

Source: Philippine Fish Marketing Authority.

Appendix Table 2. Monthly average wholesale price (₱/kg) at Magsaysay Fish Landing from 1978 to 1982. (₱8.50 = US$1.00 in 1982)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1978	–	–	–	–	–	–	–	–	–	5.47	6.92	6.28	6.22
1979	–	–	–	–	–	–	–	–	–	–	–	–	–
1980	7.46	6.82	6.33	7.22	7.30	6.75	7.35	6.65	6.55	6.55	7.35	8.20	7.04
1981	8.80	9.50	8.45	7.50	7.10	7.00	7.05	6.55	6.95	7.10	7.20	7.75	7.57
1982	8.75	9.65	8.55	8.50	–	–	–	–	–	–	–	–	8.86
Ave.	8.34	8.66	7.78	7.74	7.20	6.875	7.20	6.60	6.75	6.37	7.16	7.41	

Source: Philippine Fish Marketing Authority.

Appendix Table 3. Monthly average wholesale price (₱/kg) at Pangasinan Fish Landing from 1980 to 1982. (₱8.50 = US$1.00 in 1982)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1980	–	6.80	6.49	7.52	7.50	7.53	7.90	7.10	7.55	7.25	6.95	8.05	7.33
1981	8.35	9.85	8.95	7.95	7.20	7.00	7.15	6.75	6.90	6.85	6.95	7.10	7.58
1982	7.50	7.45	8.10	–	–	–	–	–	–	–	–	–	7.68
Ave.	7.925	8.03	7.85	7.73	7.35	7.265	7.525	6.925	7.225	7.05	6.95	7.575	

Source: Philippine Fish Marketing Authority.

Appendix Table 4. Monthly average wholesale price (₱/kg) at Dalahican Fish Landing from 1978 to 1982. (₱8.50 = US$1.00 in 1982)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1978	–	–	–	–	–	2.13	4.13	4.49	4.28	4.63	4.55	4.91	4.16
1979	–	–	–	–	–	–	–	–	–	–	–	–	–
1980	6.46	6.57	5.87	5.94	4.73	5.19	5.67	5.15	5.55	5.35	5.90	6.30	5.72
1981	6.75	6.65	4.85	5.30	4.60	5.40	5.00	5.50	4.90	4.45	5.70	6.15	5.43
1982	5.55	5.50	4.85	–	–	–	–	–	–	–	–	–	5.3
Ave.	6.25	6.24	5.19	5.62	4.665	4.24	4.93	5.05	4.91	3.27	5.38	5.79	

Source: Philippine Fish Marketing Authority.

Tilapia Marketing in Bicol, Philippines

EMMA M. ESCOVER*

ORESTES T. SALON

CRISTINA P. LIM

Ateneo de Naga
Naga City
Philippines

ESCOVER, E.M., O.T. SALON AND C.P. LIM. 1985. Tilapia marketing in Bicol, Philippines, p. 192-205. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

This study analyzes the marketing system for tilapia in Bicol, Philippines. The 37 tilapia traders interviewed in eight selected areas in Camarines Sur and Albay Provinces were mostly full-time traders who received 71% of their income from tilapia trading. They had an average capital investment of ₱105 which was lower than their monthly operating capital requirements. (₱11.00 = US$1.00 in 1983)

Tilapias from Lake Buhi and Lake Bato passed through from one to four intermediaries before they finally reached the consumers. Tilapia buying and selling was a profitable activity. After deducting all costs, including imputed labor costs, the wholesalers/retailers averaged ₱554 monthly net profit; the producers/wholesalers/retailers, ₱452; and the retailers ₱359. Marketing margins per kg were ₱1.06-1.80 for retailers and ₱0.37-0.63 for wholesalers/retailers.

Low selling price, low demand for tilapia, perishability due to long distance between source and market outlets, erratic supply and poor quality of tilapia were the common marketing problems encountered by tilapia traders, but these do not detract from a view of the profitability of tilapia marketing.

*Current address: c/o ICLARM, MC P.O. Box 1501, Makati, Metro Manila, Philippines.

Introduction

The introduction of different systems for culturing tilapia has attracted several sectors to engage in the tilapia industry. At present, tilapia is being grown commercially not only by small fishermen but also by big businessmen. The government has launched numerous ambitiously financed programs geared towards increasing fish production and tilapia projects are among them. In mid-1982, for example, Lakes Buhi and Bato tilapia cage projects in Bicol were granted ₱7.7 million[1] (Ministry of Human Settlements, Naga City, pers. comm.). More projects are expected and with all these efforts, tilapia production will certainly boom.

However, increased production alone will not assure success of these programs. Complementary post-production programs which include marketing must likewise be included in the overall plans.

Some tilapia projects implemented earlier had no specific marketing components and beneficiaries of these projects are now beset with marketing problems. Government planners must have sufficient information on the different interrelated systems, like production and marketing; and there is dearth of data on these, particularly on marketing. This study was therefore conducted to provide tilapia marketing information for the Bicol area.

Objectives

The study analyzed the tilapia marketing system in the Bicol Region of the Philippines (Fig. 1). Specifically, the objectives of the study were:

1. to determine the buying and selling practices of tilapia traders;
2. to determine the market outlets and channels of distribution of tilapia;
3. to estimate the marketing costs and margin, by type of trader; and
4. to determine the marketing problems encountered by tilapia traders.

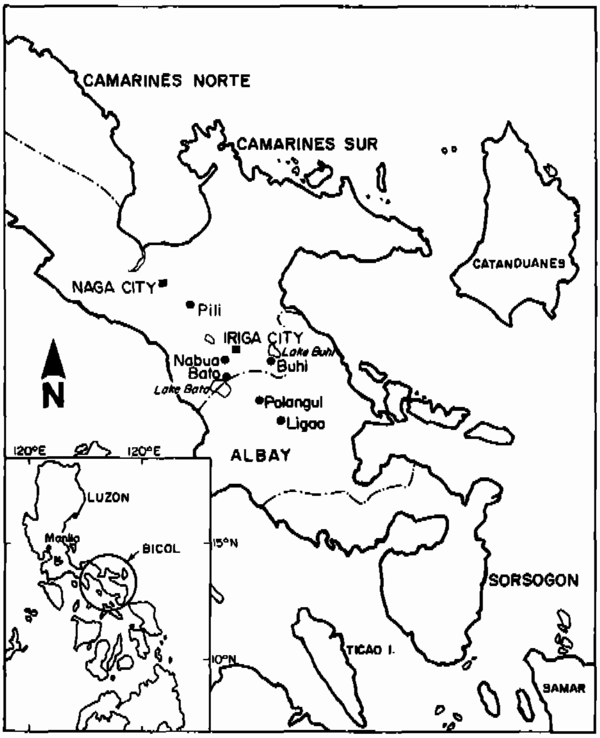


Fig. 1. Map of the Bicol Region showing study areas.

Methodology

Markets for the tilapia from Lake Buhi and Lake Bato were first identified by interviewing tilapia cage operators and some key informants from the municipalities of Buhi and Bato. After identifying the different markets, five tilapia traders each in the municipal markets of Bato, Buhi, Ligao, Nabua, Pili, Polangui and the city market of Iriga City were randomly selected and interviewed. Only two traders were interviewed in

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[1] At the time of this study (1982-1983), ₱11.00 = US$1.00.

Naga City. Geographic distribution of the markets cited above is shown in Fig. 1.

Data were tabulated and summarized at the Research and Service Center of the Ateneo de Naga. Descriptive analysis was applied in this study.

The Tilapia Traders

The tilapia traders were classified into three types, namely; retailer, wholesaler/retailer and producer/wholesaler/retailer. Many traders provided various marketing functions and therefore did not fit into neat categories. Multiple functions by marketing intermediaries are very common in the Philippines. Of the 37 traders interviewed, 19 or 51% were retailers, 15 or 41% were wholesalers/retailers, and 3 or 8% were producers/wholesalers/retailers (Table 1). On the average, the tilapia traders had been engaged in fish trading for 13.6 years, though not all of this time was with tilapia.

Seventy percent or 27 traders reported to be full-time, selling tilapia daily, and had no other occupation except fish trading. Seven or 19% were part-time traders, while the remaining three traders sold tilapia occasionally, i.e., during peak months only, whenever they had available cash to buy tilapia, or when their own cultured tilapias were of marketable size.

Of the total volume of fish bought and sold by these traders, 73% consisted of tilapia, 24% were other freshwater species and only 3% were marine species. The income from tilapia trading constituted 71% of the average traders' total income; the remaining 29% came from trading other fish species, farming and employment (Table 2).

The tilapia traders included in the study had a minimal investment of ₱105, 35% of which was spent on weighing scales, and 47% on ice boxes. Other commonly used containers for tilapia trading were *banyera* or tubs, pandan baskets and pails. Retailers had an average capital investment of ₱128; wholesalers/retailers invested ₱80; and the

Table 1. Characteristics of 37 tilapia traders in Bicol, 1983.

Item	No. reporting	%
Age		
21-30	5	14
31-40	12	32
41-50	14	38
51 and above	6	16
Ave. age	41	
Sex		
Male	5	14
Female	32	86
Civil status		
Single	1	3
Married	34	92
Widow(er)	2	5
Educational attainment		
Elementary level	9	24
Elementary graduate	17	46
High school level	6	16
High school graduate	4	10
College level	1	.3
No. of years in fish trading		
1-5	9	24
6-10	6	16
11-15	8	22
16-20	7	19
21-25	3	8
26 and above	4	11
Ave. no. of years fish trading	13.6	
Extent of involvement in fish trading		
Full-time	27	73
Part-time	7	19
Occasional	3	8
Frequency of fish trading		
Daily	27	73
2 days a week	3	8
3 days a week	5	3
4 days a week	1	3
5 days a week	1	3
Types of trader		
Retailer	19	51
Wholesaler/retailer	15	41
Producer/whole-saler/retailer	3	8

Table 2. Source of income, 37 tilapia traders in Bicol, 1983.

Type of trader	No.	Tilapia trading %	Source of income Others[1] %	Total %
Producer/wholesaler/retailer	3	68	32	100
Wholesaler/retailer	15	73	27	100
Retailer	19	73	27	100
Total	37	71	29	100

[1]Sale of other fish species, farming, employment, etc.

Table 3. Average present value of investment (in pesos)[1], 37 tilapia traders, Bicol, 1983.

Item	Producer/wholesaler/retailer (n = 3) Value	%	Wholesaler/retailer (n = 15) Value	%	Retailer (n = 19) Value	%	All Value	%
Weighing scale	13	81	27	34	49	38	37	35
Ice box	0	0	39	49	53	42	49	47
Other containers (pandan baskets, tubs, basin, etc.)	3	19	14	17	26	20	19	18
Total	16	100	80	100	128	100	105	100

[1]Not all traders owned each item listed; above figures are for the whole sample, including those without investment items.

producers/wholesalers/retailers invested only ₱16 (Table 3).

Consumers' Preferences for Tilapia

Initial findings of a study conducted on demand for tilapia in three selected areas in Camarines Sur showed that 61% of the 120 respondents preferred light-colored tilapia while only 10% or 12 respondents reported to have a preference for dark-colored tilapia (Lim 1983). Twenty-two percent were indifferent to either type (Table 4). Light-colored tilapia was preferred by most consumers because of its alleged higher percentage of females, reputed for their fatness; delicious taste and soft flesh; not having a putrid smell.

Consumers had varied preferences for various sizes of tilapia. Twenty-nine percent of the consumers interviewed preferred big tilapias ranging from 2 to 4 pieces/kg (Table

Table 4. Preferred species of tilapia, 120 consumers in three locations, Camarines Sur, 1982.

Species	Agdangan No.	Agdangan %	Pili No.	Pili %	Iriga No.	Iriga %	All No.	All %
Light-colored tilapia	30	75	23	58	20	50	73	61
Dark-colored tilapia	2	5	4	10	6	15	12	10
Combination	3	8	–	–	5	23	8	7
None	5	12	13	32	9	22	27	22
Total	40	100	40	100	40	100	120	100

Table 5. Preferred sizes of tilapia, 120 consumers in three locations, Camarines Sur, 1982.

Sizes	Agdangan No.	Agdangan %	Pili No.	Pili %	Iriga No.	Iriga %	All No.	All %
2-4 pcs/kg	12	30	12	30	11	28	35	29
5-7 pcs/kg	6	15	11	28	10	25	27	22
8-10 pcs/kg	6	15	8	20	9	22	23	19
10 pcs/kg and above	16	40	9	22	10	25	35	29
Total	40	100	40	100	40	100	120	100

5), because they are fleshy and scaling is easier. Another 29% preferred small tilapia, 10 pieces or more per kg, because of its low price. Other consumers preferred 5-7 or 8-10 pieces/kg of tilapia.

Marketing Practices

Tilapias came from various sources. Twenty traders or 36% bought from wholesalers; 32% bought directly from cage operators; and 30% from municipal fishermen. One trader reported to catch his own tilapia using *pokot* or gill net. Fifty-four percent or 20 tilapia traders usually picked up their tilapia from suppliers while 14 traders or 38% reported that the tilapias were delivered to them.

Suppliers of tilapias were either paid in cash or later after subsequent sale by the buyer. Some 43% of tilapia producers in Lakes Buhi and Bato were paid on consignment, a practice locally called *alsada* (Claveria 1983). Payment was received anytime from the afternoon of the same day to two days later.

Tilapias were graded according to size, freshness and species with the majority (62%) using size as the primary criterion (Table 6). Large tilapia numbering 4-5 pieces/kg were sold for an average price of ₱8.90/kg. Medium tilapia averaged ₱7.50/kg, while the very small ones (20-22 pieces/kg) were ₱4.65/kg. The price of iced tilapia was usually lower than that of live tilapia by ₱1.00 to ₱1.50/kg.

When asked about their method for determining their marketing markup, 81% of the traders reported that they usually had a fixed markup, while 16% reported setting their markup as a percentage of actual costs incurred.

Volume Purchased and Price Paid

The volume of tilapia bought each month by the traders varied according to the season and type of trader. On the average, retailers bought 1,293 kg/month during peak months and only 848 kg/month during lean months; wholesalers/retailers bought 2,156 kg/month and 1,141 kg/month during peak and lean months, respectively; while the producer/wholesaler/retailer bought 1,243 kg/month during peak months and 740 kg/month during lean months. These amounts are shown by source in Table 7. The most commonly mentioned lean months were July and August. Peak months reported by traders were September and November to March. Price paid by retailers per kg of tilapia ranged from ₱5.09 to ₱5.40, while wholesaler/retailers paid approximately ₱5.00/kg (Table 8).

Volume Sold and Price Received

As a group, all traders sold approximately half of their tilapia directly to consumers in both peak and lean seasons (Table 9). Retailers served an important intermediary role also. Institutional buyers (e.g., restaurants and *carenderia*) were the least important outlet for all types of traders regardless of season.

In terms of prices, the retailers of tilapia received higher prices during lean months especially from the institutional buyers (Table 10). The wholesaler/retailers, on the other hand, did not experience a similar pattern.

Table 6. Manner of grading or classifying tilapia, 37 tilapia traders in Bicol, 1983.

Item	Type of traders			
	Producer/ wholesaler/ retailer %	Wholesaler/ retailer %	Retailer %	All %
By size	67	57	67	62
By freshness	–	24	9	16
Combination of size and species	33	14	24	20
By species	–	5	–	2
Total	100	100	100	100

Table 7. Average volume of tilapia bought by season[1], source and type of trader, 37 tilapia traders, Bicol, 1983.

	Type of trader																	
	Producer/wholesaler/retailer (n = 3)						Wholesaler/retailer (n = 15)						Retailer (n = 19)					
	Peak months		Lean months		Latest months		Peak months		Lean months		Latest months		Peak months		Lean months		Latest months	
Source	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%
Cage operator	478	*38*	485	*66*	475	*65*	961	*44*	414	*36*	455	*34*	484	*38*	319	*38*	405	*37*
Municipal fishermen	45	*4*	15	*2*	15	*2*	466	*22*	200	*18*	228	*17*	220	*17*	164	*19*	214	*19*
Wholesaler	720	*58*	240	*32*	240	*33*	729	*34*	527	*46*	652	*49*	522	*40*	332	*39*	414	*38*
Others[2]	–	–	–	–	–	–	–	–	–	–	–	–	76	*5*	33	*4*	67	*6*
All	1,243	*100*	740	*100*	730	*100*	2,156	*100*	1,141	*100*	1,335	*100*	1,293	*100*	848	*100*	1,100	*100*

[1]Peak months were September and November to March. Lean months were July and August. Latest months were December 1982 and January 1983.
[2]Traders with no capital outlay; they only get a commission from the sale.

Table 8. Average price (₱/kg) paid by 37 tilapia traders by season[1], Bicol, 1983. (₱8.50 = US$1.00 in mid-August 1982)

Type of trader	Peak months	Lean months	Latest months
Producer/wholesaler/retailer	3.75	4.12	4.25
Wholesaler/retailer	4.77	4.78	4.95
Retailer	5.09	5.40	5.34

[1]Peak months were September and November to March. Lean months were July and August. Latest months were December 1982 and January 1983.

Marketing Channels for Tilapia in Bicol

The various marketing channels for tilapia in Bicol are shown in Fig. 2. Tilapia supplied by fish farmers and capture fishermen may go either directly to the retailer or through the wholesaler/retailer before reaching the final consumer. Tilapia may also be channelled through several intermediaries before it reaches the consumer. One route is through the wholesaler, to the retailer and to consumers while another route is through the wholesaler/retailer, to the retailer and to the institutional buyer. However, only 6% of the total volume of tilapia passed through the institutional buyers before reaching consumers.

Labor Input in Tilapia Trading

For all types of traders the average monthly labor input (own and family labor) used in tilapia marketing was 25.8 man-days (Table 11). Eighty-three percent of this was spent on selling, 5% in sorting and grading, 7% in transporting fish and the balance in icing,

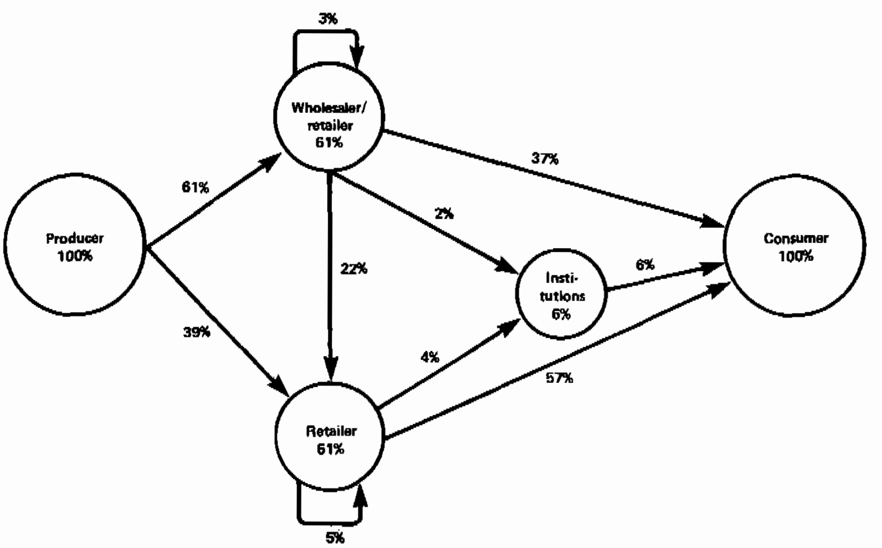

Fig. 2. Marketing channels for tilapia in Bicol.

