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REVIEW

WATER QUALITY MANAGEMENT STRATEGIES TO INCREASE THE PRODUCTIVITY OF WHITE SHRIMP *(Litopenaeus vannamei)* CULTURE

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ABSTRACT

White shrimp *(Litopenaeus vannamei)* culture has become a part of aquaculture. Proper water quality management is critical to the success and sustainability of shrimp farming operations. This article aims to investigate effective water quality management specifically tailored for *Litopenaeus vannamei* shrimp farming. Water quality parameters such as temperature, dissolved oxygen level, pH, salinity, and ammonia concentration were monitored to maintain optimal water conditions. Water quality management is critical in reducing disease outbreaks and optimizing growth and survival of shrimp populations.

Keywords: Shrimp culture, Water Quality, Water Quality Management, White Shrimp

INTRODUCTION

White shrimp *(Litopenaeus vannamei)* is an introduced shrimp originating from the Pacific West Coast of Latin America and introduced to Indonesia by the Ministry of Marine Affairs and Fisheries of the Republic of Indonesia. Number 4 Year 2001. Since its introduction to Indonesia in 2001, White shrimp *(Litopenaeus vannamei)*, also known as white shrimp, has become one of the most important commodities in the country's aquaculture sector. The management of White shrimp farming in Indonesia applies various farming patterns and systems. Starting from those who still use conventional farming systems and continuing to those who use advanced technology **(Putra *et al*., 2023).** The government recommends White shrimp *(Litopenaeus vannamei)* farming as an alternative to tiger shrimp (Penaeus monodon). The reason is to improve local shrimp species and varieties, as well as increase production, profitability, and welfare of fish farmers, White shrimp *(Litopenaeus vannamei)* is considered a superior shrimp variety. In addition, White shrimp is also in great demand by the public because it has economic value in the aquaculture industry in Indonesia. The increasing demand for vannamei shrimp in both domestic and foreign markets indicates that vannamei shrimp farming companies have good growth opportunities **(Ningsih *et al*., 2021).**

White shrimp is used as a superior variety because it has several advantages including responsiveness to feed or high appetite, more resistant to disease and poor environmental quality, faster growth, high survival rate, high stocking density, and relatively short maintenance time, which is about 90 - 100 days per cycle **(Purnamasari et al., 2017).** However, despite its success, White shrimp farming still often experiences production failures. Poor water quality during future rearing is one of the main causes of White shrimp production failure. Therefore, regulating water quality during the rearing procedure is necessary **(Halim et al., 2021).**

Water quality has a significant impact on the reproduction, growth, and survival of aquatic organisms. The physiological process of White shrimp requires appropriate environmental conditions **(Putra et al., 2023).** According to **Ningsih et al., (2021),** water quality management is an effort to strive for and maintain water quality so that it can be used optimally and continuously, with the main objective of maximizing the sustainable benefits of these waters. Pond water quality management is very important for the success of White shrimp farming. Water quality is very important for White shrimp because it functions as an internal and external medium for shrimp. As an internal medium, water functions as a raw material for body reactions, distributes food throughout the body, and acts as a temperature regulator or buffer. While as an external medium, water becomes a habitat for White shrimp. Because water plays an important role in White shrimp farming, water quality management must be maintained in accordance with the needs of White shrimp **(Sai et al., 2022).**

MATERIAL AND METHODS

This article is quantitative research. Data collection is carried out using secondary data which is a supporter sourced from various existing literature and references. Data analysis was carried out using literature review techniques including looking for similarities (compare), looking for dissimilarities (contrast), giving views (crinite), comparing (synthesize), and summarizing (summarize) from various journals. The initial search used the main keywords, then added modified keywords or additional keywords **(Putri and Mulyanti, 2023).**

RESULTS AND DISCUSSION

White Shrimp *(Litopenaeus vannamei)* Culture

White shrimp *(Litopenaeus vannamei)* is one of the most valuable fishery products. Since the tiger shrimp agro-industry in Indonesia has declined, the development of vannamei shrimp has become a viable agricultural option (Halim et al., 2021). White shrimp farming is one of the prominent fisheries businesses engaged in fisheries. Shrimp farming activities are increasingly widespread throughout Indonesia **(Adriyanto et al., 2013).** One of the factors that encourage the growth of the shrimp farming industry is that people understand that shrimp farming not only promises high profits, but also has high costs and risks, so that individuals and groups have opened land for shrimp farming **(Jarir et al., 2020).**

