Monitoring of Water Quality on Rearing Intensive Ponds of Vannamei Shrimp (*Litopenaeus vannamei*) in CV. Tirta Makmur Abadi Lombang

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Abstract

Vannamei shrimp (Litopenaeus vannamei) is a fishery commodity that has a very important value in the international market. Water quality monitoring is one of the key factors in the success of cultivation. Water quality plays an important role in determining the growth and survival of vaname shrimp. The parameters measured in this study were brightness, water color, pH, DO, temperature, salinity, alkalinity, total organic matter, ammonium, nitrite and phosphate. On the ponds 1 value of brigthness 20-50, water color green brown and green, Ph ranges 7,7-8,4, DO ranges 3,5-4,0, temperature ranges 30-33, salinity ranges 11-13, alkalinity ≥ 100 mg/l, total organic matter ≥ 55 mg/l, ammonium ranges 0-7,0 mg/l, nitrite ranges 0-5,0 mg/l and phospate ranges 0-10 mg/l. While on ponds 2 value of brigthness 10-90, water color brown, Ph ranges 7,7-8,0, DO ranges 1,5-4,0, temperature ranges 30-33, salinity ranges 11-13, alkalinity ≥ 100 mg/l, total organic matter ≥ 55 mg/l, ammonium ranges 0-5,0 mg/l, nitrite ranges 0-10 mg/l and phospate ranges 0-7,5 mg/l.

Keyword *: Litopenaeus vannamei*, *monitoring*, *water quality ≥ 55 mg/l*

Introduction

Vaname shrimp (*Litopenaeus vannamei*) is a type of shrimp with important commercial value in Indonesia and is one of the leading fishery products in the fisheries sector (Kaligis, 2015). Vannamei shrimp culture technology is also growing with the birth of intensive and supra-intensive technologies achieving high stocking densities ranging from 100-400 individuals/m² (Nababan *et al.,* 2015). With the application of intensive cultivation patterns it is very profitable because it can use high stocking densities, so it can increase the production of vannamei shrimp.

Panggabean *et al.* (2016), stated that the development of intensive aquaculture is characterized by an increase in the density of organisms and a feed supply that uses all artificial feed. The problem that then arises is the decrease in water quality caused by the accumulation of leftover feed, organic matter, phosphate compounds and toxic nitrogen due to the low rate of water exchange. Management of water quality for aquaculture purposes is very important, because water is a living medium for aquaculture organisms. Supono (2018), semi-intensive and intensively managed shrimp farming has serious problems regarding degradation of water quality. Stocking density (stocking density) and high feed input which causes high waste generated both suspended and settled at the bottom of the pond. The higher the stocking density, the higher the increase in metabolic waste. The rest of the feed will settle into dirt at the bottom of the pond and turn into toxic compounds for shrimp due to a decrease in water quality (Wulandari, 2015).

Ritonga *et al.* (2021), states that water quality management has a very important role in the success of shrimp farming. Water quality is one of the key factors for the success of shrimp farming. Decreasing water quality will cause stress to the shrimp and cause disease, which often causes failure in shrimp enlargement activities.

Based on the importance of water quality in supporting the success of intensive vannamei shrimp farming, quality management really needs to be done and the need to monitor water quality regularly.

Materials and Methods

The research was carried out in 2021 at the CV Tirta Makmur Abadi Lombang. East Java. The materials used in this study were water samples in ponds B1 and B2, probiotics, water treatment ingredients namely heromin, azomite, MgCl. The fermented ingredients are fine bran, molasses, yeast, azomite and fresh water. Parameters of pond water quality (B1 and B2) that are monitored are brightness, color, pH, DO, temperature, salinity, total alkali, TOM, ammonium, nitrite and phosphate.

