UNIVERSITI PUTRA MALAYSIA

WELFARE IMPACTS OF SOME LIMITATION ON TRAWLER CATCHES AND FISHING EFFORT IN THE GULF OF THAILAND

Penporn Janekarnkij

FEP 1986 4

WELFARE IMPACTS OF SOME LIMITATION ON TRAWLER CATCHES AND FISHING EFFORT IN THE GULF OF THAILAND

by

Penporn Janekarnkij

A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science in the Faculty of Resource Economics and Agribusiness, Universiti Pertanian Malaysia

January 1986

ACKNOWLEDGEMENTS

My sincere appreciation is recorded here for the chairman of the supervisory committee, Dr. Sahak Mamat. No less appreciation is expressed to my supervisor, Mr. Nik Mustapha Raja Abdullah for helpful suggestions and comments on the thesis drafts.

I am indebted to my co-supervisor, Mr. K. Kuperan a/l KVSN Viswanathan for his valuable counsel, discussion, and guidance during all stages in the preparation of this study. Sincere thanks is given to Mr. Geoff Harris of the University of New England, Australia for his efforts and encouragement in assisting me to undertake this study. His friendliness and thoughtfulness will be remembered.

The financial support received from the International Center for Living Aquatic Resource Management (ICLARM) throughout the years of graduate study is deeply appreciated. Special gratitude is expressed to Dr. Ian R. Smith and Dr. Brian A. Lockwood for responsibly administering the ICLARM Fellowship Award. The same is expressed to Dr. Chamnian Boonma and Mr. Thanwa Jitsanguan for initiating my interest in Fisheries Economics.

Special thanks goes to Dr. Marut Muangkaew and Dr. Ruangrai Tokrisna for their suggestions and comments. For their valuable help in computer work, I express my sincere appreciation to Dr. Roslan A. Ghaffar and Mr. Siow Kiat Foo.

I am grateful to various government officials in Thailand, especially M. Aimsaard, M. Boonyubol, and S. Rientrirut for facilitating and for giving some important suggestions with regard to data collection.

Thanks also to Luz, Man, Komal, Su, Pen, Mol, Kloey, Kot and other friends who, in one way or another, helped me to finish this task.

Finally, most of the credit of this undertaking goes to my parents for their continuous encouragement, love, and understanding. This study is dedicated to them.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
TABLE OF CONTENTS	iv
LIST OF TABLES	vii
LIST OF FIGURES	ix
ABSTRACT	x
ABSTRAK	xiii
CHAPTER I INTRODUCTION	1
Background	1
The role of marine fisheries in Thailand	1
The Gulf of Thailand	5
Trawler fisheries in the Gulf of Thailand . . .	5
Trawler fisheries industry and fish meal industry	12
Fishery regulation	22
The Problem	26
Hypotheses	27
Objectives of the Study	27
CHAPTER II REVIEW OF LITERATURE	29
Theoretical Literature	29
Producer's welfare measurement	30
Consumer's welfare measurement	35
Welfare analysis of simple market distortion	38
Welfare measurement in related market	40
Empirical Literature	44

