

# Evaluation of multidimensional sustainability status of vannamei shrimp hatchery in Situbondo regency

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## Evaluation of multidimensional sustainability status of vannamei shrimp hatchery in Situbondo regency

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**Abstract.** Vannamei shrimp (*Litopenaeus vannamei*) is a high-value commodity in fisheries. The volume of Indonesian vannamei shrimp production increased by 15.06% / year in the 2014-2018 period. This research wants to ensure that these conditions are sustainable in the future. The sustainability of the vannamei shrimp hatchery in this study is viewed from the dimensions of the environment, technology and quality system as well as the recommended policy scenario. The value of the sustainability status of the vannamei shrimp hatchery in terms of three aspects, overall is 57.34 this value is categorized as quite sustainable and the analysis of the effect of the sustainability attributes shows that in general this business can be said to be sustainable with several corrective actions, namely improving the quality of seeds and managing hatchery waste. Policy scenarios that can be offered based on the results of this research include; (1) the environmental dimension, it is to improve hatchery conditions and manage waste to avoid environmental damage; (2) the technological dimension it is to improve shrimp hatchery technology by collaborating with a marine commodity research center; (3) the quality system dimension, is to carry out an adequate production control system and evaluate the production process effectively.

### 1. Introduction

Trade blocks such as APEC and MEA in which Indonesia is a part of, have demanded to always produce products in a sustainable manner both in quality and quantity considering that the global market requires long-term continuous supply. Long-term sustainable supply can only be obtained from a sustainable production system that implements a sustainable agricultural system, namely an agricultural system that optimally applies various dimensions, namely social, economic and environmental dimensions as well as other dimensions such as technology, institutions and quality systems.

Currently, Indonesia is spurring various sectors to produce products in a sustainable manner, including the fisheries sector. The GDP growth of the fisheries sector in 2017-2019 is at a stable value, namely an average of 3.91% per year [1], even though GDP growth in the agricultural sector is slowing down [2]. Vannamei shrimp (*Litopenaeus vannamei*) is a high-value export commodity in the fisheries sector. The volume of Indonesian vannamei shrimp production increased by 15.06% per year in 2014-2018 [3]. In the same period, shrimp has also become a leading commodity for Indonesian fisheries exports with an average growth of 6.43 percent. According to [4], the volume of shrimp exports by the



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end of 2018 is estimated to be able to reach 180 thousand tons or an increase of 33 thousand compared to 2017 which reached 147 thousand tons. This research wants to ensure that these conditions will continue in the future even though Covid-19 is still endemic. In other words, the development of vannamei shrimp still prioritizes the principles of responsible production process management and applies the principles of sustainable aquaculture.

The above descriptions have encouraged this research to be carried out with a priority in the upstream sector, namely in the vannamei shrimp hatchery, considering that the quality of export shrimp is determined by the quality of the fry. This study will analyze the status of the sustainability of the vannamei shrimp hatchery process so that the necessary policies can be determined.

This research was conducted at vannamei shrimp hatchery production center in the coastal area of Situbondo Regency with the consideration that in this area there are many farmers and hatchery companies that are certified "Good / Excellent" as well as there are research centers. This area has been able to supply shrimp farmers in East Java, Central Java and even Lampung.

The problems that can be formulated based on the description above are:

- The status and conditions of sustainability of vannamei shrimp hatchery are not known yet in terms of environmental, technology and quality system aspects.
- Policies implemented have not been optimal in embracing the basic needs of farmers and all stakeholders.

The purpose of this research is to formulate a development policy scenario as a basis for increasing the production of vannamei shrimp in a sustainable manner in Situbondo Regency.

## 2. Material and methods

Data collection was conducted through in-depth interviews and observations. The data was collected using a questionnaire with stakeholders from the government, businessmen, and farmers. The data obtained is then finalized by academic experts to determine the final answers from the sources.

The sustainability of vannamei shrimp hatchery in this study is seen from three dimensions, namely the environmental dimension, the technology dimension, and the quality system dimension. The research stages include: evaluating the status of sustainability, analyzing the lever attributes, and compiling policy scenarios. The research method is adjusted to the research stages as follows:

### 2.1. To evaluate the sustainability status of the vannamei shrimp hatchery.

Detecting the level of sustainability using multidimensional scaling analysis (MDS). Through the MDS method, with the help of the Rapfish form, the sustainability index value of each dimension (environment, technology and quality system) can be visualized in the form of a kite diagram [8].

### 2.2. Analysis of the Lever Attributes

After the MDS analysis and the sustainability index, an analysis of the lever attributes is carried out to determine the attributes that contribute to the sustainability value. This leverage analysis is used to see changes in attributes in the output of the MDS analysis. The effect of each attribute is seen in the form of changes in root mean square (RMS)[5].

