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ASSESMENT OF SUSTAINABLE SHRIMP AQUACULTURE IN BANTUL REGENCY

Penilaian Budidaya Udang Berkelanjutan Kabupaten Bantul

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ABSTRACT

Vaname shrimp aquaculture in Bantul Regency is one blue economy sector with significant potential in Daerah Istimewa Yogyakarta (DIY). However, this sector experiences varios dynamics that could potentially affect its sustainability. The purpose of this study was to assess the sustainability of shrimp aquaculture in Bantul Regency. The shrimp aquaculture assessment was conducted at the company scale. Six aquaculture locations served as case studies. Primary data collection was conducted through interviews with farmers. The primary data then processed and analyzed descriptively quantitatively. The results showed that the sustainability assessment at the farmes business scale was predominantly approaching sustainable. Indicators in each component including environmental, economic, and social influenced this assessment. Six locations were categorizes as approaching sustainable, S1, S2, S3, S4 dan S5. Meanwhile S6 was categorized as far from sustainable.

Keywords: Assessment Of Sustainability, Shrimp Aquaculture, Bantul

ABSTRAK

Budidaya perikanan udang Vaname Kabupaten Bantul menjadi salah satu sektor ekonomi biru yang sangat potensial di wilayah DIY. Namun demikian, sektor ini mengalami beragam dinamika sehingga berpotensi mempengaruhi keberlanjutan aktivitas budidaya tersebut. Oleh karena hal tersebut tujuan penelitian ini adalah untuk menilai keberlanjutan budidaya udang di Kabupaten Bantul. Penilaian budidaya udang dilakukan pada skala perusahaan. Terdapat enam lokasi budidaya udang yang menjadi studi kasus. Pengambilan data primer dilakukan melalui wawancara bersama dengan pembudidaya. Data primer yang sudah diperoleh selanjutnya diolah dan dianalisis secara deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa, penilaian keberlanjutan pada skala usaha pembudidaya didominasi menuju berkelanjutan. Indokator pada setiap komponen baik itu lingkungan, ekonomi dan sosial mempengaruhi penilaian tersebut. enam lokasi masuk dalam kategori menuju berkelanjutan yaitu S1, S2, S3, S4, dan S5. Sedangkan untuk S6 masuk dalam kategori jauh dari berkelanjutan.

Kata Kunci: Penilaian Keberlanjutan, Budidaya Udang, Bantul

INTRODUCTION

The economic sector originating from coastal and marine areas has now become one of the key sectors that play an important role in improving regional economies. The blue economy serves as one of the concepts in economic development, emphasizing the sustainable utilization of marine resources (Adnan *et al.,* 2023). The blue economy was also promoted during the Rio Conference in 2012 and has become a framework for developing the marine industry, emphasizing social aspects, improved quality of life, and environmental sustainability (Robles-Herrera, 2025). The Special Region of Yogyakarta (DIY) is one of the provinces possessing diverse coastal and marine resource potentials. Several coastal and marine resource potentials in DIY include aquaculture, capture fisheries, and tourism/environmental services (Latif *et al.,* 2015). Bantul Regency is one of the regencies with aquaculture potential, including the cultivation of tilapia, catfish, pomfret, gourami, pangasius, carp, and *Litopenaeus vannamei* (whiteleg shrimp).

The cultivation of *L. vannamei* represents one of the fisheries activities with high economic value (Akbarurrasyid *et al.,*2020). This aquaculture practice has also become one of the most widely developed fisheries activities in the coastal areas of Bantul Regency. The production of *L. vannamei* in 2024 reached 711,070 kg, showing an increase compared to 2023, which recorded a production of 703,535 kg (Badan Pusat Statistik Kabupaten Bantul, 2025). However, shrimp aquaculture also generates several environmental impacts, including the degradation of environmental quality occurring along Kuwaru Beach as a result of land-use conversion into shrimp ponds (Pinto, 2016). In addition, a 2016 study examining shrimp aquaculture in Bantul Regency revealed the absence of an adequate waste management system, resulting in shrimp mortality and social conflicts in managing *L. vannamei* aquaculture (Cahyaningrum *et al.,* 2017). Meanwhile, a 2019 study of fishers in Kuwaru Hamlet stated that shrimp farming has become an alternative livelihood for coastal fishers in Bantul during wave seasons and adverse weather conditions, when going to sea is not possible (Setyaningrum & Hartanto, 2020). Moreover, shrimp farming possesses high market value, which continues to attract many fishers to engage in shrimp aquaculture activities.

