p-ISSN. 2579-4752
e-ISSN. 2620-7397

Akuakultura, 9:2 (2025): 74 - 78

jurnal akuakultura universitas teuku umar

AKUAKULTURA

CARRYING CAPACITY OF VANNAME SHRIMP *(Litopenaeus vannamei)* PONDS IN THE ASPECT OF WATER QUALITY AT PURWOREJO VILLAGE, PASIR SAKTI SUBDISTRICT, EAST LAMPUNG DISTRICT

DAYA DUKUNG TAMBAK UDANG VANAME *(Litopenaeus vannamei)* PADA ASPEK KUALITAS AIR DI DESA PURWOREJO, KECAMATAN PASIR SAKTI, KABUPATEN LAMPUNG TIMUR

Received: March 19, 2025, Revised: June 21, 2025, Accepted: September 19, 2025

Wuni Alfionita[a]*, Ellen Larasati[a] , Agus Arif Rahman[a] , Hengki Pradana[a]

[a] *Aquaculture Study Program, Faculty of Marine Sciences and Fisheries, Syiah Kuala University, Jl. Putroe Phang, Kopelma Darussalam, Syiah Kuala, Banda Aceh City, Aceh*

Abstract

The carrying capacity of ponds in vaname shrimp farming is one of the factors supporting the productivity of aquaculture. The purpose of this study was to evaluate the carrying capacity of vaname shrimp ponds in the aspects of water quality to determine efforts to develop vaname shrimp farming based on the carrying capacity of the pond environment. This research was conducted in Purworejo Village, Pasir Sakti District, East Lampung Regency. The research parameters observed included physical, chemical, and biological parameters of water. The results obtained were temperature 29°C, salinity 18.7–19.3 ppt, pH 8.1–8.3, *Dissolved Oxygen (*DO) 6.0–6.6 mg/l, *Total Ammonia Nitrogen* (TAN) 0.023–0.083 mg/l, nitrite 0.086–0.149 mg/l, *Total Organic Matter (*TOM) 63.3–72.3 mg/l, alkalinity 143–165 mg/l, hardness 1860–1933 mg/l, plankton abundance 776 x 10^3 – 1025 x 10^3 cell/ml, *Total Vibrio Count* (TVC) 1.83 x 10^3 – 2.30 x 10^3 . The conclusion obtained is that the physical and biological parameters of water quality are in optimal condition for vaname shrimp farming. In chemical parameters, the concentration of TOM exceeds the optimal limit, so it is necessary to do routine flushing and water changes.

Keywords: *Pond Productivity, Pond Carrying Capacity, Water Quality, Vanname Shrimp*

Abstract

The carrying capacity of ponds in vaname shrimp farming is one of the factors that support farming productivity. The purpose of this study was to evaluate the carrying capacity of vaname shrimp ponds in terms of water quality to determine efforts to develop vaname shrimp farming based on the carrying capacity of the pond environment. This study was conducted in Purworejo Village, Pasir Sakti Subdistrict, East Lampung Regency. The research parameters observed included physical, chemical, and biological water parameters. The results obtained were temperature 29°C, salinity 18.7–19.3 ppt, pH 8.1–8.3, *Dissolved Oxygen (*DO) 6.0–6.6 mg/l, Total Ammonia Nitrogen (TAN) 0.023–0.083 mg/l, nitrite 0.086–0.149 mg/l, *Total Organic Matter (*TOM) 63.3–72.3 mg/l, alkalinity 143–165 mg/l, hardness 1860–1933 mg/l, plankton abundance 776 x 10^3 – 1025 x 10^3 cells/ml, *Total Vibrio Count* (TVC) 1.83 x 10^3 – 2.30 x 10^3 . The conclusion is that the water quality in terms of physical and biological parameters is optimal for vaname shrimp farming. For chemical parameters, the TOM concentration exceeded the optimal limit, necessitating regular siphoning and water replacement.

