

## Farmers' Adoption of Recommended Tiger Prawn Raising Practices in Pattani Province, Southern Thailand

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### ABSTRACT

*One hundred and ten farmers in Pattani province, southern Thailand were interviewed to investigate the status of tiger prawn production, farmers' adoption of government recommendations concerning raising practices for this species, associated problems in production, and factors associated with the adoption of the recommendations.*

*It was found that investment in tiger prawn farming was undertaken primarily by non-resident owners. About one-half accessed a loan from various sources, the main source being relatives. Most profited from their investment. Farm magazines and friends were the main sources of farm information. Most farmers adopted the government recommendations for pond construction, pond preparation, stocking density, feeding, water drainage and aeration, use of drugs and chemical equipment, and environmental control and management, of which only a few were aware. Disease outbreaks and low survival rate were mentioned as major production problems. Income, use of labour and production yield were positively correlated with the farmers' adoption of recommended practices.*

*The study indicates that the overall economic situation of farmers has perhaps the major influence on their adoption behavior, in that those who follow the recommendations tend to be higher in economic status and receive better profits from their work much more than those who do not follow them. It is advisable that increased attention be paid to educating farmers to be aware of the residual effects of using drugs and other chemical substances in their operations, and thus make decisions with environmental concerns in mind.*

**Key words :** Adoption, Recommendations, Tiger Prawn, Farmers, Southern Thailand

### INTRODUCTION

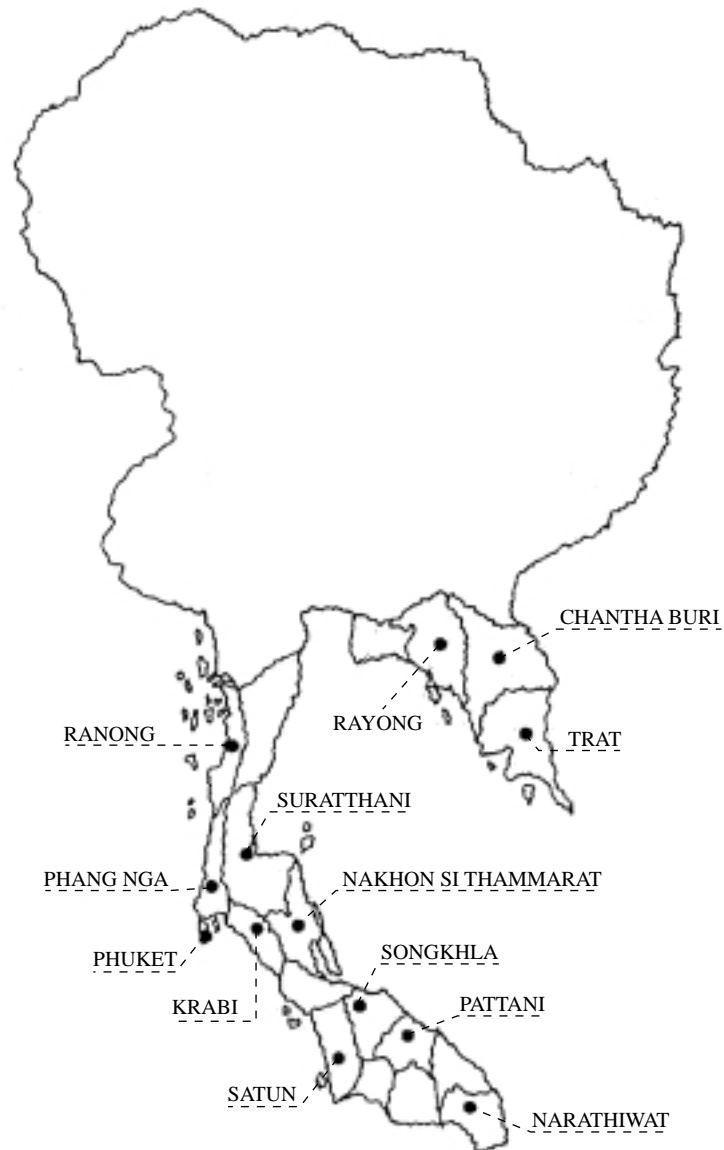
The tiger prawn is an aquatic crustacean which is economically very important to Thailand, and very easy to raise. It has a good taste and is in great demand all over the world. Thailand has thousands of kilometers of mangrove coastline, which is ideal for breeding tiger prawns, and financially there are good profits to be made from a prawn-raising operation. For these reasons and others, many people are interested in raising tiger prawns, and the shrimp-farming industry has grown rapidly over the last two decades. In 1997, Thailand

exported over 60 billion Baht worth of tiger prawns and related products (currently, US\$1  $\cong$  45 Thai Baht). This figure is expected to increase by as much as 60% in the coming years (Senate Committee on Agriculture and Cooperatives, 1997).

