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Farming system practices of seafood production in Vietnam: the case study of Pangasius small-scale farming in the Mekong River Delta

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List of abbreviations

AFA	Fishery association in An Giang
BRC	British Retail Consortium
CCP	Critical Control Points
CTU	Can Tho University
DARD	Department of Agriculture and Rural Development
EU	European Union
GAP	Good aquaculture practices
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practice
GSO	General Statistical Office of Vietnam
HACCP	Hazard Analysis and Critical Control Points
MOAF	Ministry of Agriculture and Forestry
MOFI	Ministry of Fisheries
MRD	Mekong River Delta, Vietnam
NAFIQAVED	National Fisheries Quality Assurance and Veterinary Directorate
PPC	Provincial People Committee
SQF	Safe Quality Food
SSOP	Sanitation Standard Operation Procedures
SCM	Supply Chain Management
US	United States
VASEP	Vietnam Association of Seafood Exporters and Producers
VBARD	Vietnam Bank for Agriculture and Rural Development
VINAFA	Vietnam Fishery Association
VINAFISH	Vietnam Fishery Society
VCCI	Vietnam Chamber of Commerce and Industry
VND	VN dong (local currency)

Abstract

Pangasius production is rapid expansion in Vietnam seafood industry and it leads to serious problems and significant fluctuations in production outputs. The over-intensification of the Vietnamese Pangasius industry might eventually endanger the industry if nothing is done to tackle the basic of quality control at the farm level.

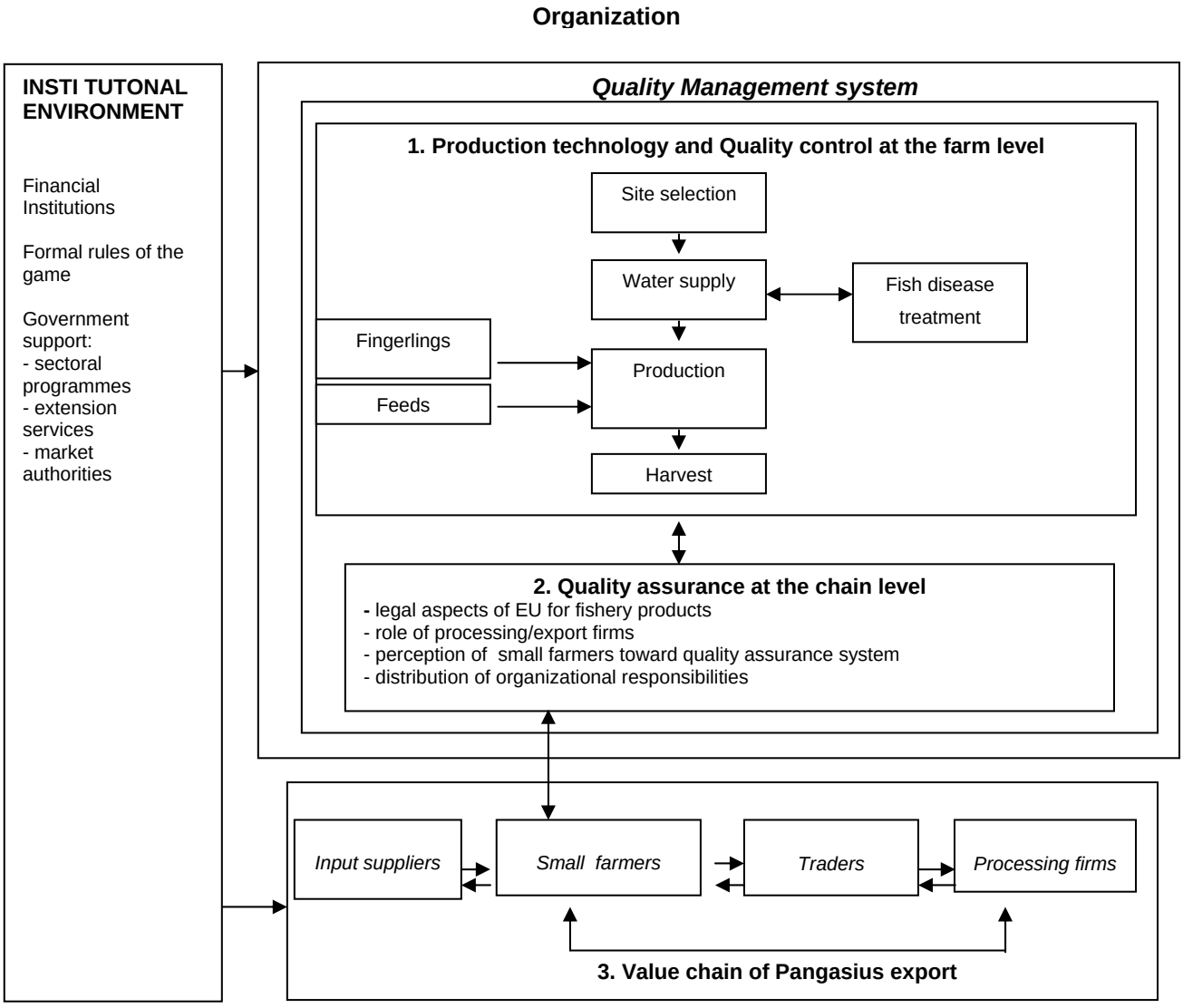
This paper presents the case study results. By conducting a multiple-case study of Pangasius production in the Mekong River Delta, we expect to achieve the primary processes and business relationships at the small-holder level toward better Pangasius value chain quality management.

1. Review of previous pilot study findings

At the beginning of the research, we did a pilot study that concerned an appraisal of stakeholders in the Pangasius industry. This included scrutinizing published works and reports as well as internal memos and survey questionnaires that described the Pangasius value chain in Vietnam (see CAS discussion paper No. 56, 2007). The pilot study allowed us to conclude that quality management in the small-holder export supply chain is a major managerial issue that requires further investigation. In particular the involvement of small-holders and the required quality assurance mechanisms were pressing queries for policy makers and processing firms. The results of this pilot study gave us an insight which suggested that we should focus on these issues, and in particular on the primary processes and business relationships *at the small-holder level*.

After having evaluated this, we developed the *conceptual framework*. Figure 1 shows the quality management model in the fish supply chain. This integrated conceptual framework consists of three key dimensions namely quality control, quality assurance, and business relationships between the chain actors. The arrows reflect the relationship between these dimensions.

Figure 1 : Food quality management model (Reilly and Kaferstein, 1997, Luning et al., 2002, and further moderated by author)



2. Research background

With this conceptual framework, we continued to go on to the second stage of the project. This survey will confirm and establish the conceptual framework that use for our thesis. The second stage started in December 2006 and involved a multi-case study of smallholder fish farming systems. Therefore, we collected information from three sources: an expert interview, a small group of 6 farmers who were tracked for a period of 6 months and a larger group of 20 farmers who were interviewed twice in order to confirm and support information.

Firstly, we conducted the interview with the experts in the Pangasius industry in order to identify the most relevant issues and questions. The interviews were conducted with 22 experts from the three most prominent Pangasius production provinces: Can Tho, An Giang, Dong Thap (appendix 1). The interview consists of open-ended questions and a set of questions in the form of a questionnaire. The findings identified some relevant issues for doing multi-case study of smallholders. The expert interview concluded that there are three models of Pangasius farming: namely pond, cage and net-pen enclosure. In addition, there are eight elements that should be controlled (critical control points) in primary production at small farms namely site selection, design and construction, preparation and cleaning, fingerlings stocking, feeding, water management, fish health management and harvesting.
The current quality assurance systems in Vietnam are HACCP, SQF and GAP. Moreover, VietGAP standards harmonized to the Eurep-GAP and SQF standards are currently being developed (Flavio, Oct.2007). At the moment (2007), the HACCP system is not yet applied in farming primary production due to financial, technological and managerial circumstances. Therefore, promoting farmers' cooperatives, training members in the production of safe and quality fish and strengthening their links to the processing/export firms are the incentives for improved fish safety and quality that meet market demands (Sinh, 2006). Currently, some processing firms can participate in the quality assurance of Pangasius raw materials at farm level, when they invest in a farm. The model APPU (AGIFISH Pangasius Pure Union) was a new model coordinating 5 member groups of the fish value chain, i.e. hatcheries, farmers, feed suppliers, veterinarians, and processors in order to provide consumers with high-quality and traceable products. At the moment (2007), APPU is considered an effective model in re-organizing production, gaining members' commitment and responsibilities to supply foods of high quality and safety; improving the collabouration among members of the Pangasius production chain. The fish farmers of APPU follow SQF 1000 code to get the good quality of fish. Moreover, there are fisheries associations in currently. These organizations are representation of the fish farmers and act as the bridge between the small farmers and the processing firms to help them in terms of productivity, needs of market, and negotiating with banks to increase the loan for the members (Binh, 2006). On the other hand, the informal organizations are formed by farmers themselves on the basis of genuine voluntarism and common interest. These informal organizations are producer groups and fishery clubs that are governed by representative boards and may play a role in improving primary production of Pangasius.

Secondly, a small group of 6 farmers will be interviewed and monitored for a period of 6 months: the length of one production cycle. Every 2 weeks they will be interviewed to discuss the primary

activities. The questionnaire contains questions about the primary activities, the technologies applied, and the business relationships with suppliers and buyers of fish farmers (appendix 3).

Finally, a larger group of 20 farmers (appendix 2) will be interviewed twice, during the same period, in order to verify the information. (The questionnaire is also appendix 3 that used for interviewing small group of 6 farmers). Moreover, the complementary information will be collected from the hatcheries, the processing firms, the traders and farm input suppliers (the questions in appendix 4).

2.1 The basic information of the small-scale farmers participating in the multi-case studies

The case studies will follow the structure of the questionnaire (appendix 3). The case studies put the focus on Pangasius quality control practices, quality assurance and business relations in different small scale farms.

Based on the issues mentioned by fish experts, our cases are to be selected so that they are a representative of other cases. We tried to find at least one case for each of the three Pangasius culture systems, which meant at least three cases. As well as this, we intended to conduct 3 cases in order to cover some of the diversities that exist in Pangasius farming.

There are 6 farms that were conducted for multi- case studies. One pond case represented for applying SQF 1000 model system (quality control system at farm level). One cage case representing a cage farming group. One organic net-pen enclosure case representing the net farming group and organic farming system. One pond case representing the vertically organized cooperation (the owner is the member of APPU). One pond case representing the horizontally organized cooperation (the owner is the member of fishery association). One pond case representing the conventional one (the owner works independently, not being belong to any fisheries association).

The structure of the case study includes 4 parts: history of the farm, quality control at the farm level, quality assurance at the chain level and business relationships between the smallholders and their chain actors. The analysis deals with the critical control points (CCPs) in the Pangasisus farming practices (appendix 5). Table 2 shows the summary of farming practices for the case study.

Table 2: Summary of farming practices for the case study

Characteristics	***Case 1***	***Case 2***	***Case 3 (organic)***	***Case 4***	***Case 5***	***Case 6***
I. General information						
- Province	Thot Not	An Giang	An Giang	An Giang	An Giang	An Giang
- Owner	Mr.A	Mr.B	Mrs. C	Mr. D	Mr. E	Mr. F
- Farming system	Pond	Cage	Pen	Pond	Pond	Pond
- Farming experiences	22 years	10 years	4 years	12 years	20 years	7 years
- Total areas	4200 m^2	280m^3	10200 m^2	5500m^2	9600 m^2	4200 m^2
Distance to water source	96 metes	0 metes	0 metes	100 metes	90 metes	300 metes
- Feed conversion ratio (FCR)	1.5	3.0	1.7	1.5	2.3	2.7
- Harvest size	800 gr- 1,2 kg	1 kg – 1,2 kg	800 gr- 1 kg	900 gr – 1,2 kg	800 gr- 1 kg	800 gr- 1 kg
- Total harvest	64 tonnes	38 tonnes	100 tonnes	176 tonnes	200 tonnes	45 tonnes
- Market purpose	Export (60% grade 1* 30% grade 2** 10% grade 3***)	Export (10% grade 1 70% grade 2 20% grade 3)	Export 100% organic standard	Export (70% grade 1 20% grade 2 10% grade 3)	Export (40% grade 1 50% grade 2 10% grade 3)	Export (15% grade 1 40% grade 2 45% grade 3)
- Production cycle (months)	6	7	7	6	6	6
II. Quality control at farm level						
*- *Site selection*	Family land	On the river	On the river Land rented from local authorities	Family land	Family land	Family land
**Design and construction pond/cage/pen*	- sediment pond - main pond	- cage	- pen - sediment pond - fingerlings pond	- sediment pond - main pond	pond	pond
* *Preparation and cleaning pond/cage/pen*	- Remove sediment/mud - Add lime - Leave to dry - pump water	- Periodically cleaning the cages - checking the anchor - get mud out of cage bottom - Add lime	- Cleaning embankments, filters and net barriers. - regular check and repair net barriers	- cut grass and clean pond - drain water, remove black organic sediments - add lime	- cut branches of trees over pond - drain water - add lime	- cut branches of trees over pond - drain water - add lime
* *Water supply*	Pumping water	River water	River water	Pumping water	Pumping water	Pumping water

- Water treatment	- Exchange water frequently - Chemical treatment - pH test - Liming - Settling pond	Liming	Liming	- exchange water everyday 30% water volume - pH test - record water level	- exchange water everyday 40% water volume - liming - chemical treatment	- exchange water 4days/week - liming - chemical treatment
* *Fingerlings and fingerlings stocking*						
- Source of fingerlings	Nursery	Nursery	Hatchery	Hatchery	Nursery	Nursery
- Stocking size (cm)	2,0 cm	2,5 cm	2,5 cm	2,0 cm	1,5 cm	2,0 cm
- Stocking number	70,000 fishes	70,000 fishes	408,000 fishes	200,000 fishes	240,000 fishes	84,000 fishes
- Stocking density (fish/m^2 or fish/m^3)	17 fish/m^2	100 fish/m^3	10 fish/m^3	36 fish/m^2	25 fish/m^2	25 fish/m^2
- Survival rate (%)	70%	54%	40%	80%	70%	63%
* *Feeds and feeding*	Industrial feeds	Industrial + home-made feeds	Industrial feeds	Industrial feeds	Industrial + home-made feeds	Industrial + home-made feeds
* *Fish health management*						
- Main diseases	- Baccillary necrosis - Haemorragic - Pop-eye - Jaundice	- Baccillary necrosis - White spot - Red spot	- Motile Aeromonad Septicaemia - White spot - Red spot	- Baccillary necrosis - Pop-eye - White spot - Red spot	- Pop-eye - White spot - Red spot	- Pop-eye - White spot - Red spot
- Fish treatment	- Decreasing feeding rate - Antibiotics - Formalin	- Decreasing feeding rate - Antibiotics	Remove dead fishes only	- Density reduction - Antibiotics - Formalin	- Decreasing feeding rate - Antibiotics	- Decreasing feeding ra - Antibiotics
* Written record	- Input materials - Fish disease symptom	Feeds cost only	Record all items for traceability	- Input materials - Fish disease symptom	Feeds cost only	Feeds cost only
* Needed capital	- farm capital - Banking loan (interest rate 1.02%/month)	- Farm capital - Informal loan (interest rate 3%/month)	- 50% farm capital - 50% Binca's investment(interest rate 0.8%/month)	- 70% farm capital - 30% AGIFISH's investment(interest rate 1 %/month	- Farm capital - Fishery association's loan	- Farm capital - relatives' loan
* role of local authorities	- training -investing and guiding SQF standards	- rules and regulations for fish safety	- leasing land - security area	- training - workshops and reading materials	- training - production organizations	- inspecting the implementation of fishe regulations
III. Quality assurance at the chain level						
- Quality assurance system	SQF	No	Organic	SQF	No	No

	No certificate		Naturland certificate	Certificate organized by AGIFISH		
- role of processing firm	Encouraging to implement SQF model	No	- Checking primary activities	Organizing quality production	Signing contract through fishery association	Signing contract depending on fish quali
- role of small farmers	Quality control following SQF standard	Quality control based on experiences	Quality control under supervision of Binca staffs	Quality control under supervision of AGIFISH staffs	Quality control based on experiences and cooperation with other members	Quality control based o experiences
- perception and behaviour	High quality and maximization export fish	Improving technological production to reduce production cost	Fish quality and traceability	Collective actions toward good quality of fish	Collective actions toward good quality of fish	Improving technologica production to reduce production cost
- role of government and market authorities	Set up the Vietnamese standards of good practices	Set up the Vietnamese standards of good practices	Set up the Vietnamese standards of good practices	Set up the Vietnamese standards of good practices	Set up the Vietnamese standards of good practices	Set up the Vietnamese standards of good practices
IV. Business relationships at small-holder level						
Farmers - farmers	- Price information - fish disease management - production techniques	- Price information	No	APPU members	Fisheries association of AG	Price information sharin
Farmers – input suppliers	- trust - product quality - price - reliability	- trust - price - delivery time	Binca bought input materials	Input suppliers are APPU members	- trust - product quality - reliability	- trust - price
Farmer - traders	No	- trust and commitments - price negotiation - payment condition	No	No	No	No
Farmers – processing firms	- trust and commitment - price negotiation - payment condition	No	Binca bought all fishes	AGIFISH bought all fishes	- signing contract before harvesting - price negotiation	- trust - price negotiation

Source: Case study result (Khoi, 2007)

Note:
* Grade 1: While and light pink color: highest demand in Europe and USA
** Grade 2: Light cream yellow: high demand in Eastern Europe
*** Grade 3: Yellow: high demand in Asia

2.2 The case study of Pangasius small-scale farming practices

2.2.1 Case 1: Mr. A's pond farming

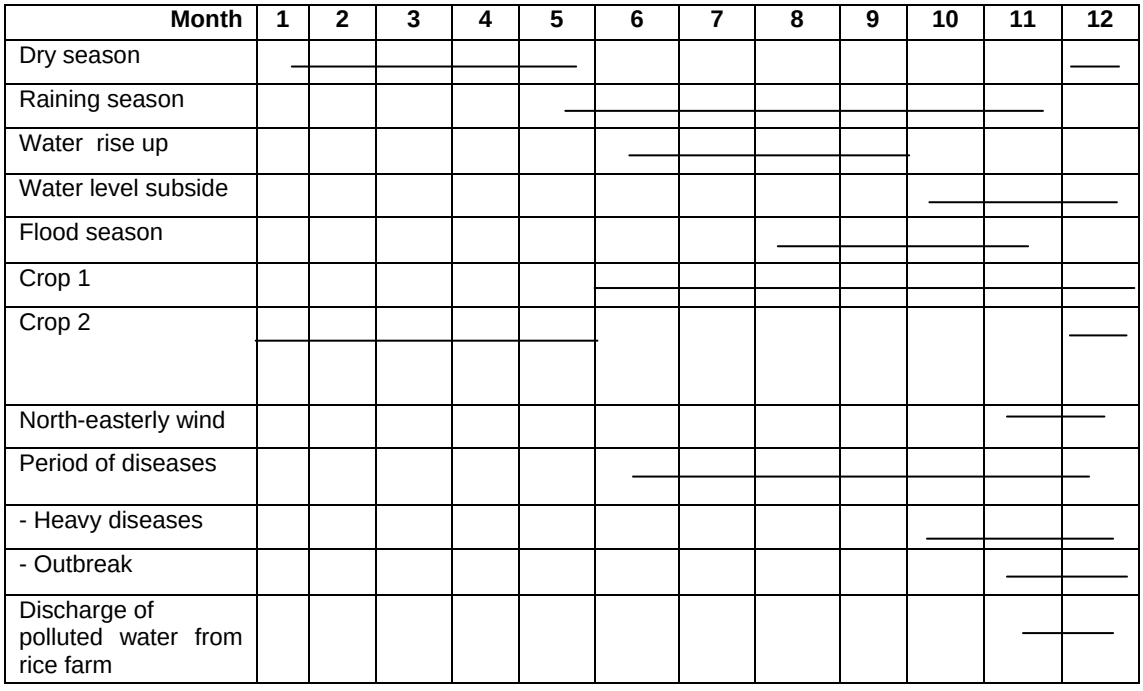
a. History of the farm

Mr. A was born in Thoi Thuan village, Thot Not province, Can Tho city and he is fifty six years old. He has secondary school education and has a wife, three sons, and one daughter. In the past, he raised duck but he get loss by bird–flu diseases. He soon recognized the development of Pangasius culture in his local area. In the early stages, he gained experience in Pangasius culture by learning from his neighbours and started engaging in Pangasius production in 2000. This doing by learning technique led to Mr. A increasing his farming knowledge. In addition, he attended some training courses for Pangasius aquaculture, given by the technical staff of Can Tho University. He also exchanged knowledge and experience with other farmers through networking, coordinated by the Thot Not Aquaculture department. Hence, he can gain new technology in order to increase yield and quality of Pangasius.

