CHAPTER 6

PROFITABILITY AND PRODUCTIVITY PERFORMANCES OF THE TWO SHRIMP AQUACULTURAL SYSTEMS

As elaborated in the methodology chapter, the economic performance criteria selected consist of profitability performance, productivity performance, TE and AE. This chapter will focus on analyzing the first two performances, profitability and productivity, of the two shrimp aquacultural systems. The two remaining performances will be analyzed in Chapter 7.

6.1 Inputs of shrimp aquaculture

Before analyzing the profitability and productivity performances, it is necessary to consider the inputs of shrimp aquaculture.

6.1.1 Human resources and management skill of farms within the two systems

There is not much difference in terms of the characteristics of human resources (members of the farm household, farm laborers, education and experience of the farms' heads). However, there are statistical differences between the management skills of the farms (training attendance and disease prevention application) in the two shrimp systems under consideration (Table 6.1). The t-tests of differences of these indicators are presented in Appendix 6.1.

With respect to average farm laborers in the two systems, they are the same with 3 persons per farm. This characteristic reflects the total number of laborers in a shrimp aquacultural farm. A family member is considered as a laborer if his age is from 18 to 60 or her age is from 18 to 55.

Regarding members per farm household of the two systems, it is observed that they are nearly the same with 6.1 and 6.5 members per farm for SSAS and ISAS,

respectively. The average farm size of the two systems (6.3 members per farm) can be considered as a large farm size.

As with the categories members per farm household and farm laborers, the experience of farms' heads within the two shrimp aquacultural systems is also about equal, 6.3 crops in SSAS and 6.4 crops in ISAS. Here, to measure farmers' experience, crops of experience are used instead of years of experience. The reason is that farms can culture 1 or 2 crops per year, subsequently, years of experience is less accurate than crops of experience. Another point considered is, as introduced in the Chapter 1, the ISAS just started in 2001, however the average experience of farmers in the ISAS is 6.4 crops. This figure (6.4 crops) for the ISAS farmers takes into account the fact that before culturing intensive shrimp, they used to culture semi-intensive shrimp. Therefore, that experience has also been calculated. It is acknowledged that technologies of the two shrimp aquacultural systems are different. However, it can be assumed that the experience accumulated from aquaculturing semi-intensive shrimp can contribute to the success of the intensive shrimp aquacultural farms.

Table 6.1 Characteristics of human resource and management skill of farms within the two shrimp aquacultural systems in Phu Vang

Characteristics	Semi-intensive		Intensive		Total	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1. Members per farm household (persons)	6.1	1.9	6.5	2.1	6.3	2.0
2. Farm laborers (persons)	3.0	1.8	3.0	1.7	3.0	1.7
3. Education (years)	6.7	3.4	7.6	3.4	7.1	3.5
4. Experience (crops)	6.3	3.9	6.4	4.7	6.3	4.3
5. Training (%)	0.7	0.5	0.9	0.3	0.8	0.4
6. Disease prevention (%)	0.5	0.5	0.7	0.4	0.6	0.5

Source: Survey data, 2002. Every indicator is calculated per farm.

In human resource characteristics, only the number of formal years of education spent at school by the farm's head differs in the two systems. On average, the head of an intensive shrimp aquacultural farm has one more year of education than the head of a semi-intensive shrimp aquacultural farm. This might mean that the more highly educated aquaculturists tend to prefer intensive shrimp aquaculture to semi-intensive shrimp aquaculture. It is expected that higher level of education of the head of the farm plays an important role in the success of the individual farm and the system as well.

The last two indicators relate to training attendance and disease prevention application in the shrimp aquacultural systems. Those farmers who have never taken part in any shrimp training courses are considered as no shrimp training attendance. The SSAS has a lower percentage of farms joining training courses (70%) when compared to the ISAS (90%). Correspondingly, the percentage of farms applying disease prevention in the SSAS (50%) is also lower than in the ISAS (70%).

6.1.2 Production input utilization

Production inputs of the two shrimp systems consist of several types. Nevertheless, the following main production inputs will be considered: shrimp seeds (stocking density and aquacultural time), cultural ponds (area and distance), reservoirs, feed, and fuel (Table 6.2).

Regarding shrimp seed, it is shown that the stocking density of the ISAS is nearly 3 times higher than that in the SSAS. Aquacultural time is the time duration from when shrimps are released into the ponds until they are harvested. Shrimps are reared longer in the ISAS (102.6 days) than in the SSAS (96.5 days). By principle, there is a relationship between aquacultural time and stocking density. The denser the stocking density, the longer the aquacultural time. This is true with the two shrimp aquacultural systems in Phu Vang district.

