Quality management in the Pangasius export supply chain in Vietnam

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9 Fish Disease Prevention and Treatment Practices at the Farm Level

9.1 Introduction

The aim of this chapter is to analyze fish disease prevention and treatment for Pangasius production at the farm level. In recent years, farming practices have intensified to increase production and maximize profit. It is widely recognized that this intensification is accompanied by an increase of diseases and problems caused by viruses, bacteria, fungi, parasites, and other pathogens. Disease is now the primary constraint to the culture of Pangasius. The cost of disease prevention and treatment is 5 to 5.5% of total production cost (Dung et al., 2008; Hung and Huy, 2005; Khoi et al., 2008). To treat fish diseases, farmers use a variety of antibiotics. The results of the multiple-case study show that most farmers do not know exactly what kind of antibiotics they should use during disease outbreak (Khoi et al., 2008). Moreover, small-scale farmers obtain information about disease treatment and veterinary drug use mainly from friends or drug sellers. In many cases, local veterinary drug suppliers have no knowledge in either aquatic organisms or veterinary drugs (Khoi et al., 2008). As a result, most farms are poorly managed and lack basic knowledge on monitoring, selection, and application of chemicals/veterinary drugs. Farmers usually deal with disease outbreaks with a high dosage of drugs and chemicals and sometimes with non-prescribed drugs. At this present time, the number of antibiotic products commercially available is larger than the number of permitted products for aquaculture (Dung et al., 2008), which leads to more fish diseases or antibiotic resistances.

This chapter first presents the current status of Pangasius diseases and levels of occurrence in Pangasius production. Subsequently, an overview of the recommendations for fish disease prevention and treatment is given. This overview is followed by the observed fish prevention and treatment methods at the farm level. The analysis is based on results of the multiple-case studies[35] in 2007 and the survey in 2008. Finally, conclusions are drawn.

[35] The multiple-case studies are based on Khoi et al. (2008), "Farming system practices of seafood production in Vietnam: the case study of Pangasius small-scale farming in the Mekong River Delta," *ASEAN business Case studies*, Center for ASEAN studies, No. 27, Antwerpen, Belgium.

9.2 Fish diseases and level of occurrence in Pangasius production

Survey results (2008) show eight common diseases in Pangasius farming in the MRD (see table 9.1). The most frequent diseases are (1) bacillary necrotic in Pangasius (BNP), recorded by 63.5% of all farmers; (2) parasite in Pangasius (45.0%); and (3) red spot disease (42%). For other diseases, such as swollen kidney, fungal disease, and intestine damage, APPU members and farmers report a somewhat higher occurrence of the specific disease. However, these diseases are easy to treat and lead to less fish loss. The spread of these diseases has been reduced because of better technical knowledge and more experience of farmers on fish health management.

Table 9.1 Common diseases in Pangasius farming in 2008

Common diseases	Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
BNP	70 (70.0%)	41 (58.6%)	16 (53.3%)	127 (63.5%)
Parasites	37 (37.0%)	36 (51.4%)	17 (56.7%)	90 (45.0%)
Red spot	40 (40.0%)	31 (44.3%)	13 (43.3%)	84 (42.0%)
Jaundice	16 (16.0%)	13 (18.6%)	5 (16.7%)	34 (17.0%)
Pop-eye	8 (8.0%)	6 (8.6%)	2 (6.7%)	16 (8.0%)
Swollen kidney	4 (4.0%)	3 (4.3%)	2 (6.7%)	9 (4.5%)
Fungal	3 (3.0%)	2 (2.9%)	4 (13.3%)	9 (4.5%)
Intestine damage	9 (9.0%)	6 (8.6%)	3 (10.0%)	18 (9.0%)

Source: Survey 1, 2008.

Table 9.2 provides a brief summary of the clinical signs, pathogenesis, and the level of the three most frequent diseases in the MRD.

