



UNIVERSITI PUTRA MALAYSIA

**THE ECONOMICS OF MILKFISH AQUACULTURE
IN ILOILO, PHILIPPINES**

MARIA CECILIA TARROSA-PESTANO

FEP 1992 4

**THE ECONOMICS OF MILKFISH AQUACULTURE
IN ILOILO, PHILIPPINES**

By

MARIA CECILIA TARROSA-PESTANO

**Thesis Submitted in Partial Fulfilment of the
Requirements for the Degree of Master of Science
in the Faculty of Economics and Management,
Universiti Pertanian Malaysia**

February 1992



To my darlings:

RC, who loves chocolate, ice cream and balloons

and

Christmas Boy, whose first smile I did not see,

just to defend this manuscript



ACKNOWLEDGEMENTS

I wish to express my sincere appreciation to several people and institutions who have helped in the accomplishment of this master's thesis.

My gratitude goes to Associate Professor Dr. Mohd. Ghazali Mohayidin, my major supervisor; Associate Professor Dr. Ishak Haji Omar and Mr. Saroni Judi, my secondary supervisors; to Associate Professor Dr. Maisom Abdullah and all my professors in the Universiti Pertanian Malaysia (UPM), for their guidance and patience.

I acknowledge the financial support of the International Development Research Center (IDRC) of Canada and likewise appreciate the Asian Fisheries Social Science Research Network (AFFSRN) at the University of the Philippines in the Visayas (UPV), for providing some materials and office supplies for this research.

I am indebted to Vice Chancellor de Castro, Teddy, Nang Claire and Nang Tes of UPV, for their guidance, encouragement and for being supportive since the start of this study.

I am also grateful to my colleagues - Vic, Sir Pabs, Jude, Ben, Rodel, Chona, Mane, Josie, Sylvia and Roger who, in some ways, have helped in the accomplishment of this manuscript; to my interviewers, my respondents and Mr. Doromal, President of the Iloilo Fish Producers Association, for their cooperation and patience during the survey. The



TABLE OF CONTENTS

ACKNOWLEDGEMENTSiii
LIST OF TABLES	ix
LIST OF FIGURES	xii
ABSTRACT	xiii
ABSTRAK	xv
CHAPTER	
I INTRODUCTION	1
Overview of the Philippine Fishing Industry	1
Fish Production	1
Aquaculture Production	3
Contribution of Aquaculture to the Economy	4
Overview of Milkfish Farming in the Philippines	5
Milkfish Aquaculture	5
Milkfish Production	6
Statement of the Problem	8
Objectives of the Study	9
Hypotheses of the Study	9
Justification of the Study	10
II REVIEW OF LITERATURE	12
Introduction	12
Previous Studies Conducted of Milkfish	12



technical assistance of Ronnie Butiong in the programming, and the efforts exerted by Mr. Ruthran and Mr. Siow in the reproduction, are highly appreciated.

My appreciation also goes to Mr. and Mrs. Paul Manalo and family; Susan and Jun; Fritzie and Romy; and to Precy and Ng, for making my stay in Malaysia a very memorably one; and to my favorite friend in FEP, Dr. Roslan, for his being very accommodating at all times.

I am thankful most of all to Mama, Nong Emil, Lyn, Marvin and Gina, for their sacrifices and encouragement; to Roel, for his immeasurable moral support; to baby RC and Christmas Boy, who gave me the remaining drive to complete this thesis; and to Papa, who passed away without seeing the completion of this manuscript. Lastly, I thank God for giving me the strength and determination, and for giving me the above people.