Sea prawns were raised as early as 1935 in Rayong and Chantaburi Provinces, Eastern region of Thailand by adapting rice fields near mangrove forests. In 1947 the price of salt production fell, and many of those who depended on producing salt for a living and were affected by the falling price switched to developing mangrove forests as prawn ponds. At that time the production was in the form of natural raising. Later, due to environmental changes, making the natural prawn larvae decreasing decreased inits number, but commercial hatcheries were able to provide the required seed, leading to an expansion of tiger prawn production. During 1987-1989, the intensive freshwater farming began in the central plains of Thailand, although this soon caused serious. This development was started not too long and it reached at the highest peak making more water pollution as a result of poor management, which added to the of the raising pollution from factories along the sea shore and led to a decline in a the number of producers. The he production then trasfered became more concentrated again in southern Thailand.

Currently there are three main areas for tiger prawn raising in Thailand: (1) Eastern: Chantaburi, Rayong and Trat provinces; (2) Southeastern: Surat Thani, Nakhon Si Thammarat, Songkhla, Pattani and Narathiwat provinces; and (3) Southwestern: Ranong, Krabi, Phangna, Phuket and Satun Provinces. (Figure 1) This production requires a relatively high investment, high technological skills and good management. Some entrepreneurs have succeeded in their production and earned high net profit while others have failed, usually due to lack of experience. Tiger prawn production in Surat Thani, Nakhon Si Thammarat and Chumporn provinces in the Southeastern region have had the same problems as provinces in the Eastern region, leaving the Southwestern region as the last major place for tiger prawn production in Thailand. Thus if new management methods fail to improve production practices and stop the serious problems of environmental degradation that poor shrimp raising practices lead to, there is concern that the shrimp industry will decline or even fail, which would be a serious blow to the economy of Thailand (Tongruk et al., 1996).

Pattani province has a total area of 1,940,357 rai, about 7.2% of the total land area in southern Thailand (Pattani Provincial Office of Fisheries, 1999). It consists of 12 districts, and has about 116 km of mangrove coastline, once offering a fertile and rich habitat for various species of plants and animals. However, since Thailand began its latest phase of development the last couple of decades, including rapid growth of the number of shrimp farming operations, there has been considerable deterioration of this great natural resource due mainly to inappropriate management and residual effects of the shrimp industry. The natural environment can no longer handle the substantial waste generated.



**Figure 1.** Location of three main areas for tiger prawn raising in Thailand.

Development in the production of tiger prawns can occur through either internal or external forces. That is, investment can be undertaken by local people or by non-residents. Normally, traditionally, development by local interests would be undertaken on a small scale, growing only gradually while taking care not to damage the local environment too much, as rural people understand that the entire community is dependant on the environment for their collective wellbeing. Such controlled growth also avoids introducing large income gaps, which the large-scale production controlled by outside interests results in as well, creating other problems in the community. Outside forces, buying or renting local land for the production of tiger prawns is less concerned about the overall health of the community, being primarily interested in maximum profits in the shortest period of time, and this attitude has led to the serious environmental problems, including depletion of the mangrove forests, that the prawn-raising areas in Thailand has experienced the last couple of decades.

Questions which this study addresses:

1. Who are the primary shrimp-farm investors in the study area - residents or non-residents?
2. Shrimp production requires a substantial investment. Do the growers access loans?
3. Are they aware of environmental concerns?
4. Do most shrimp-farm owners follow government recommendations for raising tiger prawns? If not, why not?
5. Are there any associations between social and economic factors and following of recommendations, and following of recommendations and farm success or failure?

The guidelines and alternatives for planning and development of tiger prawn production for the future are obviously important, and it is thus equally important that farmers be aware of industry and/or government recommendations for good farming practices and follow them. This study aimed to investigate the status of shrimp farm production, adoption of recommended practices, environmental concerns, associated problems, and factors associated with the adoption of recommended tiger prawn practices.

### **LITERATURE REVIEW**

Adoption is defined as the process which the innovations diffuse (natural or planned) through various sources to the community and are adopted by persons who agree with the innovations. It consists of five stages: awareness, interest, evaluation, trial, and adoption (Lionberger, 1960).

When the innovation diffuses, whether through natural or planned means, to rural communities, it will often do so depending on certain known characteristics of innovators and early adopters. Rogers (1983) believed that personal characteristics of individuals have an effect on the adoption of innovations—for instance, those who have a higher socio-economic status through things such as education, income, farm size or prior knowledge of the innovation would adopt the innovation faster than those of a lower socio-economic status. The extent of the adoption of such innovations also depends on knowledge, motives and perceived attributes of the innovation to the individuals, altogether leading to the decision whether to adopt or not.

He also proposed a model of an innovation decision process that consisted of five stages: knowledge, persuasion, decision, implementation, and confirmation. The model describes the process through which an individual passes, from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and finally to confirmation of the decision. Concerning the persuasion stage, the individual's perception of the attributes of the innovation is crucial - the more the innovation is perceived in terms of (1) relative advantage, (2) compatibility (3) complexity (4) trial-ability, and (5) observability, the more likely it will be adopted (Rogers and Shoemaker, 1971).

