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Water Quality Management in Vaname Shrimp (*Litopenaeus vannamei*) Farming at PT Bumi Harapan Jaya

Hardi Afriandi Kurnia[1], Bagus Dwi Hari Setyono[1]*

[1]Aquaculture Study Program, Faculty of Agriculture, University of Mataram
Pendidikan Street No. 37 Mataram, West Nusa Tenggara

***Correspondence**:
bagus.setyono@unram.ac.id

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ABSTRACT

The increase in vaname production is carried out to meet market demand which continues to increase from year to year, so that various strategies are carried out in vaname cultivation. Besides of feed quality and disease prevention, water quality management is an effort to regulate and manipulate environmental conditions so that optimal range can supports shrimp growth, until good shrimp quality is obtained. Location of the activity at PT Bumi Harapan Jaya where has produced a lot of shrimp with the best quality, so it is necessary to know how water quality management is applied there. The method is carried out descriptively, namely describing what is done according to conditions in the field. The results of activities in managing water quality are starting from the preparation of ponds, seeds and good water sources. Water quality management during vaname shrimp rearing activities applies measurements of physical, chemical and biological parameters, where physical parameters such as temperature and brightness are maintained in the range of 27-30 °C and 30-45 cm. In addition, the pH remains in the normal range of 7.7-8 and salinity 30-34 ppt. Carrying out regular water quality checks is the key to good water quality management, in addition to that, regular siphoning is also necessary to avoid high ammonia content in the culture water.

INTRODUCTION

Whiteleg shrimp (vaname shrimp) is a superior product of the Indonesian fisheries sector. However, vaname cultivation is still quite low, land utilization in Indonesia itself until 2017 was still 20%. Based on the graph, vaname production from 2017-2019 has increased, but in 2019 it has decreased. The decrease in the amount of production is due to several things, including the poor quality of the water in the maintenance media which causes a decrease in the immune system in shrimp which makes shrimp susceptible to disease.

Increasing the production of vaname is done to meet the increasing market demand from year to year, various strategies are carried out in the cultivation of vaname shrimp. One of them is by providing types of feed, water quality management, pest and disease control that can increase the growth and development of vaname.

Water quality management is an effort to manipulate environmental conditions so that they are within the appropriate range as in their natural habitat (Effendi, 2003). Water quality management is expressed by several parameters, namely physical parameters, chemical parameters and biological parameters. Physical parameters include temperature, turbidity, dissolved solids and so on. Chemical parameters include salinity, pH, dissolved oxygen, ammonia, nitrate and nitrite. While biological parameters are the presence of bacterial plankton and so on.

One of the vaname cultivation locations is at PT Bumi Harapan Jaya, West Sumbawa Regency, NTB. Vaname farming activities have long been developed and cultivated. Therefore, research activities were carried out to identify how water quality management is carried out at PT. Bumi Harapan Jaya, so that it can improve knowledge and skills and understand the problems that arise in managing water quality management in vaname farming.

METHODS

This activity was carried out in July - August 2022. The location is at PT. Bumi Harapan Jaya. Tambak Sari Village, Poto Tano District, West Sumbawa Regency, NTB. The data obtained were analyzed descriptively, namely describing all activities carried out clearly and in detail which were supported by literature studies, so as to provide clear and complete information. The sequence of procedures carried out includes determining the location, preparing tools and materials, spreading shrimp seeds, water quality management, feeding until harvesting.

RESULTS AND DISCUSSION

Vaname Shrimp Enlargement

The enlargement of vaname shrimp on site uses intensive pond types. Activities in the enlargement include pond preparation, spreading of fry, feed management and water quality, and harvesting. The pond preparation activities themselves consist of cleaning the plots, drying, sterilizing the water and providing fermentation. The cleaning is intended to clean dirt or pests (barnacles, moss and others) that stick to the bottom and walls of the pond that have the potential to carry pests and diseases during the cultivation process. The clean pond is then dried for 4-7 days in the sun with the aim of killing the remaining organisms and evaporating toxic organic materials at the bottom of the pond.

