ECONOMICS OF AQUACULTURE, SEA-FISHING AND COASTAL RESOURCE USE IN ASIA

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ECONOMICS OF AQUACULTURE IN THAILAND: A CASE STUDY OF CATFISH PRODUCTION 1/

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Introduction

Fish is a daily staple food of the Thai people and is a cheap source of protein. It has been estimated that by 1981 the demand for fish in Thailand will be increased by as high as 85%. In the past, 97% of fish production came from natural water resources such as marine, rivers and reservoirs and only 3% came from fish culture. 3/ At present, Thailand has a population growth rate of 2.5% per annum. 4/ This means that the demand for fish will probably increase at the same rate.

The construction of dams, factories, roads and highways, the expansion of urban areas and the use of insecticides have changed the natural environment which in turn affects fish production both in quantity and quality. In addition, mal-practice methods in fishing such as the use of electricity or explosives have caused a rapid decline in fish quantity. At present, although marine fishery industry in Thailand is quite well developed, the expansion of the sea territory of neighboring countries from 12 to 200 sea-miles 5/ will certainly affect the quantity of fish caught from the sea. The Thai Government has recognized this problem and the Fishery Department has paid attention to freshwater fish production. In the Third National Economic and Social Development Plan (1972-1976), the Fishery Department had proposed a project entitled "The Accelerated Fresh-water Fish Production" which aimed at increasing fish production through an expanding extension program. The target was to increase total fish production at the rate of not less than 7%. 6/ In addition, during the period 1973-1978, the Fishery Department with the

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1/ This paper is drawn from a research report, Economics of Fresh Water Fish Production in Selected Areas of Thailand, Research No. 26, 1976 Faculty of Economics and Business Administration Kasetsart University.

2/ Department of Agricultural Economics, Faculty of Economics and Business Administration, Kasetsart University.

3/ Confidential report, Aquaculture.

4/ National Economics and Social Development Board, *Summary of the Third National Economic and Social Development Plan*, 1972-1976, p. 9.

5/ *Bangkok Bank Monthly Review*, Vol. 8, No. 5, May 1976, p. 263.

6/ Division of Fishery Development, Department of Fishery, Hand Book for Program and Project Administration of Department of Fishery for the Year Budget of 1976, The Third National Economic and Social Development Plan. The Seminar on Development of Fishery Resources, September 22-24, 1975, pp. 1-2.

cooperation of the Canadian Government set up the National Freshwater Fishery Institute to undertake and to provide technical support. 7/ All of these programs, however, are mainly technical or biological in nature. If the extension program is to be effective, the socio-economic information must also be available.

Research on the socio-economics of fish production is extremely limited in Thailand. In fact, it could be said that prior to this research project, there had been no systematic economic research on aquaculture in Thailand.

Objectives

Specifically, the objectives of the study are:

1. to study the socio-economic conditions of the fish farmers,
2. to analyze cost and return of fish production and,
3. to study factors that affect the production and the distribution of fish.

This study will cover only catfish, which is of particular economic and commercial importance, for the period 1975-1976.

Methodology

Catfish was selected for this study due to its economic and commercial importance. The location of the study was in Tumbol Makamlom, Amphoe Bangplama and Changwat Suphan-Buri.

A simple random sampling was used. A list of farmers' names were provided by the Amphoe and/or the village headman. The interview was conducted using a questionnaire designed by a fishery scientist.

The results

There were many kinds of catfish in Thailand, but *Clarias batrachus* was the most popular since breeding was relatively easy and the rearing period was short.

Characteristics of catfish farmers

From a sample of 35 farms, 22 farms raised catfish only. The other 13 farms raised both catfish and snake-head fish. Each type of fish was raised in separate ponds. The snake-head fish had just been introduced to this area in an effort to diversify the farming to reduce risk and uncertainty.

Catfish had been raised by the farmers for over 10 years. Catfish farmers were previously rice farmers, traders and others. Their reasons for changing to fish farming were the quick turnover and the higher income. The rapid expansion of fish farming was also due to the supporting services provided by the feed producers who also provided the credit (for feed and pond construction) and the marketing of fish. However, most fish farmers still operated their previous enterprises such as rice, pig, and trading.