Page

CHAPTER III THEORETICAL FRAMEWORK AND MODEL CONSTRUCTION 54

Model Formulation and Data Requirement 54

The trash fish model 55

The model for other catches 59

Estimation Procedures 61

CHAPTER IV DISCUSSION OF EMPIRICAL RESULTS 66

Evaluation of Trash Fish 67

Statistical results 67

Producer surplus and consumer surplus 73

Evaluation of Edible Catches 76

Statistical results 79

Producer surplus and consumer surplus 80

Evaluation of Trawler Catches 82

The reduction in total trawler catches 83

The reduction in total effort 89

CHAPTER V SUMMARY AND CONCLUSION 97

A Discussion of Welfare Measurement 98

Welfare impacts from the reduction in total trawler catches 99

Welfare impacts from the reduction in trawling hours 101

Conclusions and Policy Implications 103

BIBLIOGRAPHY 106

Page

APPENDICES 109

A SUMMARY OF DATA 109

B CONSTRUCTING THE CHANCE OF GETTING FISH FROM THE SEA 123

C GLOSSARY 129

D GUIDELINES FOR DIFFERENTIATING THE FISHERIES IN THAILAND 131

E THE DERIVATION OF THE TWO-VARIABLE QUANTITY-PRICE RELATIONSHIPS FOR DEMAND AND SUPPLY EQUATIONS 132

VITA 137

LIST OF TABLES

Table		Page
1.1	Past average consumption and projected demand of fishery products	2
1.2	Quantity of annual fish production (1957-1982)	
1.2	Provinces along the Gulf of Thailand coastline	7
1.4	Number of fishing boats registered by type of fishing method, Thailand	13
1.5	Catch rate, per cent of economic catch and trash fish (including the young economic fish) from commercial trawlers in the Gulf of Thailand, 1983	15
1.6	Fish meal, number of fish meal plants, quantity of marine catches used in fish meal production and quantity produced by province around the Gulf of Thailand, 1983	19
1.7	Trash fish caught and used for fish meal production, quantity of fish meal produced and exported	23
4.1a	Summary of statistical results for the trash fish market	68
4.1b	Summary of statistical results for the trash fish when the price of trash fish is in form of index number	70
4.2	Summary of statistical results for the edible catches market	77
4.3a	Effects of reduction in total trawler catches on the supply curve of trash fish market	84
4.3b	Effects of reduction in total trawler catches on the supply curve of edible catches markets	85

Table		Page
4.4a	Welfare effects on trash fish market as a result of reduction in total trawler catches	86
4.4b	Welfare effects on trash fish market (using index of trash fish price) as a result of reduction in total trawler catches	87
4.5	Welfare effects on edible catches market as a result of reduction in total trawler catches	90
4.6	Effects of reduction in trawler fishing effort on the supply curves of trash fish and edible catches markets	92
4.7a	Welfare effects on trash fish market as a result of reduction in total trawling hours, using its own price	93
4.7b	Welfare effects on trash fish market as a result of reduction in total trawling hours, using index of trash fish price	94
4.8	Welfare effects on edible catches market as a result of reduction in total trawling efforts	96
5.1	Summary of welfare impacts from reduction of total trawler catches: by economic groups	102
5.2	Summary of welfare impacts from reduction of trawling hours: by economic groups	104

LIST OF FIGURES

Figure		Page
1.1	Thailand and the Gulf of Thailand	6
1.2	Otter board trawler	8
1.3	Pair trawler	9
1.4	Beam trawler	10
1.5	Trash fish composition from commercial trawlers, 1983	17
1.6	Marketing channel for trawler trash fish	18
2.1	The level of production for the firm	31
2.2	The level of production for the firm	33
2.3	Consumer surplus, compensated variation, and equivalent variation	36
2.4	Shift in the supply curve as a result of some market distortion	39
2.5	Vertically related market	42
2.6	Surplus due to consumers (S_c), all producers (S_p), processors and growers (S_w), and growers only (S_g)	53
3.1	Demand function and different intercept values of supply function	65
4.1	Demand for and supply of trash fish market	74
4.2	Demand for and supply of edible catches market	81
4.3	Supply and demand for trash fish after the reduction in total trawler catches	88
4.4	Supply of and demand for edible catches after the reduction in total trawler catches	91

An abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in partial fulfilment of the requirements for the Degree of Master of Science.

WELFARE IMPACTS OF SOME LIMITATION ON TRAWLER CATCHES AND FISHING EFFORT IN THE GULF OF THAILAND

by

Penporn Janekarnkij

January 1986

Chief Supervisor: Dr. Sahak Mamat

Supervisor : Mr. Nik Mustapha bin Raja Abdullah

Co-supervisor : Mr. K. Kuperan a/l KVSN Viswanathan

Faculty : Resource Economics and Agribusiness

The overall objective of the study is to examine the net welfare effects of an imposition of some fishing regulations on trawlers in the Gulf of Thailand. The factors affecting supply of and demand for trawler catches, such as, trash fish and other catches are also examined. The net social benefits and/or losses from both trash fish and edible catches exploitation to trawler fishermen, fish meal producers, and final consumers were evaluated. The assumption made in this study is that some fishery regulations have been implemented in the Gulf of Thailand thus leading to a reduction in trawler catches and fishing effort. The net change in value of social welfare from trawler fishery after the imposition of regulations on trawler catches and fishing efforts

were evaluated.