Table 9.2 Diseases and level of occurrence in Pangasius production

Name of disease	Clinical signs	Cause of infection	Pathogens	Time and conditions for disease outbreak	Treatment and prevention	Level of occurrence
Bacillary Necrosis of Pangasius (BNP)	-swim slowly -pale color -white spot on liver, kidney and spleen	-Edwardsiella ictaluri	Bacteria	-weather change - rainy season -water pollution -fingerling quality - feed quality	Florfenicol[36] Antibiotic Prebiotics Probiotics	Very high
Parasites	- body lesion - fin rot - body white spots	-ichthyophthirius multifiliis -myxosporidia	Parasites	- weather change - some rain some sunshine - high stocking density	Formalin Liming Copper sulphate	High
Red spot disease	haemorrhages on head, mouth, fins -red and swollen vent -yellow ascites -gas in gut	-aeromonas hydro-phila, -aeromonas sobria and -aeromonas caviae	Bacteria	- weather change - fingerlings transportation - water pollution	Liming Salt Formalin after a water change. Antibiotic	High

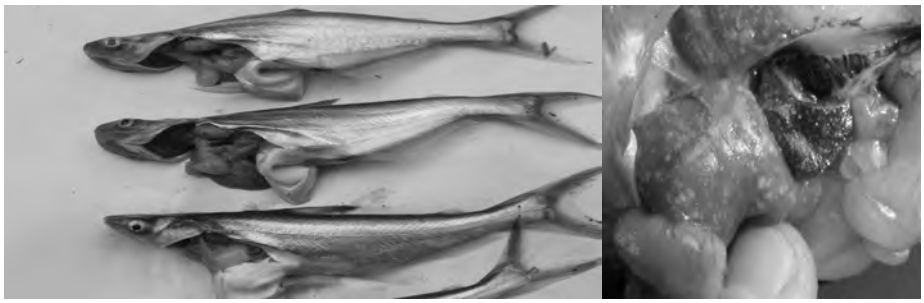
Source: Dung et al., 2008;Van der Braak, 2007; NAFIQAVED, 2007; PAD, 2008.

BNP (white spot internal organs) is a serious Pangasius disease caused by Edwardsiella ictaluri. Edwardsiella ictaluri can survive in pond water for one to two weeks, but up to three to four months in pond mud (Dung et al., 2008). The optimal growth temperature of Edwardsiella ictaluri is 28°C, which is why the disease occurs in the cooler season. This disease affects fish of all ages, although especially fingerlings in partucular seem to be affected. Conditions that favor BNP disease are high stocking densities, environmental pollutants, concurrent health problems, weather changes, moderate water temperatures (22°C-28°C) (Crumlish et al., 2002). Presently, BNP disease is widespread in the MRD and difficult to avoid. The disease is usually fatal, and mortality rates increase rapidly, with up to 60% of the fish lost in an outbreak (Dung et al., 2008). PAD (2008) discussion also showed that treatment of BNP is expensive and less effective. The farmers described the clinical signs as follows: immediately before death, fish swim slowly at the surface of water, the fish colour is pale,

[36] Florfenicol should not be fed to Pangasius for more than 10 days. Florfenicol must be withdrawn from the feed two weeks prior to harvest (Dung et al., 2008).

there are internal white spots on the liver, kidney, and spleen (Khoi et al., 2008). Figure 9.1 shows the BNP disease with internal white spot on fish's liver.

