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# The economies of scale of catfish pond culture in Banjar Regency, South Kalimantan

**Irma Febrianty[1], Emmy Sri Mahreda[1], Alim Bachri[2], Fatmawati[1]**

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[1]*Department of Fisheries and Marine Science, University of Lambung Mangkurat, Banjarbaru, South Kalimantan, Indonesia*

[2]*Department of Economic, Faculty of Economics and Business, University of Lambung Mangkurat, Banjarbaru, South Kalimantan, Indonesia*

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**Key words:** Size of production, Business feasibility, Catfish.

**Abstract**

Catfish pond culture in Banjar Regency has been widely practiced by fish-farmers from various scales of production, however, there was no study that shows comparison of which size is the most cost-effective. Therefore this study is needed to obtain the most cost-effective scale of production to start business with and in contrast to previous studies that only examined one economies of scale. The purpose of this study was to analyze the most cost-effective scale of production in catfish pond culture. The method used in this study is stratifying each scale of production in catfish pond culture. The data were collected by stratified random sampling. The investment criteria at each scale of production were used as the business feasibility analysis. The results showed that the large-scale production has the highest feasibility values (IRR 94,9), this was due to the amount of investments that was invested, and the good business management carried out by the owner based on his 25 years' fish farming experience. The small-scale production (IRR 94,65) was ranked second in terms of feasibility compared to the medium-scale (IRR 93,9), this was because the small-scale production did not spend a lot of investment costs. In general, small-scale farmers do not incur investment costs for machinery and feed structures, and the ponds built by most respondents are soil-based ponds. The medium-scale production were spending more investment costs for the ponds construction, machinery and feed structures. In conclusion, based on their level of feasibility, the most cost-effective scale of production can be sorted as large, small and medium-scale production.

***Corresponding Author:** Nopi Stiyati Prihatini ✉ ns.prihatini@ulm.ac.id

## Introduction

Banjar Regency is one of the fisheries centers in South Kalimantan. As one of the fisheries centers, Banjar Regency is developed to be one of the minapolitan areas for freshwater cultivation. This regency has the potential of public waters and sea waters (coastal areas). Estuarine/brackish waters in Banjar Regency are in Aluh-Aluh District with an area of +354.38 ha, a technical irrigation system (drainage) of 25,900 ha, and reservoir area of 9,730 ha. This potential has been used by the community for capture fisheries and aquaculture activities. The fisheries resources which are the mainstay of fisheries commodities in Banjar Regency, especially in the Minapolitan area aquaculture, are catfish and tilapia. Of all the fisheries potential that have been utilized, in 2015, the fish culture production reached 33,070.32 tons with a production value of > 750 billion Rupiah.

Fish-farmers have long tried various scales of production for aquaculture. The land sizes owned by the fish-farmers are quite diverse, this can indicate the scales of production of the fish-farmers.

Based on the statistic data of Banjar Regency (Table 1), the fish-farmers land sizes are ranging from < 0.1 ha to > 0.5 ha. When viewed from their land sizes, the fish-farmers in Banjar Regency who entered the micro-scale are 73 production households (Rumah Tangga Produksi – RTP), 505 RTPs are small-scale, and 93 RTPs are medium-scale while the large-scale has not been recorded.

Based on the facts in the field in 2014, the largest catfish pond culture in South Kalimantan suffered losses so that the farm was closed. The farm had a total land area of 170 ha where 90 ha of it was made into ponds. This shows the inefficient investment in the large-scale production. Based on the initial survey, most farmers start farming on a small-scale production, but in its development this scale is quite slow, this can be seen from the products it produces.
As a center for freshwater aquaculture, especially catfish, Banjar Regency will attract other investors/farmers. The new investors will require information about the economies of scale, which is very necessary, because at this time, the investors who have funds and want to start fish farming businesses do not know at which size of production they will have to start to avoid large losses.

The formulation of the problem was seen from the catfish pond culture background in Banjar Regency which consists of various scales of production, so it is important to know which scales of production to start business with, from the micro, small, medium and large-scale production. This study aimed to analyze the most economical scales of production of catfish pond culture in Banjar Regency.

