



**UNIVERSITI PUTRA MALAYSIA**

**AN ECONOMIC ANALYSIS OF SAND GOBY  
CAGE CULTURE IN THAILAND**

**Chatchai Pochanapan**

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AN ECONOMIC ANALYSIS OF SAND GOBY  
CAGE CULTURE IN THAILAND

by

Chatchai Pochanapan

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requirements for the degree of Master of Science  
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Finally, I dedicate this thesis to my family and to all of my teachers and lecturers.

For any misinformation, misquotation or any other errors, I hold myself solely responsible.

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Universiti Pertanian Malaysia

Chatchai Pochanapan  
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Chatchai Pochanapan

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Supervisor : Chew Tek Ann, Ph. D.  
Co-Supervisor : Tai Shzee Yew  
Faculty : Economics and Management

Sand Goby is an important species of inland cage culture. Sand Goby has the highest average price among all the fishes. Productivity of Sand Goby cage culture seems low compared to its potential. The main focus of this study is to find ways to increase productivity of Sand Goby cage culture which could reduce per unit cost of production, leading to increased profit.

A restricted profit function is employed to estimate jointly the profit and factor demand functions using farm-level data. The relative economic efficiency (included technical and price efficiency) between small and large farms, between farmers with experience more than mean and farmers with experience less than or equal to the mean were studied. The effect of province on



economic efficiency is also analysed. The Cobb-Douglas normalized restricted profit function is specified as a function of three normalized variables (labour, fingerling and feeds), two quantities of fixed inputs (capital and volume of cages) and three dummy variables (large farms, farmers with experience more than the mean and farms in Lopburi province).

The results indicate that Sand Goby farmers maximize short-term profits and respond to price changes efficiently. There is constant returns to scale in the use of inputs. Farmers with experience more than the mean have higher economic efficiency compared to the farmers with experience less than the mean. Farmers in Lopburi also has higher economic efficiency compared to farmers in Phranakhon Sriayutthaya. There is no significant difference in economic efficiency between large and small farms. The supply elasticity of Sand Goby with respect to its own price is the highest compared to other supply elasticities.

It is recommended that Sand Goby cage culture be encouraged further in Lopburi province. Consolidation of small farms into larger-sized units would not be desirable. Furthermore, since the price of Sand Goby is the most effective in terms of affecting changes in output supply and factor demand, the price of Sand Goby would be the most powerful policy instrument available.



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ANALISIS EKONOMI PEMELIHARAAN SANGKAR

'SAND GOBY' DI THAILAND

oleh

Chatchai Pochanapan

July, 1987

Penyelia : Chew Tek Ann, Ph. D.

Penyelia Bersama : Tai Shzee Yew

Fakulti : Ekonomi dan Pengurusan

'Sand Goby' merupakan spesis yang penting bagi pemeliharaan bersangkar di pedalaman Thailand dan mempunyai harga purata yang tertinggi jika dibandingkan dengan harga ikan-ikan yang lain. Produktiviti pemeliharaan sangkar 'Sand Goby' didapati rendah jika dibandingkan dengan potensinya. Fokus utama kajian ini adalah bertujuan untuk mencari kaedah meninggikan produktiviti pemeliharaan sangkar 'Sand Goby' melalui pengurangan kos per unit pengeluaran supaya meninggikan keuntungan.

'Restricted Profit Function' telah digunakan untuk menganggarkan keuntungan dan fungsi permintaan faktor dengan menggunakan data dari ladang. Kajian ini juga merangkumi kecekapan ekonomi berbanding (termasuk kecekapan harga dan teknikal)



di antara ladang kecil dan ladang besar, penternak berpengalaman dengan penternak yang kurang berpengalaman dan kesan kedaerahan ke atas ekonomi juga dikaji. Fungsi Cobb-Douglas 'normalized restricted profit' adalah dispesifikasikan sebagai fungsi kepada tiga angkubah normal (buruh, 'fingerling' dan makanan), dua kuantiti input tetap (modal dan isipadu sangkar) dan tiga angkubah 'dummy' (ladang besar, penternak berpengalaman dan ladang di daerah Lopburi).