TABLE OF CONTENTS

ACKNOWLEDGEMENTSiii
LIST OF TABLES	ix
LIST OF FIGURES	xii
ABSTRACT	xiii
ABSTRAK	xv
CHAPTER	
I INTRODUCTION	1
Overview of the Philippine Fishing Industry	1
Fish Production	1
Aquaculture Production	3
Contribution of Aquaculture to the Economy	4
Overview of Milkfish Farming in the Philippines	5
Milkfish Aquaculture	5
Milkfish Production	6
Statement of the Problem	8
Objectives of the Study	9
Hypotheses of the Study	9
Justification of the Study	10
II REVIEW OF LITERATURE	12
Introduction	12
Previous Studies Conducted of Milkfish	12



	Analytical Approaches to Production Studies	16
III	RESEARCH METHODOLOGY	24
	Conceptual Framework	24
	The Production Function	24
	The Elasticity of Substitution : Basic Concept	26
	The Translog Production Function	27
	Parametric Constraints in Translog Production Function	31
	Cost Share Functions	32
	Elasticities in the Translog Production Function	33
	The Translog Profit Function	34
	Parametric Constraints in Translog Profit Function	36
	The Factor Share Equations	36
	Elasticities in Translog Profit Function	37
	Translog Production vs Translog Profit Function	38
	Model Specification	38
	The Translog Production Function	38
	Cost Share Equations	43
	The Translog Profit Function	44
	Factor Share Equations	45
	Estimation Procedure	46
	Sampling and Data Collection	47
	Sampling Procedure	47



	Data Collection	50
	Definition of Variables	50
IV	SOCIO-ECONOMIC PROFILE OF MILKFISH FARMERS	53
	Introduction	53
	Characteristics of Milkfish Farmers	53
	Socio-demographic Profile	53
	Educational Attainment	54
	Level and Sources of Income	55
	Milkfish Pond Characteristics	57
	Tenure Status	57
	Forms of Business Organization	58
	Farm Area	58
	Types, Sizes and Age of Ponds	60
	Milkfish Production Practices and Input Use	63
	Pond Preparation	63
	Lime Application	64
	Pest Eradication	67
	Fertilization Practices	68
	Stocking Practices	70
	Feeding	72
	Water Management	73
	Labour Use	73
	Harvesting	74
	Marketing	76



V	COSTS AND RETURNS OF MILKFISH AQUACULTURE	78
	Introduction	78
	Farm Investment	78
	Cost Structure	84
	Farm Output and Revenues	88
	Profit and Rates of Return	92
VI	EMPIRICAL RESULTS	94
	Introduction	94
	Estimates of the Production Function and Cost Share Equations	95
	Hypothesis Testing in Translog Production Function	100
	Estimates of the Translog Profit Functions and Factor Share Equations	102
	Hypothesis Testing in Translog Profit Function	107
	Price Elasticity of Input Demand	110
	Own-Price Elasticities of Input Demand	110
	Cross Elasticities of Input Demand	113
VII	SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS	115
	Summary and Conclusions	115
	Implications for Policy and Research	117
	BIBLIOGRAPHY	120
	APPENDICES	124
	A Derivation of Cost Share Equation	125
	B Derivation of the CD Profit Function	126
VITA	129



LIST OF TABLES

Table		Page
1	Fish Production in the Philippines, by Sector, 1980-89 (in '000 metric tons).....	2
2	Volume and Growth of Aquaculture Production in the Philippines, 1985-89 (in metric tons)	4
3	Volume and Growth of Milkfish Production in the Philippines, 1978-88 (in '000 metric tons)	7
4	Socio-demographic Profile of Milkfish Farmers in Iloilo, Philippines	54
5	Educational Attainment of Milkfish Farmers in Iloilo, Philippines	55
6	Estimated Annual Income (in pesos) of Milkfish Farmers in Iloilo, Philippines	56
7	Major and Secondary Sources of Income of Milkfish Farmers in Iloilo, Philippines	57
8	Forms of Business Organization of Milkfish Farms by Tenure Status in Iloilo, Philippines	58
9	Size of Milkfish Farms (in hectares) by Tenure Status in Iloilo, Philippines	59
10	Size (in hectares) and Age (in years) of Milkfish Ponds by Tenure Status in Iloilo, Philippines	61
11	Use of Production Inputs in Milkfish Aquaculture by Farm Size in Iloilo, Philippines	64
12	Quantity of Inputs Used in Milkfish Aquaculture per Cropping per Hectare by Farm Size in Iloilo, Philippines	66