Figure 9.1 BNP disease



Source: Ngoc, 2007

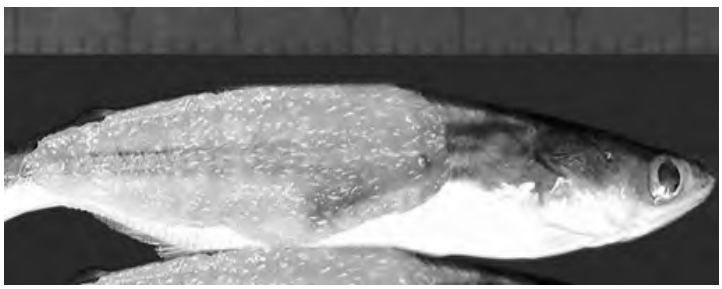
Red spot disease is caused by a group of motile aeromonas septicaemia including aeromonas hydrophila, aeromonas sobria, and aeromonas caviae (Liem et al., 2009). This disease occurs in fingerlings and during the grow-out phase of Pangasius production. Farmers describe the following clinical signs of red spot disease: slow swimming; no food intake; haemorrhages on head, mouth and at base of fins; red and swollen vent;, yellow to pink ascites, and possible gas in gut (figure 9.2). This disease often occurs during the change from the dry to rainy season and during the flood season in MRD (Khoi et al., 2008). Conditions that favor red spot disease are also high stocking densities, environmental pollutants, a large amount of organic mud in the pond (PAD, 2008).

Figure 9.2 Red spot disease

Source: Lien, 2007

Parasite diseases for Pangasius are caused by Trichodina spp and Epistylis spp (Dung et al., 2008). Dung (2008) notes a seasonal incidence of heavy infestations on Pangasius pond farms during the rainy season or in cooler weather. Farmers describe the clinical signs of parasite diseases in the following terms: slow-swimming fish at the water surface; swirling and disoriented fish; lesions, fin rot, haemorrhages, and white spots on fish body (figure 9.3). In addition, diseased fishes have reduced appetite and become very weak. Sporadic outbreaks may occur with a low mortality rate.

Figure 9.3 Parasite diseases



Source: Dung et al., 2008

9.3 Recommendations for fish disease prevention and treatment

Parasites of fish are always present in water and mud. In the aquatic environment, disease agents are ubiquitous and often present as opportunistic pathogens. Van de Braak (2008) explains that in the pond aquaculture, diseases are rarely the result of contact between the fish and a potential pathogen alone. They only invade the fish and cause a disease outbreak when one or more stressors like poor water quality, reduced oxygen level, high stocking density, low quality fingerlings, inadequate feed, etc., are present (Snieszko, 1974). PAD (2008) suggests that chemicals/antibiotics should be used for Pangasius disease prevention/treatment. (Appendix 9.1 shows some suggested chemicals/antibiotics used in fish disease prevention and treatment by fish disease experts.)

To treat bacteria infections, antibiotic agents are widely used in Pangasius aquaculture, both on a preventive and curative basis (Dung et al., 2008; Phuong et al., 2005). The survey results (2008) show that if antibiotics or chemicals are used to treat the fish, but the water quality is not improved or the stocking density is kept too high, the fish soon become infected again. Moreover, if antibiotics or chemicals are not applied properly, the fish may be harmed by residue, negatively impacting the final product quality (VASEP, 2006).

Table 9.3 Suggested guidelines for disease prevention and treatment by fish health management's experts

Fish disease prevention
1. Pond location according to zoning regulations of local authority
2. Sufficient water supply in quality and quantity
3. Fingerling quality
4. Use of high quality industrial feed, protein tested
Fish disease treatment
5. Diagnose fish disease and water quality in laboratory before treatment
6. Proper veterinary drugs for disease treatment: dosage and treatment duration, waiting period for each medicine and responsible use of chemicals and drugs - Salinity for parasites, bacteria - Antibiotics for bacteria - Formalin for parasite - Medication can only be obtained through veterinarian - Veterinarian needs to know the situation on the farm before medication may be given

Source: Adapted from Tan et al., 2004; Van der Braak, 2007; PAD, 2008.

In general, PAD (2008) shows that good aquaculture practices in pond farming limit the spread of diseases. The main practices recommended for the fish farming industry toward disease control are displayed in table 9.3. For the first four issues, these items refer to fish disease prevention. Generally, the fish

disease prevention items are related to four main issues: (1) pond location, (2) water supply, (3) fingerling quality, and (4) feed quality.

(1) The pond location should be in the zoning areas for aquaculture established by local authorities. The aquaculture zoning areas were selected for the future development of Pangasius sectors. Moreover, all Pangasius farms must be registered and controlled by the local authority. Registration of all farms allows a better overview of the existing number of farms and their production levels. Generally, fish ponds should be located near the river.