Ordinary least squares (OLS), two stage least squares (2SLS), and first order autoregressive techniques (AR1) were used to test the empirical results. Monthly data (1979-1982) on trawler catches and trawling efforts in the Gulf of Thailand, prices of trawler catches and fish meal, and price index of meats other than seafoods are used for the analysis. The estimated results indicate short run welfare impacts of a regulation on trawler fishing effort and catches. Two sets of models were constructed, one for trash fish market and ancther for edible catches market. Each model consists of the supply, demand, and identity equations. The marginal utility of money was assumed to be constant. The income effects of change in the price of commodity was assumed to be zero. The change in consumer surplus and producer surplus were used as the measurements of change in net social welfare. It is assumed that a unit gain or loss in producer surplus is equal to a unit gain or loss in consumer surplus.

The equilibrium quantity and price in trash fish market are estimated to be 45,982.6 MT and 1,033.40 bahts/MT respectively. At the equilibrium condition, the total net benefit from trash fish market is 54.72 million bahts. The net benefit to trawler fishermen is 45.66 million bahts while the net benefit to the fish meal producers is 9.06 million bahts. When the index for trash fish price is used, the equilibrium quantity and price were 45,982.6 MT and 90.66 units respectively. The producer surplus was 4,008.19 units while the consumer surplus was 795.23 units. The total net benefit from the trash fish market was 4,802.42 units.

For the edible catches, the equilibrium quantity and price were 21,988.8 MT and 89.68 units respectively. The net benefit in this market was 1,670.52 units for trawler fishermen and 95.61 units for consumers. The total net benefit was 1,766.14 units.

The results of the study indicate that when restrictions in total trawler catches and fishing efforts by 5, 10, 15, and 20 % are imposed, trawler fishermen lose the most in absolute terms, followed by fish meal producers and consumers. But in percentage terms, the consumers bear most of the losses followed by trawler fishermen and the fish meal producers. Finally, the limitation on total trawler catches have larger welfare reduction effect than on the limitation of trawler fishing efforts.

Abstrak untuk tesis yang diserahkan kepada Senet Universiti Pertanian Malaysia sebagai memenuhi sebahagian daripada keperluan bagi dikurniakan Ijazah Sarjana Sains.

KESAN KEBAJIKAN AKIBAT DARIPADA MENGHADKAN JUMLAH TANGKAPAN DAN USAHA MENANGKAP IKAN DI TELUK SIAM

oleh

Penporn Janekarnkij

Januari 1986

Ketua Penyelia : Dr. Sahak Mamat

Penyelia : Mr. Nik Mustapha bin Raja Abdullah

Pembantu Penyelia: Mr. K. Kuperan a/l KVSN Viswanathan

Fakulti : Ekonomi Sumber dan Perniagaantani

Objektif keseluruhan penyelidikan ini ialah untuk mengkaji kesan kebajikan terhadap nelayan-nelayan pukat tunda setelah peraturan undang-undang penangkapan ikan di perkenalkan di Teluk Siam. Penyelidikan ini juga akan mengkaji faktor-faktor yang menentukan permintaan dan penawaran bagi tangkapan nelayan-nelayan pukat tunda seperti ikan baja dan lain-lain tangkapan. Tangkapan selain daripada ikan baja diandaikan untuk tujuan pemakanan. Akhir sekali nilai faedah bersih sosial daripada ikan baja dan lain-lain ikan yang dieksplotasi oleh nelayan-nelayan pukat tunda, pengusaha tepong ikan dan pengguna juga di selidiki. Andaian yang diutarakan untuk penyelidikan ini ialah peraturan perundangan bagi perikanan yang diperkenalkan akan mengurangkan

tangkapan dan usaha menangkap ikan oleh nelayan-nelayan pukat tunda di Teluk Siam. Perubahan nilai kebajikan bersih sosial daripada nelayan-nelayan tersebut selepas peraturan-peraturan perundangan diperkenalkan akan juga dikaji.

