# Evaluate the feasibility of Pangasius pond farming for waste-water treatment

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***Abstract***

This paper concerned the environmental pollution of water used for Pangasius farming. Principally, pond must be located and constructed to minimize negative impacts on the other users and the environment. Particularly, the main environmental concerns in the Pangasius farming sector are the waste-water released from the farm to river. Therefore, the water in pond farming has to be taken care of and cleaned. Generally, if the Pangasius farmers pay much more attention to waste-water treatment before discharging to the river, they will avoid the problem of a polluted water source.

***Keywords:*** waste-water treatment, Pangasius farming, pond,

## I. INTRODUCTION

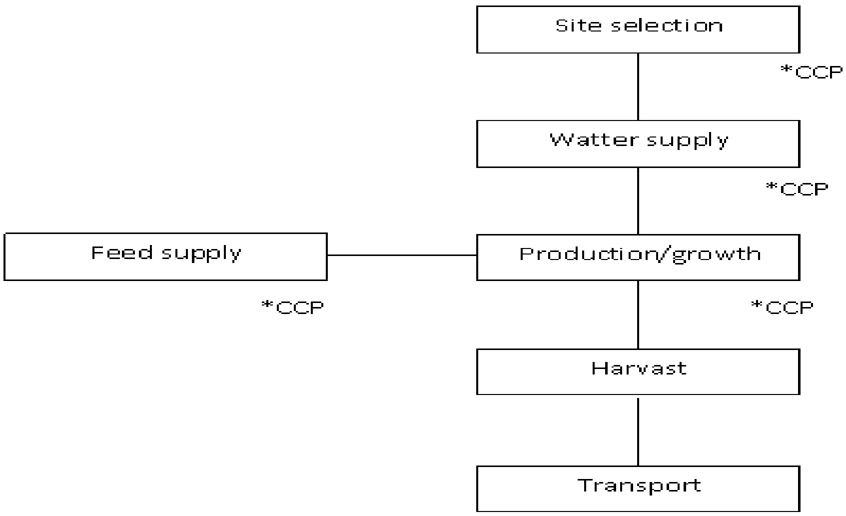
Economic renovation or "Doi moi" policies implemented at the end of the 1980s, and in particular at the beginning of the 1990s, has been important to the development of all sectors of Vietnam's economy, including fisheries and aquaculture. This shift has led to a gradual shift away from state control to market-based mechanisms. Despite this shift, the government of Vietnam maintains an extensive legal and regulatory framework for the development of the fishery sector, governed primarily by the Ministry of Agriculture and Rural Development (MARD) and the Prime Ministers Office. Besides the policies and regulations issued by the central government, some local policies are implemented at the provincial level. This framework is in principle geared to reorienting the nation's economy to higher performance in international markets.

The Pangasius products were infected by antibiotics, microbiology and other contaminants. Many Pangasius containers were sent back or destroyed as a result of the strict import quality controls in the EU and the US.

Government can contribute to providing an effective and enabling farming environment that includes introducing regulations that relate to food safety and quality, and providing arrangements to certify input quality. To implement these activities, law enforcement is needed, which implies a well-functioning official system. If the official system does not work properly, farmers may be reluctant to enter into exchanges. Moreover, governments can enhance the effectiveness of fishery associations' participation in international consultative policy processes by helping them gain access to information and providing funds to recruit experts to include input in the policy dialogue. Therefore, the role of local authorities in disseminating the proper production technology is very important.

## II. RESEARCH DESIGN

The hazard analysis and critical control points (HACCP) system is a management tool for fish safety assurance. While the implementation of HACCP-based safety assurance programs are well advanced in the Pangasius processing sector, the application of such system at the fish farm level is lacking. Reilly & Kaferstein (1997) proposed the critical control points in aquaculture production (Figure 1).




*CCP: Critical control point

**Figure 1** Model flow diagrams of CCPs for aquaculture production (Reilly & Kaferstein, 1997)

There are four CCPs associated with the proposed model in Figure 1., which are steps where control is necessary to prevent or eliminate a fish safety hazard or to reduce it to an acceptable level. These CCPs are site selection or pond location, the water supply, the input (fingerlings, feeds, chemicals) supply, and production or grow-out steps. The nature of CCPs will depend on the aquaculture system and it is essential to consider the unique conditions that exist within each fish farm when developing an HACCP system. The implementation of the HACCP system in fish farms that have adopted good aquacultural practices (GAP), is recommended as a method to improve food safety of aquaculture products (Reilly & Kaferstein, 1997)

*** Gaps analysis at the farm level**

Gap analysis refers to the differences between standards and the delivery of those standards. It indicates the difference between the quality expected by buyers and the practices they actually receive from farmers. There are some quality requirements that related to Pangasius raw materials purchased by buyers such as color, size, disease and antibiotics residues. Specially, it requires that fish farmers undertake quality control at the farm level based on good aquaculture practices (GAP). GAP are defined as those practices of the fish sector that are necessary to produce quality fish products conforming to fish laws and regulations (Reilly & Kaferstein, 1997). It includes the determination of critical control points (CCPs) in order to prevent or reduce food safety hazard to an acceptable level. The CCPs at Pangasius farm level were described in Figure 1. The farmers should apply the control measures at CCPs and monitoring and verifying of CCPs thereby enabling the assurance of fish quality and safety during culture process.