Water sterilization begins 12-14 days before the seed distribution. This water sterilization process is by adding seawater into the tank with a height of ± 130 cm, then spreading Cuprisulfate / $CuSO_4$ with a dose of 1.5-2 ppm during the day with the use of a full waterwheel. The function of Cuprisulfate / $CuSO_4$ can suppress algae growth by inhibiting the process of photosynthesis and oxidative phosphorylation in the electron transport chain (Pradeep *et al*., 2015). After 24 hours, the next treatment is the administration of chlorine with a dose of 20/30 ppm during the day. The goal is as an effort to sanitize water that can kill pathogenic bacteria and viruses as the cause of the emergence of diseases in the water and to clarify the pond water. Chlorine can also oxidize iron and other microorganisms which are pollutants which if the concentration is too high can endanger the survival of vaname. (Ernawaty dan Rochmady, 2017).

After sterilization process, then the fermentation process. The materials used in making fermentation are 2-3 kg of bran, 50 ml of Lactobacillus (Biolacto), 100 grams of Enzyme, 50 grams of Fermipan, 100 grams of Azoomit and water, then cultured for 48 hours so that the fermentation process can occur.

Spreading of Benur

After the water is sterile, sufficient plankton and probiotics are formed, then the map is ready to receive the spread of fry. The fry used come from Ayen Bali. Size of the fry spread into the pond is PL10. The number of fry spread is 611,302 with a pond area of 4,100 m². Before the fry are spread, its need to be acclimatized first. Hidayat dan Suwardi (2015), stated that the acclimatization of fry is intended to prevent high mortality rates of fry during and after spreading. Acclimatization to temperature can be done by soaking a plastic bag containing fry in a closed state until steam appears in the plastic bag. This shows that temperature in the plastic bag is the same as temperature of the pond water.

Feed Management

Feeding management for shrimp aged 1-5 days is given twice a day at 07.00 am and 15.00 pm, aged 6-10 days is given three times a day at 07.00 am, 10.00 am, and 15.00 pm, shrimp aged 10-40 days is given four times a day at 07.00, 10.00, 13.00 and 16.00 WITA manually with the Blind Feeding method. Blind Feeding is the determination of feed dosage by estimating the dose needed without sampling the weight of the shrimp. While for shrimp aged over 40 days, feeding use *ad libitum* method from 07.00 to 9.00 WITA using an auto feeder. Feeding at the age of 1-20 with a feed amount of 3 kg / 100,000 fry. At the age of 21-40 the dose of feed is around 10% of the shrimp biomass. Furthermore, the dose of feed will decrease as the shrimp age until it reaches the harvest size which is around 2-3% of the shrimp body biomass.

Water Quality Management

Water Quality Management during vaname shrimp farming activities at PT Bumi Harapan Jaya Implementing physical, chemical and biological parameter measurements. Physical parameter measurements are carried out every day, namely in the morning and evening. Chemical and biological parameter measurements are checked once a week in the PT Bumi Harapan Jaya laboratory. Physical parameter measurements are carried out directly at the pond location, temperature measurements are carried out using a thermometer, for water clarity using a secci disk and water color is carried out by direct observation of water color. Physical parameter measurement data can be seen in table 1.

Table 1. Physical Parameter Data

Parameter	Measurement Value	Optimum Value	Source
Temperature (°C)	27-30	26-30	Kurniawan & Heru (2019)
Brightness (cm)	30-45	25-45	Nuntung *et al*. (2018)

At the optimal temperature range, shrimp can digest food well, followed by good shrimp growth. The brightness value shown is quite high because the shrimp are still quite young so that the feed and feces that are excreted do not cause turbidity in the water. In addition, the regular water circulation and siphoning process also reduces the presence of particles that cause turbidity in the water.

The chemical parameters measured were salinity, pH, ammonia, nitrite, nitrate, and Total Organic Matter (TOM). The results of the chemical parameter measurements are presented in table 2.