Keywords: *Pond Productivity, Pond Carrying Capacity, Water Quality, Vaname Shrimp*

1. Introduction

Lampung is one of the regions with a long coastline and high potential for coastal commodities, so many people work as farmers. The main farm commodity is vaname shrimp (Aditama *et al.,* 2024). The majority of farmers in Purworejo Village, Pasir Sakti District, use a semi-intensive farming system. Vaname shrimp farming can achieve maximum results if supported by optimal pond carrying capacity. Pond carrying capacity is the level of ecological suitability that can accommodate the maximum capacity of a biomass or waste load in a farming ecosystem (Wafi *et al.,* 2021). Continuous shrimp farming activities can cause a decline in pond carrying capacity (Ariadi *et al.,* 2022). Ecological changes in the pond environment will affect the pond carrying capacity, which in turn will impact pond productivity. This situation is a consequence of the development of shrimp pond farming activities that are only profit-oriented without considering the pond carrying capacity.

** Correspondence: Aquaculture Study Program, Faculty of Marine Science and Fisheries, Syiah Kuala University, Jl. Putroe Phang, Kopelma Darussalam, Syiah Kuala, Banda Aceh City, Aceh*
e-mail: wunialfionita@usk.ac.id

The problem faced is that the decline in pond carrying capacity can affect water quality in aquaculture ponds. Water quality greatly affects the cultivated biota. Water quality that meets aquaculture standards will support optimal growth. Conversely, poor water quality can cause stress, thereby inhibiting growth. Therefore, in aquaculture, it is important to maintain the carrying capacity of the environment to avoid crop failure (Farabi and Latuconsina, 2023). Information on pond carrying capacity in terms of water quality, especially in Purworejo Village, is not widely available. The purpose of this study is to evaluate the carrying capacity of vaname shrimp ponds in terms of water quality and, if there are suboptimal water quality parameters, additional treatments can be provided to support the sustainability of vaname shrimp farming in Purworejo Village, Pasir Sakti District, East Lampung Regency.

2. Materials and Methods

2.1. *Time and Place*

This study was conducted in November-December 2021. Water samples were collected from vaname shrimp ponds located in Purworejo Village, Pasir Sakti District, East Lampung Regency. Water samples were analyzed at the Mini Lab Central Proteina Prima (CPP) and the Integrated Laboratory and Technology Innovation Center (LTSIT) of the University of Lampung.

2.2. *Water Quality Measurement*

Water samples were collected every two weeks. Measurements of temperature, salinity, pH, and DO were taken *in situ* at 8:00 a.m. and 5:00 p.m. Western Indonesian Time*,* while measurements of water parameters such as Total Ammonia Nitrogen (TAN), nitrite, *Total Organic Matter (*TOM), alkalinity, hardness, plankton abundance, and total vibrio were taken ex situ and then tested in the laboratory.

2.3. Data Analysis

Data were analyzed descriptively, quantitatively, and qualitatively. Data on physical, chemical, and biological water parameters were analyzed descriptively. The results obtained were compared with the optimal quality standards for vaname shrimp farming. Plankton abundance and *Total Vibrio Count (*TVC) data were analyzed quantitatively. Plankton abundance can be calculated using the following formula:

$$N = \frac{Oi}{Op} \times \frac{Vr}{Vo} \times \frac{1}{Vs} \times \frac{n}{p}$$

Explanation:
N : Number of individuals per liter
Oi : *Sedwick Rafter* cross-sectional area (mm^2)
Op : Area of one field of view (mm^2)
Vr : Volume of filtered water (ml)
Vo : Volume of water observed (ml)
Vs : Volume of filtered water (L)
N : Number of plankton found

The *Total Vibrio Count* (TVC) can be calculated using the following formula:

$$N = \frac{C}{(1 \times n_1) + (0{,}1 \times n_2) \times d}$$

Explanation:
N : Number of product colonies
c : Number of colonies on each plate counted
n_1 : Number of plates in the first dilution counted
n_2 : Number of cups in the second dilution that is counted
d : The first dilution that is counted

