Development of Tilapia cultivation strategy based local economy: case study in Wonogiri, Central Java.

L A Wati¹, N Harahab¹, H Riniwati², and T N Utami²

¹Faculty of Fisheries and Marine Science, Brawijaya University, Jl. Veteran, Malang, East Java Indonesia
²Research Group: The Resilient of Coastal and Fisheries Village

Corresponding author: linaasmara@ub.ac.id

Abstract. Tilapia is one of the fish that can be cultivated on unproductive land. Tilapia is one of the fisheries commodities favoured by the people. This research intends to describe and analyse the strategies for tilapia cultivation development based local economy. Research methods used quantitative and qualitative descriptive approaches. The results of this research indicated that some of the steps taken by cultivators have so far been less than optimal, so that it greatly influences the local economy of the community. Some steps that need to be considered from the perspective of financial analysis and non-financial analysis. The economic analysis explains that if there is an increase in production costs is a significant effect on income. From a non-financial perspective, farmers need to optimum utilize government support for maintaining a product and service quality.

1. Introduction

The Fisheries Region of the Republic of Indonesia includes a. Indonesian waters, b. Rivers, lakes, reservoirs, swamps, and other puddles in the territory of the Republic of Indonesia [1]. According to Law Number 31 of 2004 concerning Fisheries states that fish cultivation is an activity to maintain, raise and breed fish and harvest the results in a controlled environment, including activities that use ships to load, transport, store, cold, handle, process, and preserve it. In aquaculture, water quality is essential [2]. Salinity treatment significantly affected the survival rate and conversion ratio of Tilapia 0-20% [3].

The floating net pens is a culture system in a container in the form of a floating net bag with the help of a buoy and placed in water such as lakes, reservoirs, lagoons, straits, and bays [1]. Floating net pens can be an alternative for farmers to carry out aquaculture activities if they do not have large tracts of land. Tilapia can be cultivated in the net cage [4]. The Tilapia is one of the fisheries favored commodities due to its delicious taste. However, one of the obstacles in the aquaculture business is the high price of commercial feed [5]. Feed as an energy source to grow is the most significant component of production costs, which is 40-89%.

Wonogiri Regency is one of the regions in Central Java which has the Gajah Mungkur Reservoir, with an area of 8,800 hectares. Gajah Mungkur Reservoir used as a tourism and aquaculture activity [6]. An evaluation of the economic aspect would certainly help fish farmers and farm managers to adopt the most sustainable and economically feasible policies [7]. This study aimed to develop a strategy of local economy-based tilapia aquaculture.
2. Methodology
This research uses a qualitative and quantitative research method with a descriptive approach. The focus of this research entitled Tilapia Cultivation Development Strategy Based Local Economy review from a) Cultivation profile, b) Product quality improvement, c) Improving the quality of human resources, d) Increased marketing access, e) Enhancing partnerships, f) Increasing the role of government, g) Increased access to capital.
This research was carried out in the floating net pens tilapia fish farming in Wonogiri District, Wonogiri Regency, Central Java. The time for conducting the study was in December 2018. The selection of this location base on the potential of aquaculture in the Gajah Mungkur Reservoir, Wonogiri District, Central Java, which contains tilapia aquaculture with a marketing strategy that was not optimal. So, it is necessary to develop a cultivation development strategy to improve the local economy.

2.1. Strategy
The strategy is a term for the process of determining the plans of top leaders who focus on the long term goals of the organization, accompanied by the preparation of a way or effort to how these goals can achieve [12]. The strategy is an incremental action based on the perspective of consumers. According to Schendel and Higgins [13], The strategy level is divided into four levels: Enterprise strategy, Corporate sstrategy, Business strategy, Functional strategy.

2.2. Aspects of development strategy
In determining the development strategy of tilapia fish farming based on the local economy, it is not only the economic aspects that we see. Because determining the strategy will influence and affect all characters. The seven aspects for determining the development strategy were technical aspects, management aspects, law aspects, socio and economic aspects, environmental aspects, marketing aspects, and financial aspects [14, 15, 16].

Financial analysis followed a parameter of Net Present Value (NPV), Net Benefit Cost (Net B/C), Internal Rate Return (IRR), and Payback Period (PP).