Most fish farmers in this area were private enterprisers (31 farms or 88%). Only 4 farms or 12% were operating on a partnership basis. In the case of private enterprise, hired labor was needed during the harvest. Feeding was mostly done by family labor.

The partnership enterprise may be divided into two types, the general partnership enterprises which comprised of relatives or close friends and the partnership between the

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7/ Ibid, p. 24.

money lenders or fish feeders and pond owners. This second type of partnership enterprise usually occurred when the pond owner encountered crop failure and hence had no capital for new investment. The fish feeder provided funds to cover the variable costs such as seeds, feeds, and labor costs during harvest and the pond owner provided the labor. The fish feeder did the planning and the management of the farm enterprise. The pond owner shared 40% of the profit while 60% went to the fish feeder.

Land tenure

For this study, land tenure covered the area of ponds only. Land tenure for catfish farming could be divided into three types: full owner which comprised 57%, the partial and full renter consisted of 12 and 31%,respectively (Table 1). As for the nature of the contract in renting land by the 15 farms, 14 farms reported that they had to sign a contract due to the high investment in pond construction. One farm which belonged to the smallest size had an informal or verbal contract. The average rental rate was $904 per year. The cost of renting land varied inversely with the size of farm.

Assets and Liabilities

Since the catfish farmers usually had more than than one farm enterprise, it was quite difficult to estimate the asset value. Therefore, this study included only machines and equipment that were usually used in farm operation e.g. water pumps, balance, stove and pan, feed grinder, sieves and others and hence excluded the value of land, building and pond construction cost. The average value of machines and equipment was 33,789 Baht per farm (Table 2).

As the variable cost was very high, most catfish farmers (69%) had to borrow money from various sources such as relatives and neighbors, commercial banks, fish feed traders, and B.A.A.C. (Table 3). The average amount of loan per farm was 330,086 Baht. Relatives and neighbors provided the greatest amount of credit. The rate of interest was

Table 1. Type of land tenure, characteristics of the contract, and rental rate per rai in Suphan Buri, 1975.

Size of farm (square wa)	Type of land tenure (farm)			Type of the contract (farm)		Rental Rate per rai (yr.)
	Owner	Partial Renter	Full-renter	Sign	Verbal	
0-500	8	2	2	3	1	1,940,00
501-1,000	4	–	5	5	–	875.86
1,001-1,500	3	1	1	2	–	762.50
1,501-2,000	3	–	1	1	–	1,000.00
2,001-upper	2	1	2	3	–	557.50
Total	20	4	11	14	1	903.55
Per cent	57	12	31	96	4	–

Note: 1 square wa = 4 square meters, 6.25 rai = 1 hectare.
and 20.30 = U.S. $1

Table 2. Value of machine and equipment for catfish farming in Suphan Buri, 1975.

Machine and equipment	Size of farm (square wa)					Average
	0-500	501-1000	1001-1500	1501-2000	2001 & over	
			bahts			
Water pump	11,008	19,767	35,925	28,320	16,200	19,323
Balance	–	1,056	1,600	580	2,130	827
Stove and pan	682	5,356	7,450	1,370	1,796	2,915
Grinder	4,653	9,344	11,375	9,174	16,900	9,023
Sieves	307	402	18	1,963	1,206	607
Others	356	2,654	1,244	1,279	81	1,094
Total	17,007	38,578	57,611	42,659	38,313	33,789

very low averaging only to 4.65 percent per annum.

Production and marketing Costs

Since catfish farmers also raised snake-head fish, its cost of production was analyzed separately. This study shows the cost of producing, catfish only and the average production cost of both kinds of fish per farm.

Table 4 shows the average area per farm, number of ponds, size of pond, and number of fry that are used in catfish farming by size of farm. The size of catfish farm was rather small. Each farm had more than two ponds and the size of pond was small. However, farmers stocked a large number of fry per pond ranging from an average of 657 to 2,282 fry per square wa. Due to the high death rate of fry because of many diseases some farms had to stock fry more than twice per pond.

