Quality management in the Pangasius export supply chain in Vietnam

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10 Farmers' Awareness and Willingness to Apply Advanced Production Systems

10.1 Introduction

The purpose of this chapter is to analyze the gaps between APPU members and small-scale farmers as shown in chapters 8 and 9. By using independent farms for traditional farming and the APPU model for advanced farming as the reference systems, this chapter considers which measures can be taken to close the gaps and improve quality control at the farm level. APPU members fulfill the specific quality requirements for the European export market, such as usage of certified fingerlings, certified industrial feed, waste-water treatment ponds, and proper disease treatment. These quality requirements constitute a challenge for small-scale farmers who wish to access the export market. This chapter begins by summarizing the differences in farming practices between small-scale farmers and APPU members. Next, a financial analysis of the relationship between farming parameters and financial outcomes is presented by conducting a profitability assessment. The results assess the economic implications of and the reasons for adopting advanced farming practices. This phase is followed by a discussion of the survey conducted in 2009 about farmers' awareness and willingness. Farmers' awareness verifies whether farmers are aware of the positive effects of improved farming techniques,[37] and farmers' willingness verifies whether farmers are willing to invest in (adopt) the advanced farming system. Finally, conclusions on the findings are presented.

10.2 The differences in farming practice between small-scale farmers and APPU members (Survey 1, 2008)

The analyses in chapters 8 and 9 show the differences in farming practice between the small-scale farmers and APPU members as follows:

- **Fingerlings and stocking density:** APPU members purchase certified fingerlings from state-owned hatcheries that can trace the origins of fingerlings and provide a quality guarantee. Small-scale farmers purchase fingerlings from

[37] In chapter 9 we dealt with farmers' perceptions regarding disease prevention and disease treatment. Some of these perceptions are related to the issues discussed in this chapter. However, the questions have a different meaning. In chapter 9 we described perceptions regarding general elements of disease prevention and treatment, among independent, FA and APPU farmers. In this chapter we present information about the awareness of independent and FA farmers regarding the specific recommended practices applied in the APPU farming system.

private hatcheries/nurseries or fingerling traders who guarantee fingerlings in terms of quantity of loss (table 8.10). Moreover, APPU members have a lower stocking density and thus higher survival rates. Small-scale farmers use a higher stocking density, which leads to the reduction of fish growth, low survival rate, and more fish diseases (table 8.11).

- **Feed and finances**: APPU members purchase only industrial feed from a certified company that guarantees protein content and quality. Small-scale farmers usually use also home-made feed in addition to industrial feed to save on cost (table 8.12). Home-made feed is of lesser quality and results in more water pollution compared to industrial feed. Moreover, APPU members can buy feed from AGIFISH processing firms on credit (section 8.5). This practice gives them a financial advantage compared to small-scale farmers, who have difficulties getting loans from banks and are faced with a higher interest rate in the free market, which creates a huge reduction in profit.

- **Waste-water treatment:** APPU members use a waste-water treatment pond to clean the outlet water before discharging it to the river (table 8.5). Small-scale farmers do not have a waste-water treatment pond due to high investment costs and lack of land. Discharges of untreated water into the river create environmental pollution and disease outbreaks.

- **Veterinary drugs used**: APPU members diagnose the fish disease at a laboratory before treatment and use certified veterinary drugs (table 9.9 and table 9.11). Small-scale farmers treat fish disease based on experience or drug sellers' advices. They do not strictly apply the recommended dosage of veterinary drugs, resulting in antibiotic residues in fish flesh and lower survival rates (section 9.5.2).

10.3 Relationship between farming parameters and financial outcomes

In this section we investigate the financial consequences for small-scale farmers who adopt more advanced farming practices. To this end we developed a simple farming business model (reference case) based on pond size, stocking density, fingerling price, survival rate, conversion rate, feed volume and feed price, financing cost, labor volume and cost, harvest interval, cost of chemical/veterinary drugs, harvest volume, and sales price (see appendix 10.2 for the details). In sub-section 10.3.1 we analyze the effect of one-by-one changes:

- ❖ The use of certified fingerlings and application of a lower stocking density
- ❖ The use of industrial feed and financing methods
- ❖ Waste-water treatment
- ❖ Fish disease diagnosis and treatment

10.3.1 Alternative farming business models

As a reference case we use a traditional farm with a pond sized 5,000m^2 (table 8.3), two crops per year, and no waste-water treatment pond. The details of the business model are presented in appendix 10.2. The parameter values are based on collected data (Survey 1, 2008, appendix 10.3). Table 10.1 summarizes the profitability calculations of the traditional production system for different scenarios (changing the main variables).

Table 10.1 Alternative techniques and small-scale farmer benefits

Profitability	Case A (reference case)	Case B	Case C	Case D	Case E	Case F	Case G
Total benefit/year (Million VND)	4,308	4,308	2,252	4,308	4,308	4,308	4,308
Total cost/year (Million VND)	3,830	3,923	2,071	3,901	3,891	3,849	3,790
Benefit/cost	1.12	1.10	1.09	1.10	1.11	1.125	1.15
Cost per kg (break even price) (Million VND)	0.0119	0.01227	0.01225	0.0122	0.0121	0.0120	0.0118
Profit per year (Million VND)	478	385	181	407	417	459	518

Source: author's calculation, 2009.