Net Present Value (NPV) is a combination of present value receipts and present value expenditures.

\[
NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t}
\]

Note:  
Bt = revenue in period t  
n = economic age  
Ct = cost in period t  
i = interest rate

Net Benefit-Cost Ratio (Net B/C Ratio) is a comparison between the present value of positive net benefits and negative net benefits.

\[
Net \frac{B}{C} = \frac{\sum_{t=0}^{n} (B_t - C_t)}{\sum_{t=0}^{n} (C_t - B_t)}
\]

Definition:  
Net B/C < 1 = business not feasible  
Net B/C > 1 = business feasible

Internal Rate of Return (IRR) is an interest rate approach that equates the present value of cash inflows and the present value of cash outflows.
\[ AO = \sum_{i=0}^{n} \left( \frac{At}{(1+i)^2} \right) \]  

(3)

Note:

\( AO = \) cash outflow (initial investment)
\( At = \) cash inflows in period \( t \)
\( R = \) discount rate
\( n = \) the last period of expected cash flow

\[ IRR = i' + (i'' - i') \times \frac{NPV'}{NPV''} \]  

(4)

Definition:

\( i' = \) interest rate that result NPV > 0
\( i'' = \) interest rate that result NPV < 0
\( NPV' = \) NPV at the time of the \( i' \) interest rate
\( NPV'' = \) NPV at the time of the \( i'' \) interest rate

Criteria:

IRR > \( i \) = feasible
IRR < \( i \) = not feasible

Payback Period (PP) is the period required to recoup investment expenses (initial cash investment).

\[ \text{Payback period} = \frac{\text{total investment} \times 12 \text{ months}}{\text{net cash flow}} \]  

(5)

Payback Period < maximum time = project said to be feasible / acceptable
Payback Period > maximum time = project said to be inappropriate / unacceptable

Sensitivity analysis is the study of how the uncertainty in the output of a mathematical model or system (numerical or otherwise) can be divided and allocated to different sources of uncertainty in its inputs.

3. Result and Discussion

3.1. farmer profile

The history of the establishment of tilapia aquaculture activities in floating net pens located in the Gajah Mungkur Reservoir began in 1988, which was initiated by the Fisheries and Animal Husbandry Department, making floating net pens as an example for the community with 45 floating net pens. This time, the people were not too interested in the business because the initial capital spent first to start a business was quite large. Then in 1990, followed by PT. AQUA FARM co-founded the floating net pens business in Gajah Mungkur Reservoir with a market orientation. When the floating net pens owned by PT. AQUA FARM began to develop and produce results. Then, the community participated in trying the floating net pens business with semi-permanent construction, namely from bamboo. In 1990 there were 250 floating net pens plots. Whereas in 2008, there were 540 floating net pens plots. Each floating net pens plot measures 6 x 6 meters with a height of 3 meters. The types of fish that saved the types of tilapia and catfish.

From 2000 until now, the only species of fish that are kept are tilapia because they grow faster and have easier marketing. There are 41 groups of floating fish pens farmers in the Gajah Mungkur reservoir, with each group having 4-50 floating net pens plots. One of the tilapia aquacultures is a group business owned by Mr. Iswanto, which was founded in 2006, and has been developing until this time. Initially, the company that found by Mr. Iswanto only had two pounds, but now the pounds owned by Mr. Iswanto have reached forty-five pounds.

3.2. Product quality improvement
Improving the quality of this product is related to the technical aspects carried out in the cultivation process, such as infrastructure and the process of tilapia culture. Infrastructure facilities in the cultivation process must be qualified following the needs of the cultivation to improve product quality. Some foundations that are very influential in improving enhance the quality of products are access roads, vehicles, and communication tools. Improving product quality is inseparable from the quality and flow of tilapia expansion itself. The process of enlargement of tilapia in floating net pens in the Gajah Mungkur Reservoir there are several stages, there is the stage of seed spreading, the selection stage, and finally, the tilapia enlargement stage and the tilapia harvesting stage.

3.2.1. Stage of stocking of tilapia seeds
The first thing to do in tilapia aquaculture business activities in floating net pens is the sowing of seeds. Spreading the seeds is done on the day to avoid stressed fish, which can result in fish death. Other than that, the seeds that sow are 5-7 in size with a stocking density of 1,000 pcs/pond. In addition to the sowing of seeds in the process of seeds chosen, it is also very influential on the success of tilapia culture if the selected seeds do not have high quality, it will also have a negative impact in the future.

3.2.2. Tilapia fish selection stage
Then two months after the seed distribution process, the tilapia selection phase was carried out. This stage was done to separate larger fish, so there is no competition. Larger fish are transferred to other ponds to be ready to be raised to be prepared for marketing. The selection stage was usually done once every three weeks.

3.2.3. Stage of maintenance and enlargement of tilapia
The last step in the process of culturing tilapia in floating net pens is the process of maintaining and enlarging tilapia. In this process, the thing that considers is the health of the fish and the condition of its waters. In the process of maintaining and enlarging tilapia after the selection process takes one month to two months for fish to be marketed depending on consumer demand. Feeding fish is usually finish three times a day, morning, and afternoon. The feed given is in the form of floating pellets. In addition to feeding fish, it is also essential to pay attention to the condition of the waters to remain stable.

3.2.4. Improving the quality of human resources
Human resources affect all aspects of the human resources owned are of poor quality, and it will affect the quality of the cultivation, marketing, finance, and others.