Table 9. Average volume (kg) of tilapia sold per month by type of traders, outlets and season[1], 37 tilapia traders, Bicol, 1983.

	Type of trader																	
	Producer/wholesaler/retailer (n = 3)						Wholesaler/retailer (n = 15)						Retailer (n = 19)					
	Peak months		Lean months		Latest months		Peak months		Lean months		Latest months		Peak months		Lean months		Latest months	
Outlet	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%	kg	%
Wholesaler	385	*42*	172	*26*	165	*26*	92	*7*	92	*13*	124	*13*	–	–	–	–	–	–
Retailer	90	*10*	30	*5*	30	*5*	556	*42*	210	*29*	275	*30*	520	*42*	300	*44*	390	*46*
Consumer	445	*48*	442	*67*	437	*68*	651	*43*	334	*46*	405	*43*	511	*52*	336	*50*	412	*48*
Institutional buyer	5	*1*	10	*2*	9	*1*	100	*8*	94	*13*	126	*13*	64	*6*	40	*6*	55	*6*
All	925	*100*	654	*100*	641	*100*	1,309	*100*	730	*100*	930	*100*	985	*100*	676	*100*	857	*100*

[1]Peak months were September and November to March. Lean months were July and August. Latest months were December 1982 and January 1983.

Table 10. Average price (₱/kg) received by type of traders, by outlet and season[1], 37 tilapia traders, Bicol, 1983.

	Outlet											
	Wholesaler			Retailer			Consumer			Institutional buyer		
Type of trader	Peak months	Lean months	Latest months	Peak months	Lean months	Latest months	Peak months	Lean months	Latest months	Peak months	Lean months	Latest months
Retailer	–	–	–	6.00	7.00	6.50	6.19	6.53	6.25	7.61	9.43	9.72
Wholesaler/retailer	4.85	5.00	4.66	5.73	5.50	5.95	5.82	5.55	6.12	6.50	5.83	6.33
Producer/wholesaler/retailer	4.88	5.67	5.17	5.50	6.50	6.50	5.20	5.37	5.12	5.50	5.75	5.00

[1]Peak months were September and November to March. Lean months were July and August. Latest months were December 1982 and January 1983.

salting or scaling the fish. Wholesaler/retailers who handled the biggest volume of tilapia also had the highest average labor input per month, 26.9 man-days, though this was not significantly higher than the labor input of retailers. However, wholesaler/retailers also relied on small amounts of hired labor for transferring tubs of tilapia within the market; this is not included in Table 11. Scaling or removal of fish scales was reported to be practiced by some tilapia traders in Bato, while icing tilapia was commonly practiced only in Pili and Naga City.

Marketing Costs

On the average, the marketing costs per month of a tilapia trader was only ₱476. The monthly marketing costs of tilapia retailers, wholesaler/retailers, and producer/wholesaler/retailers were ₱485, ₱502 and ₱283, respectively. Of the total monthly marketing costs, the imputed value of the trader's or his family's labor was the largest cost item amounting to ₱258 for retailers; ₱271 for wholesaler/retailers; and ₱175 for producer/wholesaler/retailers (Table 12), or more than 50% of total marketing costs in each case.

Other components of marketing costs were depreciation on capital items and operating expenses which included market fees (locally known as *plasada*), cost of transporting and hauling tilapia, wrapping materials and licensing fees. In terms of marketing costs per kg, the retailer had higher costs (₱0.45) than the wholesaler/retailer (₱0.32).

Marketing Margins, Profits and Net Income

Tilapia buying and selling in selected areas in Bicol was a profitable business activity. The net marketing margin from tilapia trading

Table 11. Average monthly labor input (own and family labor in man-days) by activity and type of trader, 37 tilapia traders in Bicol, 1983.

Function performed	Producer/ wholesaler/ retailer (n = 3)		Wholesaler/ retailer (n = 15)		Retailer (n = 19)		All (n = 37)	
	Man-days	%	Man-days	%	Man-days	%	Man-days	%
Transporting/ handling/ hauling	1.8	*10*	2.4	*9*	1.5	*6*	1.9	*7*
Sorting and grading	1.4	*8*	1.5	*6*	1.0	*4*	1.2	*5*
Icing/salting	0.2	*1*	1.0	*4*	0.7	*3*	0.9	*4*
Selling	14.0	*81*	21.5	*80*	22.6	*87*	21.5	*83*
Removing scales	0.0	–	0.5	*1*	0.2	*	0.3	*1*
Total	17.4	*100*	26.9	*100*	26.0	*100*	25.8	*100*

*Less than 1%.

Table 12. Average marketing costs (₱/month) by type of trader, 37 tilapia traders in Bicol, 1983. (₱8.50 = US$1.00 in mid-August 1982)

Item	Producer/ wholesaler/retailer	Wholesaler/ retailer	Retailer	All
Labor costs	175	271	258	257
Operating expenses	106	224	218	212
Depreciation in capital items	2	7	9	7
Total costs	283	502	485	476
Average cost/kg	0.31	0.32	0.45	0.39

ranged from ₱0.37/kg for wholesaler/retailers during lean months to ₱1.80/kg for the retailers during lean months (Table 13). All types of tilapia traders showed good business performance. All had positive economic profits (returns above all cash and non-cash costs except opportunity cost of capital which was minimal in any case). Wholesaler/ retailers had the highest monthly profits amounting to ₱554, followed by producer/ wholesaler/retailers (₱452) and retailers (₱359). While these profits represented substantial returns on capital (because capital investment was low), the monthly net incomes were not high. Adding to these profits the income earned from own and family labor (charged as non-cash cost in Table 14), the monthly net incomes of the three trader types were ₱825, ₱627 and ₱617, respectively.

Marketing Problems of Tilapia Traders

The tilapia traders encountered numerous problems in buying as well as in selling tilapia. In buying tilapia, 49% of the traders reported high buying price of tilapia as their number one problem. Next in rank were the distant source of fish, poor quality of fish and lack of capital to buy larger volume of fish. Another problem experienced by traders in buying tilapia was its erratic and insufficient supply. Only 19% (or 7 traders) reported that they did not encounter any problem in buying tilapia (Table 15).

Low selling price was ranked first among the problems encountered by the traders in selling tilapia. One possible cause for this was the low demand for tilapia which was also reported as the second major problem of tilapia traders. The long distance between the source and market outlets of tilapia, the perishability of fish and inadequate supply were other important problems faced by the traders.

Conclusions

The results presented in the preceding sections showed that buying and selling tilapia in Bicol was a profitable activity. The relatively good marketing margin also implied that the volume of fish traded could still be increased. However, to be able to sustain the positive marketing margin the following should be taken into consideration:

1) Adequate supply of tilapia must be maintained to avoid big fluctuations

Table 13. Average buying and selling prices, marketing costs and net marketing margin (₱/kg) by type of trader (n = 37), Bicol, 1983. (₱8.50 = US$1.00 in mid-August 1982)

Types of traders	Buying price			Selling price			Gross margin			Marketing costs	Net marketing margin		
	Peak months	Lean months	Latest months	Peak months	Lean months	Latest months	Peak months	Lean months	Latest months		Peak months	Lean months	Latest months
Producer/wholesaler/ retailer	3.75	4.12	4.25	5.27	5.82	5.45	1.52	1.70	1.20	0.31	1.21	1.39	0.89
Wholesaler/retailer	4.77	4.78	4.95	5.72	5.45	5.77	0.95	0.69	0.82	0.32	0.63	0.37	0.50
Retailer	5.09	5.40	5.34	6.60	7.65	7.49	1.51	2.25	2.15	0.45	1.06	1.80	1.70

in prices and to assure regular supply of fish to consumers;

2) Considering the distant sources of fish from the market, timely harvesting and better marketing facilities would help the traders to supply good quality tilapia that would consequently attract more consumers; and

3) Formation of credit cooperatives among the smaller traders must be encouraged

Table 14. Average monthly costs and returns (in pesos) of tilapia trading, 37 tilapia traders in Bicol, 1983. (₱8.50 = US$1.00 in mid-August 1982)

	Types of traders			
	Producer/wholesaler/ retailer (n = 3)	Wholesaler/ retailer (n = 15)	Retailer (n = 19)	All types (n = 37)
Total cash receipts (fish sold)	2,602	4,552	3,385	3,795
Cash costs				
Fish bought	1,867	3,496	2,541	2,874
Operating expenses	106	224	218	212
Total cash costs	1,973	3,720	2,759	3,086
Non-cash costs				
Depreciation	2	7	9	7
Unpaid own and family labor	175	271	258	257
Total non-cash costs	177	278	267	264
Total costs	2,150	3,998	3,026	3,349
Profit[1]	452	554	359	446

[1] Includes return to the traders' capital, management and risk.

Table 15. Marketing problems as reported by 37 tilapia traders in Bicol, 1983.

Problem	% of traders citing problems	Problem	% of traders citing problems
Buying problems		Selling problems	
High buying price	49	Low selling price	43
Lack of capital	14	Low demand	24
Poor quality of fish	14	Market outlet is far from fish source	14
Fish source is far	14	Inadequate quantity of fish	5
Not enough fish to buy and sell	11	Too much bargaining	5
Erratic source of supply	11	Tilapia deteriorates fast	5
Competition from buyers with bigger capital	5	High market fee	3
No problem	19	Icing unsold fish lowers the price	3
		Lack of cold storage facilities	3
		Poaching during peak hours of selling	3
		Lack of good marketing facilities	3
		Delinquent debtors	3
		Losses	3
		No problem	14

to generate additional operating capital to help them compete with the small number of bigger traders and to help them acquire better marketing facilities.

Acknowledgements

The authors would like to thank the following agencies and individuals who extended various assistance in the preparation of this study: International Center for Living Aquatic Resources Management, the Philippine Council for Agriculture and Resource Research and Development, the Research and Service Center of Ateneo de Naga, Dr. Ian R. Smith, Mr. Rodrigo Claveria, Miss Hazel Undecimo, Miss Luz Yater, the Salon Family, Mrs. Norma Dumalag, Miss Baby Jimenez, and most especially the 37 tilapia traders.

References

Claveria, R. 1983. Tilapia production in Camarines Sur, Ateneo de Naga, Naga City, Philippines. M.S. thesis.

Lim, C. 1983. Demand for tilapia. Ateneo de Naga, Naga City, Philippines. M.S. thesis.

Tilapia Marketing in Laguna Province, Philippines

CORAZON T. ARAGON

JUVILYN COSICO

NERISSA SALAYO

College of Development Economics and Management
University of the Philippines at Los Baños
College, Laguna
Philippines

ARAGON, C.T., J. COSICO AND N. SALAYO. 1985. Tilapia marketing in Laguna Province, Philippines, p. 206-218. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

The important factors that affect the price of tilapia in Laguna are fish size, supply-demand conditions and degree of freshness.

Due to differences in tastes and preferences of consumers, the majority of the tilapia sellers sell both available species of tilapia *(Oreochromis niloticus* and *O. mossambicus)*. Tilapia are acquired by the majority (77%) of fish buyers on consignment basis. There is no difference in the price of tilapia regardless of the method of payment. Most of the sample respondents (54%) who purchase fish directly from tilapia producers reported that they purchase tilapia unsorted because sorting is not practiced by the tilapia producers.

The wholesalers have the highest marketing capital investment, averaging ₱6,242, followed by the retailers, wholesaler/retailers and the producer/retailers, with an average marketing investment of ₱5,270, ₱1,429 and ₱756, respectively. Vehicles are the major capital investment item of all the middlemen. Tools and equipment used in tilapia marketing are few and consist mainly of weighing scales, containers and ice boxes. None of the middlemen use cold storage facilities.

Marketing costs vary among municipalities and among types of tilapia sellers.

The problems in tilapia marketing are lack of market stalls, credit collection, fish deterioration, price variability and different taste of tilapia in some months of the year.

Introduction

The popularity and profitability of tilapia in the Philippines have encouraged many investors to enter the business. However, the success of the tilapia industry is accompanied by many potential problems and one of them is marketing. There have been numerous projects implemented by the government and others in the private sector geared towards improving or increasing production of tilapia farms but marketing the increased produce seems to be given very little attention. Increased production implies a need to also consider the development of an efficient marketing system due to the highly perishable nature of tilapia. It is for this reason that an analysis of the current marketing system of tilapia was undertaken.

This paper examines marketing of tilapia in the province of Laguna, just south of Metro Manila. The data presented in this paper were gathered during a 1982-1983 survey of 100 tilapia sellers in selected municipalities in Laguna. These municipalities are Bay, Los Baños, Calamba, Cabuyao, Sta. Rosa, Biñan, San Pablo City, Sta. Cruz, Pila, Calauan and Rizal (Fig. 1). The tilapia sellers were composed of 18 wholesalers, 16 wholesaler/retailers, 61 retailers, 3 producer/retailers and 2 brokers (Table 1).

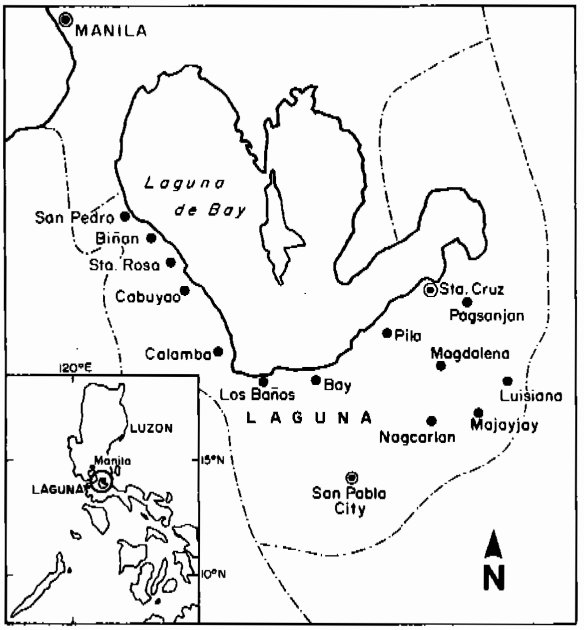

Fig. 1. Map of Laguna Province showing municipalities surveyed and proximity to Metro Manila.

Table 1. Distribution of the sample sellers by municipality and by type of seller, 100 tilapia sellers, Laguna, 1982.

	Type of seller					
Municipality	Wholesaler	Wholesaler/ retailer	Retailer	Producer/ retailer	Broker	Total
Bay	2	1	4	–	–	7
Los Baños	2	4	1	–	–	7
Calamba	5	3	14	–	1	23
Cabuyao	–	2	1	–	1	4
Sta. Rosa	1	–	5	–	–	6
Biñan	–	2	1	–	–	3
Calauan	–	–	4	–	–	4
Pila	2	–	2	–	–	4
Rizal	–	–	4	–	–	4
San Pablo	2	2	13	3	–	20
Sta. Cruz	4	2	12	–	–	18
Total	18	16	61	3	2	100

A complete list of tilapia sellers by type of marketing intermediary in each municipality was prepared. The total number of units sampled in each category in each municipality was determined by proportional allocation.

The Marketing Process

Marketing channels and product flow

A marketing channel system traces the flow of the product from the producer to the final consumer through a set of marketing intermediaries. Tilapia can take several routes before reaching the ultimate consumers (Fig. 2). In Laguna Province, ten alternative channels were identified as follows:

1) producer → broker → wholesaler → retailer → consumer;
2) producer → broker → wholesaler/retailer → consumer;
3) producer → broker → wholesaler/retailer → retailer → consumer;
4) producer → wholesaler → wholesaler/retailer → retailer → consumer;
5) producer → wholesaler → retailer → consumer;
6) producer → wholesaler/retailer → consumer;
7) producer/retailer → consumer;
8) producer → retailer → consumer;
9) producer → wholesaler → wholesaler/retailer → consumer;
10) producer → wholesaler/retailer → retailer → consumer.

The simplest channels were channels 6, 7 and 8 when the producer sells directly to the retailers or to the wholesaler/retailers then eventually to the consumers. The trade route was short in markets which were relatively near the source of supply. The most complex channels were the routes with brokers; these are the most inefficient routes since they involved many intermediaries. The brokers are usually selling on consignment for the tilapia producers, and they have the necessary contacts which producers badly need to dispose of their produce. From brokers, the fish go to wholesalers, to the wholesaler/retailers, to retailers or to consumers. Retailers outnumber all other marketing intermediaries.

The major market outlets of tilapia in Laguna Province are Sta. Cruz, San Pablo City and Calamba; 18, 20 and 23%, respectively, of the 100 fish sellers interviewed marketed tilapia in these municipalities. The middlemen (women actually) in San Pablo City were usually local residents who usually bought their fish either from Sampaloc Lake or Bunot Lake producers. Those middlemen who were from Rizal obtained their fish from Lake Calibato. Not all the tilapia sellers in Calauan and Bay were residents of these towns; some came from San Pablo City and marketed tilapia either from the lakes in San Pablo City or from Laguna de Bay. Tilapia sellers from Pila, Sta. Cruz, Los Baños, Calamba, Cabuyao, Sta. Rosa and Biñan all procured the fish they sold from Laguna de Bay.

Marketing investment

Investment costs of middlemen included expenses for vehicles, weighing scales, metal tubs *(bañeras)*, foam insulated ice boxes, other containers and miscellaneous equipment and supplies. As shown in Table 2, the wholesalers had the highest average investment

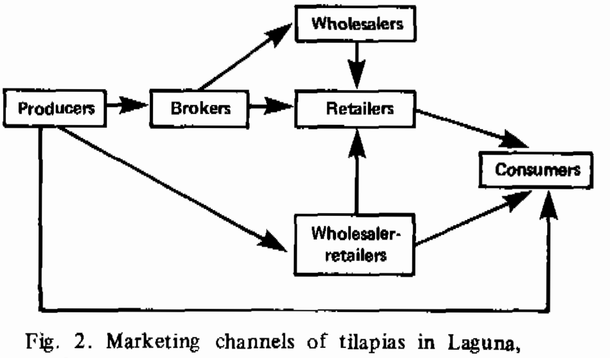

Fig. 2. Marketing channels of tilapias in Laguna, 1982.