3. Results and Discussion

Water quality plays an important role for vaname shrimp because water serves as the shrimp's living medium. Management of pond water quality plays a role in determining the success of vaname shrimp farming. Suboptimal water quality can disrupt shrimp activity, one of which is causing stress, thereby reducing the shrimp's appetite. Water quality management is carried out to maintain the chemical and biological conditions in the cultivation medium so that it remains sterile and is not easily susceptible to disease (Maknun and Sumsanto, 2023). In this study, the water quality observed included physical, chemical, and biological parameters.

Table 1.
Results of Water Quality Measurements in Vaname Shrimp Farming Ponds

Parameters	Farm			Optimal Standard
	T1	T2	T3	
Temperature (°C)	29	29	29	28 - 32°C (Kurniaji *et al.*, 2022)
Salinity (ppt)	19.3	19.3	18.7	15–37 ppt (Kurniaji *et al.*, 2022)
pH	8.3	8.1	8.1	7 – 8.3 (Kurniaji *et al.*, 2022)
DO (mg/L)	6.6	6.1	6	3–7.5 mg/L (Putra *et al.*, 2023)
TAN (mg/L)	0.023	0.083	0.074	<0.1 mg/L (Anggoro *et al.*, 2024)
Nitrite (mg/L)	0.086	0.149	0.136	0.05–1 mg/L (Venkateswarlu *et al.*, 2022)
TOM (mg/L)	72.3	63.3	68.7	55 mg/L (Halim *et al.*, 2022)
Alkalinity (ppm)	165	145	143	90–150 ppm (Listriyana *et al.*, 2023)
Hardness (ppm)	1900	1933	1866	<3000 ppm (Ramadina, 2021)
Plankton abundance (cells/mL)	776×10^3	1025×10^3	828×10^3	$10^4 – 12 \times 10^3$ (Halim *et al.*, 2023)
Total Vibrio (CFU/mL)	1.83×10^3	2.08×10^3	2.30×10^3	$10^4 – 10^6$ (Lestari *et al.*, 2018)

The results of water quality measurements consisting of physical, chemical, and biological parameters can be seen in Table 1. Based on the above data, the physical parameter observed is temperature. The temperature value obtained was 29°C, which is suitable for vaname shrimp. According to Kurniaji *et al.* (2022), the optimum temperature ranges from 28 to 32°C. If the temperature exceeds the optimum level, the metabolism in the shrimp's body will accelerate. Conversely, if the ambient temperature is lower than the optimum temperature, shrimp growth will decline, as indicated by a decrease in appetite (Supriatna *et al.,* 2020). The temperature of pond water greatly affects biological, physical, and chemical processes in the water. In addition, water temperature greatly affects the morphological growth, behavior, metabolism, and reproduction of shrimp in ponds. The effect of temperature on shrimp farming is significant, as the higher the temperature in the water, the lower the concentration of dissolved oxygen (Utami *et al.,* 2023).

The physical parameters observed in this study consisted of salinity, pH, *dissolved oxygen* (DO), total ammonia nitrogen (TAN), nitrite, *total organic matter* (TOM), alkalinity, and hardness. The salinity value in the vaname shrimp ponds at the research site ranged from 18.7 to 19.3 ppt, which is within the optimal range for vaname shrimp farming. This is in accordance with the statement by Kurniaji *et al.* (2022), that the salinity that supports vaname shrimp growth ranges from 15 to 37 ppt. Salinity plays an important role in water quality because it affects the growth of vaname shrimp. In addition, salinity also affects the molting process because it is closely related to the osmoregulation process in vaname shrimp. The higher the salinity, the greater the electrolyte concentration, and thus the higher the osmotic pressure- (Jayanti *et al.,* 2022). Shrimp living at normal temperatures and salinity levels will facilitate the molting process. Molting, or the shedding of shrimp skin, is a process that allows the shrimp's body volume to increase (Se *et al.,* 2023).