3.2.4.1. Labor Resources
The source of labor in the cultivation of floating net pens tilapia in Wonogiri is by the family system. The owner of the pens will look for workers who come from his own family. Fish farming in floating net pens is a business that is very vulnerable to fraud so that they have more confidence in their own families to work in pens. As for the pens that are owned by investors, they will bring their laborers who are not automatically the surrounding community. The workforce will learn about cultivation with local workers. However, when the workforce brought by investors cannot develop, investors will take labor from residents who have mastered tilapia fish farming in floating net pens.

3.2.4.2. Total Labor
The total of labors in the cultivation of floating net pens tilapia in Wonogiri depends on the owner of the pens. Ten pens usually employ one to two people. Whereas 3-4 pens often only employ one worker. The owner of the pens helps the workers in the cultivation process and supervises.

3.2.4.3. Labor Training
To improve the skills of the labor in the Wonogiri floating net pens, the owner of the pens or supervisor will conduct labor training before they go down directly in the pens. They are trained to deal with various problems. Labors must know how to deal with issues that occur in pens, such as fish diseases and how to deal with and prevent them.
3.2.4.4. **Labor Facilities**
Facilities obtained by labor in floating net pens are ships and floating houses. The ships are used for transportation if fisherman wants to go ashore and to take needs at the cultivation site. While the floating houses as a place to live for labor in the location of tilapia rearing. Inside the floating house, there is everything need for cultivation, bedding, feed, and other equipment.

3.2.4.5. **Labor Wages**
Wages or rewards are materials given to laborers for the work done following their duties and responsibilities. Payments serve as motivation for employees to improve quality. Wage labor in the floating net pens tilapia for each month is Rp. 1.000.000.

3.2.4.6. **Supervision Process**
The process of supervision in the cultivation of floating net pens tilapia in Wonogiri is direct supervision by the owner of each pen to the laborers in pens. Usually, pens owners will follow the cultivation process directly. So, they can supervise workers during the cultivation process. For pens that own by investors, investors will entrust their pens to business managers who are trusted by them to take care of pens.

3.2.4.7. **Sanctions**
In an organization, it is not uncommon for a subordinate to make a mistake in doing his job. In the floating net pens tilapia in Wonogiri, when a worker makes an error, the first thing his boss makes is to reprimand the worker directly. Then the worker will be guided again until he corrects his errors. If the worker still makes a mistake, the owner of the pen will replace the worker with a new one.

3.2.4.8. **Increased marketing access**
An essential thing when we will increase marketing access is to analyze the marketing strategy first. The marketing aspect is an aspect that is very influential in the success of a business that can be used to determine marketing strategies. By analyzing several aspects of marketing, a company can decide if the company is feasible or not. The marketing aspects use in the floating net pens tilapia business include market segmentation, target market, market position, and marketing mix.

3.2.5. **Market segmentation**
Market segmentation is the process of dividing markets into different groups of buyers based on needs, characteristics, or behaviors that require a separate product mix and marketing mix [12]. In other words, market segmentation is the basis for knowing that each market consists of several different segments. Each consumer group can be selected as a target market for the company to achieve with its marketing mix strategy. Market segmentation in the floating net pens tilapia aquaculture in Gajah Mungkur Reservoir is the closest area to Wonogiri, Solo, and surrounding city. The selection of segmentation is because of their interest in tilapia, and the low price.

3.2.6. **Target market**
The target market is choosing one or more market segmentation to enter or how the company optimizes a market, and in determining the target market, the company must use the concepts of priority, variability, and flexibility. The target market for tilapia will be ship to intermediaries and food stalls. The middlemen chosen are in Jogjakarta because the cultivators do not have transportation yet to send their harvest to the intermediaries. Delivery of tilapia to intermediaries using trucks from the middlemen. Whereas, the selected restaurants are restaurants around the cultivation place because the cultivator can easily send their products using the motor.

3.2.7. **Market position**
Product position in a market is the way the product defined by consumers based on several attributes or where certain products are in the mind of consumers relative to competing products. To maintain the market position of the business owner, business owners maintain consumer confidence by maximizing service to create customer satisfaction. Step take by business owners in maintaining
consumer confidence by keeping the size of fish ordered by consumers and packing when shipping to consumers outside the city. The business owner will pay attention to the size of the fish ordered and keep the fish fresh when it arrives at the delivery location.

3.2.8. Marketing mix

The marketing mix in the tilapia aquaculture business in floating net pens in the Gajah Mungkur Reservoir includes products, prices, places, and promotions.

