UNIVERSITI PUTRA MALAYSIA

PROFITABILITY AND ECONOMIC EFFICIENCY IR GILLNET FISHING IN GUIMARAS STRAIT AND ADJACENT WATERS, WESTERN VISAYAS, PHILIPPINES

RODELIO FERNANDEZ SUBADE

FEP 1991 7

PROFITABILITY AND ECONOMIC EFFICIENCY IN GILLNET FISHING IN GUIMARAS STRAIT AND ADJACENT WATERS, WESTERN VISAYAS, PHILIPPINES

By

RODELIO FERNANDEZ SUBADE

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

August 1991

UPM

ACKNOWLEDGEMENTS

I would like to express my gratitude to my supervisor, Dr. Nik Mustapha Raja Abdullah, for his support, guidance and patience in my undertaking of this thesis. My sincere thanks are also extended to my co-supervisors Dr. Roslan A.Ghafar and Assoc. Prof. Dr. Ishak Haji Omar for their comments and suggestions. The former has been helpful in the model estimation, along with PhD candidate Ferdous Alam, who also shared his invaluable ideas.

I am indebted to the International Development Research Center of Canada (IDRC) for providing the scholarship and financial support, and to my home institution the University of the Philippines in the Visayas for granting me a study leave.

I akcnowledge the encouragement of Prof. Harlan Lampe, former ICLARM-AFSSRN coordinator, for me to pursue my graduate studies. Moreover, my superiors in the University of the Philippines in the Visayas -- Prof. Lourdes V. De Castro, Dr. Elnora Cabalfin, Prof. Ted Ledesma and Prof. Melanie Padilla have been fully supportive of my further studies and academic development. To them I should also extend my sincere thanks.

I am grateful to our UPV-AFSSRN research team -- Joe, Chona, Gilma, Sam, El, Pilar, Mane, Josie, and Glen who co-

laboured with me during my term in the small pelagics research project. Obviously, our research project, as well as my thesis, could have not been accomplished without the cooperation of many fishermen and other key informants whom we have interviewed, as well as the support of a number of government and non-government institutions and organizations.

The following also deserves my gratitude for helping me in one way or another: fellow gra
Gerry, Sum and Idris; Tito Paul and family who served as my foster family; fellow Filipino students in UPM, Nong Perfing James, Susan, John, Notnot, Gingging, and others; En. Zoi and the staff at FEP Pejabat Am; draftsman Asri Ruslan; Meng Yew Choong who translated the abstract to Bahasa Malaysia.

I should acknowledge too, the moral support of my parents, brothers and sisters as I undertake my M.S. studies in UPM. The same acknowledgement is accorded to my spiritual brothers and sisters in the faith at UPM.

Most of all, unquantifiable thanks, praises and glory are attributed to the God Almighty, who through Apostle Paul has enabled me to say, "I have finished the race,...I have kept the faith.. " (II Timothy 4:7)

TABLE OF CONTENTS

		Page
ACKNOWLEDGEMENTS	.....	ii
LIST OF TABLES	.....	viii
LIST OF FIGURES	.....	xi
ABSTRACT	.....	xii
ABSTRAK	.....	xv
CHAPTER		
I INTRODUCTION	.....	1
The Philippine Fishery Sector	.....	1
Importance to the Economy	.....	1
Fishery Subsectors and Production	.....	2
Fish Marketing and Distribution	.....	3
Marine Waters and Other Water Areas Fishing Grounds and Fishing Areas	....	6
Fishing Gears and Methods	.....	7
Flora and Fauna of the Fishery	.....	10
Fishery Resource Exploitation and Increasing Population	.....	11
Guimaras Strait and Adjacent Waters	.....	13
Problem Statement	.....	18
Objectives of the Study	.....	23
Significance of the Study	.....	23
Hypotheses of the Study	.....	24