Keputusan menunjukkan penternak 'Sand Goby' memaksimakan keuntungan dalam jangkamasa pendek dan bertindak kepada perubahan harga dengan cekap serta memperolehi kadar pulangan yang konstan dalam penggunaan input. Penternak yang berpengalaman mempunyai kecekapan ekonomi yang tinggi berbanding dengan yang kurang berpengalaman. Penternak di Lopburi juga mempunyai kecekapan ekonomi yang lebih tinggi jika dibandingkan dengan penternak di Phranakhon Sriayutthaya. Keputusan juga telah menunjukkan tiada perbezaan berkesan di dalam kecekapan ekonomi di antara ladang besar dengan ladang kecil. Didapati juga keanjalan penawaran 'Sand Goby' terhadap harganya adalah tinggi berbanding dengan keanjalan-keanjalan penawaran yang lain.

Akhir sekali, adalah dicadangkan pemeliharaan 'Sand Goby' secara bersangkar digalakkan di daerah Lopburi. Menyatukan ladang kecil menjadi ladang besar adalah tidak diingini. Oleh sebab harga 'Sand Goby' adalah berkesan sekali di dalam bentuk perubahan penawaran output dan faktor permintaan, harga 'Sand Goby' adalah merupakan alat polisi yang terpenting.

## CHAPTER 1

### INTRODUCTION

#### BACKGROUND INFORMATION

#### The Fishery Sector of Thailand

The fishery sector, including aquaculture, has played a significant role in the economy of Thailand and daily life of the Thai people. From 1980 to 1984, fishery products contributed about 8.2 per cent to the real GDP. The fishery sector contributes substantially to employment and income of the people in the rural areas. Fishery product is the primary source of cheap animal protein for most of Thailand's population. Over the period from 1974 to 1983, the per capita consumption of fishery product in Thailand increased from 17.4 kilograms to 21.5 kilograms.

The contribution to Thailand's export earning by the fishery sector has increased steadily in recent years. Export earnings of fishery products increased from 1.55 billion baht in 1974 to approximately 15.08 billion baht<sup>1</sup> in 1984, at an annual rate of 17.9 per cent within this period.

The labour force of Thailand was estimated at 22.4 million in 1983, of which some 16.5 million (74 per cent) were employed in

---

1

One US\$ = 20 baht in 1975, 22 baht in 1983 and 26 baht in 1985.





the agricultural sector (including the fishery sector). The proportion of the work force employed in agriculture has declined steadily from about 82 per cent in 1960. The number of employment in the fisheries sector was estimated at 280,000 in 1982 (Asian Development Bank, 1985). Over 80 per cent (224,000) of these people were employed in marine fisheries activities, 11 per cent (29,000) in aquaculture, and nine per cent (27,000) carried out fishing in reservoirs.

Fishery production of Thailand comes from two major sources, i.e. fresh-water and marine, including brackish water. Fishery production can also be distinguished according to production from capture and production from culture. The total fisheries production in Thailand declined from 2.19 million tons in 1977 to 1.79 million tons in 1980 as a result of overfishing, water pollution and rising fuel and labour prices. A further dramatic decline in marine fish production is expected as a result of the declaration of the 200-mile exclusive economic zone (EEZ) by neighbouring countries.