Currently, he is a member of the part time staff of the Thot Not Aquaculture department. This work enables him to participate in fishery training classes and enhances his techniques for fish culture. In 2001 he borrowed VND 100 million from the Bank of Agriculture and Rural Development (BARD) with an interest rate of 1% per month in order to invest in fish culture. However, it was not enough to maintain the pond and buy fingerlings and feeds. He also borrowed money from an informal organization with higher interest (around 3% per month) when he needed more capital.

He recently (2006), borrowed 150 million VND from the BARD with interest rate 1,03% per month. If he can yield a higher amount of fish, Mr. A will stop borrowing money from the bank and invest in his pond by himself.

Season calendar of Pangasius production of Mr. A's farm



Mr. A said that there may be a relationship between the weather in locally and the occurrence of diseases. The dry season October to April/May give the best white meat of Pangasius. The rainy season May-October gives a lower quality with more yellow fillets. Especially the flooding season August-September gives a low quality product. Moreover, the sowing of rice in mid-November cause's water pollution and the pesticides are applied to the land that lead to the diseases of fish.

b. Primary activities at the farm level

1) Site selection

When we conducted the case, the pond already existed. The pond is located in the specializing of Pangasius areas that decided upon by the local authorities. In my observation, this location is suitable for Pangasius production because it is along the Hau River and has many canals and creeks. This pond is belonged to the land that Mr. A has property right. That means Mr. A can use his own land to culture Pangasius. Moreover, the pond is located in the security area for aquaculture meaning no strangers can get inside (since there are many cases of destroying whole fish ponds, after only one night by using toxic chemicals). The security of the culture area is an important factor to be considered for fish culture.

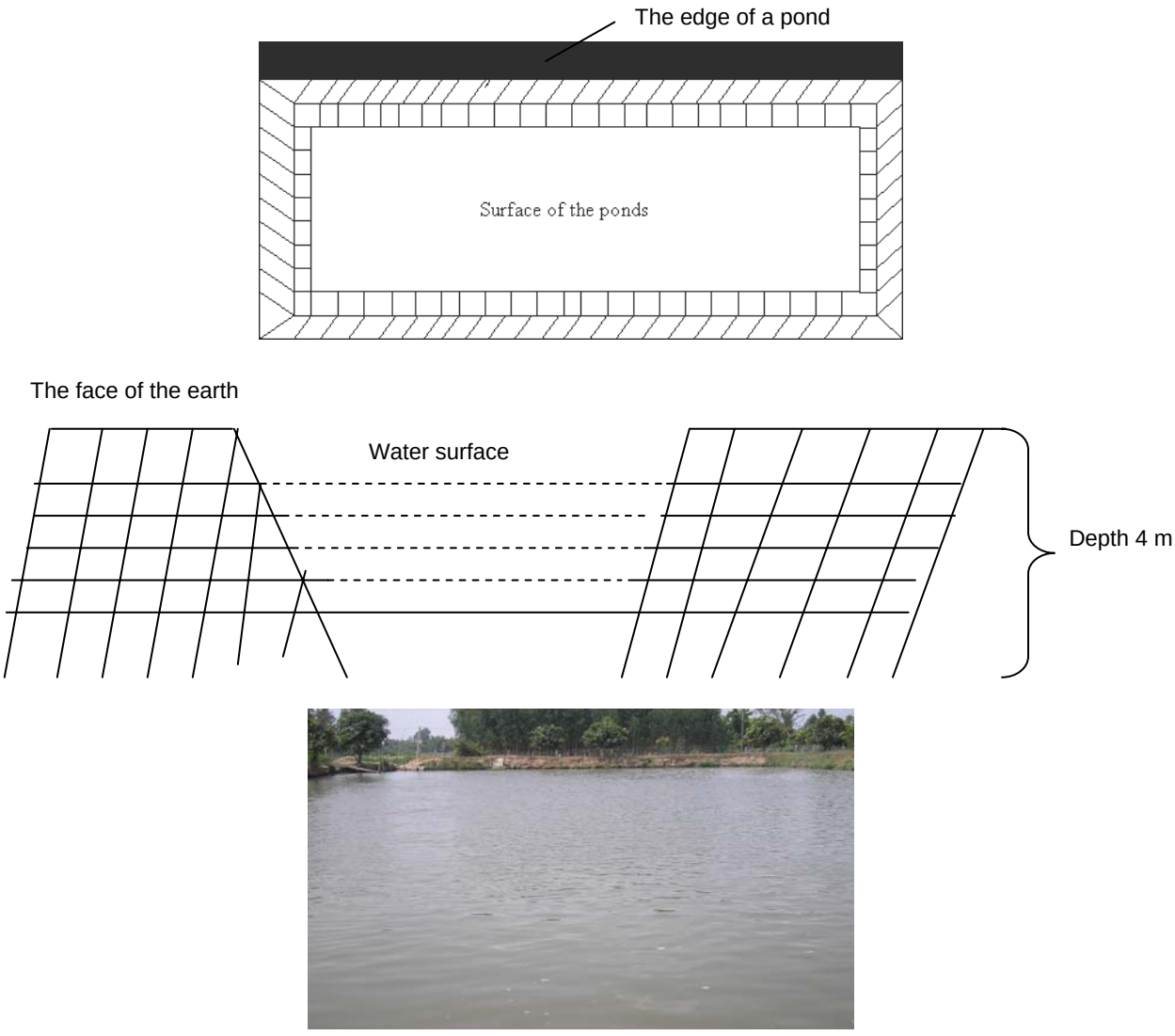
The distance between his pond and water source is 96 meters. This is a reasonable distance to get fresh water from the river. In his experiences, site the pond away from existing large trees to avoid root problems and minimize the problem of leaves falling in, decaying and causing poor water quality. Also, it should not be sited in the full sun (can overheat on hot days), but in a semi shaded location with good light, yet protected from the hot mid afternoon sun. He also mentioned that the selection of pond sites, where there is easy access to a water supply source is one of the most important considerations. The water source provides enough water for the pond through out the growing period.

In my observation, his pond is located in the right place. The pond is not to close to another neighbour farm where there is intensive use of pesticides and other chemicals. If the water exchange was polluted, it would affect the health of the fish and they would be weak and more vulnerable to infection. In addition, the pond is also located nearly the hatchery (about 5 km). Hence, it is easier for transporting fingerlings from the hatchery to the farm in a good quality condition.

Design and construction pond

The pond area is 60m (width) x 70 m (length) with 4 meters depth. The area of Mr. A's pond is easily to manage. The design and construction of the pond may look easy, but it is really a very time consuming and complicated process, which Mr. A himself mentioned. He had to hire two skilled and experienced engineers to construct the best farm for a given site. Earth removed to create the pond, was used to build dykes around the pond or put on the land. Inlet water pipeline was built to take water from outside water bodies into the pond. (See the figure of across of the Mr. A's pond)

Figure 1: Mr. A's pond



Preparation and cleaning pond

Mr. A said that after harvesting, the mud-covered bottom of pond should be cleaned, leveled and dried. Then, lime should be added to the pond at a rate of 300-500 kg per ha in order to adjust pH and kill bacteria that affect to fish quality. He followed the guideline of Pangasius culture book (source: the Aquaculture technique of fresh water fish, Bayer Vietnam). The pond was filled to a depth of 20-30 cm through screens or filter to prevent the entry of predators: the fingerlings should be stocked the following day. Moreover, I observed that Mr. A and his labourers cut grass and cleaned the pond dikes; drained water and removed black organic sediments, using rotenone (derris root) at a ratio of 3g/m2 of pond surface area to eradicate unwanted aquatic animals, then sundry these for three days. Moreover, during Pangasius culturing process, pond mud was removed 6 times (once a month) in order to reduce toxic substances that could affect the health and quality of the fish.

2) Water supply

Mr. A mentioned good water management is the important factor that affects the health of the fish and decreases the risk of loss During the Pangasius production process, uneaten feed, and excrements

have polluted the pond water, which could bring about diseases. To cope with this problem, Mr. A used pumps to drain off wastewater and pump river water into his ponds. Moreover, he changed pond water daily, the reasons given were that he wanted his pond water to be clean so that his fish could be healthy and have a good appearance (white meat) when selling. In addition, he frequently checked the water quality by carrying out pH tests.

In my observation, wastewater exchanging practice in the Pangasius culture areas was polluting local water bodies and causing nuisances to local people, as it reduced their clean water supply, aggravated shortage of clean water in the dry seasons, decreased their in-stream use as swimming and bathing, and lowered environmental aesthetics. Therefore, local governments were struggling with this problem in order to find a sustainable solution.

Building settling ponds is one of the immediate measures that local agencies asked fish farmers to do. Therefore, Mr. A also built settling pond for water treatment. This is one of the requirements of SQF model. However, in my observation, Mr. A used the settling pond for water treatment as well as culturing the fingerlings. In this case he was not using the settling pond properly. Moreover, most of fish farmers in this area do not build one. The main reason for not building settling pond in accordance with local regulations was lack of land. As well as this, land price is high, so many fish farmers could not afford to purchase more land.

To treat wastewater effectively, wastewater must stay in the settling pond 10 hours in order for pollutants in it to be decomposed before being released to the environment, but due to fish farmers' changing a bulk of water almost everyday, this measure alone cannot meet wastewater treatment requirements.

3) Production/growth

Fingerlings and fingerlings stocking

The source of fingerlings is an important factor that affects directly to Industrial fish. Mr. A used to buy fingerlings' (size of 2 cm height) from the private hatchery. The owner of this hatchery is Mr. Dan. Mr. Dan is also the chief of the Thot Not Aquaculture department. The reason Mr. A bought fingerlings at this hatchery is because he trusted Mr. Dan, who has a lot of experience in nursing fingerlings (more details in part D). Mr. A usually selects healthy fingerlings which have no evident lesions or swollen abdomen; they swim quickly and disperse throughout the nursing pond. After purchasing fingerlings from Mr.Dan's hatchery, he transports the fingerlings carefully back to the farm. Through his experience, he knows that salt should be added to the water in the transport bag at a measurement of 0,1-0,5% by weight in order to increase the level of sodium and chloride ions and so reduce the stress of the fish. Moreover, the stocking density of fingerlings in the transport bags should not be too high. He mentioned that the fingerlings re best released in June or the end of December.

In these months the weather is good for the stocking of fingerlings. He stocked fish at low density with an average of 17 fingerlings/m^2. In this season, he released 70,000 fingerlings in the pond area which comprised 4200 m^2. He mentioned that before releasing the fingerlings into the pond, he had to ensure that the water temperature in the bag was the same as in the pond. Normally, he floats the bag

in the pond for 30 minutes and the pond water then gradually integrates with the water in bag. The fingerlings swim out of the bag by themselves. In addition, the bag needed to be left open for a long time prior to release as the oxygen levels would rapidly decrease due to the density of fingerlings. In his experiences, the best time to release the fingerlings was either in the morning or in the evening as the air is then cooler. The reason behind this is that the fingerlings cannot adjust to such a large temperature difference in the water, therefore experiencing a shock.

The following day, when releasing the fingerlings, Mr. A will spray formalin all over the pond in order to remove parasites which may be carried by the fingerlings. He believed that the low density of fingerlings would help to keep fish disease at a minimum level.

Every morning, he looks at the clinical signs of the fingerlings. If the fingerlings float vertically at the waters surface and have pale gills, they are diseased. One time, I observed that the fingerlings swam in a swirling motion and I witnessed that their bodies produced a white, cloudy mucous. According to Mr. A, when the first signs of disease appear, he treats the fingerlings with formalin and continues to use this treatment for 2 days. During the treatment, feeds are reduced to the half the normal amount. After formalin treatment, the mortality rate should be reduced and the fingerlings should recover within 3 to 5 days. He also mentioned that without proper treatment, more fingerlings will die every day, and if the disease is acute, the fingerlings in the pond will all die within 3-5 days.

Mr. A monitored and recorded daily mortality and the disease status of the Pangasius. This helps him to give insight in the epidemiology of diseases and take early action in the case of disease outbreak. Mr. A usually calls the extension officers of Thot Not Aquaculture department when finding diseased fish. Then, the officers go to his farm immediately to check the symptoms and give him advice. After this process, he can go to the veterinary services to buy prescription drugs based on the advice.

Feeds and feeding

Mr. A fed the Pangasius fish 2 times/day. Fish feeding hours are usually from 11:00-12:00 a.m. and from 4:00-5:00 p.m. In my observation, he fed the fishes at the same time every day. The feed quantity varied according to Pangasius body weight or was adjusted based on the quantity eaten the previous day. According to him, the Pangaisus will eat less when it rains for a few days consecutively or if the weather is cloudy and overcast. In this case, he cut down the amount of feed given to the fish and gradually increased it again to a normal rate when the weather stabilised. Mr. A used Industrial feed produced by feed companies with brand names such as Proconco. This feed can float on the water for a while so it does not pollute the water much and is used effectively. In addition, he often mixes vitamin C, Sorbitol, Enzyme, and mineral premix into feed in order to strengthen the fish's health.

Fish health (disease) management

Mr. A mentioned that he knows which kind of diseases the Pangasius get based on the experience he has. In Pangasius health management, Mr. A used a variety of veterinary drugs to deal with fish diseases. For example, he treated fish with proper veterinary drugs like Vikon A, Vitamin C, formol and

through out the using of the combination with Metadien, Sulfa, Sorbitol in order to prevent fish disease (he recorded them in booklet).

In addition, he often used the method of changing pond water with outside water as a measure to reduce water pollution in ponds as well as to prevent fish diseases. I observed that in the rainy season, he applied lime to the pond. He believed that the lime acted as an antibiotic for the fish.

In short, because Mr. A followed the SQF program for fish culturing, the Aquaculture extension officers usually visited his farm to consult him on how to prevent and treat fish diseases. Normally, the officers would go to Mr. A's farm as he needed consulting on fish growth. Due to this, Mr. A could get the accurate information and more specifically what veterinary drugs he needed, to buy to cure or prevent the fish diseases.

In short, the technological factors of Mr. A's pond:

Factors	Unit
- Volume	16,800 m3
- Length	70m
- Width	60m
- Depth	4m
- Fingerlings	2,0 cm of body length
- Fingerlings releasing	70,000 heads
Density	17 heads/m2
- Feeding	Industrial feeds: 100%
- Culture time	6 months
- Harvesting weight	800 gr – 1,2 kg
- Yield	64 tonnes
- Capacity	15 kg /m2

The production cost per crop of Mr. A's pond as following (details in appendix 8)

Items	Costs (VND)	%
Pond preparation	3,500,000	0.65
Pond treatment	3,000,000	0.55
Fingerlings	35,000,000	6.46
Feeds	460,800,000	85.12
Chemicals/ veterinary drugs	15,000,000	2.77
Salary of the workers	8,400,000	1.55
Fuel	6,400,000	1.18
Harvesting	5,000,000	0.92
Operating interest	1,080,000	0.20
Land depreciation	2,000,000	0.37
Fixed assets depreciation per crop	1,000,000	0.18
Other cost (electronic, telephone…)	200,000	0.04
Total variable cost (VND)	541,380,000	100.00
Total production (kg)	64,000	
Production cost per kg of Pangasius (VND)	8,500	
Selling price (June 2007)	15,500	

c. Quality assurance at the chain level

In this case, the company required prerequisite program prior to the implementation of SQF such as Better management practices (BMP). Mr. A recognized the importance of fish quality management at his farm. He attended some training courses and seminars (on average three times per year) in Pangasius culture techniques that were organized by the Thot Not aquaculture extension division. In this culture season, he followed the SQF (safety quality food) program and got positive results in term of Pangasius quality. In this area, there are only two farms which follow the SQF model in order to get high quality Pangasius. The reason there is not premium price for Pangasius products of SQF model. Moreover, in order to culture fish with SQF standards, the farmers have to invest much more than conventional culture i.e. the settling pond, source of fingerlings, industrial feeds that are costly (own survey, 2007).

At this moment (2007), the local authorities encourage fish farmers to apply SQF for food security certificates, which would allow the farmers to export their production. The certificates are issued by a Swiss company (SGS) and indicate that the fish meet ISO export standards. However, Mr. A has not yet got the SQF certificate because of high cost (around 1,000 USD each crop) and the requirements for SQF standard are high. However, he applied a part of the SQF model with the help of the extension staff of the Thot Not agricultural department. Specifically, he had a settling pond, good source of fingerling, feeding Industrial feeds and monitored fish frequently with the help of aqua-extension staffs. He mentioned that he can sell Pangasius more easily and at a higher price due to applying the SQF model in Pangasius production. In feeding fish, he uses Industrial feeds for the whole crop. Mr. A mentioned that the cost of Industrial feeds is higher than home-made feeds but is of a better quality. In his experience, the average feed conversion ratio (FCR) for home-made feed ranges from 2.7 to 3.0 and for Industrial feeds ranges from 1.4 to 1.5. Mr. A also said since he uses Industrial feeds, the rate of fish death is reducing and growth is increasing.