The observed pH value ranged from 8.1 to 8.3, indicating that this pH value is suitable for shrimp farming. According to Farabi and Latuconsina (2023), the relationship between pH and vaname shrimp life is in the range of 6.1–7.5 (moderate production), in the range of 7.6–8.0 (fairly good for shrimp farming), in the range of 8.1–8.7 (good for shrimp farming), and 8.8–9.5 (production begins to decline). Water with pH values that are too high or too low can cause stress in shrimp. This is characterized by changes in the shrimp's carapace, which becomes soft and causes a higher mortality rate in shrimp. The pH value of water can decrease due to respiration and the decomposition of organic substances. This decrease in pond water pH occurs due to the decomposition of organic materials by microorganisms, which releases $CO_{(2)}$ that can reduce oxygen concentration and water pH (Halim *et al.,* 2022). If the pH is low, the dissolved oxygen content will decrease, resulting in reduced oxygen consumption, increased respiratory activity, and decreased appetite.

The dissolved oxygen values obtained in the ponds at the research site ranged from 6.0 to 6.6 mg/L, which is still suitable for supporting shrimp life. According to Putra *et al. (*2023), the optimal oxygen content for vaname shrimp farming ranges from 3 to 7.5 mg/L. Oxygen solubility in pond water will increase as the environmental carrying capacity decreases (Wafi *et al.,* 2021). Dissolved oxygen affects the growth of vaname shrimp. If dissolved oxygen conditions are not optimal, it causes competition for oxygen consumption during photosynthesis, resulting in a decrease in dissolved oxygen concentration. In addition, suboptimal dissolved oxygen concentrations can also cause the death of vaname shrimp (Yanti *et al.,* 2023). The sources of oxygen in ponds come from water exchange, the use of water wheels, and *blowers.* In the ponds at the research site, the source of oxygen came from the use of water wheels. The function of water wheels on dissolved oxygen is to stir, thereby accelerating the diffusion process and regulating the position of organic matter deposits or feed and feces residues (Suhendar *et al.,* 2020).

The Total Ammonia Nitrogen (TAN) values obtained in this study ranged from 0.023 to 0.083 mg/L, which is within the optimal range because the total ammonia nitrogen content is <0.1 mg/L. This is in accordance with the statement by Anggoro *et al. (*2024), that a good ammonia level in pond water is below 0.1 mg/L. In pond T2, the TAN level obtained was higher than in the other ponds. This occurred because pond T2 was not regularly cleaned and the water was not changed. According to Arsad *et al. (*2017), irregular water replacement and siphoning can affect the accumulation of feces and feed residues at the bottom of the water, which is a factor that triggers ammonia levels. Ammonia entering the water can have a negative impact on shrimp farming activities. Ammonia in the aquatic environment can appear in the form of un-ionized ammonia ($^{NH3)}$and ionized ammonia ($^{NH4),}$but both can combine to form Total Ammonia Nitrogen (TAN) (Wahyuningsih and Gitarama, 2020). According to Suhendar *et al. (*2020), dissolved ammonia content can increase with longer cultivation periods. In addition, high stocking densities also increase the feed requirements of shrimp in ponds, which can lead to the accumulation of feed residues and feces. Ammonia in water that exceeds the limit is considered to cause stress in shrimp, resulting in a decrease in appetite.

The nitrite concentration values obtained ranged from 0.086 to 0.149 mg/L, indicating that these values are still within the optimal range for vaname shrimp farming. The optimal nitrite content in vaname shrimp farming waters is >0.05 mg/L, while >1 mg/L can be a limiting factor (Venkateswarlu *et al.,* 2019). Nitrite is an inorganic nitrogen compound formed as a result of ammonia oxidation by *Nitrosomonas* bacteria*.* Therefore, nitrite concentration depends on the amount of ammonia. The higher the amount of ammonia, the higher the nitrite concentration in the water. Nitrite compounds in ponds need to be removed or reduced because they can be toxic to shrimp (Sambu *et al.,* 2021).

