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MANAJEMEN KUALITAS AIR PADA PEMBESARAN UDANG VANNAMEI (*Litopenaeus vannamei*) DI PT. BUMI HARAPAN JAYA, POTO TANO, SUMBAWA BARAT

Water Quality Management in Enlargement Vannamei Shrimp (Litopenaeus vannamei) in PT. Bumi Harapan Jaya, Poto Tano, Sumbawa Barat

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ABSTRAK

Udang merupakan salah satu produk utama dalam budidaya perikanan di Indonesia. Salah satu jenis udang yang memiliki nilai ekonomis tinggi dibandingkan dengan jenis udang lainnya adalah udang vannamei (*Litopenaeus vannamei*), udang jenis ini sangat diminati oleh para pembudidaya karena dapat dibudidayakan secara intensif dengan padat tebar tinggi dan pemberian pakan yang intensif untuk mencapai produksi yang tinggi. Pengelolaan kualitas air sangat menentukan keberlangsungan industri budidaya, karena pengembangan budidaya udang melalui sistem padat tebar tinggi dan pemberian pakan yang intensif dapat menimbulkan masalah seperti penurunan kualitas air tambak untuk kelangsungan hidup udang. Tujuan dari penelitian ini adalah untuk dapat mengetahui cara dan teknik manajemen kualitas air dalam pembesaran udang vannamei (*Litopenaeus vannamei)* di PT. Bumi Harapan Jaya, Poto Tano, Sumbawa Barat. Teknik pengumpulan data yang digunakan adalah secara primer dan sekunder melalui observasi, pengamatan langsung, wawancara serta melalui jurnal, buku dan literatur terkait. Pengelolaan kualitas air dibagi menjadi tiga parameter yaitu fisika, kimia dan biologi. Hasil penelitian menunjukkan nilai kualitas air pada setiap parameter fisika, kimia dan biologi di tambak PT. Bumi Harapan Jaya masih tergolong optimal. Manajemen kualitas air di tambak PT. Bumi Harapan Jaya dimulai dari pengelolaan kualitas air secara umum dibagi menjadi beberapa tahapan meliputi proses persiapan petakan, strerilisasi air, penggunaan bakteri dan pengecekan rutin berbagai parameter air.

ABSTRACT

Shrimp is one of the main products of aquaculture in Indonesia. One type of shrimp that has high economic value compared to other types of shrimp is the vannamei shrimp (Litopenaeus vannamei). This type of shrimp is in great demand by cultivators because it can be cultivated intensively with high stocking densities and intensive feeding to achieve high production. Water quality management greatly determines the sustainability of the aquaculture industry because the development of shrimp culture through a high stocking density system and intensive feeding can cause problems such as a decrease in pond water quality for shrimp survival. The purpose of this study was to find out the correct methods and techniques for water quality management in growing vannamei shrimp (Litopenaeus vannamei) at PT. Bumi Harapan Jaya, Poto Tano, West Sumbawa. Data collection techniques used were primary and secondary through observation, direct observation, interviews and through journals, books, and related literature. Water quality management is divided into three parameters, namely physics, chemistry, and biology. The research results show that water quality values for each physical, chemical, and biological parameter in the PT. Bumi Harapan Jaya ponds are still considered optimal. Water quality management at PT. Bumi Harapan Jaya's ponds begins with general water quality management, divided into several stages, including pond preparation, water sterilization, bacteria application, and routine monitoring of various water parameters.

Kata Kunci	*Udang, Kualitas Air, Intesif*
Keywords	*Shrimp, Water Quality, Intensive*
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INTRODUCTION

Shrimp is one of the main products in aquaculture in Indonesia. One type of shrimp that has high economic value compared to other types of shrimp is the whiteleg shrimp (Litopenaeus vannamei), which is highly sought after by shrimp farmers. Whiteleg shrimp (Litopenaeus vannamei) was first discovered in the waters off the west coast of the Pacific Ocean in Latin America, from southern Peru to northern Mexico. Due to the decline of the tiger shrimp farming industry in Indonesia, whiteleg shrimp has become an alternative cultivation option. Cultivating whiteleg shrimp is relatively easy in Indonesia, so in recent years many pond farmers have begun cultivating whiteleg shrimp (Halim et al., 2021).