(2) The most serious threat to Pangasius is poor water quality (PAD, 2008). Logically, pumping water from the river with a high oxygen content is a good way to prevent fish diseases. Better management practices include the incorporation of waste-water treatment ponds in the water outlet designs, and the control of water quality by measuring water parameters such as pH, oxygen, temperature, carbon dioxide, copper, phosphate, etc.

(3) The overall health status of fingerlings is a critical factor for a successful fish production cycle. Hence, the certification of fingerling quality is important for disease traceability. This certificate shows the source of brood stock, quality of fingerlings, chemical and antibiotics used during the rearing of fingerlings, and the laboratory results of fingerlings' health status.

(4) Fish should be fed with a balanced diet and a consistent supply of nutrition free from pathogens (Tan, 2005). Hence, industrial feed is often preferred over home-made feed in terms of quality. Home-made feeds are moisture feeds prepared by cooking various feed ingredients such as rice bran, broken rice, and trash fish. Home-made feed is very unstable and has a low protein content and high FCR (Khoi, 2007). Moreover, waste (uneaten feed) is much higher if home-made feeds are used, which negatively affects pond water quality. The results of Hung and Huy (2005) showed that the average FCR of fish cultured in pond systems ranges from 2.0 to 3.5 if fed with home-made feed and from 1.5 to 1.7 if fed with industrial feed (refer to chapter 8). The nutritional deficiency from an unbalanced home-made feed diet also has an adverse impact on immunity and disease resistance in the fish. Therefore, it is better to purchase feed from big companies with quality certificates.

The last two issues in table 9.3 provide fish disease treatment practices, namely (5) diagnosing diseases in a laboratory and (6) proper veterinary drugs and responsible use of chemicals/veterinary drugs.

(5) To make a diagnosis and recommend treatment, samples of sick fish and water must be collected and analyzed in a lab. This activity takes extra time and

is therefore considered disadvantageous by the small-scale farmers who are accustomed to visually checking for fish disease diagnosis. However, this process is necessary for better disease treatment. Moreover, it is recommended to monitor water oxygen levels before, during, and after treatment; to watch the fish during treatment; and to be prepared to stop treatment immediately if undesirable behaviors are noted (e.g., gasping for air, strange swimming behavior, etc.).

(6) Follow the correct dose and treatment time. Pay close attention to concentration of the active ingredient and adjust the dose accordingly if the chemical is not pure. For safety reasons, always first try the chemical/antibiotic at a given dose and treatment time with a small number of fish. Moreover, application of the regulations on banned chemotherapeutics is used. Maximum residue limits and withdrawal periods should always be considered before harvesting the fish. The veterinarians or drugs sellers need to know the disease situation on the farm before medication is given. Only registered medication is allowed in disease treatment. Furthermore, any chemical, antibiotic or pathogen residuals detected in harvested fish should be traced back to the farm for food safety purposes.

The next section presents the observed fish prevention methods at the farm level.

9.4 Perception regarding fish disease prevention

Prevention of disease is always more cost-effective than treatment (Van de Braak, 2007). Therefore, knowing how the farmers evaluate the elements affecting fish disease prevention is essential. The elements suggested by fish disease experts (table 9.4) are pond location, water supply, fingerlings, and feeds. The farmers were asked to rate these elements from 1 to 5, each variable representing the extent of importance to the farmers (5=very important; 4=important; 3=neutral; 2=not important; and 1=not important at all).

Table 9.4 Farmers' perceptions of fish disease prevention

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Pond location	Mean	3.53*	4.49*	4.30*	3.98
	Std. Deviation	.658	.608	.535	.770
Water supply	Mean	4.23	4.40	4.30	3.91
	Std. Deviation	.679	.679	.498	.656
Fingerling	Mean	3.91*	3.90*	4.27*	3.96
	Std. Deviation	.637	.593	.450	.608
Feed	Mean	4.06*	4.63*	4.60*	4.34
	Std. Deviation	.679	.487	.498	.653

All items are measured by the five-point Likert scale (not important at all to very important)
*: differences between three groups are significant at 1%.
Source: Survey 1, 2008.

