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The Effects of Additional Tuna Madihang Bone Fish Treatment on the Growth of Catfish (*Clarias gariepinus*) in Biofloc Pond in Ternate City North Maluku, Indonesia

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The need for fish protein always increases along with the increase in urban population. To meet the food needs of the people in the city of Ternate, one way is to cultivate catfish using a biofloc system. To accelerate the growth of catfish, one of the efforts made is by adding fish bone meal to standard feed. Tuna fish bone meal contains minerals, especially calcium and phosphorus, which

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can help accelerate the growth of catfish so that harvest time can be accelerated. The objectives of the research are (1) To introduce catfish cultivation with a biofloc system that is effective, efficient and easy to do even on limited land (2) Fish bone meal addition treatment with fish bone meal concentrations (0%, 10%, 15% and 20%) and (3) The catfish cultivation system using the biofloc method can provide maximum results. The method used in this research is an experimental method on a biofloc pond system which consists of three biofloc ponds with a diameter of 3x3 meters. The results of this research are (1) Catfish is a fishery product that has an important prospect for development through cultivation using biofloc ponds (2) The best average value was in the treatment of adding fish bone meal with a concentration of 20% in almost all treatments except for the growth rate treatment which was highest in treatment (c) 0.73 and (3) The addition of tuna bone meal to biofloc pond cultivation can be used as a recommendation for developing catfish cultivation because it has quite promising market prospects.

Keywords: Aquaponics; biofloc; catfish; fish bone meal; Ternate city.

1. INTRODUCTION

Catfish is one of the leading fishery commodities that is developed optimally because it has market prospects at home and abroad. Commodities are exported in the form of fillets, whole around, headless, gills and guts (whole gill gutet) and ground meat (surimi). The high market demand for this commodity encourages cultivation businesses to continue to strive for maximum production(Rukmanaet al., 2017). Efforts to increase catfish cultivation are characterized by high stocking densities followed by increased use of artificial feed rich in protein. Stocking density that is too high in catfish (C. gariepinus) can cause the fish to become stressed. Apart from that, it can cause competition for oxygen and space between cultivated organisms wich can trigger disease problems (Pramono et al., 2018).

According to Efendi, catfish do not have body protection from the environment, as a result, if write appropriately are injured, it is very easy to produce excessive mucus (Efendi, 2015). His body mucus can be used as a living medium for bacteria. The attachment of bacteria to the mucus causes disease to enter the catfish's body. Catfish are susceptible to disease if that are weak, lack food or have previous injuries caused by poor handling, so that bacteria that stick to the catfish's injured skin cause infection and disease (Nasution, 2018). Disease in catfish is one of the problems that is often encountered in catfish rearing efforts. The emergence of this disease is closely related to the environment where the fish live. Diseases that attack catfish can include ulcers, tuberculosis, fungal diseases, white spot disease and itching, as well as trematode worm disease (Sulaiman, 2011). Prevention and treatment of disease in fish is carried out by controlling the environment, apart from that, it is also necessary to know things related to the emergence of fish disease itself.

The potential for fishery resources in Ternate City is quite abundant, but the prices of marine and land fishery commodities are still quite high compared to other areas. The public's habit of consuming sea fish is quite high, however, during the lean season or wave season, the price of fish soars and is even difficult to obtain, whereas in the freshwater fish cultivation sector, for example catfish, goldfish and tilapia, there is still a shortage. Catfish are fish that live in public waters and are fish that have economic value and are liked by the public. Catfish are nocturnal, that is, they actively search for food at night. Catfish have various advantages, including fast growth, high ability to adapt to the environment, delicious taste and quite high nutritional content (Suyanto, 2006). The habitat or living environment for catfish is all fresh waters, including rivers with flows that are not too fast or calm waters such as reservoirs, lakes, ponds, swamps and standing water such as ponds. Catfish can survive in waters that contain little oxygen and are relatively resistant to pollution from organic materials. Catfish can live normally in an environment that has a dissolved oxygen content of 4 ppm and ideal water has a carbon dioxide content of less than 2 ppm, but the growth and development of catfish will be fast and healthy if they are kept from fairly clean water sources, such as rivers, springs, irrigation channels or well water (Suyanto, 2006).