The advantages of vannamei shrimp include their sensitivity to food, high appetite, and greater resistance to disease and poor environmental quality. Furthermore, they exhibit faster growth, high survival rates, high stocking densities, and a relatively short rearing period of approximately 100-120 days per cycle. Vannamei shrimp can be intensively cultivated with high stocking densities and intensive feeding to achieve high production. However, the organic waste produced from shrimp ponds is the primary source of ammonia in the culture medium. High ammonia concentrations negatively impact the life of organisms in the culture medium (Renitasari & Musa, 2020).

Water plays a crucial role in the success of vannamei shrimp cultivation, especially in intensive ponds. Proper water quality management can increase vannamei shrimp productivity. Water quality management involves regulating or conditioning all pond water quality parameters to maintain optimal conditions for shrimp growth and to achieve optimal shrimp production (Qurnianto, 2016). Water quality management is crucial for the sustainability of the aquaculture industry, as developing shrimp cultivation through high stocking densities and intensive feeding can lead to problems such as decreased pond water quality, which is detrimental to shrimp survival. The semi-biofloc system allows for better water quality maintenance in ponds because heterotrophic bacteria utilize organic matter in the water to form flocs that can be consumed by the shrimp. Therefore, increased waste pollution in waters caused by high stocking densities and excessive feeding, as well as the resulting risk of disease that leads to shrimp production failure, can be minimized (Abidin, 2022)

The Vannamei shrimp farming activities carried out at PT. Bumi Harapan Jaya are included in the intensive system, this is characterized by the technology used, stocking density and the use of large amounts of feed, by implementing the semi-floc method, where the cultivation system combines the use of good bacteria and phytoplankton appropriately and controlled in the waters. Semi-biofloc technology generally utilizes the activity of heterotrophic bacteria. Heterotrophic bacteria are a type of bacteria that require organic matter as a carbon source to grow. Heterotrophic organisms cannot synthesize organic matter or carbon compounds from inorganic materials. Therefore, this type of bacteria must obtain its food source from other heterotrophic bacteria or autotrophs. Heterotrophic bacteria are generally considered decomposers and consumers of the food chain. Aquatic heterotrophic bacteria usually use uneaten food, feces, and other organic materials as a source of protein, which is converted into inorganic ammonia (Putra et al., 2014).

Water quality measurements and monitoring that can be done at PT. Bumi Harapan Jaya are by measuring water clarity, temperature, salinity, Dissolved Oxygen, Ammonium (NH4), Nitrite (NO2), Nitrate (NO3), Ammonia (NH3), Phosphate (PO4), Total Organic Meter (TOM), plankton density and total bacteria in the waters. Therefore, it is necessary to carry out this Field Work Practice with the title Water Quality Management in Vannamei Shrimp Farming Activities at PT. Bumi Harapan Jaya Poto Tano.

METHODS

The research was conducted from March to June 2023 at PT. Bumi Harapan Jaya. Activities included daily water quality checks in the field and weekly laboratory checks. Primary and secondary data collection techniques were used through observation, direct observation, interviews, and descriptive analysis of journals, books, and related literature.

RESULT AND DISCUSSION

The results of the 13-week water quality measurements (field and laboratory) are presented in table form:

Table 1. Results of the water quality measurement research on physical parameters.

