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ABUNDANCE AND COMPOSITION OF PHYTOPLANKTON IN MILKFISH (*Chanos chanos*) TRADITIONAL PONDS IN SIDOARJO, EAST JAVA

Kelimpahan dan Komposisi Fitoplankton Pada Tambak Tradisional Ikan Bandeng (*Chanos chanos*) di Sidoarjo, Jawa Timur

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ABSTRACT

Aquatic environmental management is needed to carry out aquaculture in traditional ponds. The purpose of this study was to reveal and explain the composition of phytoplankton in traditional milkfish (Chanos chanos) ponds in Sidoarjo, East Java. The study was conducted in August - September 2024 in traditional ponds in Sidoarjo, East Java. The results showed that the plankton community structure found 37 phytoplankton genera in 3 divisions Chrysophyta, Chlorophyta, and Cyanophyta. The values ranged from 2179-27620 Ind / ml which included mesotrophic waters, the diversity index ranged from 1.92 - 2.72 in the moderate category, and the dominance index ranged from 0.27 - 0.45 which was classified as low. Air quality parameters include temperature 30-31,8°C, brightness 38-41,5 cm, pH 9, dissolved oxygen 6,87-8,4 mg/L, salinity 7-9 ppt, alkalinity 141-169 ppm, nitrate 0,87-2,35 mg/L, and orthophosphate 0,02-0,089 mg/L. As aquaculture in traditional ponds, air and soil quality management should be carried out during the preparation and maintenance of milkfish (Chanos chanos) ponds so that aquaculture management is maintained.

Keywords: Abundance, Diversity, Dominance, Phytoplankton, Water Quality

ABSTRAK

Pengelolaan lingkungan perairan diperlukan untuk melakukan budidaya perairan pada tambak tradisional. Tujuan penelitian ini adalah untuk mengetahui kelimpahan dan komposisi fitoplankton pada tambak tradisional ikan Bandeng (*Chanos chanos*) di Sidoarjo, Jawa Timur.

Penelitian dilaksanakan pada bulan Agustus – September 2024 di tambak tradisional Sidoarjo, Jawa Timur. Hasil penelitian menunjukkan struktur komunitas plankton ditemukan sebanyak 37 genus fitoplankton yang termasuk dalam 3 divisi diantaranya Chrysophyta, Chlorophyta dan Cyanophyta. Nilai kelimpahan didapatkan berkisar 2179-27620 Ind/ml yang tergolong perairan mesotrofik, indeks keanekaragaman berkisar 1,92-2,72 dalam kategori sedang, dan indeks dominansi berkisar 0,27-0,45 yang tergolong rendah. Parameter kualitas air diantaranya suhu 30-31,8°C, kecerahan 38-41,5 cm, pH 9, oksigen terlarut 6,87-8,4 mg/L, salinitas 7-9 ppt, alkalinitas 141-169 ppm, nitrat 0,87-2,35 mg/L, dan ortofosfat 0,02-0,089 mg/L. Sebagai budidaya perairan pada tambak trandisional sebaiknya dilakukan pengelolaan kualitas air dan tanah pada saat proses persiapan dan pemeliharaan tambak ikan Bandeng (*Chanos chanos*) untuk manajemen budidaya perairan tetap terjaga.

Kata Kunci: Kelimpahan, Keanekaragaman, Dominansi, Fitoplankton, Kualitas Air

INTRODUCTION

Coastal waters in Jabon District, Sidoarjo can potentially increase aquaculture businesses with relatively high economic value, especially milkfish (*Chanos chanos*). The community's need for milkfish for consumption is very high due to the content of animal protein, nutrition, and vitamin B complex needed for health. Utilization of coastal resources such as ponds can help fishermen obtain quality and quantity without causing environmental damage or biodiversity (Setianingrum, 2012).

Pond cultivation needs to pay attention to the condition of the aquatic environment, especially good water quality can affect the growth rate and life of fish in pond waters. Polluted water conditions can affect the health of cultivated commodities so that they can be easily attacked by disease and even mass death. Efforts to manage water quality need to be carried out with the correct method to maintain optimal water quality in carrying out sustainable cultivation (Akbarurrasyid et al., 2022). Water quality in an ecosystem can directly affect the life of organisms.