The demand for fish in Thailand has been rising rapidly as a result of increases in population, income per capita, exports and increases in prices of alternative sources of animal protein. In order to meet these increasing demands, the government of Thailand has implemented several programmes to develop aquaculture since the third National Economic and Social Development Plan (1972-1976). This emphasis on aquaculture is due to the recognition by the government of Thailand that aquaculture production process can be controlled and enhanced through the

proper use of inputs compared to fishery production from capture which depends on natural stocks and environment. In addition, in aquaculture programmes, attempts are made to utilize more fully the available natural resources of the country. Thailand has plentiful natural resources which can be used for coastal and inland aquaculture development. Thailand has a long coastline of 2,600 km and inland water resource of about 370,000 hectares (Marr and Hongsakul, 1976). Table 1.1 shows that aquaculture production accounted on average about eight per cent of total fishery production during the years 1975 to 1984. The aquaculture production increased from 120.63 thousand tons in 1975 to 182.66 thousand tons in 1984. Average production from aquaculture during this period was 153.09 thousand tons. The average production from inland aquaculture accounted for about 25 per cent of the total production from aquaculture.

Table 1.2 shows that the number of farms, culture area, production and value of inland aquaculture have tended to increase over time during 1975-1984 period except for the years 1979 and 1982 owing to disease problems. In 1984, the production of inland aquaculture was about 50,411 tons with an approximate value of 1,226 million baht.

The commercial important species of inland culture in 1984, ranking by quantity produced were Sepat Siam, Pangasius, Tilapia, Thai Siver Carp, Snake-head, Clarias, Giant Freshwater Prawn, Common Carp, and Sand Goby. In terms of ranking by average price, the first five were Sand Goby, Giant Freshwater Prawn, Snake-head,

TABLE 1.1  
FISHERIES PRODUCTION OF THAILAND FROM CULTURE  
AND CAPTURE, 1975-1984

Year	Culture			Capture			Total Production ( <sup>'000 tons</sup> )	% of Production from Culture
	Coastal ( <sup>'000 tons</sup> )	Inland ( <sup>'000 tons</sup> )	Total ( <sup>'000 tons</sup> )	Marine ( <sup>'000 tons</sup> )	Inland ( <sup>'000 tons</sup> )	Total ( <sup>'000 tons</sup> )		
1975	90.79	29.84	120.63	1	130.85	1,434.67	1,555.30	7.8
1976	162.51	32.36	194.87	1,389.28	114.94	1,504.22	1,699.09	11.5
1977	133.27	33.14	166.41	1,934.27	89.23	2,023.50	2,189.91	7.6
1978	108.02	39.37	147.39	1,849.77	102.12	1,951.89	2,099.28	7.0
1979	100.57	29.46	130.03	1,712.59	103.71	1,786.30	1,916.33	6.7
1980	66.27	34.51	100.78	1,581.68	110.49	1,692.17	1,792.95	5.6
1981	100.67	48.02	148.69	1,723.77	166.56	1,840.33	1,989.02	7.5
1982	125.58	45.83	171.41	1,860.99	87.73	1,948.72	2,120.13	8.1
1983	121.04	46.97	168.01	1,978.94	108.48	2,087.42	2,255.43	7.4
1984	132.25	50.41	182.66	1,840.77	111.41	1,952.18	2,134.84	8.6
Average	114.10	38.99	153.09	1,717.59	107.55	1,822.14	1,975.23	7.7

(Source: Adapted from Fisheries Statistics, Department of Fisheries, Bangkok, Thailand)

TABLE 1.2  
 NUMBER OF FARMS, AREA, PRODUCTION AND  
 VALUE OF INLAND AQUACULTURE IN THAILAND, 1975-1984

Year	No. of Farms	1 Area under culture (1,000 rais)	Production (tons)	2 Production per Area (kg/rai)	Value (million baht)
1975	24,095	144.35	29,835.5	206.7	297.00
1976	22,086	143.44	32,358.4	225.6	337.00
1977	23,427	147.59	33,141.4	224.5	415.75
1978	23,663	151.82	39,336.7	259.1	426.50
1979	25,280	152.89	29,461.7	192.7	236.25
1980	29,484	157.43	34,504.6	219.2	598.92
1981	31,676	163.69	48,023.1	293.4	1,006.04
1982	34,154	173.72	45,828.4	263.8	880.03
1983	35,751	233.73	46,966.4	200.9	1,005.58
1984	38,235	200.77	50,410.9	251.1	1,226.36
Average	28,785	166.94	38,986.7	233.7	642.94

(Source : Annual Fisheries Statistics, Department of Fisheries, Bangkok, Thailand)

<sup>1</sup> One rai equals 0.16 hectare.