Note:

- Case A: Reference case for traditional production system
- Case B: Reference case + use of certified fingerlings (higher price of one fingerling)
- Case C: Reference case + use of certified fingerlings + lower stocking density (lower stocking density than reference case)
- Case D: Reference case + use of certified industrial feed (industrial feeds instead of home-made feeds)
- Case E: Reference case + use of certified industrial feed + feed externally financed with a low interest rate (lower interest rate of loan than reference case)
- Case F: Reference case + use og waste-water treatment pond (building waste-water treatment pond to avoid water pollution)
- Case G: Reference case + better disease diagnosis and treatment (lower cost of veterinary drugs [4% of total production cost] than reference case [5% of total production cost]). (These figures are the average number in traditional farmers and APPU farmers respectively).

We conduct the changes of one main variable such as certified fingerlings (case B), lower stocking density (case C), certified industrial feed (case D), feed externally financed (case E), waste-water treatment pond (case F), and better disease diagnosis and treatment (case G) in order to investigate the financial consequences of changing the farming practice within these dimensions.

In case B, we change the reference case to use the certified fingerlings with a premium price. In the reference case, the fingerling cost is equal to 220 million VND. Buying certified fingerlings increases this price to 308 million VND. It is uncertain for the farmers whether this purchase leads to a higher survival rate or fewer diseases. Hence, when the small-scale farmers adopt certified fingerlings (cost per fingerling increasing), the break-even price increases and profits per year reduce. Moreover, the selling price does not increase because fingerling quality does not fulfil all quality farming practice requirements. Therefore, this change is simply unattractive for small-scale farmers.

In case C, we change the reference case to use the certified fingerlings and lower the stocking density to 23 heads/m^2. The survival rate (0.72) is left unchanged, however, leading to the same feed cost and fingerling cost per kg of fish. Compared to case B, the profit per year reduces considerably. The cost per kg of fish (0.0124) is also slightly higher than in case B because of the fixed cost. Therefore, this option is even less attractive than case B for smallholders. If the survival rate increases to 81%, the cost per kg of fish is 0.0123, which is still significantly higher than in the reference case. And a more severe disadvantage for the farmers is the lower profit per year (230 million VND).

In case D, the feed conversion rate (FCR) is lower than in the reference case due to the use of certified industrial feed. Hence, less feed is needed. However, this effect is more than compensated by the higher feed price (compared to home-made feed in the reference case) and the cost per kg of fish (0.0122), which is lower than the cost in cases B and C (0.01227 and 0.01225). In this case, we assume a loan interest rate equal to 2% (average rate for smallholders, Survey 1, 2008). The result shows that this option leads to higher production cost than the reference case and, therefore, is not attractive for small-scale farmers. A possible positive effect on the costs for veterinary drugs is not included here. See case G for the sensitivity of the profit per year for a reduction of the use of veterinary drugs.

In case E, the production cost per kg of fish is lower than in case D due to the lower interest rate. We suppose that farmers have access to the same interest rate (1.5% as APPU members). However, case E still results in higher cost per kilo than the reference case.

In case F, we change the reference case to use a waste-water treatment pond. The cost per kg of fish (0.0120) is reduced slightly compared to cases B, C, D, and E, due to the necessary investment. The positive effect of waste-water treatment is a reduction of the risk of pollution and infection from other ponds. In addition, the local government has banned dumping pond sediment into the water canal and farmers are formally forced to follow this regulation. The possible positive effects on the business of the individual farmer are uncertain however and therefore not included in the calculation. What is certain, however, is the fact that they must invest a large amount of money to construct the pond, such as ground price (750 million VND), or they must reserve part of their productive land for a sediment pond. This necessity explains why most farmers prefer the case A option.

In case G, the cost per kg of fish is lower than the reference case as a result of a reduction in the use of veterinary drugs. The average cost for veterinary drugs is about half the average profit per year. This equation indicates that if farmers apply better fish disease prevention and treatment, they could improve their profit. Investing in better prevention and treatment practices may be rewarding at the individual farm level.

Based on the analysis (see appendix 10.5), we can see that the cost per kg of fish increases for all cases except case G, compared to the reference case. These results reveal that small-scale farmers have no financial incentive to change their farming practices because doing so would produce a negative effect on their profit and unit cost of fish production. However, with regard to the better disease diagnosis and treatment, the cost per kg of fish is the lowest. This result confirms that fish disease control is an important issue in farming practices and provides opportunities for higher benefits. The other changes are only attractive for the small-scale farmers if they apply the whole package of advanced farming practices and therefore arrive at a higher selling price.

10.3.2 The advanced production system

This section compares the profitability of the traditional production system with the advanced system: the APPU model (see appendix 10.5).