Result and Discussion

Ponds construction

Shrimp rearing ponds are made of a circular pond with a pool diameter of 34 with an area of 907m² with a height of 2 m equipped with an inlet, control tub with outlet and central drain in the middle of the pond and covered with HDPE (High Density Polyethylene) plastic with a thickness of 0.5 mm to reduce the risk of water seeping into the pond. in the soil and to facilitate pond water management and has a very high resistance to UV exposure.

The main source of dissolved oxygen in CV. Tirta Makmur Abadi Lombang uses a blower and a waterwheel, installing aeration stones at the bottom of the pond with a distance of 3 meters for each aeration with a total of 68 aeration points. For the number of wheels installed with a diameter of 34, there are 2 wheels with a power of 2 HP (double paddle wheel). The wheels are arranged in a parallel pattern so that the current generated is evenly distributed and the dirt on the pond bottom can collect at the central drain.

Water Media Preparation

The pond media water preparation was carried out by pumping the borehole into the settling reservoir plots with a borewater salinity of 10 ppt, then flowing it over the plots using a pump. At the beginning of the media water preparation, the treatment was not carried out on the reservoirs because the treatment was carried out directly on the plots. Treatment is carried out by adding types of minerals to the plots such as heromin 2 ppm, azomite 0.5 ppm, MgCl 0.5 ppm which functions as a mineral enhancer in water because in low salinity water the mineral elements contained in water are very low therefore it is necessary to add mineral type. This type of mineral is needed for the process of metabolism and growth of all organisms in the pond, be it shrimp, bacteria and plankton.

Plankton growth was carried out by application of fermentation, using 3 kg of fine bran, 0.5 L of molasses, 150 grams of yeast, 0.5 kg of azomite and fresh water. The ingredients are mixed and then left in a closed container for 2 days without aeration, then after 2 days you can spread them on plots by taking the extracts of the fermented ingredients by squeezing and removing the substrate. As well as the addition of 1 ppm Herobacillus probiotics containing Bacillus subtilis, Bacillus lincheniformis, Pseudomonas putida, Saccharomyces cerevisiae which function to optimize the pond environment by increasing the dominance of beneficial bacteria and giving Super PS probiotics containing Rhodobacter sp bacteria which function to break down Hydrogen Sufride (H2S) and organic materials at a dose of 3 ppm. This is in accordance with the opinion of Ghufron et al. (2017), that the growth of organisms and plankton is carried out by the application of fermentation as a nutrient for microorganisms in waters and the application of probiotics. The application on the map is like Figure 1.

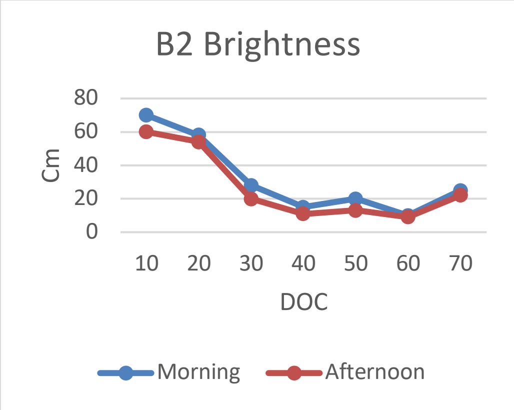
Figure 1**.** Application of probiotics
(Personal documentation, 2021)

Water quality monitoring

Monitoring water quality includes water brightness, water color, water pH, DO, temperature, salinity, total alkali, TOM, ammonium, nitrite, phosphate.

a. Brightness

Water quality measurement at CV. Tirta Makmur Abadi Lombang was carried out 2 times, namely in the morning at 06.30 WIB and in the afternoon at 14.30, the brightness measurement was carried out using a secci disk for measuring brightness, which can be seen in Figure 2.



