Input and output market risk Vaname Shrimp hatchery business (*Litopenaeus vannamei*)

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Abstract. The research aims to identify and analyze the sources of risk from the input and output markets of the vaname shrimp hatchery business, and to find strategies to overcome the risks. The study was conducted in June - August 2019 in the Barru Regency, South Sulawesi Province. Survey research type. Descriptive analysis methods are used to explain the source of risk. Value at Risk (VaR) is used to analyze the source of risk, and the analysis of preventive strategies is used to find strategies to minimize risk. The results of the study: (1) sources of input market risk consist of feed prices with a probability of 36.53% and a parent price with a probability of 25.93%. Sources of output market risk; consist of fry prices with a probability of 44.74%. and fry sales with a probability of 78.52%. (2) sources of feed price risk are in quadrant II, and sources of risk for parent prices, fry prices, and fry sales are in quadrant III. (3) strategies for overcoming risks, namely making feed purchase contracts for the stability of feed and parent prices, market control, management control, and distribution supervision to the consumer level.

1. Introduction

Shrimp is a commodity that is in great demand both at home and abroad. The high demand for shrimp in the export market opens up cultivation business opportunities. Vaname shrimp (*Litopenaeus vannamei*) is the choice of farmers with several advantages, such as the characteristics of very fast growth, short harvest period, tolerance to viruses, and survival in the low salinity range. Vaname prawns control almost all Indonesian shrimp export markets [1,2].

The availability of quality shrimp seeds (quality seeds) is one of the determining factors in the success of shrimp farming. But the availability of quality fries can not meet the needs of farmers. According to Noviantoro, A. Sudaryono, and Nugroho [3], quality fries will have an impact on production success, and vice versa, low-quality fries will have an impact on the failure of the cultivation business. The existence of shrimp hatchery is a solution that is expected to help the needs of farmers in the availability of quality fries.

In developing the vaname shrimp hatchery business, the hatcher is often faced with risks that can hamper the business, such as weather factors, imported broodstock, and especially diseases that attack the vanamei shrimp seeds. Zorriezhahra [4] states that shrimp disease continues to develop. Since 1970 every 3 or 4 years, the shrimp industry has been challenged with the emergence of new diseases. Environmental factors, climate change, is the main cause of several new diseases. Environmental factors are in direct contact with the hatcheries that cause fluctuations in vanamei shrimp seed
production and correlate with fluctuations in seed prices, parent prices, and feed prices. Price instability on the three variables causes a high market risk in hatcheries. According to Joffre, Poortvliet, and Klerkx [5], Hambrey, and Tuan [6] Shrimp farming is a "risky business." Associated with a variety of risks and uncertainties, including volatile markets, climate variability, and production risks. A risk management strategy is needed to reduce the impact of uncertainty. This study aims to identify the sources of the input market and output market risk of shrimp hatchery business, analyze the sources of risk, and find strategies to control the risk of shrimp hatchery business.

2. Methods
The study was conducted in June - August 2019 in Barru District, South Sulawesi Province. Data analysis uses qualitative and quantitative descriptive analysis. Qualitative descriptive analysis is used to identify sources of market risk in the input and output markets of the vanamei shrimp hatchery business. Value at Risk (VaR) analysis is used to measure the magnitude of the impact of the loss caused if the risk occurs in production activities and decreased revenue as a result of the occurrence of sources of risk. Furthermore, preventive analysis is used to find strategies to overcome market risk in the hatchery business. This type of survey research is research that takes a sample from one population and uses a questionnaire as a primary data collection tool [7]. Sampling was done by census on three vanamei shrimp hatchery businesses in the new district.

3. Result
3.1. Source of business risk for vanamei shrimp hatchery
The source of risk is the component of activities that inhibits business activities. Risks can have a negative impact on company goals, and can further lead to losses or threats to the survival of the company. The identification results, there are two sources of risk in the vanamei shrimp hatchery business, namely the source of risk from the input market, and the source of risk from the output market.

