Fisheries Journal, 16 (2), 749-757 (2026)
http://doi.org/10.29303/jp.v16i2.2264

ANIMAL WELFARE IN VANAME SHRIMP (*Litopenaeus vannamei*) FARMING IN CV. ANUGRAH ABADI PERKASA PONDS WITH DIFFERENT STOCKING DENSITIES

Animal Welfare pada Budidaya Pembesaran Udang Vaname (*Litopenaeus vannamei*) di Tambak CV. Anugrah Abadi Perkasa dengan Padat Tebar yang Berbeda

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(Received March 11th 2026; Accepted April 6th 2026)

ABSTRACT

This study aims to evaluate the application of animal welfare principles in the cultivation of whiteleg shrimp (*Litopenaeus vannamei*) in the ponds of CV. Anugrah Abadi Perkasa with different stocking densities. This study was motivated by the increasing global market demand for animal welfare standards in aquaculture, while its application in Indonesia is still limited. The method used is descriptive quantitative through direct observation and measurement of observed parameters, as well as active participation supported by documentation. Animal welfare assessment uses a non-invasive approach based on four main indicators, namely environment, nutrition, health, and behavior. The results show that the implementation of animal welfare at CV. Anugrah Abadi Perkasa has been running well in all research plots. The applied cultivation management, such as feed management, water quality control, and disease prevention are able to support optimal shrimp growth and survival. Most of the observed indicators are in the good welfare category. The assessment of nutritional and behavioral indicators in all four plots obtained a score of 1 (good welfare). For environmental and health indicators, the assessment score of 1 (good welfare) is found in plots 1 and 3 with low stocking densities. A score of 2 (tolerable welfare) was found in plots 2 and 4 with high stocking densities, indicating that these conditions are still within tolerable limits, but indicate a decline in environmental quality and health, potentially affecting shrimp growth and survival. This study recommends optimal stocking density management, improved shrimp health management, strengthened animal welfare principles, and the development of more comprehensive evaluation indicators to support the sustainability of whiteleg shrimp farming in Indonesia.

Keywords: Animal Welfare, Shrimp Health, Stocking Density, Sustainable Aquaculture, Whiteleg Shrimp

ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi penerapan prinsip *animal welfare* pada budidaya pembesaran udang vaname (*Litopenaeus vannamei*) di tambak CV. Anugrah Abadi Perkasa dengan padat tebar yang berbeda. Penelitian ini dilatarbelakangi oleh meningkatnya tuntutan pasar global terhadap standar kesejahteraan hewan (*animal welfare*) dalam akuakultur, sementara penerapannya di Indonesia masih terbatas. Metode yang digunakan adalah deskriptif kuantitatif melalui observasi dan pengukuran langsung parameter yang diamati, serta partisipasi aktif yang didukung oleh dokumentasi. Penilaian *animal welfare* menggunakan pendekatan non-invasif berdasarkan empat indikator utama, yaitu lingkungan, nutrisi, kesehatan, dan perilaku. Hasil penelitian menunjukkan bahwa penerapan *animal welfare* di CV. Anugrah Abadi Perkasa sudah berjalan dengan baik pada seluruh petak penelitian. Manajemen budidaya yang diterapkan, seperti manajemen pakan, pengendalian kualitas air, dan pencegahan penyakit mampu menunjang pertumbuhan serta kelangsungan hidup udang secara optimal. Sebagian besar indikator yang diamati berada pada kategori *good welfare*. Penilaian indikator nutrisi dan perilaku pada keempat petak memperoleh skor 1 (*good welfare*). Pada indikator lingkungan dan kesehatan, penilaian skor 1 (*good welfare*) terdapat pada petak 1 dan 3 dengan padat tebar rendah. Penilaian skor 2 (*tolerable welfare*) terdapat pada petak 2 dan 4 dengan padat tebar tinggi yang berarti kondisi tersebut masih berada dalam batas toleransi, namun menunjukkan adanya penurunan kualitas lingkungan dan kesehatan yang berpotensi mempengaruhi pertumbuhan dan kelangsungan hidup udang. Penelitian ini merekomendasikan pengelolaan padat tebar yang optimal, peningkatan manajemen kesehatan udang, penguatan prinsip *animal welfare*, dan pengembangan indikator evaluasi yang lebih komprehensif untuk mendukung keberlanjutan budidaya udang vaname di Indonesia.