The ratings show that feed quality is very important (mean>4) for all groups. APPU members view fingerling quality as (very) important (mean=4.27) for disease prevention. Pond location is the most important factor for FA members. Significant difference was not found among three groups' perceptions of water supply in terms of water supply. All groups perceive water supply as important for fish disease prevention. We can conclude that farmers perceive the importance of the different elements of fish disease prevention. The ratings of the individual farmers are generally somewhat below the average ratings provided by the farmers belonging to the other groups.

9.4.1 Pond location

Regarding pond location for disease prevention, the two variables considered for the survey are local zoning areas and security areas for aquaculture.

The pond must be located near the river and in the appointed aquaculture areas determined by local authorities (expert interview, 2008). The ponds of APPU members in the zoning areas are set by the local authority. Although zoning regulations for aquaculture are rather restrictive, poor implementation of the rules is a major problem that results in high levels of water pollution and fish disease outbreaks (PAD, 2008). APPU members and FA members are more concerned about the importance of local zoning areas for aquaculture than independent farmers with means equalling 4.83 and 4.21, respectively.

Security (table 9.5) means that access to the pond and, in particular, the water, is easily controlled. This issue is relevant in that many complaints occur about

water contamination as a result of the toxic chemical use by neighboring farmers (Khoi et al., 2008). This issue is most important in the perception of APPU members and FA members.

Table 9.5 Farmers' perceptions regarding the importance of the pond location for disease prevention

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Local zoning areas for aquaculture	Mean	3.88*	4.21*	4.83*	4.14
	Std. Deviation	.868	.635	.379	.802
Security areas	Mean	3.82*	4.09*	4.83*	4.07
	Std. Deviation	.936	.830	.379	.903

All items are measured by the five-point Likert scale (not important at all to very important)
*: differences between the three groups are significant at 1%.
Source: Survey 1, 2008

9.4.2 Water supply

The farmers recognize that water quality is (very) important to the fish culture in ponds (mean>4). Therefore, some farmers have basic equipment for checking water quality such as a pH test. Moreover, all farmers recognize the importance of local regulations on waste-water treatment (mean>4). However, independent farmers attach lower importance to the local regulations (mean = 4.06) compared to APPU members and FA members with a mean equal to 4.60 and 4.63, respectively.

Table 8.5 reveals that most independent farmers do not have a waste-water treatment pond at their disposal. APPU members rate water treatment as important (mean=3.93). On the other hand, independent farmers rate water treatment as less important (mean=2.84).

There is no significant difference between the three groups in terms of their perception regarding the importance of frequent fresh water exchange ($p>0.05$). APPU members frequently monitor water quality by parameters supplied by AGIFISH and treat water if necessary. Frequent fresh water exchange is considered beneficial for fish color; however, others claim that a reduction of water exchange lowers pumping costs and reduces the chance of introducing toxic compounds, pathogens, and disease vectors into the pond (expert interview, 2008).

Table 9.6 Farmers' perceptions regarding the importance of the water supply for disease prevention

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Water quality	Mean	4.27*	4.64*	4.10*	4.38
	Std. Deviation	.617	.483	.759	.630
Frequent fresh water exchange	Mean	4.22	4.34	4.27	4.27
	Std. Deviation	.705	.679	.521	.670
Water treatment	Mean	2.84*	3.67*	3.93*	3.30
	Std. Deviation	1.098	.812	.521	1.041
Local regulations of waste-water treatment	Mean	4.06*	4.29*	4.53*	4.21
	Std. Deviation	.679	.486	.507	.615

All items are measured by the five-point Likert scale (not important at all to very important)
*: differences between three groups are significant at 1%.
Source: Survey 1, 2008

9.4.3 Fingerlings

Regarding disease prevention, the three variables considered for the survey are the source of fingerlings (see section 8.3.3), fingerling health, and stocking density (table 9.7).