3.1.1 The sources of risk from input markets. Input markets are markets that provide business inputs. The main components of input for vanamei shrimp hatchery business are shrimp parent and vanamei shrimp parent feed.

a. Vanamei shrimp mains
The obstacle in hatchery activities is the lack of quality stock of shrimp broodstock [8]. The average hatchery business in the research location uses a parent imported from the United States Konabe Hawaii. They believe that the Parent from konabe has a very good quality and SPF standard that has been tested free from disease. The movement of the dollar with sharp fluctuations will greatly affect the price of a parent labeled import. The price of vannamei shrimp is largely determined by the exchange rate of the rupiah against the US dollar. Economic conditions play a major role in the formation of holding prices. Fluctuations in the price of a parent will pose a risk to the business.

b. Vanamei shrimp feed
The hatchery business at the research location uses natural squid and sea worm feed for shrimp feed. The availability of natural food is very dependent on nature (season). If the amount of natural food obtained from the sea is small (usually in the dry season), then the level of natural feed prices will increase. Conversely, if the results of natural food from the sea are abundant, the price of natural food will fall. Fluctuations in the price of natural feed cause business risks.

3.1.2. Sources of risk from output markets. The main components of the risk of the output market are the fry and vanamei shrimp fries.

a. Fry
The purpose of the business is to make a profit, but every business will not be separated from the possibility of risks that can cause large losses for business actors. The most threatening risk in the hatchery business is fluctuation in the price of fry. [9,10]. Fry price is influenced by the cost of
production (feed) and length of maintenance. Fluctuations in feed prices and length of maintenance will affect the cost of goods sold (HPP) fries. Fluctuations in fry prices cause business risks.

b. Fry Sales
Vannamei fry consumers come from all regions in Indonesia. Consumer distance or location influences distribution costs. The farther away consumers are, the higher the distribution costs, the greater the sales risk faced.

3.2. Market risk probability of Vanamei shrimp hatchery
Analysis of market risk probability of vanamei shrimp hatchery business is measured by using VaR (Value at Risk) analysis. VaR analysis is a risk measurement tool to measure portfolio exposure to market risk, or potential maximum expected loss is the maximum potential loss expected on a portfolio over a certain period of time [11–13]. Measurements made on production activities consist of; naupli production activities, fry production, degree of survival, and production. The calculation results show that the magnitude of the probability of loss incurred if a risk occurs is as follows.

Table 1. Probability of market risk input and output of the Vanamei shrimp hatchery business.

| Probability | Input Market risk Sources | Output Market RiskSources |
|-------------|---------------------------|---------------------------|
|             | Feed Price                | Main Price                | Fry Price | Sales Fry   |
| Average     | 10.87                     | 928,456,533               | 44,12     | 290,943,146 |
| Standard Deviation | 25,322,671               | 260,971,739               | 0.8952    | 58,141,591  |
| Z            | 0.0507                    | 0.3125                    | 0.2029    | 0.7979      |
| Z-table      | 0.5202                    | 0.6227                    | 0.5804    | 0.7852      |
| Probability  | 52.02%                    | 62.72%                    | 58.4%     | 78.52%      |
| Budget       | 11                        | 1,010,000                 | 44.3      | 339,433,671 |
| VaR          | 9.06                      | 786,199.73                | 42.77     | 258,541,707 |

The results of the calculation of the probability of the input market and output market risk of vanamei shrimp hatchery (table 1) show that the sale of fries has the largest percentage of risk probabilities of 78.52%, the parent price is second with a percentage of 62.27%, the price of the fry in the third position with a percentage value of 58.04% and the price feed the last position with a risk probability percentage of 52.02%. The more detailed value of Z from each source of risk based on the probability of the largest risk sequence is as follows.

a. Fry Sales
The Z value of shrimp sales is positive at 0.7979. In the normal distribution curve, the value of Z is on the right. If it is mapped on the distribution table, the value of 0.7852 will be seen, meaning that the probability of loss if the fluctuation of fry sales occurs is 78.52% or Rp. 258,541,707 / month. The risk of loss is still below the established budget of 339,433,671 / month.