Table 2. Average capital investment costs (in pesos) by type of marketing intermediary (n = 100), Laguna, 1982.

Capital item	Type of market seller				
	Wholesaler	Wholesaler/ retailer	Retailer	Producer/ retailer	Broker
Boat and engine	3,820	1,033	3,319	115	1,650
Tricycle	200	–	1,500	–	–
Weighing scale	131	107	103	565	80
Table	75	144	119	35	–
Chair	9	20	17	–	–
Tubs *(bañera)*	56	28	86	–	–
Bandeja	62	39	55	30	–
Baskets	20	6	13	8	8
Fish nets	1,780	–	–	–	500
Miscellaneous items[1]	89	52	58	3	8
Total	6,242	1,429	5,270	756	2,246

[1]Includes pail, knife, chopping board, flat selling baskets *(bilao)*, cooler (styrofoam), notebooks, bag, ballpens and basin.

costs (₱6,242) followed by the retailers, wholesalers/retailers and the producer/retailers with average capital investment of ₱5,270, ₱1,429 and ₱756, respectively. Vehicles (boats and tricycles) accounted for the highest capital investment of all the middlemen. The producer/retailers had the lowest average marketing investment because they did not invest in tricycles and their boats were usually unmotorized.

Tools and equipment used in tilapia marketing were few and consisted mainly of weighing scales, containers and ice boxes. None of the middlemen used cold storage facilities.

Tilapia species bought and sold

Due to differences in tastes and preferences of consumers, the majority of the tilapia sellers (47%) sold both *O. niloticus* and *O. mossambicus* species of tilapia (Table 3). Thirty-four percent of the 100 sample respondents sold only *O. niloticus* since according to them many buyers prefer this species to *O. mossambicus* due to its larger size and better taste. However, 19% of the sample respondents reported that selling *O. mossambicus* is more profitable since many low-income buyers with big families prefer this

Table 3. Tilapia species bought and sold by type of marketing intermediary (n = 100), Laguna, 1982.

Tilapia species	Wholesaler	Wholesaler/ retailer	Retailer	Producer/ retailer	Broker	All No.	All %
O. niloticus	7	4	22	1	–	34	34
O. mossambicus	2	3	12	–	2	19	19
Both species	9	9	27	2	–	47	47
Total	18	16	61	3	2	100	100

species, because it costs less than *O. niloticus* and contains more pieces/kg.

Sources of supply

The majority of the sample respondents reported that they bought and picked up the fish at the shoreline or in places where tilapia pens, cages and ponds were located; thus they had to shoulder all transportation costs (Table 4).

Only 23% (mostly retailers) of the 100 tilapia marketing intermediaries interviewed had the fish delivered to them in the public markets. They preferred this arrangement since it freed them from transportation costs and the inconvenience that goes with transporting large volumes of fish from the shoreline, pens, ponds or cages to the market place.

Methods of payment for tilapia purchased

As shown in Table 5, the majority of the tilapia sellers (77%) purchased tilapia on a consignment basis, while 15% paid cash upon purchase. Only 4% paid on credit. The marketing intermediaries reported that there was no difference in price of tilapia regardless of the method of payment.

Methods of tilapia purchase

Most of the sample respondents (54%) reported that they purchased tilapia in bulk because the majority of the producers did not sort their produce by size (Table 6). Forty-five percent preferred to buy tilapia sorted by size, since they claimed that large-sized fish are more in demand among high-income consumers.

Volume handled and prices

There were several factors that affected the price of tilapia in Laguna, chief among them being fish size, supply-demand conditions and degree of freshness.

As elsewhere in the country, the price of tilapia in Laguna Province varied by size of fish (Table 7). Since the size of fish influences the price level to a large extent, marketing intermediaries practiced sorting or grading even if they had purchased unsorted fish. Small fish commanded lower prices per kg than bigger ones. Generally, high-income

Table 4. Site where sellers bought or obtained tilapia by type of marketing intermediary (n = 100), Laguna, 1982.

Tilapia source	Wholesaler	Wholesaler/ retailer	Retailer	Producer/ retailer	Broker	All No.	All %
Shoreline	6	7	20	–	2	35	35
Public market	1	5	17	–	–	23	23
Place where cage/ pen/pond is located	7	4	19	3	–	33	33
Shoreline and where pen/ cage/pond is located	3	–	3	–	–	6	6
Shoreline and public market	1	–	2	–	–	3	3
Total	18	16	61	3	2	100	100

Table 5. Mode of payment by type of marketing intermediary (n = 97), Laguna, 1982.

Mode of payment	Wholesaler	Retailer	Wholesaler/ retailer	Broker	All No.	All %
Cash	5	6	3	–	14	15
Consignment	13	49	11	2	75	77
Credit	–	2	–	–	2	2
Cash and credit	–	2	–	–	2	2
Cash and consignment	–	2	2	–	4	4
Total	18	61	16	2	97	100

Table 6. Methods of purchase among marketing intermediaries (n = 97), Laguna, 1982.

Method of purchase	Wholesaler	Retailer	Wholesaler/ retailer	Broker	All No.	All %
Unsorted	9	33	8	2	52	54
Sorted by size	8	28	8	–	44	45
Both	1	–	–	–	1	1
Total	18	61	16	2	97	100

Table 7. Average price/kg (in pesos) of tilapia by size and by type of marketing intermediary (n = 45), Laguna, 1982.

Marketing intermediary	Small Buying price	Small Selling price	Medium Buying price	Medium Selling price	Large Buying price	Large Selling price
Wholesaler	6.45	7.25	8.02	9.15	10.59	11.00
Wholesaler/retailer	5.85	9.28	8.02	9.67	9.90	12.31
Retailer	7.55	9.84	8.30	9.91	11.11	13.50

Fish size

consumer prefer bigger and fatter fish while low-income consumers, particularly those with big families, prefer small fish. Hence *O. niloticus,* which is generally larger than *O. mossambicus,* commands higher prices.

The seasonality of supply in many, but not all municipalities, also affected the price of tilapia. Generally, the price of tilapia was lower during months of high supply and higher during months of low supply. Supply of tilapia, particularly from Laguna de Bay vicinity, was affected by climatic conditions; for example, at the onset of the typhoon season producers in or near the lake harvest their fish to prevent loss of fish from their cages, ponds or pens. The resulting oversupply of tilapia in the market brings down its price. In general, the sample respondents identified

December to March as the lean period for the supply of tilapia. Supply and price fluctuations were less of a problem in San Pablo City, because the cage/pen culturists in nearby small lakes that supply the city were less affected by variable climatic conditions.

Seasonality of demand also influenced the price of tilapia. Demand and hence prices for tilapia were high during special occasions such as fiestas, Holy Week and Christmas.

The degree of freshness also influenced the selling price of tilapia. Some sellers sold tilapias which were still alive since fresh fish was generally preferred by consumers. Consequently, most of the marketing intermediaries bought tilapia daily.

Most of the wholesalers, wholesaler/retailers, retailers, brokers and producer/retailers gave discounts to their regular buyers. The wholesalers gave discounts amounting to ₱0.30/kg or ₱3-5 per ₱100 worth of tilapia. Wholesaler/retailers gave discounts which ranged from ₱0.25 to ₱2.00/kg of tilapia. Higher discounts were given when they did wholesaling and lower discounts when they sold tilapia on a retail basis. The brokers usually gave discounts in the form of additional fish for their buyers. The retailers, on the other hand, gave discounts which ranged from ₱0.50 to ₱1.20/kg. The high discounts were only given when the retailers thought that the fish was no longer fresh or that it would spoil if it were not disposed of immediately.

Wholesalers and brokers did not give other incentives to their regular buyers. The wholesaler/retailers, the producer/retailers and the retailers reported that the only additional incentive that they ever gave to their regular buyers was free cleaning of tilapia.

Almost all of the sellers sold other types of fish as well as tilapia. The percentage of tilapia handled relative to the total volume of fish handled was more than 50% for all types of tilapia sellers (Table 8). Milkfish *(Chanos chanos)* and mudfish or snakehead *(Channa striata)* were the other species sold.

Wholesalers handled the highest volume of tilapia of all types of tilapia sellers (Table 9), ranging from 790 kg/month in the lean months to 4,475 kg/month in the peak months. Retailers traded an average of 647 kg/month during peak months and 396 kg/month during lean months.

Table 9 shows the large volume (500-600 kg/month) of tilapia that wholesalers in the Bay-Los Baños-Calamba-Cabuyao-Sta. Rosa-Biñan area were unable to sell. Unsold tilapia was either placed in a freezer and later sold at a lower price, consumed at home, given away to neighbors and friends, dried or, if it was spoiled, fed to pigs. In contrast, brokers and retailers generally had little difficulty disposing of their fish; wholesalers were exposed to greater marketing risk in this regard, not surprising really since wholesalers, more than other intermediaries, performed transport function.

Table 8. Average percentage of tilapia handled relative to total volume of fish handled, 100 market sellers, Laguna, 1982.

Type of marketing intermediary	Percentage of tilapia handled relative to total volume of fish handled
Wholesaler	67
Wholesaler/retailer	53
Retailer	78
Producer/retailer	89
Broker	54

Economics of Marketing

Marketing costs

Marketing costs incurred by the tilapia sellers were grouped into five categories: 1) labor cost incurred in sorting, packaging, loading, unloading and selling (this includes the imputed value of the labor of the marketing intermediary) which was based on the prevailing average wage rate of hired labor employed in the tilapia trade business (₱10/ day); 2) transportation costs; 3) operating cost such as market fees, licenses, stall fees, cost of packaging materials; 4) depreciation cost of capital items such as weighing scale, vehicle, stalls and containers and 5) miscellaneous costs such as fish losses and food expense.

Tilapia is usually packed in tubs *(bañeras)* or baskets *(kaings)* and transported to different markets immediately after harvest while the fish is still alive. Hence, it is sold in the form in which it is harvested. When transporting over short distances, such as that between Sampaloc Lake and San Pablo City, the tilapia sellers did not use ice. However, ice was used to preserve the quality of tilapia when transporting over longer distances. Fish retailed at stalls in public markets were arranged according to size and species. The retailers sometimes removed the ice because the consumers preferred fresh fish and the presence of ice usually means the fish *need* ice and hence are not fresh. Regardless of location, expenses for ice and wrapping materials per kg were higher among wholesaler/retailers and retailers than among wholesalers who held their fish for the shortest duration. Transport expenses varied among municipalities depending on the source of tilapia. Tables 10 and 11 present data on marketing costs by location and by type of tilapia sellers.

San Pablo City: Among the sample respondents from San Pablo City, in both the peak and lean months, retailers incurred the highest marketing cost and producer/ retailers the lowest marketing cost. All tilapia sellers reported that labor cost was their biggest expense item. The retailers incurred

Table 9. Average monthly volume in kg handled by type of middlemen during peak and lean months, 100 tilapia sellers, Laguna, 1982.

Location and type of seller	Peak month		Leanest month	
	Monthly volume Bought	Monthly volume Sold	Monthly volume Bought	Monthly volume Sold
Bay-Los Baños-Cabuyao-Sta. Rosa-Biñan				
Wholesaler	5,174	4,567	4,475	3,971
Retailer	647	647	553	553
Wholesaler/retailer	1,025	1,025	761	761
Broker	379	379	241	241
Calauan-San Pablo City-Pila-Sta. Cruz-Rizal				
Wholesaler	921	921	790	790
Retailer	476	476	396	396
Wholesaler/retailer	395	395	296	296
Producer/retailer	891	891	551	551

Table 10. Buying price, selling price, marketing cost and net marketing margin (in pesos) per kg during peak months by location and by type of seller (n = 100), Laguna, 1982.

Location/type of seller	Average selling price	Average buying price	Gross marketing margin	Marketing cost	Net marketing margin
Bay					
Wholesaler	8.68	7.75	0.93	0.75	0.18
Wholesaler/retailer	9.50	7.60	1.90	0.63	1.27
Retailer	12.00	8.89	3.11	1.08	2.03
Biñan					
Wholesaler/retailer	11.50	10.00	1.50	1.43	0.07
Retailer	11.50	10.00	2.00	0.82	1.18
Cabuyao					
Wholesaler/retailer	11.45	8.00	3.45	1.33	2.12
Broker*	6.00			0.64	
Retailer*	9.00	8.00	1.00	1.05	0.05
Calamba					
Wholesaler	8.83	7.75	1.08	0.17	0.91
Wholesaler/retailer	11.88	8.00	3.88	1.06	2.82
Broker*	8.00			0.42	
Retailer*	9.00	7.55	1.45	0.85	0.60
Calauan					
Retailer	11.38	10.12	1.26	1.15	0.11
Los Baños					
Wholesaler	8.67	7.75	0.92	0.16	0.76
Wholesaler/retailer	9.00	7.84	1.16	0.39	0.77
Pila					
Wholesaler	10.50	8.50	2.00	1.09	0.91
Retailer	12.50	10.50	2.00	1.77	0.23
Rizal					
Retailer	11.75	9.50	2.25	0.73	1.52
San Pablo City					
Wholesaler	11.00	9.50	2.00	1.40	0.60
Wholesaler/retailer	12.00	9.50	2.50	1.29	1.21
Retailer	13.40	11.50	1.90	1.56	0.34
Producer/retailer	10.33			1.10	
Sta. Cruz					
Wholesaler	10.50	8.25	2.25	0.37	1.88
Wholesaler/retailer	11.25	8.25	3.00	1.27	1.73
Retailer	12.00	10.50	1.50	1.14	0.36
Sta. Rosa					
Wholesaler	9.00	7.00	2.00	0.09	1.91
Retailer*	9.17	8.00	0.17	1.52	1.35

*Sold small-sized tilapia only.

Table 11. Buying price, selling price, marketing cost and net marketing margin (in pesos) per kg during lean months by location and by type of seller (n = 100), Laguna, 1982.

Location/type of seller	Average selling price	Average buying price	Gross marketing margin	Marketing cost	Net marketing margin
Bay					
Wholesaler	8.88	8.13	0.76	0.98	0.22
Wholesaler/retailer	12.00	10.50	1.50	0.77	0.73
Retailer	12.50	10.44	2.06	1.58	0.48
Biñan					
Wholesaler/retailer	12.17	10.50	1.67	1.44	0.23
Retailer	12.00	10.50	1.50	1.13	.37
Cabuyao					
Wholesaler/retailer	12.00	9.00	3.00	1.50	1.50
Broker*	7.00			2.03	
Retailer*	12.15	9.00	3.15	1.35	1.80
Calamba					
Wholesaler	8.83	7.86	0.97	0.18	0.79
Wholesaler/retailer	12.21	8.33	3.00	1.34	2.54
Broker*	10.00			1.55	
Retailer	12.48	10.28	2.20	0.89	1.31
Calauan					
Retailer	12.88	11.12	1.76	1.37	0.39
Los Baños					
Wholesaler	12.13	9.00	3.13	0.19	2.94
Wholesaler/retailer	10.42	8.58	1.84	0.47	1.37
Pila					
Wholesaler	12.00	9.00	3.00	1.66	1.34
Retailer	15.00	12.00	3.00	2.81	0.19
Rizal					
Retailer	13.25	11.00	2.25	0.92	1.33
San Pablo City					
Wholesaler	12.25	10.16	2.08	1.42	0.66
Wholesaler/retailer	13.38	10.16	3.22	1.35	1.87
Retailer	14.50	12.25	2.25	1.99	0.26
Producer/retailer	10.83			1.12	
Sta. Cruz					
Wholesaler	12.00	9.75	2.25	0.52	1.73
Wholesaler/retailer	13.20	9.75	3.45	1.57	1.88
Retailer	14.40	12.00	2.40	2.14	0.26
Sta. Rosa					
Wholesaler	10.00	7.33	2.67	0.74	1.93
Retailer	11.89	9.17	2.72	1.59	1.13

*Sold small-sized tilapias only.

the highest marketing cost per kg because they stayed longer in the market and had to pay their market tickets costing ₱3/day.

Calauan: Since some of the retailers selling tilapia in the public market in Calauan were from San Pablo City, transportation cost accounted for the highest percentage of their total marketing cost. They paid ₱1/day for their market tickets.

Pila: Transport cost was the major marketing cost item of the wholesalers in Pila market due to the gasoline used in transporting tilapia from Talim Island in Laguna de Bay to the shore and in moving the fish from the shore to the public market. In spite of this high transportation expense incurred by the wholesalers, retailers in this municipality had the highest marketing cost due to their higher labor expense.

Sta. Cruz: As in other municipalities, both the wholesaler/retailers and the retailers in Sta. Cruz incurred higher marketing cost than the wholesalers due to their higher labor cost. In addition, the wholesaler/retailers here had a higher depreciation cost than the wholesalers since they owned boats and engines. The marketing intermediaries paid daily market tickets which cost ₱0.50 during regular days and ₱1 during market days (Thursdays and Sundays).

Rizal: Among the towns studied in Laguna, the intermediaries in Rizal market had the lowest marketing cost incurred due to the proximity of their residences to the market and to Palakpakin Lake where they procured tilapia. Hence, there was no transportation cost incurred. Moreover, they did not use any special packing materials; instead, they just used netting which they made themselves. The cost of the daily market ticket paid (₱0.25) was the lowest among the towns studied.

Bay: The wholesaler/retailers and the retailers in Bay market incurred higher marketing costs per kg of tilapia than the wholesalers since they handled a relatively lower volume and incurred higher labor cost because they had to stay longer in the market than the wholesalers.

Los Baños: Los Baños cage culturists are one of the biggest groups of producers of tilapia in Laguna. The wholesaler/retailers in Los Baños markets had higher marketing costs per kg than the wholesalers because the latter handled a larger volume of tilapia. In Los Baños, transport expenses of the intermediaries were small due to the proximity of the public markets to the source.

Calamba: The cost/kg of marketing tilapia in Calamba also tended to be inversely related to volume handled. Being one of the major commercial centers in Laguna, expenses for wrapping materials in the area were quite high; however, transportation expenses were minimal due to the proximity of the municipality's market to the sources of supply.

Cabuyao: Marketing costs of marketing intermediaries in Cabuyao were high relative to those in Calamba. This might be due to the higher transport cost and the lower volume of fish handled in Cabuyao than in Calamba. Brokers here handled a smaller volume of fish than did wholesaler/retailers and retailers also incurred the least marketing cost since some of the operating expenses like the cost of ice and transportation were shouldered by the tilapia suppliers.