At this time, Mr. A has signed a contract with one company involved in Industrial feed producing. This company has widely helped him with the culture techniques and he has received guide books on feeding, fish disease treatments, and he can delay the payment sometimes. It is good for him to use these companies' products.

d. Business relationships at farm level

1) Co-operation between the fish farmers and intermediate input suppliers

According to Mr. A, the most important intermediate inputs to fish farmers are fingerling producers. He mentioned that the overall health status of fingerlings is a critical factor for a successful production cycle. Mr. A bought fingerlings from Mr. Dan's hatchery. Mr. Dan is also the chief of the Thot Not Aquaculture department. Mr. Dan has a lot of experience in producing fingerlings. He used advanced production techniques in the hatchery (healthy brood-stock, good sanitary practices, quality feed and low application of chemicals and drugs). Mr. A trusts him and he intends to establish and maintain a *long-term business relationship*. This is called competence, trust or knowledge-based trust. Competence trust is based on concrete experience concerning certain behavioural patterns. It results from the dynamic of past and future exchange processes. Mr. A views trusts as very essential for

conducting any kind of business transactions. He trusts the hatchery owner very much that even in case he faces a problem in his pond and he thought the hatchery owner did not show opportunistic behaviour.

In addition, Mr. A signed a contract 6 months (a production cycle) with Industrial feeds producers at this crop. This company will deliver feeds to his farm as he needs them. The feed company has widely promoted the culture techniques to him and he can delay the payment to feeds supplier. This means that the feeds supplier get paid next time they deliver feeds to Mr. A. This is to Mr A's 'credit' advantage, because feed is the most expensive product and makes up the highest percentage in production costs. This is the kind of *commitment* in business relations that Mr A wants.

2) Co-operation among fish farmers (fish associations)

The formation of a fishery association that represents several fish farmers can be considered as a form of co-operation among fish farmers. According to Mr. A, a fishery association was founded in 2002 in Thot Not with a purpose of supporting the fish farmers. He remembered that the idea of forming a co-operative was initiated from the Thot Not Agricultural department and later on the fish farmers were asked by members if they wanted to be beneficiaries. The fishery association established itself by electing their representatives at each fish culture area. The local authorities administered the co-operative. The co-operative started supplying market information, fingerlings sources, and credit to the members. However, in the year 2003, the fish farmers were not able to pay their debt because of the catfish anti-dumping case (America and Vietnam catfish war, 2003) leading to the lower price of Pangasius. Many fish farmers became bankrupt at this time. Moreover, the local authorities could not recover the expenses and at the same time fall short of a budget to run the co-operative. As a result, the local authorities withdrew from running it. They transferred all the responsibilities to the co-operative representatives and asked them to run it as an independent entity. Despite the representatives putting much effort into the co-operative, the fishery association did show any progress and collapsed after one year.

3) Co-operation between farmers and processing firms

According to Mr. A, the relationship between him and the processing firms has been more commonly characterized by informal agreements than by enforceable contracts. They have not included a guarantee that the processing firms will purchase the fish from him. He normally coordinates the amount of fish they will produce with the processor at the beginning of the farming season through a registration process. Prices will be negotiated at the time of harvest and depend on the market situation, fish quality and quantity. At that time the processor will check the fish quality by taking samples (normally from 5 fish). If the colour or size does not match the requirements of the processor the price will be lowered or the fish might even be rejected completely. He also mentioned that during harvesting, if the market price (current price of Pangasius) is high, the processing firms will try to buy fish as soon as possible, because they do not want to delay time to lost profit. If the market price is low, they delay the time to take fish out of pond in many ways such as they said the fish get diseases and needed to treat, not good quality of fish, the size of fish does not meet the requirements, and so on.

e. Conclusion

This is a typical case for applying the SQF model in pond farming. Mr. A is the first farmer who has applied the SQF standard in Thot Not area, Cantho city. However, he applied just a part of SQF model in quality control at the farm level with the help of extension staffs of Thot Not agricultural department. Specifically, he had settling pond, but he also used this pond for fingerlings culture. He bought fingerlings from Mr. Dan's hatchery with good quality of fingerlings as he recognized. However, this is a private hatchery and it is not yet certified by the State in terms of the source of fingerlings. Moreover, one month before harvesting, Mr. A used Dipterex in order to strengthen fish health, but Dipterex is a forbidden antibiotic. In short, the quality control at Mr. A's farm needs to be more strictly controlled.

2.2.2 Case 1: Mr. A's pond farming

a. History of the farm

Mr B said that his family is one of pioneers in cage culture. Previously his family lived in Cambodia but war forced them to go to Vietnam. Mr B's father was a fish merchant in Phnom Penh city, Cambodia and he had the largest number of cages for holding fish. Mr B said that cage aquaculture only began in 1960 with a maximum production of 500 kg for the first farm. Caged production rose to 1.5 tonnes by 1965 and to 12 tonnes by 1967. Mr. B was educated till secondary grade and due to economic problems he could not proceed with his education Since then, he has been involved in fish culture. His father's profession was fish farming and Mr B received the aquaculture knowledge from him. Mr B has one wife, three sons, and two daughters. His daughters are married. The boys are in national service. Presently, Mr B mainly produces Pangasius in his cage. Previous to 2002 was a good time for Pangasius cage culture due to higher prices and it was easier to earn a profit. However, currently the fish farmers are stopping cage culture (since 2004) because of the following reasons:

- Uncontrolled quality of the river water and the occurrence of fish diseases. Quality of water is better during the flood season from July to November, however, it is said to be a problem when rice cultivating farmers begin to grow their crops.
- Wastes from the rice field are drained to the river, and residues from pesticides and fertilizers can cause problems for cage culture.
- Lower selling price of cage Pangasius compared to pond farming although production cost is higher

Mr. B mentioned in the year 1993, he invested 600 million VND to build 2 cages which have a capacity of 100 tonnes each. In the year 2002, he continued to invest 700 millions VND to build one more cage with 150 tonnes capacity. However, this year he made a loss due to the price of Pangasius which went down to 7,000 VND/kg. But in the 2 year (2003–2004), the price was also low and he had to sell the cage that he built in the year 1993 with 30 millions VND each and in order to pay off the debt. Now, in this cage village area, there is only one cage of Mr. B maintain cage farming. Mr. B said that the reason he keeps this farming model because that is the traditional job of his family and he thinks this model will recover soon and he can get better quality of Pangasius instead of using the pond farming technique.

Season calendar of Pangasius production of Hai's farm

Month	1	2	3	4	5	6	7	8	9	10	11	12
Dry season	—	—	—	—	—							
Raining season						—	—	—	—	—	—	—
Water rise up						—	—	—	—			
Water level sub-side										—	—	—
Flood season								—	—	—	—	—
Crop 1					—	—	—	—	—	—	—	—
Crop 2	—	—	—	—	—	—	—					
North-easterly wind											—	—
Period of diseases						—	—	—	—	—	—	—
- Heavy diseases									—	—	—	—
- Outbreak											—	—

Mr. B mentioned cage culture of Pangasius can be started all year around depending on when the marketable fish in the cage is sold to empty the cage for new stocking. However, there are two main periods of stocking Pangasius. That is in May and January which is when there is good weather.

b. Primary activities at the farm level

1) Site selection

When we conducted the case, the cage was already there. According to Mr.B, the cage site selection in the specializing of Pangasius areas is decided by local authorities. He mentioned cage cultures need the permission of Department of fisheries and he would have to register to get the license. The registering procedure for getting permission to cage culture includes: Mr. B having to show his financial condition in which he needs to be able to cover the cage construction costs, he must understand the rules of cage culture (Decision of 28 TCN 192:2004), and he must not engage in activities which would pollute the environment. Then, the aquaculture department staff will inform him of the rights and obligations for cage culture. Mr. Hai also related some factors to consider for cage site selection that I also observed, such as at least 1/2 acre or more in surface area; at least 3.5 m depth of water must be below the bottom of the cage, this allows waste to be flushed away from the cage; locating the cage in the river where it is exposed to prevailing winds, will provide overall mixing and aeration; locating the cage where it will have maximum available water movement; it will be convenient for feeding and checking the fish diseases symptom. Moreover, the cage should be located in areas where it can not be contaminated with runoff containing high levels of pesticides or large amounts of livestock wastes.

In short, the water movement, water quality, convenient transportation for getting feeds, veterinary drugs and suitable distance between cages are the important factors in order to select the right cage site, Mr. B mentioned.

Figure 2 : Mr. B's cage

Design and construction cage

Mr. B mentioned that the cage design and construction combine a series of factors such as shape of cage, financial condition, properties, availability of materials and local skills. The cage design and construction of Mr. B will be based mostly on investment capacity, skills and experience in fish culture and constructional material availability. He suggested that the construction of new cage now has faced to the shortage of wood supply due to the over exploitation of forest and the increase of wood demand for housing.

In my observation, Mr. B's cage is rather big sizing 14m long x 5m wide x 4m deep. The cage consists of a strong wooden frame functioning as a foundation to make sure the cage will not be deformed by the water current and time of use. The wall of the cage is covered by species of rectangular plank placed without spacing in the outer part and by a smooth mica sheet to avoid Pangasius to be disturbed by water flow and to move continuously leading to loose energy and refusing eating as well as to be body injury. The two front sides of the cage are installed a stainless steel net. Moreover, wooden sheets contain 5 openings for feeding and harvesting the fish also cover the surface of fish cage. In addition, a complex system of this cage that considered as supporting devices for Pangasius culture includes (i) engine for water pushing during low water current period (ii) motorized boat for local transportation of owner, feed ingredients, combusting materials, and water pushing (iii) feed cooking machine

During the discussion, the factor "financial condition" was considered as important one because of high costs for construction cages. Mr. A said that the cage can use about 10 years and damage later, but if the farmers bough land for digging pond, they still have land and the price of land can be increase yearly. Next, the river water quality was concerned and Mr. B said that it affected directly to the health of fish and quality.

Preparation and cleaning of cage

Mr. B mentioned before releasing fingerlings, he and his son clean the cage carefully**.** He paid much attention to all the angle of cage in order to kill bacteria that make the diseases for fish. He also checks the anchor frequently in order to avoid the anchor breaking especially in the flooding season. Moreover, in the flooding season, there is a lot alluvium in the bottom of cage, he has to use pumping machine to get mud out of the cage bottom. Every week, he usually dives around cage for checking such as mud-guard net, removing garbage, and amending the cage's damages. In the raining season,

he used a bag of lime and hanging at a suitable place. He believed that the lime acts as an antibiotic for the fish. These activities are hard and take time to do comparing to pond cleaning and preparation.

2) Water supply

In this case, Mr. B mentioned water quality management is a key ingredient in a successful fish operation. He recognized that the water environment of the cage sites depends upon the season change of the water flow of the main stream and of the flooding season in the Mekong river. During the rainy season, the cage received strong water flow from the upstream which carried high suspended organic matters. While during the dry season, the water level reduces and water turbidity is high. The increase of pollutants at the beginning of rainy season as a result of the discharge from land environment to river by overflow of water is also considerable issue for Pangasius cage culture.

He considered that most periods of poor growth, less eating, disease and parasite outbreaks, and fish loss can be traced to water quality problems. The quality of water supply is the important factor. In cage culture situations low dissolved oxygen is particularly acute because the fish are crowded into such small areas. Most fish kills, disease outbreaks and poor growth in cage situations are directly or indirectly due to low dissolved oxygen. In his experiences, the fish diseases occur during cold rains, heavy winds and the weather changing suddenly.

3. Production/growth

Fingerlings and fingerling stocking

Mr. B mentioned that fingerlings quality is the important factor that affects directly to quality of Industrial fish. Mr. B tended to select the prestige nursery that guarantees for quality of fingerlings and he had long-term relations in the past seasons. Currently, he bought fingerlings in Dong Thap province and he himself went to the nursery to select fingerlings. Mr. B selected the fingerlings that have same size and 12-15 fingerlings are one kg totally in order to avoid big fishes eating all feeds while the small fishes still hungry, that leading to the size of fishes is difference in harvesting**.** Mr. B usually checks visually the quality of fingerlings 2-3 times before buying them. He expressed healthy fingerlings have a bright color they do not have any body deformation or injuries fins. He said that without checking fishes, the fish get diseases easily because of changing culture environment from nursing pond to cage. Before releasing the fingerlings into cage, he makes a salt-bath in order to get rid out parasite from the body of fishes. Now, the local rules encourage the farmers to buy fingerlings from the hatcheries with quality certificate from the local aquaculture department. However, Mr. B mentioned the fingerlings that produced by state hatchery are not guaranteed quality because they use chemicals/veterinary drugs that are not suitable with cage system. The stocking density of fingerlings in cage is very high with the average density of 100-120 fishes/m^3. The high density of fishes in cage leads to outbreak diseases occurrence, according Mr Hai. The price of fingerlings varies by sizes and seasons. The price of fingerlings is actually established basing on the price of Pangasius at the harvesting season. Hence, it is difficult to forecast the price of fingerlings, Mr. B mentioned.

Feeds and feeding

Mr B used Industrial feeds for the first 2 months and home-made feeds for the last period. He said that home-made feeds were formulated from local ingredients such as agro and fishery by-products. Trash

fish and rice bran were the two main ingredients used in the feeds. The recipes of the feed were differentiated by fish size and seasonal supply of feed ingredients. However, the quality of the nutritional value of the feeds is not enough protein and contains high carbohydrate (expert interview, 2007). The formula Mr. B used for different stages of Pangasius in his cage as following:

Feed formula for cage culture

Feed ingredients	**Culture stage in cage**		
	Starting (the first 2 months)	Growing	Finishing (the last 2 months)
Trash fish		25%	30%
Rice bran		50%	60%
Brewer's grains		25%	10%
Industrial feeds	100%	0	0

According to Mr. B, the advantage of home-made feeds is he can prepare by himself from low cost feed ingredients and collect locally. However, its disadvantage can be analyzed as low and imbalance nutritional values, quality variation, unstable supply of feed ingredients, time consuming, slow fish growth and high fat deposition in fish abdomen, water pollution, etc. He also mentioned the advantage of home-made feeds is that he could prepare it himself with lower cost comparing Industrial feeds and adjust the quantity of feeds according to the fish health situation daily. Mr. B mentioned that feeding frequently is important to improve the feed conversion efficiency and quality of the fish. He fed Pangasius mostly 2 times per day and feeding time 11-11:30 a.m. and from 5-5:30 p.m. In his experience, the improvements in feeds have significantly contributed to increases in growth rate, survival of fishes, and shortening of the culture cycle. In order to explain for using home-made feeds, Mr. B mentioned that materials for making feeds are locally available and cheap. Thus, the cost of Industrial feeds is higher than home-made feeds (average 1 kg of home-made feed is 3,000 VND and 1 kg of Industrial feeds is 5,000 VND). Because of limitation on capital, Mr. B has to select home-made feed for Pagasius production. In addition, he can change the ingredients of homemade feed according to necessity. Feeding is divided into two stages. The first stage uses feed containing a high level of protein and minerals to help fishes gain maximum length. It lasted 2 months. In the second stage (last three months), he usually increases the carbohydrate concentration of home-made feed for fattening fishes before harvest. He expects the fishes to grow heavier (contain more fat) and thus result in higher production. He also mentioned the death rate of fish now is higher comparing last time; it is about 50% comparing 15-20% in the year 1996-1997. He also thought that this time is the collapsing stage of the cage farming because there is more water pollution and lower price of cage fish.

Fish health (disease) management

Mr. B mentioned that he can know which diseases the Pangasius get based on external clinical signs of fish. He also prevents fish diseases by adding more vitamin C and purgative in feeds for fish. He usually use the antibiotic Baytrill 10% combine with Gentamicine and Vitamin C and specialized antibiotic Vime 333 (VMD) combined with Premix. Vitamin C can improve the resistance of the fish. Regarding to the source of veterinary drugs, Mr. B usually discuss with his friends who also culture cage fish the symptom of fish diseases. The friends will show him the information what veterinary

drugs he should buy to cure or prevent the fish diseases and he mainly based on his experiences on the disease symptom in order to treat fish. However, in my observation, Mr. B focused more on treatment than prevention. Irresponsible use of antibiotics and chemicals can lead to residue problems. Due to lack of diagnosis, Mr. B often apply antibiotic treatments when mortality rises, without knowing the cause of the disease and assuming that it is caused by a bacterial pathogen. He even uses antibiotics as a form of "preventative measure", where antibiotics are administered in anticipation of an expected disease outbreak. This has resulted in a heavy use of chemicals and drugs especially for cage culture due to density fingerlings stocking.

The technological factors of Mr. B's cage

Factors	Unit
- Volume	280 m3
- Length	5m
- Width	14m
- Depth	4m
- Fingerlings	2,5 cm of body length
- Density	100 heads/m3
- Feeding	Industrial feeds: 12.5%
	Home-made feeds: 87.5%
- Culture time	7 months
- Harvesting weight	1kg – 1,2 kg
- Yiled	38 tonnes
- Capacity	135 kg/m3

The production cost per crop of Mr. B's cage as following: (details in appendix 8)

Items	Costs (VND)	%
Cage preparation	1,800,000	0.39
Fingerlings	56,000,000	12.08
Feeds	360,000,000	77.63
Chemicals/veterinary drugs	9,920,000	2.14
Salary of the workers	5,600,000	1.21
Fuels	3,040,000	0.66
Harvesting	3,000,000	0.65
Operating interest	21,000,000	4.53
Cage depreciation	2,000,000	0.43
Fixed asset depreciation per crop	1,000,000	0.22
Other cost	400,000	0.09
Total variable cost	463,760,000	100.00
Total production (kg)	38,000	
Production cost per kg of Tra fish	12,204	
Selling price (June, 2007)	14,200	

Source: Survey, 2007

c. Quality assurance at the chain level

Mr. B recognized that quality assurance system is not available in the Pangasius cage. For himself, he tried to improve farming techniques in order to reduce production costs and increase yield. However, there are little cage in this area in currently, the role of cage owner is decreased and he sold his fish to traders only. At the moment, the processing firms are not focused on cage culture comparing last time because of the fish health management is difficult to control and the water quality is pollution. Hence, the quality assurance system for this chain is neglected.

d. Business relationships at the farm level

1) Co-operation between the fish farmers and intermediate input suppliers

The main intermediate input required by Mr. B is fingerling producers. Like Mr. A, Mr. B mentioned that overall health status of fingerlings is a critical factor for a successful production cycle, especially for cage farming. Hence, he has to select fingerlings carefully before making buy decision and get good relationship with the nursery owners. In this case, trust is also the most important factor. Mr. B also views trust as very essential for conducting business transactions. He trusts the nursery owner and he believes that this person does not show any opportunistic behaviour or cheat him for the reaction one gets is series enough to continue doing business. Because nursing fingerlings is the short period before selling to the fish farmers. Hence, if the nursery owners use antibiotic or chemicals in order to keep fish healthy, the fishes are more easily to get outbreak disease in the grow-out phase. For the feeds supplier, Mr. B use home-made feeds and he bought small sea-fishes everyday. He mentioned that he did not need establish the long-term relationships with sea-fishes suppliers because there are many sea-fishes suppliers in this region. He will buy the sea-fishes with the suppliers who offered him good price together with the quality he expected.