Catfish can live well in the lowlands to hills that are not too high, for example in mountainous areas with an altitude above 700 m. Catfish rarely show their activity during the day and prefer dark, rather deep and shady places. This is understandable because catfish are nocturnal animals that tend to be active and look for food

at night. During the day, catfish prefer to stay or take cover in dark places. However, in rearing ponds, especially in intensive cultivation, catfish can be accustomed to being fed pellets in the morning or afternoon even though their appetite is constant. The Intensification Program is a possible option to increase cultivation production with the current limitations of land and water resources. Intensive cultivation systems are characterized by increased fish density and additional external feed. This can cause problems in the form of a decrease in environmental quality caused by organic waste from leftover feed and manure, this waste is generally dominated by toxic inorganic nitrogen compounds. Therefore, a solution is needed to overcome the problem of limited land, water and food. Biofloc technology is an alternative solution to the problem of intensive cultivation waste.

This technology is the most profitable because apart from being able to reduce inorganic nitrogen waste from leftover feed and manure, this technology can also provide additional protein feed for cultivated animals so that it can increase growth and feed efficiency. So biofloc technology can be used as a solution for improving biofloc technology by adding organic carbohydrates to the maintenance medium to increase the C/N ratio and stimulate the growth of heterotrophic bacteria which can assimilate inorganic nitrogen into bacterial biomass. The application of biofloc technology can be done with other carbohydrate sources such as tapioca flour, bran flour, cornstarch, starch and so on. The addition of tapioca flour had a feed conversion value of 0.4 and 0.5 compared to 0.6 and 0.7 without the addition of carbohydrates. In principle, the growth value of fish or shrimp increases due to the addition of floc biomass such as micro algae bacteria, zooplankton, phytoplankton, as an additional food source. Apart from the natural food sources available in ponds, biofloc can also be done by growing flocs in ponds. One of the efforts made to accelerate the growth of catfish is by adding certain ingredients to the feed in the form of protein and minerals. Fish bone meal contains many benefits for accelerating the growth of catfish because it contains quite a high number of macro and micro minerals in fish bone meal, especially calcium and phosphorus content. This is in line with research by Bunga et al. which states that the higher the concentration of tuna bone meal, the faster the growth of tilapia fish (Bunga et al., 2023). This is in line with research by Nurmawati et el. that the biofloc system in catfish cultivation is very effective because it gets maximum results 9 Nurmawati et al., 2021).

The Biofloc Nutrient aquaponics system is a combination of fish cultivation techniques and hydroponic plant cultivation. Cultivating catfish using an aquaponics system, where the supply of nutrients to plants is very dependent on fish waste and leftover feed. Total nutrients are influenced by the ratio of feed input to domestic fish per day and at the same time influence the level of vegetable crop production in a certain area. Aquaponic fish cultivation in Indonesia is a relatively new. Aquaponic system fish cultivation technology is a combination of vegetable cultivation in one unified system. According to Dauhan et al*.* Diver 2005, stated that the presence of fish, plants and bacteria are very important elements, because the existence of these three elements gives birth to a symbiotic mutualism, namely a mutually beneficial relationship (Dauhan et al., 2014). Fish contribute N or P elements from feces and fish food waste. Bacteria convert fish food waste and feces into nitrates which function as a source of nutrients for plants. Plants supply water free of toxic metabolic waste gases which are very necessary for farmed fish during the rearing period through the process of using nitrogen and carbon dioxide produced from fish farming.

2. METHODS

The method used in this research was an experimental method on the effect of giving yellowfin tuna bone meal on the growth of catfish in nioflok ponds in Ternate City, North Maluku. This research consists of two stages, namely; Stage I. Making a biofloc pond using waterproof tarpaulin and circulating the water using paralon pipes. Stage II is the stocking of catfish (Clarias gariepinus) seeds with a stocking density of 1000 fish/pond with a pond size of 3x3 meters and a height of 1 meter. The research plan was carried out for 8 months and was located in Ternate City. The research design used was a completely randomized design consisting of four treatments with three replications. Treatments consisted of (a) feeding 100% commercial pellets during the maintenance of Sangkuriang catfish, (b) feeding consisting of 5% biofloc flour with 95% commercial pellets during the maintenance of Sangkuriang catfish, (c) feeding consisting of 10% addition of biofloc flour with 90% pellets during the maintenance of Sangkuriang catfish, (d) feeding consisting of 15% addition of fish bone meal with 85% pellets during maintenance of Sangkuriang catfish. The

variables observed included absolute growth, survival, feed efficiency, feed conversion ratio, absolute length growth and growth rate.

