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SHRIMP FARMING AND ITS BUSINESS FACING PRODUCTION RISKS IN KALIWUNGU DISTRICT, INDONESIA

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Abstract

Production factors are important components in the operation of a business, and these variables always fluctuate following the conditions experienced by shrimp farmers. Generally, the majority of aquaculture business players in several developing countries rely heavily on production results before determining the factors of production they want to set in the next production period. Therefore, this research using the Cobb-Douglas function wanted to find out whether vannamei shrimp farming in Kaliwungu District, Kendal Regency, had followed the Returns to Scale (RTS) practice using production factor analysis. Apart from that, the characteristics of the cultivating community and their relationship with the blue economy will also be studied through a business risk analysis to provide a point of view regarding the status of business sustainability to strengthen the economic resilience of the community in the research location. This study found that with an R/C ratio of 1.7>1, the status of the vannamei shrimp farming business at the research location has proved to be successfully doable because it has made a profit. This finding is supported by the total regression coefficient (bn) of the five production factors (1,375>1) which indicates that the production scale of vannamei shrimp in the research location shows increasing returns to scale index. However, based on risk analysis, this study found a considerable risk coefficient (0.29>0.5), implying that the risk of production loss that will be faced by the vannamei shrimp business at the research location will be quite immense in the next harvest. Although currently all business players in the research area are said to have benefited and are classified in the increasing return to scale index category, the risk of production loss that will be faced by the vannamei shrimp business in the research location is projected to be quite significant in the next harvest period. Therefore, all actors of the vannamei shrimp business in the research location are strongly advised to optimize the production factors currently used in the next harvest by anticipating market prices of inputs, management, and sales values. Besides, it is important to take into account the perspective of the blue economy, economic efficiency, and skillful shrimp cultivators with better education for embracing future business sustainability.

Subjects: Fisheries Business; Microeconomics; Production Variables; Statistics

Keywords: Production factors, Returns to Scale, vannamei shrimp, economic efficiency

1. INTRODUCTION

The fisheries sector in national development is one of the motorists of economic growth. According to Islam et al., (2020), a well-developed fisheries sector is expected to increase the income of fishermen. Furthermore, Boyd et al., (2020) stated that the success of aquaculture offers the potential for a substantial increase in production. When the fisheries sector has healthy growth, other sub-sectors will also be affected because transactions on fishery resources from fishermen to end users will involve various business actors.

Coastal areas are a medium where many fishing businesses occur, and healthy business management will optimize labor empowerment, food supply, and economic growth, and support the welfare of coastal communities. According to the World Bank (2022), billions of people in the world depend on a healthy environment as a source of work and food.

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Furthermore, the Organization for Economic Co-operation and Development emphasized that the sea contributes USD 1.5 trillion per year to the economy, and this amount is projected to increase to USD 3 trillion in 2030 on condition that the use, management, and protection of marine natural resources are carried out in a sustainable manner.