Adoption can be regarded either as unidimensional (Rogers, 1983) or multidimensional (Crouch, 1972). In this study it is regarded as multidimensional, reflecting the different modes

of adoption of innovations of the individual; that is, of various practices recommended, each would show a different adoption pattern.

Sources of farm information might be related to the adoption process. During the initial stages from awareness to interest, mass media sources would be definitely important. For the evaluation and trial stages personal sources such as friends, relatives or a local extension officer could play a very important role in confirming the adoption (Rogers and Burdge, 1972).

As a literature search turned up no research directly concerning adoption of recommended practices in shrimp farming, comparable research from other disciplines was used instead to provide a clearer picture and framework of this study.

Pattamarakha (1986) found significant differences in some characteristics between adopters and non-adopters of high-yield varieties of rice. Adopters had a more positive attitude towards the agricultural extension officer at the sub-district level, were exposed more to mass media and were more aware of innovations than were the non-adopters. They were more frequently visited by, and paid more frequent visits to, the sub-district extension officer, and were more willing to participate in a demonstration farm than were non-adopters. However, there were no significant differences in cultural practices, suggesting that adopters adopted only new varieties but not new cultural practices. The main sources of information for farmers were relatives, friends, village and subdistrict headmen, and the sub-district extension officer. Adopters placed greater emphasis on the sub-district extension officer, ranking him first of the four preferred personal information channels, compared with the non-adopters, who placed him fourth. It was also found that those who did not adopt the high-yield varieties of rice perceived that it seemed to have more pests (28%), needed more water (17.4%), had a lower yield than the native varieties (10.9%), and were more likely to follow the farming practices of their ancestors (8.7%). For those who did adopt the high-yield varieties of rice, the main reasons given were high yield and access to irrigation.

Saleegaset et al., (1994) found that many problems in the low level of adoption of artificial insemination (AI) in beef cattle were a function of low enthusiasm and misconceptions. Some farmers, for instance, believed that calves resulting from artificial insemination would have a bigger size and consume more grass, so they (the farmers) would then have to walk longer distances to find an adequate supply of grass for their cows. Others believed that beef from crossbred cattle was not as tasty as beef from native cattle, and thus more difficult to sell at markets. Some farmers believed that a calf conceived through artificial insemination could not be used for religious rituals. The study also found that those willing to use AI had more education, better literacy, more use of farm mechanization and more favorable attitudes in general towards artificial insemination than the non-adopters.

Pattamarakha et al., (1996) found that few farmers followed government recommendations for goat husbandry practices, primarily because of misperceptions. Regarding recommendations for improved health practices, most farmers believed that their goats were in good health already and did not have parasites. For use of feeding practice recommendations, they believed that it was not necessary, coupled with a lack of interest. For use of selection and breeding methods, some 50 percent did not select goats for breeding as

they felt that natural mating was less complicated. The study also found that income, living standards, number of goats, leadership status, social participation, knowledge of goat husbandry, awareness of community leadership status, social participation, knowledge of goat husbandry, awareness of community leaders, urban contact and degree of modernization of goat farmers were positively correlated with the adoption of recommended goat husbandry practices.

Pattamarakha et al., (1997) found that most farmers who raised goats were small farmers whose main reason for raising them was for additional income. In this setting, little use was made of technically sound modern goat husbandry practices. Access to markets for goats was possible at all times, but most goats were sold from the farm rather than at the market, often for the sake of convenience. Farmers were able, but were somewhat reluctant, to pass on what new knowledge of goat husbandry they had to other farmers. Relatives and neighbors were the primary source of information on raising goats.

Pattamarakha et al., (1998), in a study of farmers who followed recommended practices for insecticide application, found that farmers had a good knowledge of the symptoms of plant injury and what insecticides could or should be used, but had little knowledge of the classification of insecticides, their active ingredients and how they break down in the environment, or their residual effects. Most farmers followed the recommended guidelines during application. For alternatives to insecticides, the use of mechanical and physical controls, natural crude botanical extracts, and delayed cropping systems were used by some farmers. This study indicated that economic status, attendance at training courses, exposure to newspapers and printed materials, exposure to television, exposure to radio, an office visit paid by farmers, a home visit paid by extension officers and knowledge of insecticides were positively correlated with the use of recommended practices for insecticides.

Srinoy et al., (1999) found that most farmers raised dairy cattle for additional income as there was a ready market for the milk produced. Cows were generally fed in the shade and a concentrate pellet was provided while the cows were being milked, the amount of concentrate fed being determined by the cow's condition and level of milk production. Para grass was the major pasture species fed as a source of roughage. The cattle were vaccinated against foot and mouth disease and haemorrhagic septicaemia. Control of internal and external parasites was also practiced. Most farmers selected their own heifers for cow replacement and used artificial insemination for mating. Some 60% of farmers had mortality problems. The low conception rate of artificial insemination, the high price of concentrate pellets and a lack of roughage during summer were the main factors the farmers were concerned about as these severely impacted on the profitability of the dairy enterprise. Farmers varied widely in their use of the recommended practices for dairy production. The study also found that knowledge about dairy cattle raising, size of pasture and personal contacts with the extension officer were positively correlated with the adoption of dairy cattle recommendations.