Table 6.2 Production inputs of the two shrimp aquacultural systems in Phu Vang

Characteristics	Semi-intensive		Intensive		Total	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
1. Shrimp seed						
Stocking (P.L/m^2)	7.7	3.1	20.2	4.7	13.0	7.3
Aquacultural time (days)	96.5	16.4	102.6	19.0	99.1	17.7
2. Cultural pond						
Area (sao)	13.1	8.7	14.8	8.7	13.8	8.7
Distance (meter)	41.8	114.4	74.1	136.8	55.5	124.9
3. Reservoirs (%)	0.1	0.3	0.4	0.5	0.2	0.4
4. Feed (kg/sao)	106.9	50.5	126.2	53.4	115.1	52.4
5. Fuel (litre/sao)	24.1	15.8	48.2	32.4	34.3	27.0

Source: Survey data, 2002.

With reference to cultural ponds, the average area of the intensive shrimp aquacultural farms (14.8 sao) is greater than that of the semi-intensive aquacultural farms (13.1 sao). In the case of farms owning a large area, this is normally divided into several cultural ponds. The most common cultural pond size is about 10 sao (5,000m^2); however, it was observed during the survey that the smallest pond size was about 3 sao (1,500m^2), and the largest pond size was about 15 sao (7,500m^2). When considering the location of cultural ponds, ”distance” equals the numbers of meters from shrimp cultural ponds to the lagoon. Table 7.2 indicates that the intensive shrimp aquacultural ponds are located further away (74.1 meters) from the lagoon than the semi-intensive shrimp aquacultural ponds (41.8 meters).

Water-reserved ponds, or reservoirs, are considered as an indicator making distinct the two shrimp aquacultural systems. In Phu Vang, the percentage of farms with water reservoirs is low, 40% of farms in the ISAS and 10% in the SSAS. According to Chanratchakool *et al.* (1998) guidelines for the size of reservoirs are from 20% to 25% of the total cultural pond area. Nonetheless, it was observed from

the survey that in Phu Vang, the reservoir's areas are small and do not match the suggested guidelines of Chanratchakool *et al*. (1998). Additionally, reservoirs can be private or common properties. Reservoirs exist as common properties where shrimp farmers join shrimp aquacultural teams or cooperatives. Having cultural ponds located next to each other is one of the requirements on which shrimp aquacultural teams or cooperatives are formed. When the shrimp ponds of two or more farms are located adjacently, farmers can form an aquacultural team or join an aquacultural cooperative to use the resources (mainly reservoirs, aerators, and water pumps) efficiently. In addition, since aquacultural area is limited, using reservoirs as common properties provides a better solution than individual farms maintaining private reservoirs.

Table 6.2 shows that the last two indicators, feed and fuel, when calculated per sao in the ISAS, are 1.2 times and 2.0 times higher than in the SSAS, respectively.

By the definition, these production inputs can be considered as distinguishing characteristics of the two shrimp aquacultural systems; hence, they must be different from each other. Conversely, the definitions of the two shrimp systems can be tested by using t-tests to test the significant differences of these indicators. The tested results show that every indicator is significantly different at 0.01 level, except indicators of cultural ponds (Appendix 6.2).

In brief, there is no difference between the two systems in terms of human resource characteristics such as education, experience, members of farm household, and farm laborers, but considerable difference in terms of training attendance, disease prevention application, shrimp seed, reservoirs, feed, and fuel.

6.1.3 Production costs of the two shrimp aquacultural systems

Inputs of the two shrimp aquacultural systems continue to be considered in terms of costs of activities and materials used. Costs are calculated per unit area and then they are compared for the two shrimp aquacultural systems.

Tables 6.3 and 6.4 reflect the costs, cost structure, and the differences of the means of cost items in the two systems. The ISAS costs more for every activity and every input than the SSAS. In order to identify whether there is a significant difference or not, the differences must be tested by t-tests. The results show that they are all significantly different (Appendix 6.3).