II	LITERATURE REVIEW	25
	Introduction	25
	Review of Philippine Fisheries Policies	25
	Previcus Studies on Guimaras Strait	28
	Review of Studies on Production Economics in the Marine Fisheries	32
	Analytical Methods Used in Production Economics Studies	38
	Production Function Approach	38
	Dual Approach: Using Costs Function and Profit Function ...	40
	The Concept of Efficiency	50
III	METHODOLOGY	54
	Conceptual Framework	54
	Fundamentals of Production Theory	54
	The Fishery Production Function	56
	Limitation of Production Function Approach	63
	The Profit Function Model : with Special Reference to the Translog Form	65
	Elasticities in the Translog Profit Function Model	71
	Model Specification	76
	Estimation Procedure and Technique	81
	Definition of Variables	81
	Sampling and Data Collection	83

IV SOCIO-ECONOMIC PROFILE OF THE GILLNET FISHERY 85

Gillnet Fishing Practices and Methods ... 85

Description of Fishing Operation 85

Drift Gillnet 85

Encircling Gillnet 88

Bottomset Gillnet 88

Fishing Crew 91

Fishing Grounds Visited 92

Major Species Caught 93

Characteristics of Gillnet Fishermen 94

Educational Attainment 94

Household Size, Income Earners and Diversity of Income Sources 95

Household Income of Boat Owners 97

Labor Mobility 99

Fishing Assets Characteristics 101

Ownership Pattern 101

Boat/Geartype Distribution 102

Boat Characteristics 103

Engine Characteristics 106

Fishing Net Characteristics 108

Other Fishing Assets 112

V COSTS AND EARNINGS STRUCTURE OF THE GILLNET FISHERY 114

Introduction 114

Investment Requirements 114

Cost Structure 116

Fishing Catch or Yield 121

Earnings and Profitability 122

VI EMPIRICAL RESULTS 128

Unrestricted and Restricted Parameter Estimates of the Translog Profit Function 128

Hypotheses Testing Conducted on the Profit Function Model 131

Test on Cobb-Douglas Form 131

Test on Profit Maximization 135

Test on Relative Economic Efficiency .. 137

Test on Homogeniety 140

Input Demand and Output Supply Elasticities 140

VII SUMMARY, CONCLUSIONS, AND POLICY IMPLICATIONS 149

Summary and Conclusions 149

Policy Implications and Recommendations .. 155

BIBLIOGRAPHY 158

APPENDIX

A Additional Tables 166

B Additional Figures 179

VITA 183

LIST OF TABLES

Table		Page
1	Summary of Production in Quantity and Value by Fishery Sector (1978-1987) Unit: Quantity in Thousand Metric Tons Value in Million Pesos	4
2	Fishing Regions of the Philippines (as Classified by BFAR for Statistical Purposes) and their Estimated Shelf Areas ...	8
3	Growth of Philippine Population	12
4	Comparison of Potential Production (MT) of Philippine Fishing Areas as Estimated in the NRMC/FIDC (1980) Workshop with Actual BFAR Production Statistics for 1983-84	14
5	Marine Production in Guimaras Strait and Visayan Sea : 1978-1986 (tons)	18
6	Fishing Time, Travel Time, Fishing Trip Time and Distance Travelled Average Values	87
7	Educational Attainment by Gear Type	94
8	Educational Attainment Across Landing Sites ..	95
9	Household Size, Number of Income Earners and Diversity of Income Sources	96
10	Annual Household Income of Boat Owners	98
11	Alternative Employment Possibilities Other Than Fishing	100
12	Ownership Pattern of Fishing Assets	101
13	Location and Types of Gillnets	102
14	Mode of Boat Acquisition	103

Table		Page
15	Boat Vintage by Gear Type and Landing Site ..	104
16	Boat Motorization by Gear Type and Landing Site	105
17	Engine Horsepower by Gear Type and Landing Site	106
18	Engine Vintage by Gear Type and Landing Site	107
19	Fishing Net Dimensions (in meters)	109
20	Maximum, Minimum and Average Mesh Size (in cm.)	110
21	Mode of Net Acquisition	111
22	Net Vintage by Gear Type and Landing Site ...	112
23	Investment Requirements in Gillnet Fishing in Guimaras Strait and Adjacent Waters (1988-89)	115
24	Cost Structure Per Boat of Different Gillnets in Guimaras Strait and Adjacent Waters , 1988-89 (figures represent peso costs per fishing trip)	117
25	Cost Structure Per Kilogram of Catch for Gillnets In Guimaras Strait And Adjacent Waters, 1988-1989 (figures represent peso costs per fishing trip)	120
26	Fishing Yield and Revenues	122
27	Earnings and Profit in Gillnet Fishing Per Boat for an Average Fishing Trip (1988-1989)	123
28	Earnings and Profit in Gillnet Fishing Per Kilogram of Catch for an Average Fishing Trip(1988-1989)	126
29	Parameter Estimates of the Translog Profit Function for Gillnets in Guimaras Strait and Adjacent Waters	129