While there is widespread recognition of the need to enhance quality management in Pangasius aquaculture in the Mekong Delta, there remains a great need to increase the understanding and application of better management practices (BMPs) at the farm level. BMPs for Pangasius will be analyzed because they are practical norms that are applicable in small-scale farms. The analysis will focus on the CCPs for fish safety and quality done by farmers practically in order to meet the requirements of market access. From these issues, the gaps of quality assurance will be examined in order to point out the measures necessary to improve and assure fish quality at the farm level.

In Vietnam, particularly, some researches in relation to fishery quality chains were conducted. They focused on a growing customer demand for stable and high quality products. Processors make good products and control product quality. But, hazards are still not free from fish products because there are many quality problems occurred at the primary production. Inadequate quality management during primary production has caused hazardous infection in raw materials. Raw material production is crucial for fish quality as deficient treatment cannot be corrected later. Small farmers play an important role in this part of the production. Aquaculture production in many countries in Asia is from small-scale family-owned smallholders (Silva et al., 2009). Pangasius production supports the livelihoods (directly and indirectly) of 80,000 individuals and provides an additional 105,000 jobs in the processing sector.

## III. RESEARCH FINDINGS

The water pollution is the result of discharges of untreated farm effluent to public river. This can cause self-pollution and disease outbreak, which has resulted in the collapse of business and abandonment of farms. Therefore, the water in pond farming has to be taken care of and cleaned. Generally, if the Pangasius farmers pay much more attention to waste-water treatment before discharging to the river, they will avoid the problem of a polluted water source.

It is needed waste-water treatment system for pond water effluents. Water effluents must meet criteria before being discharged to the outside environment. As a result, the building water treatment system is the most important issue that related to aquaculture environmental pollution.

One research conducted by Lang *et al.*. (2009) to examine the environmental consequences arising from Pangasius pond farming. The results showed that the COD[1] concentration in effluent releasing from pond water was 34mg/l that exceeded the maximum allowable concentration of COD in surface water (<10mg/l) according to Vietnam standards (TCVN 5942 – 1995). Therefore, they proposed the trickling filter technology which is the most cost-effective option of small-scale farmers. In this research we analyze the cost-benefit of constructing waste-water treatment system by applying trickling filter technology for the various scale of pond farming. This research explores the economical aspects of five scenarios with and

[1] Chemical oxygen demand (COD) is a chemical measure of the amount of organic substances in water or waste-water

without waste water treatment system. The costs and benefits of alternative interventions are evaluated using the cost-benefit analysis (CBA) method to support the decision making process of constructing waste-water treatment system. Table 19 presents Pangasius production costs and returns for the assumed base scenario of with and without waste-water treatment system.

Assumption

+ Pond water surface area: 5,000 $m^2$ (average pond area in the small-scale farms)

+ Pond volume: 20,000 $m^3$ (pond water depth of 4 meters)

+ Daily discharged wastewater: 6,000 $m^3$ (average discharged rate of 30%)

+ COD concentration needs treating/cubic meter of wastewater: 0.034 kg/$m^3$

+ COD load needs treating daily: about 200 kg (= 6,000 $m^3$ * 0.034 kg/$m^3$)

+ Pollution load rate (PLR): 0.098 kg of COD/kg of Pangasius produced

+ Life span of trickling filter system: 30 years

+ Water treatment pond (26% x 5,000 $m^2$) = 1300 $m^2$

+ The fish output: 150 tonnes for 5000$m^2$

+ The cost per kg for waste-water treatment is 13,000 VND and profit is 16,000VND

+ The cost per kg for without waste-water treatment is 12,330VND and profit is 13,478VND

Table 1 *Cost benefit analysis of constructing waste-water treatment system*

**Unit: 1,000,000 VND**

| System | Investment cost | Annual OM cost | Production cost | Total cost | Total benefit | B/C ratio |
|---|---|---|---|---|---|---|
| Scenario 1* | 0 | 0 | 3,940 | 3,940 | 4,277 | 1.085 |
| Scenario 2** (NPV) | 887 | 763 | 21,315 | 22,965 | 25,861 | 1.126 |

*Scenario 1 pond areas 5,000 $m^2$ (without waste-water treatment) – one year only
*Scenario 2 pond areas 5,000 $m^2$ (with waste-water treatment) – 30 years

Source: adapted from Lang *et al.*. (2009) and author's calculation, 2018

The results of CBA were presented in table 1. For this analysis, the present value of costs and benefits are combined in order to calculate the net present value (NPV) and B/C ratio of constructing waste-water treatment after 30 years. The flow of costs and benefits were discounted at 10% discount rate. It can be seen from the Table 1 that B/C ratio is greater than 1 for both scenario. However, scenario 2 has a B/C ratio greater than scenario 1. This means that investment in waste-water treatment is more beneficial than not investmenting on these facilities. The viewpoints of this analysis have both economic and social issues for sustainable development and environment – friendly culture of Pangasius.