2) Co-operation among fish farmers (horizontal relations)

In the survey, fish farmers are involved in a joint investment in several ways. One practical example we found out from the interview is the co-operation between Mr. B and his brother. Mr. B was actively involved in fish culture and was financing his families with the income. His younger brother was involved in trading activities and he managed to buy input raw materials. Four years after he started fish culture, the young brother joined his and started working together in Chau Phu district, being involved in the Pagasius farming. According to my interview with Mr. B's younger brother, previously he did not have a good knowledge of fish culture and after working together started learning from his elder. That is kind of co-operation through transferring of production techniques knowledge.

According to the respondents, the knowledge of fish aquaculture has been transferred from one generation to the other. In currently, the production techniques that the fish farmers can get by working with experienced fisherman, fathers, relatives and other villagers. The knowledge includes feeding, disease treatment, water management, fingerlings selection and nursing. The knowledge is cumulative and gained through time. Moreover, they also make a co-operation in fingerlings transport. It is usually costly for the fish farmers with a small boat to go to hatcheries to buy fingerlings. The fish farmers usually bring all their order together and transport it with one boat called "ghe duc". They usually delegate one of the fish farmers to go with the boat and perform all the buying activities. They also get supplies by the time the boat returns to the village.

3) Co-operation between farmers and processing firms

At the moment, Pangasius culturing in cage is difficult to sell directly to processing company because of the decreasing of cage owners and the processing firms want to buy large volume of Pangasius at the same size and quality. Hence, Mr. B is mostly dependent on the local traders who developed business relations with processing firms. The traders who collect fish from some cages will classify and supply fish to processing firms. In the past Mr. B can sell fishes to the traders or processing firm as well. If he thinks that the price set by the trader is not attractive, he is free to sell to other traders. This holds true when he had a significant volume of fish and the price of fish is high at that moment. However, currently, the volume of fish is less and it is not cost efficient for him to go to processing firms because of price and quality of fish then he prefers to sell to traders. The outcome of the relationship is beneficial for both actors.

According to Mr. B, the problem of developing business relationships with processing firms is related to the quality requirement and the priority given to traders. Moreover, there is a little cage in currently, hence it made the small-scale farm like Mr. B depended on traders, who collect fish from many cage farms and classified the 1st grade to sell to processing firms. The processing firms are also located in the same area and they immediately buy the 1st grade fish, and they used to reject the 2nd and 3rd grade assuming that they are not Industrially viable and also not good for health. In general, it can be said that the relationship between Mr. B and processing firms is weak at the moment

In my observation, the relationship between the fish farmers and processing firms is rated as weak for the remote cage located in Chau Phu. The main reason given by the Mr. B is that he rarely sells to processing firms due to their price is not attractive at all. Hence, he tried to sell all fish to the traders in the price negotiation.

e. Conclusion

This is a typical case of cage farming in An Giang province. Mr. B is one of the left farmers who were still remaining cage farming in this area. However, the cage culture was decreased considerably for some reasons that already mentioned in the page 22. The main problem is water pollution and fish disease treatment. Mr. B used a cocktail of antibiotics to cure fish diseases because of much more diseases for cage farming than pond one. Moreover, the production cycle of cage is longer and higher production cost than pond farming, but the selling price is lower; hence, the cage model will be tended to disappear in the future (expert interview, 2007).

2.2.3 Case 3: Mrs. C's net–pen enclosure organic farming

a. History of the farm

The owner of organic farm is Mrs. C. She got a bachelor degree in aquaculture background; hence she has much knowledge in fish industry. She said that although she has experiences from the study, but she got loss in a couple of season in the year 2003. The reason is the price of Pangasius decreasing suddenly after the catfish anti-dumping case between Vietnam and America. In that period, she wanted to stop Pangaisus production, Mrs. C expressed. However, in the year 2004, the An Giang Fisheries Association (AFA) signed one contract with Binca company, a German importer of seafood,

to culture organic Pangasius. Currently, AFA has coordinated with related authority industry in order to set up the cooperation between the farmers and the processors. At the moment, Mrs. C has one nursery pond, and three net- pen enclosure for organic farming. One net-pen closure is about 1 ha of total area. This farm is certified organic by Naturland e.V. based on their private production standard as well as approved by the Swiss association Bio Suisse. There are a total of eight workers working on the farm; their main work is cooking fish meal, feeding the fish, moving the fish from pond to enclosure and harvesting. All workers have working contracts and medical insurance. Comparing to other small fish farms in the region, the level of workplace safety and hygiene is very high on the farm owned by Mrs. C. Farms seem to be very clean and it is taken care of workplace safety (no loose planks, no outstanding nails). Chemicals are stored in separate lockers. Moreover, the farm record daily activities in term of input and output. Driven from the wish to implement a certified system of Good Aquaculture Practice (GAP) in Pangasius production, Mrs. C is participating in a local program for developing an adequate management and documentary system. Mrs. C said that as soon as the system is developed and approved from all parties involved, inspections and certifications will be offered against “AquaGap”. Mrs. C also mentioned that the farming systems have to be made more sustainable and ecological friendly. International standards like GAP must be implemented into the farming in order to make the development more sustainable and allow an enlargement of Pangasius export in the future.

Season calendar of Pangasius farming

Month	1	2	3	4	5	6	7	8	9	10	11	12
Dry season	—	—	—	—	—							
Raining season						—	—	—	—	—	—	—
Water rise up						—	—	—	—			
Water level subside										—	—	—
Flood season								—	—	—	—	—
Crop 1							—	—	—	—	—	—
Crop 2		—	—	—	—	—						
North-easterly wind											—	—
Period of diseases						—	—	—	—	—	—	—
- Heavy diseases										—	—	—
- Outbreak											—	—

Like Mr. B, Mrs. C also said that there may be a relationship between the rising water levels with the occurrence of diseases. However, she did not use antibiotics or any other chemicals to treat fish and removed the death fish out the pen immediately. However, low density of fingerlings is easier to manage diseases than high density. In any case of fish diseases, she called the staff of Naturland and he will consult how to treat fish before the application of veterinary drugs.

b. Primary activities at the farm level

1) Site selection

When we conducted the case, the net-pen enclosure was built three years ago. According to Mrs. C, before the construction is started, information about her farm production site had to be sent to

Naturland (e.g. maps, plans, outlines and photo). The distance between organic and non-organic production areas of other potential sources of pollution must be sufficient to make sure that the risk of contamination is minimized. In my observation, the farm is located in the area that following Naturland's rules, for example; there is no possibility of pollution through neighboring conventional aquaculture farms, urban areas, conventional agriculture, industry (indicate the nearest locations of such potential polluters as well as river flow direction); the farm's own side-activities (gardening, animal husbandry) is managed according to organic principles; the farm's toilets/sewage systems will prohibit contamination of the ponds with any fecal/sewage matter, also in the case of heavy rain and high water; there is no conflict with other land-users (e.g. fishermen – where is the next fishing area). In short, before the construction work starts, the Naturland organization will give its OK to the selected site based on the maps and analytical findings.

Design and construction net-pen enclosure

According to Mrs. C, the pen design and construction should be dictated by a combination of a series of factors including Naturland approval, shape of pen, financial condition, availability of materials and the requirements for organic production. The net-pen enclosure made of wooden fences and steel mesh that are fulfilling the requirements for organic production. She also mentioned that any additional material she wanted to employ must be approved by Naturland. There is no chemical anti-fouling and waterproofing or other paintings are permitted.

Figure 3: Mrs. C's net–pen enclosure

Preparation and cleaning of net-pen closure

Mrs. C mentioned before releasing fingerlings, the pen has to be cleared of all avoidable fauna and unwanted elements, especially predators and trash fishes. The embankments, filters and net barriers have to be kept clean. In addition, she mentioned the workers made the maintenance of pens regularly. Routine maintenance operations of sluices and gates and net barriers, rigid and non-rigid, are most important. In certainty, it is about one third of the workers are divers who clean the nets. She mentioned the regular checks and repairs should be done to reduce losses in this connection.

2) Water supply

In this case, Mrs. C mentioned the water quality of adjacent river stretches shall not be deteriorated by the farm operation. Therefore, at least quarterly analyses on main nutrients (ammonia, nitrate, phosphate) shall be carried out, both inside the pen and upriver (as a reference site). It is expected

that analyses results of both sampling sites should not differ significantly (standard value < 10% of the parameters determined). In addition, the water renewal in mud pen is recommended to be done as far as possible by a natural mean using the water flow of the Mekong River instead of fuel pumps. In the environmental aspects, Naturland stipulates some issues and I also observed that feed pellet machines was properly isolated and installed in a metallic collecting tank in order to avoid any contamination of the water or the surrounding environment; fuel used for the farm operating activities, boat, pumping and pellet machines were stored inshore in metallic jerry cans, and jerry cans were placed in a metallic collecting tanks in order to avoid any contamination of water or soil; residue of fuel and oil recuperated in collecting tanks must be properly destroyed or burned; any waste/offal shall be collected and transported to urban waste management system; banks of ponds shall be kept clean from waste materials at all time; the use of energy was properly managed in order to decrease its consumption.

3) Production/ growth

Fingerlings and fingerling stocking

Mrs. C bought fingerlings from the An Giang aqua-cultural research and hatchery production center. She mentioned in the organic standards, the fingerlings must be supplied by a hatchery and not origin from the wild. Respectively, purchase documents must be supplied to Naturland. She said that at the moment, the fingerlings from certified organic hatchery are not possible; hence, at least 2/3 of the life cycle of fingerlings is in accordance with the Naturland standards. The records of the fingerlings are available for inspection. In the Naturland standard, Pangasius cultured in net-pen enclosures with 2.2 cm long and stocking density are 10 fish/m^3 during the whole production period.

Feeds and feeding

Mrs. C mentioned all feed ingredients must be approved by Naturland. Copies of the purchase documents, indicating type, quantity and organic status have to be supplied to Naturland. In addition, no conventional pellets are permitted. The industrial feeds actually used to feed the fingerlings must be replaced by home-made feed (as for the fattening), or for small fry by direct mixed meals (fish meal and organic by products meal) spreading on the surface of the ponds. In currently, because of lack of organic agriculture in Vietnam, organic vegetal ingredients (e.g. rice bran, soybean cake) will be imported, mostly from China. It is extremely important to document and trace the way of this feed from the exporter to the importer, to the organic farm. The percentage of fish meal in feed (actually approx. 25%) is accepted in organic feed formulation. The Naturland standards stipulate that fishmeal should come from either trimmings of fish caught and processed for human consumption or be by-catches of such fishery, both, as far as possible. Moreover, all suppliers of fishmeal have to be known to Naturland by address, type of product, origin. Switching of suppliers without application at Naturland is not permitted. Mrs C mentioned that samples of all types of feeds as feed ingredient have to be sent to Naturland for further analyses.

Fish health (disease) management

Mrs. C mentioned the health of organic Pangasius is very important. Hence, the prevention measurement of Naturland is adoption in order to ensure fish health. She stressed that the use of

antibiotics or any other chemicals (except from Naturland positive list) is not permitted. She showed me the Naturland positive list is below:

- use of natural physical methods (in particular drying out)
- use of not residue – building, inorganic compounds (e.g. hydrogen peroxide H_2O_2, lime $CaCO_3$, quicklime CaO, sodium hypochloride Na0Cl)
- use of naturally occurring, not residue-building organic compounds (e.g. formic acid, alcohol)
- use of homeopathic products use and stone powder
- use of naturally occurring vegetable substances

Moreover, if any substance or measure conforms to the criteria mentioned above, but does not mention by its actual name in these standards, Naturland shall be consulted before its application.

The technological factors of Mrs. C's net – pen enclosure

Factors	Unit
- Volume	40800 m^3
- Length	120m
- Width	85m
- Depth	4m
- Fingerlings	2,5 cm of body length
- Fingerlings releasing	200,000 heads
- Density	10 heads/m^3
- Feeding	Industrial feeds: 100%
- Culture time	7 months
- Harvesting weight	800gr – 1,0 kg
- Yiled	100 tonnes
- Capacity	10 kg/m^2

In my observation, the farm is strictly following the rule of Naturland.

The production cost per crop of Mrs. C's pen as following (details in appendix 8)

Items	Cost (VND)	%
Pen preparation	6,000,000	0.17
Pen depreciation	40,000,000	1.16
Fingerlings	200,000,000	5.79
Feeds	2,575,976,000	74.62
Feeds transportation +tax	510,000,000	14.77
Salary of the workers	35,000,000	1.01
Fuel	10,000,000	0.29
Land tax per crop	10,000,000	0.29
Harvesting	30,000,000	0.87
Operating interest	30,000,000	0.87
Fixed asset depreciation per crop	2,000,000	0.06
Other costs	3,000,000	0.09
Total variable cost	3,451,976,000	100.00
Total production (kg)	100,000	
Production cost per kg of Pangasius	34,519.76	

Selling price (June, 2007)	37,000	

Source: Mrs. C calculated, 2007

c. Quality assurance at the chain level

The Binca seafood company plays an important role in the organic chain. It monitored most of the organic culture process including fingerlings, feeds and non-using antibiotic. Mrs C is pioneer in organic Pangasius culture; hence she is also play an important role in organic chain. She said that organic Pangasius production represents a unique opportunity in times when the traditional markets are endangered by protectionism as well as scandals which are caused by food safety problem. According to Mrs. C, there are two organic farms in the MRD at this moment, one is her farm and other belongs to Mr. S. According to Mrs. C, the government and local authorities are interested in issuing regulations and guidelines to orientate the Pangasius production towards what is known as responsible aquaculture-organic. The principles of responsible aquaculture are elimination of the use of veterinary drugs that leading no antibiotic in fish products. Moreover, Mrs. C mentioned that involving small-scale farmers in certification schemes and providing links to better management practices is a particular challenge. The number of constraints include that record keeping accuracy, input suppliers are fragmented, the difficulty of tracing feed sources and fingerlings. In addition, organic certification schemes typically requires small farmers to adhere to stocking densities, and production methods that result in relatively low productivity from the unit area of the operation. And the most significant at the present time is proving a price premium for farmers for product grown using organic culture method.

d. Business relationships at farm level

1) Co-operation between the fish farmers and intermediate input suppliers

Ms. C bought fingerlings at state owned hatchery namely the An Giang aquacultural research and hatchery production center. She said that at the moment, the fingerlings from certified organic hatchery are not possible; hence, at least 2/3 of the life cycle of fingerlings is in accordance with the Naturland standards. She trusts the quality of fingerlings because three weeks before the fingerlings are bought a test is done by Binca to check for traces of antibiotics. This test has to be documented. When the fingerlings are purchased another document has to be distributed with the weight of fingerlings bought. These two documents are the first step in the traceability of the product. Hence, the cooperation between Mrs. C and the hatchery is rather high. Moreover, the feeds for organic Pangasius is paid by Binca company and delivered to the organic farms. Hence, Ms. C has no the relationship with feeds suppliers.

2) Co-operation among fish farmers

The cooperation between Mrs. C and other farmers are only simple exchanging market information in term of price of Pangasius in order to negotiate price with Binca company at the harvesting.

3) Co-operation between farmers and processing/export firms (Binca Seafood Company)

Mrs. C said that the market access for organic Pangasius is easier than conventional one. It creates a market for organic Pangasius growth. Mrs. C could sell 70 tonnes organic Pangasius to Binca Seafood Company in the first harvest 2005. In the year 2006, she increased to sell 200 tonnes organic Pangasius to Binca. She also said she get better margin with organic products and earn 15% more than in the conventional market. Moreover, her Pangasius is secured by the Binca Company that is the most important factor in the fluctuation market of Pangasius in currently period. The demand of organic Pangsius in the year 2007 is about 1,500 tonnes. Mrs. C said that she can get more benefit due to this model. In the organic chain business relations, Mrs. C mentioned there is a good relationship between her farm and Binca, Naturland and IMO. These organizations work together in order to produce organic Pangasius in the An Giang province.

Binca is the initiator for the farming of organic Pangasius in Vietnam Besides the function of ex- and importer, Binca invested in the intrinsic and tacit knowledge of how to apply for, how to apply the organic standards and what kind of quality control is needed for the assurance of the organic system. Binca has a very close relation with Mrs. C and a tight cooperation. She and Binca manager (Mr.Thoi) are discussed together frequently. Firstly, the farm layout will be discussed, then this the actual organic farming in which the relation of Binca and the farmers becomes clear. Moreover, the food for organic farm is paid by Binca and Mrs. C has paid the tax of feed and feed transportation fees to the farm. The farmers are paid in the end of the season. There is not a set price for a kilogram of organic pangasius, but there is a preset price premium which is not related to the amount of fish produced. The costs are calculated and a premium is added, this is divided by the amount of fish. This will be the price per kg of fish. Moreover, in order to help Mrs. C applying the organic standards, both Binca Seafood and Naturland are strongly supporting her through the help of IMO. When the Pangasius are harvest, the IMO is there to check documents and the procedure. The time from harvest (the netting) to the slaughter can not exceed 10 hours. The fish are transported in boats which are stocked at 2/3 of their capacity to decrease the stress for the fish. Hence, there is a closed business relations in Pangaisus organic chain more than conventional chain (C, 2007).

e. Conclusion

This is a typical case of organic farming. The quality control at the farm level is seemly better than other cases. The documentation in every step of critical control point ensures the traceability from the hatchery to farm to processing firm. However, the organic model is more costly and difficulty to apply for smallholders.

2.2.4 Case 4: Mr. D's pond farming

a. History of the farm

Mr. D was born in Chau Thanh district, An Giang province and he is forty eight years old. He got high school education. He has one wife, two sons who help him in Pangasius farming. He has been involved in Pangasius culture 12 years. He gained experiences in Pangasius culture by learning his neighbors. Then he gained more experiences in the way learning by doing. Currently, he has 3 ponds with aggregate area of 1.5 ha and he can maintain the Pangasius culture activities year around. Since September 2005, he was the member of AGIFISH Pangasius Pure Union (APPU). At the moment, he

is one of 32 members of APPU. APPU model tries to provide consumers with high-quality and traceable products. This is also a basis to develop “pure” Pangasius products. He recognized that APPU is an effective model in re-organizing production, gaining members’ commitment and responsibilities to supply foods of high quality and safety, improving the collabouration among the stakeholders in the production chain. In general, Mr. D followed the SQF program that issued by AGIFISH company and he get get SQF certificate together with 31 other members of APPU.

Season calendar of Pangasius production of Mr. D’s farm

Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Dry season	—	—	—	—	—							—
Raining season					—	—	—	—	—	—	—	
Water rise up						—	—	—	—			
Water level subside										—	—	—
Flood season												
Crop 1	—	—	—							—	—	—
Crop 2				—	—	—	—	—	—			
North-easterly wind											—	—
Period of diseases						—	—	—	—	—	—	—
- Heavy diseases										—	—	—
- Outbreak											—	—
Discharge of polluted water from rice farm											—	—

Mr. D said that there may be a relationship between the weather in locally and the occurrence of diseases. The beginning month of raining season and heavy windy encourage the diseases of Pangasius and affect to the cost of production. According to him, the disease can occur via the whole production cycle and he based on his experiences and the consultancy of technical officer in order to treat or prevent the diseases.

b. Primary activities at the farm level

1) Site selection

When we conducted the case, the pond was already existed. According to Mr. D, he digged the pond in the specializing of Pangasius areas that decided by local authorities. He bought the land for digging pond in the year 2000 and he had the property rights of this land that showed by red card. For him, the first consideration in selecting a site for Industrial fish is to make sure that an adequate supply of suitable quality water is available for the size farm planned. The distance between his pond and water source is 100 meters. In the discussion, water supply, soil quality is probably the two most important characteristics of a good site. Hence, his pond is located near the river source in order to get fresh water without pollution from virus, bacterium, pesticide or other chemicals. Moreover, he checked the soil for pesticide residues level. Analysis of soils for pesticide residues can be done by soil scientific Department of Can Tho University.