Sta. Rosa: Transport cost in Sta. Rosa was minimal because tilapia was procured from the town itself and from Biñan.

Biñan: Being engaged in both wholesaling and retailing, the wholesaler/retailers in Biñan incurred a relatively higher marketing cost than the retailers because of their higher labor cost and higher ice expense.

The sellers' gross marketing margin and profit margin

The gross marketing margin refers to the difference between the buying and selling prices. The gross marketing margin is considered important in the analysis of market performance because it is from this that expenses incurred in distributing the product are paid. In general, retailers had a higher gross marketing margin than the wholesalers (Tables 10 and 11). This can be explained by the fact that the retailers handled a smaller volume of tilapia and had to charge a higher markup/kg in order to increase their total earnings. Wholesalers earned more total income even if they charged a lower per unit margin because of the larger volume of tilapia they handled.

Problems in Tilapia Marketing

Despite the reasonable profit margins throughout the marketing chain, all marketing intermediaries faced marketing problems of one kind or another. Wholesalers reported that credit collection from their buyers was their main problem. Some complained that they incurred losses when the retailers could not pay them on time especially in the lean months. Since they were obliged to pay producers for the tilapias they procured from them the previous day, wholesalers were unable to get another supply of tilapia from the producers for the following day's transaction unless they had paid the latter. Other problems mentioned by wholesalers were losses due to errors in weighing tilapia, the refusal of retailers to buy small tilapia and the inability of retailers to purchase tilapia at high prices which lowered the price thereby narrowing their margin.

Producer/retailers mentioned that during the months when tilapia had unfavorable taste, the demand for tilapia by consumers was low. During this condition, they had no alternative but to lower the price of tilapia sometimes even far below the breakeven point.

Retailers cited several marketing problems. Fish deterioration, due to tilapias' high perishability, was a problem because consumers preferred live rather than dead tilapia. Death of the fish while still unsold forced the retailers to sell at a much lower price just to sell the fish and not end up with a lot of unsold, deteriorated fish. Another marketing problem cited was low price of tilapia during months of high supply due to competition among many sellers of tilapia. Retailers also confirmed the opinion of many producers that the different taste of tilapia in some months of the year resulted in lower market prices.

Credit collection from buyers or consumers was also reported as a marketing problem of the retailers in Rizal, Laguna. Unlike retailers elsewhere, it is the usual practice of the retailers in this municipality to sell tilapia on credit. In San Pablo City, retailers complained that they had to pay for every pail of water they used due to the poor water system in the market place. Price variability of tilapia depending upon source was another problem reported by the retailers especially in San Pablo City. For example, the price that consumers were willing to pay for tilapia coming from Sampaloc Lake was higher than for those coming from other lakes in San Pablo City.

The most common marketing problem encountered by the retailers was the lack of market stalls. Those sellers who do not have market stalls sold their fish from vacant spaces or from the roadside. This caused overcrowding so the sellers were driven away from time to time by policemen. Those with permanent stalls also complained that there were few buyers who went to their stalls to purchase tilapia because those sellers who just squatted on the roadside attracted the customers first. Those with stalls also complained of the rental fee which reduced the amount of profit they could get from their operations.

Conclusions

Tilapia marketing in Laguna is a profitable business as indicated by the profit margins of all marketing intermediaries. However, these individuals could all be assisted if a small-scale formal credit system could be instituted to facilitate cash transactions, particularly of retailers who are in direct contact with ultimate consumers.

Public markets in Laguna should also be improved by constructing additional market stalls. This will minimize overcrowding in public markets in the province.

The profit margin or the net marketing margin for wholesalers, wholesaler/retailers and retailers was obtained by subtracting all marketing costs from the gross marketing margin. The brokers, however, were not included in this computation of gross marketing margin and profit margin because they did not buy any of the fish they handled, but rather operated on a commission basis as the producers' representatives to facilitate the transaction. Likewise, the producer/retailers did not buy the fish they handled.

Among the 11 towns studied in Laguna, during the peak months, the wholesaler/retailers in Calamba obtained the highest net marketing margin (₱2.82/kg) while the retailers in Cabuyao had the lowest net marketing margin (₱0.05/kg). In the lean months, the wholesalers in Los Baños obtained the highest net marketing margin (₱2.94/kg) while the retailers in Pila had the lowest net marketing margin (₱0.19/kg). It can also be noted that the net marketing margins of wholesaler/retailers in Calamba were among the highest in both the peak and the lean months. It can also be noted that although the retailers in Laguna had the highest markup, the net marketing margins per kg that they got from tilapia sales were considerably lower than those of all wholesalers, except those in Bay and Calamba. This can be attributed to their higher marketing costs/kg and the lower volume of tilapia they handled.

Acknowledgements

The authors wish to express their sincere appreciation to the following: ICLARM and PCARRD for the financial support which made this study possible; the College of Development Economics and Management, U.P. at Los Baños, for all the facilities made available to the authors during the conduct of study; Mrs. Milagros Acosta for her help in the data tabulation; and lastly, all the respondents in Laguna Province for their cooperation during the data collection phase of this study.

Appendix: Definitions of Marketing Intermediaries

1. *Brokers* were considered agents of tilapia producers and tilapia dealers, because they do not own the fish they sell, but only act as an intermediary between tilapia suppliers and all types of buyers. They receive fish from the producers on consignment basis. In this study, the brokers used wholesalers and wholesaler/retailers as outlets.
2. *Wholesalers* were middlemen who bought fish in fairly large quantities. In contrast to the brokers, they took ownership of the fish they handled thereby assuming more risk. They used wholesaler/retailers and retailers as outlets.
3. *Wholesaler/retailers* were those who bought fish in fairly large quantities and sold mostly to retailers with a minimum amount to consumers.
4. *Retailers* were those who sold their tilapia to the ultimate consumers. They make buying easy and convenient for consumers.
5. *Producer/retailers* were the producers who sold the tilapia directly to the consumers.

Tilapia Marketing in Mindanao, Philippines

LYDIA P. OLIVA

Associate Professor
Southern Mindanao Agricultural Research Center
University of Southern Mindanao
Kabacan, North Cotabato
Philippines

OLIVA, L.P. 1985. Tilapia marketing in Mindanao, Philippines, p. 219-231. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

The marketing system for tilapia in selected areas of Mindanao, Philippines, was examined. Marketing channels for tilapia were found to vary from no intermediary to at most three intermediaries before the produce reached the consumers. Over one-third of the total produce was sold through the longest route, i.e., through the wholesaler/retailer and finally the consumers.

Marketing margins for retailers were relatively high, ranging from ₱0.53/kg to ₱3.11/kg. In most cases, the wholesalers and wholesalers/retailers were receiving comparatively high margins. This is indicative of the relative profitability of tilapia marketing in the selected areas. (₱11.00 = US$1.00 in 1983)

Marketing problems that beset a few producers included, among others, the high costs of transportation, low price and no storage facilities. The majority, however, had no marketing problems. Meanwhile, the most prominent problems identified by a few traders were lack of capital, no storage facilities, high transport costs and sometimes lack of transportation facilities.

Introduction

Tilapia is gaining popularity and importance among the fish in the Philippines. This may be so because of its characteristics, i.e., fast growing, resistant to diseases, adaptable to a wide range of environment, fast to reproduce and good eating quality (Talusan 1954; Devamkez 1964; Radan 1977; Villadolid et al. 1974; Alvarez 1978; Guerrero 1978 and Wohlfarth et al. 1981).

Mindanao has vast water resources for tilapia culture. It has three of the six major lakes in the Philippines namely: Lakes Mainit, Buluan and Lanao. A knowledge of tilapia culture, along with the resources, is necessary to satisfy the fish needs of the regions of Mindanao.

However, production would be futile without an efficient marketing system. While fish farms may be able to optimize the use of available water resources through tilapia culture, the benefits that should accrue to them may not be realized if the existing marketing system is inefficient. Thus, the development approach to the tilapia industry should include the concept of total production in which marketing is also considered.

Significance of the study

One problem that besets Philippine fisheries is the inadequate marketing system of the industry (Sevilleja et al. 1978). Coupled with this is a dearth of data and information which may be used in providing an in-depth analysis of the present marketing system, its structure, conduct and efficiency.

Information on market performance and marketing problems of the tilapia industry in Mindanao may provide planners and policymakers, such as those from the Ministry of Human Settlements, information which may be useful in the implementation of tilapia-related projects, as well as in the development of strategies that will improve the existing marketing system.

Objectives of the study

The study sought to analyze the marketing system of tilapia in selected areas in Mindanao. Specifically, the objectives of the study were:

1. To determine the marketing practices, market outlets and channels of distribution of tilapia produce;
2. To estimate the marketing costs and margins at various market levels or outlets;
3. To describe the method of selling tilapia; and
4. To determine the marketing problems encountered by tilapia producers and buyer/sellers.

Methodology

Source of data

The data used in the study were gathered from 121 operators of tilapia cages, pens and ponds in Lakes Buluan, Sebu and Lanao del Sur and about 96 randomly selected fish traders operating in Buluan, Tacurong, Surallah, Marbel and Marawi City. The municipalities and city involved were identified among the outlet areas for the tilapia produced in the corresponding lakes considered.

Method of data gathering

The questionnaires used to gather the necessary data for this study were pre-tested and revised before the actual survey was conducted. Two sets of questionnaires were used; one for the cage/pens/pond operators and another for the traders. The questionnaire for producers included questions about the marketing aspect of their operation. The questionnaire for the traders included questions on demographic characteristics of the respondents, their marketing practices, marketing costs, volume of operation and marketing problems.

Secondary data used in the study were collected from the Bureau of Fisheries and Aquatic Resources (BFAR) and the Southern Philippines Development Authority (SPDA).

Method of analysis

Frequency counts, percentages and averages were used to describe the marketing practices, costs, production, marketing margins and problems. A graphic presentation of the marketing channels for tilapia was also used.

Results and Discussion

The producers

Market Outlet: For the sole large producer from Lake Buluan, the only identified outlet was the wholesaler. Meanwhile, 71% of the producer respondents in Lake Sebu sold their produce to wholesalers, 15% to wholesaler/retailers, 12% to retailers and only 2% directly to consumers. On the other hand, about 73% of the producers in Lake Lanao sold their produce to retailers and the rest to wholesalers and consumers (Table 1).

Place, Method of Sale and Mode of Payment: Producers from Lakes Buluan and Sebu sold their produce to buyers who picked up their fish from the fishfarm; about 95% of the respondents in Lake Lanao did the same. The producer of Lake Buluan was paid in cash as were the majority in Lakes Sebu and Lanao (Table 2).

The tilapia producer in Lake Buluan sold his produce to the wholesalers, retailers and wholesaler/retailers by bunch or by size. In Lake Sebu where the ultimate outlets of the

Table 1. Type of outlet and method of sale for producers of the three Mindanao lakes (percentages shown by lake).

Type of buyer	Method of sale					
	Picked up			Delivered		
	Buluan	Sebu	Lanao	Buluan	Sebu	Lanao
Wholesaler	100	100	75	–	–	25
Retailer	–	100	82	–	–	18
Wholesaler/retailer	–	100	–	–	–	–
Consumer	–	100	100	–	–	–

Table 2. Mode of payment by type of buyer and location (percentages shown by lake).

Type of buyer	Mode of payment								
	Cash			Credit			Cash and credit		
	Buluan	Sebu	Lanao	Buluan	Sebu	Lanao	Buluan	Sebu	Lanao
Wholesaler	100	93	92	–	–	–	–	7	8
Retailer	–	71	93	–	–	5	–	19	2
Wholesaler/retailer	–	100	–	–	–	–	–	–	–
Consumer	–	100	100	–	–	–	–	–	–

producers were in the municipalities of Surallah and Marbel, buyers bought the produce by weight and/or according to size of fish. Lanao buyers bought by box, weight, bunch or size. A greater proportion of the retailers in this lake bought tilapia sorted according to different sizes.

Most of the buyers from Buluan and Tacurong municipalities bought at the shoreline or from ponds and cages right at the producers' place. For Surallah and Lanao buyers, a few obtained fish through delivery, or from the public market but the majority also went to the producers' site.

The traders

Selected Demographic Characteristics: Of the 96 traders interviewed, 71% were male and 29% female (Table 3). About 90% of all

Table 3. Selected demographic characteristics (in %) of tilapia traders.

Item	Wholesaler	Retailer	Wholesaler/ retailer	Total
Sex				
Male	96	69	52	72
Female	4	31	48	28
Civil status				
Single	4	11	4	7
Married	96	82	96	90
Separated/widow(er)	0	7	0	3
Educational attainment				
None	0	4	17	6
Arabic	15	18	21	18
Primary	0	2	17	5
Elementary	35	42	13	32
Secondary	35	31	38	33
College level	15	2	0	5
Age				
25-below	4	13	8	9
26-35	27	49	42	41
36 or more	69	38	50	50
Years of residence				
30-below	38	36	33	35
31-40	42	49	21	40
41 or more	20	16	46	25
Household size				
5-below	46	58	38	49
6-10	42	40	54	44
11 or more	12	2	13	7

respondents were married; only 6% did not have any formal schooling. About half of them were 36 years old and above; almost half had a family size of less than five.

Income Sources: About 88% of all respondents considered fish trading as their primary source of income while 6% earned their living mainly from farming. On the average, traders from Surallah earned more from fish trading than those from Buluan and Marawi City (Table 4).

Tilapia trading

Proportion of Trade: Table 5 shows the proportion of tilapia to other fish bought and sold by trader respondents. All wholesalers from Surallah and Marbel were engaged only in tilapia trading while retailers handled 89% tilapia. Tilapia also constituted 92% of the total fish traded by wholesaler/retailers.

Tilapia was less important to traders in Buluan and Tacurong, where only 22% of the total volume handled by wholesalers

Table 4. Average weekly income (in pesos) from fish trading by type of buyer/seller and location.

Location	Wholesaler	Retailer	Wholesaler/ retailer	Average
Buluan	186	245	110	180
Surallah	247	169	200	205
Marawi City	173	84	124	127

Table 5. Tilapia as a proportion (%) of all fish bought and sold by type of buyer and location.

Locality	Type of buyer	Proportion of tilapia
Surallah/Marbel	Wholesaler	100
	Retailer	89
	Wholesaler/retailer	92
	Ave.	94
Buluan/Tacurong	Wholesaler	22
	Retailer	24
	Wholesaler/retailer	34
	Ave.	27
Marawi City	Wholesaler	39
	Retailer	38
	Wholesaler/retailer	41
	Ave.	39
Overall average		53

were tilapia and the rest were other freshwater fish like mudfish (*Channa striata* or *dalag*) or catfish *(hito)*. For the retailers and wholesaler/retailers, only 24 and 33%, respectively, of the fish handled were tilapia. Marawi traders had a slightly higher degree of concentration on tilapia.

Comparing the foregoing results, fish trading in Surallah was more specialized than in Marawi and Buluan. This may be one way of lessening competition among buyers and sellers in the area.

Volumes Traded and Prices: Tables 6 and 7 summarize the volume and price data for various locations and types of traders. As expected, wholesalers handled larger volumes of fish than other traders. Prices paid in Buluan and Surallah were lower than in Marawi because of the proximity of producers to these former towns. Other fish sources were also available in Buluan and Surallah.

Marketing Channels: Fig. 1 shows the marketing channels for tilapia from Lake Buluan. The shortest route observed had one

Table 6. Average tilapia volume purchased per week and average price (1983) by different types of traders and sources. (₱11.00 = US$1.00 in 1983)

		Source			
		Farmer		Wholesaler	
Locality	Type of trader	Vol (kg)	Price (₱/kg)	Vol (kg)	Price (₱/kg)
Buluan	Wholesaler	3,522	5.35	1,724	5.68
	Retailer	387	4.60	335	5.55
	Wholesaler/retailer	73	4.94	156	5.46
Surallah	Wholesaler	207	5.86	1,159	6.00
	Retailer	39	6.84	104	6.03
	Wholesaler/retailer	113	6.00	388	6.25
Marawi	Wholesaler	79	9.63	2,625	11.25
	Retailer	74	8.90	3,011	10.31
	Wholesaler/retailer	175	8.63	333	11.00

Table 7. Average tilapia volume sold per week per trader and price received by different types of traders. (₱11.00 = US$1.00 in 1983)

		Buyer			
		Retailer		Consumer	
Place	Type of seller	Ave. vol. (kg)	Price (₱)	Ave. vol. (kg)	Price (₱)
Buluan	Wholesaler	1,068	6.78	–	–
	Retailer	–	–	151	7.43
	Wholesaler/retailer	100	6.55	156	6.65
Surallah	Wholesaler	169	7.48	–	–
	Retailer	–	–	34	8.50
	Wholesaler/retailer	141	7.31	96	8.75
Marawi	Wholesaler	107	11.70	–	–
	Retailer	–	–	11	13.55
	Wholesaler/retailer	188	11.50	58	13.16

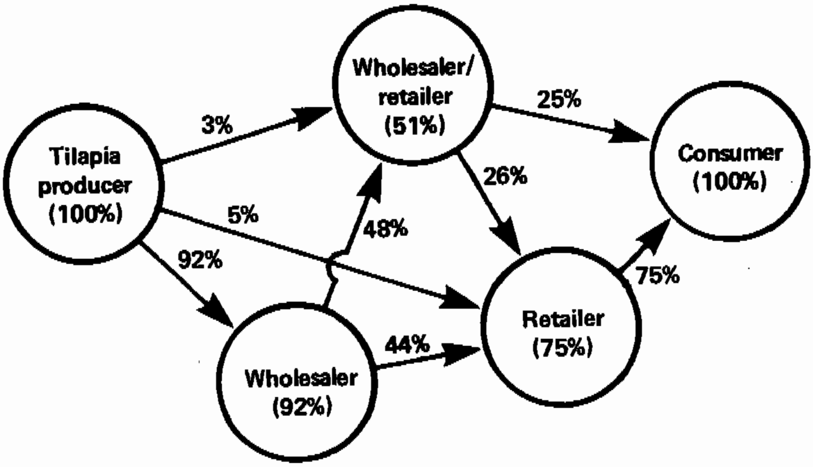

Fig. 1. Marketing channels for tilapia from Lake Buluan.

intermediary, i.e., either the wholesaler/ retailer or the retailer before tilapia reached the consumers. The longest channel noted included three intermediaries, namely: the wholesaler, the wholesaler/retailer and the retailer. This route involved around 43% of the total volume of fish sold by producers.