Table 10.2 The profitability of the advanced production system

Profitability	Case A (reference case)	Case H (advanced case including a sales contract)	Case I (advanced case without a sales contract)
Total benefit/year (Million VND)	4,308	3,130	2,899
Total cost/year (Million VND)	3,830	2,463	2,463
Benefit/cost	1.12	1.30	1.20
Cost per kg (Million VND)	0.0119	0.0126	0.0123
Profit per year (Million VND)	478	667	436

Source: author's calculation, 2009

The calculations (table 10.2) show that the B/C ratio for case H is 1.30, which is higher than all other cases. Although the cost per kg of fish is higher than the reference case, the profit increases due to a higher selling price (16,000 VND/kg of fish compared to 13,478 VND/kg in Survey 1, 2008). The total cost of the advanced model is lower than the reference case because the amounts of feed are lower (reduced stocking rate and higher survival rate) and are financed at a lower interest rate. The different outcomes for case H result from the assumption that farmers conclude a sales contract specifying all the quality requirements and related farming practices. As a result of this commitment they receive a price premium of 18% (see appendix 10.5; this is the premium price APPU members receive if they sell to the AGIFISH company).

The results also show that the profit per year for case I is lower than the profit of the reference case A, although the selling price is higher at 10%. This result makes very clear that small-scale farmers would be interested in the advanced production system only if the buyer makes a mutual commitment: i.e., this option is only attractive if farmers can negotiate a premium price (case H).
However, farmers usually face fluctuations of the sale prices (see appendix 10.11). As the sale price is lower than 11,982 VND/kg of fish, small-scale farmers will lose money (in the case of May, July and August, 2008). Therefore, they would be unwilling to invest in an advanced production system.

Concluding that the advanced farming practice is attractive raises the question of what farmers think about this alternative. The next section focuses on this issue: Are farmers aware of this opportunity, and are they willing to invest?

10.4 Discussion of survey results in 2009

We conducted fieldwork in An Giang province of the MRD to discuss the farmers' awareness and willingness to improve their farming practices toward

the advanced production system. The data collection included a survey of 100 farmers (50 traditional farmers and 50 FA members). We selected the Chau Phu district of An Giang province for our research for several reasons. First, the Chau Phu district was one of the early adopters of Pangasius pond aquaculture. Hence, this district has a large number of Pangasius ponds, many of which have been in use for over 15 years. By choosing an established area like this, we had an opportunity to evaluate potentially more established and stabilized farming practices. Second, Chau Phu was chosen because of the high percentage of small farmers in the area. Smallholder farmers are a major focus of this investigation. In the Chau Phu district, we selected Vinh Thanh Trung and Thanh My Tay communes because they house both traditional farmers and FA members. The survey questions are found in appendix 4.3. The chosen farmers were not contacted in advance, so upon arriving at the site, we asked permission to conduct the survey and, once granted, we sat with the farmer for one and a half to two hours asking questions, clarifying answers, and recording data.

This section reports the results regarding the awareness of needed changes and willingness to invest in farming practices (fingerlings, stocking density, feed, finances, waste-water treatment pond, and chemicals/veterinary drugs used for disease prevention and disease treatment).

10.4.1 Fingerlings and stocking density

Fingerlings

Most farmers (100% traditional and 90% FA members) did not purchase certified fingerlings from state-owned hatcheries (Table 10.3). This confirms the farming practice as mentioned in section 8.3.3.

Table 10.3 Source of fingerlings

Source of fingerlings		Percentage (%)
Independent farmers (N=50)	State-owned hatcheries	0.0
	Private hatcheries/nurseries	100.0
FA members (N=50)	State-owned hatcheries	10.0
	Private hatcheries/nurseries	90.0

Source: Survey 2, 2009

Farmers usually purchase fingerlings from private hatcheries or fingerling traders with the guarantee of 10-20 days for the mortality loss of fingerlings (section 8.3.3). A minority of farmers (FA farmers in particular) indicates that the quality of certified fingerlings is better and that traceability is considered

important (Table 10.4). This result makes clear that farmers' knowledge regarding quality requirements for the export market has some serious flaws.

Table 10.4 Farmers' awareness on fingerling quality

Farmers		Awareness on fingerlings quality (%)		
		Certified fingerlings are considered important	Traceability of the original fingerlings is considered important	Fingerlings produced by state-owned hatcheries are healthier than private ones
Independent farmers (N=50)	Yes	22.0	24.0	36.0
	No	54.0	44.0	48.0
	No opinion	24.0	32.0	16.0
FA members (N=50)	Yes	42.0	32.0	50.0
	No	48.0	48.0	36.0
	No opinion	10.0	20.0	14.0

Source: Survey 2, 2009

The data show that a minority of farmers is aware of the importance of certified fingerlings (22% of independent farmers and 42% of FA members) and the fingerling traceability (24% of independent farmers and 32% of FA members). In addition, some farmers recognize that state-owned hatcheries produce better fingerlings than private hatcheries (50% of FA members and 36% of independent farmers). However, other farmers (14% of independent farmers and 16% of FA members) have no idea about this issue because, most likely, they never use certified fingerlings. Moreover, a large number of farmers indicated that fingerlings produced by state-owned hatcheries are not healthier (high survival rate/less disease) than fingerlings produced by private hatcheries (48% of independent farmers and 36% of FA members).