White shrimp *(Litopenaeus vannamei)* has become one of the leading commodities in the national aquaculture sector. The management of White shrimp farming in Indonesia is carried out with various patterns and cultivation systems. Starting from those that still use traditional cultivation systems, intensive, to super intensive with diverse technology applications **(Suwoyo et al., 2015).** White shrimp *(Litopenaeus vannamei)* cultivation with intensive technology is growing rapidly due to the availability of SPF (Specific Pathogen Free) seeds, so they can be stocked at higher densities, and have high survival and production. In Indonesia, densities commonly practiced in various regions range from 80-100 ind/m^2 of White shrimp and can be increased to 244 ind/m^2, using probiotics that can produce 37.5 tons/ha/cycle. However, high production is not always followed by high profits. In addition, the application of high density is limited to the middle and upper classes of society. High production will impact the waste load generated both by feed residues if the feed conversion ratio is high, as well as shrimp feces **(Mangampa and Suwoyo, 2016).**

According to **Maimunah and Kilawati (2015)**, the development of farming systems from traditional to intensive in the majority of White shrimp ponds has the potential to increase environmental pollution. Less than optimal utilization of excessive feed will cause the accumulation of organic matter. Where the decomposition of organic matter requires oxygen in the process, so that the availability of oxygen for biota in it becomes reduced. If this happens continuously, it will cause death for shrimp and other biota. Pollution materials that are difficult to decompose by microorganisms also cause hoarding and result in damage to the environment which will directly interfere with organisms living in the environment. Organic pollution materials that function as fertilizers are detrimental due to algae blooming resulting in oxygen competition in the waters. These factors are the cause of the decreased resistance of organisms to disease attacks due to poor environmental quality. Therefore, farmers must always pay attention to water quality to maintain shrimp resistance **(Jarir et al., 2020)**.

Water Quality

There are several things that need to be considered in conducting White shrimp farming activities to get maximum results, namely, media preparation, selection of good fry, feed management, water quality management, as well as post-harvest handling, and harvesting. Water quality management includes measuring the content of chemicals in the water and the condition of the water seen from a physical appearance (**Sitanggang and Amanda, 2019)**. In White shrimp farming, water quality management is needed to support its growth and development. Water quality is defined as a spear in the success of aquaculture where all activities carried out are related to the content in a body of water. The quality of pond water greatly affects the growth of cultured biota. Good water quality according to cultivation standards (SNI. 2016) will support optimal growth. Conversely, poor water quality can cause stress, resulting in stunted growth due to decreased appetite. So in aquaculture it is important to maintain the carrying capacity of the environment to avoid crop failure **(Fabri and Latuconsina, 2023)**.

Good and bad water conditions can be seen from the amount of chemical content which is the result of the metabolism of cultured biota that is not properly decomposed. Excess and lack of these chemicals greatly affect the condition of aquaculture waters because they can be toxins. Good and bad aquaculture water conditions will affect the process of shrimp growth, shrimp activity, shrimp appetite, molting process, and shrimp body resistance to disease, which ultimately affects the results of enlargement of profit or loss. Water quality is the nature of water and the content of living things, energy substances or other components in the water. Water quality is expressed by several parameters, namely physical parameters (temperature, turbidity, dissolved solids and so on), chemical parameters (pH, dissolved oxygen, biochemical oxygen demand, metal levels and so on), and biological parameters (the presence of plankton, bacteria, and so on) **(Sitanggang and Amanda, 2019)**.

Water Quality Parameters

Temperature

One of the water quality parameters that can affect shrimp life is temperature. This is because temperature can affect the appetite and metabolic rate in shrimp. According to **Maknun and Sumsanto (2023)**, the optimum temperature value can have an impact on maximum growth results and significant survival for shrimp. However, if there is a spontaneous change in temperature, it will have a stressful impact on shrimp due to abnormal conditions. The optimum temperature value based on SNI 01-7246-2006 ranges from 28.5 to 31.5°C. When the temperature is below 18°C, the shrimp appetite will decrease, and when below 12°C or above 40°C can cause death for shrimp. High temperatures can lead to enzyme production and bacterial proliferation, Optimum temperature for White shrimp between 26-32 ° C, but the best temperature for shrimp 28-30 ° C **(Sai et al., 2022)**.

