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Water Quality Dynamics in Milkfish Ponds with Water Source from Wastewater of Vaname Shrimp Culture

Dinamika Kualitas Air Pada Tambak Ikan Bandeng Dengan Sumber Air Dari Sisa Pemeliharaan Udang Vanname

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ABSTRACT

Wastewater from vaname shrimp culture with a semi biofloc system, was used for milkfish cultivation without additional feed. Fish seeds are stocked 4000 with 18 days of age. The Milkfish pond is 2000 m2, the water level is 0,7 m. Water quality was observed 2 months cultivation. Water samples were taken everyweeks around 9 am, from March to April 2022. During the research, temperature, brightness, pH, dissolved oxygen, CO2 and salinity were relatively stable, except for nitrate and phosphate levels. First observation the levels of nitrate were 0,059 mg/l and phosphate was 0,064 mg/l. When the fish were 2,5 months, nitrate levels increased by 425,4% to 0,31 mg/l and phosphate increased by 479,7% to 0,371 mg/l. This increase is thought the addition of residual water from vannamei shrimp cultivation, so that the pond water level becomes 80 cm. Observation of milkfish at the age of 3 months, nitrate levels decreased 42,6% to 0,178 mg/l and phosphate decreased 8,4% to 0,34 mg/l. This decreasing is thought because nitrate and phosphate are used as a source of nutrients for phytoplankton. The milkfish are 3,5 months, the nitrate level decreases by 58,4% to 0,074 mg/l, but the phosphate level increases by 8,24% to 0,368 mg/l. The increase in phosphate is thought to be from the decomposition of fish feces. And the decreasing of nitrate because used as a source of nutrients for phytoplankton. Water quality monitoring must be carried out regularly, to preserve pond water quality

ABSTRAK

Air sisa budidaya udang vaname sistem semi bioflok telah digunakan untuk memelihara ikan bandeng. Luas tambak 2000 m2, ketinggian air 0,7 m diisi benih bandeng umur 18 hari sebanyak 4000 ekor tanpa pemberian pakan tambahan. Kualitas air mulai di amati saat bandeng berumur 2 bulan. Sampel air diambil setiap seminggu sekitar jam 9 pagi, dari Maret sampai April 2022. Saat bandeng berumur 2 bulan kadar nitrat 0,059 mg/l dan fosfat 0,064 mg/l. Pada pengamatan berikutnya saat umur ikan 2,5 bulan kadar nitrat naik 425,4% menjadi 0,31 mg/l dan fosfat naik 479,7% menjadi 0,371 mg/l. Kenaikan ini selain diduga dari penguraian hasil feses ikan, juga adanya penambahan air sisa budidaya udang vanname, sehingga ketinggian air tambak menjadi 80 cm. Pengamatan bandeng saat umur 3 bulan, kadar nitrat menurun 42,6% menjadi 0,178 mg/l dan fosfat menurun

8,4% menjadi 0,34 mg/l. Penurunan ini diduga karena nitrat dan fosfat digunakan sebagai sumber nutrien bagi fitoplankton. Pemanfaatan nitrat tersebut terus berlangsung sehingga pada saat umur bandeng 3,5 bulan kadar nitrat makin menurun 58,4% menjadi 0,074 mg/l, tetapi kadar fosfat mengalami kenaikan 8,24% menjadi 0,368 mg/l. Kenaikan fosfat diduga dari hasil penguaraian feses ikan. Hasil pengamatan kualitas air untuk parameter suhu berkisar antara 29,4 – 31,50C, kecerahan 30,5 – 34,5 cm, pH yaitu 8, oksigen terlarut 4,5 – 5,7 mg/l, salinitas 17,2 – 19,45 ppt, kadar CO2 tidak terdeteksi 0 mg/l. Selama penelitian suhu, kecerahan pH, oksigen terlarut, CO2 dan salinitas relatif stabil, kecuali kadar nitrat dan fosfat. Diperlukan pemantauan kualitas air secara berkala, untuk menjaga mutu air tambak.

Kata Kunci	*Bandeng, Fosfat, Limbah Budidaya, Nitrat*
Keywords	*Aquaculture Waste, Milkfish, Nitrate, Phosphate*
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INTRODUCTION

Milkfish cultivation has long been part of the business of coastal communities. Milkfish has euryhaline properties (high tolerance to salinity) so it can be cultivated in fresh and brackish water until it reaches a certain age and then the milkfish will move to the sea (Prasetyaningtyas et al., 2012). There are 3 methods of cultivation or cultivation systems in brackish water, namely intensive, semi-intensive and traditional. The differences between these three cultivation technologies can be seen from the seed stocking density cultivated and the type of feed provided. In intensive ponds, high density is usually applied with additional feed (Ula & Kusnadi, 2017). In traditional types of ponds there is no additional feeding treatment (Winarsih et al., 2011). However, this intensive system cultivation method can cause high dynamics in organic matter levels, thereby triggering extraordinary algae growth (blooming). Intensive feeding is thought to be a potential supplier of nutrient waste to ponds that can trigger algae blooms (Wulandari, 2016).

