Business analysis of vaname shrimp (*Litopenaeus vannamei*) culture in traditional ponds with monoculture system in Sedati, Sidoarjo

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**Abstract.** This study was aimed to analyze the culture business of vaname shrimp in a traditional pond with a monoculture system in Sedati, Sidoarjo, East Java, Indonesia. The study location was chosen intentionally (purposive) as considered to be one of the production locations of vaname shrimp (*Litopenaeus vannamei*) in Sidoarjo Regency. This study used a descriptive method. Data were collected through an observation method. The business analysis results showed that the monoculture system of vaname shrimp in Sedati was feasible to be developed and implemented. This can be seen based on the income value with IDR 30,048,939. The R/C ratio value was 1.86. The PP value was 3 and BEP value was IDR 13,345,778. The producer surplus received by vaname shrimp farmers in Sedati District per hectare of ponds reached IDR 22,283,561/year, therefore the total economic value of vaname shrimp monoculture in Sedati with 143 ha pond area reached IDR 3,186,549,167/year.

1. Introduction

The fishery subsector contributes considerably to support the Indonesian economy. This influences the Indonesian gross domestic product (GDP). The fishery subsectors increased 14.41% higher than the agricultural and animal farming sector with 10.43% [1]. Shrimp culture is a fisheries sector that serves as a large non-oil foreign exchange source for Indonesia. The domestic shrimp production in 2012 reached 460,000 tons, producing a foreign exchange until IDR 5.9 trillion. The foreign exchange revenue from the shrimp production is predicted to increase up to IDR 31 trillion [2]. One shrimp that becomes the main culture commodity is white shrimp or vaname shrimp. Vaname shrimp is a shrimp that entered Indonesia in the early 2000s as originated from America [3].

Aquaculture is a potential activity that can support the coastal community economy in Sidoarjo regency as the biggest fishery subsector activity that reaches more than 40% [4]. Aquaculture activities in Sidoarjo Regency have vast areas for vaname shrimp cultures, which reaches 15,531.4 ha [4]. Sedati District, Sidoarjo has a positive development on brackishwater ponds, namely in Tambak Cemandi, Kalanganyar, and Segoro Tambak Village. Each village has a different commodity either vaname shrimp or milkfish. This culture business has been done from generation to generation either
using the monoculture or polyculture system. The latest maintenance pattern is still on the semi-intensive level, which relatively results in a low production rate [5].

Business analysis is a way to identify business feasibility in terms of economics, engineering, and financial. A business is deemed worthy as capable of producing profit on a certain period time [6]. The optimum utilization of the pond culture area in Sedati for the development of monoculture will help improving the pond productivity and farmer welfare. Monoculture ponds should be able to provide economical and social benefits for farmers and the community, therefore monoculture farming is worth to be implemented.

The problem found on the traditional vaname shrimp culture is the inability to maximize the cultivation area. The culture factor complained by farmers is high production cost, especially feed, medicines, and fertilizer cost. This factor can affect the profit produced. The amount of production, income, and yield gained by farmers on each pond is influenced by the knowledge and skill of farmers, business capital, and culture experience [5]. Based on this case, it is necessary to analyze the vaname shrimp monoculture business on a traditional pond in Sedati District, Sidoarjo regency.

2. Materials and methods

2.1. Location and period

This study was conducted in Tambak Cemandi, Kalanganyar, and Segoro Tambak Village, Sedati, Sidoarjo, East Java, Indonesia. The study location was chosen intentionally (purposive) as considered to be one of the largest production locations vaname shrimp culture (Litopenaeus vannamei) in Sidoarjo. The study was conducted in February – March 2018.

2.2. Method

This study used a descriptive method by figuring the monoculture business system in vaname shrimp culture through a survey in Sedati, Sidoarjo, East Java, Indonesia [7].