Table 10.5 Reasons for not using certified fingerlings

Reasons	FA farmers (N=35)	Independent farmers (N=40)	Total (N=75)
- Insufficient supply of certified fingerlings from state-owned hatcheries	12 (34.3%)	18 (45.0%)	30 (40.0%)
- Order large volume fingerlings in advance	16 (45.7%)	14 (35.0%)	30 (40.0%)
- Far from the source of certified fingerlings	7 (20.0%)	8 (20.0%)	15 (20.0%)
Total	35 (100.0%)	40 (100.0%)	75 (100.0%)

Source: Survey 2, 2009

Three reasons are given by small-scale farmers for not purchasing certified fingerlings from state-owned hatcheries (table 10.5) are namely (1) production at state-owned hatcheries is insufficient to meet fingerling demand (40%), (2) farmers must order large volumes and one month before purchasing fingerlings; hence, it is not convenient for small-scale farmers (40%), and (3) state-owned hatcheries are far from the village, making transportation of fingerlings to the farm gate costly (20%). As a result, most small-scale farmers depend on fingerlings with unclear origins that are sold freely in the market.

Table 10.6 Farmers' willingness to purchase fingerlings

Farmers		Willingness to purchase fingerlings (%)	
		Willing to purchase certified fingerlings with a premium price	Willing to co-operate with other farmers to buy certified fingerlings
Independent farmers (N=50)	Yes	44.0	14.0
	No	56.0	66.0
	No opinion	0.0	20.0
FA members (N=50)	Yes	62.0	18.0
	No	38.0	50.0
	No opinion	0.0	32.0

Source: Survey 2, 2009

A small majority of small-scale farmers is willing to purchase from certified hatcheries with a premium price to get higher quality of fingerlings (44% of independent farmers and 62% of FA members). This willingness confirms that small-scale farmers consider fingerling quality one of the important factors that affects fish quality (table 10.5). However, during the interviews, several of them

suggested that certified fingerlings should be easily available on the markets. Other farmers do not recognize the benefits of purchasing certified fingerlings for a higher price (62% of independent farmers and 38% of FA members).

The data show that FA members have more willing to invest (table 10.6) and more awareness of the quality of (table 10.4) certified fingerlings more frequently than independent farmers. We believe that this difference reflects the effects of training, FA meetings, and information exchange among FA members. Moreover, the FA provides members a list of licensed private hatcheries that are approved by the local authority. Interestingly, only a minority of farmers, 14% of the independent farmers and 18% of the FA members, is willing to cooperate with other farmers to buy certified fingerlings.

To identify the relationship between farmers' awareness and willingness regarding certified fingerlings, a cross-tabulation is made and an analysis of variance is applied (H0: there is no relationship between awareness and willingness of farmers toward the adoption of certified fingerlings). We test the correlation of the Yes/No answers of farmers' awareness and willingness. We neglected the farmers who were not able to express their opinion. The difficulty with this part of the test population is that various reasons may explain why they are not able to answer this question. To avoid ambiguity in the interpretation of the results, we decided to exclude them from this exercise.

The test results indicate that, concerning both groups of farmers, the null hypothesis is rejected at the 1% significance level for independent farmers and FA farmers respectively (see appendix 10.12). In other words, a relation exists between farmers' awareness and willingness to use certified fingerlings. The results show that 61.1% of independent farmers and 92.0% of the FA members aware of the better quality of certified fingerlings are also willing to purchase the fingerlings with a premium price (Survey 2, 2009).

Stocking density

The stocking density of independent farmers is 39 fingerlings/m^2 on average (table 10.7). This stocking density is lower than the survey result of 2008 (44 fingerlings/m^2 on average). Remarkably, the difference between the two groups is relatively small.

Table 10.7 Stocking density

Stocking density	Frequency	Min	Max	Mean
Independent farmers (N=50)	50	35	45	38.76
FA members (N=50)	50	33	40	36.40

Farmers are aware of the fact that a lower stocking density (62% of FA members and 58% of independent farmers) may lead to a decrease in fish disease (table 10.8). In addition, a somewhat smaller group recognizes that low stocking density increases the weight of fish (54% of FA members and 38.0% of independent farmers). We observe that awareness among FA members about these effects is somewhat higher than the awareness among independent farmers.

Table 10.8 Farmers' awareness of the importance of stocking density

Farmers		Awareness on stocking density (%)	
		Low stocking density leads to decrease in fish disease	Low stocking density increases the weight of fish
Independent farmers (N=50)	Yes	58.0	38.0
	No	18.0	44.0
	No opinion	24.0	18.0
FA members (N=50)	Yes	62.0	54.0
	No	16.0	22.0
	No opinion	22.0	24.0

Source: Survey 2, 2009

The data shows that 42% of the independent farmers and 62% of the FA members are willing to use a lower stocking density, as they recognize that the fish increase in weight and endure fewer disease outbreaks (table 10.9). However, the data also show that the group of farmers refusing to apply a lower stocking density is quite large for individual farmers. Extension training is still needed.