Total Organic Matter (TOM) indicates the total organic content in a body of water, consisting of dissolved, suspended, and colloidal organic matter (Abdillah *et al.*, 2024). The measured TOM content ranged from 63.3 to 72.3 mg/L. This indicates that the total organic matter concentration in vaname shrimp ponds exceeds the optimal limit. According to Halim *et al.* (2022), the optimal limit for TOM concentration in vaname shrimp farming should not exceed 55 mg/L. The high TOM concentration in these ponds is caused by waste deposits at the bottom of the ponds, which originate from increased feeding, feces, and dead organisms in the water, such as mass plankton deaths and shrimp mortality. The amount and concentration of organic waste produced in intensive ponds are very high. In addition to cultivation waste, organic particles in ponds also come from chemical residues from the use of probiotics, liming, and fertilization in ponds. An increase in organic waste in ponds will cause the carrying capacity of the ponds to decline, as will the production of farmed shrimp. To reduce TOM levels in ponds, water changes and regular siphoning can be carried out (Ghufron *et al.,* 2017).

Alkalinity is a water quality parameter that affects the abundance of mineral ions and calcium in pond water. The alkalinity values obtained in this study ranged from 143 to 165 ppm. According to Listriyana *et al*. (2023), the optimal alkalinity for vanamei cultivation ranges from 90 to 150 ppm. In pond T1, the alkalinity value exceeded the optimal limit, requiring water replacement. Excessively high alkalinity can cause hardness and inhibit the molting process in vaname shrimp. Alkalinity within the optimal range will help provide calcium for the osmotic needs of cells in the shrimp's body. Alkalinity functions as *a* natural pH *buffer* in ponds because it can maintain pH values despite fluctuations in water pH, whether from new water, rainwater, or the application of other materials (Yunarty *et al.,* 2022).

Hardness values in ponds are related to alkalinity levels. If alkalinity is high, hardness will also be high. The hardness results obtained in vaname shrimp ponds ranged from 1866 to 1933 ppm. This indicates that the hardness in these ponds is within the optimal range. According to Ramadina (2021), the highest level of hardness is 3000 ppm. The concentration of hardness in ponds is an accumulation of calcium ($Ca^{(2+)}$)and magnesium ($Mg^{(2+)}$)hardness. In addition, hardness also correlates with the abundance of mineral ions and the type of soil conditions in the environment surrounding the ponds. If the hardness concentration is high, it will form a crust that sticks to the gills ( ), making it difficult for shrimp to breathe and causing death. This hardness can cause toxicity through certain metal ions if left unchecked (Manullang *et al.,* 2023).

In this study, the biological parameters observed were plankton abundance and total vibrio. Plankton are organisms that float in the water body, so the frequency of water exchange in the cultivation pond will affect the types of plankton present in the vaname shrimp ponds. The availability of nutrients and changes in the nutrient ratio in a water body can cause changes in plankton abundance and species composition (Aisyah *et al.,* 2023). In the research ponds, the plankton abundance values obtained ranged from $10^{(4)}$to 12 x $10^{(3)}$cells/ml. The high plankton abundance was influenced by sufficient nutrient sources and the ability of plankton to utilize these nutrients. This is in line with the statement by Halim *et al.* (2023) that pond preparation affects the growth of phytoplankton in the pond.

Fertilization will cause the pond bottom to become fertile so that aquatic plants, especially blue algae, can grow well. Fertility will decrease as the maintenance period increases.