Plankton are aquatic organisms that play a role in determining the status of water. The characteristics of plankton survive by floating and following the movement of currents so their role is needed in aquatic ecosystems, especially coastal waters (Rosanti & Harahap, 2022). Phytoplankton can produce energy by themselves which function as primary producers and can carry out the process of photosynthesis for growth with the help of sunlight. Zooplankton are heterotrophic organisms that utilize phytoplankton as primary producers. The life of zooplankton in water is used as an indicator of the level of water productivity. The importance of the role of phytoplankton and zooplankton is natural food for biota that are at a higher level and an indicator of the fertility of aquatic ecosystems (Nurrachmi et al., 2021).

Inland waters as the main habitat of plankton are ecosystems that involve interactions between organisms and the aquatic environment. Aquatic environments that have good or bad water quality can affect the diversity and structure of plankton communities (Desmawati et al., 2020). Changes in water quality can have an impact on the structure of plankton communities which affect changes in the composition, type, and number of plankton related to the trophic structure of waters by phytoplankton groups (Sirait et al., 2018). This study aims to determine the abundance and composition of phytoplankton in traditional milkfish ponds (*Chanos chanos*) in Sidoarjo, East Java.

METHODS

The research material includes identifying and analyzing phytoplankton communities. This study was conducted by taking direct samples in the field 4 (four) times of phytoplankton sampling and physical and chemical water quality in August - September 2024. The method used in this study is the survey method, namely taking samples from traditional milkfish ponds in Sidoarjo, East Java. Phytoplankton samples were taken from traditional ponds. 25 liters of sample water was taken using a bucket and filtered with a planktonet. The film bottle that had been filled with sample water was then preserved using 10% Lugol, stored at low temperatures, and kept away from sunlight. Furthermore, observations were made under a microscope at 400x magnification. The process of identifying and analyzing phytoplankton was carried out in the laboratory. The physical and chemical parameters measured included temperature, brightness, pH, dissolved oxygen (DO), nitrate, orthophosphate, and alkalinity.

Phytoplankton abundance data analysis was calculated using the modified Luckey Drop method (Odum, 1996; Herawati *et al.,* 2019) as follows:

$$N = \frac{T \times V}{L \times v \times p \times W} \times n$$

N : Total number of phytoplankton (Ind/ml)
n : Number of Plankton in each field of view
T : Cover glass area (20x20 mm)
L : Area of one field of view
r : Radius of the field of view

Analysis of phytoplankton diversity index data based on the formula from (Odum, 1996; Maretta *et al.,* 2023) as follows:

$$H' = -\sum Pi \ln Pi$$

H' : Diversity Index
Pi/N : Total number of genera

Analysis of phytoplankton dominance index data based on the formula from (Odum, 1996; Maretta et al., 2023) as follows:

$$D = \sum (Pi)^2$$

D : Dominance index
Pi : ni/N (Proportion of plankton types)

RESULTS

Community Structure and Abundance of Phytoplankton

The results of the study in traditional ponds found 37 genera of phytoplankton included in 3 divisions, namely the Chrysophyta, Chlorophyta, and Cyanophyta divisions. The division most commonly found in this study was from Chlorophyta. The composition of the genus found during the study from the Chlorophyta division was 19 genera such as *Closterium, Binuclearia, Sirogonium, Groenglodia, Entransia, Scoderia, Pseudotetraspora, Genicularia, Roya, Gaminela, Tentrepohlia, Chlorella, Tabellaria, Quadrigula, Netrium, Ulothrix, Cosmarium, Pleurotaenium and Mougeotia*. The composition of the Chrysophyta division was 13 genera such as *Heterothrix, Stychochrisis, Chaetoceros, Scholiopleura, synedra, Tribonema, Melosira, Fragillaria, Navicula, Nitzchia, Lagynion, Pleurogaster and Frustulia*. The Cyanophyta division contains 5 genera such as *Plectonema, Desmonema, Cylindosperma, Aphazinemon, and Lyngbya.*