In order to select the optimal waste-water treatment system, an analysis of scale effect will be made We continue to calculate the NPV, IRR, and BCR for the cases of ponds larger than 5,000$m^2$ such as 10,000 $m^2$, 15,000 $m^2$, or 20,000 $m^2$. The results will give the farmers the optimal selection for constructing waste-water treatment pond. Our objective is to test whether scale effect apply. According to Mr Vinh (2009), we need to consider the cooperation of small-scale farm operators to increase the pond farming areas without increasing the number of farm. For example, the cooperation of 2 farms with total of 10,000 $m^2$ is more effective than 10 farms with total of 10,000 $m^2$. The reason is that more farms would mean more challenges in managing human behavior and organizing small farms together to share cost. An economic analysis of Pangasius production was conducted with four alternative farm areas for waste-water treatment system. Cost benefit analysis for this section focuses on financial perspective of building water treatment system. Financial analysis gives a greater hope for project feasibility as presented by the Net Present Values (NPV), internal rate of return (IRR), and B/C ratio in the outline of cost-benefit analysis. Table 2 shows the results of cost benefit analysis of 4 alternative scenarios with waste-water treatment system.

Table 2 NPV, IRR, and B/C ratio of alternative scenario

Unit: 1,000,000VND

| System | Investment cost | Annual OM[2] cost | Production cost | NPV cost | NPV benefit | NPV profit | B/C ratio | IRR | Cost per kg |
|---|---|---|---|---|---|---|---|---|---|
| Scenario 2** | 887 | 763 | 21,315 | 22,965 | 25,861 | 2,896 | 1.126 | 45% | 0.0142 |
| Scenario 3*** | 1,634 | 1,093 | 42,380 | 45,355 | 51,721 | 6,366 | 1.140 | 52% | 0.014 |
| Scenario 4**** | 2,476, | 1,548 | 62,396 | 67,194 | 77,582 | 10,388 | 1.155 | 55% | 0.0138 |
| Scenario 5**** | 2,791 | 1,991 | 83,714, | 88,495 | 103,442 | 14,945 | 1.169 | 67.42% | 0.0136 |

Scenario 2** pond areas 5,000 $m^2$ (with wastewater treatment) – 30 years
Scenario 3*** pond areas 10,000 $m^2$ (with wastewater treatment) – 30 years
Scenario 4*** pond areas 15,000 $m^2$ (with wastewater treatment) – 30 years
Scenario 5***** pond areas 20,000 $m^2$ (with wastewater treatment) – 30 years

Source: Author's calculation, 2018

It is clearer there is the scale affect to the areas of pond. Expand the farm scale leads to higher NPV. The data confirms rather strongly the direct relationship between farm size and farm efficiency, in that smaller farm size gives a lower net farm income (see table 10.3). Moreover, we look at the cost per kg of fish. The findings showed if the pond farm areas increased from 5000$m^2$ to 20,000 $m^2$, the cost per kg of fish will decrease from 14,208 VND to 13,688 VND.

## IV. CONCLUSION

In conslusion, to construct effectively the waste-water treatment system requires both local government support and the farmers' skills in order to monitor and maintain this system properly. For example, the agricultural infrastructure, particularly irrigation and transportation network, must be improved as a perquisite for better waste-water treatment system practices. As a result, the local government has set up the aquaculture specialization areas to promote more efficient use of the irrigation system for water supply.

[2] OM: Operation and management

Currently, water management in Vietnam is organized based on the law on water resources which came into effect in 1999. The law presents a river basin approach to water resource management involving all stakeholders at national level and aims to strengthen coordination between provinces among the river basins at local level. Moreover, a concept of water right is pointed out and financial obligation of water users, including compensation for polluting water is stated. A fine of 2,000,000 VND is charged to the polluter. In 2012, the Ministry of Natural Resources and Environment (MoNRE) was created and it took over the main water management responsibilities from MARD. MONRE has recently finalized national standards for water quality and is working toward strengthening the environmental monitoring network. In each province of Viet Nam, a Department of Natural Resources and Environment (DoNRE) attached to the People's Committee supports locally the action of the MoNRE.

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