Table	Page
13	Quantity of Inputs Used in Milkfish Aquaculture per Cropping per Farm Area by Farm Size in Iloilo, Philippines 66
14	Type of Pesticides Used by Milkfish Farmers in Iloilo, Philippines 67
15	Type of Organic and Inorganic Fertilizers Used by Milkfish Farmers in Iloilo, Philippines 69
16	Stocking Practices of Milkfish Farmers in Iloilo, Philippines 71
17	Type of Supplementary Feeds Used by Milkfish Farmers in Iloilo, Philippines 72
18	Quantity (manhours) and Percentage of Labour Used per Cropping per Hectare by Milkfish Farmers by Farm Size in Iloilo, Philippines 74
19	Reasons Cited by Milkfish Farmers for Their Schedule of Harvest in Iloilo, Philippines 75
20	Marketing Practices of Milkfish Farmers in Iloilo, Philippines 77
21	Construction and Equipment Investment on Milkfish Aquaculture (in pesos) per Farm Area by Farm Size in Iloilo, Philippines 79
22	Construction and Equipment Investment on on Milkfish Aquaculture (in pesos) per Hectare by Farm Size in Iloilo, Philippines 81
23	Depreciation on Construction and Equipment in Milkfish Aquaculture (in pesos) per Cropping per Farm Area by Farm Size in Iloilo, Philippines 82
24	Depreciation on Construction and Equipment in Milkfish Aquaculture (in pesos) per Cropping per Hectare by Farm Size in Iloilo, Philippines 83
25	Production Costs of Milkfish Aquaculture per Cropping per Farm Area by Farm Size in Iloilo, Philippines (in pesos) 85



Table	Page
26	Production Costs of Milkfish Aquaculture per Cropping per Hectare by Farm Size in Iloilo, Philippines (in pesos) 87
27	Yield, Revenues, Costs and Profit in Milkfish Aquaculture per Cropping per Hectare/ per Kilogram by Farm Size in Iloilo, Philippines (in pesos) 88
28	Yield, Price, Revenues, Costs, Profit and Rates of Return in Milkfish Aquaculture per Cropping per Farm Area by Farm size in Iloilo, Philippines (in pesos) 91
29	OLS and ZEF Estimates of the Translog Production Function for Milkfish Aquaculture in Iloilo, Philippines 96
30	OLS and ZEF Estimates of the Cost Share Equations for Milkfish Aquaculture in Iloilo, Philippines 98
31	Summary of F-ratios of Various Hypotheses Tested in the Translog Production Function for Milkfish Aquaculture in Iloilo, Philippines100
32	OLS and ZEF Estimates of the Translog Profit Function for Milkfish Aquaculture in Iloilo, Philippines103
33	OLS and ZEF Estimates of the Factor Share Equations for Milkfish Aquaculture in Iloilo, Philippines105
34	Summary of F-ratios for Various Hypotheses Tested in the Translog Profit Function for Milkfish Aquaculture in Iloilo, Philippines108
35	Own-Price and Cross Elasticities of Input Demand in Milkfish Aquaculture in Iloilo, Philippines.....110



LIST OF FIGURES

Figure		Page
1	Map of Iloilo, Philippines, Showing the Municipalities Surveyed	49
2	A Typical Milkfish Farm Layout	62



Abstract of thesis submitted to the Senate of Universiti Pertanian Malaysia in partial fulfilment of the requirements for the degree of Master of Science

**THE ECONOMICS OF MILKFISH AQUACULTURE
IN ILOILO, PHILIPPINES**

By

MARIA CECILIA TARROSA-PESTANO

February 1992

Supervisor: Associate Professor Dr. Mohd. Ghazali Mohayidin

Faculty : Economics and Management

The milkfish (Chanos chanos) industry plays a vital role in the Philippine economy. The industry, however, is facing the problem of low productivity.