Shrimp aquaculture management in the coastal areas of Bantul can be conducted sustainably. The concept of sustainability refers to the capacity for long-term endurance and is synonymous with sustainable development (FAO, 2013). The sustainable development concept applied in the fisheries sector is expected to preserve land resources without causing environmental degradation, to be economically viable, and to be socially acceptable (FAO, 2013). Three main dimensions are utilized to measure sustainability: economic, social, and environmental (FAO, 2013; Oliveira *et al.,* 2025). Therefore, sustainable shrimp aquaculture presents its own challenges in the management process.

Based on the aforementioned discussion, it can be concluded that shrimp aquaculture, as part of the blue economy sector, holds great potential for development in Bantul Regency. Several studies also indicate that shrimp aquaculture represents one of the potential drivers for blue economy development in a region (Adibrata *et al.,* 2022; Ristiawati *et al.,* 2024). Many fishers rely on shrimp aquaculture to improve their livelihoods. The cultivation of *L. vannamei* in Bantul Regency can be developed sustainably to minimize environmental impacts. Therefore, the objective of this study is to assess the sustainability of shrimp aquaculture, encompassing environmental, economic, and social dimensions of shrimp farming in Bantul Regency.

METHODS

The research was conducted from June to September 2025. The study location was in the coastal shrimp farming area of Bantul Regency. Case studies were conducted at six shrimp farming locations on Parangtritis Beach and Kuwaru Beach, coded S1, S2, S3, S4, S5, and S6

(Figure 1). The tools and materials used for the research included stationery, a map of the research location, a Global Positioning System (GPS), a camera, and a recording device.

The data collected included primary and secondary data. Data collection techniques were conducted through field observations and interviews with farmers and local government officials. The research components and indicators are outlined in Table 1.

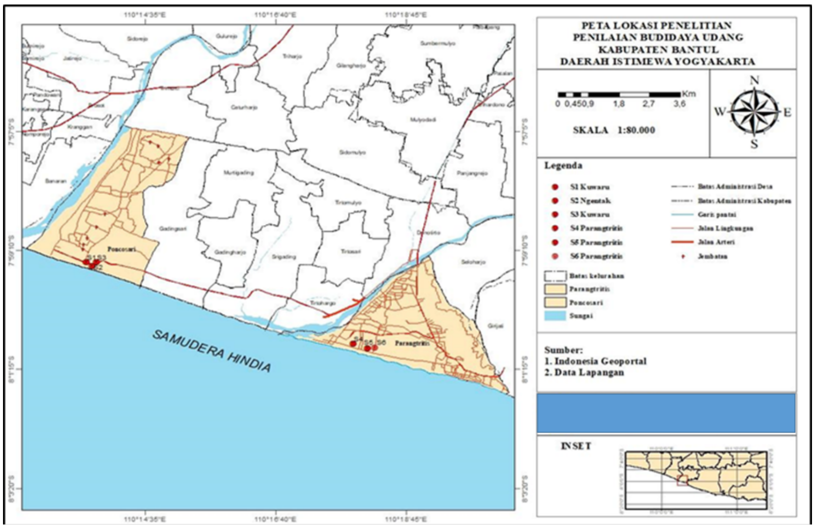

Figure 1. Research Location

Table 1. Research Indicators/Variables

Research Objective	Component	Indicator/Variable
To assess the sustainability of shrimp aquaculture in Bantul Regency	Economic Component	Profit and income
		Risk of loss
		Product diversification
	Environmental Component	Environmental pollution
		Use of renewable energy
		Spatial planning conformity
	Social Component	Stakeholder involvement during the aquaculture planning process
		Use of local labor
		Relationship with surrounding communities and social conflicts

Source: (FOESA, 2010)*
*With modifications to suit field conditions

The assessment of whiteleg shrimp cultivation in Bantul Regency uses a company scale, with local farmers being assessed. The indicators for each component described above are then assigned a score. Each indicator has a total of 5 points and is outlined in Table 2.