Aramlar et al., (2000) found that most farmers raised Holstein Friesian (black and white cattle) in an open free-stall barn situation. Ruzi grass and para grass were grown for use as roughage feed. Concentrates were provided to each animal according to the amount of milk produced. Breeding animals were artificially inseminated by veterinary technicians. Milking

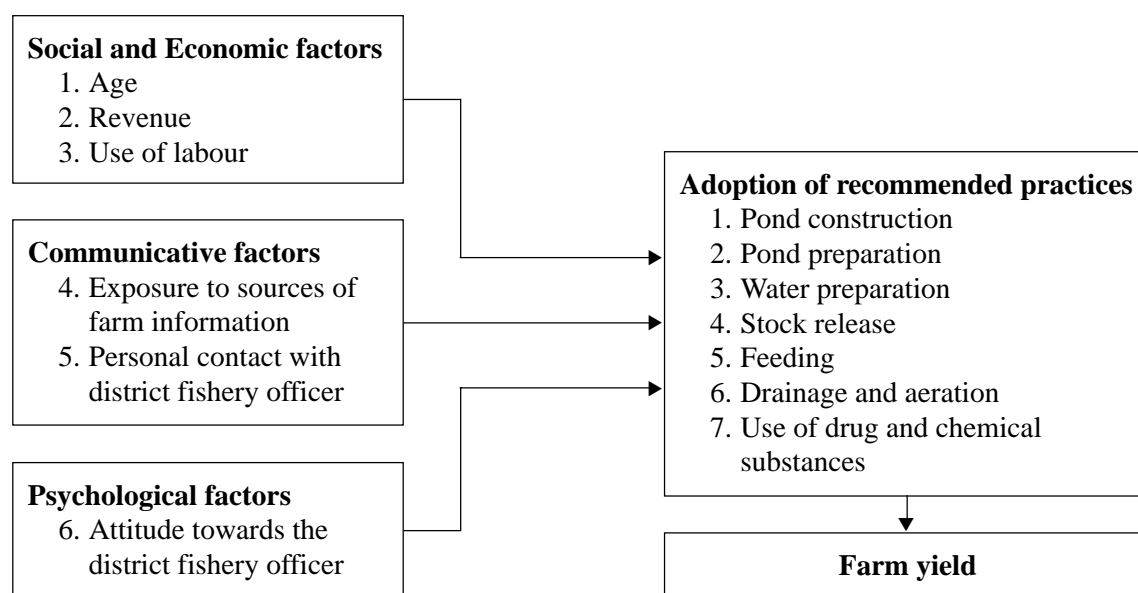
was mostly done by hand. About one-fourth of milking cows showed teat infection. For associated problems, farmers mentioned flooding in forage plots, low conception rates, and a lack of skills in dairy raising. In comparing characteristics of the adopting and non-adopting groups, it was found that those who were still in dairy farming had a higher number of dairy cattle, larger pasture area, better knowledge of cattle raising, more positive attitudes toward dairy cattle raising, more personal contact with livestock officers, more attendance at short-training courses, and more adoption of recommended practices than those who had quit raising dairy cattle.

Pattamarakha et al., (2000), in a study on adoption of recommended practices for mungbean production, found that most farmers ploughed land twice and used rhizobium mixed with seed before planting. They used plant protection for cercospora leaf spot, stem borer, and pod borer, and after collection of the mungbean pods exposed the seeds to sunlight. About one-fourth used drill planting instead of broadcasting as they felt it was much more convenient. They applied less than the recommended amounts of chemical fertilizers because they believed that the soil was still rich after the rice harvest. For associated problems, they noted that the high cost of production, a shortage of available finance, and a lack of knowledge of production methods were the major constraints perceived by the farmers. Family income, size of mungbean area planted, knowledge of mungbean production, social participation and personal contact with the sub-district extension officer were found to be positively correlated with the adoption of recommended mungbean growing practices.

Kongsuwan (2001) found that most farmers showed a moderate level of adoption of recommendations in fish culture. Television, friends, and extension officers were major sources of farm information. Most accessed a loan from the Bank for Agriculture and Agricultural Cooperatives (BAAC) and were in debt. The study also found that family income from the operation, attitudes towards fresh water fish raising, use of farm mechanization, frequent reading of newspapers, and personal contact with the fishery officer were positively correlated with the adoption of fresh water fish raising practices.