Kata Kunci: Akuakultur Berkelanjutan, *Animal Welfare*, Kesehatan Udang, Padat Tebar, Udang Vaname

INTRODUCTION

Whiteleg shrimp (*Litopenaeus vannamei*) cultivation is a rapidly growing aquaculture sector and contributes significantly to global fisheries production. Whiteleg shrimp are widely cultivated due to their advantages, such as rapid growth, high feed efficiency, and broad tolerance to environmental conditions. Furthermore, whiteleg shrimp exhibit good adaptability to intensive cultivation systems, making them a key species in the development of modern aquaculture in various tropical and subtropical countries (Krummenauer et al., 2016; FAO, 2024). Since their widespread introduction in Asia in the early 2000s, whiteleg shrimp have become a key commodity in the aquaculture industry, including in Indonesia, where they are a leading national commodity (Suharyanto & Nurhayati, 2025). The significant increase in production in recent years demonstrates the strategic role of whiteleg shrimp in supporting food security and the fisheries economy (Waldhorn, 2022).

Intensifying aquaculture practices, characterized by the use of high stocking densities, have given rise to various issues, particularly those related to animal welfare. Several studies have shown that high stocking densities can degrade aquatic environmental quality by increasing concentrations of ammonia, nitrite, and organic matter, which can lead to physiological stress and a decrease in the shrimp's immune system (Campa-Córdova et al., 2022; Tinh et al., 2023). Increased stocking densities can also lead to organic matter accumulation, dissolved oxygen fluctuations, and increased physiological stress, which impact shrimp growth performance and survival rates (Facanha et al., 2016; Qadri et al., 2026). Furthermore, previous research indicates that although low stocking densities are more favorable for shrimp welfare, these conditions are often considered suboptimal in terms of productivity (Pratiwi et al., 2022). This indicates a research gap regarding determining stocking

densities that balance productivity and the application of animal welfare principles.

Attention to animal welfare issues in shrimp farming is increasing in line with global market demands that require the implementation of animal welfare standards in the production process. The concept of animal welfare in aquaculture encompasses meeting the organism's biological needs, adapting to the environment, and minimizing stress during the rearing process (Gamberoni et al., 2026). Major export destinations such as Europe and North America have implemented strict regulations regarding sustainable and ethical aquaculture practices (EFSA, 2013). However, the application of animal welfare concepts in Indonesia remains relatively limited and has not yet become a primary focus in aquaculture practices. This situation emphasizes the importance of scientific studies that are not only oriented towards increasing production but also consider aspects of animal welfare as part of a sustainable aquaculture system.

Based on these issues, this study aims to evaluate the application of animal welfare principles to whiteleg shrimp grow-out cultivation at different stocking densities, and to analyze the relationship between stocking density and welfare indicators, including environmental, nutritional, health, and behavioral aspects. The approach used refers to non-invasive assessment methods to obtain a comprehensive picture of shrimp welfare conditions in the culture system.

This research is expected to provide a scientific basis for determining optimal stocking density management strategies to maintain a balance between shrimp productivity and welfare. Furthermore, the results of this study have the potential to enrich the literature on the application of animal welfare in aquaculture, particularly for whiteleg shrimp, and serve as a reference for practitioners and policymakers in developing more sustainable and welfare-oriented aquaculture systems.

RESEARCH METHODS

Research Timeline and Location

The research was conducted at the whiteleg shrimp farming pond of CV. Anugrah Abadi Perkasa, in Candikusuma Village, Melaya District, Jembrana Regency (Figure 1). The research activities were carried out for 45 days, from January to February 2026.

Figure 1. Research Location

Type of Research Design

A quantitative descriptive design was used in this study to systematically, factually, and accurately describe animal welfare indicators in whiteleg shrimp farming in ponds with different stocking densities. The data collection process in this study included not only the collection and compilation stages but also the analysis and discussion of the results of the whiteleg shrimp animal welfare assessment. The assessment was conducted using a non-

invasive method based on the four main domains of nutrition, environment, health, and behavior as proposed by Pedrazzani et al. (2023).

Subjects and Objects of the Study

The whiteleg shrimp cultivated in the four plots at CV. Anugrah Abadi Perkasa was the primary subject of the study. Animal welfare indicators such as environment, nutrition, health, and behavior were also included in the study.

Population and Sample

The population in this study was whiteleg shrimp found in four aquaculture ponds owned by CV. Anugrah Abadi Perkasa. Ponds 1 and 3 had a stocking density of 250 individuals/m², while Ponds 2 and 4 had a higher stocking density of 400 individuals/m². Based on these differences in density, Ponds 1 and 3 had a population of 225,000 individuals, and Ponds 2 and 4 had a population of 360,000 individuals, resulting in a total population of 585,000 individuals.

A total of 100 shrimps were sampled using a purposive sampling technique, considering the representative conditions in each pond. This sample size refers to the recommendation of Lee & Chen (2019), who stated that 50–100 individuals is sufficient for a representative analysis of shrimp welfare.