The presence of solar radiation, air temperature, weather and climate will affect the amount of water temperature. High temperatures during the day than at night because of the role of solar radiation. When the temperature is more than the optimum number, the metabolism in the body of White shrimp will take place quickly which makes White shrimp become stressed and will cause saturation of oxygen levels and limit the source of oxygen intake for shrimp. So that the temperature is not too high and is in the optimum range, it is done by deepening or raising the water level by entering new water with a lower temperature and also growing plankton to reduce brightness. Meanwhile, when the temperature is low, the metabolism of White shrimp becomes slow and clearly affects the appetite of White shrimp which decreases. To anticipate very low temperature changes and keep the temperature within the optimum range can be done by reducing the volume of pond water and operating the wheel **(Sai et al., 2022)**.

Water Transparency

Water brightness is a measure of the clarity of a body of water, the higher the brightness value of a body of water, the deeper the light penetrates into the water. The brightness (transparency) of waters is influenced by fine materials floating in the water in the form of organic materials such as plankton, microorganisms, detritus and inorganic materials such as mud and sand. Water brightness in the cultivation of White Shrimp needs to be in accordance with the ideal range of 30-50 cm (SNI, 2016), with the recommended steps to immediately change the water by the manager of the low brightness shrimp pond, according to research by **Renitasari and Musa (2020),** in order to prevent sequential death of phytoplankton which can result in a drastic decrease in dissolved oxygen levels, or if high water brightness indicates an adequate supply of natural food or plankton. The way to handle if the brightness level is low is to do a water change and if the brightness is high, fermentation should be given to grow plankton (**Sai et al., 2022).**

Water Colors

The color of aquaculture water, whether in fish or shrimp is the first thing that is seen when we are in the pond area. In many aquaculture ponds, the color of the water varies from one area to another or one pond to another. The color of pond water is determined by the amount of plankton in the pond. Plankton are known as additional food for shrimp, and of course their presence in ponds is very useful and expected **(Ningsih et al., 2021).** The presence of phytoplankton in the pond can be identified from the color of the water, a good water color for shrimp is brownish yellow and brownish green and brownish green water color is caused by the balance of phytoplankton and zooplankton in the pond, usually consisting of Chlorophyta and Diantom **(Farabi and Latuconsina, 2023).** The appropriate color indicates the life of White shrimp is included in the optimal state. However, if there is a color mismatch for the shrimp pond itself, several ways can be done, namely by changing water regularly, giving probiotics to help grow plankton and giving chlorine during the first cultivation cycle **(Renitasari and Musa, 2020).**

Total Organic Matter (TOM)

Total Organic Matter (TOM) contained in the pond will affect directly and indirectly on the life of pond biota, especially White shrimp. According to Pearson correlation analysis, TOM has a close relationship with pH, where the amount of pH in White shrimp ponds has a positive effect on Total Organic Matter or TOM **(Mahmudi et al., 2020).** Total Organic Matter (TOM) describes the total organic matter content of a body of water consisting of dissolved, suspended, and colloidal materials. High TOM content can reduce the dissolved oxygen content in water, thereby reducing shrimp resistance. The optimum value of organic matter according to SNI 01-7246-2006 is 55 ppm while according to KEP. 28 / MEN / 2004, the range of optimum value of TOM is < 90 ppm. If the value of TOM is high, dilution or addition of water will be done and do the pensioning **(Sai et al., 2022).**

Ammonia

Ammonia is a water quality parameter that has an influence on the survival of White shrimp. The presence of ammonia in the pond has toxic properties for shrimp. Ammonia can irritate the gills of shrimp resulting in difficulty in absorbing oxygen. Ammonia levels in ponds can be influenced by several factors, such as temperature and humidity. The higher the temperature and humidity, the ammonia levels will also increase. Increasing the age of cultivation will cause ammonia levels to increase, this is because the accumulation of organic matter in the pond is the starting material for the formation of ammonia **(Yunarty et al., 2022).**

Ammonia levels that can still be tolerated by aquaculture organisms range from 0-1.04 mg/L. How to handle high ammonia levels can be done by changing the water in aquaculture ponds **(Yunarty et al., 2022).** Handling high ammonia levels can also be done with a cultivation system using bio floc technology. Bio floc technology itself is a biological water treatment technique that utilizes bacillus sp. bacteria to form flocs. this technology can help manage water quality in White shrimp farming ponds, especially in dealing with ammonia problems **(Adipu, 2019).**