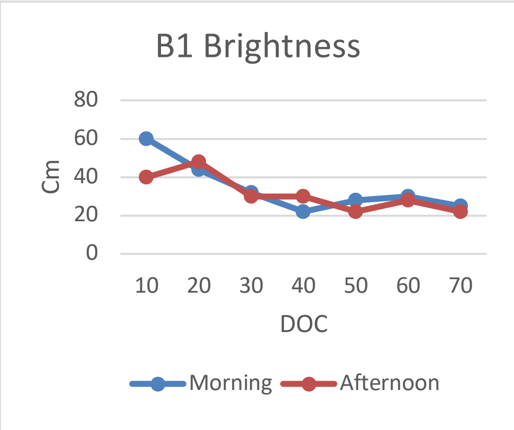


Figure 2. brightness chart (Primary data, 2021)

Based on brightness measurements in plot B2 the brightness value is 10 – 90 even the water brightness in plot B2 is the most concentrated in DOC 30 until harvest, while in plot B1 the brightness fluctuations also vary but in plot B1 the brightness does not reach a value of 10, for example in DOC 30 – harvest brightness ranges from 20 – 50. This indicates that the increasing DOC of the shrimp, the water in the plots is also getting thicker, this is due to the high organic matter in the ponds which comes from feed, manure and fermentation so that the brightness will decrease, high material Organic matter is used by Phytoplankton as a nutrient and can also cause a decrease in the brightness of pond water.

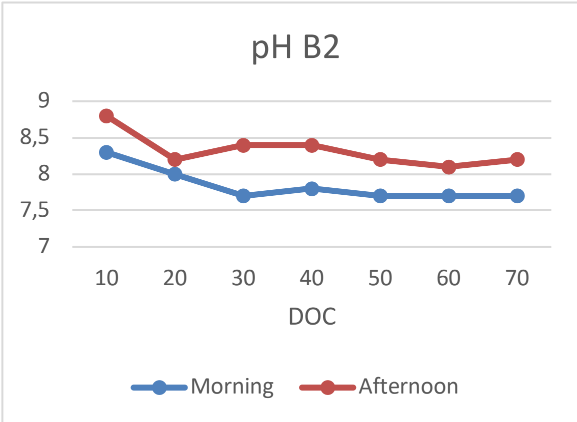
The factors that affect the level of brightness in the plotted water are weather factors, plankton density, time of measurement and accuracy of people in measuring. Brightness that is too low is also not good because it can interfere with photosynthesis and the decomposition of organic matter which can become toxic if it is too dense (Putra and Mannan, 2014). To overcome excessive brightness, siphoning and treatment are also carried out in controlling plankton, changing water, and good feed management so that accumulation does not occur at the bottom of the plot.

b. Water color

In the initial DOC the color of the water in CV. Tirta Makmur Abadi Lombang is green as the shrimp rearing period increases, the water will often change, this is caused by organic matter dissolved in the water which causes changes to occur, such as in plot B2 the color of the water tends to be brown while in plot B1 the color of the water is green brown and brown . Erlangga (2012), states that changes in the color of pond water generally describe the instability of the environment in the pond. Giving probiotics during the rearing period has a positive impact on stabilizing plankton so that it has a direct impact on the color of pond water which tends to remain stable.

c. Acidity (pH)

Water pH measurement at CV. Tirta Makmur Abadi Lombang is held every day. The graph of water measurements in plots B2 and B1 is in Figure 3.



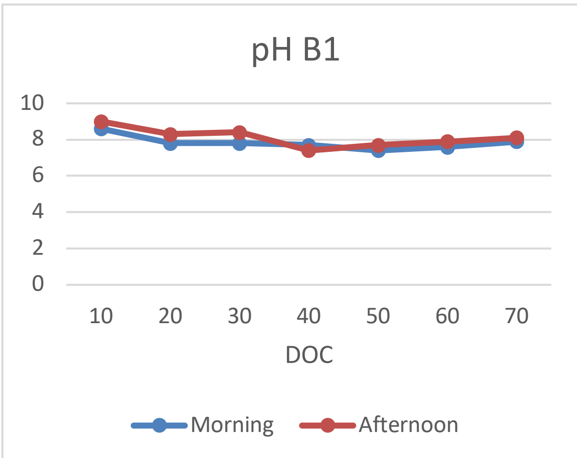


Figure 3. pHchart (Primary data, 2021)