## Materials and methods

*Time and Place*

The study was conducted in May 2017 until July 2018. The study took place in Martapura City and West Martapura District in Banjar Regency, with consideration that the area was a center of catfish pond culture with a population of 90 RTPs consisting of various scales of production (from the initial survey). The scales of production were based on the provisions of the Minister of Maritime Affairs and Fisheries Regulation No. 13 of 2008 and the Regulation of the Minister of Marine and Fisheries No. 05 of 2009, namely the micro, small, medium and large-scale production.

*Data sources*

The data taken in this study was primary data and secondary data. The primary data include: respondent identities, investment costs, fixed costs, variable costs, benefits and other matters related to this study. Whereas the secondary data was obtained from relevant agencies and literatures related to this study.

*Sampling techniques*

Sampling was carried out by stratified random sampling by stratifying each scale of production of catfish pond culture. Micro-scale (<1000 $m^2$), small-

scale (1000 – 5000 m²), medium-scale (>5000 – 20,000 m²) and large-scale production (>20,000 m²). The determination of the scales of production carried out based on the area of the cultivation business unit owned by farmers.

*Data analysis*

The analysis used in this study was detailed as follows: The business feasibility analysis used in this study was to use the investment criteria on each scale of production, namely micro-scale, small-scale, medium-scale and large-scale production, according to Clive Gray *et al*. (2005) as follows:

*NPV (Net Present Value)*

NPV is the difference between the present value of cash inflows (benefits) and the present value of cash outflows (costs). The purpose of NPV analysis of catfish (*Pangasius pangasius*) pond culture is to find out the business profit if it is assessed based on the interest rate at the Bank.

*Investment criteria*

Positive NPV, then the investment is accepted, and if Negative NPV, the investment should be rejected.

*Net Benefit Cost Ratio (Net B/C)*

Net B/C Ratio shows a comparison between all the benefit (cash inflows) values with all the costs (cash outflows) values over the life of a project with a certain interest rate.

*Criteria*

If Net BCR > 1 means that the project is profitable and vice versa if Net BCR < 1 means that the project is not profitable.

*Internal Rate of Return (IRR)*

IRR shows the discount rate value when the NPV = 0. Usually the IRR formula cannot be solved directly, but can be approached by interpolation, namely by first determining the positive NPV and the negative NPV with each interest rate.

*Criteria*

If IRR > i (discount rate), means NPV > 0, indicating that the project is profitable.

**Results and discussion**

The results showed that from 45 respondents, 3 (scale of production) was obtained from the 4 scales of production based on the provisions of the Minister of Maritime Affairs and Fisheries Regulation No. 13 of 2008 and the Regulation of the Minister of Marine and Fisheries No. 05 of 2009, namely the micro, small, medium and large-scale production.

The scales of catfish pond culture production in Banjar Regency are small, medium and large-scale production. From 45 respondents, the most scale of production in Banjar Regency was the small-scale production with 26 RTPs, the medium-scale was 17 RTPs and the large-scale was 2 RTPs.

**Table 1.** The numbers of pond culture households according to the category of their scale of production in Banjar Regency.

| N No. | Regency | Total (RTP) | Size of Production Category Based on Land Sizes | | | |
|---|---|---|---|---|---|---|
| | | | < 0.1 ha (<1000m²) | 0.1-0.3 Ha (1000-3000m²) | 0.3-0.5 Ha (3000-5000m²) | >0.5 Ha (>5000m²) |
| 1 | Banjar | 671 | 73 | 406 | 99 | 93 |

Source: Statistics of the Fisheries and Maritime Service in 2015 .

*Small-scale production*

The small-scale production has the characteristics of land sizes of 2000 - 5000 m2. The investment costs of small-scale production come from the components of land purchase, pond constructions, guard house, water pump, feed machine and nets. Fixed costs include permanent labor wages, maintenance costs and depreciation costs. Variable costs include the costs of seeds, feed, diesel fuel, medicines, lime, and harvest costs. The business conditions can be seen in the Table 2.