Vibrio is a group of opportunistic pathogenic bacteria commonly found in brackish water. Members of this bacterial group are characterized by their short rod shape, facultative aerobic nature, lack of capsule, gram-negative binary fission reproduction, flagella, lack of spores, and growth on *Thiosulfate Citrate Bile Salt Sucrose (*TCBS) media (Idami and Nasution, 2020). In this study, the total number of Vibrio obtained was 1.83 x^{10^3}– 2.30 x 10^3CFU/mL, which is still safe for vaname shrimp farming activities. Bacterial isolates will be pathogenic to shrimp when their concentration is$^{10^4}$–$^{10^7}$CFU/mL and will affect shrimp survival after 24 – 48 hours (Lestari *et al.,* 2018). High TVC indicates that water quality is not well maintained, which affects shrimp appetite, survival rate, and growth rate (Wafi *et al.,* 2021). According to Amrullah *et al. (*2023), an increase in the number of *Vibrio* sp. bacteria in aquaculture is the main cause of disease in shrimp. In addition, environmental factors also influence the emergence of diseases caused by instability in pH, salinity, oxygen levels, temperature, ammonia, and organic materials, as these can cause stress and disease in shrimp.

4. Conclusion

Based on the results of research on the carrying capacity of vaname shrimp ponds in terms of water quality, it can be concluded that the physical parameters of the water are optimal for vaname shrimp farming. In terms of chemical parameters, the *Total Organic Matter* (TOM) value exceeds the optimum limit, so measures such as siphoning and routine water replacement are necessary. Regarding biological parameters, the abundance of plankton and total vibrio levels remain within safe conditions for vaname shrimp farming activities.

References

Abdillah, F. D., Agustini, M. dan Sumaryam. 2024. Pengaruh Frekuensi Pemberian Pakan yang Berbeda terhadap Pertumbuhan Berat Mutlak Budidaya Udang Vaname *(Litopenaeus vannamei)* dalam Bak Pemeliharaan. *Juvenil* 5(2): 172 – 177.

Aditama W. E., Noer, I., Kusmaria, dan Humaidi, E. (2024). Efisiensi Pemasaran Udang Vaname di Kecamatan Pasir Sakti Kabupaten Lampung Timur. *Jurnal Manajemen Agribisnis Terapan* 2(2): 91 – 96.

Aisyah, D., Ramadhani, A. W., Fattah, M., Sofiati, D., dan Anandya, A. (2023). Pengaruh Kelimpahan Plankton dan Kualitas Air terhadap Performa Pertumbuhan Udang Vanname pada Sistem Budidaya Intensif. *Jurnal Ilmu Perikanan dan Kelautan,* 5(2): 173 – 182.

Amrullah, S. H., Mar'iyah, K., Afandi, A. A. (2023). Analisis Total Bakteri Vibrio pada Sampel Air Tambak Udang Vaname di Balai Perikanan Budidaya Air Payau Takalar. *Jurnal Pendidikan dan Sains Biologi,* 6(1): 8 – 14.

Anggoro, M. F., Yulianto, B., dan Suryono. (2024). Analisis Kadar TAN terhadap Bobot Udang di Tambak Udang Mangrove Jembatan Api-Api, Kulonprogo. *Journal Marine of Research,* 13(2): 381 – 388.

Ariadi, H., Madusari, B. D., dan Mardhiyana, D. (2022). Analisis Pengaruh Daya Dukung Lingkungan Budidaya terhadap Laju Pertumbuhan Udang Vaname *(L. vannamei). EaviroScienteae,* 18(1): 29 – 37.

Arsad, S. Afandy, A. Purwadhi, A. P., Saputra, D. K., dan Buwono, N. R. (2017). Studi Kegiatan Budidaya Pembesaran Udang Vaname *(Litopenaeus vannamei)* dengan Penerapan Sistem Pemeliharaan Berbeda. *Jurnal Ilmiah Perikanan dan Kelautan,* 9(1): 1 – 14.