Based on the graph above, the pH value varies greatly with the pH range in plot B2, namely 7.7 – 8.0, while the pH in plot B1 ranges from 7.7 – 8.4. It can be seen that the comparison of pH in the morning and evening, the pH in the morning tends to be lower than in the afternoon. This happens due to the fact that at night the plankton does not carry out the photosynthesis process but only does respiration and produces CO_2 so that the pH tends to be low in the morning, whereas in the afternoon to the evening photosynthesis occurs so that the pH becomes high because during the photosynthesis process the CO_2 concentration decreases thereby increasing the pH water. Referring to SNI (2014), which states that the optimum pH range for shrimp culture is 7 – 8.5.

d. Dissolved oxygen (DO)

DO measurements are carried out every day considering that DO in round ponds is not good by relying only on windmills and blowers. DO measurement graph can be seen in Figure 4.

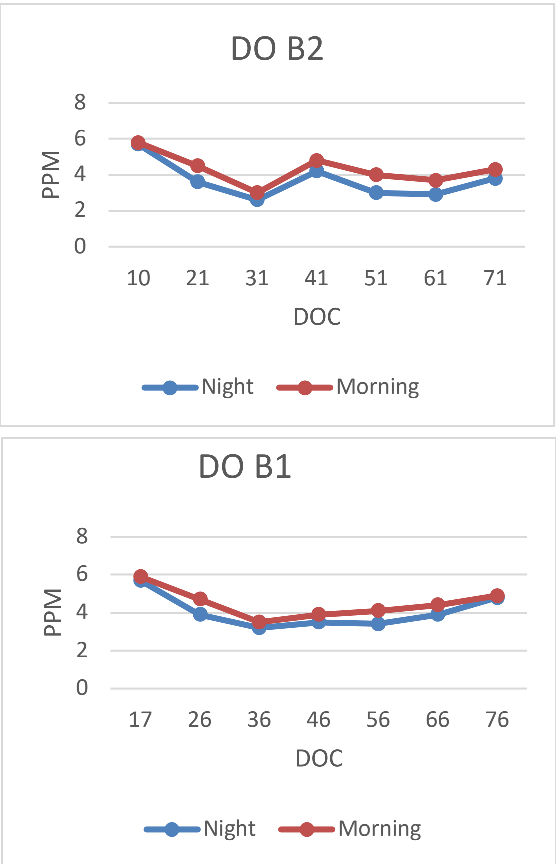


Figure 4. Dissolved oxygen chart (Primary data, 2021).

Based on the graph above, it shows that DO is lower at night than morning DO, this happens because shrimp are nocturnal or active at night so that they use more dissolved oxygen in the morning. The graph shows DO fluctuations in plots B2 and plot B1 which are still quite good with a DO range of 3.5 – 4.0, but in plot B2 when DOC 20 – 30 DO decreased with a DO range of 1.5 – 2.5. In contrast to the opinion of Purnamasari (2017), that in intensive shrimp ponds the dissolved oxygen content for shrimp life ranges from 4-8 ppm, this decrease occurs due to a lack of pinwheels, a decrease in DO can occur due to plankton density so that DO becomes low due to many microorganisms utilizing DO while DO during the day increases because plankton photosynthesizes by utilizing sunlight so that DO increases, not only that the maximum use of the waterwheel can also increase DO.

e. Temperature

Temperature measurements were carried out simultaneously with DO measurements. Temperature measurements can be seen in Figure 5.