**Table 2.** Average investment costs, fixed costs, variable costs and acceptance of small-scale production.

| No. | Type of cost/Benefit | Value (IDR/Year) |
|---|---|---|
| 1. | Investment costs | 191,717,301 |
| 2. | Fixed costs | 44,909,202 |
| 3. | Variable costs | 137,775,043 |
| 4. | Benefits | 364,118,461 |

The investment costs of small-scale production come from the components of land purchase, pond constructions, guard house, water pump, feed machine and nets. Fixed costs include permanent labor wages, maintenance costs and depreciation costs. Variable costs include the cost of seeds, feed, diesel fuel, medicines, lime, and harvest costs. The results of the business feasibility analysis for the small-scale production show that the value meets the feasibility criteria which means that the catfish culture in small-scale ponds is feasible to continue.

**Table 3.** Results of feasibility analysis of small-scale production.

| No. | Feasibility criteria | Value | Information |
|---|---|---|---|
| 1. | NPV @ 12% | IDR 1,119,347,625 | NPV > 0, the business is feasible |
| 2. | Net B/C @ 12% | 1.69 | Net B/C > 1, the business is feasible |
| 3. | IRR | 94.894% | IRR is greater than the applicable interest rate, the business is feasible |

Source: Primary data processed.

*Medium-scale production*

The results of the costs and benefits analysis of the medium-scale production are in Table 4.

The investment costs of the medium-scale production are derived from the components of land purchase, pond constructions, guard house, water pump, feed machine, feed-making warehouse and nets. Fixed costs include permanent labor wages, maintenance costs, electricity and depreciation costs. Variable costs include the cost of seeds, feed, diesel fuel, medicines, lime, and harvest costs. The results of the business feasibility analysis for the medium-scale production show that the value meets the feasibility criteria which means that the catfish culture in medium-scale ponds is feasible to continue.

**Table 4.** Average investment costs, fixed costs, variable costs and acceptance of medium-scale production.

| No. | Type of cost/Benefit | Value (IDR/Year) |
|---|---|---|
| 1. | Investment costs | 394,455,882 |
| 2. | Fixed costs | 30,369,095 |
| 3. | Variable costs | 194,192,235 |
| 4. | Benefits | 601,995,882 |

*Large-scale production*

The results of the analysis of the cost and acceptance of large-scale production are in Table 6.

The investment costs of large-scale production come from land purchase, pond constructions, guard house, water pumps, feed machines, feed-making warehouse and net components. Fixed costs include permanent labor wages, maintenance costs, electricity, freight cars and depreciation costs. Variable costs include the cost of seeds, feed, diesel fuel, medicines, lime, and harvest costs.

The results of the business feasibility analysis (Table 7) for large-scale production shows that the value meets the feasibility criteria which means the catfish culture in large-scale ponds is feasible to continue. Unlike the small and medium-scale production, the IRR value on a large-scale production is exceeding 100% therefore it is written infinitely.

**Table 5.** Results of feasibility analysis of medium-scale production.

| No. | Feasibility criteria | Value | Information |
|---|---|---|---|
| 1. | NPV @ 12% | IDR 1,695,351,797 | NPV > 0, the business is feasible |
| 2. | Net B/C @ 12% | 1.5 | Net B/C > 1, the business is feasible |
| 3. | IRR | 93.90% | IRR is greater than the applicable interest rate, the business is feasible |

Source: Primary data processed.

The data on the field show that there are only 3 (three) scale of production in Banjar Regency, namely small, medium and large-scale production. The micro-scale production was nowhere to be found. The criteria were based on the Regulation of the Minister of Maritime Affairs and Fisheries No. 13 of 2008 and the Regulation of the Minister of Marine and Fisheries No. 05 of 2009. The absence of the micro-scale production was based on the data that show that the land sizes owned by the catfish farmers is greater than 1000 m², this shows that the available land for catfish culture in Banjar Regency is still widely available.