Figure 4: Mr. D's pond

Design and construction pond

Mr. D had the ponds designed and constructed following SQF standards (appendix 7). According to him, pond design is determined by the type of species cultured, financial condition, land availability, water availability, and other variables. His ponds are rectangular in shape, and the area of his pond is 60m (with) x 80m (lengh) with 3 meters depth. He also mentioned good pond construction begins with good site selection. Moreover, his ponds are also used for two different purposes: nursery fingerlings, and grow out Industrial fish. After the pond bottom is completed, the water inlet and outlet structures are constructed. Inlet water pipeline was built to take water from outside water bodies into the pond. Outlet water pipeline was built to take waste water out the pond. He had water treatment pond to treat water before releasing into river.

Preparation and cleaning of pond

Mr. Son said that proper pond preparation is critical to ensure survival of newly stocked fingerlings. He drained the pond completely for several weeks prior to starting a new grow-out cycle in order to completely eliminate the threat of trash fish and any remaining puddles treated with rotenone. Then, he filled the pond with well water and no more than seven days prior to the fingerlings stocking. Within the first several days of filling, he supplied the pond with a source of inorganic and organic fertilizers to establish blooms of phytoplankton and zooplankton in order to control unwanted aquatic vegetation. Mr. Son also applied quicklime in order to correct acidic conditions and kill bacteria. Moreover, during Pangasius production cycle, pond sediment was removed monthly in order to reduce toxic substances that could affect fish health and quality.

2) Water supply

Mr. D get the training in SQF course, hence he know water quality is essential for successfully producing Pangasius. He usually measured pH and recorded the results of water checking. He pumped and changed water everyday and the water changing per day is about 30% the water volume in pond that following SQF standard. He mentioned that oxygen is necessary for survival of fishes. In his experiences, oxygen depletion occurs after a heavy rain, strong winds, cloudy days, and the water color changes suddenly. In this crop, he observed the signs of oxygen depletion include large numbers of fish swim to the top and gulp at night or early in the morning and feeding habits suddenly change. In this case, he takes corrective action immediately by changing water or reducing feeds or using mechanical aeration of the water.

3) Production/growth

Fingerlings and fingerlings stocking

In SQF model, the source of fingerlings is very important factor that affects directly to Industrial fish. Mr.Son bougth fingerlings from the An Giang aquaculture research and hatchery production center (hatchery member of APPU) with high quality. Be member of APPU, he was supplied fingerlings of healthy origin which verified and certified. He mentioned that he can know source of fingerlings and it is more security than other source. This crop, he bought fingerlings' size of 2.0 cm and about 32 fishes per kg. He also keeps the document of the origin of the fingerlings in order to trace source of fingerlings if necessary. He stocked fish at low rates, averaged 36 fingerlings/m^2 that means for the total area of pond is 5500 m^2, and he released 200,000 fingerlings. This crop, he sold 160 tonnes Pangasius with average 1 kg/fish. The loss rate is 20%.

Feeds and feding

In feeding fish, Mr. D fed Pangasius 2 times/day. Fish feeding hours are usually from 11:30-12:00 a.m. and from 4:30-5:00 p.m. He mentioned the feed quantity varied according to Pangasius weight or was adjusted based on feed quantity eaten on previous day. Mr. D used Industrial feed produced and supplied by Feed Manufacturing Company namely Proconco (feed supplier of APPU). I observed that this feed can float on the water for a while so it does not pollute water much and is used effectively. Moreover, Mr. D followed the formula of feeding veterinary drugs that supplied by Veterinary Medicine Manufacturing and Trading Company namely Vemedim (Veterinary drugs supplier of APPU). More importantly, he recorded the feeds and disease treatment in the farm record booklet supplied by Vemedim. Hence, it is easy to trace the source of feeds and veterinary drugs in the production cycle.

Fish health (disease) management

Mr. D has many experiences in fish diseases by looking at the external clinical signs of fish. He also said there are two kinds of disease such as red spot and bacillary necrosis that occurred frequently. However, Mr. D usually asks the aquacultural technicians of AGIFISH Company for the symptom of fish diseases. The technicians of AGIFISH can make water quality analysis, pathological diagnostic, hence Mr. D can get the reasonable consultants for fish treatment and successfully.

The technological factors of Mr.D's pond:

Factors	***Unit***
- Volume	16,800 m^3
- Length	80m
- Width	70m
- Depth	3,0 m
- Fingerlings	2,0 cm of body length
- Fingerlings releasing	200,000 heads
Density	36 heads/m^2
- Feeding	Industrial feeds: 100%

- Culture time	6 months
- Harvesting weight	900 gr – 1,2 kg
- Yield	160 tones
- Capacity	28 kg /m^2

The production cost per crop of Mr.D's pond as following (details in appendix 8)

Items	Costs (VND)	%
Pond preparation	4,800,000	0.33
Pond treatment	4,580,000	0.31
Fingerlings	100,000,000	6.79
Feeds	1,293,600,000	87.82
Chemicals/ veterinary drugs	10,400,000	0.71
Salary of the workers	9,600,000	0.65
Fuel	17,600,000	1.19
Harvesting	10,000,000	0.68
Operating interest	18,000,000	1.22
Land depreciation	2,000,000	0.14
Fixed asset depreciation per crop	1,500,000	0.10
Other cost	1,000,000	0.07
Total variable cost (VND)	1,473,080,000	100.00
Total production (kg)	176,000	
Production cost per kg of Pangasius (VND)	8,370	
Selling price (June 2007)	17,000	

c. Quality assurance at the chain level

In expert' discussion, APPU is a model that organizes quality assurance along fish chain. This group is coordinated 5 member groups of the fisheries production chain that include hatchery (An Giang aquaculture research and hatchery production center), farmers (32 members), Veterinary drugs supplier (Vemedim company), Feeds supplier (Proconco manufacturing company) and AGIFISH company. Hence, the role of every chain member is clear toward fish quality assurance. Mr. D is the member of APPU and he mentioned that he get benefit from this organization. All the farms are well-invested in terms of facilities for quality fish farming. He can increase knowledge know how to use industrial feed so as not to pollute the water resource and how to use chemicals and antibiotics in aquaculture to meet the customer's safety requirements.

He mentioned some benefit that he got as APPU's member:

- Fingerlings: APPU recommend and supply fingerlings of healthy origin which verified and certified.
- Production techniques: he can apply modern technology by training, educating such as SQF 1000 program, food safe program, antibiotics treatment method, receiving and publicizing information on policy, guided on disease treatment that organized by AGIFISH company.
- Capital investment: AGIFISH put on the priority to consider on capital investment in farming process through the ways of feed supply, veterinary drugs once needed.
- Product consumption: he can sell the good quality of Pangasius to AGIFISH company according to APPU's plan of production and consumption.

d. Business relationships at farm level

1) Co-operation between the fish farmers and intermediate input suppliers

As mentioned above, APPU is a model coordinating 5 member groups of the Pangasius value chain; hence, there is good business relationship among Mr. D and input suppliers such as hatchery, feed supplier, and veterinarians. Mr. D mentioned the most important intermediate input suppliers are hatchery. The An Giang Aquacultural research and hatchery production center produce fingerlings following SQF standards. And in 2006, this hatchery was certified for SQF 1000 (MOFI, 2006). Hence, Mr.Son is secured by the quality of fingerlings and feeds and veterinary services.

2) Co-operation among fish farmers

APPU is set up by AGIFISH company and considered as an effective model in re-organizing production, gaining members' commitment and responsibilities to supply foods of high quality and safety, improving the collabouration among members of Pangasius production chain (VASEP, 2007). In just one year of operation, the APPU has made great stride with its members increasing from 19 to 32 farmers, farming area rising from 500,000 m^2 to almost 720,000 m^2 and production reaching 61,000 tonnes in 2006. Hence, the cooperation among fish farmers in APPU is very tight. All the farms are well-invested in terms of facilities for safety and quality fish farming. The farmers get many training in term of advance technology in order to know how to use industrial feed so as not to pollute the water and how to use chemicals and antibiotics in Pangasius production to meet the customer's safety requirements. As a result, the percentage of first – class fish farming since the establishment of APPU was 25% higher than before (Agifish, 2007).

3) Co-operation between farmers and processing firms

Mr. Ngo Phuoc Hau, General Director of Agifish started the Project called "Agifish Pure Pangasius Union" (APPU) with 32 farmers who are main suppliers of company. In this project, the farmers get feeds and the technical advice for their farm, as a subsidy of Agifish. The feeds and farming method are controlled very tightly by Agifish Quality Management department. Moreover, the farmers have to sign a contract to follow the rules and the farm will be constantly monitored. Mr. Hau employed an outside international auditing Operation from the US to set standards for Good Farming Management and implemented this into APPU group. Hence, the business relationships between farmers and AGIFISH company are very tightly in term of quality control at farm level and quality management at the chain actors. The farmers who belong to APPU can sell fish easier and higher price than normal smallholders.

e. Conclusion

This is a typical case of APPU farmer who conducted SQF model for Pangasius culture. The APPU model is coordinating five chain actors that include hatchery, farmers, feed mills, veterinary drugs suppliers and processors. This model is considered as an effective one for quality management at the whole Pangasius export chain. There is good business relationship between farmer and the chain actor because they belong to an organization namely APPU. This model can develop in order to get better coordination among chain actors toward quality management of Pangasius products.

2.2.5 Case 5: Mr. E's pond farming

a. History of the farm

Mr. E was born in Binh Thuy village, Chau Phu district, An Giang province and he is fifty years old. He had been involved in aquaculture for more than 40 years. 40 years ago, his father passed away while he was a small kid. He was lived with his uncle who was fish farmers and to support his uncle, Mr. E was also involved in fish culture activities. He get much aquaculture knowledge from his uncle. Since 2000, he bough land and dig pond for Pangasius farming. His uncle support money for him, hence he did not need to borrow money from bank. In the year 2002, the price of Pangasius is high, he get much profit and pay back the money for his uncle. Currently, he has two ponds with aggregate area of 1.5 ha. His wife is a housemaid and is only involved in cooking and take care their house. He has five sons- two are on national service, one is working with him, and the other two are students. Currently, he is the member of the An Giang Fisheries Association (AFA) and belongs to Long Thanh fisheries association in Chau Phu district.

Season calendar of Pangasius farming

Month	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Dry season	—	—	—	—	—							—
Raining season					—	—	—	—	—	—	—	
Water rise up						—	—	—	—			
Water level subside										—	—	—
Flood season								—	—	—	—	
Crop 1						—	—	—	—	—	—	—
Crop 2	—	—	—	—	—	—						—
North-easterly wind											—	—
Period of diseases						—	—	—	—	—	—	—
- Heavy diseases										—	—	—
- Outbreak											—	—
Discharge of polluted water from rice farm											—	—

Mr. E also said that there may be a relationship between the weather in locally and the occurrence of diseases. The beginning month of raining season and heavy windy encourage the diseases of Pangasius and affect to the cost of production. According to Mr.E, the disease can occur via the whole production cycle and he based on his experiences in order to treat or prevent the diseases. He mentioned he cultured fish 90% basing on his experiences and 10% left based on training and seminars he attended as the member of fisheries association.

b. Primary activities at the farm level

1) Site selection

When we conducted the case, the pond was already existed. According to Mr. E, the suitable water resource is the important factor in selecting pond location. Hence, the primary criterion for site selection is adequate water of desirable quality be available. He also mentioned that he bought land

for digging fish pond in the year 2000 with low price, but the price of land is so expensive now and the farmers need more capital in order to buy good location for digging pond. The distance between his pond and water source is 90 meters. This is a reasonable distance to get fresh water from the river.

Design and construction pond

The area of Mr. E 's grow out pond is 80m (width) x 120m (length) with 3 meters depth. According to Mr. E, shape and topography of the property affect pond size and shape. His ponds are rectangular in shape and 0,5 ha for fingerling ponds and 1 ha for grow-out ponds. His ponds are rectangular with 2:3 width to length ratio, as this shape makes it easy to harvest fish with a seine. Inlet water pipeline was built to take water from outside water bodies into the pond.

Figure 5: Mr. E's pond

Preparation and cleaning of pond

In pond preparation and cleaning, he said that every new culture cycle, he cleaned and dried the pond before releasing fingerlings. This crop, he used lime of 1000 kg for 1 ha area of pond. After scattering lime over the pond, he pumped water into the pond with 60 cm water level. The water pH has to be less than 7.5, Mr. E measured it. Then, chemical for water treatment namely Vimekon was soaked in water for 24 hours and only the supernatant added to the pond. He used 2.5 kg of chemical for his pond. Following this treatment, the water will gradually turn green. Moreover, during Pangasius production cycle, pond sediment was removed six more times in order to reduce toxic substances that could affect fish health and quality.

2) Water supply

According to Mr. E, the initial water depth of 60 cm has to be increased to 1.5m after one month and by 10-20 cm every week until the water level is 3m depth. The water exchange rate of 30% every day usually starts after the first month. Under such favorable water quality, 2.5 cm fingerlings will generally grow to the market size 500 gr in 3 months and in this period the survival rate is usually around 70%, Mr. E expressed.

3) Production/growth

Fingerlings and fingerlings stocking

Mr. E also mentioned the source of fingerlings is the important factor that affects directly to Industrial fish. Mr. E used to buy fingerlings' size of 1.5 cm height from fingerling traders. After that, he nursed fingerlings in his nursery pond for 2 months. When the fingerlings get 2.5 cm height of body, he moved

them to grow-out pond to continue culturing in 4 more months before harvesting and selling. Mr. E mentioned this helps the fingerlings same size and avoid big fishes eating all feeds while the small fishes still hungry that leading to the size of fishes is difference in harvesting**.** He stocked fish at high rates, averaged 25 fingerlings/m^2 that means for the total area of pond is 9,600 m^2, he released 240,000 fingerlings. This crop, he sold 200 tonnes Pangasius with average 1 kg/head. The loss rate is 20%.

Feeds and feeding

In feeding fish, Mr. E fed Pangasius 2 times/day. Fish feeding hours are usually from 11-12:00 a.m. and from 5-6:00 p.m. In the first two month, Mr. E used Industrial feed produced by feed companies with brand names Cargill. When fish became bigger, in order to save feed cost, he used home-made feed with high-protein content. It usually consists of rice bran (45%), marine fish or Tra fish meal (40%), and soybean (15%). In addition, he often mixes vitamin C, Sorbitol, Enzyme, and mineral premix into feed in order to strengthen fish's health. Moreover, Mr. E often uses the method of changing pond water daily in order to reduce water pollution in ponds as well as to prevent fish diseases.

The formula of feeds as following :

Feed ingredients (%)	**Culture stage in cage**		
	Starting (the first 2 months)	Growing (3 months)	Finishing (the last 1 months)
Trash fish		40	
Rice bran		45	
Soybean		15	
Industrial feeds	100	0	100

Fish health (disease) management

Mr. E mentioned that he can know which kind of diseases the Pangasius get based on his experiences. However, he usually shares the fish disease treatment with other members of fishery association. Moreover, he took fish disease sample to the aqua cultural extension officer. The extension officer will show him the accurate information what veterinary drugs he should buy to cure or prevent the fish diseases. Be member of fishery association, he also attended many training courses and seminars that mentioned how to treat fish disease and fish health management issues. In his observations, the fish diseases occur during cold rains, heavy winds and the weather changing suddenly. He adjusted the feeds ratio when he observes the weather changing and the clinical signs of fishes.

The technological factors of Mr. E's pond

Factors	***Unit***
- Volume	28,800 m^3
- Length	1200m
- Width	80m
- Depth	3,0 m
- Fingerlings	2,5 cm of body length
- Fingerlings releasing	240,000 heads
- Density	25 heads/m^2
- Feeding	Industrial feeds: 20%
	Home-made feeds: 80%
- Culture time	6 months
- Harvesting weight	800 gr – 1,0 kg
- Yield	200 tonnes
- Capacity	20 kg /m^2

The production cost per crop of Mr. E's pond as following (details in appendix 8)

Items	**Costs (VND)**	**%**
Pond preparation	7,200,000	0.39
Pond treatment	6,900,000	0.37
Fingerlings (240,000 x 600 VND/piece)	144,000,000	7.74
Feed (200,000 kg x 2.3x 3,500VND/kg)	1,610,000,000	86.50
Chemicals/ veterinary drugs	22,000,000	1.18
Salary of the workers	9,600,000	0.52
Fuel	20,000,000	1.07
Harvesting	15,000,000	0.81
Operating interest	21,600,000	1.16
Land depreciation	1,500,000	0.08
Fixed asset depreciation per crop	2,000,000	0.11
Other cost (electronic, telephone…)	1,500,000	0.08
Total variable cost (VND)	1,861,300,000	100.00
Total production (kg)	200,000	
Production cost per kg of Pangasius (VND)	9,302	
Selling price (June 2007)	16,200	

c. Quality assurance at the chain level

Mr. E is the member of Long Thanh Fisheries Association. This association is the branch of AFA in Chau Phu district. According to Mr. E, the members of fisheries association are provided with access to credit and training programmers and also the cooperative is expected to set up a strong marketing unit, which ensures that processing firms will set attractive fish price. He also mentioned the fisheries association set up contract farming with processing firms and he can sell fish easier at the harvest season. This crop he sold fish by advance contract. He gave an example of the contract between Nam Viet Ltd Company and Long Thanh fisheries association. This contract was signed at the beginning of

the Pangasius season (December 2006 to June 2007). However, it is not really an economic contract or a purchase contract. The contract's product item is Pangasius, with an average weight of 1-1.2 kilo each, and a total volume of 2.995 tons per season (+/- 10% outside factors). The contract regulates the quality of fish, through color and appearance (for fish under standard). The price is calculated according to the market price upon purchase and as agreed by both sides. Payment is made after delivery of the fish and within 15 days of delivery. If the payment is made later, Nam Viet Ltd Company has to pay interest to Long Thanh Fishing Association, not longer than 30 days from the date of delivery. The contract includes an article on breaches of contract. If the Long Thanh Fishing Association breaches the contract, it has to pay Nam Viet Company the per diem for the company's workers and other workshop expenses of 12 million VND. If Nam Viet Company breaches the contract, it has to compensate Long Thanh Fishing Association for the cost of fish food and losses of 3.5 million VND/day/100 tons.

d. Business relationships at farm level

1) Co-operation between the fish farmers and intermediate input suppliers

In this season, Mr. E buys the fingerlings from the fingerlings trader named Hung who lived in Dong Thap. Mr. E did business relationship with Mr. Hung four years ago and he trusted Mr. Hung so much in term of prestige business. This crop, Mr. E ordered fingerlings from Mr. Hung one month before releasing fingerlings, hence; he can selects good quality of fingerlings. Moreover, Mr. E bought fingerlings with other members in his fishery association; hence, they can save cost for transporting fingerling to their pond and lower price with large volume of fingerlings.

