The Economic Benefit of Chicken Manure Utilization in Fish Production in Thailand

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Introduction

The Pond Dynamics/Aquaculture CRSP has conducted basic research since 1983 on the biological and chemical factors that influence fish production. The goal of these studies is the improved well-being of farmers that adopt new aquaculture technologies. The ultimate test of the value of the research results generated is if farmers themselves demonstrate the economic benefit by incorporating new technologies into their farming systems. Therefore, economic analysis of the costs and benefits to the farmer of the various technologies developed will provide insight into the value of these technologies to farmers.

Fish farming in Northeast Thailand

Thailand's aquaculture production is extremely diversified. In various agro-ecological regions of the country fish aquaculture can be considered a traditional activity, or in some cases such as the Northeast, a recently introduced one (Edwards et al., 1983, 1990; Smith, 1945). At present, Thailand is experiencing rapid economic growth and development (TRDI, 1988). Since the Second World War and increasingly up to the present these changes have, by necessity, restructured national agriculture and aquaculture production strategies (Charoensino-larn, 1988). National Thai aquaculture development policy has consequently pursued dualistic goals. Coastal aquaculture is an export-oriented activity while freshwater aquaculture is focused on the provision of improved nutrition, income and employment (Suraswadi, 1989).

Within this developmental context, the Thailand Pond Dynamics/Aquaculture CRSP has, over the course of several years, conducted intensive research on the biological and chemical factors which influence freshwater fish production in Thailand. The need for this type of work is critical in a country such as Thailand. Freshwater fish is the major source of animal protein for the rural poor in the Northeast (Prapertchob,1989), where the per capita income level is 40 percent ($400 U.S.) of the national average. In the 1990s, pond-based aquaculture grow-out will require more concerted attention by research, extension, and development in terms of improving overall bio-socio-economic efficiency (Tomich, 1988).

Small-scale aquaculture

The majority of Northeast Thai aquaculture producers tend to be subsistence or small-scale. “Small-scale" is a relative term which is dependent on the level of investment in a particular

country. In contrast to large commercial, agro-industrial ventures where adequate financing, information, and resources are available, small-scale producers tend to be politically and economically marginal (Bailey and Skladany, 1990). These village-family level producers are further constrained by a wide variety of environmental, social, and cultural factors (Edwards et al., 1988).

Thai fish culture is primarily a cash oriented activity. Consumption within the home does take place and the amounts vary relative to the amounts of production and needs of producers. In Thailand, integration of fish subsystems into farming systems are also actively promoted. The benefits of such systems elsewhere have been examined by Engle (1987) and in Thailand by Edwards et al. (1986), who found that positive social and economic impacts can be substantial.

Pond Dynamics CRSP / Thailand research

Pond Dynamics CRSP/Thailand research has compared inorganic fertilization regimens to the utilization of organic fertilizers, specifically chicken manure, in experimental investigations. Nile tilapia *(Oreochromis niloticus)* are commonly grown in ponds fertilized to increase primary and secondary production. The fertilization of fishponds has been widely studied, often with conflicting results. Temperate ponds with low stocking densities seem to require only phosphorus additions (Yamada,1986). In contrast, subtropical or tropical ponds with higher stocking densities achieve higher yields with nitrogen and phosphorus additions (Boyd,1976). Inorganic fertilizer has been promoted as more desirable due to its lower loading rates (due to higher nutrient contents) and lower oxygen demand (Yamada, 1986; Coleman and Edwards, 1987). However, manure has often been demonstrated to increase fish yield beyond that expected from the addition of inorganic forms of N and P alone (Schroeder, 1978; Noriega-Curtis, 1979).

CRSP studies have shown that there is a significantly higher level of fish yield in ponds fertilized with chicken manure than in ponds fertilized with inorganic fertilizer alone (Diana et al.,1990). This study examined the economic effect of the utilization of chicken manure in fish production in Thailand.

Data

Four farm management case studies were developed to construct a data set of representative farm management indicators. A total of three Northeastern Provinces were visited: Nong Khai, Surin, and Ubol Ratchathani. Nong Khai Province was the most productive site visited and provided the majority of findings and results. In contrast, investigations in the two southern Northeast Provinces of Surin and Ubol Ratchathani were limited by a variety of environmental, economic, and social factors.