Research Instruments and Data Analysis

The research instruments included water quality measuring instruments (thermometer, pH meter, refractometer, and Secchi disk), cultivation equipment, and observation sheets for welfare assessment. Assessments were conducted using a non-invasive method based on a four-domain approach: environment, nutrition, health, and behavior (Pedrazzani et al., 2023). Environmental parameters included temperature, pH, salinity, and water clarity; nutritional indicators included feeding management and feed conversion ratio (FCR); health indicators were observed through physical condition and mortality rates; and behavioral indicators were assessed based on swimming activity and response to feed.

Data collection was carried out through direct observation, periodic measurements, and recording of cultivation activities. Water quality measurements were conducted twice daily (morning and afternoon) to ensure stable environmental conditions. Nutritional data were obtained through recording feed amounts and calculating FCR, while health and behavioral data were obtained through routine visual observations throughout the study period. This observation method follows a systematic approach in field studies to obtain accurate and representative data (Siregar et al., 2022; Cornwall, 2008). The data obtained were analyzed by comparing results between stocking density treatments. Welfare assessments were conducted using a scoring system based on the categories of good welfare, tolerable welfare, and critical welfare, according to the non-invasive approach used. The analysis results were then interpreted to comprehensively assess the effect of stocking density on shrimp welfare.

RESULT

Differences in stocking density have been shown to impact the cultivation performance and welfare of whiteleg shrimp (*Litopenaeus vannamei*). In general, low stocking densities (250 individuals/m²) yielded better performance than high stocking densities (400 individuals/m²) (Table 1). Feed efficiency, measured by the feed conversion ratio (FCR), showed that low stocking densities had lower values than high stocking densities. Furthermore, survival rates were also higher at low stocking densities than at high stocking densities (Table 1). Total feed utilization and biomass gain were higher at high stocking densities, indicating increased production as the number of individuals in the pond increased (Table 1).

Water quality during cultivation was within the optimal range for supporting whiteleg shrimp life. However, at high stocking densities, several parameters, such as pH, salinity, and clarity, tended to approach or exceed the optimal range (Table 2).

Disease prevention in whiteleg shrimp in CV. Anugrah Abadi Perkasa's ponds is carried out through the implementation of a biosecurity system to prevent the entry of pathogens and pests into the cultivation area. According to Supono (2021), consistent biosecurity implementation and optimal water quality management are key to reducing disease risk in intensive shrimp farming because environmental stability directly impacts the shrimp's physiological resilience and immune response. This includes providing hygiene facilities such as foot and hand basins, as well as separate equipment for each plot, such as Secchi disks, treatment buckets, feed buckets, and sampling bottles. Shared equipment, such as sampling nets and water quality meters, is always cleaned with potassium permanganate (PK) solution after use to prevent cross-contamination. The ponds are also equipped with CCTV and perimeter fencing as additional protection from wild animals that could potentially carry diseases. The fry used are also certified Specific Pathogen Free (SPF), ensuring they are free from certain pathogens. In addition to biosecurity, water quality management is also a crucial step in disease prevention. Water changes are carried out routinely, approximately 10% every two days, and can be increased to 25–50% if ammonia levels increase. The bottom of the pond is siphoned every three days to remove leftover feed and organic matter. Minerals such as activated lime (CaO) and Vineral products are added periodically, especially during shrimp moulting, to support carapace formation and maintain water quality. Water sterilization is also carried out using products such as Sanitrex every four days to suppress the growth of pathogenic bacteria, particularly Vibrio sp. With a combination of biosecurity and good water quality management, the risk of disease can be reduced, thus maintaining optimal shrimp growth and productivity.

Assessment of animal welfare indicators shows that, in terms of environmental aspects, low stocking densities fall into the good welfare category, while high stocking densities tend to fall into the tolerable welfare category. For nutritional and behavioral indicators, both treatments show good welfare. Meanwhile, for health indicators, low stocking densities indicate good welfare, while high stocking densities are predominantly in the tolerable welfare category (Table 3).

Overall, the results of the study indicate that low stocking densities provide conditions that are more conducive to the welfare of whiteleg shrimp, while high stocking densities increase biomass production but at the cost of decreasing several welfare indicators.

Table 1. Whiteleg Shrimp Cultivation Performance Based on Stocking Density

Parameter	Low Stocking Density	High Stocking Density
Total Feed (kg)	3,906	6,152
Initial Biomass (kg)	4.5	7.2
Final Biomass (kg)	3,090.9	4,294.8
Biomass Increase (kg)	3,086.4	4,287.6
FCR	1.26	1.43
Survival Rate (%)	87.5	79

Table 2. Water Quality Parameter Measurement Results

Parameter	Low Stocking Density	High Stocking Density	Optimal Range (SNI 01-7246-2006)
Temperature	29.3	30.5	28.5 - 32
pH	8.18	8.48	7.5 – 8.5

Parameter	Low Stocking Density	High Stocking Density	Optimal Range (SNI 01-7246-2006)
Salinity	21.7	25.7	15 - 25
Brightness	32.7	48.2	30 - 45