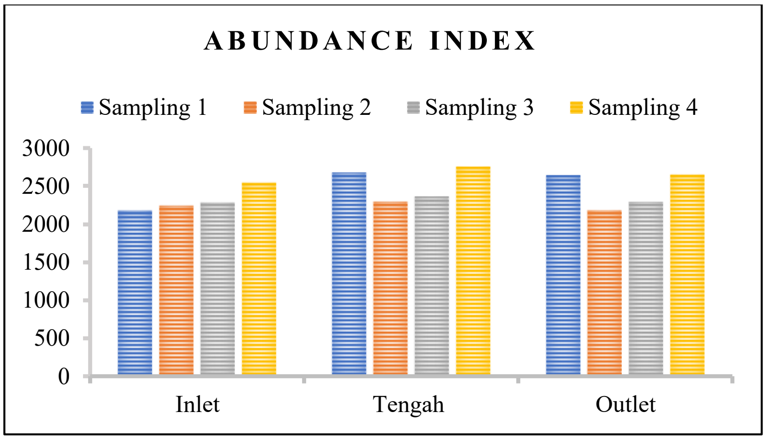


Figure 1. Abundance Index

Based on the graph above, it can be seen in Figure 1 that the plankton abundance value in the first sampling of the inlet station is 2179 Ind/ml, at the middle station it has a higher value of 2679 Ind/ml, and the outlet station has a slightly different value from the middle station, which is 2641 Ind/ml. in the second sampling at the inlet station it has a value of 2244 Ind/ml, this value has increased compared to the first sampling of the inlet station. In the second sampling of the middle station and outlet station, the values are 2296 Ind/ml and 2184 Ind/ml, these values are lower than the abundance value of the middle station in the first sampling. In the third sampling of the inlet station ranged from 2289 Ind/ml there was no significant increase from the previous sampling, in the third sampling of the middle station and outlet station had values ranging from 2362 Ind/ml and 2290 Ind/ml where there was no significant increase. The value of the fourth sampling at the inlet station was 2547 Ind/ml, the middle station was 2762 Ind/ml and the outlet station was 2653 Ind/ml. The abundance of phytoplankton in the fourth sampling had a higher average value compared to the average value in the first, second, and third sampling. The high average in the fourth sampling was also the same in the division stations, namely the inlet outlet and middle. The highest phytoplankton abundance value in the fourth sampling at the middle station was 2762 Ind/ml while the lowest abundance value was in the first sampling at the inlet station, which was 2179 Ind/ml.

Diversity Index and Dominance Index of Phytoplankton

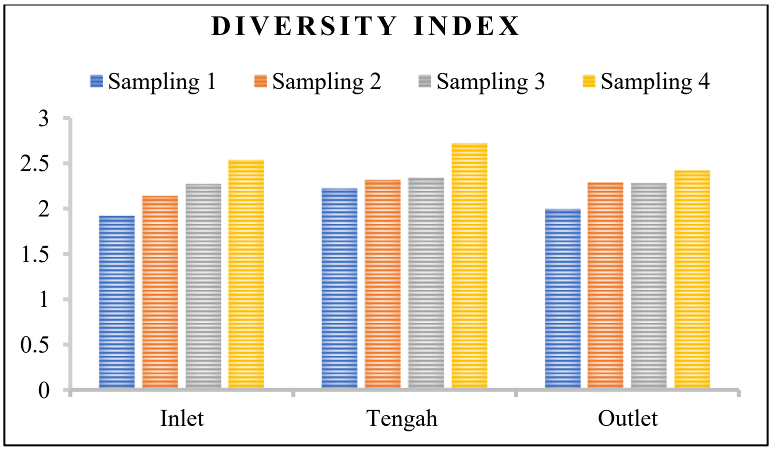


Figure 2. Diversity Index

The results of the diversity index at all stations in the first sampling, second sampling, third sampling and fourth sampling in traditional ponds were below 3 and above 1. This shows that the diversity index in traditional ponds is included in the moderate category as seen in Figure 2.