Table 10.9 Farmers' willingness to use a lower stocking density

Farmers		Willing to use a lower stocking density (%)
Independent farmers (N=50)	Yes	42.0
	No	40.0
	No opinion	18.0
FA members (N=50)	Yes	62.0
	No	28.0
	No opinion	10.0

Source: Survey 2, 2009

A cross-tabulation analysis is also applied to test whether a relationship exsits between awareness of stocking density and willingness to use a lower stocking density (H0: there is no relationship). The results reveal that the null hypothesis is not rejected for independent farmers (see appendix 10.13); that is, no relationship is found between awareness on stocking density and willingness to use a lower stocking density.

However, the null hypothesis is rejected for the FA members. In other words, a relationship exists between awareness of the advantage of a lower stocking density and willingness to adopt a lower stocking density. The results show that 75.9% of the FA members who believe a lower stocking density affects fish disease and weight are willing to apply a lower stocking density.

10.4.2 Feed and finances

Table 10.10 shows that 40% of the independent farmers and 60% of the FA members used industrial feed only (table 10.10). Moreover, a large group of farmers (40% of independent farmers and 40% of FA members) use a combination of industrial feed (first two months of production cycle) and home-made feed. The remaining 20% of the independent farmers used home-made feed only throughout the whole production.

Table 10.10 Type of feed used

Type of farmers	Types of feed	Percentage (%)
Independent farmers (N=50)	Industrial	40.0
	Home-made	20.0
	Both	40.0
FA members (N=50)	Industrial	60
	Home-made	0.0
	Both	40.0

Source: Survey 2, 2009

Farmers can trace the origin of industrial feed by the ingredients in the bag; however, they cannot trace the source of trash fish, which is used to produce home-made feed. Farmers agree that industrial feed has a better quality than home-made feed (70% of FA members and 54% of independent farmers). In addition, farmers also recognize that home-made feed has a higher FCR than industrial feed (80% of FA members and 70% of independent farmers). However, a substantial number of farmers (22% of FA members and 34% of independent farmers) complain about the quality of industrial feed. Most complaints are related to the protein content, which is higher on the bags' nutritional label than in actuality (they checked the quality of feed at the feed quality service center). Therefore, FA members do not trust the quality of

industrial feed. As a result, they tend to use home-made feed because they can control (estimate) the protein content and quality.

Farmers evaluate the quality of industrial feed in terms of increasing the white color of fish (28% of FA members and 20% of independent farmers), increasing fish weight (50% of FA members and 22% of independent farmers), and decreasing fish diseases (62% of FA members and 44% of independent farmers) (table 10.11). Regarding the willingness of using only industrial feed for the whole production cycle, 50% of FA members and 36% of independent farmers are willing to do this. This finding confirms that a significant number of small-scale farmers recognize the quality of industrial feed, and they have the capacity to access this source.

Table 10.11 Farmers' awareness and willingness on feeds used

Farmers		Awareness of feed used (%)					Willingness to use industrial feed	
		Industrial feed has a better quality than home-made feed	Trace the origins of feed is considered important	Industrial feed increases the white color of fish	Industrial feed increases the weight of fish	Industrial feed decreases fish disease	Willing to use industrial feed for the whole production cycle	Willing to cooperate to purchase large volumes of industrial feed
Independent farmers (N=50)	Yes	54.0	40.0	20.0	22.0	44.0	36.0	26.0
	No	34.0	40.0	56.0	58.0	40.0	42.0	62.0
	No opinion	12.0	20.0	24.0	20.0	16.0	22.0	12.0
FA members (N=50)	Yes	70.0	60.0	28.0	50.0	62.0	50.0	42.0
	No	22.0	40.0	58.0	38.0	32.0	32.0	50.0
	No opinion	8.0	0.0	14.0	12.0	6.0	18.0	8.0

Source: Survey 2, 2009

The data show that 26% of the independent farmers and 42% of the FA members are willing to cooperate to purchase larger quantities of industrial feed to receive the benefit of a discounted rate (see appendix 10.8). Most farmers state that they could not cooperate with other farmers to buy larger amounts of industrial feed because they lack capital and they usually buy feed gradually (62% of independent farmers and 50% of FA members). In the case of FA members, FA also provides them with a list of certified feed suppliers and advises them to purchase feed from these suppliers; although, FA cannot financially assist the members in purchasing a small amount of industrial feed (Survey 2, 2009).