To control fluctuations in organic matter, an intensive cultivation system using the biofloc technique was tried. The biofloc technique is one technology that is able to overcome the problem of aquaculture waste, namely by adding heterotrophic material which is able to convert inorganic nitrogen originating from feces and food waste into single cells which can later be used as a food source for fish or shrimp. Current cultivation technology allows reducing the intensity of cultivation water changes or even does not require water changes, namely by applying the biofloc technique. This system is still not successful, as evidenced by the fact that decomposing bacteria have limited ability to break down organic and inorganic materials. If the amount of waste organic material exceeds its capacity limit and environmental factors are less supportive, such as temperature, oxygen, pH and organic material that is difficult for bacteria to decompose completely, it can have a negative impact on water conditions (Putra et al., 2014). The failure of using the biofloc system was then tried using a semi-biofloc cultivation system.

The semi-biofloc cultivation system is a fish cultivation technology that adds probiotics and plankton (Taw, 2014). The semi-biofloc system (Hybrid system) is a way out of the shortcomings or problems of the autotroph system (blooming plankton) and biofloc/heterotroph technology as well as polluted sea water conditions. A hybrid system is a combination of the use of heterotrophic organisms (Bacillus sp.) obtained from probiotics and autotrophic organisms, in this case plankton (Renitasari & Musa, 2020). The probiotic added to this pond is Aquazim which is known to contain a community of decomposer bacteria and heterotrophic organisms, namely Bacillus sp., besides that it also contains photosynthetic bacteria and fermenting fungi (Saccharomzyces sp.) which function as natural decomposers of organic matter (Munawaroh et al., 2013).

Vanname shrimp waste, namely water left over from shrimp cultivation, after the shrimp are harvested, is known to contain phytoplankton consisting of the phylum Bacillariophyta, Chlorophyta, Euglenophyta, Cyanophyta, Crysophyta, Dinoflagellates and the zooplankton Rotifera, Arthopoda and Sarcodina. The waste water from cultivating vannamei shrimp in ponds with a semi-biofloc cultivation system in this study was used as a source of pond water for raising milkfish. Based on the experience of farmers in ponds, water left over from vaname shrimp cultivation can grow milkfish without providing additional feed because the existing phytoplankton and zooplankton can be used as natural food for milkfish.

According to Irawan & Handayani (2021), water quality is the main thing for cultivation activities in ponds. Good water quality is the main factor in supporting the growth and life of fish in pond waters. Water quality parameters can also fluctuate, because they are influenced by weather, plankton abundance and water entering from around the pond. Thus, research is needed with the aim of obtaining the dynamics of water quality in milkfish ponds with water sources from the remaining rearing of vannamei shrimp from the age of 2 - 3.5 months.

METHODS

Research sites

The research location was in milkfish ponds in Probolinggo City, East Java, with water sources from the remains of rearing vaname shrimp or pond water that had been used to raise vaname shrimp for 120 days. Water samples are taken every week at around 09.00 WIB from March to April 2022. The pond area is 2000 m2, the water level is 0.7 m, filled with 4000 18-day-old milkfish seeds. Water quality began to be observed when the milkfish were 2 months to 3.5 months old. A map of the research location can be seen in Figure 1.

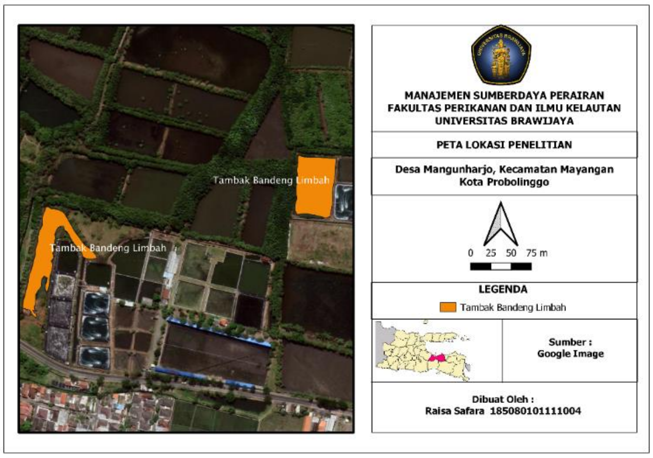

Figure 1. Research location for milkfish ponds with water sources left over from rearing vanname shrimp

Research Tools and Materials

The tools used for this research activity are a Secchi disk to measure brightness, a Trans Instrument brand DO meter type HD3030 to measure temperature and dissolved oxygen, pH paper to measure water pH, a Smart Sensor brand salinometer type AB8012 to measure salinity. Carbon dioxide (CO_2) is measured using the Na_2CO_3 titration method and a spectrophotometer to measure nitrate and phosphate levels.