OLS, 2SLS dan AR1 digunakan untuk menguji bagi mendapatkan kuputusan-keputusan empirikal. Data bulanan dari tahun 1978 hingga ke tahun 1982 digunakan bagi mencapai matlamat penyelidikan. Maklumat-maklumat yang digunakan ialah jumlah tangkapan nelayan-nelayan pukat tunda, lama masa menunda, harga ikan hasil tangkapan nelayan dan tepong ikan dan indeks harga bagi daging selain daripada makanan laut. Dengan menggunakan data bulanan, keputusan empirikal bagi jangka masa pendek didapati. Dua model diperkenalkan, satu untuk pasaran ikan baja sementara yang satu lagi untuk pasaran ikan yang digunakan tanpa prosesan. Setiap model mengandungi permintaan, penawaran dan funsi persamaan. Utiliti sut bagi wang diandaikan sebagai konstan. Kesan pendapatan terhadap perubahan harga komoditi diandaikan sebagai kosong. Perubahan didalam lebihan pengguna dan pengeluar digunakan untuk mengukur perubahan didalam nilai kebajikan bersih sosial.

Kuantiti keseimbangan dan harga komoditi bagi pasaran ikan baja dianggarkan sebanyak 45,982.6 ton metrik dan 1,033.40 baht/MT. Ditahap ini jumlah faedah bersih dari pasaran ikan dianggarkan sebanyak 54.72 juta baht, 45.66 juta baht bahagian nelayan-nelayan pukat tunda dan pengeluar tepong ikan memegang sebanyak 9.06 juta baht. Dengan menggunakan indeks harga bagi ikan baja, kuantiti dan harga keseimbangan menjadi 45,982.6 tan metrik dan 90.66 unit. Lebihan pengeluar ialah sebanyak 4,008.19 unit sementara lebihan

CHAPTER I

INTRODUCTION

BACKGROUND

The Role of Marine Fisheries in Thailand

The fisheries sector plays a vital role in Thailand's economy. It is a source of cheap protein and the per capita consumption of fish in Thailand was estimated to be 14.72 kg in 1977, the highest among protein-rich foods (Division of Thai Agricultural Economics, 1977). The average fish consumption per capita in 1972-1974 was 21.1 kg, a figure well above the world's and developing countries' average fish consumption of 13.1 kg and 8.4 kg, respectively (Table 1.1).

In 1981, the export value of fishery products of Thailand was about 8.8 thousand million baht and the number of people involved in the fisheries sector was estimated at 150,000 (Rientrirut, 1983). Over 40 per cent (73,000) of these people were employed in marine fisheries activities, 34 per cent (51,107) in aquaculture, and 13 per cent (20,000) carried out fishing in reservoirs. In addition, 10 per cent (14,691) were employed in fisheries related industries such as ice factories, boat building, and boat repairing.

About 80-90 per cent of the total fish supply is marine fish.

TABLE 1.1

PAST AVERAGE CONSUMPTION AND PROJECTED DEMAND OF FISHERY PRODUCTS

kilogram per person

	Consumption 1972-74	Projected demand 1985
World	13.1	14.9
Developing countries	8.4	10.4
Malaysia	22.5	23.8
Thailand	21.1	23.7
Chile	16.9	18.2
Peru	15.6	16.5
Indonesia	9.6	12.0

Source: Fishery: Sector Policy Paper, 1982.