3. RESULTS AND DISCUSSION

Fish bone meal contains quite high levels of minerals, especially calcium and phosphorus. Based on the results of previous studies, the calcium and phosphorus content has quite a lot of benefits for body health. Apart from being beneficial for the human body, fish bone meal has also been widely applied in the world of medicine, pharmacy and food and is also used as an addition to animal feed and also for fish farming. The results of chemical analysis of yellowfin tuna bone meal based on research on yellowfin tuna with total minerals in yellowfin tuna bone meal in the NaOH boiling treatment with calcium and phosphorus values respectively are as follows (287.08; 99.33 mg/g dw) (Talib et al., 2020). Calcium is a macro molecule that is very important in the growth and development of bones and teeth (Harris and Gustiano 1989). Fish bones have quite high mineral content, especially in the form of calcium phosphate. Calcium phosphate is a mineral that is very important for forming the structure of bones and teeth and is useful in body metabolism, therefore the need for calcium intake and balanced nutrition must be provided every day. Yellowfin fish bone meal is made using two treatments to obtain. High quality bone meal, low in fat and protein and high in calcium and phosphorus content.

3.1 Absolute Growth

The research results showed that the absolute growth of catfish seeds was the average absolute growth of catfish in two weeks, the absolute growth on treatment day 0 was (a 8.22), treatment (b 10.25), treatment (c 11.07) , and treatment (d 13, 52). The absolute growth rate of catfish is presented in Fig. 1.

Based on the results of the research conducted, it shows that the addition of fish bone meal (d) 15% has the highest value with a value of (13.52%) and the lowest is treatment (a) or control without the addition of fish bone meal but using standard feed with a value of (8.22%). This is in accordance with research (Jelsia *et al,* 2023) which states that the increase in absolute growth of tilapia fry with the addition of tuna bone meal has an average absolute growth value for tilapia in the fourth week, in treatment (a) 9.3, treatment (b) 11.25, treatment (c) 12.45, and treatment (d) 13.65 respectively with the addition of tuna bone meal (0, 5, 10 and 15%) (Talib et al., 2020). These results also indicate that the greater the addition of fish bone meal, the faster the growth of tilapia fish. It is suspected that the greater the addition of bone meal to fish feed, the faster the growth because the high levels of minerals, especially calcium and phosphorus, also influence fish growth.

3.2 Life Sustainability

The results of the research showed that the absolute growth of catfish seeds was the average absolute growth of catfish in two weeks, the absolute growth on treatment day 0 was (a) 93.25, treatment (b) 92.25, treatment (c) 93.57 , and treatment (d) 94.77. The graph of the absolute growth rate of catfish is presented in Fig. 2.

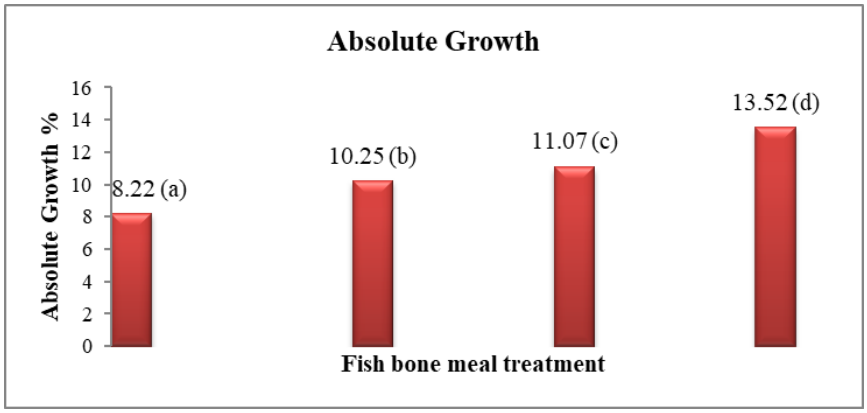


Fig. 1. Absolute growth rate of catfish
Description;Treatment
(a) =Control (c) Treatment c=15%
(b) Treatment =10% (d) Treatment d=20%

