Open Access Research Journal of
Multidisciplinary Studies

Journals home page: https://oarjpublication/journals/oarjms/

ISSN: 2783-0268 (Online)

OARJ OPEN ACCESS RESEARCH JOURNALS

(REVIEW ARTICLE)

Modular system innovation for increasing milkfish production on traditional ponds in Usto village, Mare district, Bone

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Open Access Research Journal of Multidisciplinary Studies, 2024, 07(01), 001–011

Publication history: Received on 16 November 2023; revised on 02 January 2024; accepted on 05 January 2024

Article DOI: https://doi.org/10.53022/oarjms.2024.7.1.0061

Abstract

One of the milkfish cultivation techniques (*Chanos chanos*) to increase pond productivity is a modular system. Modular system is a pond cultivation technique with a tiered plot model, where connecting between ponds is made, the purpose of which is to make milkfish easily move between ponds. The purpose of this study is to analyze the effectiveness of modular system innovation techniques (tiered plots) in increasing the production of bait milkfish in traditional ponds in Usto Village, Mare District, Bone. The research was conducted from August to the end of November 2023, at the location of the 2023 Matching Fund - Kedaireka program in a traditional pond in Usto Village, Mare District, Bone Regency, South Sulawesi Province. The research method used is a quantitative research method with a type of experimental research. Primary data measurements include; water quality measurement, including; temperature, salinity, pH and dissolved oxygen. While the parameters of the organization include the length of the fish from stocking to harvest. The data analysis method used is descriptive statistical analysis, in order to obtain an overview of the success of modular system techniques in traditional ponds. The results of the study obtained that the modular system technique can increase fish growth quickly, with the process of transferring fish periodically between ponds, making fish experience different conditions and physiological conditions that feel new. The modular system provides an average fish growth rate of 4.5 cm within 3 months or an average of 0.15 cm per day, with the highest rate occurring in rearing pond I, which is during the initial phase of post-stunting maintenance, which is an average growth rate of 6.2 cm per month, or 0.21 per day. Thus, this modular system technique can be used to increase the productivity of traditional ponds.

Keywords: Seed; Survival rate; Milkfish; Water quality

1. Introduction

Milkfish farming activities have been going on for a long time and are carried out for generations from generation to generation. Cultivation techniques to tradition are in it and occur naturally. Generally, farmers or also known as fish

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farmers, obtain cultivation knowledge from the previous generation, which is then practiced while perfecting it (learning by doing) and providing various inputs based on the times. Milkfish or known as milkfish or sponge fish in the Bugis-Makassar community is one of the fish that is widely cultivated in coastal areas of Indonesia, including in Usto Village, Mare District, Bone Regency, South Sulawesi Province. Generally, the cultivation technique or system carried out by farmers in Usto Village is a polyculture system, which is cultivating simultaneously between milkfish and shrimp.

Polyculture system is the cultivation of two or more species in the same place and time, in which a combination / integration between animal, plant and animal species, a combination of aquatic animal species, or aquatic animal species and aquatic animals (Stickney 2000). One of the common things done by the community in Usto Village is the polyculture system between milkfish and shrimp. It is further stated that polyculture is a method of cultivation by placing several species in one cultivation container with different eating habits aimed at minimizing interspecific competition and increasing production profits (Milstein 2005 in Aubin et al. 2014; Thomas et al. 2020). The application of the polyculture system in fish farming activities aims to improve land and feed efficiency, minimize operational costs used and provide additional compression for farmers (Zimmerman & New 2000; Tomatala et al. 2019). The application of tiger shrimp and milkfish polyculture system has a positive side in the stability of pond waters (Yustiati et al. 2018). Milkfish function as a controller of plankton growth, both plankton needed in waters and harmful plankton in ponds (Stickey 2013). The role of milkfish is very important in ponds, in addition to being a controller it also functions as a regulator of pond quality, with the movement carried out will produce oxygen dissolved in the water, so that DO levels become stable. This is as stated by Murachman et al. (2010) that milkfish have a pattern of motion that is always clustered, so that it can increase the process of oxygen diffusion in waters.

The results of research by Riana et al. (2022) stated that the cultivation system carried out by the community in Usto Village is a polyculture system, which combines milkfish with shrimp. It is further stated that the system is sufficient to provide good results or very feasible to strive for, with an NPV value obtained of 2.92 (greater than >0 or categorized as very feasible), and a Net B/C value of 14.89 (>1.0 or categorized as very feasible). Husain & Mulyo (2016) also obtained in a study in Pangkep Regency that the cost in the polyculture system community fishery business is greater at Rp14,722,597 from the monoculture system community fishery business at a cost of Rp13,191,880, as well as the income obtained is also greater at Rp10,285,066 and in polyculture system cultivation activities compared to the income from the monoculture cultivation system which is Rp6,710,486. However, in terms of profit, So in fact, the monoculture cultivation system is much more profitable, which is a profit of Rp6,481,394, compared to the profit obtained from the cultivation of a polyculture system, which is only Rp4,437,531. The results of research by Mahmud et al. (2007) in Pinrang Regency, South Sulawesi related to the comparison of monoculture system cultivation income with polyculture also reinforce that the actual benefits obtained from monoculture system cultivation are higher, namely Rp15,489,000 per hectare per harvest, compared to the polyculture cultivation system which is only Rp4,365,000 per hectare per harvest. In the end, the monoculture cultivation system continues to develop along with efforts to optimize land and focus on one superior commodity, such as; Consumption milkfish, bait milkfish, tiger shrimp, and vaname shrimp.