Farabi, A. I., dan Latuconsina, H. (2023). Manajemen Kualitas Air pada Pembesaran Udang Vaname *(Litopenaeus vannamei)* di UPT. BAPL (Budidaya Air Payau dan Laut) Bangil Pasuruan Jawa Timur. *Jurnal Riset Perikanan dan Kelautan,* 5(1). 1 – 13.

Ghufron, M., Lamid, M., Sari, P. D. W., dan Suprapto, H. (2017). Teknik Pembesaran Udang Vaname *(Litopenaeus vannamei)* pada Tambak Pendampingan PT. Central Proteina Prima Tbk di Desa Randutatah, Kecamatan Paiton, Probolinggo, Jawa Timur. *Journal of Aquaculture and Fish Health,* 7(2): 70 – 77.

Halim, A. M., Fauziah, A., dan Aisyah, N. (2022). Kesesuaian Kualitas Air pada Tambak Udang Vanname *(Litopenaeus vannamei)* di CV. Lancar Sejahtera Abadi, Probolinggo, Jawa Timur. *Chanos-chanos,* 20(2): 77 – 88.

Halim, A. M., Fauziah, A., Ritonga, L. B. R., Arifin, M. Z., dan Wulandari, A. (2023). Tingkat Kepadatan *Vibrio* sp. dan Kelimpahan Plankton pada Pertumbuhan Udang Vannamei *(Litopenaeus vannamei)* di CV. Rejo Royal Banyuwangi Jawa Timur. *Jurnal Perikanan Pantura,* 6(2). 405 – 414.

Idami, Z. dan Nasution, R. A. (2020). Kelimpahan Koloni Bakteri *Vibrio* sp. Berdasarkan Lokasi Budidaya Tambak Udang di Kabupaten Pidie. *Bioma: Jurnal Biologi dan Pembelajaran Biologi,* 5(2). 121 – 134.

Jayanti, S. L. L., Atjo, A. A., Fitriah, R., Lestari, D., dan Nur, M. (2022). Pengaruh Perbedaan Salinitas terhadap Pertumbuhan dan Sintasan Larva Udang Vaname *(Litopenaeus vannamei). Aquacoastmarine,* 1(1): 40 – 48.

Kurniaji, A., Yunarty, Budiyati, Renitasari, D. P., Resa, M. (2022). Karakteristik Kualitas Air dan Performa Pertumbuhan Budidaya Udang Vaname *(Litopenaeus vannamei)* Pola Intensif. *Jurnal Ilmiah Perikanan dan Kelautan,* 21(1): 75 – 88.

Lestari, N. P. T., Julyantoro, P. G. S., dan Suryaningtyas, E. W. (2018). Uji Tantang Bakteri *Vibrio harveyi* pada Pacsa Larva Udang Vaname *(Litopenaeus vannamei). Current Trends in Aquatic Science,* 1(1): 114 – 121.

Listriyana, A., Handayani, C., dan Pahlevi, A. D. (2023). Analisis Kualitas Air Alkalinitas pada Perairan Tambak Intensif Situbindo. *Zona Laut: Jurnal Inovasi Sains dan Teknologi Kelautana,* 4(2). 96 – 101.

Mahmudi, S. M., Musa, M., dan Kusriani. (2020). Hubungan pH dengan Parameter Kualitas Air pada Tambak Intensif Udang Vaname *(Litopenaeus vannamei). Journal of Fisheries and Marine Research,* 4(3). 368 – 374.

Maknun, L. dan Sumsanto, M. (2023). Studi Teknik Pengelolaan Kualitas Air pada Pemeliharaan Induk Udang Vaname *(Litopenaeus vannamei)* di PT. Suri Tani Pemuka Unit Hatchery Singaraja, Bali. *Jurnal Ilmu Perikanan dan Kelautan,* 5(3). 507 – 516.