2.3. Data collection

Data were collected using an observation method. According to previous study [7], observation is part of the collection of data or information that must be conducted through an observation effort directly to the determined location. Data were collected from the respondents using questionnaires and interviews to dig more information about the business analysis of vaname shrimp monoculture activities.

2.4. Population and sample

2.4.1. Population

According to previous study [7], the population is the whole study subject. The population in this study were all vaname shrimp pond monoculture farmers in Sedati with a total of 33 people.

Table 1. The number of vaname shrimp farmers based on pond business area in study location

| No. | Village            | Vaname shrimp farmers |
|-----|--------------------|-----------------------|
| 1   | Tambak Cemandi     | 5                     |
| 2   | Kalanganyar        | 15                    |
| 3   | Segoro Tambak      | 13                    |
| 4   | Banjar Kemuning    | 0                     |
| Total|                    | 33                    |

2.4.2. Samples

According to previous study [8], samples are part of the number and characteristics owned by the population. According to previous study [9], when the subject had a large number, then it could be taken between 10-15% or 20-25% or more depending on:

A. The ability of researchers based on period, effort, and funds.
B. The observation area of each subject as concerned with the data gained.
C. Small risks incurred by researchers. For researchers who were at great risk, large samples would be much better of results would be better.

Based on the opinions that had been expressed above, sampling was performed 100% of the population due to only 33 subjects contained in the population.

2.5. Data analysis
Data analysis as a data simplification process into a more readable and implementable form [10], then performed data processing and analysis. The data and information obtained were processed using Microsoft Excel.

2.6. Business analysis
According to previous study [11], fishery business analysis was a financial checking to determine the business success achieved during the fishery business activities. Business analysis in this study included the analysis of business revenues, break even point (BEP), payback period (PP), and revenue cost ratio.

2.6.1. Business revenue
The business revenue was analyzed based on the difference between the total receiver and cost presented in Indonesian Rupiah (IDR). This analysis was aimed to identify the profit gained from the business [12].

2.6.2. Revenue cost ratio (R/C)
The Revenue Cost Ratio (R/C) was the comparative value between the total receiver and cost based on [13] as system could be written in the following formula:

\[ R/C = \frac{\text{Total revenue}}{\text{Operational cost}} \]

R/C > 1 means business gained a profit, R/C < 1 means business gained a loss, and R/C = 1 means the break even point was created.

2.6.3. Break even point (BEP)
BEP was a break even where the amount of income and cost equal or balanced without any profits or losses gained. BEP was calculated based on the fixed and variable cost, and selling results [14]. BEP could be calculated by the formula:

\[
\begin{align*}
\text{BEP Production} &= \frac{\text{Operational cost}}{\text{Selling price/unit/kg}} \\
\text{BEP Price} &= \frac{\text{Operational cost}}{\text{Total production}}
\end{align*}
\]

2.6.4. Payback period (PP)
The payback period is the approximate return period of capital or investment for business activities. The formula was [15]:

\[ PP = \frac{\text{Investment \times 1 year}}{\text{Profit}} \]
3. Result and discussion

3.1. Result

3.1.1. Respondents business analysis of vaname shrimp monoculture system in Sedati, Sidoarjo

33 farmer respondents in this study owned ponds in Sedati, as 15 farmers from Kalanganyar Village, 5 farmers from Tambak Cemandi Village, and 13 farmers from Segoro Tambak Village. Respondents or samples chosen were used as a population prediction characteristic. Farmer respondent data were presented in Table 2.