<sup>2</sup> Computed by dividing production with area under culture.

TABLE 1.3  
 PRODUCTION, VALUE AND AVERAGE PRICE  
 OF MAIN SPECIES IN INLAND FISH CULTURE IN THAILAND, 1984

Species	Production		Value		Average Price (baht/kg)
	tons	%	1,000 baht	%	
Sepat Siam	11,780.67	23.37	143,797.68	11.73	12.21
Pangasius	8,173.75	16.21	88,539.08	7.22	10.83
Tilapia	7,953.24	15.78	115,881.78	9.45	14.57
Thai Silver Carp	4,914.28	9.75	94,400.57	7.70	19.21
Snake-head	4,862.81	9.64	162,688.25	13.27	33.46
Clarias	4,598.75	9.13	136,056.23	11.09	29.58
Giant Fresh- water Prawn	3,102.22	6.15	342,535.69	27.93	110.42
Common Carp	1,211.70	2.40	33,891.45	2.76	27.57
Sand Goby	281.65	0.56	50,306.15	4.10	178.61
Others	3,531.83	7.01	58,261.26	4.75	16.50
Total	50,410.90	100.00	1,226,358.14	100.00	24.33

( Source : Fisheries Statistics, Department of Fisheries, Bangkok, Thailand )

Clarias and Common Carp, as in Table 1.3. Although Sand Goby is the least important in terms of quantity, it is approximately 4.10 per cent in terms of total value produced. Because Sand Goby ranks the highest in terms of average price, it has been identified as an important species for further development in inland aquaculture. There is increasing domestic and foreign demand for this species.

#### SAND GOBY CULTURE IN THAILAND

Sand (Marble) Goby is commercially caught in natural waters of Thailand. Sand Goby (*Oxyeleotris Marmorata*) is the largest in size (see Appendix A). The natural range of Sand Goby includes Thailand and Malaysia as well as Sumatra and Borneo in Southeast Asia. The species occurs in rivers and reservoirs in Thailand. The largest concentration is in the central part of the Chao Phraya River system including the main stream and its associated tributaries such as the Nan, Lopburi, Pasak and Ta Chin (see Appendix B).

Sand Goby farming started about ten years ago in Thailand and grew rapidly. It is now mostly produced from cage culturing. Pond culture of Sand Goby is also being carried out but only on a small scale. Output of Sand Goby increased from 13.80 tons in 1975 to 601.84 tons in 1981 but plummeted to 95.52, 85.08 and 281.65 tons in 1982 through 1984 due to unexplained excessive mortalities. General information indicates a recovery of production in 1983 and 1984 with some recurring mortality problems. The average Sand Goby

TABLE 1.4  
SAND GOBY CULTURE PRODUCTION,  
AMOUNT AND (FARM-GATE) VALUE IN THAILAND, 1975-1984

Year	Production (tons)	Value (million baht)	Average Price <sup>1</sup> (baht/kg)
1975	13.80	0.87	62.91
1976	13.70	1.15	84.21
1977	96.09	9.16	95.36
1978	25.02	2.74	109.57
1979	127.31	15.99	125.62
1980	162.82	26.13	160.48
1981	601.84	108.14	179.69
1982	95.52	17.99	188.36
1983	85.08	14.92	175.63
1984	281.65	50.31	178.61
Average	150.28	24.74	136.04

( Source : Adapted from Fisheries Statistics, Department of Fisheries, Bangkok, Thailand )

<sup>1</sup> computed by dividing value with production.