Feasibility Analysis of Tilapia Fish Farming in Floating Net Cages (KJA) in Lake Ranau

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Abstract
Lake Ranau is located on the border of West Lampung Regency, Lampung Province and South Ogan Komering Ulu Regency, South Sumatra Province. Lake Ranau has functions including ecological and socio-economic cultural functions. Some important technical aspects in a tilapia aquaculture business in KJA include KJA components, maintenance/production processes ranging from seed stocking, feeding to harvesting and constraints faced by farmers during the production process. The criteria observed in determining the feasibility of tilapia KJA cultivation include: investment costs, profits, profitability, BEP (Break Event Point) and R / C Ratio (Revenue Cost Ratio). Economically, tilapia aquaculture in KJA in the waters of Lake Ranau is profitable and feasible for both category I and category II. The profitability value of this KJA farming business is 115% for category I and 119% for category II. The R/C ratio value in one production cycle is 2.15 for category I and 2.19 for category II which means the business is feasible to establish.

Keywords: Lake Ranau; Feasibility; Tilapia; Floating Net Cages

Introduction
Lake Ranau has a water surface area of approximately 12,398 hectares (123.98 km\(^2\)), is the second largest lake on the island of Sumatra after Lake Toba in North Sumatra. Lake Ranau is located in two administrative areas, in South Ogan Komering Ulu Regency of South Sumatra Province covering an area of 8,423 ha and in West Lampung Regency of Lampung Province covering an area of 4,167 ha. The Lake Ranau region has great potential in the field of fisheries, especially for the development of fish farming with the Floating Net Cage (KJA) system. Floating Net Cages offer several important advantages such as: Use of non-drainable water bodies suitable for aquaculture, management flexibility with multiple production units, ease and low cost of harvesting, close proximity facilitates observation of feeding response and fish health and relatively low capital investment compared to other culture techniques.

One of the most widely cultured species is tilapia (Oreochromis niloticus). Positive characteristics of tilapia in aquaculture are its good tolerance to water quality and the fact that it feeds on a variety of natural food organisms. In Indonesia and Thailand, cage culture of O. niloticus and red tilapia is practiced in rivers, irrigation canals and lakes/reservoirs using semi-intensive and intensive methods. KJA tilapia in Indonesia is mostly found in West Java, Jambi, South Sumatra and Kalimantan.

Profitability is the ability of a business to make a profit from its business. Profitability can be seen from the ratio of the comparison of profit or business profits obtained with the investment invested. Short-term analysis is conducted to determine the feasibility of a business within one year. Short-term investment analysis can be done by calculating several values such as profit, profitability,
BEP (Break Event Point) and R/C Ratio (Revenue Cost Ratio). In calculating profits, financial analysis is used which is grouped into fixed capital, working capital, total investment, fixed costs, variable costs, total costs, gross income and net business income. The purpose of this study was to determine the investment value, income and feasibility of tilapia fish farming in KJA in Lake Ranau.

**Research Methods**

The method used in this research is the survey method. Determination of respondents is done by purposive sampling, data collection, namely primary data and secondary data is done by interview.

**Data Analysis**

Business profit is the amount of revenue earned by the costs incurred for the production process, both fixed costs and non-fixed costs or variable costs. Profits can be found using the formula:

$$\pi = TR - TC$$

$\pi$ = Profit  
$TR$ = Total Revenue  
$TC$ = Total Cost

The profitability of a business shows the ratio between profit and the capital that produces that profit. It is the ability of a business to generate profits over a certain period of time. To calculate the rentability value can be calculated by the formula:

$$R = \frac{L}{M} \times 100\%$$

$L$ = The amount of profit or profit earned during a certain period  
$M$ = Capital used to generate profit

BEP (Break Event Point) is an analytical technique to study the relationship between fixed and variable costs, profits and volume of activity. BEP is used to determine how much business results must be generated to determine the break-even point of a business. BEP calculations can be done with the formula:

$$BEP = \frac{FC}{P - V}$$

$FC$ = fixed cost  
$P$ = selling price per unit  
$V$ = variable cost

Revenue Cost Ratio (R/C Ratio), which is the ratio or balance between total revenue and total costs, with the formula:

$$R/C \text{ Ratio} = \frac{TR}{TC}$$

$TR$ = Total Revenue  
$TC$ = Total Effort (Cost)

The criteria are:

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If the R/C value > 1, then the business is profitable
If the R/C value = 1, then the business breaks even
If the R/C value < 1, then the business is losing money.

The payback period can be done by summing up all the capital invested and then dividing the profit earned in one year. The formula used is as follows:

\[
\text{Payback period} = \frac{\text{Total Invest}}{\text{Profitability}}
\]

Results and Discussion

Overview of Lake Ranau Waters

Lake Ranau is located on the border of West Lampung Regency, Lampung Province and South Ogan Komering Ulu Regency, South Sumatra Province. Its geographical position is approximately between 4° 51'59" - 4° 58'42" LS and between 103° 55'07" - 104° 01'37" East. Administratively, the water area of Lake Ranau is included in Banding Agung sub-district, South OKU (Ogan Komering Ulu) Regency, South Sumatra Province covering an area of 84.23 km² and the remaining 41.67 km² is included in the administrative area of West Lampung Regency, Lampung Province.