This study evaluates the efficiency of resource use in milkfish aquaculture. The translog production and translog profit functions were estimated using cross-sectional data obtained through a survey of 67 milkfish farmers surveyed in Iloilo, Philippines. In both functions, the explanatory variables were inorganic fertilizer, seed, labour, pesticides, age of pond and respondent's experience. Farm size was entered as dummy variable for small, medium and large farms.

The performance of each farm category was evaluated using economic indicators such as rate of return on investment, rate of return on operating cost, ratio of net profit to gross revenues and ratio of net profit to variable costs. The results showed that the small farms had performed better than the other farm groups.



The regression results revealed that the milkfish farmers were profit-maximizers. The translog profit function was found to be better than the translog production function in explaining the farmers' production process at 5% level of significance. In addition, the variable inputs were found to be highly price inelastic; cross elasticities of inorganic fertilizer, seed and labour with pesticide were low while complementarity of inorganic fertilizers with seed and labour were high.

The study concludes that the present productivity level of milkfish aquaculture can only be increased through technological advancement since milkfish farmers are already price efficient. However, the technological innovation that should be propagated must suit the farmers' scale of fishpond operation. For instance, a less capital intensive culture technique, such as the use of cheaper supplementary feeds from indigenous materials should be investigated.



bahawa ladang kecil mempunyai prestasi yang baik berbanding dengan ladang-ladang lain.

Keputusan regresi menunjukkan bahawa penternak "milkfish" adalah pemaksimum keuntungan. Fungsi keuntungan translog didapati lebih baik dari fungsi pengeluaran translog di dalam menerangkan proses pengeluaran penternak pada tahap 5% signifikan. Disamping itu, input berubah didapati sangat anjal dari segi harga. Keanjalan silang baja bukan organan, biji benih dan buruh dengan racun perosak adalah rendah, manakala daya penggenap baja bukan organan dengan biji benih dan buruh adalah tinggi.

Kajian ini merumuskan bahawa tahap daya pengeluaran masakini akuakultur "milkfish" hanya boleh ditingkatkan melalui perkembangan teknologikal kerana penternak telahpun cekap dari segi harga. Tetapi, inovasi teknologi yang harus dikembangkan mestilah sesuai dengan skel operasi penternakan. Sebagai contoh, teknik kultur yang tidak intensif modal, seperti penggunaan makanan tambahan yang murah dari bahan-bahan yang wujud di tempat berkenaan, harus diselidiki.

CHAPTER I

INTRODUCTION

Overview of the Philippine Fishing Industry

Fish Production

The Philippines is one of the world's top consumers and producers of fish and other fishery products. For Filipinos, fish is the major and cheapest source of protein which accounts for more than one half of the Filipinos' protein intake.

In terms of production, the country accounted for 2.15% of the world's total nominal catch in 1987. This represents about one sixth of the contribution of Japan, the world's leading producer as well as consumer of fish (FAO, 1987).

The Philippine fishing industry consists of production activities (fish capture and fish culture) as well as processing and marketing of fish and fishery products. The contribution of the industry to the Gross National Product (GNP) amounted to about 5.0% in 1987, almost one-fifth of the agriculture's share.

Fish production in the Philippines comes from three sectors: commercial fisheries, aquaculture and municipal fisheries.



Total fish production grew at an average annual rate of 4% for the period 1980-1989. In 1989, total volume of fish produce reached almost 2,367 mt, 47% of which came from municipal fisheries, 26% from commercial fisheries, while aquaculture accounted for 27% (Table 1).