Table 2. Chemical Parameter Data

Parameter	Measurement Value	Optimum Value	Source
pH	7,7-8,0	7,5-8,5	Nuntung *et al*. (2018)
Salinity (ppt)	30-34	5-45	Rakhfid *et al*. (2019)
Amonia (ppm)	0,009	<0,01	Wulandari *et al*. (2015)
Nitrite (ppm)	0,016-0,02	0,25	Kurniawan & Heru (2019)
Nitrate (ppm)	1-5	3,9-15,5	Kurniawan & Heru (2019)
TOM (ppm)	105-112	<150	Kurniawan & Heru (2019)

Parameters measurement above indicate the optimal value for the survival of vaname shrimp. pH values that change too high or too low can stress aquatic animals (Febriani *et al*., 2018). Salinity plays a role in osmoregulation, where if it is not in the optimal range, osmoregulation and growth will be disrupted (Ghufron *et al*., 2018). Ammonia and nitrite levels that are outside the optimal limits can make shrimp susceptible to stress to the point that their immunity decreases and they are susceptible to death (Heni *et al*., 2014). Nitrate content that is less than the optimal limit can be a limiting factor, especially for the growth of natural feed such as phytoplankton (Wulandari *et al*., 2015).

The biological parameters measured were observations of plankton types and densities. The results of the plankton type grouping can be seen in table 3.

Table 3. Biological Parameter Data

Types of Plankton	Amount (%)
Green Algae	66,8
Blue Green Algae	21,1
Dinoflagelata	5,6
Protozoa	4,2
Diatom	2,3

Total density of plankton counted in the pond was 867,813 cells/ml, where this value is still optimal for the survival of shrimp, in accordance with the opinion of Nuhman (2008), that optimum number of plankton density is 500,000-2,000,000 cells/ml. This condition is optimal because the composition of the existing plankton consists of various types, and is dominated by green algae which are classified as harmless plankton. Meanwhile, types of dangerous plankton include Dinoflagellates (*Gymnodinium* sp., *Alexandrium* sp.), Protozoa and several species of Blue Green Algae such as *Anabaena* sp. and *Oscillatoria* sp (Panjaitan *et al*., 2015).

The process that must be carried out to overcome the dangerous type of BGA is by using Bacillus 10 ppm, Thiobacillus 5 ppm, H_2O_2 2-4 ppm every day and CaO_2 10 ppm every 3 days. To overcome the dangerous type of Dinoflagellate, with the application of BKC 1-3 ppm (50%), CaO_2 10 gr/m2 every 2-3 days, and captain 10 ppm every night for 3-4 consecutive days, and it is necessary to routinely drain surface water and also add fresh water.

Harvesting

Harvesting can be done when the shrimp are 120 days old. Harvesting can be done in bulk or partially. If there are shrimp that are attacked by disease, early harvesting will generally be carried out. Harvesting will consider several aspects such as shrimp health and growth, as well as market prices. If there is no disease and growth remains good.

Waste Treatment

The feed given will mostly be utilized by shrimp through the digestion process, energy and nutrients stored in shrimp tissue as biomass will be obtained. The rest will be wasted as a result of excretion, either in dissolved form or feces that are discharged into the water body and undergo a process of dissolution, sedimentation, mineralization, and dispersion.

Kaligis (2015) stated that leftover feed will produce sediment waste whose composition consists of organic and inorganic materials. Organic materials consist of protein, carbohydrates and fats while inorganic materials consist of mud particles. In line with the growth of shrimp, the percentage of feed given will increase and the remaining feed will also increase. If this continues, the sediment waste that settles on the bottom will undergo a decomposition process producing nitrate, nitrite, ammonia, carbon dioxide and hydrogen sulfide. This content, if above the threshold, will affect water quality and endanger shrimp survival. Efforts to overcome the decline in water quality due to the accumulation of organic waste include using technology by utilizing microorganisms that are able to break down organic materials. Microorganisms that provide these benefits are probiotics. Providing probiotics can create a good environment for shrimp so that it can affect the mortality rate and growth rate of shrimp during maintenance (Supono, 2008).