Table		Page
30	Hypotheses Testing on the Translog Profit Function Model for all Gillnets	133
31	Hypothesis Testing on Cobb-Douglas Form of the Profit Function for Different Gillnet Types	134
32	Hypothesis Testing on Profit Maximization for Different Gillnet Types	136
33	Hypothesis Testing on Equal Relative Economic Efficiency Among Paired Gillnet Types	138
34	Input Demand Elasticities	141
35	Output Supply Elasticities	146
36	Parameter Estimates of the Translog Profit Function for Drift Gillnets in Guimaras Strait and Adjacent Waters	167
37	Parameter Estimates of the Translog Profit Function for Encircling Gillnets in Guimaras Strait and Adjacent Waters	169
38	Parameter Estimates of the Translog Profit Function for Bottomset Gillnets in Guimaras Strait and Adjacent Waters	171
39	Parameter Estimates of the Translog Profit Function Based from the Pooled SUR for Paired Gillnet Types in Guimaras Strait and Adjacent Waters, 1988-89	173
40	Statistical Fishing Areas and Marine Fishing Grounds in the Philippines	175

LIST OF FIGURES

Figure		Page
1	Map of the Philippines Showing Different Administration Regions and Fishing Areas Which Include the Guimaras Strait	9
2	The Study Area : Guimaras Strait and Adjacent Waters , with Different Landing Sites and Coastal Towns or Villages	16
3	Growth Curve	57
4	Production Function	58
5	Effort Curve	59
6	Sustainable Yield Function	60
7	Drift Gillnet	86
8	Encircling Gillnet	89
9	Bottomset Gillnet	90
10	Guimaras Strait, Adjacent Waters and Surrounding Islands	180
11	Types of Fishing Gears in Use in the Philippines	181
12	Major Small Pelagic Species Caught by Gillnets from Guimaras Strait and Adjacent Waters	182

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

PROFITABILITY AND ECONOMIC EFFICIENCY IN GILLNET FISHING IN GUIMARAS STRAIT AND ADJACENT WATERS, WESTERN VISAYAS, PHILIPPINES

By

RODELIO FERNANDEZ SUBADE
August 1991

Supervisor : Dr. Nik Mustapha Raja Abdullah

Faculty : Economics and Management

Gillnets contribute a significant portion of fish production in the Philippine fisheries sector, as well as in Guimaras Strait and adjacent waters. It has been found out however, that many small-scale or municipal fishermen, to which the gillnet fishermen belong are living below the poverty threshold. Moreover, a number of studies and available secondary data showed the evident overfishing in Guimaras Strait and adjacent waters.

This study examines the socio-economic profile, profitability and economic efficiency in gillnet fishing in Guimaras Strait and adjacent waters.

The socio-economic profile revealed that most of the gillnet fishermen attained elementary or high school level of

education. Average household size was 5.7 members while 71 percent of the households were dependent on only one income earner in the family. Sixty one percent of the households depended on fishing as the only source of income. The study also found that there were other employment alternatives, aside from fishing, which were available for the gillnet fishermen.

Costs and earnings analysis showed that both drift gillnets and bottomset gillnets earned fishing incomes below that of the national poverty threshold. Encircling gillnets, meanwhile, earned 68675.68 pesos, the highest of the three gear types.

The normalized restricted translog profit function was used to assess whether gillnet fishermen were able to maximize profits and to examine relative economic efficiency. The results which was estimated using the seemingly unrelated regressions (SUR) technique, revealed that all gillnets were not able to maximize profits based on pooled regressions and individual gear type regressions. Encircling gillnets were found to be the most economic efficient while the drift gillnets were found to be the least economic efficient.