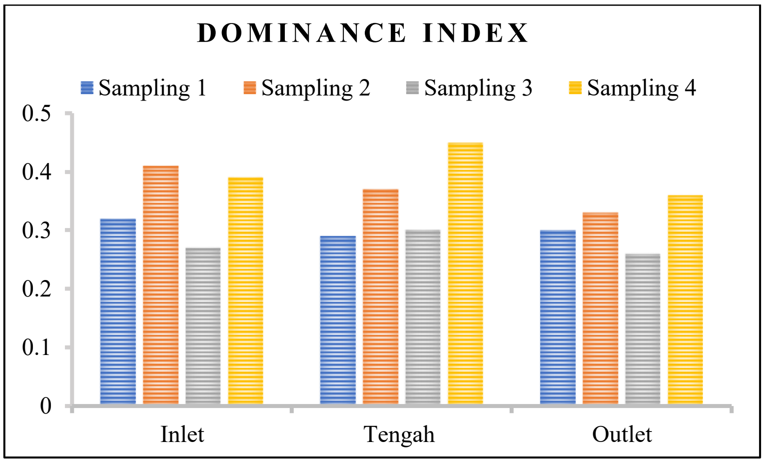
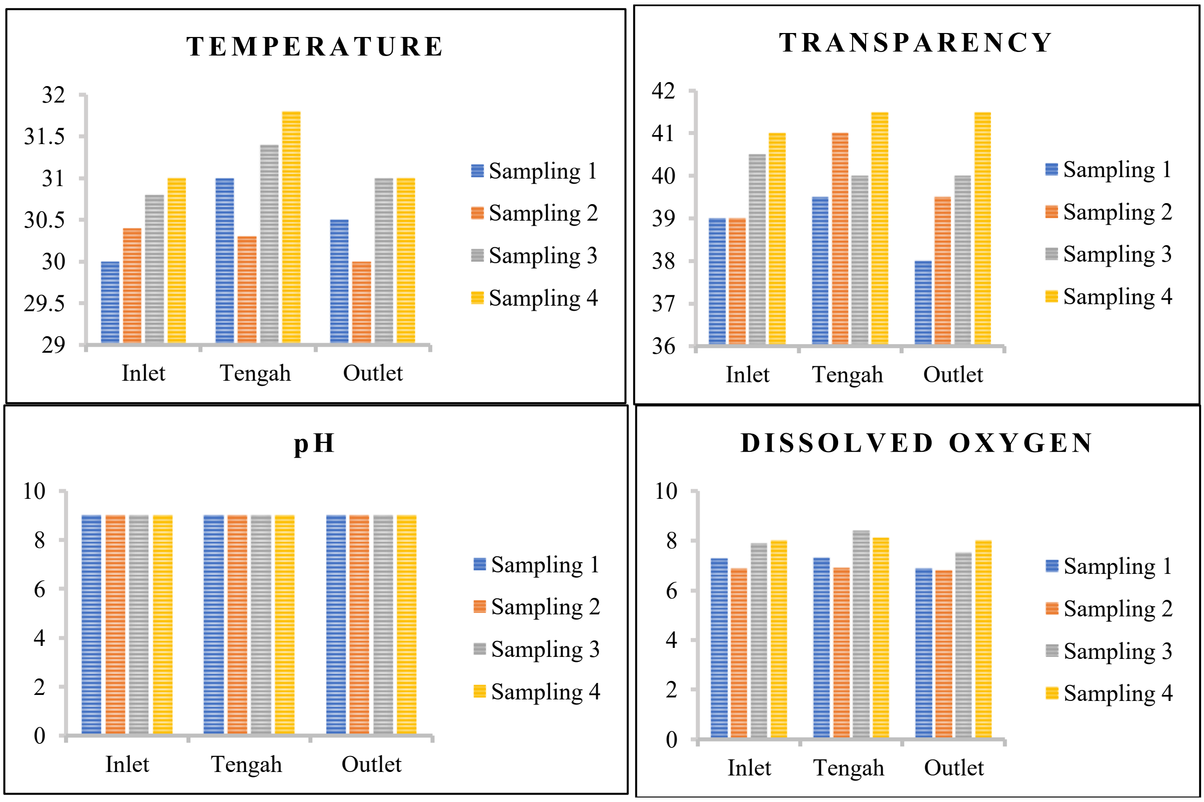


Figure 3. Dominance Index

The results of the dominance index in the study conducted in traditional ponds ranged from 0.27-0.45 as shown in Figure 3. Where this number is in the range below 0.50 which is still far from the number 1 which means that there is no dominance of phytoplankton types in traditional ponds.

Water Quality

Water quality is the nature of water and the content of living things, energy substances or other components in the water (Effendi, 2003).