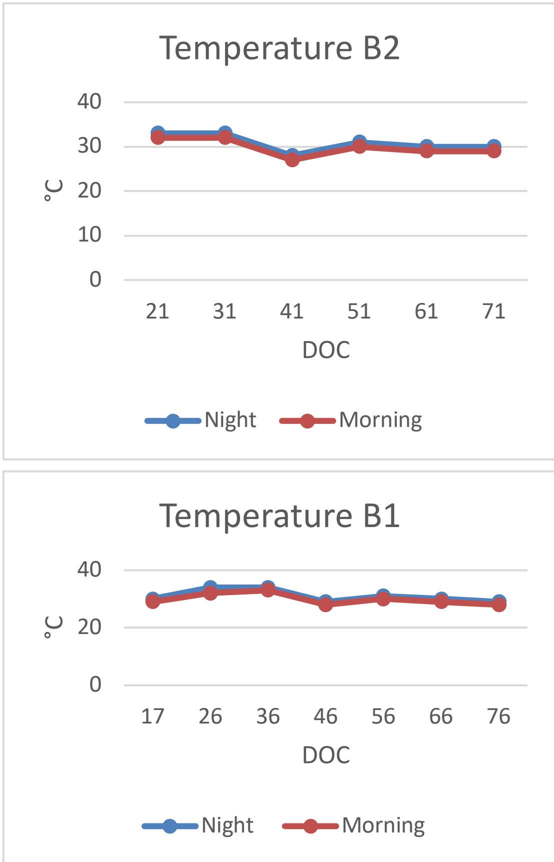


Figure 5. Temperature chart (Primary data, 2021).

Based on the graph, it can be seen that temperature fluctuations in plots B2 and B1 are still stable with temperatures ranging from 30 – 33. Referring to SNI (2014), that the water temperature for shrimp farming ranges from 28 - 33°C, temperature changes are influenced by sunlight, temperature air and weather. Extreme fluctuations in the waters of vannamei shrimp ponds can reduce the vannamei shrimp's appetite, so that it will inhibit their growth.

f. Salinity

Salinity measurements on the plot ranged from 11 – 13 ppt. These results are still within the optimal range of SNI (2006), that a good range of salinity for shrimp is 10 - 35 ppt.

Low salinity due to the use of water sourced from drilled wells so that the salinity tends to be lower, therefore MgcL treatment is carried out every evening or mineral treatment such as azomite heromin. A graph of salinity measurements can be seen in Figure 6.

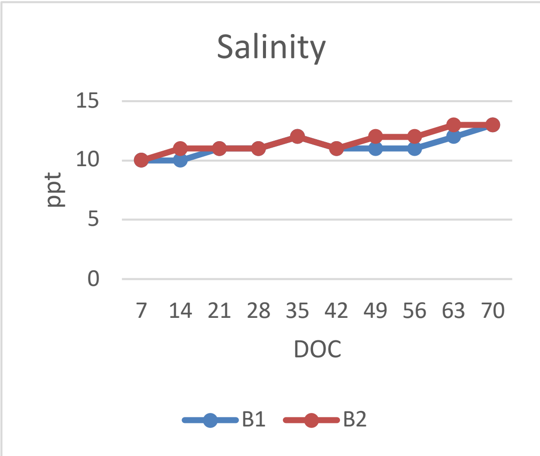


Figure 6. Salinity chart (Primary data, 2021).

g. Alkalinity

Alkalinity measurements were carried out in the morning by titration. Based on SNI standards (2006), that the range of alkalinity for vannamei shrimp culture is 100 – 150 ppm. Alkalinity measurements can be seen in Figure 7.

Based on the above graph, plot B2 has high alkalinity in DOC 62 with total alkali 192, while in plot B1 the total alkali is high in DOC 35 with total alkali 182. The total alkali in plot B2 tends to increase compared to plot B1 where the total alkali is lowest at DOC 53 with total alkali 116. SNI (2006), states that the range of alkalinity for vannamei shrimp culture is 100 – 150 mg/l.