In feeds purchasing, there are many feeds and veterinary input suppliers in the market, hence Mr. E did not need to establish good business relations but the business is mainly based on the price and quality of feeds and chemicals supplied.

2) Co-operation among the farmers in Long Thanh fishery association

Currently, Mr. E is the member of the An Giang Fisheries Association (AFA) and belongs to Long Thanh fisheries association in Chau Phu district. According to Mr. Be, being established since 2005, Long Thanh has coordinated with related local authority in order to set up the cooperation between the farmers and the processors. Now, there are 20 members of Long Thanh fishery association. All members meet together once month. The main activities are sharing experiences on production techniques, technical training by extension staffs, market information, harvesting plans to sell Pangasius to processing firms, field visit. Long Thanh club plans to expand its membership and activities together with well organized in the future.

3) Co-operation between the fish farmers and processing firm

Mr. E said that the Long Thanh fishery association acts as the bridge between his farm and the processing firms to help him in terms of productivity, needs of market, and negotiating with banks to increase the loan for the members. Currently, the Long Thanh fisheries association set up contract farming with processing firms and he can sell fish easier at the harvest season. In general, the contract farming give more benefit to fisheries association members

e. Conclusion

This is the typical case of fishery association farmer conducted pond farming. In this case, the farmer can sell fish to processing firm under contract farming that signed between fishery associations and processing firm at the beginning of crop. The contract farming will help smallholders saving transaction costs by settling a premium for higher quality with a one-time negotiation.

2.2.6 Case 6: Mr. F's pond farming

a. History of the farm

Mr. F was born and grown up in Chau Phu. He is 49 years old and he got secondary education. He has been involved in Pangasius farming since 2000. He mentioned before 2000, Tra fish was traditionally cultured in ponds to supply mainly poor farming households. Going with the improvement in Pangasius farming practices and technology, it has become an important export item since 2000. He has one son who is engaged in Pangasius farming. Moreover, his wife helps him in farming. Currently, he owns 2 ponds with aggregate area of 0.8 ha. He bough land in 2000 and dig pond for Pangasius farming. The money he spent to buy land from the four flocks of pig that his family raised since 1998. Regarding his experience in Pangasius farming, he got the farming knowledge from his father and his friends who were also Pangasius farmers. According to him, the knowledge of Pangasius culture has been transfer from one generation to the other. Since his father was known in the Chau Phu village, he was meeting numerous people involved in Pangasius farming. Hence, Mr. F got the opportunity to learn how to produce Pangasius. After that, based on the knowledge he got from his father, he started Pangasius culture himself since 2000. Thanks to experiences, he never gets loss and this crop he did not need to borrow money from the bank and he can mange production cost by himself. At present, he rent a labour that helps him in cooking fish meal, feeding the fish, and harvesting. The worker lived at his farm. Every day, his wife gives the worker money for smoking and free 3 meals. Every early morning, the worker goes to the sea fishes market in order to buy trash fishes to cook feeds for Pangasius. There are three grades of sea fish: grade 1, grade 2 and grade 3. Some farmers used grade 1 but Mr. F used grade 2. In his experiences grade 2 is good for quality and less costly. He had never used Grade 3 because the most important criterion for feed was freshness. He was also concerned about pond water quality from using Grade 3 sea fish. Mr. F did not record the daily activities of Pangasius culture. He is just recording how much money he spent for fingerlings, trash fishes, bran, veterinary drugs. He used 300-600 kg trash fishes per day depending on the size of Pangasius. He fed the Pangasius with trash fish and rice-bran at a ratio of 2:1.

Season calendar of Pangasius production of Mr.F's farm

Month	1	2	3	4	5	6	7	8	9	10	11	12
Dry season	—	—	—	—	—							—
Raining season						—	—	—	—	—	—	
Water rise up						—	—	—	—			
Water level subside										—	—	—
Flood season								—	—	—	—	
Crop 1						—	—	—	—	—	—	—
Crop 2		—	—	—	—	—						
North-easterly wind											—	—
Period of diseases						—	—	—	—	—	—	—
- Heavy diseases										—	—	—
- Outbreak											—	—
Discharge of polluted water from rice farm											—	—

The season calendar that Mr. F described is the same with the case of Mr. E because of they are living in Chau Phu district. He mentioned that Pangasius can culture throughout the year. Unlike rice production, there is no strict schedule in releasing fingerlings into ponds. He culture fish 2 crops/year by alternating fish in two ponds. He usually waits for the cheaper price of fingerlings to buy and releasing into pond. Mr. F alternated fish production in two ponds in order to actively respond to market price fluctuations.

b. Primary activities at the farm level

1) Site selection

When we conducted the case, the pond was already existed. According to Mr. F, Chau Phu district is the land that suitable for aquaculture, hence it is easier to select site for Pangasius culture. However, the distance between Mr. F's pond and water source is 300 meters. It is unreasonable distance to get water directly from the river. This is a disadvantage of his farm. The reason is local government rebuild a bridge that crosses out the old pond of Mr. F. Hence, he had to buy a new land for digging pond where is far from the river source. In currently, Mr. F has to build inlet pipeline for pumping water and get water only 3 days per week that depended on the schedule of water pumping of local authority.

Design and construction of pond

The area of Mr. F's pond is 60m (width) x 70 m (length) with 4 meters depth. Like Mr. A's case, earth removed from pond digging was used to build dykes around the pond or put on land. Inlet water pipeline was built to take water from outside water bodies into the pond. In my observation, Mr. F's ponds designed rectangular and this shape makes it easy to harvest fish with a net

Figure 6: Mr. F's pond at the harvest

Preparation and cleaning of pond

Mr. F mentioned after harvesting in November 2006, the muddy of pond was cleaned, leveled and dried. Then, lime is broadcasting over the bottom of pond with the total 200 kg in order to adjust pH. Then, the pond was filled water to a depth of 60 cm in 2-3 days. At that time, the worker begun removing all plants and overgrown plants were cut. However, Mr. F thought planting around the outside of the pond will provide useful additional shade and shelter, which helps to moderate temperature and algae. Moreover, during Pangaius production cycle, Mr. F rent the worker to remove pond sediment 3 times (once per two months) in order to reduce toxic substances that can create fish diseases or less eating of fishes.

2) Water supply

Mr. F mentioned the most serious threat to Pangasius in ponds is poor water quality. Low dissolved oxygen is by far the most common problem. Most low oxygen problems occur in July, August and September. Because of limiting of water pumping calendar for week, he tried to pump and change water when he considered good quality of river water. According to Mr. F, the number of pumping times varied according to fish size. In my observation, he pumped water 4 times/day in the first month of Pangasius culture, and the time for exchanging water were 3 hours/time. Since the third month of Pangasius production cycle, he pumped water 2 times per day and the time for exchanging water was 5 hours/time. The water changing per day is about 20-50% the water volume in pond.

3) Production/growth

Fingerlings and fingerlings stocking

Source of fingerlings is the important factor that affects directly to Industrial fish. Mr. F used to buy fingerlings' size of 2.0 cm height from fingerling traders. He selected the fingerling traders who have good relationship with him in the past crops. Mr. F mentioned the fingerlings needed to be same size and is about 15 fishes per kg in order to avoid big fishes eating all feeds while the small fishes still hungry, that leading to the size of fishes is difference in harvesting. He stocked fish at low rates, averaged 20 fingerlings/m^2 that means for the total area of pond is 4200 m^2, he released 84,000 fingerlings. This crop, he sold 50 tonnes Pangasius with average 1 kg/head. The loss rate is 40%.

Feeds and feeding

In feeding fish, Mr. F fed Pangasius 2 times/day. Fish feeding hours are usually from 11-11:30 a.m. and from 5-5:30 p.m. When fish was small, Mr. F usually used Industrial feed produced by feed companies with many different brand names like Cargill, Con co, Mekong. I also observed that these feeds can float on the water for a while so it does not pollute water much and is used effectively. However, due to its high price, these feeds were only used in small fish stages. When fish became bigger, in order to save feed cost, he usually used home-made feed. The home-made feeds consisted of rice bran, broken rice, sea- fish and soybean. In addition, Mr. F often mixes vitamin C, Sorbitol, enzyme, and mineral premix into feed in order to strengthen fish's health. The formula of Mr. F's home-made feeds as following :

Feed ingredients (%)	**Culture stage in pond**		
	Starting (the first 2 months)	Growing	Finishing (the last 2 months)
Trash fish		40	50
Rice bran		20	20
Broken rice		25	10
Soybean		15	20
Industrial feeds	100	0	0

Fish health (disease) management

In his observations, the fish diseases occur during cold rains, heavy winds and the weather changing suddenly. He adjusted the feeds ratio due to weather changing and fish health. He said that there were two kinds of disease such as red spot and bacillary necrosis that occurred in this crop. With Red spot disease, the fish died very quickly while with bacillary necrosis, the fish can be cured but this requires lot money for veterinary drugs. He also prevents fish diseases by adding more Aqua C and enzyme in feeds for fish. In order to make sure the treatment method for fish, Mr. F also asked the neighbors and his farther about the symptom of fish diseases. They will show him the information what veterinary drugs he should buy to cure or prevent the fish diseases. He mentioned that the veterinarians are seldom consulted fish farmers and he mostly trusts the advice of their friends or his experiences in fish disease symptoms. Moreover, the information from the private sale agents may not be entirely accurate because they have an interest in selling more. Thus, information and/or assistance from veterinarians may not be as helpful as possible.

The technological factors of Mr.F's pond

Factors	***Unit***
- Volume	12,600 m^3
- Length	70m
- Width	60m
- Depth	3,0 m
- Fingerlings	2,0 cm of body length
- Fingerlings releasing	84,000 heads
- Density	20 heads/m^2
- Feeding	Industrial feeds: 20%
	Home-made feeds: 80%
- Culture time	6 months
- Harvesting weight	800 gr – 1,0 kg
- Yield	50 tones
- Capacity	12 kg /m^2

The production cost per crop of Mr.F's pond as following (details in appendix 8)

Items	**Costs (VND)**	**%**
Pond preparation	1,000,000	0.22
Pond treatment	5,100,000	1.14
Fingerlings	33,600,000	7.50
Feeds	364,500,000	81.41
Chemicals/ veterinary drugs	9,110,000	2.03
Salary of the workers	3,600,000	0.80
Fuel	4,500,000	1.01
Harvesting	5,000,000	1.12
Operating interest	18,000,000	4.02
Land depreciation	2,000,000	0.45
Fixed asset depreciation	1,000,000	0.22
Other cost	300,000	0.07
Total variable cost (VND)	447,71,000	100.00
Total production (kg)	45,000	
Production cost per kg of Tra fish (VND)	9,950	
Selling price (June 2007)	14,800	

c. Quality assurance at the chain level

At the moment, the role of processing firms is not clear for the pond farming like Mr. F's pond. Mr. F he did not attend any training courses of Pangasius culture provided by supporting institutions. He mentioned that the local authorities do not open such training course and he based on his experiences in Pangasius culture through many years. He can also sell fish directly to processing firms for export. In order to get proper techniques, he always watches television in the "Farmer bridge" program in order to get Pangasius culturing techniques. The problems faced by Mr. F as expressed during the interview can be grouped into main categories: market access and quality of Pangasius.

Market access subsumes problems connected to selling and marketing harvested Pangasius including information on output market. The three most problematic issues mentioned by the owner regarding to market access were:

- the low and fluctuating price
- difficulty to obtain details of processing firm' demands in advance
- processors have already determined where to buy their fish

Quality problems are closed connected to shortcomings with production technology and fish disease treatment. For him, it is clear that a lack of appropriate technology or sufficient know-how will immediately reduce the quality of his fish. In his ideas, he mentioned especially:

- high production cost (feeds and fingerlings)
- difficult to get the high requirements of Pangasius quality from processing firms

outbreak of diseases.

The role of local authorities is also important in term of development culture areas, the level of antibiotics usage as well as veterinary drugs for fish safety, Mr. F mentioned.

d. Business relationships at the farm level

1) Co-operation between the fish farmers and intermediate input suppliers

Currently, Mr. F buys the fingerlings from the fingerlings trader named An. Mr. F has good business relationship with Mr. An and he trusts him. The reason Mr. F chooses him is that he can selects the fingerlings more easily and return the fingerlings of poor quality. Moreover, in the process of transporting fingerling to the Mr. F' pond, Mr. An always guarantee fish quality within 7 days if the quality of the fingerlings is not up to standard. In other words, if Mr. F buys fingerlings from a hatchery, he needs facilities to transport the fish to his farm. And this is difficult for him because he lived far away from hatcheries and buy small quantity of fingerlings. He can also suffer a great loss in transportation.

2) Co-operation among fish farmers

According to Mr. F, he and other fish farmers develop close contacts and exchange information on prices of Pangasius, fingerlings and other related supplies which are important for their primary activities. With regard to fish price, he usually informs each other about the prevailing prices of Pangasius. This information increases the bargaining power of him in negotiating price with processing firm. But most important, the price information is used as base for deciding which processing firm he can sell fish at the harvest. Moreover, Mr. F co-operate with other farmers in buying fingerlings in group. This resulted good quality of fingerlings can be selected.

3) Co-operation between the fish farmers and processing/export firms

In our discussion, the business relation between Mr. F and processing firm has been more commonly characterized by informal agreements than by enforceable contract. The contract has not included a guarantee that the processor will purchase the fish from him. Mr. Khen normally coordinates the amount of fish he produced with the processor at the end of the farming season through a registration process. When Mr. F needed to sell fish, he came to processing company to make a registration for selling fish. The content of registration form includes Pangasius culture system (pond/cage/pen),

average weight per fish, supply volume, culturing area, and date of deliver fish sample. Moreover, the registration form also concludes the guarantees of farmer such as Chloramphenicol, Nitrofuran, Malachite Green, and Fluoroquinolones and Vietnamese banned antibiotics have not been used and that allowed limit antibiotic residues must be stopped 28 days before harvesting. And in case of the antibiotics are found over maximum residue limit (MRL), the processing firm return and claim for a compensation as well. These are some binders between the processing firm and farmer. After Pangasius were testing without antibiotic residues, Mr. F and processing firm start to sign official contract. Prices will be negotiated at the time of signing official contract and depend on the market situation, fish quality and quantity. At that time the results of fish sample taking will be shown. If content, color or size does not match the requirements of the processor the price will be lower or the fish might even be rejected completely. Thus the quality gives problems in the reliability of the relation between the farmer and processor.

This crop he sold Pangasius to Nam Viet company. The reason he chooses Nam Viet for selling, because he can get the payment back within 10 days after harvesting and he had good business relationship with this company in the last two crops. In the harvest, fish price and payment are two most important things the farmers concerned, Mr. F mentioned.

e. Conclusion

This is the typical case for conventional pond farming. The small farmer cultures Pangasius independently and he is not being belonged to any association or fishery clubs. In this case, Mr. F bases mostly on his experiences in quality control at the farm level. Hence, the quality of fish is not stable and guarantee. He needs more training and investment on fish farming practices in order to improve fish quality.

3. Conclusion and further research

This paper represents one of the first multi-case studies with regard to small-scale farming of Pangasius production. The results of case study have shown there are three factors that affect directly to final fish quality products namely (1) fingerlings; (2) feeds; and (3) fish disease treatment. In order to meet the export requirements for Pangasius quality, these factors should be controlled on a proper way. The further research should focus on fish disease treatment due to some reasons:

(1) It affects the requirements of the export market directly
(2) Quality assurance is a major challenge as proper disease treatment is a necessary condition for export market access
(3) Business relationships are expected to play an important role as tests for quality control (proper disease treatment) are incomplete.

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APPENDICES

Appendix 1: The list of experts interview

No.	Name	Position	Interview Method
I.	**Researchers**		
1	Dr. Nguyen Thanh Phuong	Dean of Aquaculture Facultuty, Can tho University	Directly by open questions
2	Dr. Le Xuan Sinh	Aquaculture Facultuty, Can tho University	Directly by open questions
3	Dr. Tu Thanh C	Aquaculture Facultuty, Can tho University	Directly by open questions
4	Dr. Flavio Corsin	Senior Aquaculture advisor, WWF	Directly by open questions
5	Dr. Marc Campet	Aquaculture Manager of Ocialis	Directly by open questions
6	Dr. Philippe Serene	General Manager of IMO	Directly by open questions
7	Mr. Tomas Sporrer	Project manager of SIPPO	Directly by open questions
II.	**Pangasius hatcheries**		
8	Ms. Vo Thi Thanh Van	Deputy director of the An Giang aquacultural research and hatchery production center	Directly by open questions
9	Mr. Tan Hung	Tan Hung hatchery, Phu Loi A commune, Phu Thuan B district, Dong Thap Province	Directly by open questions
10	Ms. Y Van	Binh Thanh hatchery, An Chau district, Long Xuyen city	Directly by open questions
11	Ms. Trieu Thi Phuoi	My Chau hatchery, Chau Doc province	Directly by open questions
III.	**Institutions**		
12	Dr. Nguyen Huu Dzung	General Secretary of VASEP	
13	Mr. Le Chi Binh	Vice chairman of AFA (An Giang fisheries association)	Directly by open questions
14	Mr. Tran Sau	Chairman of CAFA (Can tho fisheries association	Directly by open questions
15	Mr. Nguyen Van Nhi	Deputy director of An Giang Fisheries Department	Directly by open questions
16	Mr. Tran Van Minh	Chief of Long Thanh Fisheries Association, Chau Phu district, An Giang province	Directly by open questions
IV.	**Quality control office**		
17	Nguyen Van Hung	Deputy Director of NAFIQUAVED, Mekong Delta branch	Directly by open questions
18	Nguyen Dinh Xuan Quy	Head of Aquatic Animal of NAFIQUAVED, Mekong Delta branch	Directly by open questions
V.	**Processing/export company**		
19	Buu Huy	Deputy Director of Afiex company, An Giang province	Directly by open questions
20	Vo Dong Duc	Director of Factory, CATACO, Can tho city	Directly by open questions
21	Pham Quoc Khanh	Forwarding of Agifish joint-stock company, An Giang province	Directly by open questions
22	Kim Nhat Thanh	Sales manager of Thuan Hung fisheries company, Can Tho city	Directly by open questions

Appendix 2: The List of Pangasius farmers interview

I.	Group I	Address
	Mr. Vo Van A	Thoi Thuan, Thot Not, Can Tho
	Mr. Nguyen Van B	Vinh Thanh Trung, Chau Phu , An Giang
	Mrs. Nguyen Thi C	My Hoa Hung, Long Xuyen, An Giang
	Mr. Nguyen Van D	Chau Thanh, Long Xuyen, An Giang
	Mr. Nguyen Van E	Binh Thuy, Chau Phu, An Giang
	Mr. Nguyen Van F	Vinh Thanh Trung, Chau Phu , An Giang
II.	**Group II**	**Address**
	An Giang	
	Pond	
	Mr. Nguyen Van Nam	Vinh Thanh Trung, Chau Phu
	Mr. Vo Ke Nghiep	Vinh Thanh Trung, Chau Phu
	Mr. Nguyen Minh Tai	Vinh Thanh Trung, Chau Phu
	Mr. Nguyen Van Hau	Vinh Thanh Trung, Chau Phu
	Mr. Nguyen Cao Ba	Vinh Thanh Trung, Chau Phu
	Cage	
	Mr. Nguyen Van Huu	Da Phuoc, An Phu
	Mr. Nguyen Van Dao	Da Phuoc, An Phu
	Mr. Le Van Luc	Da Phuoc, An Phu
	Net-pen enclosure	
	Mr. Nguyen Van Gon	My Hoa Hung, Long Xuyen
	Mr. Nguyen Van Hoang	My Hoa Hung, Long Xuyen
	Dong Thap	
	Pond	
	Mr. Nguyen Van Hai	Da Phuoc, Hong Ngu
	Mr. Nguyen Van Hau	Da Phuoc, Hong Ngu
	Mr. Nguyen Van Thanh	Da Phuoc, Hong Ngu
	Net- pen enclosure	
	Mr. Nguyen Van Son	An Nhon, Chau Thanh
	Mr. Le Van Dung	Da Phuoc, Hong Ngu
	Can Tho	
	Pond	
	Nguyen Van Xo	Thoi Thuan, Thot Not
	Nguyen Huu Phong	Thoi Thuan, Thot Not
	Tru Ngoc Thanh	Thoi Thuan, Thot Not
	Nguyen Thanh Tong	Thoi Thuan, Thot Not
	Le Van Ngai	Thoi Thuan, Thot Not

Appendix 3

Form No:……..