### 2.3. Develop sustainability policy scenarios.

These scenarios are a combination of key variables that may occur in the future. In this study, the scenarios are grouped into three clusters, namely the pessimistic, moderate, and optimistic scenarios.

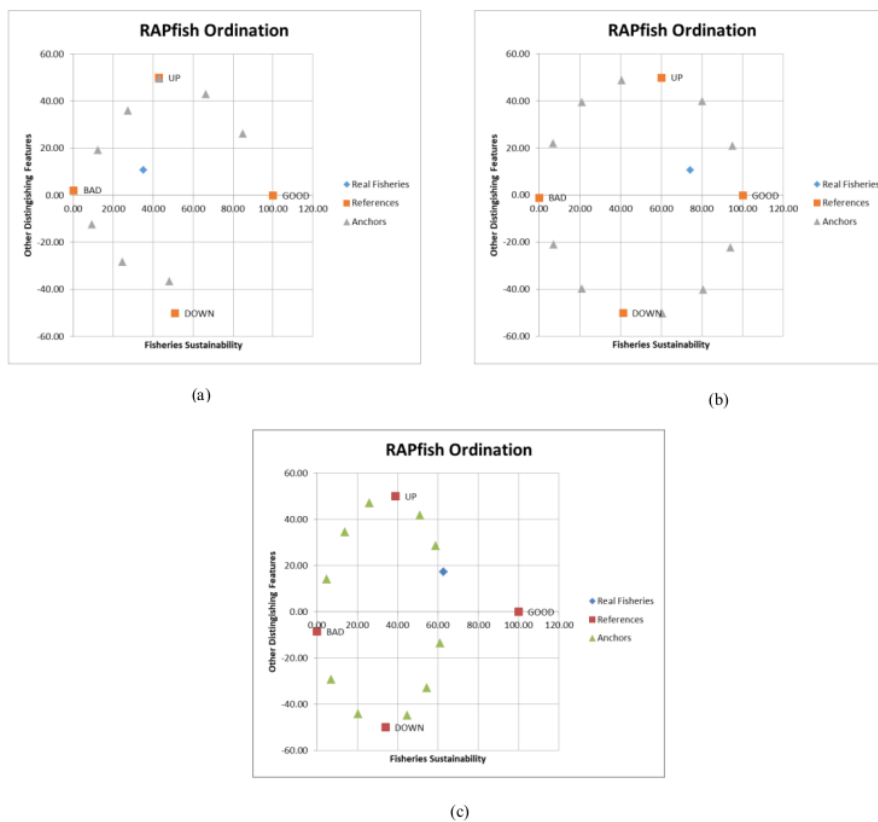
## 3. Result and Discussion

Research data processing was conducted in multi-dimensional scaling (MDS) format with the help of a Rapfish device. The results of data processing can be seen in Table 1.

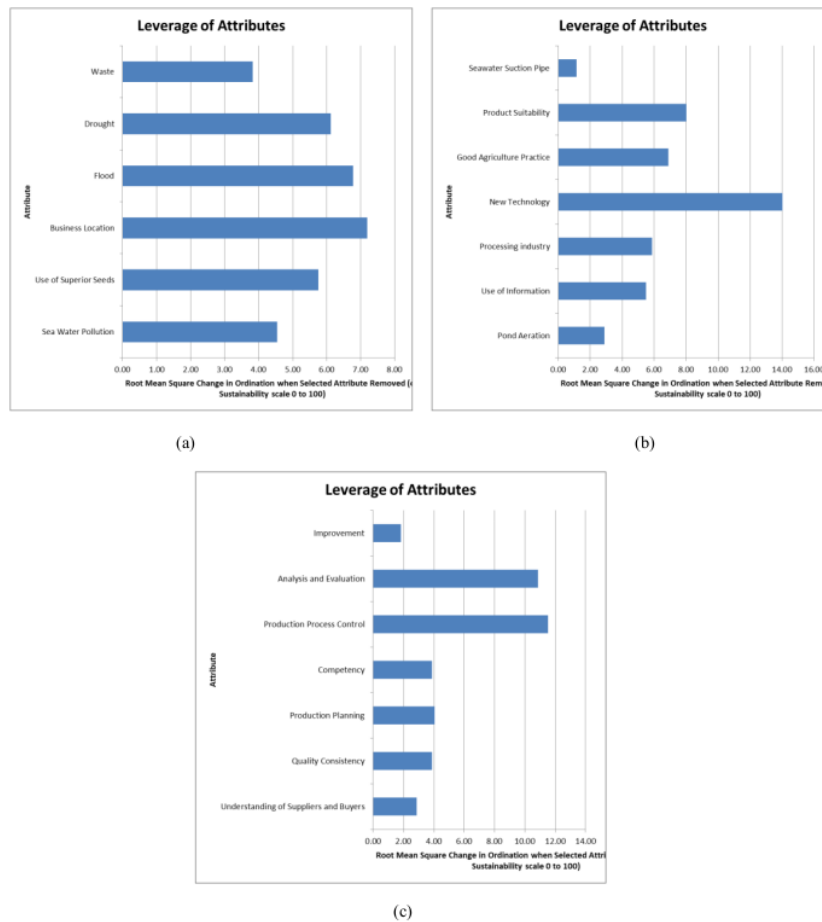
**Table 1.** The Value of Sustainability of The Vannamei Shrimp Hatchery Business in Situbondo Regency