Even though Indonesia is the second country with the longest coastline in the world which most coastal communities depend on for their livelihood (Nag, 2020), this fact has not been able to set Indonesia as the number two shrimp exporter. According to the Food and Agriculture Organization (2021), fish consumption with a base period of 2019-21 will increase by 15% in 2031. The high consumption of fish currently indicates that the need for nutritional fulfillment for many people in the world is quite high. Unfortunately, more than 50% of the shrimp farming industry in Indonesia is not run diligently, which causes the value of shrimp aquaculture production to be far from optimal utilization even though Indonesia is blessed with natural resources such as long coastlines and a supportive tropical climate (Antara, 2022). Therefore, Indonesia should be able to become one of the main players in dominating the global shrimp market by meeting the world's nutritional needs. The theory of production in a simple scheme consists of the relationship between the level of production of an item and its factors of production. According to Färe (1988) factors of production are inputs that influence output and are closely related to one another. In shrimp farming, these production factors generally consist of pond areas, feeds, seeds, labor, and pesticides. Considering that production factors affect production yields and production value, income in shrimp farming is determined by yields and sales by farmers. Up until now, there has been a lot of attention dedicated by cultivators to improving profitable cultivation practices according to their own experiential design. However, the optimization carried out was still uneven because the business activities of each cultivator varied based on their own activities. According to Kuznetsova et al., (2020), intelligent control over production factors in business is very necessary. Production factors in shrimp farming such as pond areas, feeds, seeds, labor, and pesticides require careful consideration by looking at the quantity and price which represents an analysis of efficiency. In addition, a sustainable business must consider the role of ecology considering the environment is the main instrument in which shrimp farming is carried out. Edwards et al., (2019) stated that aquaculture is one of the most serious business sectors in terms of damaging the environment because entrepreneurs in this business often neglect environmental sustainability. People running an aquaculture business on any scale must pay attention to environmental aspects in addition to production and market interests. Aquaculture businesses that often lack proper direction and careful consideration require management that is more mature and has respect for environmental sustainability in addition to benefits. For people in Kaliwungu District, the shrimp business is one of the main sources of income. However, if production efficiency is carried out yet environmental health is neglected, then people's welfare will be affected because production results are determined by environmental quality as well. Therefore, this research using the Cobb-Douglas production function wanted to find out whether vannamei shrimp farming in Kaliwungu District, Kendal Regency, had followed the Returns to Scale (RTS) practice through production factor analysis. In addition, the characteristics of the cultivation community and its relationship with the blue economy will be discussed to provide a bit of an overview

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regarding the status of business sustainability to strengthen the economic resilience of the community in the research area.

2. METHODS

In this study, the factors of production consisted of land area, feed, seeds, labor, and insecticides. From the data collected on 36 shrimp farmers in Kaliwungu District, Kendal Regency, it is known that the production factors used vary according to the purchasing power of each cultivator. Variations in the number of seeds ultimately affect production results, which in turn affect the use of production factors for the next production process. The production factor overview of vannamei shrimp farming obtained from 36 farmers is presented in Table 1 below:

Table 1: The Vannamei shrimp farming production factors in Kaliwungu District

Production factor	Total	Average
Pond area (ha)	70.7	1.96
Feeds (Kg)	13,789	383.0
Seeds (Larvae)	3,266,000	90,722.2
Labor (Person)	346	10
Pesticides (Kg)	1,410	39.2
Output (Kg)	8,190	227.5

Based on Table 1, the average number of seeds used in one production period was 90,722.2 larvae with an average feed of 383 Kg. By using an average pesticide of 39.2 Kg, the average production obtained was 227.5 Kg in an average pond area of almost 2 ha managed by an average of 10 workers.

a) Regression Coefficient for Returns to Scale Index

The regression coefficient in this study was obtained using the Multiple Linear Regression Method using Statistical Package for the Social Sciences (SPSS v.26) to determine the effect of production factors on the production of Vannamei shrimp business. The production factors used are pond area (b1), feeds (b2), seeds (b3), labor (b4), and pesticides (b5). Data processed using SPSS v.26 produces coefficients as presented in Table 2 below:

Table 2: Regression coefficient of production factors

Model	Regression Coefficients	Std. Dev
Pond area	0.479	0.183
Feeds	0.063	0.066
Seeds	0.011	0.059
Labor	0.438	0.202
Pesticides	0.384	0.198

To see whether vannamei shrimp farming in Kaliwungu District, Kendal Regency has followed the Returns to Scale (RTS) principle, this research uses production factor analysis using the Cobb-Douglas function. The return to scale equation is found from the results of the Cobb-Douglas function:

The Seybold Report
ISSN 1533-9211
DOI 10.17605/OSF.IO/87Q92

$$Y = X_1^{b1}.X_2^{b2}.e^V \text{ ....(1)}$$

Which later can be examined, as follows:

$$1 < (b1 + b2) < 1 \text{ ....(2)}$$

Therefore, there are three types of returns to scale categories:

a. Decreasing returns to scale index if (b1+...bn+1) < 1. In such circumstances, the proportion of production factor added will lead to a less proportional increase in output;

b. Constant returns to scale, if (b1+...bn+1) = 1. In such circumstances, the proportion of production factor added will be proportional to the output obtained;

c. Increasing returns to scale, if (b1+...bn+1) > 1. In such circumstances, the proportion of production factor added will produce a larger proportion of output.

b) Risk analysis

The calculation of profit in the shrimp farming business is defined through the relationship between the expenditure required during production and the sales of production. Production factors, if regulated in the right combination, can support cultivation efficiency, especially if they are supported by elements such as exceptional seed sources, high-quality feed, healthy ecology, and skilled labor.

The net income of the vannamei shrimp farming business at the research location is carried out by the following equation:

$$TR = P X Q \text{ ....(3)}$$

Annotation:

TR = Average revenue (total revenue obtained).

P = Average product selling price.

Q = Average quantity (production results achieved)

When total revenue is found, net income is obtained by finding the difference between the total revenue received and the fixed costs incurred during the production process:

$$Y = TR - TC \text{ ....(4)}$$

Annotation:

Y = Net income

TR = Average of revenue

TC = Average of production cost

If zero product is sold, then total revenue (TR) is zero. On the other hand, if the quantity of goods (Q) that is sold increases, the income will also be higher and affect the TR. If the

ISSN 1533-9211

DOI 10.17605/OSF.IO/87Q92

cultivator sells for less than Q^v, the total cost of production is always higher than the total revenue, so the producer will lose. The relationship between TC and TR is divided as follows:

If TC > TR, therefore $\pi < 0$, where $Q < Q^v$ dan $Q > Q^w$

If TC < TR, therefore $\pi > 0$, where $Q^v < Q < Q^w$

If TC = TR, therefore $\pi = 0$, where $Q = Q^v$ and $Q > Q^w$

Shrimp cultivators will benefit if TC < TR. Therefore, the production should fall between Q^v and Q^w.

Risk assessment in this study was carried out by measuring the deviation value based on primary data (Koller, 2005) which begins with the calculation of the expected result (E), followed by a measure of variance (variance) and standard deviation (standard deviation). The coefficient of risk is the ratio between the risk and income from the capital used in the production process. The greater the value of the risk coefficient, the greater the risk that will be borne by business players in the research study. According to Hernanto (1999), if CV > 0.5, the production risk borne by farmers is greater. Conversely, if the CV <0.5, then the risk is smaller. In finding risk assessment, some formulas were processed as follows:

Range:

$$R = Xn - X1 \quad (5)$$

Xn : The highest production value.

X1 : The lowest production value.

Average deviation ($d\bar{X}$):

$$d\bar{X} = \frac{\sum |x - \bar{X}|}{n} \quad (6)$$

x: Each production by farmers.

$\bar{X}$: Average of production value.

n: Total samples.

Standard deviation (S):

$$S = \sqrt{\frac{\sum (x - \bar{X})^2}{n-1}} \quad (7)$$

x: Production value

$\bar{X}$: Average of production value

n: Total sample

Variance and variance coefficient:

$$\text{Variance} = s^2 \quad (8)$$

ISSN 1533-9211

DOI 10.17605/OSF.IO/87Q92

Risk coefficient (CV)

$$CV = \frac{S}{\bar{x}} 100\% \quad \text{.......... (9)}$$

s: Standard deviation

x: Average production

3. RESULTS AND DISCUSSIONS

3.1 Returns to Scale (RTS)

Production factor analysis using the Cobb-Douglas function for finding the total coefficient and calculating the Returns to Scale (RTS) index are presented in Table 3:

Table 3: The Cobb-Douglas function results

Variable	Coefficients
Pond area (b1)	0.479
Feeds (b2)	0.063
Seeds (b3)	0.011
Labor (b4)	0.438
Pesticides (b5)	0.384

a) Pond area coefficient (b1) is positive at 0.479. Therefore, an increase of healthy pond area by 1% will increase production output by 0.479%;

b) Feed coefficient (b2) is positive at 0.063. Therefore, the addition of high-quality feed by 1% will increase production output by 0.063%;

c) The seed coefficient (b3) is positive at 0.011. Therefore, the addition of vigorous seeds by 1% will increase production output by 0.011%;

d) The labor coefficient (b4) is positive at 0.438. Therefore, a 1% increase in labor will increase production output by 0.438%; and

e) The coefficient of pesticides (b5) is positive at 0.384. Therefore, the addition of pesticides by 1% will increase production output by 0.384%.

Input factors are unique based on how they are managed. Many input factors do not necessarily provide a lot of output because these input factors may actually prolong the management process but are not directly proportional to the quality and quantity of output.

A group of shrimp cultivation may take a long time due to the lack of efficiency in input factors from the start. Economically speaking, the more goods produced per unit of time, effort, and cost, the more efficient a business is in its process (Farrell, 1957; Alchian & Demsetz, 1972).

The total regression coefficient (b_n) of the five production factors is 1,375. Because the b_n for all production factors is greater than one (1,375 > 1), the production scale for vannamei shrimp ponds in Kaliwungu District, Kendal Regency shows an increasing return to scale index. In such circumstances, the proportion of production factor added will result in a larger proportion

The Seybold Report
ISSN 1533-9211
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of output. Therefore, attention needs to be given to shrimp farmers in the research area to further optimize the current production factors or maintain the existing ones.

3.2 Business Risk Analysis

The calculation of profit in the shrimp farming business is defined through the relationship between the expenditure required during production and the sale of production. The total revenue and net worth of vannamei shrimp farming at the research location are presented in Table 4 and Table 5 below:

Table 4: Calculation of Revenue

P	Q	TR (PxQ)
IDR86,667	227.5	IDR19,716,667

Q: Average product selling price (IDR)
Q: Average production quantity (Kg)
TR: Average of revenue (IDR)

Table 5: Total net worth

TR	TC	Y (TR-TC)	TR/TC ratio
IDR19,716,667	IDR11,653,139	8063527.778	1.69196187

TR: Average of revenue (IDR)
TC: Average production variable value (IDR)
Y: Net worth (IDR)

Since the value of TC is less than TR, production falls between Q^v and Q^w, at which point the cultivator makes a profit. Besides, from the R/C ratio value of 1.7> 1, as shown in Table 5, it can be seen that the vannamei shrimp farming business at the research location can be said to be doable because it has made a profit.

Therefore, with an R/C ratio of 1.7, for every IDR1,000 spent on the factor of production, the cultivator gets a profit of IDR1,700 as a result of production. Furthermore, the risk assessment in this study was carried out by looking for the deviation value, starting with the calculation of the expected result (E), variance (variance), and standard deviation (standard deviation). Risk assessment is a comparison between the risk and the income generated by business capital used during the production process.

Table 6: Risk assessment elements

Variables	Value
Range	200 Kg
Expectation (E)	228 Kg
Variance (S^2)	4265.25
Standard deviation (S)	65.30
Coefficient of risk (CV)	0.29
Average deviation ($d\bar{X}$)	58.05
Base value (Kg)	130 Kg

The Seybold REPORT

ISSN 1533-9211

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a) Expected results (E)

The E value is obtained by finding the average production yield in the production period by all shrimp farmers. With an expected value of 228 Kg, the net production expected by vannamei shrimp farmers at the study site during the next harvest is 228 Kg to at least be effective in the business they are doing.

b) Variance (S2)

The variance value represents deviations that occur in the analysis of risks faced. The greater the variance value, the greater the risks that may be faced by vannamei shrimp business cultivators at the research location. Conversely, a small variance value indicates that the risks that will be faced by shrimp farmers are also getting smaller. The variance value obtained in this study was 4265.25.