Lake Ranau has functions including ecological and socio-economic cultural functions. Some of its functions include as a source of clean water, a source of fisheries and a place for various aquatic biota to live, a producer of fish and aquatic plants, a source of electricity (PLTA), a regulator of water management, and as a center of religious activities and traditions. Lake Ranau waters are used for drinking water, agriculture, fisheries, transportation and as a leading tourist attraction for Lampung and South Sumatra provinces.

The waters of Lake Ranau, especially the waters of Lumbok Seminung, are the most commonly established KJA locations. From observations in the field, some important technical aspects in a tilapia farming business in KJA include KJA components, maintenance/production processes ranging from seed stocking, feeding to harvesting, labor and constraints faced by farmers during the production process.

Floating Net Cage Component

In the process of establishing a tilapia farming business in KJA, the main component required is the assembly of KJA construction. In general, KJA in the research location uses iron frames, bamboo, wood and fiber drum floats. The use of iron as the main frame of KJA aims to make the cage frame last longer than just using bamboo and wood. The iron used is 5 meters long, 5 cm wide and 4 mm thick. Bamboo is also used as a tool to support the cage at the bottom of the cage frame, the bamboo used is generally larger than the iron frame, with a total of 40 sticks in one KJA unit. This framework serves as a place to place the rectangular bag.

Each cage unit consists of two or four mesh bags. The net used is a net made of polyethylene (PE 210 D/12) with a mesh size of 1 inch. The cage unit has bags with a size of 5 x 5 x 7 meters, the number of bags is adjusted to the ability of the cultivator, generally there are 2 and 4 bags in one unit. Weights or anchors are attached to the bottom of the cage net so that it can be spread out perfectly.

Fish Maintenance

The tilapia rearing process at the research site is generally carried out for a 3-month rearing
period. The seed used is black tilapia seed. Observations show that most of the seeds are currently obtained from local nurseries. Some farmers have their own hatchery ponds but there are still farmers who do not have hatchery ponds.

Feeding is the largest cost component in the process of tilapia cultivation in KJA. Farmers incur feed costs for tilapia during the 3-month rearing period. Additional feed given to fish is artificial feed in the form of pellets purchased from traders outside the area with trucks as a means of transportation. Feed spent in one production cycle can reach 14 tons with the type of maintenance with 2 bags. Starter grower feed is given for 1 month of rearing, usually consuming 750 kg to 1000 kg of feed or 15 - 20 sacks of feed in two bag rearing and two 40 sacks of feed for four bag rearing type. In the second month of rearing until harvest, grower feed or feed that matches the mouth opening of the fish is used. The protein content of the feed is 28 - 30%. Grower feed is given until the fish are 3 months old or the fish are ready to be harvested and on average consumes 12,000 kg or 240 sacks of feed for two rearing bags.

From the feeding, it can be seen the value of the ratio of the amount of feed to the resulting fish production. The FCR (Food Conversion Ratio) feed conversion value for tilapia enlargement in net cages observed in the research location is 1:1. This means that for every 1 kg of tilapia produced, 1 kg of additional feed (pellets) is required. This can be realized due to various important supporting factors, such as good water quality conditions, and a survival rate of 85%.

Cultivation Constraints

The obstacle faced in the tilapia enlargement business in KJA is the mass death of fish caused by the upwelling process. The phenomenon of stirring from the bottom of the lake causes harmful organic matter such as ammonia and sulfur to rise to the surface and cause low dissolved oxygen content. However, the timing of this problem cannot be predicted, some farmers stated that there are signs before the stirring phenomenon occurs, namely the presence of waves and winds that come continuously over a period of one week. Within one year, the occurrence of upwelling may not be felt by farmers.

Investment in Floating Net Cage Business

To find out the total cost of investment invested by farmers in KJA business in Lake Ranau waters is done by calculating all investment expenditures both fixed capital (MT) and working capital (MK).

Fixed Capital

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<th>Jumlah Kategori II</th>
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<th>Harga (Rp) Kategori II</th>
<th>Bahan Unit</th>
<th>Biaya (Rp) Kategori I</th>
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Figure 1. Fixed Capital

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Fixed capital expenditures are incurred at the beginning of the first year to procure KJA business such as: iron, bamboo, wood, drum floats, nets, anchors, boats, cage installation costs and electricity (Figure 1). There are two categories of KJA with 2 bags (Category I) and 4 bags (Category II) in one unit. The results show the value of fixed capital costs for category I KJA amounting to Rp. 46,200,000 and for category II KJA with 4 bags amounting to Rp. 73,700,000. The total investment of category II KJA businesses is greater than category I KJA businesses, this is because category II KJA businesses are larger in scale so that the components needed are more than category I businesses.