This total supply, however, has been fluctuating over the last 30 years (Table 1.2). Before 1960, marine fisheries contributed about 73 per cent of total fish supply in the country. The introduction of trawl fishing in 1960-61 increased marine catches to 76 per cent in 1961 and 79 per cent in 1962, and has been increasing since then. Fuel price has increased from 0.68 baht/litre in 1973 to 2.30 baht/litre in 1974. This resulted in the reduction of marine fish catch by 12 per cent between 1973 to 1974 due to the increase in operating cost of the fishing vessels. Fish landings, however, recovered from 1.35 million MT in 1974 to 1.55 million MT in 1976. At the end of 1977, Burma and India implemented their exclusive economic zones (EEZ) to 200 miles of the high seas. This extension affected the Thai fishermen by reducing their fishing area. It resulted in the decline of marine catches by 5.31 per cent between 1977 and 1978. Fuel price increased again from 2.33 baht/litre in 1979 to 3.03 baht/litre. This led to a further reduction in marine catches by 7.39 per cent. A further increase in fuel prices from 3.03 baht/litre in 1979 to 7.39 baht/litre in 1980 reduced marine fish catch by 9.1 per cent.

The National Economic and Social Development Plans of Thailand (1961-66, 1967-71, and 1977-81) emphasised the need to increase marine fish production. Included in the plans were measures to safeguard the proper utilization of the marine fisheries potentials. The plans were carried out by utilizing the untapped fisheries resources, especially the demersal fisheries in the Gulf of Thailand. In 1981, 54 per cent of the total marine fish caught were demersal fish. In terms of value, this accounted for 21 per cent of the total fish landed in the country.

TABLE 1.2

QUANTITY OF ANNUAL FISH PRODUCTION (1957-1982)

Year	Total production MT	Marine MT	%	Freshwater MT	%
1957	234,570	170,000	73	63,670	27
1958	196,300	145,000	74	51,300	26
1959	204,790	147,770	72	57,020	28
1960	219,045	146,471	67	72,574	33
1961	305,605	233,275	76	72,330	24
1962	339,788	269,709	79	70,079	21
1963	418,685	323,374	77	95,311	23
1964	576,986	494,196	86	82,790	14
1965	615,120	529,483	86	85,637	14
1966	720,282	635,165	88	85,117	12
1967	847,443	762,188	90	85,255	10
1968	1,089,303	1,004,058	92	85,245	8
1969	1,270,034	1,179,595	93	90,439	7
1970	1,448,404	1,335,690	92	112,714	8
1971	1,587,077	1,470,289	93	116,788	7
1972	1,679,540	1,548,157	92	131,383	8
1973	1,678,901	1,538,016	92	140,885	8
1974	1,510,466	1,351,590	89	158,876	11
1975	1,555,300	1,394,608	90	160,692	10
1976	1,699,086	1,551,792	91	147,294	9
1977	2,189,907	2,067,533	94	122,374	6
1978	2,099,281	1,957,785	93	141,496	7
1979	1,946,334	1,813,158	93	133,176	7
1980	1,792,948	1,647,953	92	144,995	8
1981	1,989,025	1,824,444	92	164,580	8
1982	2,120,133	1,986,571	92	133,562	8

Source: Fisheries Statistics of Thailand.

The Gulf of Thailand

The Gulf of Thailand is the most important fishing ground in Thailand. It lies to the west of the South China Sea (Figure 1.1). This Gulf covers a total area of about 308,700 km^2. It is 23 m to 75 m deep with a 1,884.80 km coast line. Seventeen provinces are located along the Gulf's coast line (Table 1.3).

Fishing gears commonly used in the Gulf of Thailand include several kinds of trawls, purse seines and other encircling nets, lift nets, gill nets, bag nets, cast nets, beach sienes, surface longlines, bottom longlines, hook and line, trolling lines, several kinds of stake traps, and fish pots. All these gears are being used in the inshore and offshore areas, depending on the vessel size, gear type, and scale[1] of fishing activity.

Trawler Fisheries in the Gulf of Thailand

The trawl gear is one of the marine fishing gears[2] popularly used in the Gulf of Thailand. There are two types of trawlers that are commonly used, namely the single trawler and the pair trawler. The two types of single trawlers are: (i) those using beam, and (ii) those using otter-board in order to open the mouth of trawl. The pair trawler consists of two fishing vessels and one trawl, working together as a unit (Figure 1.2, 1.3, and 1.4).

The classification of trawlers[3] used in the Gulf of Thailand

---

1 see more detail in Appendix D.

2 see more detail in Appendix C.

3 Trawlers are classified by the length of vessel. Those that are less than 14 m fall into the small class, 14-18 m into the medium class, and those larger than 18 m are included in the large class.