Table 2. Indicator Points

Point	Description	Total Points
5	Sustainable	40–45
4	Nearly Sustainable	35–40
3	Approaching Sustainable	25–35
2	Far from Sustainable	20–25
1	Unsustainable	<20

Source: (FOESA, 2010)*
*With modifications to suit field conditions

RESULTS

The results of the assessment of each indicator are presented in Table 3 and Table 4. The assessment of each indicator is based on the condition of each component being assessed.

Table 3. Results of Sustainability Indicator Assessment

Component	Indicator	S1	S2	S3	S4	S5	S6
Economic Component	Profit and Income	3	3	3	3	3	3
	Risk of Loss	3	3	3	3	3	3
	Product Diversification	4	2	2	2	2	2
Environmental Component	Environmental Pollution	3	3	3	3	3	3
	Use of Renewable Energy	2	2	2	3	3	2
	Spatial Planning Conformity	2	2	2	1	1	1
Social Component	Stakeholder Involvement During the Aquaculture Planning Process	3	3	3	3	3	3
	Use of Local Labor	5	5	5	2	5	2
	Relationship with Surrounding Communities and Social Conflicts	5	5	5	5	5	5
TOTAL		30	28	28	25	28	

Source: (FOESA, 2010) and Primary Data Processing, 2025

Table 4 Sustainability Assessment of Vaname Shrimp Cultivation in Bantul Regency

Location	Total Points	Description
S1	29	Approaching Sustainable
S2	28	Approaching Sustainable
S3	28	Approaching Sustainable
S4	25	Approaching Sustainable
S5	28	Approaching Sustainable
S6	24	Far from Sustainable

Source: Primary Data Processing, 2025

DISCUSSION

There are four scales or levels that serve as the basis for assessing the sustainability of shrimp aquaculture, namely national, regional, local, and enterprise levels (FOESA, 2010; FAO, 2013). In the six locations used as case studies, it was found that sites S1, S2, S3, S4, and S5 fall under the "approaching sustainable" category with point values ranging from 25 to 35, while S6 is categorized as "far from sustainable." Several indicators within each component did not achieve maximum values, and thus cannot yet be classified as fully sustainable. The description of each sustainability assessment component presented in Table 3 is explained as follows.

Economic Component

Indicators in the economic aspect assessment include profit and income, product diversification, and risk of loss (FOESA, 2010). In general, based on the profit and income indicators, shrimp aquaculture provides considerable economic benefits to farmers. However, shrimp farmers sometimes experience significant losses. Profits can reach up to twice the invested capital, but disease outbreaks that cause shrimp mortality can lead to substantial financial losses. According to farmers in location S5, failures may result from several factors, including shrimp mortality at a young age and unpredictable weather conditions caused by unstable climatic patterns. A study conducted by Arini *et al.* (2023) stated that rainfall and temperature show a positive correlation with shrimp production data. However, the study also indicated that it remains challenging to conclusively demonstrate the impact of climate change on shrimp aquaculture. Other studies have likewise identified extreme temperature and rainfall variations as important factors influencing shrimp aquaculture activities (Arini *et al.,* 2023).

Regarding product diversification, farmers at site S1 have diversified their income sources by operating a small food stall, whereas others sell fresh shrimp directly to local traders. In terms of marketing, fresh shrimp are sold directly to traders in local markets and middlemen. Based on field interviews, shrimp aquaculture is considered highly risky, with farmers potentially facing financial losses and negative returns. Farmers at site S5 reported that failures could occur up to twice in a single year. Meanwhile, farmers at site S6 stated that although profits could sometimes double their capital, they often experienced financial setbacks or merely broke even when faced with production failures.