Appendix 10.4 shows that feed cost is the major cost component in Pangasius production. Consequently, credit for feed expenses is a crucial issue for farmers. Small-scale Pangasius farmers fund themselves through their family savings or they get a loan from the black market against 3-4% interest per month. In addition, farmers state that they can access credit by giving the bank a "red book" (the official paperwork required to prove land use rights) as collateral. However, the bank evaluates their land value as much lower than market value; hence, the money they get from the bank is not enough for the whole production cycle (60% of independent farmers and 50% of FA members). Farmers who take a loan and then have a bad harvest often immediately go bankrupt and, as a consequence, their land is seized by the bank. Currently, the government has a new policy to loan farmers with a favored interest rate (4% per year). However, a prerequisite for access to these loans is a selling contract with processing firms (case of APPU). The absence of a selling contract makes the small-scale farmers vulnerable to the market price, demand fluctuations, and the power of the processors. Small-scale farmers who deliver directly to processing factories usually do not have contracts either. Whenever a contract is in place, it is an oral contract and is easily broken by one of the parties. Small-scale farmers who have no long-term relationship with a processing factory find it harder to make a farming contract therefore a sustainable profit.

To identify the relationship between farmers' awareness of applying and willingness to apply certified industrial feed, an analysis of variance is applied to test the null hypothesis (H0: there is no relationship between farmers' awareness of the better quality of industrial feed and farmers' willingness to buy industrial feed). The results indicate that for both groups of farmers, the null hypothesis is rejected at the significant level of 1% (see appendix 10.14). In other words, a relationship exists between farmers' awareness of applying and willingness to apply certified industrial feed. The results show that 66.7% of the independent farmers and 78.1% of the FA members who are aware of the better quality of certified industrial feed are thus willing to use industrial feed in the whole production cycle.

To conclude, farmers' awareness of the better quality of industrial feed is quite high. The general picture is somewhat better for FA farmers. A larger percentage of these farmers is aware of the positive consequences of industrial feed, and the percentage of farmers without an opinion is quite small. Again, this result seems to reflect the effect of the extension services and FA group meetings. However, we found that a large number of small-scale farmers lack the capital to purchase industrial feed. FA members are more willing to purchase industrial feed in a group to receive a discount and credit. Moreover, enhancing the inspection of industrial feed quality by the local authority is

suggested. It is very important to create the trust of farmers who are willing to use industrial feed for the whole production cycle.

10.4.3 Waste-water treatment pond

The data show that 100% of the independent farmers and 90% of the FA members have no waste-water treatment pond (table 10.12). Farmers usually discharge waste-water to three places: paddy fields (18%), orchards (18%) and rivers/canals (64%) (table 10.13). They say that the discharged water is re-used in paddy fields/orchards for fertilization. Farmers state that the pond sludge and sediment applied to paddy fields or orchards help to prevent waste discharge to the river (Survey 2, 2009). The other 10% of FA members have waste-water treatment pond and use chemical treatment and vegetables ("water hyacinth" or "water dragon") to clean water before discharging to the river. Some farmers recognized that water pollution as a result of Pangasius production is a problem (30% of independent farmers and 30% of FA members). They have observed that the increase of fish diseases and lower survival rate in recent years (Survey 1 and 2, 2008 and 2009 respectively). Therefore, they agree that the waste-water treatment reduces the dangers of water pollution (36% of FA members and 32% of independent farmers). The majority of farmers do not recognize that water pollution is caused by Pangasius production (68% of independent farmers and 70% of FA members). They say that the water pollution is caused by waste water from processing firms or other agricultural activities. A majority of farmers recognize that polluted inlet water affects the white color of fish (60% of FA members and 50% of independent farmers) and the health of fish (80% of FA members and 75% of independent farmers) (table 10.14).

Table 10.12 Use of waste-water treatment pond

Use of waste-water treatment pond		Percentage (%)
Independent farmers (N=50)	Yes	0,0
	No	100,0
FA members (N=50)	Yes	10,0
	No	90,0

Source: Survey 2, 2009

In total, 32% of the FA members and 20% of the independent farmers are willing to build a waste-water treatment pond. For other farmers who are not willing to construct waste-water treatment ponds, they give some reasons, namely (1) lack of land (58.5%), high land price (16.9%), and the fact that they discharge waste-water to other places such as paddy fields or orchards without going directly to the river (24.6%) (table 10.15). Some farmers state that a common pond of water treatment between several farmers is necessary under the responsibility of the Farmers' Union or the local authority.

To identify the relationship between farmers' awareness of applying and willingness to apply a waste-water treatment pond, a cross-tabulation analysis is applied to test the null hypothesis (H0: there is no relationship between farmers' awareness that a waste-water treatment pond reduces the danger of water pollution and farmers' willingness of construct a waste-water treatment pond).

Table 10.13 Waste-water discharging

Waste-water discharged (N=100)	Percentage (%)
To rivers/canals	64,0
To paddy fields	18,0
To orchards	18,0

Source: Survey 2, 2009

The tes results indicate that, concerning both groups of farmers, the null hypothesis is rejected at the significant level of 1% (see appendix 10.15). In other words, a relation exists between farmers' awareness of applying and willingness to apply a waste-water treatment pond. The results show that 72.7% of the independent farmers and 100% of FA members who are aware that waste-water treatment reduces water pollution are also willing to construct a waste-water treatment pond. In addition, 20.0% of the independent farmers and 32.0% of the FA members who are willing to apply a waste-water treatment pond. This finding is consistent with the previous finding that FA members are more concerned with water pollution, which affects to fish quality.