Pantipa (2002) found that most farmers (74.7%) agreed that tiger prawn production contributed to the deterioration of the local natural resources and the environment. Some 16.5% who lived far from the sea and had no recycle pond because they had only a small piece of land and/or a lack of money to build a recycle pond would drain waste to nearby areas of other farms, which usually caused conflict between them. About 50% participated in finding a successful solution to managing the freshwater management situation in the community and often followed government recommendations concerning natural resource conservation. Sources of farm information were from salesman and printed materials. Seminars, demonstrations and study tours were attended by most farmers. Most (91.2%) would continue to raise tiger prawns in the future, while a few planned to stop raising, change to a new enterprise, or wait for a better economic situation. The study also recommended that development of the shrimp raising industry should focus on personal development research and give attention to the use of local resources in terms of labour, practice skills, and technology. The cooperation of entrepreneurs, academics, officers, public organizations and the private sector should be of prime concern in order to protect the environment for future sustainable development of the shrimp industry.

There are many factors affecting farmers' adoption of recommended tiger prawn raising practices. Based on the theoretical framework and empirical research reviewed, a conceptual model was developed, including three main areas that might primarily affect farmers' adoption of recommended practices: social and economic factors, communicative factors, and psychological factors (Figure 2).



**Figure 2.** Conceptual model of factors affecting farmers' adoption of recommended practices in tiger prawn production.

The basic proposition of the study was that the adoption of recommended tiger prawn raising practices is a function which varies according to personal characteristics. Thus, from the proposition, the following hypotheses were developed:

**Hypothesis 1** – Age will be negatively correlated with the adoption of recommended tiger prawn raising practices.

**Hypothesis 2** – Revenue will be positively correlated with the adoption of recommended tiger prawn raising practices.

**Hypothesis 3** – Use of laborers will be positively correlated with the adoption of recommended tiger prawn raising practices.

**Hypothesis 4** – Exposure to a variety of sources of information will be positively correlated with the adoption of recommended tiger prawn raising practices.

**Hypothesis 5** – Regular personal contact with the district fishery officer will be positively correlated with the adoption of recommended tiger prawn raising practices.

**Hypothesis 6** – Positive attitudes towards the district fishery officer will be positively correlated with the adoption of recommended tiger prawn raising practices.

**Hypothesis 7** – Adoption of recommended tiger prawn raising practices will be positively correlated with yield.



## METHODOLOGY

### Selection of the Study Area

Pattani Province province has a long coastline along the gulf of Thailand whereand many tiger prawn processing plants have been established. The following subdistricts were intentionally selected for the study, as they had the largest number of shrimp farmersfor smapling : Muang Pattani, Nong Chik, Yaring, Panare, Sai Buri and Khok Pho.

### Background of the Study Area

Pattani Province province consists of 12 districts with a total population of 602,886 (301,700 male and 301,186 female) at the time of the census of 30 September 2000. Of the 274,323 strong labour force, 267,896 (or 97.6 percent) were employed while 5,679 were unemployed and 748 were seasonal and waiting. Of the 150,043 school-age population 75,971 were enrolled at the primary level, 41,964 at the secondary level, and 6,591 at the tertiary level. The population was Muslim 85.5%, Buddhist 13.7% and the remaining 0.8% Christian and others. The area contains 1,212,722 rai (1 ha = 6.25 rai) with 947,680 rai cultivated. Most of the land is used for rice farming (37.6%) and rubber plantation (39.2%), with the remainder in various other uses such as agronomy, horticulture, animal husbandry, and pond fisheries (23.2%). Tiger prawn production at the time of the study was practiced by 163 farmers covering an area of 4,480 rai.

### Population and Sampling Procedure

Of the many farmers who raised tiger prawns in the study areas, 70% was required as a statistically valid sample, and 114 members were then selected by simple random sampling.

### Data Collection

Personal interviews were assigned as the method of data collection. Before the interviews, the questionnaires were developed and tested with 20 members in September, 2,000. A deficit in some aspects was found and improvements made to achieve a precise and accurate collection tool. The interviews started in October, 2000 and lasted until January, 2001. One hundred and ten farmers were interviewed; the remaining 4 farmers refused the interviews as they did not feel confident in their ability to tell the facts concerning tiger prawn raising. Thus, the final sample represented 67.4% of the total population.

### Data Organization and Analysis

After completing the field survey, the questionnaires were checked and found to be completed correctly. Coding and a code book were then prepared. The analysis of data was undertaken at the Computer Center at Prince of Songkla University. The Statistical Package for the Social Sciences (SPSS) was employed as the tool for data analysis. The Pearson correlation was used as a means for testing the hypotheses.

### Reliability Test

After the final survey, the alpha coefficient was tested for the attitudes towards the fishery development officer, giving 0.76, which was a high value.

## RESULTS AND DISCUSSION

### Characteristics of the Respondents

Most of the respondents were male and married with an average age of 37.6 years and 1.8 children. 70.9% were Buddhist and the remaining 29.1% were Muslim. Most had obtained formal education above the secondary level. For material possessions, more than 70% had television, radio, telephone, cell telephone, motorcycle and motor car. Tiger prawn production was regarded as their major occupation (accounting for most of their working time). Some had minor occupations in public service, state enterprise, private organizations, retailing, animal raising, rubber plantation or rice farming. Most were members of a Tiger Prawn Association. They had attended seminars about tiger prawn production and had neutral attitudes towards the fishery extension officer.