Research Implementation and Observation Parameters

This research uses an exploratory descriptive survey method, sampling uses a purposive sampling method, so the sample is taken randomly. Descriptive research aims to provide an objective picture or description of a situation (Juniarta et al., 2016). Purposive sampling method sampling is based on certain objectives (Heridiansyah, 2012). The ponds used in this research were 2 ponds. Water samples are taken from each pond in a composite manner from 3 sampling points, namely inlet, middle and outlet. 5 liters of water samples at each point were taken, then mixed in one container, then the mixed water was used as sample water from one pond to observe the water quality, and the same was done for other ponds. To observe nitrate and phosphate levels, water samples were placed in 450 ml bottles, then stored in a cool box and then sent to the laboratory for observation.

RESULT AND DISCUSSION

Dynamics of water quality parameters include temperature, brightness, pH, dissolved oxygen, carbon dioxide (CO_2) and salinity in milkfish ponds with residual water sources reared by semi-biofloc vanname shrimp from fish aged 2 months to 3.5 months. The results of temperature parameter measurements during the study ranged from 29.4 – 31.5 oC, brightness ranged from 30.5 – 34.5 cm, pH was 8, dissolved oxygen ranged from 4.6 – 5.7 mg/l, carbon dioxide was 0 mg/l (not detected), salinity ranged from 17.2 – 19.45 ppt. The results of measuring the water quality parameters of temperature, brightness, dissolved oxygen and relatively stable salinity can be seen in Figures 2, 3, 4, 5. The results of measuring nitrate parameters during the study ranged from 0.059 – 0.314 mg/l. During observations when the fish were 2 months old, the nitrate level was 0.059 mg/l. When the fish were 2.5 months old, nitrate levels rose 425.4% to 0.31 mg/l. Observing milkfish at 3 months of age, nitrate levels decreased by 42.6% to 0.178 mg/l. When the milkfish was 3.5 months old, the nitrate level decreased again by 58.4% to 0.074 mg/l. The results of measuring nitrate parameters can be seen in Figure 6. The results of measuring nitrate parameters during the research ranged from 0.059 – 0.314 mg/l. The results of phosphate parameter measurements during the study ranged from 0.036 – 0.388 mg/l. When observing fish aged 2 months, the phosphate value was 0.064 mg/l. When the fish were 2.5 months old, phosphate levels rose 479.7% to 0.371 mg/l. When the milkfish was 3 months old, the phosphate level decreased by 8.4% to 0.34 mg/l and when the milkfish was 3.5 months old, the phosphate level increased again by 8.24% to 0.368 mg/l. The results of measuring phosphate parameters can be seen in Figure **7.**