Salinity

Salinity is one of the water quality parameters that greatly influences the survival and growth of White shrimp larvae. Fluctuating changes in salinity in the cultivation media can cause high mortality rates of shrimp larvae **(Jayanti, 2022).** The salinity range suitable for the growth of White Shrimp varies depending on the development stage of the shrimp. Young shrimp aged 1-2 months require salinity between 15 and 25 ppt for optimal growth. When shrimp are more than 2 months old, they still grow well at a salinity of between 5 and 30 ppt **(Supono, 2019).** After spreading the shrimp fry, the optimal salinity range is between 10 to 30 ppt, while for the White shrimp rearing stage, the ideal salinity is in the range of 26 to 32 ppt. The optimal salinity range for growth and survival of White shrimp according to SNI 01-7246-2006 is 15 – 25 ppt **(Farabi and Latuconsina, 2023).**

Raising White shrimp with low salinity means that mineral availability in ponds tends to be very low. This will affect the length of time for shrimp to molt or change their skin. Salinity itself is a water quality parameter that greatly influences the molting process, this condition is related to the osmoregulation process in White shrimp. Salinity also greatly influences the osmotic pressure of water, namely the osmotic properties come from all the electrolytes dissolved in the water. The higher the salinity, the greater the electrolyte concentration and osmotic pressure **(Jayanti et al., 2022).** Handling salinity that is not suitable for White shrimp cultivation can be done by changing or adding water so that the salinity is optimal **(Adipu, 2019).**

pH

The pH value is an important parameter in the life of White. According to **Han et al., (2018)** pH fluctuations that occur in White ponds generally range between 6.6-10.2. This fluctuation is mainly caused during the day when carbon dioxide from the respiration of shrimp, bacteria and other animals in the pond is taken up by phytoplankton for the photosynthesis process, while at night it can be said that all biota in the pond releases carbon dioxide. Other reasons for pH fluctuations are exposure to pond bottom sediment due to shrimp movement, erosion of acidic soil due to rain and accumulation of organic material which causes ponds to become overly fertile (eutrophication).

According to Duan et al. (2019) the optimal pH value for White growth according to SNI 01-7246-2006 is around 7.5 – 8.5, while pH values below 6.9 and above 9.7 will cause stress. It was further explained that when fish have been exposed for more than 72 hours to this pH stress condition, what happens is changes in the morphology of the intestine, changes in the activity of digestive enzymes such as amylase, lipase, trypsin which is characterized by increased activity of the enzymes hexokinase (HK), pyruvate kinase (PK), cytochrome c- oxidase (CCO), lactate dehydrogenase (LDH) and oxygen production capacity. Meanwhile, enzymes related to anti-oxidant capacity, such as superoxide dismutase (SOD), glutathione S-transferase (GST), decreased their activity. The pH of shrimp pond water can change to acid when there is an increase in rotting objects from food remains and so on. The degree of water acidity in the afternoon is usually higher than in the morning because the photosynthetic activity of phytoplankton in the water absorbs less CO2, whereas in the morning there is a lot of CO_2 as a result of the respiratory activities of animals and phytoplankton and also decay in the water. The way to deal with low pH is to apply lime soaking and water changes, whereas if the pH is high then fermentation and water changes are applied **(Sai et al., 2022).**

Dissolved Oxygen

Dissolved oxygen (DO) is the main limiting element for shrimp life because it is involved in the oxidation of nutrients which are converted into energy; Lack of oxygen intake can have a major negative impact on the growth and development of cultivated shrimp **(Maknun and Sumsanto, 2023).** Dissolved oxygen levels in White shrimp ponds are generally stable both at night and in the morning. DO values are higher in the morning than in the afternoon because bacteria, phytoplankton and other biota, as well as shrimp, need oxygen at night. Meanwhile, at 06.30 WIB in the morning, the photosynthesis process is underway which produces O2, resulting in high DO levels **(Renitasari and Musa, 2020).**