Upon arriving in Nong Khai, the investigator was fortunate to make acquaintance with the owner of Sarnmitr Store. This shop functions as a major wholesaler of hen eggs in Nong Khai. After a day of riding about the area, meeting farm operators, picking up eggs and delivering feed with the son of the owner, criteria were developed for interviews which were conducted from November 1 to 24,1990. Resource levels, fixed and variable costs, and constraints were quantified. More specifically, the size of operation in terms of land holdings, labor inputs into the operation,

management practices, number of enterprises, and constraints were documented and quantified.
The investigator focused on four operations which ranged from 0.4-1.32 hectares. Farm income was the most important source of income for the study farms selected. Hence the families interviewed spent the majority of their time on the farm.
The number of significant income producing enterprises employed varied from 2-4 per farm. In addition, unpenned native chicken, lemon grass, banana, papaya, and mango were planted on the pond banks but-little income was reported to have been derived from these sources.
Based on data collected from the case studies, representative enterprise budgets were developed for the following scenarios: fish production with inorganic fertilization, fish production with chicken manure collected from chicken coops, and fish production with chicken manure dropped into ponds from coops constructed over the ponds.

Description of Fish and Chicken Production Activities

Total farm size ranged from 0.4 ha to 1.32 ha. Length of ownership of farms studied ranged from 2 to 5 years so the farms can be considered to be relatively newly-owned farms. Farm enterprises commonly found in the region include chickens (both broilers and layers, as well as native chicken), fish, cattle, swine, lemon grass, papaya, bananas, goats, mangos, and turkeys.
Most of the farmers interviewed have credit histories and borrow money most frequently for investments such as for pond construction or construction of chicken coops. Financial lenders utilized included the Bank for Agriculture and Agriculture Cooperatives (BAAC), the Thai Military Bank, and the Bangkok Bank. However, farmers were not comfortable with cash savings, and deposits with banks. Rather it was stressed repeatedly that the fish, cattle, and pigs were “assets" or “savings" (amsaph) and in times of need could be readily sold or traded.
Labor patterns on the farm show that the husband generally is responsible for feeding livestock and putting the cattle and goats out to graze. The wife is responsible for household activities such as child care and meal preparation. The wife also collects eggs which are packed in trays which are generally picked up two to three times per week by an egg wholesaler from Nong Khai (Sarnmitr Store).
In contrast to weekly egg marketing activities, fish are sold in large quantities to retailers in the Nong Khai Market as the occasion arises. Some farmers sell small quantities of table fish which enable them to get a better price per kilogram (14 Baht).

Chicken-fish integration

Integrated layer-fish operations are relatively common in Northeast Thailand. For example, Tambon Bakh
integration is estimated to be 90 hectares/100,000 hens. The size of individual ponds may range from 0.4 to 1.2 ha. A typical chicken coop will have dimensions of roughly 3-6m x 18-30m x 1.5m. Pens are usually situated in various corners of the pond. Chicken manure and some spilled feed are the only inputs into the pond. Water is occasionally pumped from either adjacent reservoirs or irrigation pipe for topping off.
Farmers interviewed also discussed factors which acted as constraints. These primarily centered

around fish production and entailed low market prices, lack of bargaining power, the desire for larger fish-size production (hence price increases of 100%) and limited information available about new management methods in fish culture. Another major constraint expressed was the limited land holdings currently held. One operator was actively seeking new land elsewhere to expend operations in order to raise layers/penned cattle.

Use of collected chicken manure in fish production

If not integrated directly into fish production, chicken manure was occasionally sold to fish pond operators. A small layer operation in Nong Khai sold manure to vegetable garden operators for O.5 Baht/kg. In Amnat Jalurn District of Ubol Ratchathani, a seedfish operator who had ceased rearing layers reported purchasing 10 tons of chicken manure from Nakorn Ratchasima for 15,000 Baht. This manure is used to facilitate primary production in nursery and brood stock ponds. Some operators in Nong Khai spoke of situating pens over dry ground with the idea of eventually selling manure.

Economics of Utilizing Chicken Manure in Fish Production

Tables 1 to 3 present representative enterprise budgets for fish production with inorganic fertilization, fish production with chicken manure collected from chicken coops, and fish production with chicken manure dropped into ponds from coops constructed over the ponds.
Yield of fish produced with inorganic fertilizer was approximately 77 percent of that produced with chicken manure. Total cost was highest for fish produced with collected chicken manure, followed by inorganic fertilization and lowest for integrated systems. In the integrated system, manure application to the pond represents the same activity as waste disposal for chicken production.