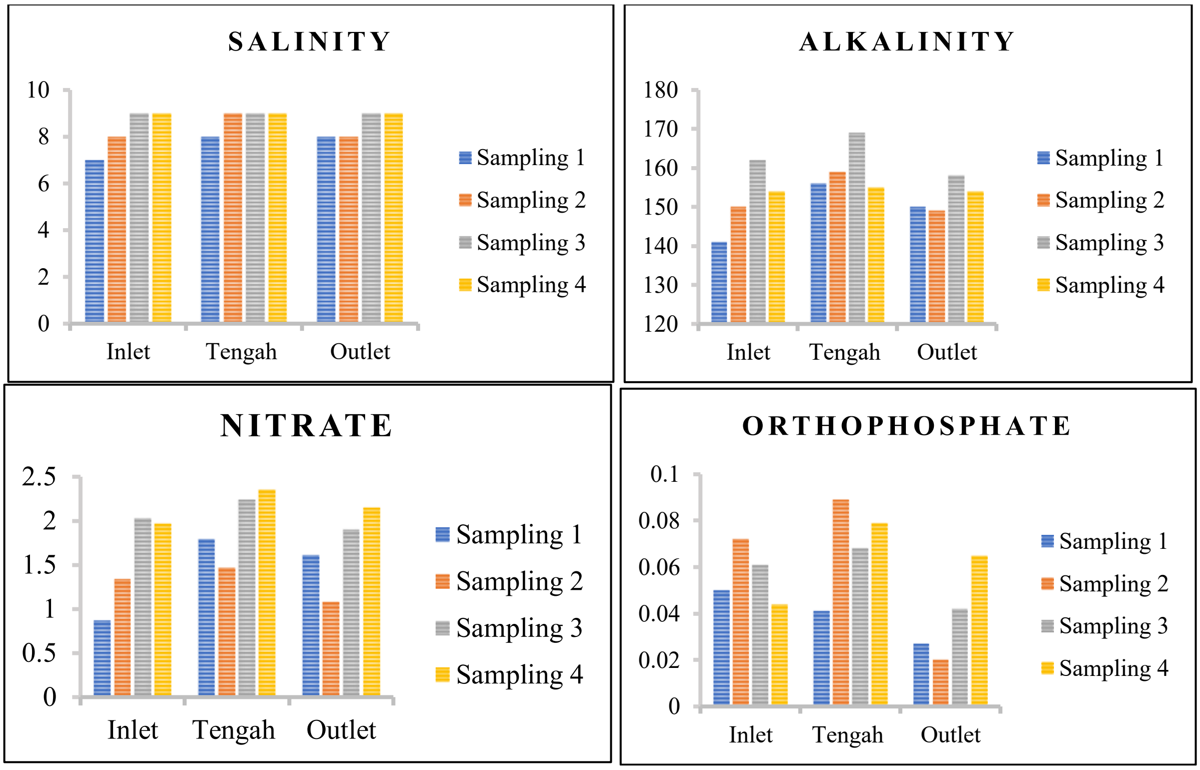


Figure 4. Water Quality

Water quality measurements in this study are shown in Figure 4, which shows a temperature of 30-31.8ºC, brightness of 38-41.5 cm, pH of 9, dissolved oxygen of 6.87-8.4 mg/L, salinity of 7-9 ppt, alkalinity of 141-169 ppm, nitrate of 0.87-2.35 mg/L, and orthophosphate of 0.02-0.089 mg/L.

DISCUSSION

Phytoplankton from the Chlorophyta division have a higher composition than those from the Chrysophyta and Cyanophyta divisions. This is because the sampling time was carried out during the day when phytoplankton were photosynthesizing. Especially phytoplankton from the Chlorophyta division. Where this is also related to water quality. Physical and chemical parameters greatly influence the composition of phytoplankton as a response to the environment. This is in line with the statement from Maretta *et al.* (2023), which states that the presence of plankton in waters will change at various levels in response to environmental changes, both those influenced by the physical and chemical parameters of the water.