The level of DO is influenced by temperature, age of the shrimp and water level. Increased temperature can cause high oxygen consumption, so DO will be low. Apart from that, shrimp age also influences oxygen consumption **(Halim et al., 2021).** The minimum limit for dissolved oxygen for rearing White shrimp is in the range of >4 mg/L (SNI, 2016). A dissolved oxygen concentration of 1-5 mg/L growth will be disrupted if it continues continuously, 5 mg/L until saturation is very good for growth. The solubility of oxygen in pond waters will increase as the environmental carrying capacity decreases **(Wafi et al., 2021).** Steps taken if dissolved oxygen is low, to anticipate a lack of oxygen, the pond is equipped with a water wheel or aerator **(Farabi and Latuconsina, 2023).**

Alkalinity

Alkalinity is a water buffer. The optimum value of alkalinity in ponds according to **Sumarni (2019)** is 90 - 150 ppm, while based on SNI 01-7246-2006, the optimum value of alkalinity is 100 - 150 ppm. According to **Manan and Putra (2014),** the optimum standard value of alkalinity for the development of the life of White shrimp is in the range of ≥100 ppm and the total value of alkalinity levels required for fisheries purposes is in the range of 50-300 ppm. It is known that if the alkalinity value exceeds the standard value, it will have a negative impact on the development and metabolism of shrimp. In accordance with the statement from **Manan and Putra (2014)**, alkalinity content that is below the required value will cause excessive or abnormal molting of the shrimp's shell. However, alkalinity content that exceeds the required threshold also causes shrimp to experience difficulties in molting activities. Treatment carried out if the alkalinity value is high is by changing the water, whereas if the value is low then applying lime, changing the water or adding water **(Sai et al., 2022).**

Plankton

Plankton is used as a biological parameter of water quality that can be used to identify water quality conditions. Plankton is an organism in waters that is very small and moves in accordance with the direction of the water current. Plankton is divided into 2 types, namely zooplankton (animals) and phytoplankton (plants) **(Sai et al., 2022).** Plankton can help as a stabilizer in the pond media, namely the clarity of the water. The ideal plankton density in ponds is around 10,000 ± 12,000 cells/ml. The types of plankton expected in ponds include phytoplankton (*Chlorella* sp, and *Skeletonema* sp.), Diatomae (*Chaetoceros* and other diatomae), and Cyanobacteria. Meanwhile, what is most avoided or not expected is several types of *Dinoflagellate* sp. **(Putra and Manan, 2014).** The presence of plankton is related to the brightness and color of the water, the more plankton in the water, the lower the brightness and the darker the color of the water. Apart from that, the presence of high amounts of plankton can cause high oxygen levels in a body of water, resulting in lower shrimp saturation. This is because dissolved oxygen plays a role in the oxidation and reduction processes of organic and inorganic materials, as well as determining the biological processes carried out by aerobic or anaerobic organisms **(Farabi and Latuconsina, 2023).**

Water Quality Management

Water quality management is one way that farmers can do to increase vannamei shrimp production. One way to maintain water quality is by managing water quality. If water quality management has been carried out optimally, supported by the existence of supporting facilities and infrastructure, it is hoped that the vannamei shrimp pond environment will be optimal in accordance with the life range of the shrimp so that shrimp growth is fast and ultimately maximum production is created **(Putra and Manan, 2014).**

Siphoning

Siphoning is to reduce abnormally high levels of ammonia, nitrite and H2S levels, as well as sediment in the pond due to dead plankton, molting residue, food waste and feces, suctioning is carried out. Vacuuming is often done two or three times a week in the morning or evening, starting when the shrimp are thirty to forty days old. Using a spiral hose, suction is done by directing the end of the hose towards the mud and sucking it up. The sludge is then discharged to the outlet pipe through the central drain **(Sai et al., 2022).**

Liming

Adding lime is one way to raise the pH and increase alkalinity. Lime is given 2 times a week. It is best to spread lime in the morning to control plankton growth. Spreading lime at night can produce minerals and act as a pH buffer. This is in accordance with the opinion of **Wardiyanto and Supono (2017),** that the use of captan has the function of binding hydrogen so as to reduce the degree of acidity and increase the pH of water and soil, which can increase alkalinity **(Sai et al., 2022).**