**Working Capital**

The components of working capital costs incurred in the KJA tilapia aquaculture business in the waters of Lake Ranau can be seen in Figure 2. The largest cost in working capital is the cost of feed which reached Rp. 126,600,000 for category I and Rp. 252,600,000 for category II. Based on the calculation of working capital, it was found that for one production cycle, it costs Rp. 156,100,000 for category I and Rp. 305,900,000 for category II. Meanwhile, for a production period of 1 year, it will cost Rp. 624,400,000 for category I and Rp. 1,223,600,000 for category II.

**Business Income**

Business income is the result of sales received from the amount of KJA production multiplied by the selling price of tilapia. Based on the results of the calculation it can be seen that the net income obtained from category I KJA business amounted to Rp. 719,600,000 per year and for category II KJA business obtained a net income of Rp. 1,464,400,000 per year with a total of four production periods. This net income can be obtained if the lake water conditions are in normal conditions, stable physical and chemical conditions of the waters and minimal attacks of pests and diseases. However, when there is mass mortality of fish due to upwelling, the income earned in a year is far below the income earned when the quality of lake waters is normal.

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</table>

**Figure 2. Working Capital**

**R/C Ratio**

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R/C (Revenue Cost) Ratio is the ratio between total revenue and total costs incurred (Hasnidar et al., 2017). The R/C ratio value in one production cycle from the calculation results is 2.15 for category I and 2.19 for category II. A business is said to be feasible and profitable if the R/C value is greater than 1 (R/C>1). The greater the R/C value, the more feasible a business is. From the calculation results, the R/C ratio value is 2.15 and 2.19. Because the value of R/C>1, it can be concluded that tilapia farming in KJA in Lake Ranau waters is profitable and feasible for both category I and category II.

Rentability

Rentability shows the level of investment ability to generate profits (Widjayayanti, 2015). The profitability value of this KJA cultivation business is 115% for category I and 119% for category II. This value means that in its operation the cultivator gets a high profit which is more than 100% of the invested capital. Wowor et al. (2016) conducted a study on the feasibility analysis of tilapia aquaculture and obtained a profitability value of 166%. This shows that tilapia farming is a profitable business, because profitability is the ratio of net profit to the investment of one business unit.

Break Event Point (BEP)

There are two types of BEP values, namely sales BEP and unit BEP. Sales and unit BEP analysis describes the break-even point of a business and this value is the reference value that must be achieved by aquaculture entrepreneurs for zero profit, meaning that fish production and sales must be more than sales and unit BEP (Sambuaga et al., 2016). The results of the calculation obtained the sales BEP value of tilapia aquaculture business amounted to Rp. 58,998,260 for category I, while the sales BEP value for category II was Rp. 93,160,362. Based on this value, it can be said that tilapia aquaculture business in KJA in Lake Ranau waters experienced a break-even point when it has sold fish for Rp. 58,998,260 (category I) and Rp. 93,160,362 (category II). For BEP unit, the value obtained for category I is 2,458 kg and 3,881 kg for category II. The value means that tilapia aquaculture business activities in KJA waters of Lake Ranau will break even if it has succeeded in producing and selling fish as much as 2,458 kg and 3,881 kg from each category. Based on the BEP value, it can be said that tilapia farming in KJA waters of Lake Ranau has exceeded the break-even point and means the business is profitable.

Payback Period (PP)

Payback Period is a value where from this value it can be seen how long the business run can return the capital invested both fixed and non-fixed capital (Mahyuddin et al., 2014). The results of the payback period analysis which is a comparison between the amount of investment and profit obtained a value of 0.25 years for category I, and 0.20 years for category II. 0.25 years when converted into months is 3 months, which means that the investment invested will return the investment used for 3 months for category I. For category II, the PP value obtained after being converted into months is 2.4 months, which means that the investment invested will return the investment used for 2.4 months. In this case, category II businesses have a faster PP value, so that the amount of capital spent will also quickly return. In addition, the production of tilapia is relatively fast with a maintenance time of three months already producing consumption-sized tilapia, which causes the investment to return quickly.

Conclusion

Based on the results of research that has been conducted in the waters of Lake Ranau, the following conclusions are obtained: the value of fixed capital costs for category I KJA is Rp. 46,200,000 and for category II KJA with 4 bags amounting to Rp. 73,700,000. Working capital costs for one production cycle cost Rp. 156,100,000 in category I and Rp. 305,900,000 for category II. The
net income obtained from category I KJA business amounted to Rp. 719,600,000 per year and for category II KJA business obtained a net income of Rp. 1,464,400,000 per year with a total of four production periods.

Economically, tilapia aquaculture in KJA in Lake Ranau waters is profitable and feasible for both category I and category II. The profitability value of this KJA farming business is 115% for category I and 119% for category II. The R/C ratio value in one production cycle is 2.15 for category I and 2.19 for category II which means the business is feasible to establish.

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