Figs. 2, 3 and 4 likewise show the channels of distribution of tilapia from Lakes Sebu and Lanao and for all the lakes under consideration. Unlike in Lake Buluan, for Lakes Sebu and Lanao only about 1% of the total volume sold by tilapia producers reached the consumers directly with no intermediary involved. However, the longest route also included the three intermediaries mentioned for Buluan. These routes involved about 29 and 43% of the total volume sold by producers in Lakes Sebu and Lanao, respectively. Taken as a whole, the lakes had an average

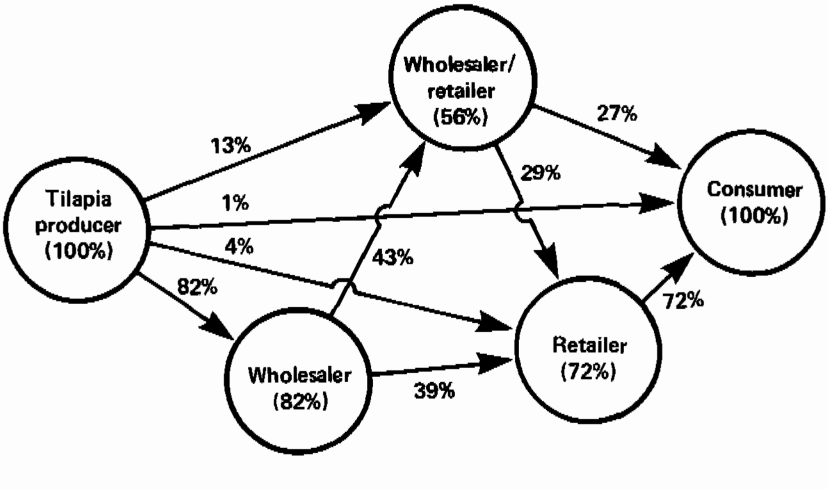

Fig. 2. Marketing channels for tilapia from Lake Sebu.

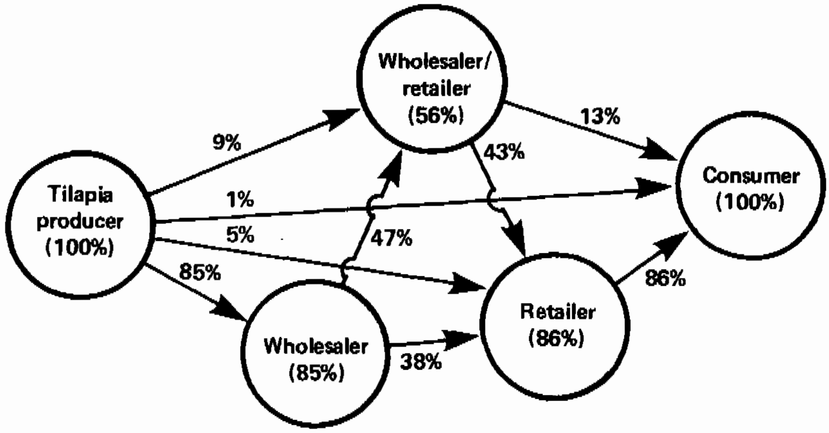

Fig. 3. Marketing channels for tilapia from Lake Lanao.

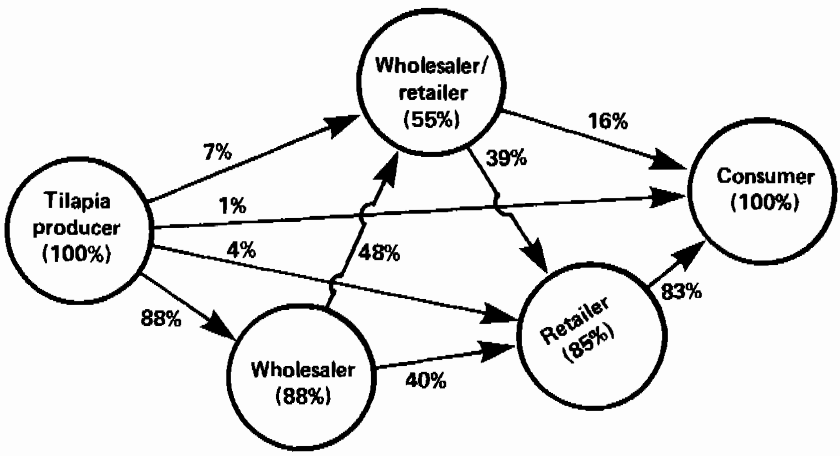

Fig. 4. Marketing channels for tilapia from Lakes Buluan, Sebu and Lanao.

of 39% of the total volume sold passing through the longest route which involved three types of intermediaries.

Labor Use: Tilapia marketing is a labor intensive activity (Table 8). In Buluan and Tacurong, looking for prospective fish sources was a major activity of the wholesalers, occupying an average of 3.4 man-days of their own and hired labor per week. As expected, the major activity of the retailers was selling which comprised about half of total man-days spent by this group. A similar trend was observed in the labor utilization of traders in Surallah and Marawi.

Marketing Costs: Marketing costs incurred by the traders per week included labor (cash and non-cash or unpaid family labor), transportation costs, packing materials and others (Table 9). For Buluan respondents, labor costs topped all other items, followed by transport cost (for wholesalers) and permit and licenses. Depreciation charges of fixed investment and equipment were minimal because capital expenditure for fish trading is very low. In the other areas, a similar trend was also observed although the wholesalers tended to spend more for transportation than any other type of trader, because they had to pick up the produce themselves from the producers.

In terms of the average marketing cost per kg of fish, the highest at ₱2.03/kg, was incurred by retailers from Surallah, followed by the wholesalers/retailers from Buluan. Marketing costs were lowest for wholesalers, because the volume that they handled was usually large and therefore some economies of scale in fish trading prevailed.

The average net marketing margins after deducting costs from markups for the different traders are presented in Table 10. The results imply that buying and selling tilapia is generally profitable. In fact, the wholesalers seemed to be the ones getting the most benefit from the business considering the bulk of tilapia they handled. Referring back to Table 7, since the average weekly volume of fish sold by wholesalers in Buluan was 1,067 kg for wholesalers, then the wholesalers' net return per week above all costs would amount to ₱1,067. Wholesaler/retailers here would be losing, but in all areas on average would still be earning profits.

Marketing Problems

Producers' level

The tilapia cage operators in Lake Buluan did not experience any marketing problem for their produce. However, for Lake Sebu, low price offered was a problem identified by the growers, but even here, 80% of the respondents did not consider marketing as a problem. Low price was also cited as the marketing problem of those in Lake Lanao followed by high cost of transportation.

Table 8. Average man-days of labor per week used, by location and type of traders.

Type of buyer	No. of respondents	Activity: Looking for prospective sources of supply	Acquiring fish	Hauling/ transporting	Selling	Total
Buluan/Tacurong						
Wholesaler	5	3.4	1.4	2.1	3.4	10.3
Retailer	5	2.8	0.7	2.4	5.8	11.7
Wholesaler/retailer	15	2.1	1.2	2.2	9.4	15.0
Surallah/Marbel						
Wholesaler	9	1.1	0.8	1.4	1.5	4.7
Retailer	14	0.9	0.4	0.2	5.2	6.7
Wholesaler/retailer	6	1.7	1.1	1.5	3.8	8.0
Marawi City						
Wholesaler	10	2.8	1.5	0.8	1.5	6.6
Retailer	26	1.4	0.8	1.2	5.2	8.6
Wholesaler/retailer	5	1.4	0.6	0.9	4.1	7.1

Table 9. Average marketing costs (pesos per week) by type of traders and location. (₱11.00 = US$1.00 in 1983)

Marketing cost item	Buluan			Surallah			Marawi		
	Wholesaler	Retailer	Wholesaler/ retailer	Wholesaler	Retailer	Wholesaler/ retailer	Wholesaler	Retailer	Wholesaler/ retailer
Labor (cash and non-cash)	772	175	224	70	100	120	99	129	106
Transportation	332	29	51	155	–	58	222	19	10
Packing materials	4	15	19	5	11	17	47	9	10
Permit and licenses	133	120	109	145	147	104	94	112	133
Taxes	52	70	2	14	14	5	21	14	14
Stall rental	–	14	12	41	5	5	29	5	–
Other costs (interest, *tongs,* losses due to spoilage)	56	27	14	6	11	5	8	22	11
Depreciation	0.38	0.12	0.17	0.85	0.12	0.17	2.45	1.10	1.08
Total costs	1,350	388	432	435	289	314	597	311	382
Ave. costs/kg	.26	.54	1.65	0.32	2.03	.63	0.22	0.83	0.75

Table 10. Average net marketing margin (₱/kg) of traders by location. (₱11.00 = US$1.00 in 1983)

Place	Type of buyer/ seller	Selling price	Buying price	Gross margin	Marketing costs	Net margin
Buluan/Tacurong	Wholesaler	6.78	5.52	1.26	0.26	1.00
	Retailer	7.42	4.97	2.45	0.54	1.89
	Wholesaler/ retailer	6.80	5.20	1.40	1.65	(0.25)
Surallah	Wholesaler	7.48	5.93	1.55	0.32	1.23
	Retailer	9.00	6.44	2.56	2.03	0.53
	Wholesaler/ retailer	7.90	6.13	1.77	0.63	1.14
Marawi City	Wholesaler	11.70	10.43	1.27	0.22	1.05
	Retailer	13.55	9.61	3.94	0.83	3.11
	Wholesaler/ retailer	12.33	9.81	2.53	0.75	1.78
Overall average	Wholesaler	8.65	7.58	1.07	0.33	0.74
	Retailer	9.99	7.39	2.60	0.91	1.69
	Wholesaler/ retailer	8.94	7.57	1.37	1.04	0.33

Traders' level

Among traders, the first three most frequently cited problems in the Buluan/Tacurong area were: 1) lack of storage facilities, 2) lack of capital and 3) shortage of supply of fish. For the traders in Lake Sebu, lack of capital was the most frequently mentioned problem followed by high transport costs and/or lack of transport facilities and price fluctuation. For Lanao, the major problem was lack of capital, followed by lack of storage facilities. The majority of the Lake Lanao traders, however, thought they had no marketing problem at all.

These results imply that to date marketing has not posed a major problem. Hence, the prospect for tilapia in these areas and perhaps in the neighboring communities may still be considered bright and there is still room for expansion.

Consumer Preferences

Table 11 shows the preferences of consumers between the two major tilapia species as perceived by the traders. For Buluan, the preference was *Oreochromis niloticus* because of its larger size, while for Surallah and Marawi, it was *O. mossambicus* because it was considered tastier.

Table 11. Consumers' preference (in %) as perceived by traders.

Item	Buluan	Surallah	Marawi
Preference:			
O. niloticus	69	34	27
O. mossambicus	31	66	71
None (like both)	0	0	2

Recommendations

Tilapia marketing in the identified areas posed no serious problems. The marketing system seems to be operating efficiently considering the very few and not so serious problems encountered by most concerned parties. However, to minimize the use of longer-than-necessary routes in the marketing of tilapia, marketing or vendors' associations could be established. In this manner, producers could sell their produce collectively and perhaps take the role of the wholesaler or other intermediaries, thus enabling them to benefit from the margins that intermediaries presently earn.

Market structure seemed to vary by areas; therefore, it is highly probable that the market behavior may also be different in other areas of Mindanao. Additional marketing studies are needed in other areas. Moreover, consumer respondents should be included in future studies to measure consumers' preferences as far as the different species of tilapia are concerned. While the fish may be very acceptable in Luzon and Visayas, this may not be so in some sectors of Mindanao, considering the wide variety of fish available at a much lower price.

Acknowledgements

The author wishes to extend gratitude to ICLARM-PCARRD for providing financial assistance; to Drs. Corazon Aragon, Ian Smith and Elvira Tan who had been mainly responsible for the inclusion of the study in their project; to Asst. Director Seni Macabalang (BFAR, Region XII) and Cesar Pagdilao (PCARRD) for their helpful comments and suggestions; and to Ellyn, Sylvia, Nul, Sugra and Mapiamama for helping in the data collection and collation.

References

Alvarez, R.C. 1981. Growing tilapia in floating cages. Greenfields 11(12): 8-10.

Devamkez, L.C. 1964. *Tilapia mossambica* Peters. Current Affairs Bulletin. Indo-Pac. Fish. Coun. FAO-UN, Bangkok, Thailand.

Guerrero, R.D. III. 1978. Cage culture of Nile tilapia. Agrix Publishing Corporation, Philippines.

Radan, R.R. 1977. The floating cages of Lake Bunot, San Pablo, Laguna. Greenfields 7(4): 46.

Sevilleja, R.C. and E.W. McCoy. 1978. Fish marketing in Central Luzon, Philippines. R and D Series No. 21. International Center for Aquaculture. Auburn University, Auburn, Alabama.

Talusan, V. 1954. Tilapia culture. Sunday Times Magazine, Philippines (27 June 1954): 12.

Villadolid, D.V. and P.A. Acosta. 1974. Raising tilapia for food and profit. Bureau of Fisheries and Aquatic Resources, Philippines. 9 p. (mimeo)

Wohlfarth, G.W. and G.I. Hulata. 1981. Applied genetics of tilapias. ICLARM Studies and Reviews 6, 26 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

Philippine Tilapia Marketing in the Context of Structural Demand for Protein: A Comment

LEONARDO A. GONZALES

International Rice Research Institute
Los Baños, Laguna, Philippines

GONZALES, L.A. 1985. Philippine tilapia marketing in the context of structural demand for protein: a comment, p. 232-237. *In* Smith, I.R., E.B. Torres and E.O. Tan (eds.) Philippine tilapia economics. ICLARM Conference Proceedings 12, 261 p. Philippine Council for Agriculture and Resources Research and Development, Los Baños, Laguna and International Center for Living Aquatic Resources Management, Manila, Philippines.

Abstract

Prepared and presented as a comment on the four tilapia marketing papers at the Philippine tilapia economics workshop, this paper discusses the apparent profitability of tilapia marketing in the context of market structure and demand for protein. It is suggested that estimation of structural demand relationships for tilapia will help clarify the production and marketing strategies that are necessary to support the young tilapia industry.

Introduction

The four research papers in this volume (Torres and Navera; Aragon et al.; Escover et al.; and Oliva) on tilapia marketing in the different regions of the Philippines presented a very "rosy picture" of the tilapia trade. This is very encouraging considering that the commodity competes with many different fish species with traditionally established markets.

The majority of these papers also agreed that the tilapia marketing chain was short and very simple, i.e., the product emanated from the producers to wholesalers, then to retailers and finally to the consumers. Of course, there were slight variations like the producer/retailer category in the case of Laguna Province and the producer/wholesaler/retailer as in Bicol, but other than these the functions in the marketing channel were relatively well delineated.

It is expected that due to regional diversity in culture and eating habits among regions in the Philippines, that tastes and preferences also vary. This was reflected in the preference for specific species due to size, freshness and taste. In Metro Manila as well as the Laguna area, for example, consumers generally preferred the relatively larger-sized tilapia. In contrast, in the Central and Northern Luzon provinces, like Nueva Ecija, Nueva Vizcaya, Isabela and Cagayan, the market-size tilapias were relatively smaller.

The fact that there were no overwhelming problems in tilapia marketing is an indication that the young industry is heading in the right direction. The presence of relatively high marketing margins in tilapia trade, especially among retailers, implies that there is still room for volume expansion in tilapia trade. For retailers, the marketing margins ranged from ₱0.77/kg in Laguna to ₱2.82/kg in Central Luzon (Table 1). Wholesalers likewise were also making positive marketing margins ranging from ₱0.58/kg (Metro Manila) to ₱2.96/kg (Central Luzon). Regionwise, Central Luzon had the highest marketing margins among the different trading categories. This is understandable since geographically, the region has very limited access to the sea.

In terms of the volume of tilapia traded as a proportion to total fish being marketed by the traders interviewed, Laguna, Bicol and Mindanao had the highest percentage ratios ranging from 43% (Mindanao) to 91% (Bicol). Metro Manila had the lowest proportion of tilapia to other fish traded (10-36%) followed by Central Luzon with a range of 30 to 40% (Table 2). These figures imply that at least in

Table 1. Marketing margins (₱/kg) for various types of tilapia traders, by different regions in the Philippines, 1983. (₱11.00 = US$1.00 in 1983)

Category	Metro Manila	Central Luzon	Laguna	Bicol	Mindanao
Wholesaler	0.58	2.96	1.35	–	0.74
Wholesaler/retailer	0.44	1.38	1.44	0.23	0.33
Retailer	1.60	2.82	0.77	1.21	1.69
Producer/retailer	–	–	–	–	–
Producer/wholesaler/retailer	–	–	–	1.00	–

Source: Torres and Navera (this vol.); Aragon et al. (this vol.); Escover et al. (this vol.) and Oliva (this vol.).

Table 2. Proportion of the volume of tilapia traded as percent of all fish traded by respondent traders, by category of traders and different regions in the Philippines, 1983.

Category	Metro Manila	Central Luzon	Laguna	Bicol	Mindanao
Wholesaler	10	33	67	–	58
Wholesaler/retailer	10	30	52	79	49
Retailer	36	40	78	66	43
Producer/retailer	–	–	54	–	–
Producer/wholesaler/retailer	–	–	–	91	–

Source: Torres and Navera (this vol.); Aragon et al. (this vol.); Escover et al. (this vol.) and Oliva (this vol.).

some areas, tilapia trading specialists and emphasis have already emerged.

The above empirical findings on tilapia marketing in the Philippines seem to suggest that this is the best time to think about the configuration of the tilapia trade that should emerge in the future. As the industry expands in the future, and there are indications that it will, what other forms of tilapia products or by-products can be envisioned in the market? Is there room for processed tilapia for domestic consumption and for export? To answer some of these questions it is necessary to understand the current tastes and preferences of consumers and how these would evolve in the future. In short, there is a need to understand the structural demand for tilapia.

Structural Demand for Tilapia

Recent research has begun to provide some information that is relevant to the future of the tilapia industry. This includes research on:

a) trends of per capita rates of use in total seafood consumption from 1970 to 1980;
b) the relative competition between *bangus* and tilapia consumption;
c) descriptive statistics on total fish consumption by income group; and
d) the estimated demand parameters for total fish consumption.