Cost of catfish production

The cost of catfish production was calculated from the 22 farms that raised catfish only. The cost was divided into two types: fixed and variable costs. Fixed cost was composed of land tax, land rent and depreciation of equipment. The depreciation of pond and building was not included in the analysis. The average fixed cost was 7,343 Baht per farm or 2% of the total cost (Table 5). Variable costs were made up of labor, seed, feed,

Table 3. Number of borrowers, average amount of loan per farm, and interest rate from various sources of loan in catfish farming, Suphan Buri, 1975.

Item	Sources of Loan				Total
	Relatives and Neighbor	Fish Feed Trader	B.A.A.C.	Commercial Bank	
No. of borrower					
(farm)	12	5	3	5	25
(Per cent)	48	20	12	20	100
Amount of loan					
(Baht)	254,314	24,571	343	50,857	330,086
(Per cent	77.05	7.44	0.10	15.41	100
Interest rate					
(Per cent/year)	1.98	19.81	12.00	10.62	4.65

Table 4. Average area, number of ponds, size of pond and number of fry per farm by size of farm in Suphan Buri, 1975.

Item	Size of farm (square wa)					Average
	0-500	501-1000	1001-1500	1501-2000	2001 and over	
Area per farm (wa^2)	272.75	775.11	1242.20	1695.50	3596.40	1177.82
No. of ponds	2.67	3.44	4.80	11.00	14.80	5.85
Area/pond (wa^2)	102.15	225.32	258.79	154.13	243.00	201.34
No. of fry						
pefarm	516983	1768444	1524000	2266250	1961220	1607376
per pond	193627	514083	317500	206023	132514	274765
per wa^2	1895	2282	1227	1337	657	1365

medical, gasoline and maintenance costs which constituted 97% of the total cost. Most of the investment in catfish farming was in feeds which constituted 72% of the total cost. Seeds accounted for about 21%. Other costs, except medicine and gasoline, were less than one percent. The average cost of production per farm was 355,599 baht or 12.93 baht per kg.

Cost of production of all farms. Some farms were raising snake-head fish. Although they used the same type of feed they were different from catfish farming in terms of rearing time (8months), and feed conversion ratio (Table 6). The proportion of variable cost was higher than in catfish farms due to the higher cost of snake-head seeds. Both kinds of seeds accounted for 34% of the variable cost. Other costs were almost the same as in catfish farming. The average total cost per farm was 599,291 baht, or 15.36 baht per kg.

Factors Affecting Catfish Farming

There were many problems in catfish farming. The most serious one was diseases which was reported by every farm or 46 percent of the respondents. The second serious problem was that the price which farmers received in 1975 was quite low and was even

Table 5. Average cost of catfish production per farm, Suphan Buri, 1975.

Type of Expenses	Amount (baht)	Per cent
Variable Costs	328,256	97.94
Permanent labor expenses	2,527	0.73
Removing mud	2,304	0.66
Lime	125	0.04
Salt	303	0.09
Seeds	72,003	20.68
Feed	247,964	72.19
Medicine	9,544	2.74
Gasoline	7,911	2,23
Harvesting	2,732	0.78
Maintenance	2,844	0.82
Fixed Costs	7,343	2.06
Land tax	13	0.17
Land rent	1,998	27.20
Depreciation	5,333	72.63
Total Cost	355,599	100.00

Table 6. Average production cost of catfish and snake-head fish farming per farm in Suphan Buri, 1975.

Type of Expenses	Amount (bath)	Per cent
Variable Cost	590,822	98.59
Permanent labor cost	6,389	1.08
Removing mud	3,934	0.67
Lime sand salt	397	0.07
Seeds	198,078	33.52
Catfish	66,831	11.31
Snake-head fish	131,247	22.21
Feed	349,325	59.13
Medicine	8,343	1,41
Gasoline	11,295	1.91
Harvesting	9,470	1.60
Maintenance	3,592	0.61
Fixed Costs	8,469	1.41
Land tax	43	0.51
Land rent	2,151	25.39
Depreciation	6,276	74.10
Total Costs	599,291	100.00

lower than the cost of production. Other problems included no market for the produce, rising cost of feed, insufficient fund, high cost of gasoline, and lack of irrigation water (Table 7). The farmers tried to solve these problems by using medicines to cure the diseases, borrowing money, and changing the variety of fish. Some farms did not produce at all.