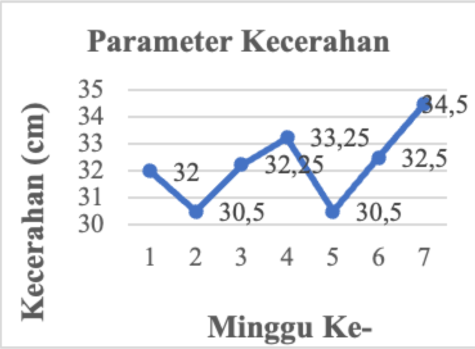

Figure 2. Temperature Parameter Measurement Results

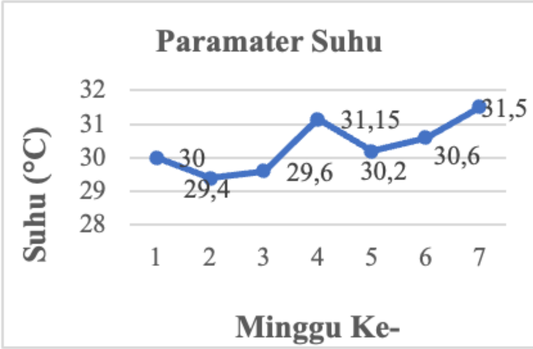

Figure 3. Brightness Parameter Measurement Results

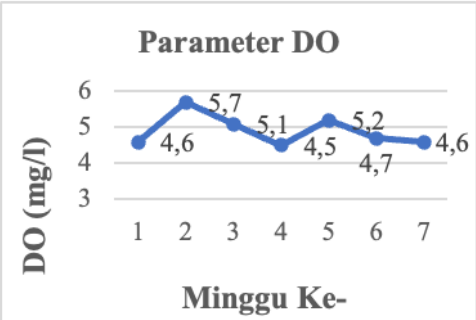

Figure 4. DO Parameter Measurement Results

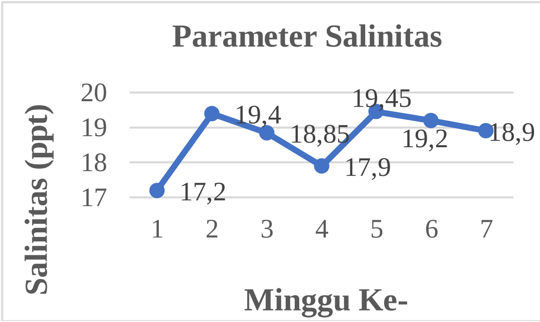

Figure 5. Salinity Parameter Measurement Results

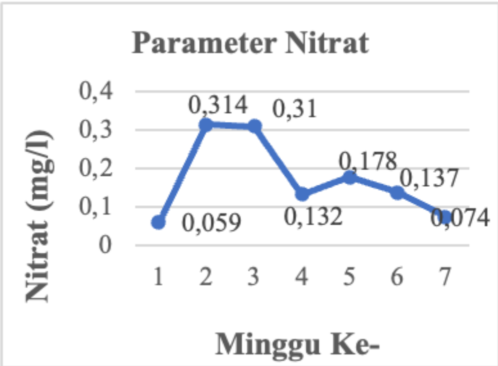

Figure 6. Nitrate Parameter Measurement Results

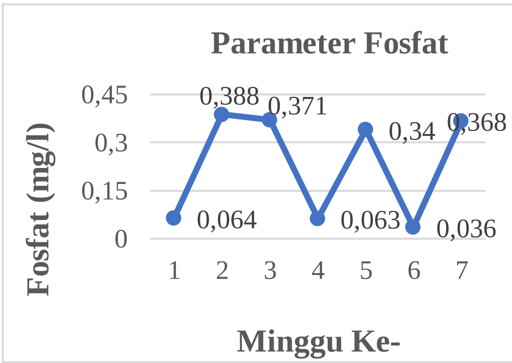

Figure 7. Phosphate Parameter Measurement Results

Water quality parameters during the study such as temperature, brightness, pH, dissolved oxygen and salinity were still considered stable, while the parameters for nitrate and phosphate experienced changes at several observation times. The results of temperature measurements during the research ranged from 29.4 – 31.5oC. Temperature is one of the water quality parameters that can affect the biota in aquaculture ponds. This temperature range is optimal for the growth of plankton and milkfish, because the optimal temperature level in tropical waters for fish life is around 28 - 32 oC (Kadim & Pasisingi, 2018). Temperature greatly influences the presence of fish. Temperatures that are too high will cause stress conditions in the fish's body (Mainassy, 2018). The brightness parameter in waters shows the ability of light to penetrate into the water at a certain depth (Harris & Yusanti, 2018). The results of brightness measurements during the research ranged from 30.5 – 34.5 cm and were included in the optimal category. The optimal brightness limit for pond waters is 30 – 45 cm (Sudinno et al., 2015 & Irawan & Handayani, 2021). Brightness values are influenced by measurement time, weather conditions, suspended solids and phytoplankton abundance (Aziz et al., 2015).

The results of pH measurements during the research from week 1 - week 7 were in the optimal category, namely 8. The optimal pH for fish growth was 5 - 9 (Simanjuntak & Kamlasi, 2012). Increasing pH will reduce the abundance of phytoplankton, thereby causing disruption to the metabolic and respiration systems in aquatic organisms, and very low pH content will result in toxic waters (Samudera et al., 2021). The results of dissolved oxygen (DO) measurements during the study were 4.5 – 5.7 mg/l. The results of DO measurements during the research were in the optimal category, because the dissolved oxygen limit in cultivating milkfish so that it grows well in dissolved oxygen ranges from 3 - 8 mg/l (Athirah et al., 2013). Oxygen has a very real effect on cultivation and a lack of dissolved oxygen can slow down fish growth and even kill fish (Kabalmay et al., 2017). Oxygen used for metabolic rate results in a lack of dissolved oxygen content in the water (Effendi, 2003).