Per capita rates of use in total seafood consumption from 1970 to 1980 indicate a decline from almost 40 kg/capita/annum in 1970 to around 25 kg/capita in 1980 (Fig. 1). Fresh and frozen seafood which comprised the bulk of total seafood followed this declining trend. Per capita rates of use for smoked and dried fish remained constant while per capita rates for canned consumption was very low. On the supply side, the fishery subsector had some increases over the 1970 decade but the cost of living as represented by the Consumer Price Index (CPI) tripled from 1970 to

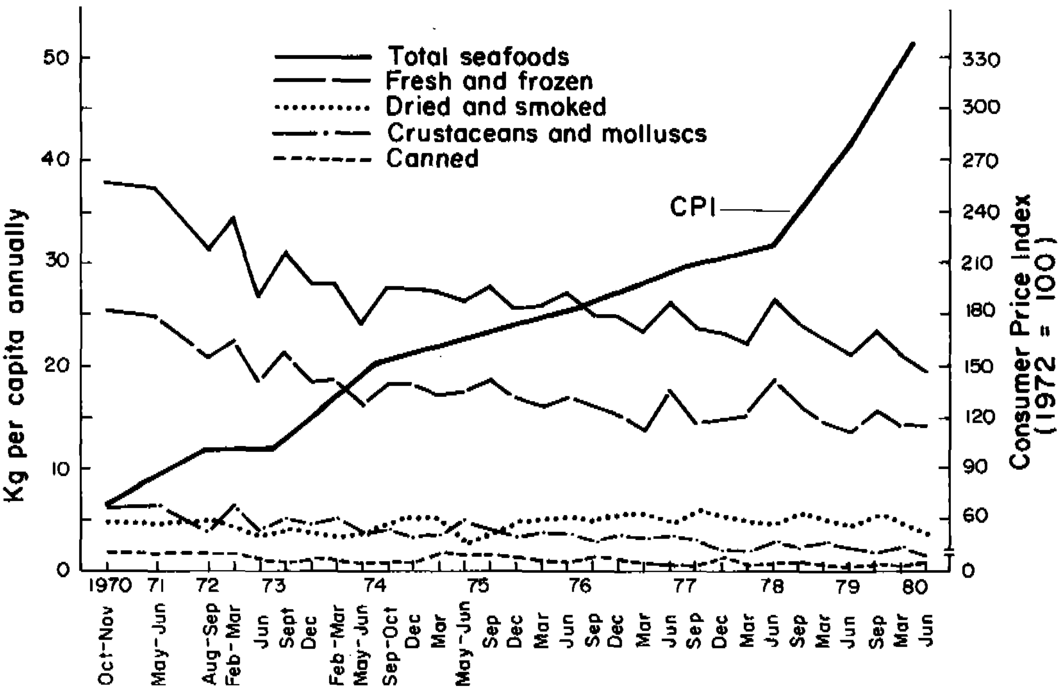

Fig. 1. Average annual per capita rates of use, seafood and related products, 31 surveys, Philippines, 1970-1980. (Source: Food Consumption Surveys, Special Studies Division, Ministry of Agriculture).

1980, eroding the purchasing power of consumers as eventually shown in the declining per capita consumption.

Of the cultured fish, milkfish (*Chanos chanos* or *bangus*) has dominated the market over the years. This can be shown by the relatively higher per capita consumption of milkfish from 1970 to 1976 (unfortunately, data were not available to continue the series to 1980) in contrast to tilapia (Fig. 2). During this period milkfish was 10% of total fish consumed in the country in contrast to only 2% for tilapia. However, production indicators for cultured fish since 1977 show the slight substitutability of tilapia for milkfish.

Selected descriptive statistics on total fish consumption for the Philippines from 1973 to 1976 indicate that the first quartile (I) low income group had a per capita consumption of 0.604 kg of total fish/week or 31.4 kg/capita/year (Table 3). Of this, milkfish comprised 7.45% in contrast to 2.3% per capita share for tilapia. Among the highest income group (IV), total fish consumption was around 42.3 kg/capita/year. In this income grouping, milkfish consumption share was around 13.7% in contrast to tilapia which was only 2.9%.

In terms of per capita income spent on food, the highest percent proportion at all levels of income was for rice; fish was next, followed by meat. The percent share of total per capita food expenditure on fish was almost stable across levels of income grouping; this was decreasing for rice while percent of total per capita food expenditure spent on

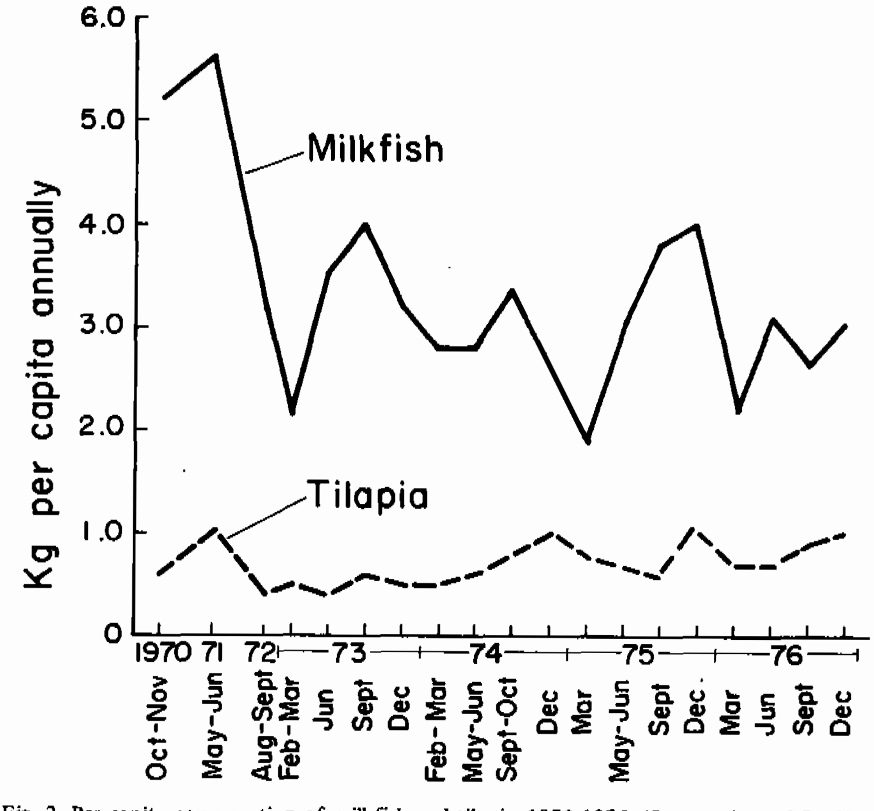

Fig. 2. Per capita consumption of milkfish and tilapia, 1970-1976. (Source: Special Studies Division, Ministry of Agriculture).

Table 3. Selected descriptive statistics on total fish consumption by income stratum, 15 surveys of the Special Studies Division (Food Consumption Surveys), 1973-1976, Philippines. Source: Regalado (1984).

Statistic	Income groups I (lowest)	II	III	IV (highest)	Average/ total
Weekly ave. per capita quantity consumed (kg)					
Total fish	0.60	0.69	0.79	0.81	0.73
Milkfish quantity (kg)	0.05	0.07	0.09	0.11	0.08
% of total fish	(7.45)	(9.51)	(10.72)	(13.76)	(10.61)
Tilapia quantity (kg)	0.01	0.02	0.03	0.02	0.02
% of total fish	(2.32)	(3.02)	(3.40)	(2.95)	(3.03)
% of per capita income spent for					
Fish	21.19	11.22	7.92	4.79	11.38
Meat	17.37	11.07	9.46	7.51	11.42
Rice	50.65	21.68	13.41	6.63	23.36
% of total per capita food expenditure spent for					
Fish	13.51	14.49	14.44	14.26	14.17
Meat	9.50	12.80	15.75	21.02	14.68
Rice	31.51	29.44	26.66	21.28	27.30
% of consuming sample households					
Total fish	83.16	86.63	86.78	85.95	85.71
Milkfish	19.95	27.65	33.13	40.65	30.68
Tilapia	6.78	9.46	9.43	9.62	8.01

meat increased as income levels increased. Finally, fish was consumed by 83-87% of consuming households. Milkfish was highly favored by higher income consumers over tilapia during the survey period.

Table 4 shows the demand parameter estimates (elasticities) for total fish demand by income groups. As expected, own-price elasticity of demand for total fish was highly elastic at low incomes and was less elastic at higher incomes. The table also shows that fish is highly substitutable with meat and such substitutability increases among the high income groups (III and IV). Finally, the consumption of total fish is more elastic at lower levels of income than at high income levels.

Conclusions

The above structural demand relationships, when specifically estimated for tilapia, can assist in evolving tilapia production and marketing strategies in the future. It is hoped that the encouraging positive signs of tilapia production-marketing-consumption will be sustained in the years to come.

Table 4. Estimated demand elasticities for total fish by income stratum, based on data from 15 surveys of the Special Studies Division (Food Consumption Surveys), 1973-1976, Philippines. Source: Regalado (1984).

Demand elasticity	Income groups I	II	III	IV	Average
Own-price elasticity	−1.4441***	−0.9508***	−0.8888***	−0.4800***	−0.9976***
Cross-price elasticity with					
rice	0.2800***	0.1464*	0.0599 n.s.	0.1832*	0.1774***
meat	0.4968***	0.2714**	0.5000***	0.9201***	0.5048***
Income elasticity	0.4673***	0.3977***	0.2406*	0.0636	0.3843***

***Highly significant at 1% level.
**Significant at 5% level.
*Significant at 10% level.
ns Not significant.

Reference

Regalado, B.M. 1984. The distributional impacts of food policies on human nutrition in the less developed countries; the case of the Philippines. College of Development Economics and Management, University of the Philippines, Los Baños, College, Laguna. M.S. thesis.

Working Group Reports

Four working groups met to consider economic, technical and institutional issues related to constraints to expansion of the tilapia industry, technology transfer, roles of private and public sectors including development and management policies, and recommendations for research.

- GROUP A : Inputs
- GROUP B : Lake-based production systems
- GROUP C : Land-based production systems
- GROUP D : Marketing

GROUP A : INPUTS

Members : C. Aragon (Chairperson)
A. Abordo
V. Corre
C. Dacanay
D. de Guzman
E. Escover
F. Fermin
L. Oliva
I. Smith

Discussion framework: The inputs working group confined its discussion to the hatchery sector and in particular to:

- technical, economic and institutional constraints to expansion or efficiency of the hatchery sector of the tilapia industry;
- the role of the private and public sectors in the development of the hatchery sector and related policy issues; and
- research strategies and priorities in the tilapia hatchery sector.

Constraints: Based on the experience of the private and government-operated hatcheries, several problems were identified, particularly in the management and operation of hatcheries which may serve as constraints to the development and expansion of the tilapia industry (Table 1). The specific inputs required for hatchery operations, and which may to varying degrees constrain the development of the industry, are broodstock, feed, fertilizer, labor, water and land. While the level of production of tilapia fingerlings by the private sector and government hatcheries is indeed impressive, it is apparent that serious constraints are developing particularly in the area of broodstock management. Some location-specific problems, such as land and water quality or seasonal water shortages, may also constrain the production of individual hatchery producers. Table 1 itemizes those technical, economic and institutional factors that the working group believed to be most important. These problem areas reflect the relative newness of the industry.

Policy issues: With the foregoing identified problems, the following policies are hereby recommended for implementation:

1. Expansion of hatchery training programs.
2. Establishment of more demonstration farms in provinces.
3. Encouragement of hatchery operators to form groups to avail of economies of

Table 1. Constraints to expansion of hatchery operation.

Technical factors	Economic factors	Institutional factors
A. PRODUCTION OF FINGERLINGS		
1. Breeders ● Poor quality and inappropriate broodstock – Inbreeding – Contamination/cross-breeding – Infrequent broodstock replacement – Inadequate broodstock selection criteria	1. Breeders ● Lack of supply of good quality broodstock	General Problems: ● Lack of technical know-how ● Difficulty in securing loan assistance ● Lack of information dissemination on loan assistance ● Lack of coordination among credit institutions ● Demand for technical services is expanding more rapidly than the capabilities of the extension institutions
2. Feeds/fertilizer ● Feed formulation problem for broodstock ● Poor quality of feed ingredients due to adulteration ● Lack of standardization of types, frequency and rates of application of fertilizers for given physical conditions	2. Feeds/fertilizer ● Irregular feed and fertilizer supply ● Increase in price due to competition with other food-producing industries and hatcheries using these inputs	
3. Land/water ● Seasonality of water supply and quality problem (location specific) ● Lack of technical know-how on pond design and construction ● Water retention problem due to soil characteristics (location specific)	3. Land/water ● Competition for the use of water and land due to hatchery expansion and other users ● High cost of water pumps/ reservoirs and wells in areas where irrigation water is inadequate (location specific) ● Insecurity of land tenure and influence of the landlord	
4. Labor ● Lack of manpower with technical know-how on hatchery operation	4. Labor ● Inability of small operators to hire skilled manpower	
B. MARKETING OF FINGERLINGS	● Seasonality of demand for fingerlings ● Deteriorating quality of fingerlings ● Economies of scale in marketing to fill the bulk orders favoring large-scale hatcheries ● Increase in competition due to the expanding number of hatcheries, thus reducing profit margin	

scale for purchase of inputs and marketing of fingerlings.

4. Establishment and creation of a National Tilapia Broodstock Board and Center.
5. Generation of income from selling broodstock by the Center and allocation of said income for research.
6. Effective information dissemination and translation to local dialects of the available technologies on tilapia hatchery management and loan assistance.

Research: The following technical, economic and institutional research topics in order of their priority are likewise recommended to provide solutions to the identified problems and constraints to the hatchery sector of the tilapia industry:

A. *Technical*

1. Broodstock development and improvement
   a) hybridization
   b) cross-breeding of different strains
   c) development of low-cost and practical methods for broodstock selection and monitoring
2. Nutrition of broodstock
3. Development of low-cost feeds out of locally available feed ingredients.
4. Standardization of fertilization techniques.
5. Engineering studies on hatchery design.

B. *Economics*

1. Survey of the status of government and private support services and programs.
2. Assessment of risk and uncertainty in hatchery operations.
3. Supply and demand studies for tilapia broodstock and fingerlings.
4. Assessment of demand for skilled labor in hatchery operations.
5. Comparative analysis on the profitability of the different hatchery systems.
6. Assessment of credit needs of the tilapia hatchery industry.
7. Price analysis of broodstock and fingerlings.
8. Assessment of marketing systems for broodstock and fingerlings.
9. Determination of optimal sizes and locations of hatcheries.
10. Impact study of the different hatchery programs.

C. *Institutional*

1. Assessment of the existing strategies for technology transfer to the tilapia hatcheries.

GROUP B : LAKE-BASED PRODUCTION SYSTEMS

Members : W. Cruz (Chairperson)
M. Beveridge
J. Bisuna
J. Dimapilis
E. Gonzales
A. Mines

Discussion framework: Instead of focusing separately on the three questions of constraints to expansion, private vs. public sector roles, and research strategies and priorities, the group decided to go directly into observed problems and, in the analysis of these problems, to evaluate the implications for (a) research and extension programs and (b) private sector vs. government role in developing the industry. The problem areas discussed may be classified under three topics: (a) technology dissemination and differing lake environments; (b) the lake system and carrying capacity; and (c) external (factor supply) constraints. These topics form the organizing framework for this report.

Technology, environment and dissemination: While the basic technological research into cage culture has been done, a general technology "package" cannot presently be disseminated because of many *site-specific* factors that arise in the lake environment. For example, there are eutrophic vs. oligotrophic lakes with different water retention rates, surface areas, and depths. Even within a specific natural-environment classification, the roles of human populations differ with respect to uses of the lake. And yet the basic technology seems productive enough to encourage private operators to do their own experimentation and modifications to suit special conditions.

These observations point to the following:

1. Learning-by-doing at this stage of technical development has high payoffs, and government research and extension activities should be closely coordinated. Emphasis should be on the identification of major lake-environment types and on-site pilot studies.
2. The extension process itself should be rationalized so that present dependence of operators on informal links to government technical sources will be reduced. Also there might be large gains if public extension programs (with their limited resources) can tie-up with private breeders for improving grow-out operations. For example, hatchery operators should be encouraged to operate grow-out cages, especially in low adoption areas. There is a need to identify and exploit the coincidence of private and public goals; in general, the government should not expect private grow-out operators to assist in technical dissemination to potential competitors.
3. Finally, private initiative and capability in research or experimentation should be viewed as equal in importance to government agency research. Existing practices of operators should be evaluated and, with refinements/modifications, should be included in the on-site research activities.

Carrying capacity and the need for lake management: Observed problems in the context of lake management include:

1. Lag in the development of formal institutions (e.g., licensing or zoning laws) and informal rules (e.g., community or cultural sanctions on poaching) in the context of technical and economic change.
2. Overcrowding within the tilapia cage culture fishery leading to decreased productivity.
3. Competition with other fisheries (both culture and capture) and with other lake users.

These problems underscore the need to view the cage culture fishery within the basin or lake system. In this system, there are different decisionmaking units and the objectives vary based on competing private uses and the social or public goals.

The "watershed" sector includes the many users (e.g., agriculture/watershed, industry, domestic sector) and their corresponding uses or outputs that affect lake quality and therefore lake-based activities (Fig. 1). These lake-based activities are classified as "Fishery" and "Other Activities", and they may be viewed as interacting subsystems within the lake which also interact with the watershed sector.

In Fig. 1, note the cage culture subsystem with the dotted outline. This is the object of the individual cage culture operator's decisionmaking, and his objective is straightforward: to make a living. But his activities affect the whole lake system just as some non-lake factors (e.g., feed sources) affect his decisionmaking. As long as there is some profit to be earned, he will want to expand his operation, and this will be true for others like him. It does not matter to him if the resulting overcrowding decreases the general productivity of the lake.