As for the market and the price for the produce and the feed, the farmers used group action by setting up an association, "Bang Pla-ma Fisheries Association", in 1973. However, this association was not effective because of the conflict between the members of the association which composed of small and big farmers.

As farmers were faced with many problems and the economic situation of catfish farming was not very good, their future plan as indicated in Table 8 changed remarkably.

Marketing and Marketing Costs

There were three types of middlemen in the area: local middlemen, dealers from the Central Market in Bangkok, and middlemen from other provinces. Local middlemen were usually the feed dealers or big farmers. They acted as brokers for the middlemen in other areas and provided the fish at the quantity they wanted.

Table 7. Types of problems of catfish farmers in Suphan Buri, 1975.

Type of problem	Number of farms	Per cent
Disease	35	46.05
Price of fish	20	26.32
Price of feed	6	7.89
Market for fish	7	9.22
Operating capital	3	3.94
Gasoline	3	3.94
Irrigation water	2	2.64

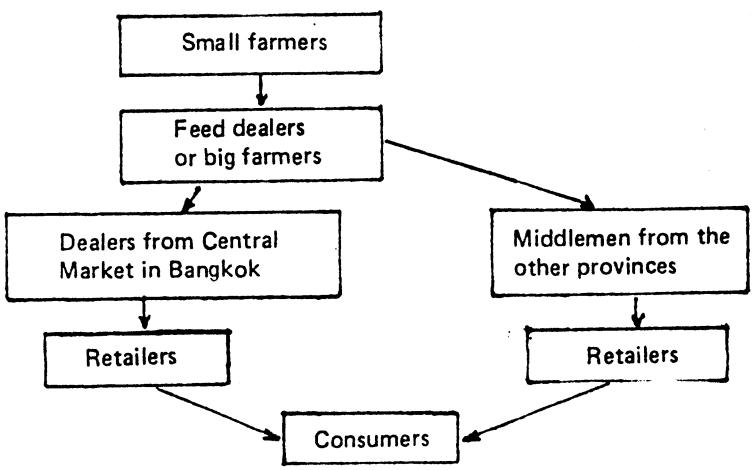
Table 8. Future plans.

Future Plan	Number of farms	Per cent
Raise at the same amount	6	17.2
Reduce the production	3	8.5
Change to other fish	2	5.7
Uncertain: depending on	16	45.7
Market	6	17.2
Price of fish	9	25.8
Feed	2	5.7
Disease	1	2.9
Give up	6	17.2
No plan	2	5.7

Dealers from the Bangkok Central Market bought fish from feed dealers or big farmers for sale by auction at the Central Market in Bangkok. Usually, fish farmers could not sell their fish directly to the Central Market. These dealers would determine the price, the cost of transportation, the damage of the produce during transport, and the terms of payment. They usually had to pay the farmers about 7-15 days after harvest. If the seller and buyer did not know each other, the feed dealer or the big farmer served as the guarantor and hence would get the service charge of 5 baht per container.

Middlemen from other provinces came from the Central plain, the North and the North East provinces. Usually, they bought the small size fish (i.e. an average of 10 heads per kg.). The selling and buying practices were the same as dealers from Central Market in Bangkok.

A flow chart of catfish marketing is drawn below.



The marketing costs of catfish farmers were composed of transportation, commission fee, discounted weight rate and guaranteed charge in selling and buying. Transportation cost from Suphan Buri to Bangkok by truck as provided by the dealers from the Central Market in Bangkok was 500 baht per trip. One truck load was 70 containers.

Commission fee was the service charged by the Central Market in Bangkok at the rate of 6% of the selling price. The dealers also deducted this amount from the fish farmers.