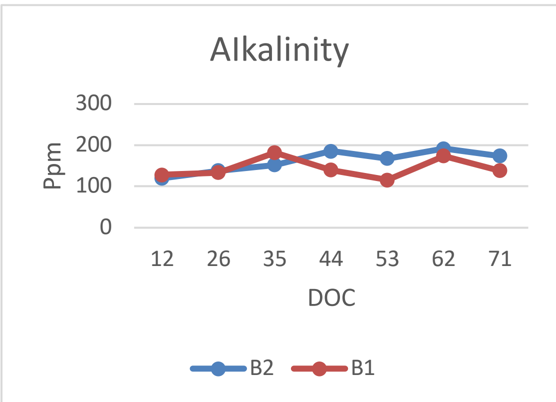


Figure 7.Alkalinity chart (Primary data, 2021)

h. *Total Organic Matter* (TOM)

Measurement of total organic matter (TOM) was carried out once every seven days in the morning by means of titration. TOM measurement aims to measure the total dissolved organics contained in water. TOM dynamics in plots B2 and B1 can be seen in Figure 8.

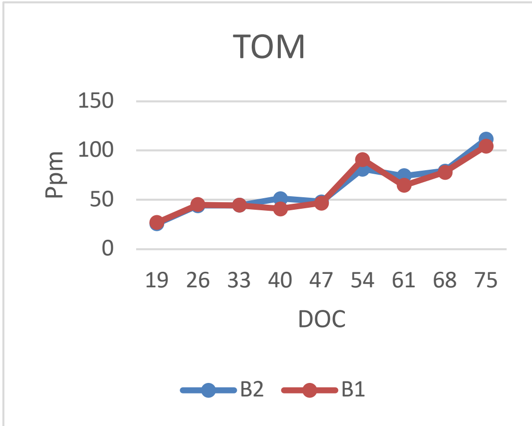


Figure 8. TOM chart (Primary data, 2021).

The measurement results in the graph show that total organic matter in plots B2 and B1 tends to increase with increasing DOC in shrimp such as in DOC 54 and in DOC 75 with total organic matter (TOM) in plot B2 which is 111.60 and in plot B1 namely 104.7. The high total organic matter can be detrimental during shrimp farming, this occurs due to leftover feed, dead plankton, and precipitation from water changes. SNI (2006), states that the maximum limit for the amount of organic matter in ponds is <55 mg/l. To overcome the high total organic meter, it can be done by tapping, siphoning, and adding molasses.

i. Ammonium (NH_4)

Ammonium measurements are carried out once in five days to minimize costs. Ammonium measurement serves to find out how much plankton nutrition and the results of bacterial metabolism are produced. Ammonium

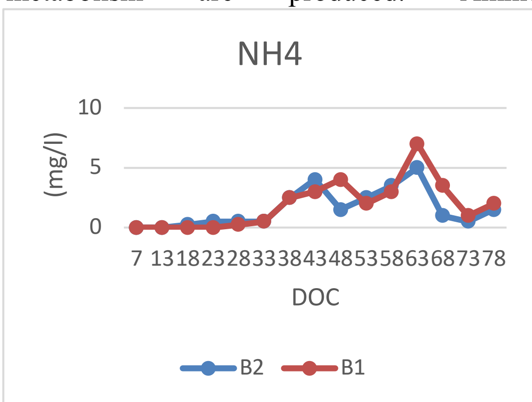


Figure 9. NH4 chart (Primary data, 2021).

In DOC 1 – 13 the yield was 0 (mg/l) in plot B2 while in plot B1 the lowest yield was obtained in DOC 1 – 18, namely 0 (mg/l). While the highest measurement results for plot B2 were DOC 63 with an increase in ammonium of 5 (mg/l), even in plot B1 the ammonium level was up to 7 (mg/l). This result is not in accordance with the opinion of SNI (2006), that the maximum ammonium content is 0.3 mg/l. The high ammonium occurs due to the CV shrimp ponds. Tirta Makmur Abadi Siphoning was not carried out in Lombang, but sewage disposal at the bottom was only carried out with determination on the central drain.

j. Nitrit (NO2)

NO2 measurements are carried out every five days with the aim of saving expenses, NO2 measurements use the NO2 test. NO2 measurements in plots B2 and B1 can be seen in Figure 10.