Week to	Temperatur (°C)		Brightness (m)	
	Morning	Afternoon	Morning	Afternoon
1	29	31	95	90
2	28	30	65	60
3	28	30	55	50
4	28	30	70	65
5	28	30	60	55
6	28	30	45	40
7	28	30	40	35
8	28	30	40	35
9	26	28	40	35
10	27	29	30	30
11	27	29	40	35
12	27	29	40	35
13	26	28	40	35

Table 2. Results of the water quality measurement research on chemical parameters

Minggu Ke	Nitrite (NO2)	Nitrate (NO3)	Ammonium (NH4)	Ammoniak (NH3)	TOM	Alkalinity	Phosfate	pH		Salinity
								Morning	Afternoon	
1	0,021	0	0	0	66	120	0	8,4	8,6	36
2	0,034	10	0	0	86	120	0	8,8	8,9	39
3	0,04	10	0	0	99	125	0,25	8,1	8,4	39
4	0,019	10	0,75	0,033	99	120	0,75	7,9	8,1	39
5	0,032	5	0	0	94	125	0,75	8,0	8,3	40
6	0,033	5	0	0	98	125	2	7,7	7,9	38
7	0,026	5	0	0	101	145	1,75	7,9	7,9	37
8	0,026	5	0,5	0,018	106	110	1,5	7,8	8,1	35
9	0,051	5	0,75	0,012	103	130	2,5	7,5	7,8	36
10	0,13	5	0,75	0,013	99	135	2,5	7,5	7,8	36
11	1,195	5	3	0,081	95	150	3	7,7	8,0	36
12	1,136	10	2	0,068	92	145	5	7,8	8,1	35
13	2,33	17,5	3	0,117	88	155	4	7,9	8,2	36

DISCUSSION

Water quality management is essentially an activity carried out to maintain good water conditions in accordance with company standards, in achieving the optimal range in terms of physical, chemical, or biological parameters. Water quality management activities will greatly influence the success or failure of shrimp farming activities. Water quality management activities at Pt. Bumi Harapan Jaya begin with the preparation of the plot starting with sterilization by providing 50 ppm of chlorine at a water level of 40 cm and left for approximately 3 days after which the water is removed, 80% HCL is sprayed on each wall, the floor of the pond and is carried out lime and fertilization. After the pond preparation is done, the water is sterilized. Water sterilization aims to clean the water from moss, shellfish, predators and other algae, can be done using cupric sulfate while for crabs and the like can use crustacide (Supono, 2019). Water sterilization is carried out 12-15 days before the spread of the fry. In addition to sterilization, periodic water condition control is required, namely daily checks in the morning and evening. In addition to sterilization, water quality monitoring is necessary through daily morning and evening checks. Water quality management includes checking the physical, chemical, and biological parameters of the water.

Based on the research results in Table 1, the average temperature for aquaculture ponds in the morning ranges between 27-29°C, while during the day it ranges between 29-31°C. The temperature range in aquaculture ponds is considered optimal for cultivation activities. This is in accordance with Muzahar's statement (2020), who stated that the optimal temperature for shrimp growth is between 28-30°C. Temperature is a condition of the aquatic environment in the form of heat or cold expressed in degrees. Water temperature greatly affects the condition of shrimp, especially their appetite. This is related to the metabolic processes of the shrimp's body. The higher the water temperature, the higher the metabolic processes in the shrimp's body. Conversely, if the water temperature is very low, the shrimp's metabolism will also decrease.

The clarity of a body of water is an important indicator in determining treatment in aquaculture activities. Clarity is influenced by fine materials floating in the water, both in the form of organic materials such as plankton, microorganisms, detritus, and inorganic materials such as mud and sand. In aquaculture ponds, plankton density plays the largest role in determining clarity, although suspended particles in the water also have an effect. Based on the results of the study, the average clarity in the morning in aquaculture ponds ranges from 30-40 cm. Sometimes there are some ponds that have a clarity of more than 40 cm because the plankton is less but the coarse and fine particles dominate. Clarity in aquaculture ponds is already included in the optimal range for carrying out aquaculture activities. This is in accordance with the statement of Supono (2019), who said that in aquaculture ponds, the density Plankton plays the largest role in determining water clarity, although suspended particles also play a role. Optimal water clarity for shrimp cultivation is between 30 and 40 cm.