Table 10.14 Farmers' awareness on the effects on water pollution and willingness to invest in waste -water treatment pond

Farmers		Awareness on water pollution (%)				Willingness to invest in a waste-water treatment pond
		Water pollution is a problem as a result of Pangasius production	Waste-water treatment reduces danger of water pollution	Water pollution affects white color of fish	Water pollution affects the health of fish	Willing to invest a waste-water treatment pond
Independent farmers (N=50)	Yes	30.0	32.0	50.0	80.0	20.0
	No	68.0	68.0	50.0	20.0	56.0
	No opinion	2.0	0.0	0.0	0.0	24.0
FA members (N=50)	Yes	30.0	36.0	60.0	80.0	32.0
	No	70.0	54.0	40.0	20.0	32.0
	No opinion	0.0	10.0	0.0	00.0	36.0

Source: Survey 2, 2009

To conclude, many farmers (including both FA members and independent farmers) are not aware of the advantages of a waste-water treatment pond. We found that most small-scale farmers do not have a sediment pond at their disposal due to a lack of land and/or a high land price. However, farmers who are aware of the benefits of a waste-water treatment pond are willing to invest in it. We encourage clusters of farmers who use the same river source to construct a common waste-water treatment pond to make water clean before discharging into the river. Moreover, a water discharging schedule should be constructed for the clusters of farmers, as it would minimize the contamination between farms and also provide a good quality water inlet.

Table 10.15 Reasons for not accepting the waste-water treatment pond

Reasons	FA farmers (N=30)	Independent farmers (N=35)	Total (N=65)
- Lack of land	18 (60%)	20 (57.1%)	38 (58.5%)
- High land price	5 (16.7%)	6 (17.1%)	11 (16.9%)
- Not discharging directly to the river	7 (23.3%)	9 (25.8%)	16 (24.6%)
Total	30 (100.0%)	35 (100.0%)	65 (100.0%)

Source: Survey 2, 2009

10.4.4 Chemicals/veterinary drugs used

The majority of farmers is willing to use legal chemicals (100% of FA and independent farmers) and certified veterinary drugs (80% of FA members and 70% of independent farmers) (table 10.16). Most farmers use chemicals for disease prevention such as lime, salt, yuca, enzymes, pro-biotics, which are legal chemicals (Survey 2, 2009).

Approximately half of the farmers recognize that certified veterinary drugs are better than non-certified drugs (65.1% of FA members and 34.9% of independent farmers). However, many others (64% of independent farmers and 42% of FA members) disagree with the statement on the quality of certified veterinary drugs, as they recognize that there are some raw materials in antibiotics without brand names available on the free market, which they can obtain without consulting a fish health specialist. Moreover, these non-certified drugs are stronger than certified ones and can treat fish diseases more effectively. The data also reveal that most farmers (100% of independent farmers and 80% of FA members) do not keep records (name, dates, amounts, and withdrawal times) of all chemicals/drugs that they use in the grow-out period. Farmers are not aware of the importance of diagnosing fish diseases in a laboratory (88% of independent farmers and 84% of FA members). In cases of disease outbreak, farmers send samples to veterinarians and the veterinarians send the samples to laboratories for diagnosis. However, this method requires

several days of waiting before the results are received; hence, farmers experience greater difficulty when disease breaks out, and they often endure fish loss (Survey 2, 2009).

Farmers are aware that obtaining knowledge about fish disease treatment through training is achievable. Most farmers (100% of FA members and 64% of independent farmers) are aware of the importance of training, and they received training about the use of chemicals/antibiotics from the veterinary drug companies or local authority. However, proper disease treatment based on laboratory diagnosis is lacking (10% of independent farmers and 16% of FA members are aware of the importance). Most of farmers (88% of FA members and 62% of independent farmers) are willing to share knowledge with their neighbors in term of disease symptoms and veterinary drug usage and dosage. Moreover, FA members can share knowledge and get more training than independent farmers. The FA magazine is usually updated with new information on fish disease prevention and treatment as well as new diseases occurring in the crop.

Table 10.16 Farmers' awareness of using and willingness to use chemicals/veterinary drugs

Farmers		Awareness of chemicals/veterinary drugs used (%)				Willingness to cooperate (%)		
		Certified drugs are better than non-certified drugs	Keeping all records of drugs used is considered important	Diagnosing fish disease at laboratory is considered important	Training in disease treatment and prevention	Use certified chemicals	Use certified veterinary drugs	Share disease treatment knowledge
Independent farmers (N=50)	Yes	30.0	0.0	10.0	64.0	100.0	70.0	62.0
	No	64.0	100.0	88.0	36.0	0.0	30.0	30.0
	No opinion	6.0	0.0	2.0	0.0	0.0	0.0	8.0
FA members (N=50)	Yes	56.0	20.0	16.0	100.0	100.0	80.0	88.0
	No	42.0	80.0	84.0	0.0	0.0	20.0	4.0
	No opinion	2.0	0.0	0.0	0.0	0.0	0.0	8.0

Source: Survey 2, 2009.