The public sector decisionmaker, however, clearly has different goals. He may wish to increase total fish output (regardless of

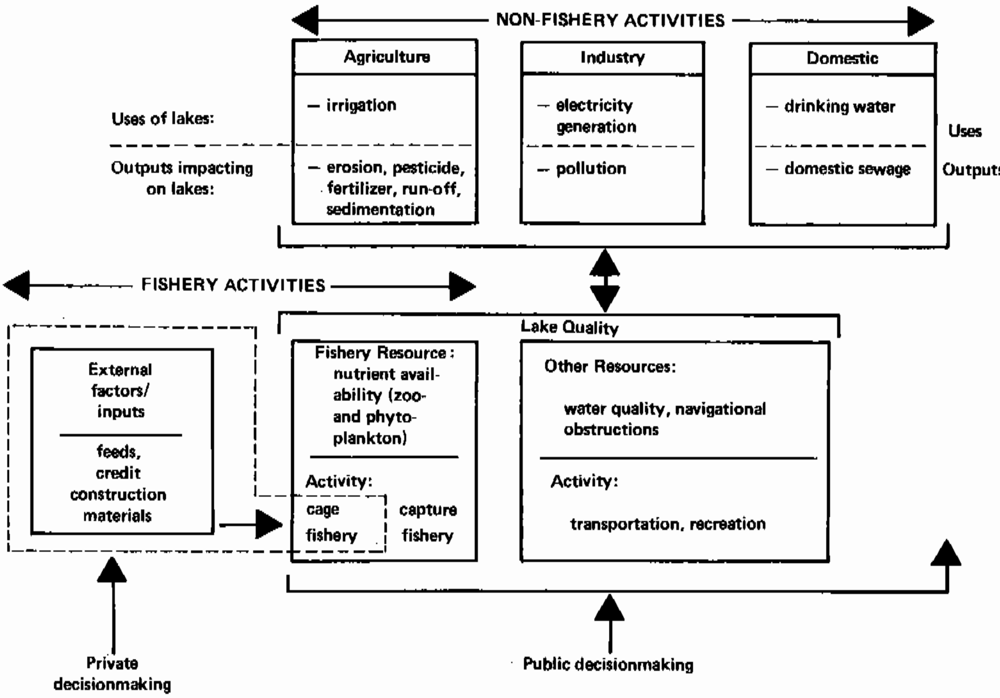

Fig. 1. The watershed sector includes agricultural, industrial and domestic users with uses and outputs which interact within lakes. Broken lines show the cage culture subsystem.

whether it is from the culture or capture fishery) while minimizing the use of scarce fertilizer or feed stocks. Or he may emphasize the other uses of the lake (e.g., irrigation) if this will be more effective at increasing total (national) income.

Following from this, the ideal procedure is to model the whole basin-lake system to optimize social gains. As a practical matter, however, such an effort will be time-consuming and costly (and may, in the end, have little to contribute to specific policy questions). An intermediate and policy-oriented procedure is to go ahead with the basic specification of current conditions (or requirements) and technical relationships (coefficients) among the activities in the system. This should then be used as the given environment in which a fishery (capture and culture) sub-model should be developed in detail. Carrying capacity for the culture fishery may then be determined simultaneously with the production of the capture fishery.

Fig. 2 illustrates how the two fishery sectors could be expected to interact over time and how total output *may be* determined in the vertical summation of the "culture" and "capture" curves.

Finally, institutional design and implementation strategies may follow from this procedure. The problem of institutional lag and the absence of effective rule changes and enforcement arise from this lack of appreciation of limited carrying capacity and competition. Aside from licensing and zoning regulations, effort should concentrate on local enforcement and administration. If equity is also an important goal, then regulating the size of

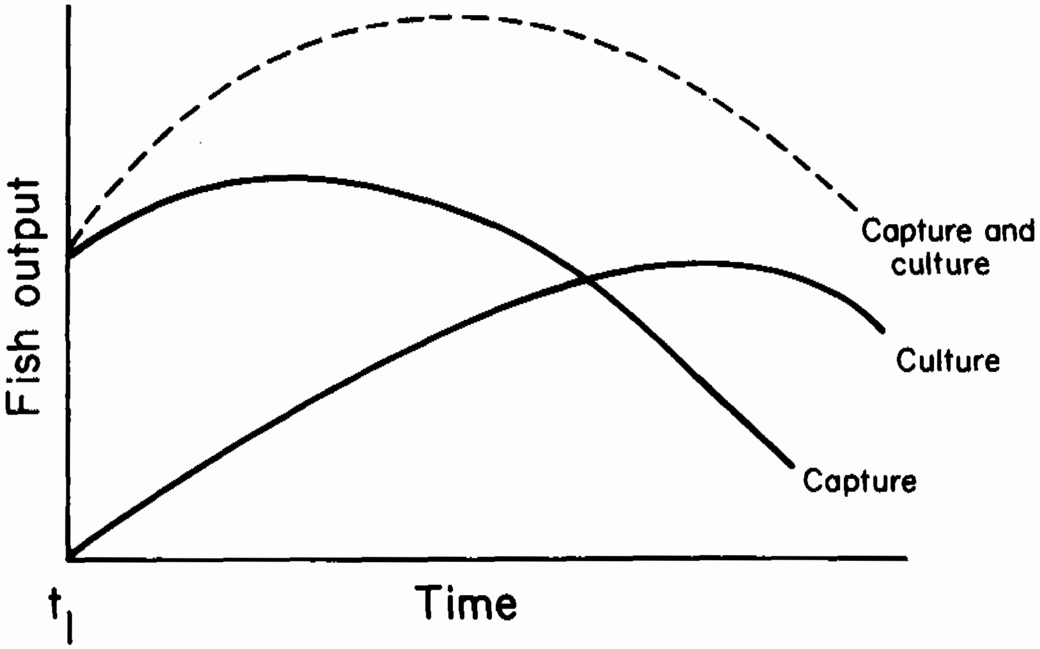

Fig. 2. The introduction of culture fisheries in a lake at time t_1 and the likely output of a lake over time in the absence of lake management. The decline in the capture fishery results from overfishing as too many fishermen enter the fishery; overcrowding in the culture sector similarly leads to decreased productivity.

culture operations, encouraging local initiative (through the licensing system), and integrating capture with culture operations should contribute to reducing the poaching problem.

External constraints: The group recognized the importance of input (or factor) supply as the basic external constraint.

For inputs, fry quality vs. quantity was emphasized as the major problem. It was observed that grow-out operators were willing to pay a premium for the assurance of quality in their fingerlings, and local hatcheries have an important role for both seed supply and grow-out technology dissemination.

The sources of raw materials for cage construction (e.g., bamboo) should also be studied as this is the major cash requirement and costs have been increasing. Researchers on cage design should check substitutes, and locally developed adaptations should be studied.

Credit may be a major bottleneck especially when the prospective operator cannot offer collateral. To safeguard the access of low income households of small-scale entrepreneurs to the industry, organized credit schemes will have to be promoted.

Finally, commercial or supplementary feeds should be studied. The first step is to outline the basic nutritional requirements and how potential feeds supply these and at what cost. Subsequently, current lake environments and their nutrient contents should be incorporated in the study. This again brings up the site-specific problems and complicates the use of standard linear programming techniques for determining the optimal feeding regime.

GROUP C : LAND-BASED PRODUCTION (GROW-OUT) SYSTEMS

Members : L. Gonzales (Chairperson)
M. Broussard
L. Darvin
L. Elizalde
R. Fabro
W. Rosario
R. Sevilleja
R. Tagarino
E. Tan

Introduction: The group attempted to describe and identify the different subsystems under the Land-Based Production (Grow-out) Systems category. Three general subsystems with various production schemes were identified by the group. These are: the agri-aqua integrated subsystem (crop-fish and animal-fish combinations); the pond subsystem (freshwater and brackishwater); and non-traditional systems (skypond, barricade fish culture and cages-in-ponds).

In trying to understand these subsystems, Group C developed the following matrix of concerns composed of: the description of the subsystems; constraints in the adoption of these subsystems; strategies to overcome these constraints; implications for policy insofar as private and public participation is concerned; and possible areas of research. A complete classification of each subsystem is given in Table 1.

Description of various land-based production (grow-out) systems:

A. AGRI-AQUA INTEGRATED SYSTEMS

- *Rice-fish:* Rice-fish technology consists of simultaneous production of rice and fish in the same paddy. The rice paddy is modified by construction of trenches that occupy approximately 10% of the total paddy area. Tilapia are stocked at a rate of 5,000/ha. Production period for fish is approximately 90-100 days. At the end of the production cycle both market size fish and fingerlings are harvested.
- *Integrated livestock-fish systems:* The major feature of these systems is the complementarity between the livestock and fish components. The manure output from the livestock operation is used in the fish culture operation. Thus, the livestock facilities (e.g., pig pens, chicken houses) are built on the fishpond dikes or just adjacent to the ponds to facilitate manure loading into the ponds. Minimal or no feeding and/or inorganic fertilization of the pond is done.

B. POND SYSTEMS

- *Freshwater ponds:*
  - Backyard

    The operation involves small-scale fishponds, the production of which is primarily intended for home consumption. Management is carried out at a limited scale with labor being provided by family members. Pond design and construction is simple and capital investment is low.
  - Semi-commercial

    This type of operation has higher capital and management requirements. A portion of the production is sold for cash. Fish stocks are either bought or produced on the farm, mainly through collection of fingerlings produced in the rearing ponds. Feeding and fertilization activities are carried out, but at irregular intervals.
  - Commercial

    This type of operation is characterized by high capital and management requirements and involves systematic and definite schemes. There is a definite cropping pattern and feeding and fertilization are done according to schedule. A separate breeding/nursery component may be incorporated in the farm set-up.

Table 1. Matrix of concerns for land-based production (grow-out) systems.

Subsystem	Constraints	Strategies to overcome constraints	Policy implications	Possible research areas
A. AGRI-AQUA INTEGRATED SYSTEMS				
Rice-fish culture	1. management practices must be adapted to rice as primary crop, hence risk of pesticide contamination	analysis and modification of technology to suit farmer's managerial capability; evaluation of rotational cropping as alternative production scheme	support existing technology verification programs	establishing the economic viability of recommended technologies; technology verification for rotational cropping
	2. non-adherence to recommended practices	same as above	increased level of operation and closer monitoring of demonstration fish farms for integrated culture	evaluation of extent of technology adoption
	3. high managerial requirement			
	4. small size of fish at harvest	stock larger fish;[1] use rice-fish area for nursery purposes		
	5. limited availability of fish of desired size for stocking	integration of hatchery with production system		
	6. poaching	synchronized cropping within community		
	7. lack of coordination at the field level between extension groups among involved agencies	better or more specific delineation of agency goals and functions at the field level		
Integrated fish-livestock culture	1. high capital requirements for new venture	restrict adoption to established/existing livestock of fish entrepreneurs[2]; avail of subsidized credit for potential operators	inclusion of this project in the Kilusang Kabuhayan at Kaunlaran (KKK) livelihood program	

Continued

Table 1. Continued

Subsystem	Constraints	Strategies to overcome constraints	Policy implications	Possible research areas
A. AGRI-AQUA INTEGRATED SYSTEMS (Cont.)				
	2. consumer bias against fish produced in manure loaded ponds	information campaign on acceptability of fish; adoption of "freshening" techniques		consumer demand studies
	3. high managerial requirement	training of potential operators		
	4. risks to human health	follow deworming practices for animals		research on parasitic load of fish
	5. ecological implications			
	6. need for technology refinements			technology generation for other crop-livestock-fish combinations; delineation of optimum stocking combinations
B. POND SYSTEMS				
Freshwater ponds				
– Backyard fishponds	overcrowding of fish population (surplus fingerlings)	monosex culture; polyculture with predatory species; more selective harvesting; high stocking density to inhibit reproduction[3]	marketing assistance on sale of excess fingerlings	production of monosex fish under hatchery conditions (technology verification)
– Semi-commercial and commercial fishponds	1. limited availability of capital			
	2. overcrowding fish population	training of hatchery operators on production of monosex fingerlings		

Continued

Table 1. Continued

Subsystem	Constraints	Strategies to overcome constraints	Policy implications	Possible research areas
B. POND SYSTEMS (Cont.)				
	3. inadequate extension program	improvement of logistics and incentive systems; appropriate training; improvement of facilities of BFAR demonstration facilities	review and improve national fisheries extension programs	
	4. increasing demand for manure as input	refer to Group A		alternative organic fertilizers (e.g., rice hull, compost)
	5. high input cost	group buying to avail of economies of scale for purchase of inputs		
	6. limited availability of low-cost commercial feeds	evaluation of commercially available fish feed		verification of formula of commercial feeds; use of indigenous materials in feed formulation
	7. poor quality fingerlings	maintenance of high quality of broodstock	broodstock improvement program	genetic research on broodstock selection
Brackishwater ponds	1. high fingerling mortality for *O. niloticus* due to salinity stress	dissemination and verification of acclimation technique	training of brackishwater extension agents on tilapia culture	hybridization for production of salinity tolerant strains[4]
	2. overcrowding of fish population *(O. mossambicus)*			

Continued

Table 1. Continued

Subsystem	Constraints	Strategies to overcome constraints	Policy implications	Possible research areas
B. POND SYSTEMS (Cont.)				
	3. modification in cultural practices			studies on pond management systems (appropriate food base), evaluation of economics of milkfish vs. tilapia production
	4. inability to install hatcheries in brackishwater for *O. niloticus*	support from freshwater hatcheries		
C. NON-TRADITIONAL SYSTEMS				
1. Upland or skyponds 2. Barricade system 3. Cage-in-pond	verification of biological and economic aspects required			studies on biological and economic aspects

[1] But prices of larger (> 35 g) fish may be prohibitive.
[2] A minority opinion.
[3] > 30,000/ha stocking rates may inhibit reproduction and actually increase average size at harvest.
[4] *O. niloticus* x *O. aureus* cross or *O. niloticus*. Suggest avoid *O. mossambicus*.

- *Brackishwater ponds:*
  These are ponds constructed largely on mangrove areas or adjacent to estuaries; salinity ranges from 15 to 30 ppt. In the Philippines, the ponds are traditionally used for milkfish and prawn production.

C. NON-TRADITIONAL SYSTEMS

- *Skypond:* This is a land-based production system for tilapia involving the use of highland ponds supplied with rain or stream water. The system can be integrated with other systems such as agro-forestry.
- *Barricade fish culture:* A system in Pampanga Province of growing tilapia in dead rivers and impounded waters partitioned by nets. Compartments are relatively smaller than in fish pens. The system is normally adopted in impounded waters along flood control dikes.
- *Cage-in-pond:* This involves the installation of small cages in undrainable ponds for easier management of fish stocks.

Conclusion: Reviews of land-based systems for grow-out of tilapia indicate a potential for continued development in this sector. Although constraints were identified for all systems, strategies to overcome most of these constraints were identified. Major policy changes or implications were also identified. Continued research and adequate extension programs are needed to expedite development of this sector.

GROUP D : MARKETING
Members : E. Navera (Chairperson)
C. Reyes
O. Salon
E. Torres
N. Ty

Introduction: The present market for tilapia looks prosperous, with a few problems confronting the traders. Profit margins are highly positive with quantity supplied lagging behind what is being demanded. As more and more producers and traders are attracted to the industry and supply catches up with demand, different and bigger marketing problems are going to surface. The less significant problems enumerated and discussed in the following section could become important problems, which, if ignored, would inhibit the expansion of the tilapia industry.

About 90% of traders had some marketing problems, but only 30% of producers identified any such problems. The problems noted are shown in Table 2 for various geographical areas. Both the nature and ranking of problems varied in the five localities surveyed. Table 3 summarizes the marketing constraints, as well as research priorities and suggested roles of the public sector.

Constraints to expansion or efficiency in the distribution and marketing of tilapia:

a) Cited as the main constraint to the expansion in tilapia marketing in Metro Manila and Central Luzon is the lack of supply from producers and its wide seasonal fluctuation; this problem, however, is not reported in Mindanao where the greater bulk of tilapia production is by the Southern Philippines Development Authority (SPDA). Because of its volume of output, SPDA times its production such that harvesting is more or less distributed uniformly throughout the year. Small producers in Laguna, Rizal and Central Luzon could probably organize themselves into an association or associations and agree on a workable and acceptable production program for a common objective of obtaining fair and stable prices. Such a system should consider the seasonality of competing marine fish and other freshwater fish such as milkfish. A more or less seasonally stable aggregate fish supply may be achieved. Expansion of production may be achieved through credit and technical assistance to producers and traders.

b) Fluctuations in prices due to variations in quality of tilapia from different sources as perceived by the consumers and reported by traders is a problem in Laguna. Variations in taste during certain periods of the year which caused variations in prices were also reported. Investigations on the causes or sources of the variations in quality including taste, size and color across geographical locations and across seasons should be conducted. The findings from such investigations should yield valuable information which can be used as a basis for adopting quality control measures.

c) The demand-related problems include poor quality (freshness, taste/smell, color and size) and perishability of tilapia. Unfavorable taste of the fish has been pointed out as a seasonal phenomenon in Laguna while black color and small size have been long-time deterring factors for wider consumer acceptability in many areas (especially of *O. mossambica*) before the introduction of Nile and red tilapias. Where

Table 2. Marketing problems reported by tilapia traders ranked according to importance in several locations in the Philippines, 1982. Source: workshop papers.

Constraints	Metro Manila	Laguna	Central Luzon	Bicol	Mindanao
Traders			Rank		
Lack of supply/seasonally erratic supply	1		1	4	
Poor quality	2		2	5	
Distant source of supply	3		4	5	
Low demand	3			3	
Perishability/lack of cold storage	5	4	3		2
Credit collection		1			
Weighing problems		2			
Seasonal unfavorable taste		3			
Low selling price		5		2	
Variation in price due to difference in quality by source of supply	6				
Poor market stalls (water)	7				
High buying price				1	
Lack of capital				5	1
High transport cost					3
Producers					
Low price received					1
High transportation cost					2

consumer preference is for live, freshwater tilapia, perishability becomes another major problem especially in regions where the production sites are situated far from the main consumption points. Traders who have thin, small, and dead tilapia have no option except to sell these fish at a lower price (as in Bicol and Mindanao) or on credit (as in Laguna). However, for traders who are able to maintain the freshness of the fish and have the big-sized tilapias to sell, high demand and high selling price naturally result and there is no marketing problem at all. The development of appropriate technologies to improve the efficiency of post-harvest activities such as handling, packaging, storage and processing of tilapia can do much to minimize the perishability and quality deterioration problem. Improved technologies in the production of the preferred sizes, color, taste, and species of tilapia should also improve prices.

d) Lack of capital and difficulties in collecting payment from buyers were the major problems of Laguna and Bicol tilapia traders. Some financing scheme in the form of credit cooperatives may

Table 3. Summary of constraints, research priorities and suggested role of the public sector in tilapia marketing.

Constraint	Research priorities	Role of public sector
1. Lack of marketable supply	Expansion of supply and reduction of seasonal fluctuation through improved production technology and management	Assist in the efficient distribution of supply
2. Unstable price due to seasonal fluctuation of supply	Research on demand creation and structure of supply important to planning	Institute measures to prevent or minimize unfair trade practices
3. Variability of fish quality at certain periods of the year	Development of appropriate technologies to improve post-harvest practices in handling, packaging, storage and processing	Provide market intelligence and price monitoring services
4. Perishability and rapid quality deterioration	Development of quality control measures consistent with consumer preferences	Provide research and extension services on improving post-harvest technologies
5. Lack of capital and poor credit collection by traders		Provide credit assistance to the private sector
6. Inadequate and poor market facilities	Study on optimal size, number and location of fish landing, storage and processing facilities	Provision of market infrastructures and facilities for trading
7. High transport cost		

evolve among the traders themselves or perhaps a financing scheme for marketing purposes may be packaged by government financing institutions.

e) Poor marketing facilities such as lack of market stalls, and fresh water supply were also mentioned by a few traders in Laguna. Improvement of market facilities is important to reduce the deterioration rate of the fish.