FIGURE 1.1

THAILAND AND THE GULF OF THAILAND

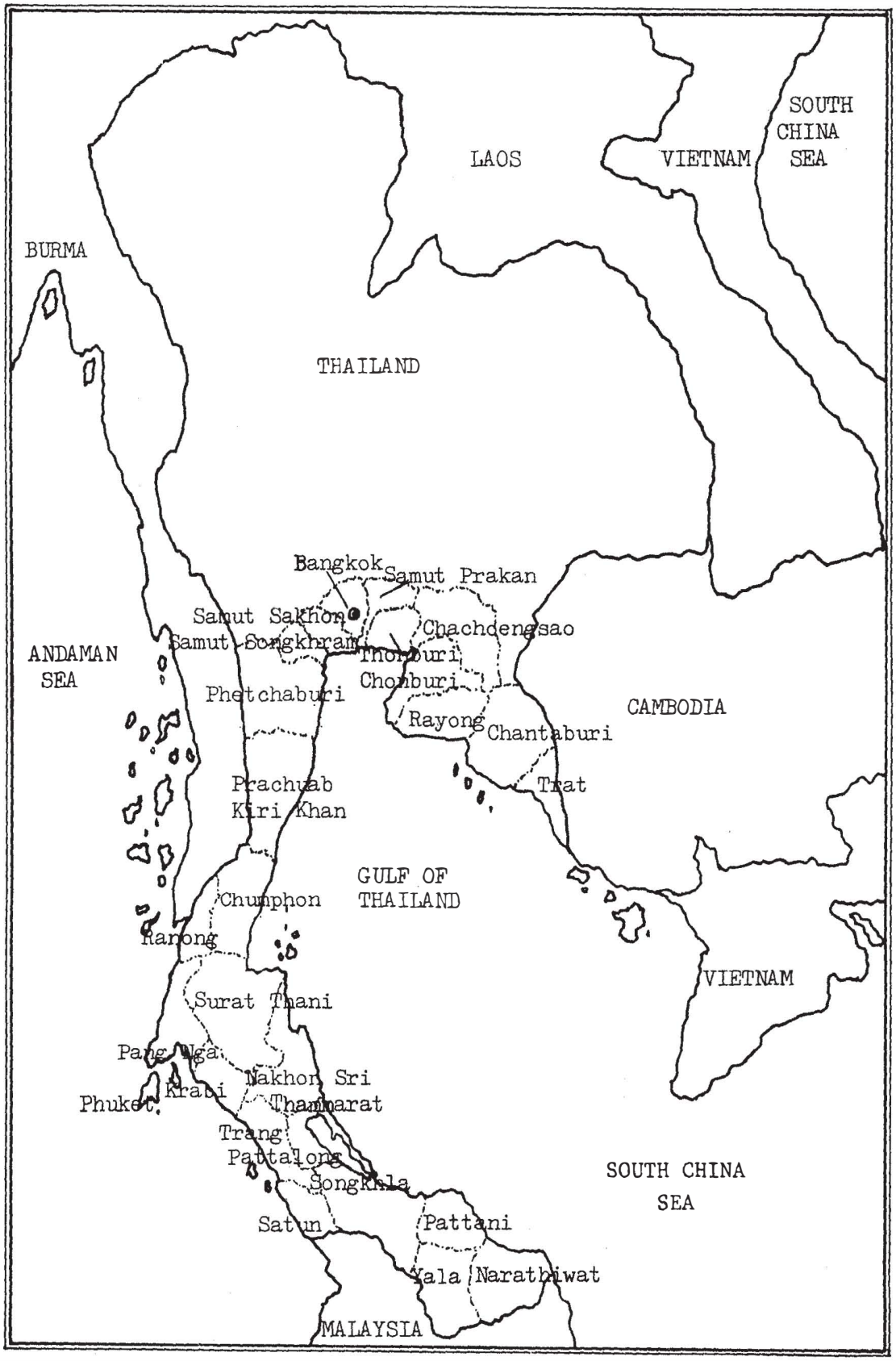


TABLE 1.3

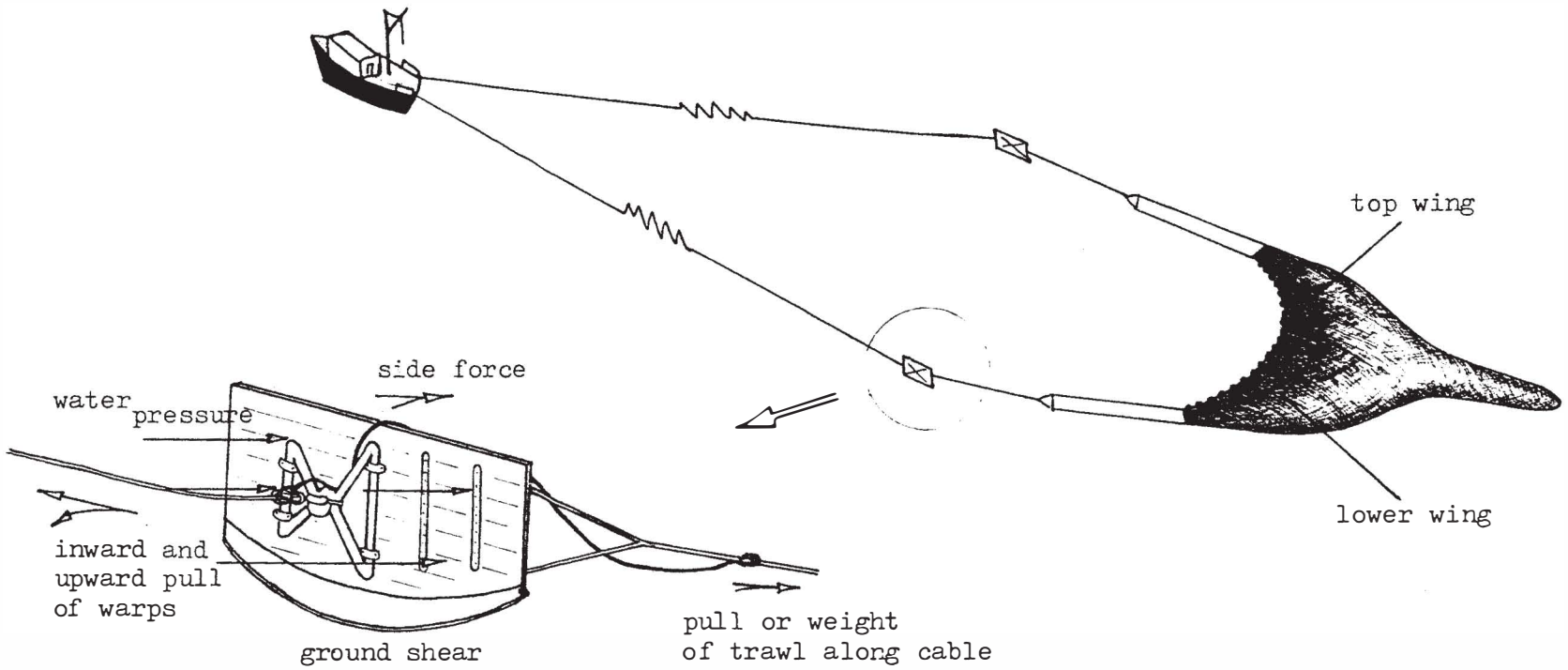
PROVINCES ALONG THE GULF OF THAILAND COASTLINE

Province	Length of cost line (km)
Gulf coast and Pacific coast	1,885
Trat	166
Chanthaburi	80
Rayong	100
Chonburi	157
Chacheongsao	12
Samut Prakarn	47
Thonburi	4
Samut Sakhon	39
Phetchaburi	91
Prachuab Kiri Khan	225
Chumphon	222
Surat Thani	156
Nakhon Sri Thammarat	225
Songkhla	155
Pattani	116
Narathiwat	59

Source: Statistical Yearbook, Thailand, 1983.

FIGURE 1.2

OTTER BOARD TRAWLER



main forces acting on otter board during operation