QUESTIONNAIRE

FOR INTERVIEWING FISH FARMERS IN THE MRD

Research project title

QUALITY IN THE EXPORT PANGASIUS SUPPLY CHAIN IN VIETNAM

Interviewer: ……..

Date:……. ……..

Dec. 2006

CASE STUDY QUESTIONS TO PANGASISUS SMALL-SCALE FARMERS

Good morning (!) I am a SEBA (School of Economics and Business Administration) lecturer of Cantho University. I am studying the quality in the export Pangasius supply chain in Vietnam. The objective of the study aims to **organize the quality assurance system in the fish supply chain of small-scale Pangasius farming in the Mekong River Delta (MRD).** If you do not mind, please tell me what the process that your fish production done by answering the following questions. I ensure to keep secret all answered information of yours.

PART 1: GENERAL QUESTIONS

I. PERSONAL QUESTIONS

1. Name:
2. Age:
3. Sex: ☐ Male
4. Address: Village: District: Province:
5. Telephone number:
6. Education level:
7. Years of experience in Pangasius farming:
8. Number of employees involved in fish activities:
9. Classification of employees:
10. Brain storming questions

- To what extent do you believe the fish quality is facing a problem with regard to the following issues?

No	Factors consideration	Important	Neutral	Not important
1	Production technologies			
2	Input services			
3	Beginning crop			
4	Harvesting crop			
5	Site selection			
6	Design and construction of pond/cage/pen			
7	Preparation and cleaning of pond/cage/pen			
8	Fingerlings and fingerlings stocking			
9	Feeds and feedings			
10	Water management in culture area			
11	Fish health (disease) management			
12	Infrastructure			
13	Capital status			
14	Production cooperation			
15	Payment methods			
16	Local rules in fish culture			
17	Market information			
18	Other (specify)			

II. HISTORY OF THE FARM

1. How many years have you engaged in Pangasius farming?
2. Description your location for Pangasius farming (specify that effect to Pangasius industry)
3. Why did you choose this industry? Reasons/motivation for giving efforts to these works?
4. How did you get Pangasius farming knowledge?
5. How do you explain the knowledge transfer developed through generations?
6. What criteria are used to get access right to Pangasius farming? (e.g. residence rule, membership of a fisheries cooperatives/associations, licence registration, ownership of a land, etc.)
7. Is there any local rule that specifies the area where one can culture Pangasius?
8. Is there any technical requirement that must be followed?
9. Did you attend any training class of culture Pangasius provided by the supporting institutions? □Yes □No
10. If yes, which supporting institutions gave you the lessons? .....
11. What are the criteria for selecting trainee?
12. How many times did you participate in training?
13. What was the content and objective of the training?

Season calendar of Pangasius farming

Month	1	2	3	4	5	6	7	8	9	10	11	12
Dry season												
Raining season												
Water rise up												
Water level subside												
Flood season												
Crop 1												
Crop 2												
North-easterly wind												
Period of diseases												
- Heavy diseases												
- Outbreak												
Discharge of polluted water from rice farm												

Note: Make clear the month of releasing fingerlings, diseases occur, harvesting

PART 2: PRIMARY ACTIVITIES AT FARM LEVEL

III. DETAIL INFORMATION RELATES TO THE PREPARATION FOR PRIMARY PRODUCTION OF PANGASIUS (Third interview)

1. Site selection

Factors consideration for site selection	*Important*	*Neutral*	*Not important*
Specializing of Pangasius area			
Suitable water source			
Technical support availability			
Area security			
Local rules			
Others (specify): - Convenient transportation - Suitable distance between cages			

2. Design and construction of pond/cage/pen

Factors consideration for design and construction cage	*Important*	*Neutral*	*Not important*
Local rules			
Shape of cage			
Financial condition			
Convenience for water inlet and outlet			
Separating feeds cooking area			
Materials for making cage			
Biological requirements			
Others (specify): - Electricity for water pumping			

3. Preparation and cleaning of cage

Factors consideration for preparation and cleaning of cage	*Important*	*Neutral*	*Not important*
Preparation cage after harvesting			
Liming/salting			
Disinfection (dry, chemical)			
Others (specify):			

IV. DETAIL INFORMATION RELATES TO PRIMARY PRODUCTION OF PANGASIUS

(Fourth interview)

1. Fingerlings and fingerlings stocking

Factors consideration for fingerlings and fingerlings stocking	*Important*	*Neutral*	*Not important*
Source of fingerlings			
Fingerling quality			
Density of fingerlings stocking			
Size of fingerlings			
Price of fingerlings			
Fingerlings releasing time			
Local rules for buying fingerlings			
Others (specify):			

2. Feeds and feeding

Factors consideration for feeds and feeding	*Important*	*Neutral*	*Not important*
Type and source of feeds			
Quality of feeds			
Amount of feeds and frequently of feeding			
Formula of feeding			
Method of feeding			
Price of feeds			
Fingerlings releasing time			
Local rules for feeds			
Others (specify):			

3. Water management in culture area

Factors consideration for water management	*Importantt*	*Neutral*	*Not important*
Quality of water supply			
Frequently of water movement			
Water treatment (DO, pH, NH3)			
Local rules for water elimination			
Fingerlings releasing time			
Others (specify):			

4. Fish health (disease) management

Factors consideration for fish health management	*Important*	*Neutral*	*Not important*
external clinical signs of fish			
prevention of fish disease			
fish disease treatment methods			
Source of veterinary drugs			
technical supporting institutions			
Others (specify):			

V. DETAILS FOR COST OF PRODUCTION (Fifth interview)

Please state Tra fish production cost (for the pond area stated above) Area: m2

Items	**Unit**	**Unit value**	**Quantity**	**Value**	**Notes**
Pond preparation (sediment removal, bank adjustment,...)					
Hired labour	Day				
Family labour	Day				
Pond treatment cost before releasing fingerlings					
CaO	Kg				
Dolomite	Kg				
Zeolite	Kg				
Others	Kg				
Eliminating undesired fish					
Saponin	Kg				
Fish killing plant	Kg				
Fingerling cost					
- Tra fingerlings	Head				
- Transportation cost	VND				
Feed cost					
Industrial feed	Kg				
- Fresh feed	Kg				
Veterinary cost					
- Anti-biotic	gram				
- Vitamin	gram				
- Other	gram				
Labour for fish feeding					
Hired	Month				
Family	Month				
Water exchanging cost					
Fuel	Liter				
Labour	Hour				
Harvest cost					
- Labour	Day				

Loan interest	VND				
Other cost	VND				
Total cost	VND				
Output Turnover	Kg VND				

PART 3: QUALITY ASSURANCE AT THE CHAIN LEVEL

VI. THE ROLE OF CHAIN ACTORS TOWARD QUALITY ASSURANCE SYSTEM AT THE CHAIN LEVEL

1.1 Which is the quality assurance system in the fish chain?
1.2 What is the role of processing/export firms in implementing this system?
1.3 Do you have any help from processing/export firms? What is the role of processing/export
1.4 firm in the quality assurance system?
1.5 Do you know any idea regarding how to culture high quality fish? Which quality assurance system that you applied?
1.6 Who help you to know?
1.7 Where do you buy input materials for fish and how do you realize their quality?
1.8 How do you think the perception and behaviour of chain actors toward quality assurance system?
1.9 Do you receive any document related to forbidden anti-biotic? and from where?
1.10 How about local management and extension centre?
1.11 Do extension staffs help you to grow “clean product”? And how?
1.12 Who controls and investigates during your growing time? Please, specify

PART 4: BUSINESS RELATIONSHIPS AT THE SMALL-HOLDER LEVEL

V. FARMER – FARMER COOPERATION

1.1 How do you explain about your relations with other fish farmers?
1.2 Is there any instance that you managed to purchase input through a joint investment with other fish farmers?
1.3 To what extent do you co-operate with other fish farmers in terms of exchanging market information (price, quality, etc.)?
1.4 Can you tell us other areas in which you want to co-operate with other fish farmers?
1.5 Are there traditional fishing co-operatives at village level?
1.6 What is the similarity and difference between old and new fishery cooperatives?
1.7 How do you evaluate the fishery co-operative? (in terms of its objectives, activities, its organisation, members, its relations with fishery authority, its strengths and weaknesses)?
1.8 Do you think the fishery co-operative is effective enough for fish quality?
1.9 1.7 So far, what benefits have you got from the fishery co-operative? (please, specify)
1.10 How do you explain the values/ beliefs of the fishery communities?
1.11 How do these values promote learning and information sharing? (in terms of knowledge transfer from father to son or to cluster members)
1.12 If there is no transfer of knowledge, then how do you get the knowledge?

VIII. FARMER – INPUT SUPPLIERS

2.1 How do you evaluate your relationship with the input suppliers? (fingerling, feed, veterinary drugs suppliers)
2.2 How do you know them?
2.3 How do you choose them?
2.4 Have you made any kind of contractual agreements? (Please, specify)
2.5 How do you evaluate the service they provide? (e.g. just-in-time, good quality, etc.)
2.6 Do you make on the spot payment or the payment procedure is flexible?
2.7 In general, how do you evaluate the co-operative behaviour of the intermediate input owners?

IX FARMER - TRADERS

3.1 How do you explain your relationship with the traders?
3.2 How do you know them?
3.3 How do you choose them?
3.4 How do you exchange information with the traders regarding the price and quality of fish required by the market?
3.5 How credible and important is the information provided?
3.6 What kinds of facilities to you get from the processing firm? (training, credit, input, etc.)
3.7 What are the norms that are helpful in governing the transactions?
3.8 How do you explain the role of trust in governing the transaction?
3.9 How do you manage the conflict that arises during the transactions?

X FARMER – PROCESSING/EXPORT FIRMS

4.1 How do you explain your relationship with the processing firm?
4.2 How do you exchange information with the processing firm regarding the price and quality of fish required by the market?
4.3 Does the processing firm provide information affecting your business?
4.4 If any, how credible and important is the information provided?
4.5 What kinds of facilities to you get from the processing firm? (training, credit, input, etc.)
4.6 What are the norms that are helpful in governing the transactions?
4.7 How do you explain the role of trust in governing the transaction?
4.8 How do manage the conflict that arises during the transactions? (contract farming)

XI ROLE OF LOCAL AUTHORITIES

5.1 Did you participate in the training provided by the supporting institutions? (Please explain for Yes/No)
5.2 What are the criteria for selecting trainee?
5.3 How many times did you participate in training per year?
5.4 How many people from your community got training?
5.5 What are the content and objective of the training?
5.6 Do you think the training you got was very beneficial for your business? (in terms of skill and technology development)
5.7 Do the extension staffs provide proper production techniques? And how?

Thank you for your co-operation!

Appendix 4: Fish chain stakeholder's interview

I. Main questions to interview fisheries association

1.1 Do you know any idea regarding how to grow high quality product?
1.2 Who help you to know? How about local management and Extension centre?
1.3 Where do you buy fingerlings and how do you realize fingerling quality?
1.4 Do you receive any document related to forbidden anti-biotic? and from where?
1.5 Do extension staffs help you to grow "clean product"? And how?
1.6 Who controls and investigates during your growing time? Please, specify
1.7 From where do you buy feed? And you have any help about techniques from them?
1.8 Who buys you product?
1.9 And do you have any help from processing/export firms?
1.10 What do you suggest for getting high product quality with high price?

II. Main questions to interview hatcheries

2.1 Do you know any idea regarding how to grow high quality fingerlings?
2.2 Is there any combination between your hatchery with small farmers and local department to help farmers? And how? Is it necessary? Please, explain for Yes/No
2.3 Do you know any affection from your fingerlings to fish quality at the small farm?
2.4 How do you think the role of small farmers in the chain quality management?
2.5 How do you think that can improve farmers' product quality to meet market requirements?
2.6 Which quality standards are required for fingerlings now? And what are you doing to meet the requirements?
2.7 What do you suggest for getting high product quality?

III. Main questions to interview traders

3.1 Where do you buy product? And how do you know the right time to
3.2 harvest the product?
3.3 How do you recognize "clean product" before buying?
3.4 How about your means for maintaining and ensuring product quality?
3.5 What policies to keep high product quality of processing firms applied to you ?
3.6 Is there any relation between you and local management in ensuring
3.7 product quality and safety?
3.8 How do you think the role of small farmers in the chain quality management?
3.9 What do you suggest for getting high product quality?

IV. Main questions to interview processing/export firms

4.1 How do you buy "clean" raw materials?
4.2 How did you establish the stable relationships with your suppliers?
4.3 Which criteria did the company use to select the suppliers?
4.4 What methods to control and maintain high quality materials from your traders and farmers?
4.5 What methods did the company use to audit supplier quality? (inspection of product, meeting with suppliers to review quality status, review of statistical process control, or test)
4.6 What are the agreements between the company and the suppliers? (oral contract, farming contract). Please, specify.
4.7 What quality systems did the company currently use? Please, specify
4.8 Is there any relation between processing firms, VASEP, NAFIQAVED and local management for control product quality? And how?
4.9 How about quality management and technological investment for quality improvement in your chain?
4.10 Is there any partnership with other processing/export firms? What kind of partnerships?
4.11 How about your transportation means and storage conditions?
4.12 What do you suggest more for quality improvement in the whole chain?

V. Main questions to interview feed wholesaler/veterinary drugs services

5.1 Do you know clearly about your product quality?
5.2 Is there any combination between your hatchery with small farmers and local department to help farmers? And how? Is it necessary? Please, explain for Yes/No
5.3 Do you know any affection from your feed product to fish quality
5.4 grown at the field?
5.5 How do you think the role of small farmers in the chain quality management?
5.6 How do you think that can improve farmers' product quality to meet market requirements?

VI. Main questions to interview NAFIQAVED:

6.1 For whom centres of NAFIQAVED implement their responsibilities? Which aspects?
6.2 How about technology and equipment at the centre?
6.3 How to control and manage hazard infection in provinces?
6.4 What is responsible for processing/export firms' support?
6.5 How to combine management of the centre, local government as well as other support organizations?
6.6 How about market requirements about test level of the hazards?
6.7 What do you think about fisheries culture planning with large scale and relevant issues?
6.8 What do you suggest for quality improvement inside the centre and for the whole chain?

VII. Main questions to interview VASEP

7.1 What areas do you concern for seafood quality and safety regarding management and technology?
7.2 Which policies issued for this goal? And for whom?
7.3 How to implement them?
7.4 How to test and control them?
7.5 How to evaluate the implementation?
7.6 What is linkage between VASEP and other managerial units for quality assurance objectives?
7.7 What do you think about fisheries culture planning with large scale and relevant issues?
7.8 7.8 What do you suggest for fish upply chain quality improvement?

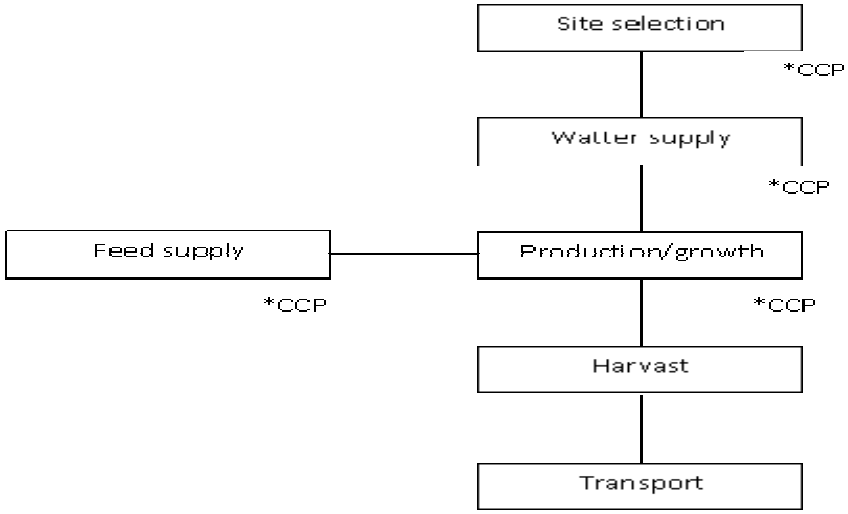
VIII. Main questions to interview the Extension Centre and Fisheries Department

8.1 What areas of fisheries quality and safety do you manage and control in primary production?
8.2 How do you expand them to farmers? How about knowing their implementation and audit?
8.3 How do you know the feedback?
8.4 What areas do you link with other chain organizations (mostly NAFIQAVED) to manage fish quality and safety?
8.5 How about test technology and equipment to help farmers?
8.6 What do you think about fisheries culture planning with large scale and relevant issues?
8.7 What do you suggest for more safe, clean and high quality of products in management and technology?

IX. Main questions to interview Expert

9.1 According to your experience, what managerial aspects in the chain need to focus on fish quality and safety? Who is involved? And why?
9.2 How about technology investment?
9.3 What is the most important management for fish safety and quality in primary production? In processing/export firms? And in other stages of the chain?
9.4 What do you think about fisheries culture planning with large scale and relevant issues?
9.5 What are your suggestions for seafood quality improvement?