b. Main Price
The value of parent price Z is a positive value of 0.3125. In the normal distribution curve, the value of Z is on the right. If mapped on the distribution table, the value of 0.6227 will be seen, meaning that the probability of loss if there is a fluctuation in the parent price of 62.27% or Rp.786,199 / head. The risk of loss is still below the established budget of Rp1,010,000 / head.

c. Fry prices
The Z value of the fry price is positive at 0.2029. In the normal distribution curve, the value of Z is on the right. If mapped on the distribution table, the value of 0.5804 will be seen, meaning that the probability of loss, if there is a fluctuation in the price of fry, is 58.04% or Rp. 42.8 / head. The probability of this risk of loss is still below the established budget of 44.3 / head.
d. *Feed Price*

The $z$ value of feed prices is positive at 0.0507. In the normal distribution curve, the value of $Z$ is on the right. If mapped on the distribution table, the value of 0.5202 will be seen, meaning that the probability of loss, if there is a fluctuation in feed prices, is 52.02% or Rp. 9.06 / kg. The risk of loss is still below the budget set by the business management of Rp.11 / kg.

3.3. *Mapping the probability and impact of risk sources*

Probability mapping is intended to get a picture of the risk position of each risk source. Mapping is done using the average value as follows.

| No. | Source Of Risk | Probability | VaR   |
|-----|----------------|-------------|-------|
| 1   | Fry Sales      | 52.02       | 9.06  |
| 2   | Main Price     | 62.27       | 786,199|
| 3   | Fry Price      | 58.04       | 42.77 |
| 4   | Feed Price     | 78.52       | 258,541,707 |
|     | Amount         | 252.85      | 258,542,545 |
|     | Average        | 63.21       | 64,635,636  |

Table 2 shows the average value of probability 63.03% and the average value of VaR Rp.64,635,636. By using a risk map, the two average values are used as the value of the middle limit of the level of loss to describe the size of the risks faced. The results of risk mapping are as follows.

![Figure 1. Risk mapping.](image)

The position of the source of risk in Figure 1 shows that the price of feed is in quadrant II. Sources of risk of fry selling, parent prices, and fry prices are in quadrant III. This risk mapping explains that fluctuations in the price of feed have a risk probability of harming the hatchery business, having a large value above 63.21%, and having a large value of loss above Rp. 64,635,636. Conversely, fluctuations in frying sales, fluctuations in parent prices, and fluctuations in frying prices have the risk of harming small-scale hatchery businesses, below 63.21%, and the impact of small-value risks, under Rp.64,635,636.

3.4. *Risk management strategies*

The results of identification and measurement of risk show that fluctuations in feed prices have a risk level with a large probability and have a major impact on the continuity of the hatchery business. Therefore a preventive handling strategy is needed to shift the source of feed price risk from quadrant II to quadrant IV so that the source of feed price risk changes to risk with a small probability. The preventive strategy models that can be carried out are as follows:
a. Make a contract to purchase feed with suppliers so that company needs can be addressed without price changes
b. Establish a standard price tolerance for natural feed for the Parent with the highest price limit and the lowest food price limit.
c. Control the market so that the fry that has been produced can be sold on time. If there is a delay in sales so that the production is not sold, there will be a long post larva so that it requires high feed costs.

4. Discussion
The initial problem in the vanamei shrimp hatchery business is the availability of parent shrimp. The businessman or Vanamei shrimp hatcher has difficulty in obtaining broodstock. The domestic shrimp parent market is very limited. If there is any parent available, in general, the quality of the Parent is very low, so that it will produce low-quality fry. To get quality shrimp broodstock, breeders bring broodstock from abroad (US) with prime quality and have certificates as proof that they have passed the disease-free test. But on the other hand, the price of imported label mains is very expensive (high). And the price of import labeled parent fluctuates with the movement of the rupiah against foreign currencies. Parent price fluctuation has a probability of loss risk for the vanamei shrimp hatchery business. If the value of the rupiah weakens against the dollar, the price of the parent shrimp will rise, and vice versa, if the exchange rate of the rupiah strengthens against the dollar, then the price of shrimp shrimps will go down. During 2019, prices of parent prices fluctuated with relatively large ranges. The lowest holding price is Rp. 1,437,920, and the highest holding price is Rp. 1,727,273 per head.