The carbon dioxide (CO2) value during observations in this study was not detected, namely 0 mg/l. The non-detection of carbon dioxide (CO2) content was probably due to observations made when the sun was high, so photosynthesis which requires carbon dioxide was already taking place (Dahlia et al., 2015). Carbon dioxide (CO2) is an exhaust gas resulting from the respiration process (night) and is needed by phytoplankton for photosynthesis (during the day). The optimal limit for carbon dioxide (CO2) levels for the growth of milkfish and plankton is 2 mg/l (Prasetyawan et al., 2017). The results of salinity measurements during the research were in the optimal category, namely ranging from 17.2 – 19.45 ppt. The optimal salinity for the life of milkfish in cultivation is 15 – 25 ppt (Pujautama et al., 2020). Salinity is the total concentration of ions contained in waters. Salinity is related to aquatic organisms in terms of maintaining osmotic pressure in their bodies. Salinity levels that are too low can result in stunted fish growth because the fish need energy for metabolism and adaptation (Daimalindu, 2019).

The results of nitrate measurements during the study ranged from 0.059 – 0.314 mg/l. During observations when the fish were 2 months old, the nitrate level was 0.059 mg/l. When the fish were 2.5 months old, nitrate levels rose 425.4% to 0.31 mg/l. Apart from the increase in nitrates, it is thought that the result of the decomposition of fish feces is also the addition of water left over from cultivating vannamei shrimp, as evidenced by the height of the pond water which has increased from the original 70 cm to 80 cm. Observing milkfish at 3 months of age, nitrate levels decreased by 42.6% to 0.178 mg/l. The decrease in nitrate levels at 3 months of age is thought to be because nitrate is used as a nutrient source for phytoplankton, which can be seen from the dissolved oxygen results which increase at 3 months of age in milkfish because it comes from the results of phytoplankton photosynthesis. The use of nitrate continues so that when the milkfish is 3.5 months old, the nitrate level decreases again by 58.4% to 0.074 mg/l. The decrease in nitrate is thought to be due to continuous absorption of nutrients by phytoplankton in the waters (Fitriyah et al., 2022). Optimal nitrate levels for phytoplankton growth range from 3.9 – 15.5 ppm. A nitrate content of less than 0.114 ppm will cause nitrate levels to become a limiting factor (Rumanti et al., 2014). Based on PP no. 82 of 2001, the maximum value of nitrate for fisheries purposes is 20 mg/l (Jannah *et al.*, 2021).

Phosphate levels during the study ranged between 0.036 – 0.388 mg/l. When observing fish aged 2 months, the phosphate value was 0.064 mg/l. When the fish were

2.5 months old, phosphate levels rose 479.7% to 0.371 mg/l. This increase is not only thought to be due to the decomposition of fish feces, but also due to the addition of water left over from cultivating vannamei shrimp. Observing milkfish at 3 months of age, phosphate levels decreased by 8.4% to 0.34 mg/l. This decrease is thought to be because phosphate is used as a nutrient source for phytoplankton. The decrease in phosphate is thought to be due to continuous absorption of nutrients by phytoplankton in the waters (Fitriyah et al., 2022). When the milkfish was 3.5 months old, the phosphate level increased again by 8.24% to 0.368 mg/l. The increase in phosphate levels is thought to also come from the decomposition of fish feces, as well as the addition of waste water from cultivating vannamei shrimp into ponds. According to Darmawan et al., (2018), the main source of phosphate is accumulation from agricultural activities and fish ponds. The optimal phosphate content for phytoplankton growth is in the range of 0.27 – 5.51 mg/l. A phosphate content of less than 0.02 mg/l will be a limiting factor (Rumanti et al., 2014). Based on Quality Standards PP No. 82 of 2001, the appropriate phosphate level for fish life is ≤ 1 mg/l (Amri, 2021)

CONCLUSSION

In milkfish ponds with water sources from the remains of vannamei shrimp cultivation, it is known that dynamics have occurred in water quality parameters for nitrate and phosphate. Meanwhile, other parameters such as temperature, brightness, dissolved oxygen, carbon dioxide, pH and salinity are relatively stable. When the milkfish were 2 months old, nitrate and phosphate increased up to 4 times, then decreased until when the fish were harvested at 3.5 months of age, the nitrate level remained at 0.34 mg/l. Meanwhile, phosphate increased by 8.24% when the fish were 3.5 months old, bringing the level to 0.368 mg/l. Therefore, in cultivating milkfish, regular monitoring of water quality is required, so that if any discrepancy occurs it can be corrected immediately.

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