Plankton abundance can describe the amount of food availability, as well as the environmental carrying capacity that can support the life of organisms in a body of water. Therefore, changes that occur in a body of water can be identified by looking at changes in the abundance and diversity of plankton. The presence of zooplankton in a body of water can be used to determine the quality and fertility of a body of water (Syahputra *et al.,* 2023). The abundance of phytoplankton at the inlet, middle, and outlet stations carried out in the first, second, third, and fourth samplings ranged from the mesotrophic waters category, namely in the range of 2179-27620 ind/ml. This is in line with the opinion of Habibi (2020), who stated that based on the abundance of phytoplankton, it is divided into three categories, namely the range of 0 - 2000 ind/ml is included in the range of oligotrophic waters or low abundance, 2000-15000 ind/ml waters with moderate or mesotrophic plankton abundance and the range >15,000 ind/ml is included in the eutrophic category with high plankton abundance.

The value of the diversity index is used to determine the high or low level of species diversity in an environment. If the value of the diversity has a number that exceeds or is equal to 1, then the level of species diversity of the area is included in the moderate category. If the value is more than 3, then the diversity value of the species is high. However, if it is less than 1, the value is included in the low category (Baderan *et al.,* 2021). The highest results were obtained in the fourth sampling at the middle station. The lowest results were obtained at the first inlet sampling station. Although the highest and lowest values obtained from the results of research in traditional ponds are still in the moderate diversity category. The moderate diversity index indicates that the condition of diversity is normal but shows that there is starting to be disturbance from the environment, this is in line with the statement of Diniawirisan and Rahmadani (2023), which states that if the diversity index is in the range of 1 - 3, the condition of the ecosystem is still quite normal even though there is starting to be environmental disturbance supported by appropriate water quality parameters.

The dominance index is generally used to see whether or not a type of plankton dominates a body of water. The results of the dominance index of phytoplankton have a range of values between 0 and 1. Where if the value of the dominance index is smaller and approaches 0, it indicates that there is no dominance of one genus in the body of water. However, if the results show otherwise if the value obtained is large or close to 1, it indicates the dominance of a particular type of species (Sirait *et al.,* 2018). The results of the dominance index obtained in research conducted in traditional ponds ranged from 0.30-0.45. The factors that cause dominance are the physics and chemistry of water. This is in line with the opinion of Setyowardani et al. (2021), which states that the dominance index of $0.0 < D \leq 0.5$ is included in low dominance, $0.5 < D \leq 0.75$ is in the medium category and $0.75 < D \leq 1$ is included in the high category. According to Harahap & Harahap (2023), the high and low values of the diversity and dominance index in aquatic ecosystems are influenced by a number of physical factors of water, nutrient content, and the utilization of nutrients which are not the same by each individual.

Water temperature affects biological, physical, and chemical processes in water. Increased temperature can be tolerated by cultivated organisms followed by an increase in metabolic rate and photosynthetic activity of natural feed (Suwarsih *et al.,* 2016). Temperature also affects survival, morphological growth, behavior, reproduction, the molting process, and shrimp metabolism. Water temperature plays a role in determining the presence of phytoplankton in waters which will affect the rate of photosynthesis both directly and indirectly (Guming *et al.,* 2020). The optimal water temperature for phytoplankton life is 25 - 30°C (Zainuri *et al.,* 2023).

According to Kordi *et al.* (2007) stated that the optimal brightness value for cultivating milkfish is 30 - 40 cm. The brightness of the water is influenced by the amount of suspended inorganic particles and the density of phytoplankton. Low brightness values in water can inhibit the growth of phytoplankton. This, phytoplankton are natural food and oxygen producers in waters. Meanwhile, the high level of sunlight intensity entering the water indicates low primary productivity and causes fish to experience stress and even death (Irawan & Handayani, 2021).

The pH of water can affect the level of water fertility. The pH content of water that is too acidic will affect the microorganisms in it. Acidic waters are said to be less productive because they can kill fish, while low pH results in reduced dissolved oxygen content. This condition will have an impact on cultivated organisms where oxygen consumption decreases, respiratory activity will increase so that appetite decreases (Amanda, 2016). The pH concentration is also influenced by photosynthesis, respiration of aquatic organisms, temperature, and ions in the water. In addition, the pH of water is also related to the concentration of CO_2. Phytoplankton as primary producers in water and photosynthetic organisms that take CO_2 from water increase the pH during the day, then high water pH will interfere with enzyme activity and photosynthesis is not optimal (Astriana *et al.,* 2022). Algae growth can live in a pH range of 6.8 - 9.6 (Burdames & Ngangi, 2014).