Table 9.7 Farmers' perceptions regarding the importance of fingerling for disease prevention

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Source of fingerlings	Mean	4.16	4.17	4.10	4.16
	Std. Deviation	1.032	1.035	1.213	1.057
Fingerling health	Mean	4.57***	4.70***	4.83***	4.66
	Std. Deviation	.685	.574	.379	.615
Stocking density	Mean	3.22	3.36	3.40	3.29
	Std. Deviation	1.031	1.155	1.241	1.104

All items are measured by the five-point Likert scale (not important at all to very important)
***: differences between three groups are significant at 10%.
Source: Survey 1, 2008

Fingerling health is perceived as a (very) important factor (mean>4) for all groups. This perception is in line with the observation derived from Survey 1 (2008) that mortality rates of fingerlings are highest within the first month after hatching, ranging up to 80%.

Although we observed that the three groups buy fingerlings from different types of suppliers (table 8.10), the source of fingerlings, as a means to reduce diseases, is (very) important for all groups (table 9.7). This belief shows that all farmers are at least aware of the disease risk involved when sub-standard fingerlings are used.

The stocking density is (very) important for APPU members (mean=4.37), but it is not important for FA members and individual farmers, with means of 3.36 and 3.22, respectively (table 9.7). This result may explain why the stocking densities (table 8.10) are much higher among independent farmers and FA members. Apparently, extension services fail to solve this knowledge gap.

9.4.4 Feed

Regarding disease prevention, the two variables considered for the survey are feed sources, and quality of feed. Feed sources are the kinds of food that farmers use to feed fish. The findings shows that APPU members recognize feed sources as (very) important (mean=4.67), while FA members and independent farmers view them as less important (mean=3.96 and 3.80, respectively) (table 9.7). APPU members buy industrial feed from prestigious feed companies because they recognize that industrial feed reduces fish diseases and environmental pollution via feed residuals (table 8.12). Alternatively, smallholders use trash fish and fish meal to produce home-made feeds, which are not consistent in feed sources and can substantially reduce growth and cause high fat deposition in the visceral area of the fish (section 8.3.4)

The results show that feed quality is perceived as a (very) important factor (mean>4) for disease prevention by all groups. However, a significant difference exists between the three groups. In chapter 8 we noted that the farmers use different types of feed. APPU members purchase the recommended industrial feed and they keep records of feed used for traceability. Moreover, they use feed according to the formula prescribed by the feed company to avoid overfeeding and to assure that most of the feed is consumed by fish. Other groups used home-made feed or a combination of industrial and home-made feed. For home-made feeds, there is no quality control exists because it is produced by the farmers themselves. As a consequence the pond gets more polluted. Moreover, home-made feeds consist of many ingredients such as fish meal, soybean meal, corn, dried fish, meat bone meal, and poultry; therefore, it is difficult to keep records of all ingredients. In addition, home-made feeds are usually result in over-feeding, which causes pollution from residues. As discussed in chapter 8 some farmers assert that they can secure high proteins in home-made feeds (Survey 1, 2008), while other farmers are reluctant to buy industrial feeds, as

they claim that the feed manufacturers add less protein to the feed than the ingredients presented on the bags (section 8.3.4).

Table 9.8 Farmers' perceptions regarding the importance of feeds for disease prevention

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Feed sources	Mean	3.80*	3.96*	4.67*	3.99
	Std. Deviation	.725	.600	.479	.712
Quality of feed	Mean	4.06*	4.30*	4.77*	4.25
	Std. Deviation	.694	.521	.430	.648

All items are measured by the five-point Likert scale (not important at all to very important)
*: differences between three groups are significant at 1%.
Source: Survey 1, 2008

9.5 Fish disease treatment

As presented in table 9.3, the fish disease treatment practices are related to two main issues: diagnosis and treatment of diseases and responsible use of chemicals/veterinary drugs.