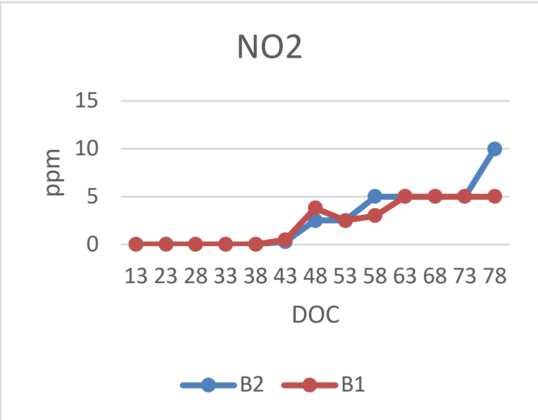


Figure 10. NO2 chart (Primary data, 2021).

NO2 measurement results in plots B2 and B1 showed the lowest results in DOC 1 – 43 with 0 ppm while in plot B2 in DOC 78 NO2 measurements were high with 10 ppm, while in plot B1 DOC 63 – 78 nitrite measurements were always high with 5 ppm. Referring to SNI (2006), the maximum content of nitrite is 0.01 mg/l, this is due to the accumulation of organic matter at the bottom of the plots and also the lack of siphoning.

k. Phospate (PO4)

Measurement of PO4 shrimp ponds CV. Tirta Makmur Abadi Lombang is conducted every five days. Phosphate (PO4) is a source of nutrition that is needed by plankton to grow because PO4 contains phosphorus compounds, which are the main ingredients of plankton nutrition. PO4 measurement graph can be seen in Figure 11.

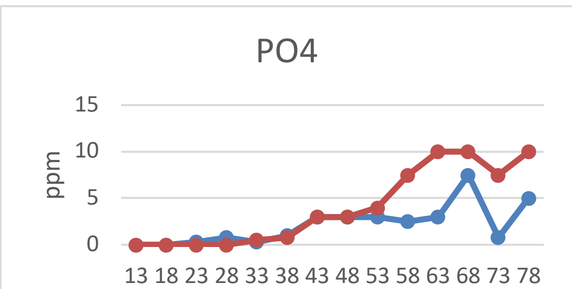


Figure 11. PO4 chart (Primary data, 2021).

Measurement of PO4 shrimp ponds CV. Tirta Makmur Abadi The lowest Lombang was at DOC 1 – 18 with a measurement result of 0 ppm, while in plot B1 the measurement result was quite high at DOC 58 – 79 with a result of 7 – 10 ppm, the highest PO4 measurement result was in plot B2 namely at DOC 68 with a result 7.5. The high PO4 in plots B2 and B1 is caused by leftover feed, faeces, and excrement from the water, PO4 is a source of nutrition for plankton. This condition is not good for the waters because it can cause plankton blooms as can be seen in plots B2 DOC 73, the PO4 content decreases, this can happen because the phosphorus content in PO4 has been utilized by plankton. Referring to SNI (2006), the minimum value of PO4 is 0.1 mg/l.

Conclusion

From the results of research on "Monitoring Water Quality in Intensive Growing Vanamei Shrimp (Litopenaeus vannamei) Ponds at CV. Tirta Abadi Lombang concluded that the water quality in the pond still met the vannamei shrimp growth standards. The results of water quality measurements such as TOM content in plot B2 reached 80 ppm and in plot B1 reached 104 ppm, measurements of nitrite B2 5 ppm plot B1 10 ppm, ammonium plot B2 5 ppm plot B1 7 ppm, PO4 plot B2 7.5 ppm plot B1 10 ppm and still at the tolerance limit which still supports vannamei shrimp cultivation.

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