### Status of the Enterprise

As shown in Table 1, most farms were intensive. Difference in three types of the production were due to the availability of larvae, and; feed. The extensive (natural) farms required no larvae, and feed. The semi-intensive, and intensive farms required larvae but different feed-supplementary, and commercial feed respectively. 40% of the owners took a significant role in farm management, in the sense of being aware of the overall situation and not allowing others to manage the operation for them, while some 60% of the owners lived far away and let hired employees do most of the work, meaning that development of tiger prawn production was mostly undertaken by the outsiders (non-residents) who might or might not be aware of local issues concerning environmental conservation as they did not live in the area. Many received help from their relatives, although most (86.4%) hired external labour as family labour was not enough. The average number of workers employed was 2.3, with 2.2 family members also helping on average.

### Sources and Sizes of Loans

As shown in Table 2, about one-half of the owners had accessed a loan at some time for their farming venture. The major source of loans was relatives - owners preferred relatives as loan sources rather than private banks or cooperatives, possibly because access to loans from relatives is easier with fewer conditions than private banks or cooperatives demand. Many who did or could not borrow from a relative still had a relative suggest a loan source. Those who accessed loans were mostly resident-owners. Of those who did borrow money, most (63%) had loans over 170,000 Baht, with the average loan being 220,018 Baht. This high figure shows that raising shrimp is a capital-intensive occupation.

**Table 1.** Basic data of prawn farming operations in Pattani province.

Attribute	Number (n = 110)	Percentage
<b>Types of production</b>		
Extensive	1	0.9
Semi-intensive	30	27.3
Intensive	79	71.8
<b>Status of farm manager</b>		
Owner	44	40.0
Employed worker	29	26.4
Appointed farm manager	24	21.8
Relative	13	11.8
<b>Laborers employed</b>		
None	15	13.6
1 – 2	58	52.7
3 – 4	26	23.7
More than 4	11	10.0
Average = 2.3		
<b>Tenure status of pond(s)</b>		
Own	30	27.3
Own and rent	18	16.4
Rent	62	56.3
<b>If self-owned, number of ponds owned (n = 30)</b>		
1 – 2	14	46.6
3 – 4	11	36.7
5 – 6	2	6.7
More than 6	3	10.0
Average = 2.6, range = 1 – 10		
<b>Combined owned and rented ponds (n = 18)</b>		
1 – 2	1	5.6
3 – 4	9	50.0
5 – 6	5	27.7
More than 6	3	16.7
Average = 2.6, range = 1 > 10		
<b>Number of rented ponds (n = 62)</b>		
1 – 2	23	37.1
3 – 4	23	37.1
5 – 6	5	8.1
More than 6	11	17.7
Average = 2.8, range = 1 – 11		

**Table 2.** Sources and sizes of loans.

Attribute	Number (n = 110)	Percentage
<b>Source of loan</b>		
Did not access loan	56	50.9
Relatives	31	28.2
The Bank for Agriculture and Agricultural Cooperatives	10	9.1
Private banks	7	6.4
Agricultural cooperatives	3	2.7
Other	3	2.7
<b>Size of loan (n = 54)</b>		
90,000 Baht or less	10	18.5
90,001 – 170,000 Baht	10	18.5
More than 170,000 Baht	34	63.0
Average = 220,018 Baht		

### Costs of Production and Revenue

Most farmers produced 1-5 metric tonnes of prawns per cycle per pond (Table 3), with an average yield of 1.8 metric tonnes. About one-third (38.2%) produced below average. Most received 200-300 Baht/kg, with an average selling price of 255 Baht/kg. It was expected that at least 17.3 percent of owners would lose rather than gain the profit. Not surprisingly, those farmers receiving the lowest price made no profit, but lost money for their work (Table 3). The cost of production included pond rent or pond construction, stock, feed, drugs and chemical substances, petrol and electricity, labour, cleaning sludge, and maintenance. The average cost of production per cycle per pond was 344,148 Baht while the average revenue was 489,764 Baht. Some 68.2% of farmers made over the approximately 500,000 Baht necessary to show a decent amount of profit, and a relatively high return on investment.

### Sources of Farm Information and Personal Contact

Most prawn farmers received information about tiger prawn production from farm magazines or other mass media sources (Table 4). In addition, they also received information from friends who raised tiger prawns. The reason that farm magazines were regarded as a major source of information might be due to the fact that many varieties of farm magazines are available and could more easily be accessed compared to other media. For personal sources, farmers usually lived close to other farmers and they were similar in many characteristics so they talked to friends rather than public servants. In this regard, it can be noted that only 19.1% initiated a visit to the fishery extension office, and about one-third of the fishery extension officers paid a visit to a farm. Contact between farmers and fishery extension officers seemed to be low as only about 20% of farmers initiated personal contacts with the fishery officer. This was associated mainly with consultations concerning protection from

disease, use of drugs and chemical substances, feed and feeding, collecting samples of water and prawns, and the officer's experimental plots.