Manullang, R., Undap, S. L., Pangkey, H., Kusen, D. J., Kalesaran, O. J., dan Longdong, S. N. J. (2023). Kualitas Air pada Pembesaran Udang Vaname *(Litopenaeus vannamei)* PL

8 PT. Budi Agri Sejahtera, Kecamatan Tempilang, Provinsi Bangka Belitung. *E-Journal Budidaya Perairan,* 11(1). 52 – 61.

Romadhona, B., Yulianto, B., dan Sudarno, S. (2016). Fluktuasi Kandungan Amonia dan Beban Cemaran Lingkungan Tambak Udang Vaname Intensif dengan Teknik Panen Parsial dan Panen Total. *Saintek Perikanan: Indonesian Journal of Fisheries Science and Technology,* 11(2): 84 – 93.

Sambu, A. H., Malik, A., dan Anwar, A. (2021). Efektivitas Bakteri Nitrifikasi dan Denitrifikasi pada Limbah Organik Budidaya Udang Vanname . *Jurnal Harpodon Borneo,* 14(2): 102 – 110.

Se, A. N., Santoso, P., dan Liufeto, F. C. (2023). Pengaruh Perbedaan Suhu dan Salinitas terhadap Pertumbuhan Post Larva Udang Vaname *(Litopenaeus vannamei). Jurnal Vokasi Ilmu-Ilmu Perikanan,* 3(2). 84 – 89.

Suhendar, D. T., Zaidy, A. B., dan Sachoemar, S. I. (2020). Profil Oksigen Terlarut, Total Padatan Tersuspensi, Amonia, Nitrat, Fosfat dan Suhu pada Tambak Udang Vanamei secara Intensif. *Jurnal Akuatek,* 1(1): 1 – 11.

Utami, R. S., Roslidar, Mufti, A., Rizki, M. (2023). Sistem Kendali dan Pemantau Kualitas Air Tambak Udang Berbasis Salinitas, Suhu, dan pH Air. *KITEKRO: Jurnal Komputer, Informasi Teknologi, dan Elektro,* 8(1). 43 – 48.

Venkateswarlu, V., Seshaiah, P. V., Arun, P., dan Behra, P. C. (2019). A Study on Water Quality Parameters in Shrimp *L. vannamei* Semi-Intensif Grow-Out Culture Farms in Coastal Districts of Andhra Pradesh, India. *International Journal of Fisheries and Aquatic Studies*, 7(4): 394 – 399.

Wafi, A., Ariadi, H., Muqsith, A., Mahmudi, M., dan Fadjar, M. (2021). Oxygen Consumption of *Litopenaeus vannamei* in Intensive Ponds Based on the Dynamic Modeling System. *Journal of Aquaculture and Fish Health,* 10(1): 17 – 24.

Wafi, A., Ariadi, H., Khumaidi, A., Muqsith, A. (2021). Pemetaan Kesesuaian Lahan Budidaya Rumput Laut di Kecamatan Banyuputih, Situbondo Berdasarkan Indikator Kimia Air. *Samakia: Jurnal Ilmu Perikanan,* 12(2): 170 – 179.

Wahyuningsih, N., Jufriadi, J. dan Surur, D. (2023). Amonia pada Sistem Budidaya Ikan. *Syntax Literate: Jurnal Ilmiah Indonesia,* 5(2). 112 – 125.

Yanti, H. A., Fajriyah, S. Z., dan Putri, D. A. (2023). Simulasi Sistem Monitoring Oksigen Terlarut (DO) pada Budidaya Udang Vaname Berbasis *Internet of Things* (IoT). *Journal of Informatics and Communications Technology,* 5(1): 57 – 67.

Yunarty, Kurniaji, A., Budiyati, Renitasari, D. P., Resa, M. (2022). Karakteristik Kualitas Air dan Performa Pertumbuhan Budidaya Udang Vaname *(Litopenaeus vannamei)* Pola Intensif. *PENA Akuatika: Jurnal Ilmiah Perikanan dan Kelautan,* 21(1): 75 – 88.