The price elasticity of demand for labour was found to be inelastic (-0.79). Own price elasticity for fuel was close to unity (-0.96), while that for crew provisions was quite elastic (-1.38). Cross price elasticity estimates revealed that the

above (three) variable inputs were substitutes at varying degrees. Input demand elasticities for labour, fuel, and crew provisions with respect to net mesh size suggest that bigger net mesh size would lead to lower labour and fuel use, and lower crew provisions.

The results also showed that increase in fish prices will increase labour, fuel and crew provisions use. The estimated own price elasticity of output or fish catch implied the evident overfishing in Guimaras Strait and adjacent waters. This finding confirms the assessment of previous studies and the suggestion of secondary data about the status of the fishery.

Abstrak tesis yang dikemukakan kepada Senat Universiti Pertanian Malaysia sebagai memenuhi sebahagian daripada syarat yang diperlukan untuk mendapatkan Ijazah Master Sains

POTENSI KEUNTUNGAN DAN KECEKAPAN EKONOMIK UNTUK PENGGUNAAN PUKAT HANYUT DI SELAT GUIMARAS DAN PERAIRAN YANG BERHAMPIRAN DI KEPULAUAN VISAYA BARAT, FILIPINA

Oleh

RODELIO FERNANDEZ SUBADE
Ogos 1991

Penyelia : Dr. Nik Mustapha Raja Abdullah

Fakulti : Ekonomi dan Pengurusan

Sumbangan pukat hanyut terhadap pengeluaran perikanan di Filipina adalah signifikan, begitu juga di Selat Guimaras dan perairan yang berhampiran. Namun begitu, didapati kebanyakan nelayan kecil-kecilan, yang mana kebanyakannya nelayan pukat hanyut hidup di bawah garis kemiskinan. Tambahan lagi, beberapa kajian dan data sekunder menunjukkan penangkapan berlebihan berlaku di Selat Guimaras dan perairan yang berhampiran.

Kajian ini mengkaji profil sosioekonomi, potensi keuntungan dan kecekapan ekonomi di dalam perikanan pukat hanyut di Selat Guimaras dan perairan yang berhampiran.

Profil sosioekonomi menunjukkan kebanyakan nelayan pukat hanyut mencapai tahap pendidikan di peringkat sekolah rendah

atau menengah. Saiz isirumah purata ialah 5.7 ahli manakala 71 peratus dari isirumah-isirumah bergantung kepada hanya seorang ahli keluarga sebagai sumber pendapatan. Enam puluh satu peratus dari isirumah-isirumah hanya bergantung kepada penangkapan ikan sebagai sumber pendapatan. Kajian ini mendapati bahawa ada peluang pekerjaan dalam bidang lain, selain dari penangkapan ikan yang boleh diceburi oleh nelayan pukat hanyut.

Analisis kos dan pendapatan menunjukkan kedua-dua pukat hanyut dan pukat hanyut dasar memperolehi pendapatan di bawah tahap kemiskinan negara. Sementara itu, pukat hanyut keliling memperolehi pendapatan yang tertinggi di antara ketiga-tiga jenis pukat itu, iaitu sebanyak 68675.68 pesos.

"Normalized restricted translog profit function" digunakan untuk menilai sama ada nelayan pukat hanyut berupaya untuk memaksimumkan keuntungan dan juga mengkaji kecekapan ekonomik relatif. Keputusan-keputusan yang dianggarkan dengan menggunakan teknik "Seemingly Unrelated Regressions" (SUR) untuk keseluruhan dan setiap jenis pukat menunjukkan bahawa kesemua jenis pukat hanyut tidak berupaya untuk memaksimumkan keuntungan. Pukat hanyut keliling didapati paling cekap dari segi ekonomik manakala pukat hanyut adalah paling rendah kecekapan ekonomiknya.

Keanjalan harga permintaan untuk buruh didapati tidak anjal (-0.79). Bahanapi dan bekalan anak kapal mempunyai keanjalan harga masing-masing hampir kepada uniti (-0.96) dan anjal (-1.38). Anggaran keanjalan harga silang menunjukkan bahawa ketiga-tiga input berubah di atas merupakan pengganti yang tidak tepat. Keanjalan permintaan input untuk buruh, bahanapi dan bekalan anak kapal berbanding dengan mata pukat mencadangkan bahawa mata pukat yang lebih besar akan memyebabkan penggunaan buruh, bahanapi dan bekalan anak kapal yang lebih rendah.