Table 1
Fish Production in the Philippines by Sector, 1980-89 (in '000 metric tons)

Year	Total mt	Commercial		Aquaculture		Municipal	
		mt	% of total	mt	% of total	mt	% of total
1980	1,672.254	488.478	29.21	289.166	17.29	894.600	53.50
1981	1,772.897	494.768	27.91	339.501	19.15	938.600	52.94
1982	1,896.983	526.273	27.74	392.348	20.68	978.300	51.58
1983	2,110.230	519.316	24.61	445.073	21.09	1,145.800	54.30
1984	2,080.439	513.335	24.67	477.887	22.97	1,089.217	52.36
1985	2,052.111	511.987	24.95	494.742	24.11	1,045.382	50.94
1986	2,089.484	546.230	26.14	470.893	22.54	1,072.361	48.68
1987	2,213.040	591.192	26.71	560.970	25.35	1,060.879	47.94
1988	2,269.744	599.995	26.43	599.550	26.41	1,070.195	47.16
1989	2,366.588	624.655	26.39	637.307	26.93	1,104.626	46.68
Annual Growth (%)	4.00		2.8		39.42		2.55

Source: Bureau of Fisheries and Aquatic Resources, 1980-89.

While capture fisheries (municipal and commercial) remains the primary source of fish, the growing contribution of aquaculture to total fish production can hardly be ignored. In the past decade, the percentage share of aquaculture to total production has increased from 17% to 27%, while contributions of municipal and commercial fisheries declined from 53.50% to 46.68% and from 29.21% to 26.39%, respectively.

In terms of average annual growth, the aquaculture sector grew at 9.42%, the highest rate registered among the three sectors

Aquaculture Production

Aquaculture can further be categorized into three subsectors, namely: (1) mariculture, which includes oyster, mussel and seaweed culture; (2) freshwater culture, such as fishpens and fish cages, and; (3) fishpond culture, which is either brackishwater or freshwater pond culture.

In 1985-1989, aquaculture production increased by 28.82%, with mariculture achieving the highest growth rate of 38.48% (Table 2). The relatively high increase in mariculture production could be attributed to increasing popularity of seaweed culture. In the case of fishpond culture, production also attained a relatively high increase of 34.23%. Production from freshwater pond culture escalated tremendously by about 115% in the same period. However, brackishwater production remained dominant, accounting for 88% of total fish production, or 253,580 mt in 1989.

Table 2
Volume and Growth of Aquaculture Production
in the Philippines, 1985-89 (in metric tons)

Subsector	1985		1989		Growth (%)
	Volume	%	Volume	%	1985-1989
Total	494,742	100.00	637,307	100.00	28.82
Mariculture	220,894	44.65	305,885	48.00	38.48
Freshwater	59,420	12.01	43,604	6.84	(26.62)
Fishponds	214,428	43.34	287,818	45.16	34.23
brackishwater	198,546	92.59	253,580	88.10	27.72
freshwater	15,882	7.41	34,238	11.90	115.58

Source: Bureau of Fisheries and Aquatic Resources, 1985-89.

For fishpen and fish cage culture (freshwater), production declined by 26.62%. This could be attributed to the reported decrease in fishpen area from about 29,000 ha in 1985 to 24,000 ha after a year. This is despite the fact that annual average yield from fishpen culture is five times greater than the average yield from fishpond culture. The unpredictability of the weather, which carries with it greater risk and uncertainty in production, may be one of the reasons why fishpen operation declined.

Contribution of Aquaculture to the Economy

Admittedly, the aquaculture sector has been significantly contributing to fish production. As the country's population continues

to rise, demand for fish is likely to increase, necessitating further increase in production. The role of aquaculture becomes more pressing as the contribution of capture fisheries (commercial and municipal) to fish production has been declining in the past decade. Due to the declining share of capture fisheries which may be attributed to the biological limits of the fishery resource and the continuous increase in fishing effort, the bulk of the future increases in fish production is expected to come from the aquaculture sector.