To test the relationship between farmers' awareness and willingness regarding the use of certified veterinary drugs, a cross-tabulation analysis is applied (H0: there is no relationship between farmers' awareness that certified drugs are better than non-certified drugs and farmers' willingness to use certified veterinary drugs for fish disease treatment). The testing results reveal that, concerning independent farmers, the null hypothesis is not rejected (see appendix 10.16), that is, no relationship exists between awareness of certified veterinary drugs and willingness to use them.

However, the test result for the null hypothesis is rejected at the significant level of 1% concerning FA members. In other words, a relationship does exsit between awareness of applying and willingness to apply certified veterinary drugs. The results show that 75.0% of FA members are aware that certified veterinary drugs are of better quality than non-certified drugs, and thus they are willing to use certified drugs only. In addition, 80.0% of the FA members are willing to use certified veterinary drugs. This finding is consistent with the previous finding that FA members receive more training in veterinary drug usage to treat fish diseases than independent farmers.

To conclude, about half of the farmers questioned are aware of the importance of using legal chemicals/ veterinary drugs for fish disease prevention and treatment. This result implies that a large group of farmers is still not yet convinced that the use of recommended drugs leads to the best outcome. The challenges that small-scale encounter are access to certified veterinary drugs and proper disease treatment based on laboratory diagnosis. We found that small-scale farmers lack records of brand names and application protocol of antibiotics and chemicals/ veterinary drugs used. Most farmers are willing to cooperate to share knowledge in disease treatment.

Section 10.4.5 presents small-scale farmers' behavior toward the package of an advanced production system.

10.4.5 Advanced production system

As analyzed in section 10.2.2, small-scale farmers can receive better profits and market access by adopting the whole package of an advanced production system. This section identifies which factors in the advanced production system may influence small-scale farmers' acceptance of it. The survey results (2009) reveal that a large number of farmers see themselves as capable of operating the whole package of an advanced production system (30% of independent farmers and 60% of FA members) (table 10.17).

Table 10.17 Assessment of advanced production system

Farmers		Capability of operating an advanced system (%)
Independent farmers	Yes	30.0
(N=50)	No	50.0
	No opinion	20.0
FA members	Yes	60.0
(N=50)	No	30.0
	No opinion	10.0

Source: Survey 2, 2009

For the farmers who are not capable (be in line with the table) of adopting this advanced production system, the survey results indicate that among the items of the advanced production system, the waste-water treatment pond is the largest obstacle preventing the Pangasius farmers from applying this new system (72.5%), followed by the certified fingerlings (62.5%), certified industrial feed (50.0%), and a lower stocking density (42.5%). The use of certified veterinary drugs is considered the slightest constraint (32.5%) (table 10.18). The reasons for not being able to apply this advanced production system are already discussed in sections 10.3.1–10.3.4. These results are used to generate feasible solutions that are expected to help the smallholders overcome the existing obstacles to adopt the advanced production system. These feasible solutions are to discussed in section 11.3 – 11.6.

Table 10.18 Ranking of unattainable farming practices

Farmers		Unattainable farming practice (%)				
		Certified fingerlings	Lower stocking density	Certified industrial feed	Waste-water treatment pond	Certified veterinary drugs
Independent	%	60.0	40.0	48.0	72.0	32.0
farmers (N=25)	Ranking	II	IV	III	I	V
FA members	%	66.7	46.7	53.3	73.3	33.0
(N=15)	Ranking	II	IV	III	I	V
Total (N=40)	%	62.5	42.5	50.0	72.5	32.5
	Ranking	II	IV	III	I	V

Source: Survey 2, 2009.

Generally, transformation of traditional practices into advanced system often brings about difficulties with traditional fish farmers in the initial stages due to their traditional ways of thinking. Therefore, it is important to point out solutions to change their perceptions toward advanced technology to enable them to understand the principles and benefits of an advanced system practice. Such changes are only made through good demonstration of the advantages of the advanced systems and information sharing mechanisms. This process must be facilitated by the public service systems supported by the government.

10.5 Conclusion

The aim of this chapter is to analyze the farmers' awareness of the positive effects of improved farming techniques and farmers' willingness to invest in the advanced production system. The analysis shows some differences in quality control at the farm level between FA members and individual farmers. These differences are certified fingerlings, stocking density, certified feeds, waste-water treatment pond, and certified veterinary drugs for disease treatment. Small-scale farmers must implement advanced systems at the farm level to obtain access to the market. The results show that if the advanced system is completely adopted, the performance (profit) of the representative farm improves. The FA members are more willing to adopt the advanced production system, as they aware of the positive effects of improved farming techniques. We observe that the willingness to invest is high among farmers who are aware of the potential improvements. Regarding the package of advanced farming system, the results reveal that small-scale farmers rank the waste-water treatment pond as the most difficult item to attain. Certified fingerlings rank second. Certified industrial feed, a lower stocking density, and certified veterinary drugs rank third, fourth, and fifth respectively. However, many farmers are not aware of, or disagree with, the claimed improvements. This finding implies that there is a need for extension services, but also for improved access to financial means and better quality assurance of industrial feed.