9.5.1 Disease diagnosis

Regarding diagnosis for fish disease treatment, the six variables considered for the survey are the farmers' own experiences, neighboring farmers, extension officers, laboratory test, veterinary drug sellers, and university researchers. These categories are all methods that farmers used for fish disease diagnosis (Khoi et al., 2008).

Table 9.9 Farmers' perceptions of diagnosing fish diseases

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Farmers' own experience	Mean	4.64	4.43	3.95	4.26
	Std. Deviation	.628	.525	.504	.663
Neighbouring farmers	Mean	3.81*	3.64*	3.53*	3.71
	Std. Deviation	.419	.483	.507	.466
Extension officers	Mean	3.59*	3.67*	4.40*	3.74
	Std. Deviation	.753	.717	.498	.758
Laboratory test	Mean	3.58*	4.40*	4.73*	4.04
	Std. Deviation	.831	.600	.450	.850
Veterinary drug agents	Mean	4.46*	4.16*	4.67*	4.39
	Std. Deviation	.809	.735	.479	.761
University researchers	Mean	3.08*	3.19*	3.53*	3.19
	Std. Deviation	.631	.839	.507	.709

All items are measured by the five-point Likert scale (not important at all to very important)
*: differences between three groups are significant at 1%.
Source: Survey 1, 2008

The findings show that fish farmers perceive a diagnosis of diseases based on their own experiences as (very) important (mean>4.0) (table 9.9). In fact, they can look at the fish to evaluate which kinds of diseases the fish get (section 9.2). Abnormal behavior and appearance, as well as external clinical sings of fish, are recognized by the farmers as criteria for sickness in fish. Moreover, they find that seeking advice from neighboring farmers as well as from extension officers is important. In addition, veterinary drug agents were also considered good sources of fish disease treatment consultants by all groups (mean>4.0). The university researchers also play an important role in diagnosing fish diseases. Moreover, farmers can call researchers to get the consultancies for diagnosing fish diseases. However, the APPU members usually get free consultations for disease treatment and free fish disease testing at the AGIFISH fishery service centre to ensure proper disease and treatment (section 9.2).

9.5.2 Disease treatment and responsible use of chemicals/veterinary drugs

Regarding fish disease treatment, the four variables considered for the survey are as follows: follow other farmers' advices, follow laboratory staff advice, follow veterinary drugs sellers' advice, and follow aquaculture extension staff advice (table 9.10). These elements are selected from Van der Braak, 2007, and PAD discussion, 2008.

The findings show that APPU members and FA members perceive laboratory staff advice and aquaculture extension staff advice as (very) important (mean>4.0). However, the independent farmers rate these items as significantly less important (mean=2.35 and 2.32, respectively). This occurrence may be related to the fact that independent farmers have greater difficulty getting access to those services. On the other hand, the independent farmers perceive disease treatment advice from other farmers and drug agents as important (mean=3.82 and 3.92, respectively). While APPU members recognize that the farmers' advice for disease treatment is not as important (mean =1.7) as the advice from laboratory staff for proper disease treatment (mean = 4.6).

Table 9.10 Farmers' perceptions regarding the importance of proper disease treatment

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Follow other farmers' advice	Mean	3.82*	3.50*	1.70*	3.58
	Std. Deviation	.796	.654	.466	1.109
Follow laboratory staff advice	Mean	2.35*	4.07*	4.60*	3.29
	Std. Deviation	1.258	.767	.498	1.395
Follow veterinary drug agents' advice	Mean	3.92*	3.56*	4.60*	3.90
	Std. Deviation	.872	1.223	.498	1.024
Follow aquaculture extension staff advice	Mean	2.32*	4.29*	4.80*	3.38
	Std. Deviation	.634	.950	.407	1.302

All items are measured by the five-point Likert scale (not important at all to very important)
*: differences between three groups are significant at 1%.
Source: Survey 1, 2008

To treat fish diseases, farmers usually purchase veterinary drugs from aquaculture drug stores (88.5%). APPU members can buy veterinary drugs at the AGIFISH fishery service centre, where they can get advice from the veterinarian or a fish disease test in the laboratory for free before buying veterinary drugs. Hence, they can detect the fish disease and get proper disease treatment. APPU members also buy veterinary drugs at the aquaculture drug store (table 9.11).