Production from culture fisheries is also an important source of foreign exchange earnings. In 1988, exports of fish and other fish products amounted to 128,902 mt worth P9.6 billion (US\$420.5 million), mostly traded to Japan, USA, Canada, Hongkong and West Germany. Exports of shrimps and prawns accounted for 55.21% of total export earnings or P5.3 billion (US\$232.97 million), while that of milkfish was valued at P75.86 million (US\$3.33 million) (Philippines, BFAR, 1989).

The aquaculture sector also provides employment to over 220,000 people. Among them are fishpond managers and caretakers, hired labourers, fry gatherers, concessionaires, dealers and middlemen who, directly or indirectly, depend on aquaculture for their livelihood.

Overview of Milkfish Farming in the Philippines

Milkfish Aquaculture

In the Philippines, milkfish is the most important pond cultured species in terms of land area and volume of production.



In 1988, the total hectarage of brackishwater ponds in operation was 210,680 ha with a total production of 240,206 mt. About 73% of the volume produced were milkfish, while prawn accounted for 17.3% (Philippines, BFAR, 1989). Although there is no official estimate as to the area devoted to milkfish, most brackishwater fishponds were used for milkfish culture, with an estimated yield of 800 kg/ha/yr. Locally known as "bangos", milkfish is one of the best suited species for brackishwater pond culture .

Brackishwater pond culture of milkfish can either be intensive or extensive. Intensive culture refers to a culture system which uses recent techniques, such as scientific pond design, fertilization, feeding, stock manipulation and pest control (Shang, 1976). Extensive culture on the other hand, is a traditional method, relying heavily on natural food bases such as "lablab" (micro-benthic algae), "lumut" (filamentous green algae) and plankton.

Milkfish Production

The average annual growth of milkfish production during the period 1978-88 was 4.46% (Table 3). However, production has shown a declining trend since 1983 at an average rate of 4.67%.

Table 3
Volume and Growth of Milkfish Production
in the Philippines, 1978-88 (in '000 mt)

Year	Volume ('000 mt)	Growth (%)
1978	127.02	-
1979	138.91	9.36
1980	171.94	23.78
1981	236.33	37.45
1982	252.16	6.70
1983	245.26	(2.74)
1984	241.32	(1.61)
1985	195.66	(18.92)
1986	184.91	(5.49)
1987	199.25	7.76
1988	175.94	(11.70)
Average		4.46

Source: Bureau of Fisheries and Aquatic Resources, 1978-88.

The decline in milkfish production may be attributed to rise in demand for prawns in the international market. Milkfish farmers were caught in a dilemma, of whether to polyculture prawns with milkfish or to entirely shift to prawn culture. Due to the export potential of prawns, the area devoted to prawns has been reported to increase, which implies that some milkfish farmers were already shifting to prawn culture.

Statement of the Problem

Several studies conducted on milkfish aquaculture (Librero, 1977; Shang, 1976; Chong and Lizarondo, 1982; Chong et al. 1982; Chong et al. 1984) indicate that milkfish farms were mostly underutilized. Intensification of culture system, or adoption of improved techniques, was largely constrained by biotechnical, economic and institutional factors.

A majority of milkfish farms, even those intensively operated or using supplementary inputs, were producing far below the national average yield of about 800 kg/ha/yr. Even the national average yield is low, considering a yield of over 2,000 kg/ha achieved in experimental stations of the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC-AQD). In fact, a yield of 2,000 kg/ha or more is not entirely experimental but has already been obtained by some farmers, especially those located in the provinces of Bulacan, Iloilo and Pangasinan.

The productivity of the Philippine milkfish culture is much lower compared with that of Taiwan, where milkfish farms recently yield over 3,000 kg/ha due to greater use of inputs and good management.

Clearly, a yield gap of over 1,000 kg/ha exists, and the possibility of increasing the current yield by two-fold is not remote. Essentially, the problem is how to attain further increases in milkfish productivity which, could raise profits or minimize costs per unit output to producers.