Table 3. Animal Welfare Indicator Assessment

Indicator	Low Stocking Density	Category	High Stocking Density	Category
Environment	1.00	Good welfare	1.50	Tolerable welfare
Nutrition	1.00	Good welfare	1.00	Good welfare
Health	1.00	Good welfare	1.80	Tolerable welfare
Behavior	1.00	Good welfare	1.00	Good welfare

DISCUSSION

The difference in cultivation performance between low and high stocking densities indicates that density is a major limiting factor in the efficiency of the production system. Better feed efficiency at low stocking densities indicates that more space and lower competition allow shrimp to utilize feed more optimally. A low feed conversion ratio (FCR) indicates better feed utilization efficiency and reflects a more stable cultivation environment for the growth of aquatic organisms (Boyd & Tucker, 1998; Tinh et al., 2023). Conversely, at high stocking densities, increased competition between individuals causes uneven feed distribution, thus reducing utilization efficiency. This condition shows that increasing the amount of feed is not always directly proportional to production efficiency. The higher survival rate at low stocking densities indicates that environmental stress at high densities directly impacts the biological condition of shrimp. Survival rate is one of the main indicators of the success of intensive cultivation because it is directly related to the organism's ability to adapt to environmental stress (Stickney, 2009; Pratiwi et al., 2022). Although water quality parameters generally remain within tolerable limits, the tendency for some parameters, such as salinity and clarity, to approach or exceed optimal limits at high stocking densities indicates ecological stress within the culture system. This indicates that general water quality standards do not fully reflect the microenvironmental conditions experienced by the organisms, and also impacts the shrimp's well-being during the culture period. This aligns with research conducted by Yudasmara (2021), which states that the success of whiteleg shrimp cultivation is strongly influenced by water quality management and the stability of environmental parameters during the culture period.

The increase in total feed and biomass at high stocking densities indicates a production advantage. However, this also reflects a trade-off between production quantity and organism welfare. This is common in intensive aquaculture systems, where increased biomass production is often accompanied by increased environmental stress and the risk of health problems for the cultivated organisms (Tinh et al., 2023; FAO, 2024). Higher production is achieved at the expense of increased environmental stress, decreased feed efficiency, and changes in health and behavioral indicators. Animal welfare assessments further strengthened these findings, with environmental and health indicators showing more significant differences between treatments than nutritional and behavioral indicators. This suggests that changes in environmental conditions due to increased stocking density are more readily reflected in physiological and morphological aspects than in relatively stable behavioral aspects. Therefore, health and environmental indicators are more sensitive parameters for detecting declines in welfare in intensive culture systems. This aligns with the opinion Yudasmara et al. (2026), who stated that the health of aquatic organisms is a crucial indicator for assessing the success of culture environment management and the welfare of aquatic biota.

This study's findings align with the general pattern that increasing stocking density tends to increase production but can also reduce the biological quality of the culture system. The strength of this study lies in its evaluation approach, which simultaneously integrates production and welfare aspects, providing a more comprehensive picture of culture conditions. Optimizing stocking density is a determining factor in maintaining the balance between productivity and welfare of whiteleg shrimp. Determining optimal stocking density is crucial for maintaining a balance between production efficiency, water quality stability, and the implementation of sustainable aquaculture principles based on animal welfare (Utami et al., 2022; Zhang et al., 2026). Future research is recommended to develop optimal stocking density models with a more comprehensive approach, including the integration of physiological and economic analyses to support sustainable aquaculture practices.

CONCLUSION

Differences in stocking density significantly impacted the cultivation performance and welfare of whiteleg shrimp (*Litopenaeus vannamei*). Lower stocking densities (250 individuals/m²) demonstrated better results, characterized by higher feed efficiency and higher survival rates, compared to higher densities (400 individuals/m²). Animal welfare conditions at low stocking densities consistently fell within the good welfare category, while at high stocking densities, several indicators, particularly environmental and health, declined, which fell within the tolerable welfare category. Although high stocking densities increased total biomass production, they were accompanied by increased environmental pressure and decreased cultivation system efficiency.

This situation indicates a crucial balance between increasing production and meeting animal welfare requirements. Overall, determining optimal stocking densities is a crucial factor in maintaining the balance between increasing production and implementing animal welfare principles. These findings are expected to serve as a foundation for developing sustainable whiteleg shrimp cultivation practices that prioritize animal welfare.

ACKNOWLEDGEMENT

My deepest gratitude goes to the Rector of Undiksha, the Dean of the Faculty of Mathematics and Natural Sciences of Undiksha, the Coordinator of the Aquaculture Undergraduate Study Program, the Supervisors, the Lecturers and Laboratory Staff in the Aquaculture Study Program, the Management of CV. Anugrah Abadi Perkasa, and my beloved parents and brother.

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