Table 2. Respondent characteristics

| No. | Characteristics       | Farmer | Percentage (%) |
|-----|-----------------------|--------|----------------|
| 1.  | Age:                  |        |                |
|     | 30 – 39               | 9      | 28 %           |
|     | 40 – 49               | 14     | 42 %           |
|     | 50 – 59               | 10     | 30 %           |
| 2.  | Sex:                  |        |                |
|     | Male                  | 33     | 100 %          |
|     | Female                | 0      | 0 %            |
| 3.  | Educational background: |      |                |
|     | Elementary school     | 6      | 19 %           |
|     | Middle school         | 11     | 33 %           |
|     | High school           | 14     | 42 %           |
|     | Bachelor              | 2      | 6 %            |

3.1.2. The average of production value on vaname shrimp monoculture system (Litopenaeus vannamei) in Sedati, Sidoarjo

A. Production cost

Production cost was a cost component invested by farmers to obtain materials needed during the monoculture system business activity. The average production cost on monoculture pond per ha in one year was presented in Table 3.

Table 3. The average of production cost in monoculture system

| No. | Component                  | Ha/year cost (IDR) |
|-----|----------------------------|--------------------|
| 1.  | Fixed cost                |                    |
|     | Pond tax                  | 387,879            |
|     | Pond rehabilitation       | 500,909            |
|     | Worker salary             | 9,869,697          |
|     | Pond rent                 | 363,636            |
|     | Total                     | 11,122,121         |
| 2.  | Variable cost             |                    |
|     | Vaname shrimp seeds       | 3,910,000          |
|     | Medicines                 | 168,182            |
|     | Fertilizer                | 393,182            |
|     | Fuel                      | 545,227            |
|     | Total                     | 5,016,591          |
| 3.  | Total production cost     | 16,138,712         |

B. Production cost analysis

The production cost was the harvesting result obtained from the culture. The average of production value on vaname shrimp monoculture system per ha pond in a year was presented in Table 4.
3.1.3. Vaname shrimp (Litopenaeus vanamei) monoculture production in Sedati, Sidoarjo

Techniques carried out in the culture business of vaname shrimp monoculture system in Sedati included culture activities, marketing strategies, and culture management. In culture activities, vaname shrimp seeds stocked were obtained from Gresik and Lamongan. Vaname shrimp seeds stocked were at the PL 10-12 stage size with F1 quality. Shrimp seeds were stocked after the pond preparation was completed approximately 5-8 days. The maintenance carried out in traditional shrimp monoculture shrimp ponds included pond control activities and feeding. The type of feed used for cultivation could be divided into two, namely natural food and artificial feed. The definition of natural food was usually used in the initial period of rearing (larva and seed size), while the artificial feed was given to fish rearing. The natural feed contained with high enough protein, fat, crude fiber, vitamins, and minerals that were quite complete so that it was very beneficial for fish [16, 17, 18], [17]. Some types of natural food that were commonly used are Chlorella, Spirulina, Dunaliella, Porphyridium, Artemia, Moina, Daphnia, water fleas, maggots, maggots, and worms [19, 20, 21]. The natural feed was a type of a feed available in waters which was a primary producer or first high consumer [22, 23, 24]. Artificial or commercial feed was a feed that was made with attention to the nutritional content needed by fish and its physical appearance, both color and attractive aroma. The need for food depends on the type of fish being kept, for example, carnivores (meat-eaters), omnivores (eaters of everything), or plant-eaters (herbivores). The harvesting process was carried out gradually. Vaname shrimp harvest was performed partially as the maintenance was short for about 3 months to reach 60 size.

The producer surplus-value of vaname shrimp monoculture in Sedati namely per hectare pond was IDR 22,283,561/year. The total land area for the pond was 143 Ha for shrimp monoculture. Therefore, as all ponds managed by the respondents in Sedati were utilized and produced for shrimp monoculture ponds, hence the total economic value of monoculture area in Sedati was IDR 3,186,549,167/year. The analysis results showed that the vaname shrimp culture produced a high producer surplus following [25, 26].