In addition to the high and fluctuating price of broodstock, the vanamei shrimp hatchery business is inseparable from the problem of natural feed. The availability of natural food in the form of squid and sea worms is very limited. Quality natural food is needed to increase productivity and produce quality seeds [14,15]. At the research location, natural food is still very dependent on nature, so that the price of natural food in the input market is unstable (fluctuating). The instability of the price of natural feed has a high risk of loss, having a big impact on the vanamei shrimp hatchery business. Changes in feed prices to production costs are very elastic. Little changes that occur in the price of feed will have a major impact on production costs. Production costs will rise and will directly affect the price and demand for output (fries) produced. Throughout 2019 the prices of natural feed for worms and squid experienced price fluctuations with relatively large ranges. The lowest worm price is Rp. 75,000 and the highest price of worms Rp. 85,000 per kilogram, the lowest price of squid is Rp.50,000 per kg, and the highest price of squid is Rp.70,000 per kilogram.

The next problem is related to fry prices. The high fry prices cause consumers (vanamei shrimp farmers) to make adjustments. In line with the theory of demand and supply, if prices are high, consumers will reduce demand, and vice versa, if prices are low, consumers will increase demand. Adjustments made by consumers by reducing the purchase of a number of fries pose a risk to the sale of fries. Sales delays occur. Fries that are not sold will occur long post larvae, so that requires high feed costs. In other words, unsold seedlings will increase production costs. But the increase in production costs is not significant with the increase in fry prices. During 2019 fry prices fluctuated with relatively small increases. The lowest fry prices are Rp 42 per fish, and the highest fry prices are Rp. 45 per fish.

All problem variables, both in the input market and in the output market of the hatchery business, if not addressed immediately, will potentially become a source of risk with a significant impact on the continuity of the vanamei shrimp hatchery business carried out by the vanamei shrimp hatchers. A preventive strategy is needed in the form of controlling market input and output at three stages of business activities to prevent, reduce or minimize risk; first in the pre-activity stage, establishing SOPs for the purchase of the Parent and the production process, making a contract to purchase feed to the supplier so that the company's needs can be addressed without any price changes. Establish a standard price tolerance for natural feed for broodstock with the highest price limit and the lowest
feed price limit. Second, at the stage of the production process; ensure that all goes well according to SOP standards that have been set. And third, in the post-harvest stage, controlling the market so that the fries that have been produced can be sold on time, controlling and supervising the fries to the consumers with good quality, following the development of the fries that have been purchased by consumers to stay well in the system cultivation.

5. Conclusion
   a. The source of business risk for vanamei shrimp hatchery from the input market consists of feed price with a risk probability value of 36.53% and a parent price with a risk probability value of 25.93%. Source of business risk for vanamei shrimp hatchery from the output market; consists of fry prices with a risk probability value of 44.74% and fry sales with a risk value of 78.52%.
   b. The position of the source price risk of feed is in quadrant II, and the source of risk of fry sales, the price of broodstock, and fry prices are in quadrate III. This risk mapping explains that fluctuations in feed prices have a risk probability of harming hatcheries above 63.21% with the impact of large losses above Rp. 64,635,636 and vice versa fluctuations in fry sales, fluctuations in broodstock prices and fluctuations in fry prices have a probability of harming the hatchery business below 63.21% with a small risk impact below Rp.64,635,636.
   c. A preventive strategy is used to prevent, reduce, or minimize the risk, making feed purchase contracts to stabilize feed and parent prices, market control, management control, and distribution supervision to the consumer level.

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