Table 6.3 Costs per sao within the two shrimp aquacultural systems

Unit: VND 1,000/sao

Cost type	Semi-intensive		Intensive		Total	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Seed (Fry)	193.3	149.5	338.4	147.4	254.8	164.6
Feed	1,421.2	632.3	1,828.4	768.5	1,593.7	719.1
Disease prevention	58.7	92.1	125.8	139.7	87.1	118.9
Pond depreciation	139.1	84.2	216.4	111.0	171.8	103.4
Pond preparation	146.4	73.8	375.5	240.0	243.5	200.4
Machine depreciation	111.3	59.1	271.9	144.8	179.3	130.9
Tools	40.6	26.8	68.2	45.4	52.3	38.2
Maintenance	28.6	26.8	47.4	55.4	36.6	42.2
Fuel	101.0	66.4	202.2	136.2	143.9	113.2
Interest	20.5	22.0	79.5	97.5	45.5	71.5
Harvest	47.3	20.3	58.2	29.9	51.9	25.3
Labor	291.7	166.0	406.1	239.3	340.2	207.3
Total cost	**2,600.0**	**921.1**	**4,018.0**	**1,283.4**	**3,200.8**	**1,292.7**
Fixed cost	250.4	100.5	488.3	180.4	351.2	182.6
Variable cost	2,349.5	889.3	3,529.7	1,184.8	2,849.6	1,176.4

Source: Survey data, 2002.

Regarding total cost (TC), on average the intensive shrimp aquacultural farms (VND 4,018,000.0) invest more than 1.5 times the amount invested in the semi-

intensive shrimp aquacultural farms (VND 2,600,000.0). This is consistent with the definitions of the shrimp aquacultural systems in Chapter 5.

In both systems, the (processed and fresh) feed cost makes up the biggest proportion in TC, 49.8% within the two systems; 54.7% and 45.5% for the SSAS and ISAS, respectively. It is evident that feed plays a crucial role in shrimp aquaculture.

Table 6.4 Cost structure per sao of the two shrimp aquacultural systems

Unit: %

Cost type	Semi-intensive	Intensive	Total
Seed (Fry)	7.4	8.4	8.0
Feed (processed and fresh)	54.7	45.5	49.8
Disease prevention	2.3	3.1	2.7
Pond depreciation	5.4	5.4	5.4
Pond preparation	5.6	9.3	7.6
Machine depreciation	4.3	6.8	5.6
Tools	1.6	1.7	1.6
Maintenance	1.1	1.2	1.1
Fuel	3.9	5.0	4.5
Interest	0.8	2.0	1.4
Harvest	1.8	1.4	1.6
Labor care	11.2	10.1	10.6
Total cost	**100.0**	**100.0**	**100.0**
Fixed cost	9.6	12.2	11.0
Variable cost	90.4	87.8	89.0

Source: Survey data, 2002.

The ISAS has higher costs for seed, disease prevention, pond depreciation, pond preparation, machine depreciation, and fuel higher than the SSAS in terms of absolute and relative (%) numbers. This proves the difference between the two aquacultural

systems in terms of investment. Therefore, one of the criteria applied to distinguish the shrimp aquacultural systems is investment level. According to the definition, the required investment in the SSAS is lower than that in the ISAS, especially with the cost items mentioned.

Since the density of the ISAS is higher than that of the SSAS, the cost of fry per unit of pond area of the ISAS is higher than that of the SSAS. In addition, with higher density, the intensive shrimp aquaculturists are more afraid of shrimp diseases occurring; and therefore they will invest more in disease prevention.

Some cost items are very similar in both systems in terms of relative numbers (%), such as tools, maintenance and harvest costs. However, if they are compared in terms of absolute numbers or value of investment, then significant differences are observed.

Fixed costs are those costs incurred in the use of non activity-specific physical farm capital and pertain to its maintenance, operation and provision for its eventual end of life replacement. According to McConnell and Dillon (1997), the importance of farm fixed cost will vary according to the farm type under consideration. Fixed cost should consist of pond depreciation, machine depreciation, interest, and maintenance in a certain farm type. However, in the study it consists of only two items, pond depreciation and machine depreciation. The latter items, interest and maintenance are not included since it is obvious that they change together with the level of shrimp production. When more fuel is used and when shrimp eat more, machines will be used more and more money will need to be borrowed. The factors lead to change in the maintenance cost and interest. It should be noticed that variable costs will consist of the remaining cost items (Chapter 4).

It can be concluded that the investment of farms differed significantly between SSAS and ISAS. With the difference in investment, it is expected that the higher investment shrimp system would gain better profitability and productivity performances than the lower investment system.

6.2 Profitability and productivity performance of the two shrimp aquacultural systems

The profitability and productivity performance criteria were elaborated in Chapter 4, they are now calculated and presented in Table 6.5.