| Dimension      | Dimension Status | Monte Carlo | Delta | Stress |
|----------------|------------------|-------------|-------|--------|
| Environment    | 35.01            | 35.91       | 0.90  | 0.156  |
| Technology     | 74.14            | 70.96       | 3.18  | 0.138  |
| Quality System | 62.87            | 61.15       | 1.72  | 0.164  |

Table 1 is shown that the value of sustainability for environmental dimension 35.01 (less sustainable), technology dimension 74.14 (quite sustainable), and quality system dimension 62.87 (quite sustainable). The average value of sustainability status from the three dimensions is 57.34, this value can be categorized as quite sustainability. The status of sustainability of all dimension is presented in Figure 1.



**Figure 1.** Sustainability Status of Environmental (a), Technology (b) and Quality System (c) Dimensions



**Figure 2.** Leverage Attributes of Environmental (a), Technology (b) and Quality System (c) Dimension

Based on Figures 1 and 2 it can be explained that the results of the sustainability assessment of the vannamei shrimp hatchery business from the 3 dimensions observed in the results exposure and the following discussion:

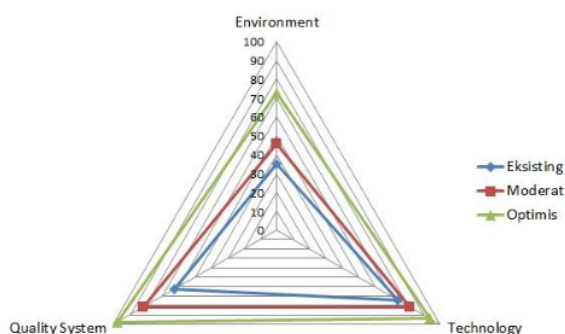
The results of the MDS analysis show that the environmental dimension sustainability status value is 35.01, this value indicates a low category for its sustainability, and based on leveraging factors, the location of the business causes the low value of the sustainability of this business from an environmental aspect. This can be caused by the large number of vannamei shrimp hatcheries along the coast of Situbondo district, especially in the Pecaron area to Banyuglugur which dispose of their hatchery waste directly to the sea so that in the long run it can cause environmental damage. Damage to the aquatic environment has an impact on water quality which greatly affects the quality of the vannamei shrimp seeds produced, this has an impact on the difficulty for farmers to obtain quality vannamei shrimp seeds [6].

The results of MDS analysis which are also supported by leverage factor analysis show that the technology dimension has a sufficient value of sustainability status, namely 74.14, this is because most of the vannamei shrimp hatcheries have adopted good shrimp hatchery technology, such as feed technology, sea water filtration technology, and pond aeration technology. However, this sufficient

value still has to be followed up with other efforts that can increase the sustainability value of the vannamei shrimp hatchery business [7].

The value of the sustainability of the quality system dimension is 62.87 which can be categorized as "quite sustainable" and the results of the leverage factor analysis show that the main leverage factor affecting the quality system is the production control process. Therefore, in addition to keeping up with technological developments in shrimp hatchery, improvement and control of the production process must be carried out continuously [5], [9].

The results of data analysis based on data processing using Rappfish and leverage factor analysis are presented in the form of a kite diagram. Based on the conditions of the key factors and possible future changes in the management of sustainable vannamei commodities, as shown in Figure 3.3.



**Figure 3.** Kite Diagrams for Sustainability Index in Existing, Moderate and Optimistic Scenarios.

Based on Figure 3 specific and detailed policy scenario recommendations that can be provided from the results of this study, among others; (1) the environmental dimension, it is to improve hatchery conditions and manage waste to avoid environmental damage; (2) the technological dimension it is to improve shrimp hatchery technology by collaborating with a marine commodity research center; (3) the quality system dimension, is to carry out an adequate production control system and evaluate the production process effectively [10].

#### 4. Conclusion

Generally, the sustainability status of vannamei shrimp hatchery in Situbondo regency can be said to be continued with corrective action that need to be taken, including improving seed production and improving the handling of vannamei shrimp hatchery waste.

#### 5. Acknowledgments

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