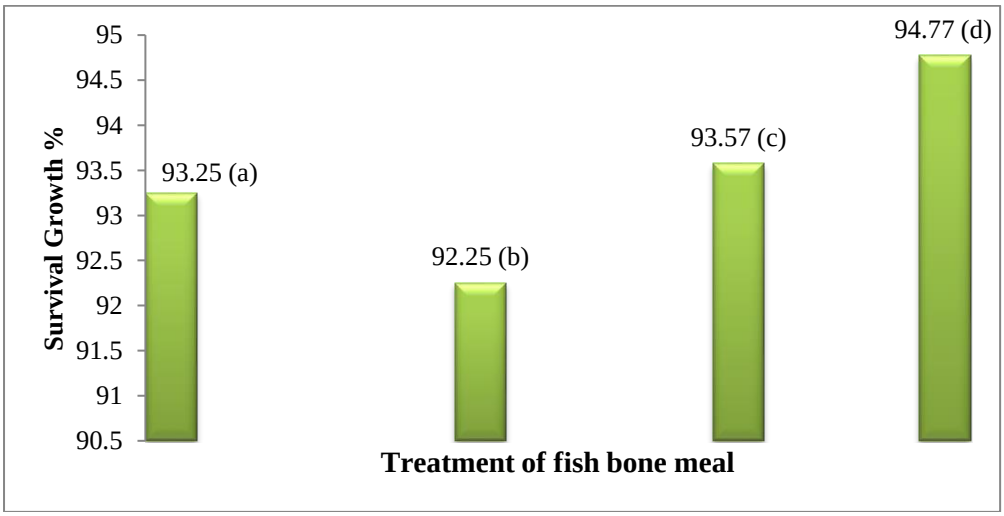


Fig. 2. Survival graph

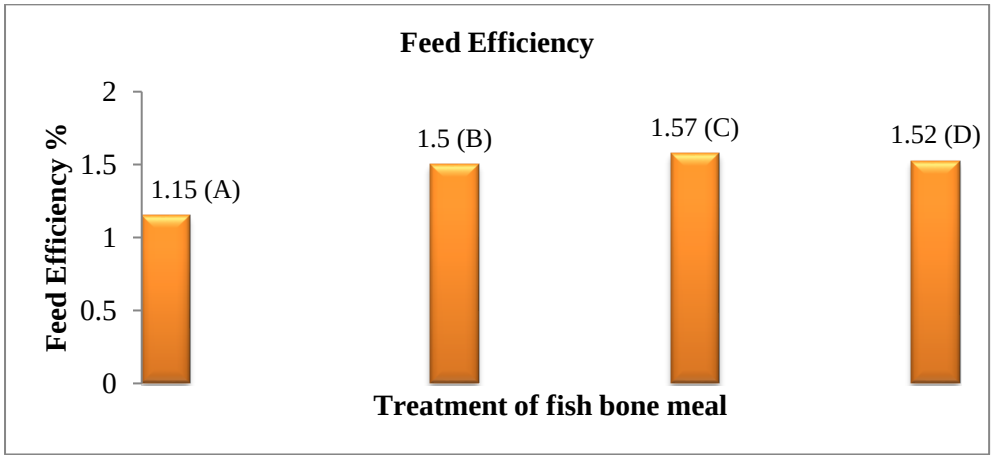


Fig. 3. Feed efficiency graph

This is in line with research by Huwoyon and Gustiano in Tinondo Swamp, with catfish survival at 61.66% (Huwoyon and Gustiano, 2013). This Fig. 2 is lower when compared to research, namely 70%-80% of catfish kept for 20 days at a salinity of 0-8 ppt, daily length growth of 0.14-0.17 and daily weight of 0.30-0.36 g/day (Sitioet et al., 20170. The same results were also shown in research (Jelsia *et al,* 2023) with successive survival rates as follows (93.25, 92, 93 and 92.3%) (Bunga et al., 2023). These results suggest that calcium in fish bones can influence the survival rate of catfish growth. This is because the calcium in tuna bones is an essential mineral that is needed for fish growth and can help various metabolic processes for bone formation (Mulyani et al., 2013).

3.3 Feed Efficiency

The results of the analysis show that the feed efficiency level data is distributed normally, is additive and homogeneous. The research results related to feed efficiency can be seen in Fig. 3.