Dissolved oxygen in water can support fish growth. Dissolved oxygen needs to be considered to improve water quality so that fish growth and survival remain in good condition. Low dissolved oxygen can inhibit growth and can kill farmed fish. The method used to improve dissolved oxygen values is by installing water wheels or aerators by replacing new water and removing leftover food and dirt (Lestari & Utami, 2016). Aeration can produce currents in the waters and the process of stirring the mass of pond water to maintain bacteria and microorganisms in suspension conditions. At night there is no photosynthesis process that should be able to produce oxygen so the aeration system is needed from midnight to morning (Makmur *et al.,* 2018). The concentration of dissolved oxygen in water can fluctuate due to water temperature and the stirring process. The accumulation of organic matter comes from uneaten leftover food, resulting in the depletion of dissolved oxygen in the waters (Rustam & Prabawa, 2015). Based on the results of the study, dissolved oxygen in water is 6.87 - 8.4 mg / L. This is by the statement of Irawan & Handayani (2021), that dissolved oxygen for the life of milkfish is > 3 mg/L.

The salinity obtained from the results of this study was 7 - 9 ppt. Water salinity can affect the osmotic pressure of the water where the higher the salinity level, the osmotic pressure will increase. This condition will also affect maintaining the balance of osmolarity pressure and the balance of electrolyte content, meaning that a high level of osmotic performance is directly proportional to the energy wasted for greater osmotic performance (Budiasti *et al.,* 2015). The low salinity content is due to the difficult entry of seawater into the pond due to the presence of new land from the sedimentation process, which has an effect on decreasing production (Utama *et al.,* 2022).

Alkalinity is the capacity of water to neutralize additional acid without reducing the pH value of the water. Alkalinity acts as a buffer against the effects of acidification. The unit of water alkalinity is expressed in mg $CaCO_3$/liter of water (ppm). According to BBPBAP Jepara (2007), alkalinity in water can affect the optimal growth rate of plankton with a range of 80 - 120 ppm. Alkalinity functions to increase the hardness and pH of the water. Alkalinity elements such as carbonate and bicarbonate act as buffers in maintaining the pH of the water. Alkalinity content> 150 ppm requires dilution of salinity and plankton concentration as well as sufficient oxygenation (Arsad *et al.,* 2017). In the study conducted, the alkalinity value was obtained at 141 - 169 ppm.

Nitrate obtained in traditional ponds is 0.87 - 2.35 mg/L. This condition is still considered optimal in waters according to Suparjo statement (2008), phytoplankton can grow optimally at a nitrate concentration of 0.09 - 3.5 mg/L. The nitrate value of <0.01 mg/L and >4.5 mg / L is a limiting factor. Low dissolved oxygen will affect the decomposition of organic matter by microorganisms such as the denitrification process. The denitrification process is a microbiological process that converts nitrate and nitrite ions into nitrogen molecules (N_2) resulting in decreased nutrients (Rumanti *et al.,* 2016).

Orthophosphate is a form of phosphate that can dissolve in water and can be utilized directly by aquatic plants (Komarawidjaja & Kurniawan, 2008). Aquatic organisms that require orthophosphate elements are phytoplankton which are used for the photosynthesis process (Putri *et al.,* 2016). According to Aminin *et al.* (2019) stated that orthophosphate levels are in three classifications including oligotrophic waters of (0.003 - 0.01 mg/L), mesotrophic waters of (0.011 - 0.03 mg/L), and eutrophic waters of (0.031 - 0.1 mg/L). This compound can come from soil erosion, animal waste, and plant decay. In addition, sources of phosphorus can be found from the weathering of drifting mineral rocks which are then absorbed by phytoplankton and the next food chain. The results of the study obtained orthophosphate levels of 0.02 - 0.089 mg/L.

CONCLUSION

The average water quality parameters obtained values of temperature, brightness, pH, dissolved oxygen, salinity, alkalinity, nitrate, and orthophosphate are still in optimum conditions for aquaculture. The dynamics of the plankton community structure found 37 phytoplankton genera included in 3 divisions Chrysophyta, Chlorophyta, and Cyanophyta. The calculation of plankton obtained from traditional ponds included in the abundance index category classified as mesotrophic waters, the diversity index in the moderate category, and the low dominance index.

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