However, since integrating the two systems actually reduces the cost of waste disposal of chicken manure, no charge is levied against fish production. Collected manure represented an additional labor charge, or in other cases a market price of chicken manure purchased from large chicken farms. Therefore, total production cost was higher for collected chicken manure as opposed to integrated fish chicken systems.
Net returns were highest for fish produced with chicken manure in integrated systems, second highest for fish produced with collected chicken manure and lowest for fish produced with inorganic fertilizer. The lower yields with inorganic fertilizer caused the lowest net returns for the latter scenario, while the higher production cost of collected chicken manure produced lower returns for collected chicken manure systems as compared to integrated chicken-fish systems.
Returns on average investment followed a pattern similar to that of net returns. It must be pointed out that land values in Thailand have escalated dramatically over the last decade, increasing from 7,000-10,000 Baht/rai in 1980 to 100,000 Baht/rai in 1990. Returns on average investment in ponds and equipment alone were 72% for fish production with inorganic fertilizer, 132% for fish produced with collected chicken manure, and 142% for fish produced in integrated systems. With

the investment in land (averaged over the years 19801990 at $343,750/ha), return on average investment was 5% for fish production with inorganic fertilizer, 10% for fish produced with collected chicken manure, and 10% for fish produced in integrated chicken-fish systems.

Table 1. Net returns to fish production utilizing inorganic fertilization (1 ha pond), Thailand Case Studies, 1990.

	Item	Unit	Price/ Cost-Unit	Quantity	Value
1.	Gross Income				
	a. Table fish	kg.	12	4,646	55,752
2.	Variable Costs				
	i. Fingerlings				
	a. Mirigal	100	5	129,310	6,466
	b. Puntius	100	5	12,930	646
	c. Silver carp	100	15	8,620	1,293
	d. Common carp	100	15	17,241	2,586
	e. Tilapia	100	10	90,520	9,052
	Sub-total				20,044
	ii. Lime	kg	6	43	258
	iii. Urea	kg	7	43	301
	TSP	kg	12	143	1,716
	iv. Energy				
	a. diesel	ltr.	12	43	516
	v. Marketing				
	a. rent net	1	100/day	6	600
	vi. Interest on operating capital 12%/yr.				1,406
3.	Total Variable Costs				24,841
4.	Income above VC				30,911
5.	Fixed Costs				
	i. pond depreciation	2	50,000	10 yrs	5,000
	ii. equipment (pump)	1	3,500	10	350
	iii. interest on fixed capital 12%/yr.				6,420
6.	Total Fixed Costs				11,770
7.	Total Costs				36,611
8.	Net Returns				19,141
9.	Breakeven Production Yield	at 12 Baht/kg.			3,051
		at 10 Baht/kg.			3,661
10.	Breakeven Price				7.9
11.	Return to Average Investment in Ponds and Equipment				72%
12.	Return to Average Total Investment				5%

Economic Effect of CRSP Technologies

The CRSP technologies utilizing chicken manure increased net returns by 85% and 98%, for chicken manure collected for use on fish ponds and for that applied directly from integrated systems, respectively. Returns on average investment on ponds and equipment increased by 60--70% while returns on average total investment (including land) increased by 5% (from 5% to 10%) by adopting CRSP technologies of chicken manure fertilization regimes.

Table 2. Net returns to fish production utilizing collected chicken manure (1 ha pond), Thailand Case Studies, 1990.