Water Changing

In managing water quality so that water quality remains stable, a water exchange process is carried out which is useful for diluting organic materials originating from metabolic waste and feed waste. Water changes are carried out when the shrimp are 25 days old. In other research, it is stated that water changes are carried out every 2 days. The number of daily water changes is adjusted to the age of the shrimp, namely around 1-5% until the second month of cultivation, 5-7% in the third and fourth months. The water discharged from ponds is bottom water which is discharged through central drainage or side pipes (**Renitasari and Musa, 2020).** Water changes are carried out at a height of 10 cm if the water condition is bad. Apart from that, water quality data is checked periodically, namely once every week **(Putra and Manan, 2014).**

Water Quality Daily Monitoring

Water quality monitoring should be carried out periodically to identify fluctuations in water quality parameters that could result in poor conditions in the pond. This monitoring includes testing water quality parameters such as temperature, pH, dissolved oxygen, salinity, water color, and other water quality parameters that are not appropriate **(Nuntung et al., 2018).** The sustainability of pond cultivation is very dependent on the quality of water management. Different water environmental conditions can affect environmental quality conditions both physically, chemically and biologically. In pond cultivation, water quality is a key factor in success because it is an absolute requirement for maintaining cultivated organisms **(Wahyuni et al., 2020).** Maintaining water quality can be done by adding molasses or probiotics in the form of "superbio" to cultivation ponds. Adding molasses to intensive shrimp cultivation ponds can maintain carbon and nitrogen balance and is also useful in helping heterotrophic bacteria break down ammonia **(Ichsan et al., 2021).**

Chlorination

Adding chlorine functions to purify the water. Chlorine is given at the first cultivation cycle of 10 ppm, this means the water is still clear, but nowadays, because the water is polluted, a dose of 20-30 ppm is given. Next, the water is left for 24 hours and the waterwheel is turned on for 2-3 hours to stir the chlorine so that it spreads quickly. This chlorine is not directly added to the cultivation pond because the nature of chlorine is that it settles to the bottom or accumulates at the bottom and this happens within 30-40 days, so if it is directly added to the cultivation pond it will disrupt the life of the shrimp in the pond. Stirring with a water wheel aims to distribute the applied chlorine evenly to the bottom of the pond, so that the media water can immediately be completely sterile. To maximize the harmful potential of the active ingredient, chlorine is best applied in the afternoon when sunlight intensity is low **(Renitasari and Musa, 2020).**

Application of Probiotic

During maintenance, probiotics are applied twice a week at a dose of 1-2 ppm depending on the condition of the shrimp and the environment. If environmental conditions are bad, the dose given can be increased to between 2-3 times the normal dose **(Putra and Manan, 2014).**

Application of Saponin

Improve poor water quality by administering saponin. Saponin is given when the water is too thick, which functions to absorb or kill plankton so that it can improve water quality. Saponin is a type of glycoside that is found in many plants, one of which is tea seeds. The oil from tea seeds (*Camellia sinensis*) can be extracted, and the dregs, when ground into flour, have amounts of toxic saponins that range from 10 to 13 parts per million. Saponin has the ability to produce foam that can form and last a long time if it reacts with water and is shaken. Some of the properties of saponins include bitter taste, foaming in water and poisonous to cold-blooded animals, haemolysis activity, damaging red blood cells **(Renitasari and Musa, 2020).**

Feeding Management

Implementing good and measured feed management is very important to maintain water quality. This is because excessive feeding can increase the amount of organic waste in the pond water, which can then have an impact on water quality. Good feed management also helps increase FCR (Feed Conversion Rate) efficiency and prevent disease due to overfeeding **(Hertika et al., 2021).** Based on several data compilations and analysis of the relationship between water quality variables and shrimp FCR values, a low FCR value will have a good impact on water quality in the pond ecosystem environment, this is because the lower the FCR value, the less feed waste will be. which is wasted into the pond ecosystem environment. So the nutrient load in ponds will decrease and water quality conditions will tend to be stable throughout the cultivation journey **(Ariadi et al., 2020).**

CONCLUSION

The cultivation of White shrimp *(Litopenaeus vannamei)* is crucial in the fisheries sector in Indonesia. White shrimp cultivation has several diverse patterns and systems, ranging from traditional methods to intensive and super intensive methods. White shrimp cultivation activities require water quality management because it can have a direct effect on the growth and development of White shrimp. The main parameters of water quality include temperature, brightness, color, TOM, ammonia, salinity, pH, DO, alkalinity and plankton. Managing water quality can be done using several techniques, such as siphoning, lime application, water changes, regular water quality monitoring, chlorine administration, probiotic administration, saponin administration, and feed management.

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