The variance value obtained is large which indicates that there has been a significant deviation. Therefore, the level of production risk faced by shrimp farmers in the study area is categorized as massive.

c) Standard Deviation (S)

The standard deviation is obtained by finding the square root of the variance value. Because the value of the variance is directly proportional to the standard deviation, a large standard deviation will cause the risks to be faced by cultivators at the study site to be even greater. The standard deviation obtained in this study is 65.30 which indicates the level of production risk faced by shrimp farmers at the study site is quite large in the coming period.

d) Risk Coefficient (CV)

The risk coefficient is the ratio between the standard deviation value and the expected return value. The greater the value of the risk coefficient, the greater the risk that shrimp farmers will face. This study found a risk coefficient of 0.29.

Because the risk coefficient obtained is greater than 0.5 ($0.29 > 0.5$), the risk of loss of production that will be faced by the vannamei shrimp pond business at the research location will be quite large in the next harvest period. The business process in the fisheries sector must not solely focus on the quantity and quality of output since a sustainable business must also be able to survive in the market competition so that prosperity can at least be maintained.

In order for a business to produce output following the expectations without compromising the quality of inputs (in this case seeds), it is necessary to emphasize the efficiency of the production process by optimizing other production factors such as skilled labor, high-quality feed, and a very healthy cultivation environment. Although this study found that the vannamei shrimp business actors in the research location had made profits (R/C ratio value of $1.7 > 1$), the risk analysis showed that the risk of production loss that would be faced by the vannamei shrimp business at the research location would be quite large in the future harvest.

For dealing with business risks in the future, shrimp farming business actors in the research area must be able to master economic efficiency which will only be achieved if business actors

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are able to allocate production factors proportionately as it relates to technical efficiency and price efficiency. Proficiency in technical efficiency and price efficiency is closely related to the principles of the blue economy which can be achieved by improving the quality of education. According to Suyanto (1996) the majority of coastal communities in the world, especially Indonesia, suffer from structural poverty due to their limited ability to access important resources in their work domain. Even worse, economic and political policies that are not standing by the side of fishing communities have made it more difficult for them to achieve economic independence.

Several studies (Achenbaum, 2013; Wekke & Hamid, 2013; Jackson, 2014; Roy, 2014) found that structural poverty experienced by fishing communities often occurs due to their inability to experience education, especially to continue their education to a higher level. Such deficiencies will usually affect the skills needed by shrimp cultivators in optimizing their production processes, especially in terms of economic efficiency which also covers technical efficiency and price efficiency. Integration between factors of production, skills, output optimization, advanced processing, and immaculate logistics is needed if fishery development exists to be projected to become the main driver of fishing community development.

The perspective of sustainable marine resources can be said to be carried out based on the principles of the blue economy if it is executed in a firm and integrated manner because the blue economy requires firm, structured, environmentally oriented efforts, and must be carried out with openness. A study by Gulo (2015) found that economic development based on sustainable business can accelerate regional development, catalyze economic progress, and open access that can support community involvement within the integration of strong economic resilience. Therefore, the blue economy principles in Kaliwungu District, Kendal Regency need to be applied so that risks that may occur in the future can be minimized without sacrificing production factors which also ultimately affect output quality and quantity.

4. CONCLUSIONS

The present study found an R/C ratio value of 1.7> 1, indicating that the vannamei shrimp farming business at the study site was classified as doable because it had made a profit. The obtained profit status is strengthened by the accumulated regression coefficient (bn) of the five production factors (1,375 > 1) which proves that the production scale of vannamei shrimp in Kaliwungu District, Kendal Regency is categorized as increasing return to scale index. However, based on risk analysis, this study found a large risk coefficient (0.29 > 0.5).

Because the risk of production loss that will be faced by the vannamei shrimp business in the research location will be quite extensive in the next harvest period, it is highly recommended to all vannamei shrimp business actors in the research location optimize the production factors that are currently used in the next harvest period by anticipating the price increase, skilled labor, high-quality feed, a very healthy cultivation environment, pond management, and sales value.

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