On the subject of profitability performance, it can be seen that three criteria applied to the ISAS are greater than in the SSAS. Total gross return (TGR) of the ISAS is 1.5 times that of the SSAS. Similarly, gross margin (GM) of the ISAS (VND 2,219,600) is also 1.5 times that of the SSAS (VND 1,517,300). Being in line with TGR and GM, net return (NR) of the ISAS is 1.4 times greater than that of the SSAS (VND 1,731,300 and VND 1,266,900, respectively).

The test of differences in the profitability performance criteria between the two systems (Appendix 6.4) found that TGR and GM were significantly different at 0.01 and 0.1 levels, correspondingly. However, NR was insignificant.

With regards to the productivity performance, all criteria of the SSAS are higher than those of the ISAS, except net returns on feed (NR/Feed), net returns on labor (NR/Labor), and shrimp yield.

Firstly, concerning the total factor productivity. This criterion reflects the general productivity performance of the system. Two indicators of total factor productivity have been selected i.e. gross total factor productivity (GTFP) and net total factor productivity (NTFP). They measure how much total gross return (TGR) or net return (NR) will be generated from one unit of total cost (TC) invested, respectively. One VND invested in total costs will create VND1.47 and VND 1.41 for the semi-intensive and intensive shrimp farms, correspondingly. In the same way, one VND invested in total costs will create VND0.47 and VND 0.41 for the semi-intensive and intensive shrimp farms, in that order.

Secondly, pertaining to net returns on main inputs used. It has been found from the study that fry or seed, feed, labor and fuel are the main inputs with the top

percentages in cost structure of the two shrimp aquacultural systems. Therefore, net returns are calculated on these main inputs. These indicators specify how much total gross return (TGR) will be generated from one post larva, one kg of feed, one man-day and one litre of fuel, in that order. Of these four indicators, the former (NR/PL) and the latter (NR/Fuel) of the SSAS are higher than those of the ISAS. Conversely, the NR/Feed and NR/Labor of the ISAS are higher than those of the SSAS.

Thirdly, regarding shrimp yield. The shrimp yield of the ISAS (70.1kg/sao) is greater than that of SSAS (46.2 kg/sao). It is suggested that the higher investment and management levels in stocking density might contribute to the yield of the ISAS. However, it can be said that the average shrimp yields of the two systems, especially the ISAS, are much lower than in other regions in Vietnam and other countries.

Table 6.5 Profitability and productivity performance of the SSAS and ISAS (per sao)

Performance criteria	Unit	Semi-intensive	Intensive
1. Profitability performance			
Total gross return (TGR)	VND 1,000	3,866.8	5,749.2
Gross margin (GM)	VND 1,000	1,517.3	2,219.6
Net return (NR)	VND 1,000	1,266.9	1,731.3
2. Productivity performance			
a. Total factor productivity			
Gross total factor productivity (GTFP)	Times	1.47	1.41
Net total factor productivity (NTFP)	Times	0.47	0.41
b. Net returns on main inputs used			
Net returns on post larva (NR/PL)	VND 1,000/PL	0.41	0.21
Net returns on feed (NR/Feed)	VND 1,000/kg	24.86	26.19
Net returns on labor (NR/Labor)	VND 1,000/man-day	117.60	124.73
Net returns on fuel (NR/Fuel)	VND 1,000/litre	65.70	48.82
c. Shrimp yield	Kg/sao	46.2	70.1
d. FCR	kg feed/kg shrimp	2.5	2.0

Source: Survey, 2002.

Finally, food conversion ratio (FCR) is analyzed. This indicator of the ISAS is smaller than that of the SSAS, meaning that the ISAS uses feed better than the SSAS. In order to obtain 1 kg of shrimp, farmers in the ISAS use only 2.0 kg of feed while farmers in the SSAS have to use 2.5 kg of feed. According to Chanratchakool *et al*. (1998), FCR varies depending on the stocking density, quality of feed, amount of natural feed and the size at which the shrimps are harvested, but ideally it should not be higher than 1.8 in the high yield systems and 1.5 in lower yield systems. Both FCRs of the ISAS and SSAS are greater than the Chanratchakool *et al*.'s benchmarks.

These productivity performance criteria are tested by t-tests and the results are depicted in Appendix 6.4. The results reveals that only 3 indicators: net return on post larva (NR/PL), shrimp yield and FCR are statistically different.

In summary, on the topic of profitability performance, total gross returns (TGR) and gross margin (GM) of the ISAS are better than those of the SSAS. As regards productivity performance, net returns on post larvae (NR/PL) of the SSAS is better than that of the ISAS; however, shrimp yield and FCR of ISAS are better than those of the SSAS.