Appendix 5: Model flow Diagram for aquaculture production with CCP



(Source: Reilly and Kaferstein, 1997)

Appendix 6: BMPs used

1. Good pond preparation
2. Good quality fingerlings selection
3. Water quality management
4. Feed management
5. Health monitoring/Biosecurity
6. Pond bottom monitoring
7. Disease management
8. Better Harvest and post-harvest Practices
9. Record maintenance/Traceability
10. Environmental awareness

Appendix 7: The results of 20 farmer's survey and chain actors

1. Quality control at the farm level

Main findings are found in the surveys at the farm level:

- Most of the pond farmers interviewed owned the land on which their farm was based. For cage and pen culture system, the farmers have no right property.
- Although some of farmers had been involved with fish farming for many generations, there appeared to be an increasing number of farmers who were starting to practice Pangasius.
- The most common type of small-scale is pond culture
- Most of the fish farmers relied on other farmers or their own experiences for diagnosing and treating their fish stocks. Stocking is a critical period in the production cycle for which farmers need an adequate knowledge in order to ensure a suitable environment for the culture of the young fish
- Most of fish farmers were aware of the important of good pond preparation, high quality of fingerlings, high quality nutrition of feeds and also the important of good water quality.
- Most of farmers bought fingerlings without the documents of fingerlings source and nursing records
- The main months in which fish were stocked tended to be April, May and June compared with any other time
- The main months in which fish were harvested tended to be March, April and December
- Water quality problems were found to occur throughout the year, but a higher number is in January, March and April compared with any other time
- Fish disease occurred throughout the year, but most farmers claimed that disease outbreak in their stocks from October to January compared with any other time of year
- Small scale farmers claimed they received some form of training in fish health and disease outbreaks mainly from the extension officers.
- Treatment application ranged from providing antibiotics mixed in the feed in order to give antibiotics and chemical treatment such as lime, salt and vitamin C
- Fish farmers bough veterinary drugs from drug agents
- Some small scale farmers said they need to have an additional training relating to quality management issues and other resources for quality control i.e. training, technical information, documentation and data.
- Most of fish farmers claimed that the extension staffs did not provide an adequate service to them. Reasons for this were thought to be due to their lack of technical knowledge, lack of appropriate equipment for sampling and lack of people to conduct sampling works.
- It was found from the fish farmer survey (n=20) that 10% of farmers interviewed kept some form of written record about their fish farming activities. The remainder of farmers interviewed found it difficult, if not possible, to recall information relating to other farming activities.
- The information recorded by these farmers was related to their cost associated with fish production. Only one farmer recorded information relating to disease outbreak in his pond. Information relating to fish losses due to disease is necessary to help establish the economic impact of disease outbreak on the livelihoods of the farm.
- In the fish farmer survey (n=20), only 3 farmers kept details records for the duration of research and had previous contacts with the researcher. It was evident from the survey that many small-

scale farmers were unable to recall information related to fish farming practices that they carried out either on a day to a basis. For example, some farmers did not know the number of fish in their pond or were unable to calculate the productivity of their farm, since they did not have the relevant information to do so. They also did not view the exercise as useful and did not see the benefit of keeping records on their culture activities. This in turn may be linked to their perceptions of how important fish farming is to their culture activities and how much time they spend fish farming.

- Regular contact with the researcher (through 2 weeks visiting) did not improve the farmers' willingness to perform the activities asked of them.
- However, the researcher found that most farmers were eager to receive information relating to management and disease prevention for Pangasius culture.

2. Quality assurance systems at the chain level

- Role of small farmers:

Small-holders play the most important role in assuring quality of fish. The type of quality management of Pangasius farming practices in the MRD varies from one farm to another. Most of the farms in Mekong Delta are private (90%) and run by the owner (VASEP, 2006). In the Mekong River Delta, the HACCP system is not yet applied in primary production due to financial, technological and managerial circumstances (Vung, 2007). But now the farmers tend to follow SQF model for Pangasius culture. If the farmers get SQF certificate on their farms, they can sell fish to processing firms easier. However, most of the owners have no technical or academic background in aquaculture and training and competence of the staff is very low. Some of the bigger farms hire competent technical managers but most learned through experience. Hence, most farms are poorly managed and lack basic knowledge on planning, monitoring and selection, purchasing and application of inputs. Throughout the survey, several challenges in Pangasius culture have identified, which quality management and market issues play the major part

3. Business relationship at the small-holder level

<u>* Farmer – input suppliers:</u>

As it has already mentioned, input quality such as fingerling, feeds and veterinary drugs affected directly to fish raw materials. According to small-holders, the most important intermediate inputs to fish farmers are fingerlings producers. They also mentioned that the overall health status of fry and fingerlings is a critical factor for a successful production cycle. The husbandry techniques used in the hatchery (healthy broodstock, good sanitary practices, quality feed and low application of chemicals and drugs) are important to obtain a constant supply of good quality fingerlings. In this case, the role of trust is very important. Trust is believed to be the glue that holds the exchange partners to be close with each other. The farmers view trust as very essential for conducting any kind of business transactions. They trust input suppliers very much that even in case one faces a problem the other does not show opportunistic behaviour. Through out survey, the transformation of production technologies may increase vertical coordination as input suppliers drive through technological change at multiple points in the value chain. In Vietnam, with the increasing introduction of technological packages, small farmers become dependent upon input suppliers. On the one hand, the farmers' knowledge base of production practices is derived from input suppliers who may supply complete

packages of related products as illustrated by the case of APPU model. The business relationship between small farmers and input suppliers is considered in order to improve quality of fish raw materials.

* Farmer – farmers:

The type of cooperation between small fish farmers can be explained in terms of the extent of relationship between two small fish farmers on one hand and the existence of fishery cooperatives/associations on the other. The relationship between two small fish farmers is only limited to technical support and market information exchange about price and demand of fish from processing firms such as color, weight and size of fish. As it has been already stated, the small fish farmers lack the knowledge base of production techniques and capital. However, these problems can be solved by developing partnerships in order to guarantee fish quality and just in time delivery. There are two kinds of farmer-farmer cooperation namely formal organization and informal organization.

The formal organization is fisheries cooperatives. Cooperatives have been recognized as useful means for small farmers to overcome constraints of quality problems The fisheries cooperatives play a leading role in strengthening the participation of small farmers in the supply chain, therefore, this issue is considered in the research. However, in currently, the fishery cooperatives in Vietnam are weak in operation (own survey, 2007). Currently, most of the fishery cooperatives provide some technical training and market information to members only (own survey, 2007).

On the other hand, the informal organizations are formed by farmers themselves on the basis of genuine voluntarism and common interest (own survey, 2007). Currently, these informal organizations namely producer groups and clubs that governed by representative boards may play a role in improving food safety and fish health. Producer groups are formed as the results of the needs of small farmers and vary in form and function depending on the local production profile and socio-economics conditions. Members of these groups may help each other during harvesting seasons, borrow money from each other, establish fishery extension teams and share services. However, their importance remains uncertain because of their lack of legal status and support from local authorities in the region (own survey, 2007). In addition, various forms of farmers' associations occur around an enterprise (often private) based on a specific product and common market objectives, resulting in integrated supply chains from production to marketing. For example, some big companies such as AGIFISH, AFIEX, NAM VIET in An Giang province set up fishery clubs. The clubs supply inputs to club's members and these companies will buy Pangsius products of the club's members.

The thesis will analyze the contribution of formal and informal organizations of small farmers in alleviating the quality problems in the fish supply chain.

* Farmer – trader:

Traders' activities are simple such as buying, storing and transporting fish to processing firms. But they are ones affecting directly to fish quality. The small farmers have to develop good relationships with traders in order to sell fish easily in harvest and get more information in term of quality that required by processing firms. At the moment, most Pangasius traders become employees of the processing/export firms. They usually base on the purchasing plan of processing/export firm such as quantity, price of fish within a week and they will come to everywhere to look for and buy fish from the

farmer. Normally, these traders have a force of local brokers and pay them a commission fee, so that it is easy for them to do business via telephone. They collect fish at contracted farms. In fact, farmers sold fish to these collectors under contract between farmer and the processing/export firms. Moreover, the traders can rent the transporter in the harvest and the transporter gets paid per transport and they are not responsibility for fish quality.

* Farmers – processing/export firms:

Through survey, the relationship between small-holders and processing/export firms has been more commonly characterized by informal agreements than by enforceable contracts. They have not included a guarantee that the processor will purchase the fish from the farmer. Fish farmers normally coordinate the amount of fish they will produce with the processor at the beginning of the farming season through a registration process. Prices will be negotiated at the time of harvest and depend on the market situation, fish quality and quantity. At that time the processor will check the fish quality by taking samples. If content, colour or size do not match the requirements of the processor the price will be lower or the fish might even be rejected completely. At the moment, the weak cooperation between fish farmers and processors was found to limit the efficiency of this link in the Pangasius value chain. The processing/export firms emphasized the low quality of fish provided by the fish farmers. They stated that quality and quantity of purchased inputs was unreliable and did not match processors' demands in many cases. At the time of harvest, the fish often had the wrong size or even contained chemicals and/or antibiotics. The processing/export firms believed that the majority of the small-holders do not have the capacity to improve current production methods on their own.

Appendix 8: Production costs of six case studies

Case 1: Mr. A's pond

- Production cycle: 6 months
- Area of the ponds: 70m x 60m = 4,200m2
- Stocking size of fingerlings: 2.0 cm of body length
- Average price per fingerlings: 500 VND
- Density: 17 fingerlings/m2
- Total of fingerlings releasing: 70,000 fingerlings

*** The production cost calculation**

- Pond preparation: (6 days x 2 persons x 300,000 VND per day) = **3,500,000 VND**
- Pond treatment (2000 kg Cao x 1000 VND/kg + 500 kg salt x 600 VND/kg + 2 kg Vikon x 350,000 VND/kg) = **3,000,000 VND**
- Fingerlings: (70,000 fingerlings x 500 VND/fingerling) = **35,000,000 VND**
- Feeds: (64,000 kg x 1.5 (FCR)x 4800VND/kg) = **460,800,000 VND**
- Chemicals/Veterinary drugs (Sorbitol: 60 kg x 195,000VND/kg + Vitasol: 30kgx100,000 VND/kg + Osamet: 20kg x 13,000VND/kg + Enzym: 1kg x 40,000VND/kg) = **15,000,000VND**
- Salary of the workers (2 persons x 700,000 VND/person/month x 6 months) = **8,400,000 VND**
- Fuel (water pumping) (64 tonnes x 25 liters/ton x 4,000 VND /liter) = **6,400,000 VND**
- Harvesting (net, labour, transportation renting) = **5,000,000 VND**
- Operating interest (150,000,000VND x 1.2%/month x 6month) = **1,080,000 VND**
- Land depreciation: 200,000,000 VND x 1% per crop = **2,000,000 VND**
- Fixed asset depreciation per crop (pipeline, equipment, storage house) = **1,000,000 VND**
- Other cost (electronic, telephone fees, communication costs) = **500,000 VND**

Case 2: Mr. B's cage

- Production cycle: 7 months
- Area of the ponds: 5m x 14m x 4m = 280 m3
- Stocking size of fingerlings: 2.5 cm of body length
- Average price per fingerlings: 800 VND
- Density: 100 fingerlings/m3
- Total of fingerlings releasing: 70,000 fingerlings

*** The production cost calculation**

- Cage preparation: (3 days x 2 persons x 300,000 VND per day) = **1,800,000 VND**
- Fingerlings: (70,000 fingerlings x 800 VND/fingerling) = **56,000,000 VND**
- Feeds: (40,000 kg x 3 (FCR) x 3,000VND/kg) = **360,000,000 VND**
- Chemicals/Veterinary drugs (Sorbitol: 40 kg x 200,000VND/kg + Premix: 10 kg x 100,000 VND/kg + Vitamin C: 40kg x 20,000VND/kg + Enzym: 3kg x 40,000VND/kg) = **9,920,000 VND**

- Salary of the workers (1 persons x 800,000 VND/person/month x 7 months) = **5,600,000 VND**
- Fuel (water pumping) (38 tonnes x 20 liters/ton x 4,000 VND /liter) = **3,040,000 VND**
- Harvesting (net, labour, transportation renting) = **3,000,000 VND**
- Operating interest (100,000,000VND x 3%/month x 7 month) = **21,000,000 VND**
- Cage depreciation: 200,000,000 VND x 10% per crop = **2,000,000 VND**
- Fixed asset depreciation per crop (grinding machine, equipment, storage house) = **1,000,000 VND**
- Other cost (electronic, telephone fees, communication costs) = **400,000 VND**

Case 3: Mrs. C's net-pen enclosure

- Production cycle: 7 months
- Area of the pen: 120m x 85m x 4m = 40,800m3
- Stocking size of fingerlings: 2.5 cm of body length
- Average price per fingerlings: 1,000 VND
- Density: 10 fingerlings/m3
- Total of fingerlings releasing: 200,000 fingerlings

*** The production cost calculation**

- Pen preparation: (5 days x 4 persons x 300,000 VND/person/day) = **6,000,000 VND**
- Pen depreciation = 4% per crop x 1,000,000,000 VND]= **40,000,000 VND**
- Fingerlings: (2000,000 fingerlings x 1000 VND/fingerling) = **200,000,000 VND**
- Feeds: (100,000 kg x 1.7 (FCR)x 0.94 USD/kg x 16.110 VND/USD) = **2,575,976, 000 VND**
- Feed transportation + tax (from Israel): 100,000 kg x 1.7 x 3,000 VND = **510,000,000 VND**
- Salary of the workers (5 persons x 1,000,000 VND/person/month x 7 months) = **35,000,000 VND**
- Fuel (water pumping) (100 tonnes x 25 liters/ton x 4,000 VND /liter) = **10,000,000 VND**
- Land tax per crop = **10,000,000 VND**
- Harvesting (net, labour, transportation renting) = **30,000,000 VND**
- Operating interest (535,714,285VND x 0.8%/month x 7month) = **30,000,000 VND**
- Fixed asset depreciation per crop (pipeline, equipment, storage house) = **2,000,000 VND**
- Other cost (electronic, telephone fees, communication costs) = **3,000,000 VND**

Case 4: Mr. D's pond

- Production cycle: 6 months

- Area of the ponds: 80m x 70m = 5,600m2
- Stocking size of fingerlings: 2.0 cm of body length
- Average price per fingerlings: 500 VND
- Density: 36 fingerlings/m2
- Total of fingerlings releasing: 200,000 fingerlings

*** The production cost calculation**

- Pond preparation: (6 days x 2 persons x 400,000 VND per day) = **4,800,000 VND**
- Pond treatment (2000 kg Cao x 1000 VND/kg + 800 kg salt x 600 VND/kg + 6 kg Vikon x 350,000 VND/kg) = **4,580,000 VND**
- Fingerlings: (200,000 fingerlings x 500 VND/fingerling) = **100,000,000 VND**
- Feeds: (176,000 kg x 1.5 (FCR)x 4900VND/kg) = **1,293,600, 000 VND**
- Chemicals/Veterinary drugs (Zeolite: 50kg x 100,000VND/kg + Vitamin C: 50kg x 80,000 VND/kg + Premix: 50kg x 20,000VND/kg + Enzym: 10kg x 40,000VND/kg) = **10,400,000 VND**
- Salary of the workers (2 persons x 800,000 VND/person/month x 6 months) = **9,600,000 VND**
- Fuel (water pumping) (176 tonnes x 25 liters/ton x 4,000 VND /liter) = **17,600,000 VND**
- Harvesting (net, labour, transportation renting) = **10,000,000 VND**
- Operating interest (250,000,000VND x 1.2%/month x 6month) = **18,000,000 VND**
- Land depreciation: 200,000,000 VND x 1% per crop = **2,000,000 VND**
- Fixed asset depreciation per crop (pipeline, equipment, storage house) = **1,500,000 VND**
- Other cost (electronic, telephone fees, communication costs) = **1,000,000 VND**

Case 5: Mr. E's pond

- Production cycle: 6 months
- Area of the ponds: 120m x 80m = 9,600m2
- Stocking size of fingerlings: 2.5 cm of body length
- Average price per fingerlings: 600 VND
- Density: 25 fingerlings/m2
- Total of fingerlings releasing: 240,000 fingerlings

*** The production cost calculation**

- Pond preparation: (6 days x 4 persons x 300,000 VND per day) = **7,200,000 V**ND
- Pond treatment (2500 kg Cao x 1000 VND/kg + 1500 kg salt x 600 VND/kg + 10 kg Vikon x 350,000 VND/kg) = **6,900,000 VND**
- Fingerlings: (240,000 fingerlings x 600 VND/fingerling) = **144,000,000 VND**
- Feeds: (200,000 kg x 2.3 (FCR)x 3500VND/kg) = **1,610,000, 000 VND**
- Chemicals/Veterinary drugs (Flophenicol: 50kg x 200,000VND/kg + Vitamin C: 100kg x 80,000 VND/kg + Zeolite: 20kg x 100,000VND/kg + Enzym: 50kg x 40,000VND/kg) = **22,000,000 VND**
- Salary of the workers (2 persons x 800,000 VND/person/month x 6 months) = **9,600,000 V**ND
- Fuel (water pumping) (200 tonnes x 25 liters/ton x 4,000 VND /liter) = **20,000,000 VND**
- Harvesting (net, labour, transportation renting) = **15,000,000 VND**

- Operating interest (300,000,000VND x 1.2%/month x 6month) = **21,600,000 VND**
- Land depreciation: 150,000,000 VND x 1% per crop = **1,500,000 VND**
- Fixed asset depreciation per crop (pipeline, equipment, storage house) = **2,000,000 VND**
- Other cost (electronic, telephone fees, communication costs) = **1,500,000 VND**

Case 6: Mr. F's pond

- Production cycle: 6 months
- Area of the ponds: 70m x 60m = 4,200m2
- Stocking size of fingerlings: 2.5 cm of body length
- Average price per fingerlings: 400 VND
- Density: 20 fingerlings/m2
- Total of fingerlings releasing: 84,000 fingerlings

*** The production cost calculation**

- Pond preparation: (2 days x 2 persons x 250,000 VND per day) = **1,000,000 VND**
- Pond treatment (1000 kg Cao x 1000 VND/kg + 1000 kg salt x 600 VND/kg + 10 kg Vikon x 350,000 VND/kg) = **5,100,000 VND**
- Fingerlings: (84,000 fingerlings x 400 VND/fingerling) = **33,600,000 VND**
- Feeds: (45,000 kg x 2.7 (FCR)x 3000VND/kg) = **364,500,000, 000 VND**
- Chemicals/Veterinary drugs (Sorbitol: 40 kg x 195,000VND/kg + Vitasol: 10kg x 100,000 VND/kg + Osamet: 10kg x 13,000VND/kg + Enzym: 2kg x 40,000VND/kg) = **9,110,000VND**
- Salary of the workers (1 persons x 600,000 VND/person/month x 6 months) = **3,600,000 VND**
- Fuel (water pumping) (45 tonnes x 25 liters/ton x 4,000 VND /liter) = **4,500,000 VND**
- Harvesting (net, labour, transportation renting) = **5,000,000 VND**
- Operating interest (100,000,000VND x 3%/month x 6month) = **18,000,000 VND**
- Land depreciation: 200,000,000 VND x 1% per crop = **2,000,000 VND**
- Fixed asset depreciation per crop (pipeline, equipment, storage house) = **1,000,000 VND**
- Other cost (electronic, telephone fees, communication costs) = **300,000 VND**