The average of vaname shrimp monoculture area was 4.33 Ha. The pond preparation on monoculture pond was aimed to improve the pond construction that has been damaged such as pond leakage, organic material removal, good soil and water quality maintenance for monoculture pond

### Table 4. The average of production value on vaname shrimp monoculture system

| Business revenue | Production/season (Kg) | Price (IDR/Kg) | Production value (IDR/ha) |
|------------------|------------------------|----------------|--------------------------|
| Vaname shrimp    | 160                    | 79,848         | 12,807,424               |

#### C. Producer of surplus analysis

The producer surplus was calculated from the difference in product revenue and cost. The economical value was obtained from the producer surplus value on vaname shrimp monoculture system in Sedati as presented in Table 5.

### Table 5. The economical value of culture area utilization

| No.   | Component                        | Cost (IDR) |
|-------|----------------------------------|------------|
| 1.    | Production revenue (ha/year)     | 38,422,273 |
| 2.    | Production cost (ha/year)        |            |
|       | a. Fixed cost                    | 11,122,121 |
|       | b. Variable cost                 | 5,016,591  |
|       | c. Total production cost         | 16,138,712 |
| 3.    | Producer surplus (ha/year)       | 22,283,561 |
|       | Total economical value/year      | 3,186,549,167 |

**Table 4.** The average of production value on vaname shrimp monoculture system

**Table 5.** The economical value of culture area utilization
business, pest and competitor eradication, and commodity disruptors [27, 28, 29]. The pond control carried out was pond condition checking, water quality maintenance, and pest prevention. Feeding was only done by a few farmers as they assume that natural feed was sufficient to fulfill the nutritional content of shrimp vaname to save the production cost [30, 31, 32].

For marketing strategy, the interview results of each respondent farmer obtained marketed vaname shrimps in various sizes among 40-70 per kg along with different vaname shrimp prices. The vaname shrimp price on the culture level was IDR 70,000-80,000/kg following the decision of collectors and market price. Based on the interview results, farmers thought that the price they received from the monoculture production was still quite good and based on the prevailing market prices. Vaname shrimp monoculture farmers sold their product to traders, restaurants, and markets inside and outside Sidoarjo, and the community. The distribution of vaname shrimp was carried out directly from farmers to collectors, people around Sedati District, and several fish markets, such as Sidoarjo and Pabean fish market.

The marketing strategy according to [33] was based on a thorough analysis of the company’s external and internal environmental factors. Judging from the vaname shrimp monoculture production, this business was quite beneficial. When the whole pond was utilized optimally for shrimp culture, the maximum contribution was produced to obtain an economic value. This could help increase the community income and welfare in Sedati. The management aspect essentially assesses the business managers and organizational structures existing [34]. The management system of the monoculture system in Sedati was still relatively simple. In Sedati, the shrimp monoculture business was an individual business.

Inflow was everything that can increase business cashflow revenue [35]. Residual value helped the reception at the end of IDR 38,422,273. The projected results in the next ten years showed that the selling price of vaname shrimp in the first year was smaller than the following years. This was due to the initial period was used to make investments for pond preparation and three time harvest.

The reinvestment cost was a cashflow related to the cash age of an investment project. There were 5 components in reinvestment cost, namely water pumps, water opener, culture net, harvesting net, and harvesting gear. Based on the interview result, the pond tax for each pond was different. The average value of pond tax in Sedati was IDR 389,879. The pond rehabilitation cost was generally issued twice a year. It was also known that the rehabilitation process was done within a week of harvesting time. The rehabilitation cost on each respondent was varied as it was averagely IDR 500,909/year.

About the culture business management, the management system carried out by farmers was the daily business activity management and control as well as production result notation and production costs incurred on each season. The control system was implemented to maintain the marketed product quality and quantity. Result notation and production costs increment were done to make sure the profit gained by farmers from their fishpond business.

The worker service management in a monoculture system was used by the culture owners who had another job or more than one area. The salary received by the workers reached 1.2 million/month. Based on the interview results, there were 13 of 33 respondents who used workers. The average total cost incurred for the worker’s salary was IDR 9,869,697/year. The pond rental cost in this study was around 3 million/ha/year. It was known that there were 5 farmers who managed the business with the ownership of 16 ha pond rental, therefore the average rental cost for a monoculture pond in Sedati was IDR 363,636/ha/year.