The results of the research feed efficiency analysis are as follows (a) 1.15; (b) 1.5; (c) 1.57 and (d) 1.52. The highest value in this study was in treatment (c) 1.57 and the lowest was in treatment (a) or control 1.15). This is in line with research with the addition of different doses of fish bone meal, namely in treatment (a) control treatment, without additional fish bone meal) an efficiency value of 1.23% was obtained, treatment (b) 5% addition of fish bone meal, obtained an efficiency value of 1.53%, treatment (c) 10% additional fish bone meal obtained an efficiency value of 1.44%, and treatment (d) 15% additional fish bone meal obtained an efficiency value of 1.61% (Bunga et al., 2023). These results show that feed efficiency is slightly higher in treatment (a), and the lowest at a dose of 15% produces a better level of feed efficiency. In this

study, in treatment (c) 1.57 with a bone meal concentration of 20%, it is suspected that the higher the concentration of fish bone meal can affect seeding process because fish bone meal still has a fairly high fat content so it can affect the level of seeding. solubility in catfish feed.

3.4 Feed Conversion Ratio

The results of research on the feed conversion ratio for cultivation in biofloc ponds can be presented in Fig. 4.

The results of analysis of variance regarding the feed conversion ratio were highest in treatment (c) 0.72 and lowest in treatment (b) 0.5. This is in accordance with research by Jelsia et al, 2023 showing that the treatment of adding fish bone meal in different portions in tilapia cultivation did not have a significant effect (P>0.05) on the feed conversion ratio (Bunga et al., 2023). Feed conversion is the ratio (ratio) of the number of kilograms of feed that can be converted into 1 kilogram of meat. The feed conversion value will be low if the amount of feed given is smaller than the weight gain of the fish produced, and conversely the feed conversion value will be high if the amount of feed given is more. much more than the weight increase of the test fish 9 Yulfiperius, 2014). The smaller the feed conversion value means the feed utilization level is more efficient. Conversely, if the feed conversion is large, the feed utilization rate is less efficient (Iskandar, 2015).

3.5 Absolute Length Growth

The results of the analysis show that the highest absolute length growth rate in treatment (d) was 7.58 and the lowest in treatment (a) 3.56 can be presented in Fig. 5.