Roles of the private and public sectors: Since the tilapia industry is relatively young, such that supply is still less than the apparent demand, it is time that policies be established so that the mistakes committed with other similar commodities can be avoided. The public sector can do a lot to encourage the growth of the industry through provision of incentives, institution building and creating a favorable climate to enhance efficient distribution of the product especially to those who need it the most.

The potential market for tilapia is generally large in areas far from the coastline. Thus, land-based producers must be provided with incentives to ensure that tilapia reaches the protein-deficient inland areas. Possible incentives would be provision of financing to traders servicing these areas or encouraging area marketing cooperatives to tie up with producers in the disposal of their produce.

Marketing and distribution of tilapia should be primarily left to the private sector.

The government should be careful not to compete with the private sector especially when the private sector is already performing the function well. Nevertheless, there are several functions that can very usefully be performed by the public sector. These include:

- Provision of research and extension services for improving post-harvest technologies, such as increasing the shelf-life of tilapia to make possible the lengthening of the trade route geographically so that fish can be made available to more people.
- Provision of marketing infrastructures including transport and storage facilities.
- Provision of credit assistance in order to encourage the private sector to improve its marketing services.
- Assistance in efficient distribution of tilapia such as through the KADIWA operations of the National Food Authority (NFA) during periods of excess supply.
- Provision of market intelligence and price monitoring services. Timely information on production, price levels and market outlets provided by agencies like Bureau of Fisheries and Aquatic Resources (BFAR), Bureau of Agricultural Economics (BAEcon) and NFA is essential to planning and management of the industry.
- Institution of measures to prevent or minimize unfair trade practices such as short selling and exploitation of consumers and producers.

Research priorities: The following research strategies (in order of their importance) are proposed in anticipation of the problems that are bound to arise as competition among producers and traders of tilapia increases.

1. *Expansion of supply and reduction of seasonal fluctuations of supply levels through improved production technology and management.* As implied by the large profit margins of traders, supply of tilapia lags behind demand. Traders in general complain of not having enough fish to buy and sell. Improving production technology should lead to expansion in tilapia production. Wide seasonal fluctuation in supply of tilapia is also a problem which could be improved through programming and scheduling of production such that a more or less stable supply of the fish within a year may be achieved. A study to look into the seasonality of production from the biological as well as management points of view with regard to raising tilapia should be a first step towards minimizing supply fluctuations.
2. *Market research studies on the development of acceptable standards or quality control measures consistent with consumers' preferences, as to species, size, color and freshness.* The results of such a study should be useful as a guide to both producers and traders in the industry.
3. *Development of appropriate technologies to improve post-harvest practice such as handling and packaging, storage and processing.* Some innovations in these directions should prove profitable. For example, if indeed the consumers' preference for live tilapia is great such that consumers would be willing to pay a premium price for it, selling the fish in aquarium-type containers may be profitable. Some experiments on tilapia processing into dried fish or fresh frozen fish fillets may also be useful.
4. *Economic research on the structure of the supply function for tilapia by size, species, sex and geographical location* as well as the nature of production whether land-based or lake-based is important to planning a development program for tilapia.
5. *Estimation of the demand parameters for tilapia* is even more important than that of supply. Consumer response

to changes in the price of fish (price elasticities) and income changes (income elasticities), as well as to changes in the prices of other substitute or competing goods, including other fish species, meat, poultry, etc. (cross price elasticities), should be investigated. A knowledge of these parameters should make possible the systematic planning of production targets consistent with market conditions.

6. *Price analysis (seasonal and trend) of tilapia, considering inflationary and demographic conditions* should also provide valuable information for monitoring and assessing the performance of the industry so that planning and programming of development activities for the industry may be properly guided and directed.
7. *Market research studies on demand creation for tilapia* which should include analysis of the nutritional content of tilapia and food preparation technology.
8. *A study on the feasibility of raising tilapia in very small backyard ponds* for the nutritionally disadvantaged subsistence households may also be explored. Production in this case would be more for consumption within the household rather than for the market.
9. *A study on the optimal size, number and locations of fish landings, storage and processing facilities* should be conducted and used to guide future development projects for tilapia.

Final Discussion and Recommendations of the Workshop

After presentation of the preceding four working group reports, a general discussion was held by participants on a variety of related topics.

Discussion of working group reports: There was some debate regarding the seasonality of demand for fingerlings. Demand for fingerlings is derived from the market demand for tilapia. While some participants observed that demand for fingerlings is adversely affected at certain times of the year due to bad taste of market-size tilapia and consequent difficulties in product disposal, others believed that in fact the conditions which produced bad taste were those which indicated good growing conditions in lakes and consequently increased demand for fingerlings. The latter may be true for Laguna de Bay, but it was pointed out that grow-out cage operators in smaller lakes (e.g., San Pablo Lakes) do indeed have seasonal demand for fingerlings because of upwelling in those lakes during colder months.

A question was raised regarding why Group A (Inputs) considered lack of quality control over feed ingredients to be an economic rather than a purely technical problem. In answer, the group explained that poor quality control leads buyers to favor only those sellers whom they can trust. This in turn contributes to a small-number-of-sellers condition in the feed market which may result in manipulation of feed prices to the advantage of these sellers. Better quality control would thus reduce the risk incurred by feed buyers and encourage competition among sellers.

Group B (Lake-based production systems) was asked why they thought tilapia growing was catching on and what role the private sector could play in disseminating cage culture technology. In reply, the group stated that the Philippines is a generally poor country with low, if not declining, real wages. Therefore, consumers are being made to adapt to a less-desired commodity such as tilapia, instead of consuming the traditional, now higher-priced, marine species and milkfish. Given the favorable market conditions that currently prevail for tilapia, it was believed to be unreasonable to expect the private sector to take the initiative in disseminating technology because it will only increase production and hence competition for the existing producers. Therefore, technology dissemination was clearly a role for the public sector.

A question was raised as to whether the conversion of riceland to fishponds was in conflict with the country's Land Reform program. In answer, a PCARRD official commented that the government seems to presently tolerate such conversion, but there is a need to examine this issue further to see if restrictions on riceland conversion may become a constraint to expansion of the tilapia industry.

Group D (Marketing) was questioned regarding which agencies, if any, could be the primary implementors of the various marketing strategies recommended by the group. The Bureau of Fisheries and Aquatic Resources (BFAR) and the Bureau of Agricultural

Economics (BAEcon) were both suggested as possibilities, though the question of overlapping and duplicative responsibilities would need to be resolved. The final comment made on the marketing issue was that one should be very cautious about saying there is a deficiency in supply of tilapia and that it is dangerous to base projected demand upon concepts of nutritional deficiency without taking effective purchasing power into account.

The participants were informed that an ad-hoc committee of researchers, private producers and government officials had already recommended the creation of a National Tilapia Broodstock Center and Board. A similar recommendation had been made by workshop Group A (Inputs) in hopes of stimulating research on broodstock management, quality control and hybridization. The aquaculture consultant to the BFAR-USAID Tilapia Hatchery project in Muñoz, Nueva Ecija stressed that certification of strains is a complicated and extremely touchy subject. Nevertheless, research on tilapia genetics and broodstock improvement is definitely needed.

The final issue of general discussion related to the need for economists and biologists to work together in interdisciplinary research. It was suggested that experimental data on tilapia production would be a good area in which to begin. Some participants had reservations about economists working with biological experimental data, and suggested instead that the most beneficial time for constructive interaction between economists and biologists could come during the pilot-scale testing of tilapia production technologies and would preferably involve testing and evaluation under actual farm conditions of private producers.

Recommendations: In addition to the specific recommendations of each of the working groups (see p. 238-253), the workshop made two general recommendations. These were:

- Endorsement of the proposed establishing of a *National Tilapia Broodstock Center* where research on genetics, broodstock management and fingerling production could be undertaken.
- Initiation of a *statistics collection system for tilapia.* At a minimum, these data should include area (by type of system and location), production and prices. The collection of secondary data suitable for economic analysis is recommended so that expensive primary surveys of producers need be undertaken at less frequent intervals. This recommendation applies not only to tilapia but to the entire Philippine aquaculture industry.

Program of Activities

August 9 (Tuesday Evening) : Arrival and Registration of Participants

August 10 (Wednesday) **Morning**

Session 1 : Overview

Introductory Remarks – Dr. Ramon V. Valmayor (PCARRD), Dr. Ian R. Smith (ICLARM)

Tilapia Farming in the Philippines: Practices, Problems and Prospects – Dr. Rafael D. Guerrero III

Master of Ceremonies/Moderator – Dr. Elvira O. Tan

Session 2 : Tilapia Hatcheries

Economics of Private Tilapia Hatcheries in Laguna and Rizal Provinces, Philippines – Ms. Luz R. Yater, Dr. Ian R. Smith

Cost Analysis of a Large-Scale Hatchery for the Production of *Oreochromis niloticus* Fingerlings in Central Luzon, Philippines – Dr. Meryl C. Broussard, Jr., Ms. Cecilia G. Reyes

The Adoption of Tilapia Farming and Its Impact on the Community of Sto. Domingo, Bay, Laguna, Philippines – Ms. Ma. Corazon B. Gaite, Mr. Jose Noel A. Morales, Ms. Olga Criselda R. Orilla, Ms. Bernadine B. Pili

Panel Discussants – Dr. Roger S.V. Pullin, Ms. Nida R. Ty

Moderator – Dr. Enriqueta B. Torres

Afternoon

Session 3 : Cage Culture Systems

The Economics of Tilapia Cage Culture in Bicol Freshwater Lakes, Philippines – Ms. Emma M. Escover, Mr. Rodrigo L. Claveria

Economics of Tilapia Cage Culture in Laguna Province, Philippines – Dr. Corazon T. Aragon, Mr. Miguelito M. de Lim, Mr. Gerardo L. Tioseco

Economics of Tilapia Cage Culture in Mindanao, Philippines – Dr. Lydia P. Oliva

Financial and Economic Analyses of Grow-Out Tilapia Cage Farming in Laguna de Bay, Philippines – Mr. Jovenal F. Lazaga, Mr. Leonardo L. Roa

Panel Discussants – Dr. Rafael D. Guerrero III, Dr. Wilfrido D. Cruz

Moderator – Dr. Meryl C. Broussard, Jr.

August 11 (Thursday) **Morning**

Session 4 : Land-Based Culture Systems

Tilapia Production in Freshwater Fishponds of Central Luzon, Philippines – Mr. Ruben C. Sevilleja

Economics of Rice-Fish Culture Systems, Luzon, Philippines – Mr. Rogelio N. Tagarino

The Introduction of Integrated Backyard Fishponds in Lowland Cavite, Philippines – Mr. Frank Fermin

Status, Potential and Needs of Tilapia Culture in Panay Islands, Philippines – Mr. Valeriano L. Corre, Jr.

Transfer of Fish Culture Technology in Central Luzon, Philippines – Mr. Westly R. Rosario

Panel Discussants – Dr. Aida R. Librero, Mr. Manuel Banzon

Moderator – Dr. Rodolfo G. Arce

Afternoon

Session 5 : Tilapia Marketing

Tilapia Marketing in Central Luzon and Metro Manila, Philippines – Dr. Enriqueta B. Torres, Dr. Emeline R. Navera

Tilapia Marketing in Bicol, Philippines – Ms. Emma M. Escover, Mr. Orestes T. Salon, Ms. Cristina P. Lim

Tilapia Marketing in Laguna Province, Philippines – Dr. Corazon T. Aragon, Ms. Juvilyn Cosico, Ms. Nerissa Salayo

Tilapia Marketing in Mindanao, Philippines – Dr. Lydia P. Oliva

Panel Discussants – Dr. Leonardo A. Gonzales, Atty. Benito Bengzon

Moderator – Mr. Rogelio N. Tagarino

Evening

Film Showing

August 12 (Friday) **Morning**

Session 6 : Working Group Sessions

Afternoon

Session 7 : Continuation of Working Group Sessions

Working Group Chairpersons:

1. Inputs – Dr. Corazon T. Aragon
2. Lake-Based Production Systems – Dr. Wilfrido D. Cruz
3. Land-Based Production Systems – Dr. Leonardo A. Gonzales
4. Marketing – Dr. Emeline R. Navera

August 13 (Saturday) **Morning**

Session 8 : Working Group Presentations and Concluding Discussions

Afternoon

Session 9 : Field Trip
: Departure from CEC
: BFAR Station, Sto. Domingo, Bay, Laguna
: Mang Pascual's Backyard Tilapia Hatchery, Sto. Domingo, Bay, Laguna
: Mane's Hatchery Farm, Calauan, Laguna
: Austria's Tilapia Farm, Sampaloc Lake, San Pablo City

Evening

Dinner, Sampaloc Lake

August 14 (Sunday) : Departure of Participants

List of Participants

Ms. Aurea G. Abordo
Researcher
Agribusiness and Natural Resources Research Department
Development Bank of the Philippines
Buendia, Makati, Metro Manila

Mr. Ruperto Angodung, Jr.
President
Philippine Federation of Aquaculturists
16 C.L. Montelibano
Bacolod City, Negros Occidental

Dr. Corazon T. Aragon
Assistant Professor
College of Development Economics and Management
University of the Philippines at Los Baños
College, Laguna

Dr. Rodolfo G. Arce
Director, Freshwater Aquaculture Center
Central Luzon State University
Muñoz, Nueva Ecija

Mr. Manuel Banzon
National Food and Agriculture Council
Elliptical Road
Diliman, Quezon City

Dr. Malcolm Beveridge
Research Fellow
Institute of Fisheries Development and Research
College of Fisheries
University of the Philippines in the Visayas
Diliman, Quezon City

Mr. Job Bisuña
Jobski Fish Farm
Baao, Camarines Sur

Dr. Meryl C. Broussard, Jr.
Department of Wildlife and Fisheries Sciences
Texas A&M University
College Station, Texas
U.S.A.

Mr. Valeriano L. Corre, Jr.
Assistant Professor
University of the Philippines in the Visayas
College of Fisheries
Brackishwater Aquaculture Center
Leganes, Iloilo

Dr. Wilfrido D. Cruz
Assistant Professor
College of Development Economics and Management
University of the Philippines at Los Baños
College, Laguna

Mr. Calvert C. Dacanay
Industry Specialist
National Lakes Development Programs
19th Floor, Strata Bldg.
Pasig, Metro Manila

Ms. Loureeda C. Darvin
Science Research Specialist
PCARRD
Los Baños, Laguna

Ms. Dalisay L. de Guzman
Science Research Specialist
PCARRD
Los Baños, Laguna

Ms. Julieta R. Dimapilis
ICLARM
MC P.O. Box 1501
Makati, Metro Manila

Ms. Lucia P. Elizalde
Fishery Industry Project Officer
Fishery Industry Development Council
East Avenue, Diliman, Quezon City

Ms. Emma M. Escover
Junior Research Fellow
ICLARM
MC P.O. Box 1501
Makati, Metro Manila

Ms. Rita M. Fabio
Science Research Specialist
PCARRD
Los Baños, Laguna

Mr. Frank Fermin
International Institute of Rural Reconstruction
Silang, Cavite

Ms. Ma. Corazon B. Gaite
Department of Communications
Ateneo de Manila University
Quezon City

Mr. Ernesto R. Gonzales
Research Associate
Binangonan Research Station-SEAFDEC
Binangonan, Rizal

Dr. Leonardo A. Gonzales
IFPRI Liaison Scientist for Asia and
IRRI Agricultural Economist
International Rice Research Institute
Los Baños, Laguna

Ms. Luzviminda A. Guerrero
General Manager
Aquatic Biosystems
Bay, Laguna

Dr. Rafael D. Guerrero III
Aquatic Biosystems
Bay, Laguna

Mr. Jovenal F. Lazaga
Research Associate
SEAFDEC Aquaculture Department
Ortigas Ave., Mandaluyong
Metro Manila

Dr. Aida R. Librero
Director for Social Science Research
PCARRD
Los Baños, Laguna

Mr. Christopher Maccormac
Program Officer-Economics
IDRC, P.O. Box 101 Tanglin
Singapore 9124

Mr. Andres M. Mane
Mayondon, Los Baños
Laguna

Prof. Antonio N. Mines
Laguna Lake Development Authority
4th Floor, Rudgen Bldg.
Shaw Blvd., Pasig, Metro Manila

Mr. Jose Noel A. Morales
Department of Communications
Ateneo de Manila University
Quezon City

Dr. Emeline R. Navera
Regional Manager, NACIDA Region V
BAEcon-NACIDA
Legaspi City

Dr. Lydia P. Oliva
Associate Professor
Southern Mindanao Agricultural Research Center
University of Southern Mindanao
Kabacan, North Cotabato

Ms. Olga Criselda R. Orilla
Department of Communications
Ateneo de Manila University
Quezon City

Ms. Bernadine B. Pili
Department of Communications
Ateneo de Manila University
Quezon City

Dr. Roger S.V. Pullin
Director, Aquaculture Program
ICLARM
MC P.O. Box 1501
Makati, Metro Manila

Ms. Cecilia G. Reyes
Supervising Fishery Technologist
Bureau of Fisheries and Aquatic Resources
Muñoz, Nueva Ecija

Mr. Leonardo L. Roa
Assistant Instructor, Economics
Ateneo de Manila University
Quezon City

Mr. Westly R. Rosario
Freshwater Fish Hatchery and Extension Training Center
Bureau of Fisheries and Aquatic Resources
Muñoz, Nueva Ecija

Mr. Orestes T. Salon
ICLARM
MC P.O. Box 1501
Makati, Metro Manila

Mr. Ruben C. Sevilleja
Instructor
College of Inland Fisheries and
Researcher, Freshwater Aquaculture Center
Central Luzon State University
Muñoz, Nueva Ecija

Dr. Ian R. Smith
Director General
ICLARM
MC P.O. Box 1501
Makati, Metro Manila

Mr. Rogelio N. Tagarino
Researcher I
Center for Policy and Development Studies
University of the Philippines at Los Baños
College, Laguna

Dr. Elvira O. Tan
Director for Fisheries Research
PCARRD
Los Baños, Laguna

Dr. Enriqueta B. Torres
Associate Professor
College of Development Economics and Management
University of the Philippines at Los Baños
College, Laguna

Ms. Nida R. Ty
Assistant Professor in Economics
College of Arts and Sciences
University of the Philippines in the Visayas
Iloilo City

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