Table 9.11 Sources of veterinary drug purchasing

		Independent farmers (N=100)	FA members (N=70)	APPU members (N=30)	Total (N=200)
Aquaculture drugstore	Frequency	91 (91.0%)	64 (91.4%)	22 (73.3%)	177 (88.5%)
Animal drugstore	Frequency	14 (14.0%)	5 (7.1%)	0 (0.0%)	19 (9.5%)
Usual drugstore	Frequency	5 (5.0%)	3 (4.3%)	0 (0.0%)	8 (4.0%)
AGIFISH fishery service store	Frequency	10 (10.0%)	40 (57.1%)	30 (100.0%)	80 (40.0%)

Source: Survey 1, 2008.

9.6 Conclusions

The main theme of this chapter is the presentation of farmers' perceptions regarding fish disease prevention and treatment at the farm level. We identified the following diseases in Pangasius production: BNP, parasites, and red spot diseases. Results indicate significant differences regarding disease prevention among the perceptions of the three groups of farmers in terms of site selection, water supply, fingerlings, and feeds. APPU members locate ponds in the appointed aquaculture areas as decided by local authorities, while FA members and independent farmers use their private land to build ponds, allowing them to manage fish easily. As a result, it is difficult for the local government to appoint specialization areas for aquaculture due to the fragmentation of farms and inability to properly manage fish disease outbreak.

The APPU members typically use a pH meter to test water quality, as they recognize that water quality ensures that fish stay healthy and grow efficiently. In contrast, independent farmers usually check water quality by looking at water color and water odor, and they adjust the quality of water based on their own experiences. Regarding fingerlings, all groups recognize that the quality of fingerlings directly affects the quality of fish. However, APPU members recognize the better quality of certified fingerlings supplied by state-owned hatcheries, while FA members and independent farmers still purchase fingerlings from private hatcheries or fingerlings traders with whom they have long-term business relationships and therefore trust. Regarding feed, APPU members recognize the good quality of industrial feeds supplied by prestigious companies, and they use feed according to the stable formula prescribed by the feed company to avoid overfeeding and to assure that most of the feed is consumed by fish to prevent fish disease. Alternatively, FA members and independent farmers use both home-made feeds and industrial feeds as they think some feed companies mislead farmers regarding the protein content of the feed.

For disease treatment, the findings show significant differences between the three groups. APPU members treat fish diseases based on laboratory diagnoses. They also keep a record of the name, dates, amounts, and withdrawal times of all chemicals and antibiotics used in Pangasius production. However, FA members usually send the fish disease samples to the aquaculture extension officers to get advice before buying veterinary drugs. Moreover, they keep a list of banned antibiotics at their farms and follow the guide for good farming practices for disease treatment. In contrast, independent farmers have little knowledge of diseases and about the products they are using in terms of composition, appropriate application, withdrawal period and possible consequences. They mostly trust the advice of their friends, the neighbors, or medical sales personnel. Obviously the quality of this last source is questionable because medical sales representatives are not certified and are intent on selling the drugs for their own commission.

In general, we conclude that prevention and treatment are considered important by all farmers. However, some differences are observed: APPU farmers generally rate the importance somewhat higher than independent and FA farmers (local zoning areas for aquaculture, local regulations of waste-water treatment, fingerling health, quality of feed, proper disease treatment following laboratory diagnosis, etc.). An interesting observation is that the three groups of farmers implement different treatments. APPU farmers deal with treatment in line with recommendations of experts. Traditional farmers do it differently. The good news is that farmers are aware of the importance of prevention and proper treatment. The key question now is to know whether they are aware of the proper prevention/treatment techniques and whether they are willing to invest in them. This is the topic of the next chapter.