Keputusan juga menunjukkan bahawa pertambahan dalam harga ikan memyebabkan pertambahan dalam penggunaan buruh, bahanapi dan bekalan anak kapal. Anggaran keanjalan harga output atau tangkapan ikan menunjukkan bahawa penangkapan berlebihan berlaku di Selat Guimaras dan perairan yang berhampiran. Penemuan kajian ini adalah selaras dengan kajian-kajian yang lepas dan penerangan data sekunder tentang status perikanan.

CHAPTER I

INTRODUCTION

The Philippine Fisheries Sector

Importance to the Economy

The fisheries sector has a vital role in the Philippine economy. It is a major component of the agricultural sector, a main source of food for the population, and contributes significantly to the economy in terms of national income, employment, and export earnings.

In 1988, the fisheries sector accounted for 4.5 percent of the Philippine Gross National Product (GNP). It directly employed an estimated one million fishermen and fishfarmers, out of which 250,000 were engaged in aquaculture operations, about 700,000 in municipal fisheries and 42,000 in commercial fishing (BFAR,1989). With an average Filipino family size of six persons, the total number of people who are directly dependent on the sector approximates about ten percent of the total population. Moreover, the sector indirectly provides employment to those engaged in fish distribution and marketing, fish processing, operation of ice plants and cold storages and in allied or related industries such as net making, boat building, boat engine/motor, and others. It also feeds the

population a per capita intake of 41 kg of fish annually (BFAR, 1987), which is about 60 percent of their total animal protein requirements (Ronquillo and Gabral-Llana, 1987).

According to the Bureau of Fisheries and Aquatic Resources (BFAR) performance review of the fisheries sector (1989), the country has had a positive balance of trade in fish and fishery products since 1975. In fact, fish products contribute about 4.9 percent of the total value of national foreign exchange earnings. The value of exports increased steadily from 782 million pesos or 64,890 MT in 1979 to 9.6 billion pesos or 128,899 MT in 1988. Of the total export revenues from the sector, the top five dollar earners were the following: shrimp/prawn (55 percent), tuna (25 percent), seaweeds (6 percent), shellcraft articles (3 percent), and cuttlefish/squid (2 percent).

Fisheries Subsectors and Production

As defined by the national agencies concerned with the fisheries in the country, the Philippine fisheries is divided into the marine and inland fisheries subsectors (Flores and Silvestre, 1987). The marine subsector includes fish capture activities in bays, seas or marine areas of the country, while the inland subsector includes fishing activities in inland water bodies such as lakes and rivers (i.e. inland municipal fisheries), and also aquaculture. The marine subsector is

further subdivided into the commercial and municipal fisheries, in which the latter involves the use of boats 3 gross tons or less. The marine commercial subsector involves the use of vessels over 3 gross tons. Furthermore, the municipal fisheries also includes fishing activities that do not involve the use of vessels/boat.

There has been an increasing share of the aquaculture sector to the total fish production, but a decreasing trend on the part of the commercial and municipal sectors. In 1978 the commercial subsector accounted for 32 percent of the total production, while the municipal subsector, and aquaculture contributed 54.3 percent and 13.7 percent, respectivley. However, in 1988 this changed to: 26.4 percent in commercial subsector; 46.7 percent in municipal subsector; and 26.9 percent in aquaculture. Table 1 shows the production of the different sectors/subsectors for the period 1978-1987. As shown, the declining total production of municipal inland fisheries despite increases in total production of all other subsectors, may also explain the increasing share of aquaculture to total fish production.