Handling of waste from leftover feed that will produce sediment waste during the cultivation process in shrimp ponds of PT. Bumi Harapan Jaya uses 3 types of probiotics, namely Bacillus (Quick Pro Direct), Lactobacillus (Biolacto), and Thiobacillus (Thionat Direct). Quick Pro Direct is a high-quality bacillus probiotic with a content of 12 types of bacillus bacteria (Ervia, 2010). The content of bacillus bacteria is superior strain bacteria that can produce protoase enzymes that can decompose waste pollutants from leftover feed and shrimp feces and help the nitification process in the ammonia detoxification process, Produce amylase and lipase enzymes to decompose residual carbohydrates and fats from feed, in addition to producing enzymes, bacillus bacteria in Quick Pro Direct also produce bacitracin compounds that can inhibit other harmful microorganisms such as vibrio and aeromonas, pathogens and Blue Green Algae (BGA). This is in accordance with the statement (Dugassa *et al*., 2018), which states that, in addition to influencing water quality, the application of Bacillus subtilis probiotics can also suppress the population of vibrio bacteria.

Biolakto (Lactobacillus) is a probiotic that plays an important role in digestive function, immune system and basic health of shrimp ponds (Kharisma *et al*., 2013). Biolakto has 7 types of Lactobacillus bacteria content, one of which plays a role in the decomposition of organic matter at the bottom of the pond is Lactobacillus rhamnosus which can ferment organic matter at the bottom of the pond anaerobically, thus breaking down the production of toxic gases from the bottom of the pond

Tionat Direct (Thiobacillus) is a probiotic that can be applied to pond water to overcome H2S (Hydrogen Sulfide) waste. The bottom of the pond that contains a lot of sulfide will be black and smell of sulfur. The benefits of Tionat Direct (Lactobacillus) neutralize toxic pollutants H2S (sulfuric acid), reduce blackish anaerobic sludge, overcome shrimp stress, decreased appetite and death due to H2S accumulation (Tresnawati, 2006). Content of Tionat Direct are *Thiobacillus denitrificans, Thiobacillus ferooxidans, Thiobacillus thiooxidans, Thiobacillus noveltus.*

Post-harvest waste processing is important because aquaculture waste can cause environmental pollution. Waste that is discharged directly into the environment can cause algae blooms, low dissolved oxygen (DO), and damage to benthic habitats. Waste from shrimp farming has a very high nutrient content so that it can cause autrophication (Sulastri and Ahmad, 2014). Autrophication causes low DO concentrations, causing aquatic organisms such as fish, shrimp, and crabs in nature to lack DO. Autrophication can also cause the dominance of blue green algae (BGA) or dinoflagellates which can produce toxins. The elements N and P are important in waste processing, if the concentration of these two elements can be suppressed, the risk of autrophication in open waters is reduced.

Another problem that arises if it is disposed of directly is the spread of disease germs or pathogens into nature. This certainly threatens the health of wild biota in rivers, estuaries, or the sea. Especially ponds that experience crop failure due to disease must be wise in disposing of their waste not directly, but rather processed first to minimize the risk of spreading disease.

Waste processing is carried out during cultivation and after cultivation is completed or at harvest time. In some ponds that apply intensive technology during cultivation, siphoning is applied, namely the removal of pond bottom mud, this waste is included in cultivation waste and should also go through a waste processing process. Waste processing includes 4 types of processes, namely control, processing, disposal, and reuse.

CONCLUSION

Based on the activities that have been carried out for 45 days, it can be concluded that the water quality parameters that are commonly measured at PT. Bumi Harapan Jaya (BHJ) are temperature (27-30°C), brightness (30-50 cm), pH (7.7-8.0), salinity (32-34 ppt), ammonia (0.009 ppm), nitrate (1-5), nitrite (0.016-0.02 mg/l), and TOM (Total Organic Meter) (105-108 ppm). Water quality management techniques are carried out by observing physical parameters every day and chemical parameters are carried out once a week.

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The suggestion that can be given is the need to carry out a waste processing process before it is dumped into the sea.

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