**Product.** The product produced in aquaculture in the floating net pens is tilapia. The selection of tilapia base on the market because the people of Wonogiri and surrounding areas prefer tilapia as consumption than other fish. **Price.** For one kilogram of tilapia should be sold at IDR 25,000 with the contents of three to four fish. **Place.** The location is very strategic, which is located right on the edge of the highway and close to the tourist attractions of the Gajah Mungkur Reservoir, which facilitates the marketing and production process. Delivery of tilapia is via land transportation. **Promotion.** Promotion conducted by tilapia aquaculture business owners in floating net pens is only through individual or via telephone. The owners have not used the maximum technology available, such as social media. That is because the stock of fish offered still does not meet the maximum consumer demand.

3.2.9. Enhancing partnerships

The partnership of PT Aqua Farm with Minister of Agriculture's under No.940 / KPTS / OT.210 / 10/97 is the AOC pattern (Agribusiness Operational Cooperation). PT Aqua Farm, as a partner company, provides a loan for feed costs (as capital), management, and procurement of production facilities in the form of fish seeds. Whereas partner farmers provide land, facilities, and labor. Besides that, PT. Aqua Farm also plays a role in ensuring the market for tilapia from the nursery partners.

3.2.10. Increasing the role of government

The Government of Wonogiri Regency has a role in the development of the red tilapia enlargement business in Wonogiri District, Wonogiri Regency. The counseling on tilapia culture on floating net pens needs to be improved.

3.2.11. Increased access to capital

Capital is an important thing needed in fish cultivation. The provision of production facilities in the form of seeds and fish feed requires substantial and sustainable costs. One of the weaknesses of the fish group in developing their business is limited capital. There are opportunities for government policy to increase fish production and fish demand.

For improving the Tilapia business, the financial analysis should be performed. Table 1 and Table 2 described the result of the analysis. Based on the analysis, the Tilapia culture in floating net is feasible enough for the business.

**Table 1.** Long-term financial analysis.

| Numb | Analysis | Value          | Explanation                                           |
|------|----------|----------------|-------------------------------------------------------|
| 1    | NPV      | Rp 4,532,510,550 | Showing a positive value means that the cultivation can run. |
| 2    | Net B/C  | 86.6           | Indicates a value higher than one so that the cultivation is feasible to run. |
| 3    | IRR      | 24.2%          | Shows a higher value than the bank interest rate of 12% so that this cultivation is feasible. |
| 4    | PP       | 0.55 year      | It means that when compared to investments in banks, this cultivation is more feasible. |
Table 2. Sensitivity analysis.

| Numb | Assumption          | %  | NPV (Rp)        | Net B/C | IRR (%) | PP (year) |
|------|---------------------|----|----------------|---------|---------|-----------|
| 1    | Benefit (up)        | 120| 3,881,230.64    | 83.2    | 23.6    | 0.57      |
| 2    | Benefit (down)      | 80 | 2,529,439.56    | 54.6    | 13.9    | 0.86      |
| 3    | Cost (up)           | 115| 2,932,820.77    | 56.2    | 15.8    | 0.85      |
|      | Benefit (down)      | 65 |                |         |         |           |

4. Conclusion
The results indicated that some of the steps taken by farmers have so far been less than optimal. The financial analysis explained that the business was still feasible. However, conditions such as government support, product, and service quality need to be improved.

5. References
[1] M Agam 2012 *Journal of Fisheries and Maritime Affairs* 3
[2] Frits 2013 *Journal of Fish Culture* 1
[3] AS Fitria 2012 *Journal of Aquaculture Management and Technology* 1 18-34
[4] A Djunaedi, R Hartati, R Pribadi, S Redjeki, RW Astuti, Septiarani and Bintang 2016 *Tropical marine journal* 19 131-142
[5] Afrianto and L Evi 2005 *Fish feed*. Yogyakarta: Kanasius, 2005.
[6] R Pramoda 2017 *Social Economy and Fisheries Journal* 3
[7] El-Sayed and MA Fattah 2006 *Tilapia Culture* (CABI)
[8] RL Kaufman and AJM Kester 1982 *61* 2143-2166
[9] H Saanin, Taxonomies and Keys 1984 *To Fish Identification, second* (Bogor: Binacipta)
[10] K Amri and Khairuman 2008 *Smartbook Cultivation 15 Fish Consumption* (Jakarta: Agro Media Pustaka)
[11] Shinta 2010 *Fisheries Journal* 5
[12] D Hendika, Z Arifin and Sunarti 2015 *Journal of Business Administration* 29
[13] D Schendel and CH Higgins 1985 *Strategic Decision Making. For public organizations and Non-profit Organizations, 1 ed.* (Jakarta: Grasindo)
[14] LA Wati 2018 *Analyzing the development of Indonesia shrimp industry*
[15] V Christensen and J Maclean 2011 *Ecosystem Approaches to Fisheries: A Global Perspective* (Cambridge: Cambridge University Press)
[16] M Milazzo 1998 *Subsidies in world fisheries: a re-examination. World Bank Technical Paper* (Washington DC: The World Bank)