**Table 6.** Average investment costs, fixed costs, variable costs and acceptance of large-scale production.

| No. | Type of cost/Benefit | Value (IDR/Year) |
|---|---|---|
| 1. | Investment costs | 1,738,325.000 |
| 2. | Fixed costs | 1,378,643,900 |
| 3. | Variable costs | 238,300,000 |
| 4. | Benefits | 3,420,000,000 |

Source: Primary data processed.

The results of the business feasibility analysis (Table 8) show that all small, medium and large-scale production meet the feasibility criteria to be further attempted. The difference is the values obtained, where the large-scale production has a higher level of feasibility, followed by small and medium-scale production.

**Table 7.** Results of feasibility analysis of large-scale production.

| No. | Feasibility criteria | Value | Information |
|---|---|---|---|
| 1. | NPV @ 12% | IDR 12,105,737,999 | NPV > 0, the business is feasible |
| 2. | Net B/C @ 12% | 1.82 | Net B/C > 1, the business is feasible |
| 3. | IRR | ∞ | IRR is greater than the applicable interest rate, the business is feasible |

Source: Primary data processed.

The large-scale production has the highest feasibility value, this is due to the amount of investment invested, and the good business management carried out by the owner based on the 25 years' of experience in fish farming. The feasibility of the small-scale production is higher than the medium-scale, this is because the small-scale production does not spend much on investment costs. In general, they do not

spend investment costs such as machinery and feed structures and generally the ponds are constructed from soil. The medium-scale production is spending more investment costs for the manufacture of ponds from cement, machinery and feed structures.

Small-scale production is considered a small contribution to the economy, but from Michele Barnes-Mauthe study, it is known to contribute significantly to food security, act as a livelihood, and improving the welfare of fishermen on the coast, but long-term management strategies for ecological sustainability and fishermen's economy is still needed.

**Table 8.** Comparison of the feasibility level value of the large, medium and small-scale production.

| No. | Scale of production | NPV | Net B/C | IRR |
|---|---|---|---|---|
| 1. | Large | IDR 12,105,737,999 | 1.82 | ∞ |
| 2. | Small | IDR 1,119,347,625 | 1.69 | 94.65 |
| 3. | Medium | IDR 1,695,351,797 | 1.5 | 93.90 |

Source: Primary data processed.

There's a need for national and regional policies for the long-term development of small-scale capture fisheries.

The study of Michele Barnes-Mauthe (2013) show that the small-scale fisheries sector employs 87% of the adult population, generates an average of 82% of household income, and provides a single source of protein in 99% of all household foods.

In 2010, an estimated 5524 metric tons (t) of fish and invertebrates were captured annually by small-scale fishermen in the region, mainly from coral reef ecosystems, of which 83% were sold commercially, producing fisheries income of nearly $ 6.0 million. When calculating subsistence catches, the total annual catch has an estimated value of $ 6.9 million.

Francese Maynou's (2012) analyzed the socioeconomic status of these small-scale fisheries using economic indicators derived from data obtained through questionnaires.

The results show that the economic profitability of this activity is low, and under the current economic situation. As producers of high-quality fresh fish at relatively high prices, small-scale fishermen must have a good future if the factors that influence low economic viability can be improved (such as the excessive fishing pressure on resources because they are shared with commercial or other recreational fishermen, and the inadequate price system).

Business feasibility is used to see whether the investment invested provides benefits for the future, the results of this study show that all scales are feasible to continue and can be compared with the previous study. Litara's (2015) study of catfish culture with pond area of 1,058.37 m2 in Kampar District in Riau Province, shows that the largest production facilities allocation is the use of fish feed which is 77.72% of the total costs, the average production cost was IDR 43,273,744.44 with an average production of 4,320 kg. The average income received was IDR 47,515,000.00 with a profit rate of IDR 4,241,255.56 with an RCR value of 1.09. Based on the area of the pond analyzed, the catfish culture is included in the of small-scale category, while for other scales, there is no comparison.