Based on the research conducted, the chemical parameters in Table 2 include pH. The average pH value in the morning ranges from 7.6-7.8, while during the day it ranges from 8.0-8.2. This pH range is considered optimal for vannamei shrimp cultivation. This is in accordance with the statement of Purnamasari et al., (2017), who stated that the normal pH value for vannamei shrimp growth is between 7.5-8.5. Acidity is an important parameter in cultivation activities. pH is a dynamic water quality variable and fluctuates throughout the day. Daily changes in pH can cause stress in aquatic animals. An increase in pH can increase ammonia concentration, while at a low pH there is an increase in H_2S concentration. This also increases the toxicity of ammonia at high pH and H2S at low pH. Water conditions with extreme pH can also stress shrimp, softening the carapace, and reduce survival (Supriatna et al., 2020). Therefore, liming is used to increase total alkalinity and is necessary for water buffer stability and reducing fluctuations. Salinity is a water quality parameter that plays a crucial role in the survival and growth of Vannamei shrimp. Salinity plays a role in osmoregulation and molting processes in shrimp. Therefore, optimal environmental salinity is needed for shrimp to maintain their growth. If the salinity level in pond water is too high, we can change the water more frequently (Salsabiela, 2020).

The average salinity value in the cultivation plots was found to be between 35-39 ppt. Water salinity measurements were conducted once a week using a refractometer. This value is considered suboptimal for shrimp growth, although shrimp can survive in salinity ranges between 1-40 ppt (Tangguda et al., 2018). This is supported by Muzahar (2020) who stated that the optimal salt content for shrimp growth is between 15-30 ppt. Both high and low salinity levels disrupt shrimp growth due to impaired osmoregulation. The alkalinity value obtained was between 110-155, which is considered optimal in waters. This is in accordance with Putra's statement (2014), which states that a good alkalinity value ranges from 90-150 mg/l. Alkalinity is a buffer or buffer against the effects of acid that can neutralize additional acid without increasing the pH of the solution. Alkalinity is expressed in mg/l $CaCO3$. According to Sitanggang & Amanda (2019), alkalinity that is too low will cause shrimp to frequently change their shells or molt abnormally. Meanwhile, if the alkalinity is too high, it will make it difficult for shrimp to molt. One way to maintain alkalinity levels in water is to maintain the pH value so that it does not experience drastic changes, namely by liming, which is carried out every two to three days. This is in accordance with the statement of Saputra (2022), who said that to maintain alkalinity in waters within the optimal range, namely by maintaining the pH value so that it does not experience significant changes, which can be done by liming the water regularly every three days to maintain alkalinity at optimum conditions.

Water chemical parameters such as nitrate (NO_3^-), nitrite (NO_2^-), ammonia (NH_3), ammonium ($NH4$), phosphate and total organic matter (TOM) interact with each other and determine the level of stress, health, and growth rate of shrimp. These parameters are generally indicators of the level of organic waste (feed and feces) and the effectiveness of the nitrification system in the pond. Based on the results of the study, Table 2 shows that nitrate values range from 0-17.5 ppm and nitrite 0.021-2.33 ppm. The nitrite and nitrate values in this study are still within the optimal range. This is in accordance with the statement of Rusdi et al., (2021), who said that according to PP No. 82 of 2001 concerning water quality management and water pollution control, the nitrate level that is still within the safe limit is 100 mg/l and the statement of Hendrawati et al (2008), the maximum threshold for the quality standard for nitrite content calculated as N according to PP No. 82 of 2002 is 0.06 mg/l. Nitrate can come from the fertilizer used and from the oxidation of nitrite by nitrobacteria bacteria which will convert ammonia to nitrite and into nitrate. If the nitrate threshold exceeds the standard, what can be done in the field is to apply bacteria such as Bacillus sp as heterotrophic bacteria and also frequently carry out siphoning. This is also in accordance with the statement of Yuka et al., (2020), who said that heterotrophic bacteria require organic carbon and inorganic nitrogen as energy sources, these bacteria are also able to utilize ammonium and nitrate as nitrogen sources. Nitrite is the result of the nitrification process by bacteria, nitrite is one of the nitrogen compounds derived from feed and can be toxic to shrimp. Efforts that can also be done when the nitrite content in a body of water is high is by applying bacteria.