Each container contained 68 kg of catfish. However, the dealers or middlemen sould count only 63 kg. per container, the difference being used to cover the loss in weight during transport. As for the snake-head fish, each container weighed 40 kg. but no discount weight was charged.

In this study, marketing cost was divided into two types in accordance to the type of farming: farms that raised only catfish and farms which raised both kinds of fish. The averaged marketing cost per farm is shown in Table 9, which indicates that cost of discount weight is the highest (57%) for the farms that raise catfish only. This was almost the same as the commission charge for all farms.

For the Philippine purse seiners the major cost items were fuel and lube oil (23% to 39%) and expenses for icing and refrigeration were almost as high as crew expenses. Repair and maintenance expenses were also a large (9% to 12%) of the cost component. (Table 9).

Crew expenses were low (11% to 13%) for Philippine purse seiners but slightly higher than the Philippine trawlers.

For Thai purse seiners the major cost items were crew expenses (19% to 33%) and fuel and lube oil (23% to 36%) (Table 9). Food expenses for the crew were also quite high (9% to 14%). Repair and maintenance were moderate (7% to 9%). Depreciation was also high compared to the other countries, class D (8%), 4% for Malaysian and 2% for Philippine purse seiners and the depreciation for Thai class D purse seiners (8%).

Table 9. Average marketing cost of catfish farming in Suphan-Buri, 1975.

Items	Catfish Farms Only			All Farms		
	Quantity	Per cent	Catfish	Snake-head fish	Total Quantity	Total Per cent
Quantity produced (kg.)	27,353	100	29,384	9,490.00	38,874	100.00
Quantity sold (kg.)	25,148	91.94	27,155	9,490.00	36,645	94.26
Quantity discounted (kg.)	2,205	8.06	2,229	–	2,229	5.74
Cost of weight discounted (B)	30,908	56.64	31,036	–	31,026	46.27
Transportation cost (B)	3,250	5.96	–	–	4,777	7.12
Commission charge (B)	20,408	37.40	–	–	31,262	46.61
Total cost (B)	54,566	100	31,026	–	67,065	100.00

Returns to Catfish Farming

Catfish required 3.5 to 4 months to rear get the average market size of 6-8 heads per kg. Snake-head fish needed at least 8 months to attain a market size of about 3 head per kg. Therefore, the return on catfish way twice faster than that of the snake-head fish.

However, for the year under study, more than 50% of the farms gave up their farming due to various factors such as high death rate due to diseases, high price of feed and gasoline, and a drop in price of fish. On the average, catfish farming had a loss of B26,682 per farm while all farms lost B97,600 per farm (Table 10).

Conclusions:

From the study, some conclusions may be drawn:

a) Due to limited market for catfish, the rapid increase in fish production caused a great decrease in price. Lack of information on the demand for fish also caused surplus

supply.

b) For many enterprise that had a high variable cost, the bigger farmer was in a better position than the smaller farmer in farm adjustments.

c) Lack of government assistance on fish diseases had made fish farming less profitable. An increase in personnel and funds were required to have an effective extension program.

Table 10. Average returns per farm of catfish farming in Suphan Buri. 1975.

Item	Catfish only	All Farms		
		Catfish	Snake-head	Total
Quantity produced (kg.)	27,353	29,384	9,490	38,874
Price (Bkg.)	14.02	13.92	16.60	14.57
Return (B)	383,484	409,029	157,534	566,563
Production cost (B)	355,599	–	–	597,097
Marketing cost (B)	54,566	–	–	67,065
Net loss (B)	26,682	–	–	97,600

d) Thrash fish is the major prominent compound of feed. This will be a problem in the near future as fish meal industry is growing. A substitution of other feed instead of thrash fish is necessary.

e) Price fluctuations directly affected the production and the income of the fish farmers. Most of them reported harvesting the fish when the price was low. Price information was therefore, required for production and marketing planning.

f) Further research on marketing costs was required to obtain more information which would be useful for policy making. Furthermore, a study of the structure, conduct, and performance of the Central Market in Bangkok should be conducted.