The vaname shrimp seeds on each season were 25,000-50,000 seeds/ha. The seed distribution was performed three times per year. The vaname shrimp seeds were stocked with the size of PL 10-12 at the price of IDR 22/seed. The average total cost to purchase vaname shrimp seeds for the monoculture business in Sedati was IDR 3,910,000/ha/year.

The type of medication used was Lodang. In general, the use of Anyok provided in a year was 16-30 sack/ha with IDR 7,500/sack. The total cost to purchase Anyok was IDR 168,182/ha/year. The fertilizer type used in the study site was a ZA fertilizer (Petrokimia, Indonesia) subsidized from
Sidoarjo government. The fertilizer was performed based on the needs and conditions of the monoculture pond. The total cost for purchasing the fertilizer was IDR 393,182/ha/year. The purchase of fuel oil was conducted to operate the water pump. The type of fuel used was solar with IDR 7,500/L. The average total cost for purchasing fuel was IDR 545,227/year.

Benefit flow or inflow from monoculture pond business was obtained annually, while the remaining investment value was not used up during the business period. The average income obtained by monoculture farmers on each harvest season was around IDR 12,804,793/ha or IDR 38,422,273 ha/year.

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Increment flow or commonly called outflow of monoculture pond business was divided into three cost types, namely investment, fixed, and variable cost. The investment cost calculated on the cashflow contained the investment cost in the first year and reinvestment cost during the project period. The initial investment cost contained pond construction and facilitation investment. The average of initial investment could be seen in Table 6.

| No. | Investment type | Unit | Technical age (year) | Total cost (IDR) |
|-----|----------------|------|----------------------|-----------------|
| 1.  | Land           | Ha   | 5                    | 40,349,650      |
| 2.  | Water pump     | Unit |                      | 2,272,727       |
| 3.  | Water opener   | Unit |                      | 1,718,182       |
| 4.  | Culture net    | Unit |                      | 522,727         |
| 5.  | Harvesting net | Unit | 5                    | 1,048,485       |
| 6.  | Harvesting gear| Unit | 5                    | 813,636         |
| 7.  | Guard house    | Unit | 10                   | 2,290,909       |
|     | Total Investment Cost |       |                      | 49,016,317      |

A fixed cost incurred in the monoculture business contained tax, pond rehabilitation, salary, and pond rent cost. The average fixed cost on monoculture system in Sedati could be seen in Table 7.

| No. | Component          | Cost Ha/year (IDR) |
|-----|--------------------|--------------------|
| 1.  | Land tax           | 387,879            |
| 2.  | Pond rehabilitation| 500,909            |
| 3.  | Worker salary      | 9,869,697          |
| 4.  | Pond rent          | 363,636            |
|     | Total Fixed Cost   | 11,122,121         |

Variable cost incurred on the monoculture system in Sedati contained vaname shrimp seed, medicine, fertilizer, feed, and fuel cost. The average of variable cost on monoculture system in Sedati can be seen on Table 8.
Table 8. The average of variable cost on vaname shrimp monoculture system

| No. | Component            | Biaya Hektar/Tahun (IDR) |
|-----|----------------------|--------------------------|
| 1.  | Vaname shrimp seeds  | 3,910,000                |
| 2.  | Medicines            | 168,182                  |
| 3.  | Fertilizer           | 393,182                  |
| 4.  | Fuel                 | 545,227                  |
|     | Total Variable Cost  | 5,016,591                |

Table 9. The average analysis of vaname shrimp monoculture business income

| No. | Component       | Total (IDR Ha/year) |
|-----|-----------------|---------------------|
| 1.  | Total revenue   | 30,048,939          |
| 2.  | Total production cost | 16,138,712       |
|     | Business income | 13,910,227          |

R/C ratio analysis was obtained from the division of total revenue and production cost. R/C ratio analysis was performed to observe whether the production cost resulted in a sufficient revenue to obtain profit and assess the cost-efficiency. The average R/C ratio value obtained from the vaname shrimp culture business in Sedati was 2.00.