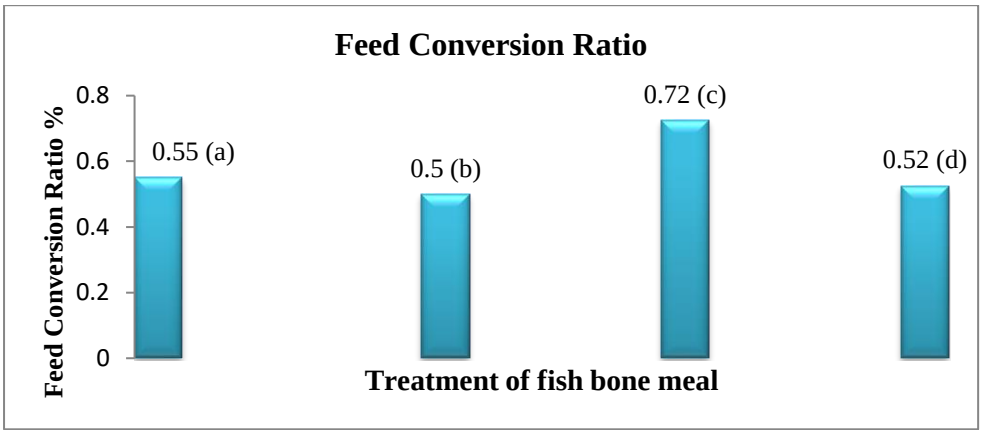


Fig. 4. Feed conversion ratio graph

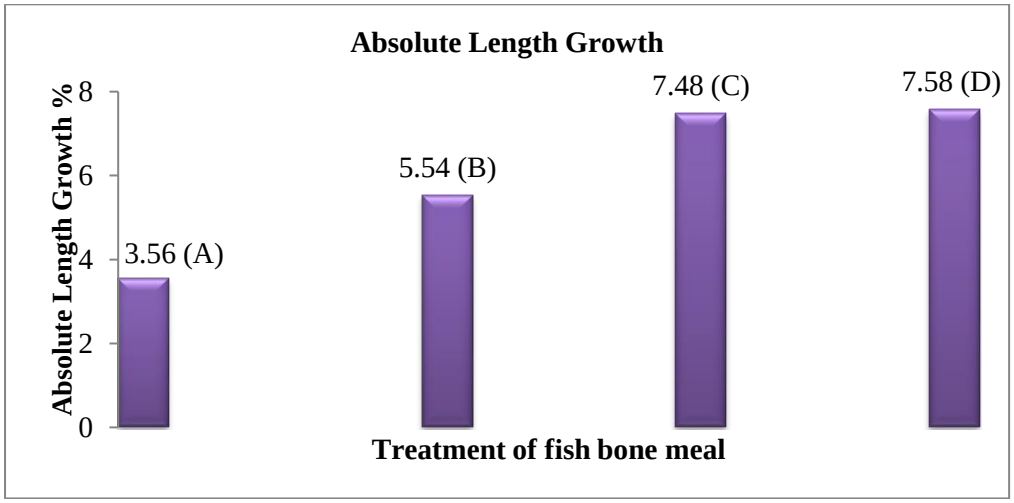


Fig. 5. Absolute Length Growth Graph

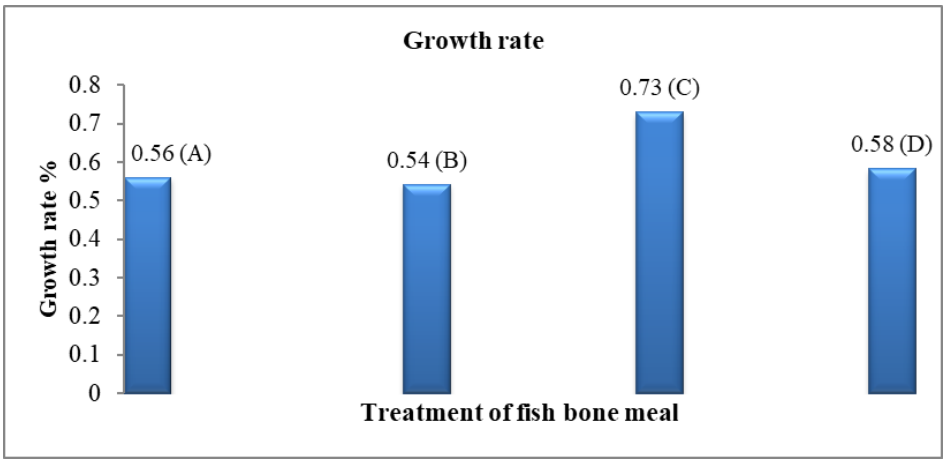


Fig. 6. Growth rate graph for catfish

This is in line with research by Bunga et al. that the absolute length growth of tilapia shows the value of absolute length growth. It is known that treatments (d) and (c) are significantly different (P<0.05) to treatments (a) and (b) 9 Bunga et al., 2023). This is in accordance with research by Huwoyon & Gustiano (2013), namely 70-80%. Catfish are reared for 20 days at a salinity of 0-8 ppt, daily length growth of 0.14-0.17 and daily weight of 0.30-0.36 g/day (Sitioet et al. 2017). According to Effendie (1997) length growth is influenced by internal and external factors, internal factors partly depend on the condition of the fish, external factors such as environmental factors which include water quality, temperature, pH and dissolved oxygen.

3.6 Growth Rate

The results of the analysis show that the highest growth rate in treatment (c) was 0.73 and the lowest in treatment (b) 0.54 can be presented in Fig. 6.

The results of previous research showed that treatment (a) had a very low growth rate of 0.33 grams per day and the highest was in aquaculture (d) 15% additional fish bone meal and a growth rate of 0.49 grams per day). According to Effendie Length growth is influenced by internal and external factors (Effendie, 1997). Internal factors partly depend on the condition of the fish, for example the fish's ability to utilize the remaining energy and protein after metabolism for growth, meanwhile, external factors such as environmental factors include water quality, temperature, pH, dissolved oxygen and feed factors provided. Feeding greatly influences the growth in length of Tilapia fish, feed with good quality and the right quantity will support the growth in length of the organism. These two factors will balance the condition of the fish's body while in the rearing medium and support the growth of Tilapia (*Oreochromis sp*). This is in accordance with Afrianto and Liviawaty who stated that to achieve nutritional balance in feed, protein should be used from vegetable and animal sources. Feed whose components consist of two or more protein sources can trigger the growth of tilapia and will provide good results. better than feed containing only one protein source (Afriant and Liviawaty, 2005).

4. CONCLUSION

1. Catfish is a fishery product that has an important prospect for development through a biofloc pond cultivation system.
2. The best average value was in the treatment with the addition of fish bone meal with a concentration of 20% in almost all treatments except for the growth rate parameter which was the highest in treatment (c) 0.73.
3. The addition of tuna bone meal to biofloc pond cultivation can be used as a recommendation for developing catfish cultivation because it has quite promising market prospects.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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