Rosalina (2013) studied on The Business Feasibility Analysis of Catfish Cultivation in Tarpaulin Ponds in Namang Village, Central Bangka Regency. Based on the result of this study, with an investment of IDR 8,680,000 (not including operational costs which consist of fixed costs and variable costs) then the

value of the income to cost ratio (R/C) in catfish culture was 1.78. The payback period (PP) for 0.53 years. The BEP of catfish production in the first year was 844 kg. The catfish sales in the second year up to the fifth year will reach BEP of 1,012 kg/year. NPV value is IDR 33,482,143.00 and IRR value being 62%.

Business feasibility is inseparable from good business management, where the large-scale production has good business management resulting in the greatest feasibility analysis value. This can be seen from the study results of Robert L. *et al.* regarding future management in the field of fisheries.

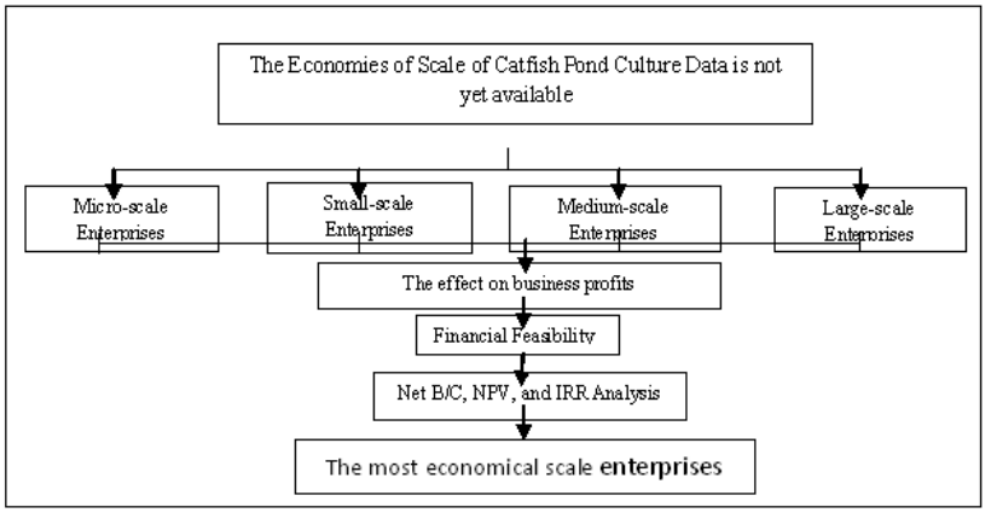


**Fig. 1.** Research design.

Robert L. Stephenson and Daniel E. Lane (2011) says that the future management in the field of fisheries must focus on integrated fisheries, not only on fish populations, it requires a combination of biological considerations that are in accordance with fisheries operational, social and economic considerations. This requires the development of both an appropriate conceptual framework and methodology for interdisciplinary decision making in fisheries management. The researcher proposes the integration of traditional fields of fisheries and management science with a scientific approach to management science to form Fisheries Management Sciences. Fisheries management science provides a framework and methodology for defining various objectives and constraints, modeling of alternative management scenarios, and assessing and managing risks. This framework accepts a variety of sources of information towards anticipatory decision making and consensus building and offers a new paradigm in which effective fisheries management. Business feasibility is very dependent on investment costs, fixed costs, variable costs used, costs incurred will affect the benefits earned.

The results of a study by Andrew Jeffs, Simon Hooker (2007), a profitable spiny lobster culture will depend heavily on reducing investment and operating costs of land-based agricultural operations, as well as reducing feed and labor costs. Financial simulations show that increasing productivity through faster growth rates and decreasing cultural mortality will only have little effect on profitability unless investment and operational costs can be significantly reduced. Sea cage culture or sea ranching barbed lobsters may offer ways to avoid high investment costs associated with land-based farming operations. Development of artificial feed that can effectively reduce costs will be a priority to improve economic prospects for cultivating spiny lobsters.

The results of this study are relevant to the development of spiny lobster cultivation in other temperate regions of the world.

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