Payback period (PP) was the ratio of initial cash investment and cash inflow. Payback period analysis was aimed to identify the period needed (in year or month) to cover the investment cost. The payback period calculation result on vaname shrimp monoculture business in Sedati was 3.12. The average of payback period value could be seen in Table 10.

Table 10. The average of payback period on vaname shrimp and milkfish polyculture

| No. | Component       | Total (IDR Ha/year) |
|-----|-----------------|---------------------|
| 1.  | Total investment | 42,254,470          |
| 2.  | Total profit    | 13,910,227          |
|     | Payback Period  | 3.12                |

Break event point was calculated by identifying the fixed cost, production cost, and selling result. The calculation result of break even point on vaname shrimp monoculture in Sedati was IDR 13,345,778,22. The average BEP could be seen in Table 11.

Table 11. The calculation result of break event point on vaname shrimp monoculture

| No. | Component | Total (IDR Ha/year) |
|-----|-----------|---------------------|
| 1.  | Fixed cost| 11,122,121          |
| 2.  | Variable cost | 5,016,591       |
| 3.  | Total revenue | 30,048,939       |
| 4.  | BEP value  | 13,345,778,22      |
The type of medication used was *Lodang*. In general, the use of *Anyok* provided in a year was 16-30 sack/Ha with IDR 7,500/sack. The total cost to purchase *Anyok* was IDR 168,182/ha/year. The fertilizer type used in the study site was a ZA fertilizer (*Petrokimia, Indonesia*) subsidized from Sidoarjo government. The fertilizer was performed based on the needs and conditions of the monoculture pond. The total cost for purchasing the fertilizer was IDR 393,182/ha/year. The purchase of fuel oil was conducted to operate the water pump. The type of fuel used was *solar* with IDR 7,500/L. The average total cost for purchasing fuel was IDR 545,227/year.

The business income analysis was the difference result between total revenue and cost [36]. Total revenue was the multiplication result of total production cost with the price per unit product. The average total annual revenue obtained was IDR 30,048,939. Total average cost incurred from the farmer population was IDR 16,138,712 based on the business analysis for a year, which gained a profit of IDR 13,910,227/ha/year.

The R/C ratio analysis results of the shrimp monoculture in Sedati was 1.86. According to previous study [13], profit was reached when R/C>1. The results of R/C ratio indicated that the shrimp vaname monoculture was economical, therefore deserving to be cultured and brought benefits [37]. According to previous study [38], the payback period was a method that calculates how quickly the investments could be returned. The calculation result of payback period to return the vaname shrimp monoculture in Sedati was 3, which meant that the investment incurred for shrimp monoculture process would be returned after held for 3 years. Previous study [38] stated that a payback period within 3 years could be said to be quite quickly.

The result of BEP calculation on vaname shrimp monoculture in Sedati was [38] IDR 13,345,778, which meant that the monoculture system will reach breakeven whenever producing IDR 13,345,778/ha/year. The shrimp monoculture business was categorized as a worthy effort as reaching IDR 38,422,273/ha/year and 65.3% higher than the BEP value.

4. Conclusion
The study result on the business profile and analysis of vaname shrimp monoculture in Sedati, Sidoarjo concludes that this business was considered to be feasible and could be continued as seen from the business analysis results with the total income of IDR 30,048,939, R/C value of 1.86, PP value of 3, and BEP value of IDR 13,345,778.

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6. Acknowledgment
The authors gratefully acknowledge the publication support from the Annual Work Plan Budget (RKAT) of the Faculty of Fisheries and Marine as well as the instrument laboratory support.