**Table 3.** Cost and revenue from tiger prawn production.

Attribute	Number (n = 110)	Percentage
<b>Farm yield per cycle per pond</b>		
Less than 1 metric tonne	42	38.2
1 – 5 metric tonnes	65	59.1
6 – 10 metric tonnes	2	1.8
More than 10 metric tonnes	1	0.9
Average = 1.8 metric tonnes		
<b>Selling price per kilogram</b>		
200 Baht or less	19	17.3
200 – 300 Baht	84	76.3
More than 300 Baht	7	6.4
Average = 255.20 Baht		
<b>Total cost of production per cycle per pond (n = 108)</b>		
100,000 Baht or less	6	5.6
100,001 – 250,000 Baht	31	28.7
250,001 – 400,000 Baht	39	36.1
More than 400,000 Baht	32	29.6
Average = 344,148 Baht		
<b>Total revenue per cycle per pond</b>		
100,000 Baht or less	8	7.3
100,001 – 500,000 Baht	27	24.5
500,001 – 900,000 Baht	66	60.0
More than 900,000 Baht	9	8.2
Average = 489,764 Baht		

**Table 4.** Sources of farm information and personal contact.

Attribute	Number (n = 110)	Percentage
<b>Mass media sources*</b>		
Farm magazines	84	76.4
Television	41	37.2
Radio	25	22.7
Newspapers	13	11.8
<b>Personal sources*</b>		
Friends who raised tiger prawns	84	76.4
Fishery extension officer	19	7.3
<b>Personal contact with the district fishery extension officer</b>		
No contact	89	80.9
Contact	21	19.1
<b>Objectives of contact with fishery officer (n = 21)*</b>		
Prevention of prawn diseases	20	95.2
Use of drugs and/or chemical substances	18	85.7
Correct practices for raising	12	57.1
Feed and feeding	10	47.6
Apply for membership	6	25.5
<b>Personal visit received from the district fishery extension officer</b>		
Did not receive	69	62.7
Received	41	37.3
<b>Reason for contact (n = 41)*</b>		
Collect samples of water and/or prawns	41	37.3
Look for cause of disease	38	34.5
Following experimental plot	4	3.6

\*Quoted from more than one source.

### **Adoption of Recommended Practices in Tiger Prawn Production and Environmental Concerns**

As shown in Table 5, owners adopted some government recommendations but not all, and adoption of individual measures varied between farmers. More than two-thirds adopted recommendations concerning pond size, pond slope, land clearing and waste elimination, pond exposure to sunlight, size of post-larvae, aeration, feed provisions, feed adjustment, feed consumption check, and use of tea seed cake for disease elimination - which was not full adoption, but at least partial adoption. Those who refused to follow some recommendations gave various reasons – for instance, some felt that some practices were not serious, thus there was no need to follow them, others said that some practices took much more time and cost more, and their farms were already in good condition, and yet others claimed that they had no knowledge, no equipment, were busy or had just started raising.

With reference to environmental concerns, 48.2% did not construct water storage ponds as recommended in a 2:3 relation to the raising pond, and 76.4% did not construct a treatment pond. They claimed that they had only a limited area (small plot of land) and they did not want to pay more money, thus, it was impossible to follow such recommendations. Those who lived close to sea could drain their pond(s) directly into the sea, but those who lived too far away from the sea to do so would drain waste into nearby areas of other farms, often leading to the outbreak of animal diseases, which was also noted in the study of Pantipa (2002). Such inappropriate draining of waste water is one of the main environmental concerns about raising tiger prawns. Also, some farmers applied a higher concentration of chemical substances than instructed, which also had a residual effect on prawns and thus the farmer > when such prawns are exported and tested for chemicals, they often do not meet export standards and are thus not allowed for export.

**Table 5.** Adoption of recommended practices in tiger prawn production.

<b>Recommended practice</b>	<b>Number (n = 110)</b>	<b>Percentage</b>
<b>Pond construction</b>		
Proper size 3 – 5 rai (1 ha = 6.25rai)	100	90.9
Slope with a ratio of 1 : 2	76	69.1
Rectangular shape	65	59.1
<b>Pond preparation</b>		
Land clearing and waste elimination	104	94.5
Use of lime 80 – 100 kg/rai	48	43.6
Exposure to sunlight for drying 2 – 3 weeks prior to adding water and the commencement of raising	96	87.3
<b>Water preparation</b>		
Water level 1.5 – 2.0 m	53	48.2
Water should be collected from the storage pond at least 6 – 8 weeks prior to commencing operations	10	9.1
<b>Stock release</b>		
Post-larvae 10 – 15 days	110	100.0
Aeration 1 – 2 days before beginning raising	98	84.5
Stocking density 30,000 – 50,000 prawns/rai	9	8.2
<b>Feeding</b>		
Feed 4 – 6 times per day	98	89.1
Adjust feed every 5 – 7 days	76	69.1
At least one lift feed checking net	51	46.4
Check feed consumption every 2 hours after feeding	79	71.8
<b>Water drainage and aeration</b>		
Stop aeration 10 – 15 minutes before feeding	70	63.6
Drain the water every 1 – 7 days	22	20.0
<b>Use of drug and chemical substances</b>		
Eliminate diseases and pests by using tea seed cake 20 kg/rai	76	69.1
Prevent brown gill disease by using formalin 30 ml/ton water	28	25.5
Prevent luminescence disease using chlorine dust 20 – 30 gm/ton water	40	36.9
Cure white-spot syndrome by using Fulasicone 8 l/ rai at a depth of 50 cm	2	1.8