Fish Marketing and Distribution

Production is not the only main task and concern for the fisheries sector. An efficient system of fish distribution from the point of production to the point of consumption should

Table 1
Summary of Production In Quantity and Value By Fishery Sector (1978-1987)
Unit: Quantity In Thousand Metric Tons , Value In Million Pesos

Year	Total		Commercial		Municipal				Aquaculture	
					Marine		Inland			
	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value	Qty.	Value
1978	1580	9477	506	3465	687	4474	171	336	216	1202
1979	1581	10537	501	3512	635	4873	204	492	241	1660
1980	1672	11644	489	3785	647	5410	247	607	289	1842
1981	1773	13954	495	4125	710	6263	229	700	339	2866
1982	1897	15064	526	4355	708	6488	271	828	392	3393
1983	2110	18981	519	4643	771	7463	375	2076	445	4799
1984	2080	25650	513	6521	790	10291	299	1572	478	7266
1985	2052	31297	512	7857	785	12796	260	1920	495	8724
1986	2089	37331	546	9248	807	14611	265	2640	471	10832
1987	2213	37349	591	9821	816	14216	245	1891	561	11421

Source: Bureau of Fisheries and Aquatic Resources

complement the sector's production if its huge and increasing output is to benefit the consumers (Librero, 1985). An analysis of the fish marketing system by Librero (1985) defined an oligopolistic and multi-layered marketing structure for fish in the Philippines. From the fishermen, catch is disposed and distributed through a few brokers; then, to the more numerous wholesaler-retailers, wholesalers, and retailers; then, to other middlemen, until it reaches the consumers (Panayotou, 1985). Thus, this structure means a higher capital requirement the nearer is the buyer-seller (specifically the broker) to the fisherman/producer in the channel of the distribution system. Nevertheless, on the average, every fisherman remains a price taker of output based on the current market price which is usually determined through auction sale or the so called "bulungan" system. Such is influenced largely by the brokers.

Fish delivery and trade were often sea-based as 50 percent of the total quantity of fish traded in 1987 were transported by boat. By-land delivery (by truck) was 26 percent while air-lifted fish amounted to 24 percent of total fish traded for the same year.

According to the study by Librero (1985), there were some problems which must be addressed by the government to have a more efficient marketing system. These were: lack of adequate fish landing areas; inefficient collection and distribution of fish which results in areas of fish surpluses and areas of

deficit, thereby resulting to large price differentials; and involvement of a long chain of middlemen in fish trading which inflate marketing costs and hence the price of fish. Since the study was made, however, several government programs and projects have been initiated and carried out to address those problems. For instance, several commercial and municipal fishing ports have been constructed. Also, fish cooperatives have been encouraged and formed to take charge of the marketing of catch. However, the efficacy of the projects and programs concerned still need to be examined or investigated.

Marine Waters and Other Water Areas, Fishing Areas and Fishing Grounds

The aforementioned massive fish production are caught and produced from the vast water resources of the country. Being archipelagic in nature, the Philippines is endowed with huge marine waters which totalled 1,934,000 sq km according to the estimate of the Natural Resources Management Center (NRMC). Moreover, other authors computed the figure to as high as 2.1 million sq km (Silvestre,1987). Both estimates cover the exclusive economic zone (EEZ) of the country's territory, which is included in the oceanic waters sprawling an area of 1,400,000 sq km. The total marine waters also consist 270,000 sq km of coastal waters, and 127,000 sq km of traditional fishing grounds. Furthermore, inland waters include 68 lakes with an area of 200,000 hectares; 421 principal rivers

covering an area of 31,000 hectares; 380,000 hectares of swamplands; 224,263 hectares of brackishwater and freshwater ponds and 19,000 hectares of reservoir (BFAR 1983,1987).

For monitoring and statistical purposes, BFAR has divided the marine waters into 24 fishing areas, which are further grouped into 6 fishing regions. Under these, there are a total of 115 specific fishing grounds (see Table 2, Figure 1 and Table 40 in Appendix A).

Fishing Gears and Methods

There are a total of 55 types of fishing gears and methods employed in the Philippine fisheries classified into textile and non-textile devices (Umali, 1950) . They were further classified into hand instruments, barriers and traps, lines and nets. Smith *et al.* (1980) and Umali (1950) illustrate and discuss how these gears are used and operated. Albeit such number, BFAR statistics records fish production only for 12 gears in the commercial sector and 22 gears for the municipal sector.

Major gears used by the marine commercial fishing vessels ranked according to their shares to the sector's volume of catch in 1987 were purse seines (40.54 percent), trawl (24.92 percent), bagnet (15.63 percent), ring net (14.58 percent), and muro-ami or drive-in net (1.94 percent). For the municipal