Environmental Component

Indicators in the environmental aspect assessment include environmental pollution, conformity with spatial planning, and the use of renewable energy (FOESA, 2010). Environmental pollution issues have not yet become significant. Waste from feed residues and shrimp excrement are among the common pollutants found in aquaculture areas. Plastic waste was also observed near pond locations, originating not only from aquaculture sites but also from surrounding areas. Based on interviews with farmers, aquaculture operations currently lack wastewater treatment installations (IPAL). Previous studies have shown that the implementation of IPAL systems can reduce waste concentrations discharged into aquatic environments (Syah *et al.,* 2014). Shrimp aquaculture operations without IPAL have the potential to cause water pollution, and feed residues may deteriorate water quality within the ponds. This finding is consistent with research stating that uneaten feed tends to accumulate at the pond bottom, subsequently affecting water quality (Khairil & Frinaldi, 2023). Other studies have also emphasized that water quality plays a crucial role in the survival of aquatic organisms (Putra *et al.,* 2023).

According to the 2024–2044 South Coast Detailed Spatial Plan (RDTR), the shrimp pond sites S1, S2, and S3 are located in tourism zones, while sites S4, S5, and S6 are located within protected geological zones, specifically in the Gumuk Pasir area (Pemerintah Kabupaten Bantul, 2024). In the RDTR, sites S1, S2, and S3 are not explicitly designated for aquaculture activities, but seasonal agricultural activities are conditionally permitted. In contrast, aquaculture activities are prohibited at sites S4, S5, and S6. Renewable energy has not yet been applied in the pond systems, as electricity remains the main energy source. When power outages occur, farmers at sites S4 and S5 use diesel-powered generators as an alternative energy source.

Social Component

Indicators of the social component include stakeholder involvement during the aquaculture planning process, the use of local labor, and relationships with surrounding communities and government agencies (FOESA, 2010). The Marine and Fisheries Office (DKP) of Bantul Regency serves as a key government stakeholder responsible for policies related to shrimp aquaculture. Regarding governmental involvement, water quality assessments have been conducted at sites S2 and S3, but not in other locations. However, according to farmers at S2, S3, and S6, while water samples were taken, the laboratory results were delayed, often arriving after the harvest period, rendering the data less useful.

In general, shrimp farmers employ local labor for production and harvesting activities, except at sites S4 and S6, which predominantly employ workers from outside Bantul Regency and have established formal payroll systems. According to farmers at S3, extension services are difficult to access because they are not part of any aquaculture farmer groups. Nevertheless, the relationship between farmers and surrounding communities is harmonious, with no conflicts reported. Although no social conflicts have yet arisen between shrimp farmers and local communities at the study sites, potential conflicts may emerge with increasing aquaculture activities. A study by Hidayatillah (2017) in Andulang Village, Gapura District, Sumenep Regency, demonstrated that the industrialization of shrimp farming and the influx of investors have led to conflicts with local communities due to agricultural land pollution and the degradation of local fishing grounds.

Sustainability Assessment

Based on the sustainability assessment conducted at sites S1, S2, S3, S4, S5, and S6, it was found that only S6 falls into the “far from sustainable” category, while the remaining sites are classified as “approaching sustainable.” Several indicators contributing to these scores have been discussed above. Spatial planning conformity was identified as one of the key indicators leading to lower assessment scores. In 2020, Tohari *et al.* (2020) conducted a study on farmers’ perceptions of the sustainability of shrimp pond operations along the southern coasts of the Special Region of Yogyakarta and Central Java. The study supported the present findings, emphasizing that spatial planning and licensing aspects must be prioritized to ensure the long-term sustainability of shrimp farming enterprises. In addition to spatial conformity, limited product diversification and the lack of renewable energy utilization are also contributing factors to the lower sustainability scores. For locations categorized as “approaching sustainable,” future management efforts should focus on pollution control and minimizing financial risks in shrimp aquaculture.

CONCLUSION

A case study of whiteleg shrimp cultivation was conducted at six locations: S1, S2, S3, S4, S5, and S6. Shrimp cultivation at locations S1, S2, S3, S4, and S5 was categorized as being on the way to sustainability, while S6 was categorized as far from sustainability. Spatial planning suitability, potential losses, and the use of labor from outside the region were among the contributing factors to the low assessment. Shrimp cultivation has significant potential, therefore, further policies are needed to promote sustainable shrimp cultivation in Bantul Regency.

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