The content of ammonium ($NH4$) and ammonia ($NH3$) in cultivation activities will increase, along with the increasing age of the shrimp and the amount of feed needed. The ammonium content in the first week was 0 mg/l and increased in the 4th week, namely 0.75 mg/l, then decreased again in the following week and began to increase in the 8th week, namely 0.5 mg/l to the 13th week, namely 3 mg/l, while the ammonia (NH_3) value increased from the 1st week, namely 0 mg/l to the 13th week, namely 0.117 mg/l. Based on the ammonium and ammonia values in this study, it is still considered safe. According to Utami et al., (2022), stated that the ammonium content that can be tolerated by cultivated organisms is 0-1.04 mg/l while according to Muzahar (2020), said that the free ammonia level in standardized shrimp pond waters is a maximum of 0.01 mg/l. Things that can be done if the ammonium and ammonia content continues to increase are frequent siphoning, adding probiotics and changing the water. This is in accordance with the statement of Budiyati et al., (2022), saying that the nitrite and ammonium content that continues to increase can be managed by water quality, namely siphoning, applying probiotics and changing the water.

Phosphate is a limiting factor for plankton productivity so its presence in pond water must always be monitored and is a compound dissolved in water bodies or waters that has a function for aquatic biota, for example protein formation and photosynthesis processes. The phosphate content in the pond increased from the first week to the 13th week, although there was a decrease in value in the 8th and 13th weeks. Hendrwati et al., (2008), said that the maximum phosphate concentration set by PP No. 82 of 2001 was 1 mg/l.

TOM (Total Organic Matter) is the total organic material present in the water and pond bottom, both dissolved and suspended. This organic material comes from feed and feces. Based on field work practices that have been carried out, the range of values obtained is between 66-106 mg/l, this shows that the range of values is still included in the optimum limit. Supriatna et al., (2020), stated that the maximum limit of organic matter in vannamei shrimp cultivation is 88.4 mg/l. Organic matter is an important source of nutrients, which are needed by marine organisms. One of the functions of organic matter in waters is as an indicator of water quality, because organic matter naturally comes from the waters themselves through the process of decomposition, weathering, or decomposition of plants, the remains of dead organisms and feces.

The biological research parameter indicators in this study consisted of the presence of plankton. Plankton functions as a sediment or barrier between the brightness of shrimp and sunlight in a body of water. Samadan et al., (2020), stated that plankton is useful as natural food for shrimp, especially in the early stages of cultivation after the release of fry, suppressing the growth of klekap and moss on the pond floor. Plankton found in shrimp pond waters is divided into Several types of green algae, blue algae, diatoms, and dinoflagellates. Research shows that the most frequently encountered plankton are green algae, diatoms, and sometimes dinoflagellates. The type of plankton in the waters can affect the color and clarity of aquaculture ponds. This is consistent with Ningsih & Sulthoniyah (2021) who stated that pond water with a brownish-green color indicates the dominance of diatomaceous plankton.

CONCLUSION

Water quality management at PT. Bumi Harapan Jaya's ponds begins with several stages, including plot preparation, water sterilization, bacteria application, and routine monitoring of various water parameters, including physical parameters such as temperature, clarity, and color. Chemical parameters include nitrate, nitrite, ammonium, alkalinity, total oxygen saturation (TOM), and hardness. Biological parameters include viruses, bacteria, and plankton.

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