	Item	Unit	Price/ Cost-Unit	Quantity	Value
1.	Gross Income				
	a. Table fish	kg.	12	6,034	72,408
2.	Variable Costs				
	i. Fingerlings				
	a. Mirigal	100	5	129,310	6,466
	b. Puntius	100	5	12,930	646
	c. Silver carp	100	15	8,620	1,293
	d. Common carp	100	15	17,241	2,586
	e. Tilapia	100	10	90,520	9,052
	Sub-total				20,044
	ii. Lime	kg	6	43	258
	iii. Manure	kg	0.25	9,600	2,400
	iv. Energy				
	a. diesel	ltr.	12	43	516
	v. Marketing				
	a. rent net	1	100/day	6	600
	vi. Interest on operating capital 12%/yr.				1,429
3.	Total Variable Costs				25,247
4.	Income above VC				47,161
5.	Fixed Costs				
	i. pond depreciation	2	50,000	10 yrs	5,000
	ii. equipment (pump)	1	3,500	10	350
	iii. interest on fixed capital 12%/yr.				6,420
6.	Total Fixed Costs				11,770
7.	Total Costs				37,017
8.	Net Returns				35,391
9.	Breakeven Production Yield	at 12 Baht/kg.			3,085
		at 10 Baht/kg.			3,702
10.	Breakeven Price				6.1
11.	Return to Average Investment in Ponds and Equipment				132%
12.	Return to Average Total Investment				10%

There are, to date, no reliable estimates of the total number of farmers that have adopted the technology of fertilizing fish ponds with chicken manure. However, observations from this study indicate that these systems have become numerous in Northeast Thailand over the last 2 to 5 years. The increased returns from the improved technology will benefit not only the individual producers but also multiply through out the economy of this region in Thailand.

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Table 3. Net returns to fish production utilizing chicken manure from chicken coops constructed over fishponds (1 ha pond), Thailand Case Studies, 1990.

	Item	Unit	Price/ Cost-Unit	Quantity	Value
1.	Gross Income				
	a. Table fish	kg.	12	6,034	72,408
2.	Variable Costs				
	i. Fingerlings				
	a. Mirigal	100	5	129,310	6,466
	b. Puntius	100	5	12,930	646
	c. Silver carp	100	15	8,620	1,293
	d. Common carp	100	15	17,241	2,586
	e. Tilapia	100	10	90,520	9,052
	Sub-total				20,043
	ii. Lime	kg	6	43	258
	iii. Energy				
	a. diesel	ltr.	12	43	516
	v. Marketing				
	a. rent net	1	100/day	6	600
	vi. Interest on operating capital 12%/yr.				1,285
3.	Total Variable Costs				22,702
4.	Income above VC				49,706
5.	Fixed Costs				
	i. pond depreciation	2	50,000	10 yrs	5,000
	ii. equipment (pump)	1	3,500	10	350
	iii. interest on fixed capital 12%/yr.				6,420
6.	Total Fixed Costs				11,770
7.	Total Costs				34,472
8.	Net Returns				37,936
9.	Breakeven Production Yield	at 12 Baht/kg.			2,873
		at 10 Baht/kg.			3,447
10.	Breakeven Price				5.7
11.	Return to Average Investment in Ponds and Equipment				142%
12.	Return to Average Total Investment				10%

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APPENDIX A

Typical Farm Prices Encountered:
Nong Khai Farms

l Cost Items	Unit	Cost
,and purchase cost		
initial (1980)	rai	4,000-17,000
current (1990)	rai	100,000
'ond construction	rai	7,000-11,000
Vater pumps		
diesel	1 7HP	3,500
'lectricity installation	1	2,000
'ehicles		
Motorcycle	1	8,000-45,000
'hicken pen		
coop (3x18x1.5)	1	7,000
coop (6x30x1.5)	1	15,000
coop roof (3x18x1.5)	1	1,500
coop roof (6x30x1.5)	1	3,500
blue netting (30 meter)	1 roll	120
feed tray	1	45
water tray	1	35
basket	1	5
'ig pen (5x20x1.5)	1	20
shovel	1	100
scale 60 kg.	1	520
water pipe	1	500
shallow well (7 meters)	1	3,500

Typical Farm Prices Encountered:
Nong Khai Farms

Fixed Cost Items	Unit	Cost
Fish Sub-system		
i. Fingerlings		
•Tilapia	100	6-10
•Tilapia	kg.	10
•Mirigal	100	5-6
•Puntius	100	5-6
•Silver Carp	100	15
•Big Head	100	15
•Common Carp	100	10-15
ii. Fertilizer		
•TSP 0-46-0 (Nong Khai)	kg	20
•urea	kg	5
•chicken manure (wet)	kg	0.25
•chicken manure (dry)	kg	0.50
Reference: Udorn		
ODA-AIT Report #3		
iii. Lime	kg	6
iv. Energy		
•diesel	ltr	12
v. Marketing		
•rent net	day	100
vi. Interest	%/yr.	12