**Associated Problems**

Outbreak of disease and infection and low survival rates were major problems mentioned by most owners (Table 6). Low quality of larvae, poor management, and a lack of responsibility of agencies concerned were also noted, but as less serious problems. To avoid disease outbreaks, owners should carefully monitor water quality and the residual effects of chemical substances at all times. Aeration and water drainage, and sludge clear-off, should be undertaken continuously when needed.

**Table 6.** Major problems associated with tiger prawn production.

<b>Problem</b>	<b>Number (n = 110)</b>	<b>Percentage*</b>
Outbreak of diseases and infection	102	92.7
Low survival rate	75	68.2
Low quality of larvae	58	52.7
Poor management	49	44.5
A lack of responsibility of agencies concerned	46	41.8

\*Quoted from more than one source.

**Association Between Factors and the Adoption of Recommended Practices in Tiger Prawn Production**

As shown in Table 7, it was found that total revenue from tiger prawn raising, use of labour, and farm yield were positively correlated with the adoption of tiger prawn raising recommendations. As mentioned earlier, shrimp production requires high investment, and this investment is partly associated with the use of labour, as more than 80% of the farms hired external labour. Thus, the adoption of recommended practices reflected the total revenue from raising and the use of labour as key factors. In addition, the farm yield was also associated with the adoption of recommendations, reflecting the fact that those who adopted the recommendations generally received a higher yield from their farm’s produce.

**Table 7.** Association between factors and the adoption of recommended practices in tiger prawn production.

<b>Factor</b>	<b>Correlation coefficient (r)</b>
<b>Social and economic factors</b>	
Age	r = 0.047
Income	r = 0.210*
Use of labour	r = 0.263**
<b>Communicative factors</b>	
Exposure to information about raising	r = 0.083
Personal contact with the district fishery extension officer	r = -0.092
<b>Psychological factors</b>	
Attitudes towards the district fishery extension officer	r = -0.083
<b>Farm yield</b>	r = 0.190*

\*Significant at 0.05% level.

\*\*Significant at 0.01% level.

## CONCLUSIONS AND RECOMMENDATIONS

Tiger Prawn production is a high investment business enterprise which is common in southern Thailand. The production covers many stages of processing and labor employment. In this study, it was found that most farms were operated as intensive productions by non-residents. Most farmers received farm information from farm magazines and friends and participated in seminars concerning their business. About one-third accessed loans, mostly from a relative. They had less contact with, and had neutral attitudes towards, the district fishery extension officers. Most followed some recommendations but not all. The outbreak of diseases and infection and low larval survival rate were mentioned as major problems. From the hypotheses tested, it was found that revenue from the farm, use of labour, and farm yield were positively correlated with the adoption of recommendations.

Based on this study, the following recommendations are offered :

1. A low level of personal contact between farmers and the fishery extension officer indicated that more personal contact could promote a better understanding and cooperation for better outcomes of tiger prawn production.

2. Some farmers use chemical substances in much greater quantities than indicated by the product guidelines. This has a residual effect on the prawns, and can also be dangerous to consumers. To avoid this, farmers should be instructed in the proper and safe use of these chemicals.

3. Polycultural raising should be encouraged to replace the current widespread monocultures, as monocultures are by their nature a considerably higher risk, and also there are no guarantees that the monocultural crop will be a good seller every year. Thus, raising other kinds of aquatic animals together with the tiger prawn will help create a more diverse income base.

4. Training is important, especially in disease diagnosis and countering the low post-larval survival rate. The Fishery Department should undertake more training in appropriate areas, and encourage farmers to participate more actively in such training sessions.

5. Hired labour should, as much as possible, be drawn from local areas, helping reduce unemployment in those areas.

6. The adoption of tiger prawn raising recommendations has been achieved to some extent. Many recommended practices which farmers do not accept should be more encouraged as the adoption is associated with improving the yield.

7. Major loss in tiger prawn production was, and is, due to the outbreak of various diseases, many of which are related to environmental degradation resulting from poor management practices. Environmental conservation and protection should be of prime concern, and the farmers helped to understand that environmental protection and sustainable production are closely related.

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