One of the commodities that currently has high demand and high market prices with the aim of export and domestic markets is the bait milkfish commodity. This is as stated by Ismail & Pratiwi (2001) that milkfish farming today has also focused a lot on efforts to utilize milkfish as tuna bait, in addition to consumption. The same thing is also stated by Ghuffran & Kordi (2010) that milkfish has advantages over other fish, because milkfish can be produced as fish for domestic consumption, export and as bait for catching tuna (Thunnus) and skipjack (Katsuwonus). It is further stated that (Rinaldi et al. 2019). Bait milkfish is a type of milkfish that is relatively small compared to consumption milkfish, which is an average size of 100-200 grams per head, with a relatively short maintenance period of only 3-4 months of maintenance. Milkfish is very good to be used as bait for large fish such as; TTC (skipjack cob tuna). According to Dharma et al. (2019), milkfish has advantages as bait, namely having a flat and elongated body, and has shiny scales that can be an attraction for large fish, such as tuna and cob.

The demand for milkfish, especially bait milkfish, continues to increase every year in line with the increase in fishing efforts at sea, especially in TTC fish. The need for feedstock milkfish is intended both at the domestic level (Jakarta, Sukabumi, Kendari, Ambon, Maluku and Surabaya) and export (Taiwan, Sri Lanka, South Korea, South Africa, Vietnam, Ghana, China, and the United States. The demand for bait milkfish is still difficult to meet considering the low production and still lack of farmers who cultivate milkfish for bait purposes. In addition, the cultivation system that is different from consumption milkfish is also an obstacle in the cultivation of bait milkfish, namely the cultivation of bait milkfish is more monoculture, while farmers (cultivators) generally know and are familiar with the polyculture cultivation system. For this reason, various efforts and innovations are needed in the cultivation of bait milkfish, including modular systems or tiered plot systems. This is the purpose of this research, namely the innovation of milkfish cultivation techniques with a modular system (tiered plots) in an effort to increase traditional pond production in Usto Village, Mare District, Bone Regency, South Sulawesi Province.

2. Material and methods

2.1. Time and Location of Research

The research was conducted for 4 (four) months, from early August to the end of November 2023, at the location of the 2023 Matching Fund -Kedaireka program in a traditional pond in Usto Village, Mare District, Bone Regency, South Sulawesi.

2.2. Methods and Types of Research

The research method used in this study is a quantitative method with a type of experimental research. Quantitative research methods are considered appropriate and in accordance with the purpose of the study, namely testing experiments carried out in the form of modular system techniques in milkfish farming in traditional ponds with monoculture cultivation systems. According to Yusuf et al. (2020) that quantitative research methods are research methods whose research design or design is rigid from the beginning and cannot be changed in the implementation of research. Meanwhile, according to Sugiyono (2018) that quantitative research methods are research methods based on the philosophy of positivism, namely relying on existing empiricism (facts) using data collection techniques in the form of objective research instruments, and quantitative or statistical data analysis, with the aim of testing hypotheses that have been set at the beginning of the study.

The right type of research used in this research is the type of experimental research. According to Sugiyono (2018) that this type of experimental research is a research technique used to look for the effect of certain treatments on others under controlled conditions. In other words, that the type of experimental research is research to find out the consequences of the treatment (experiment) given to something under study. Meanwhile, according to Latipun (2015) that experimental research is predictive research, which predicts the consequences of a manipulation (experiment) of the variables tested.

2.3. Research Hypothesis

Hypothesis is a temporary answer to the problem formulation in research, where the problem formulation can be expressed in the form of statement sentences (Sugiyono 2018) or in the form of question sentences (Yusuf & Daris 2018). The main hypothesis to be proven in this experimental research is that the modular system technique (tiered plots) in bait milkfish farming can accelerate growth and accelerate harvest periods and increase traditional pond production.

2.4. Research Design

Research design is a comprehensive scheme / stage related to programs to be carried out in research (Kerlinger & Lee 2000), starting from determining research methods or research approaches, types of research, data collection methods to data analysis methods (Yusuf et al. 2020). The research design carried out was the construction of ponds with a size of 20 x 40 m^2 (stunting pond) and a pond size of 100 x 200 m^2 (cultivate pond I), and 200 x 250 m^2 (cultivate pond II). The pond is constructed with a connecting system using a wooden sluice gate measuring 2 x 1 m^2, as many as 2 units installed with stunting ponds with cultivate pond I, and cultivate pond I with cultivate pond II. In both ponds, water quality measurements were carried out including; temperature, salinity, pH, and dissolved oxygen (DO). Water quality measurements are carried out in each pond, namely measurements in stunting ponds, cultivate ponds I and cultivate ponds II, so that 12 (twelve) measurement data are obtained. Furthermore, the results of measuring these parameters are compared with pond water quality standards. Measurement of the success test of the modular system technique is carried out on each map to then see the growth rate against maintenance time. The indicator of the growth rate of the fish is an indicator of the success of the modular system technique applied.

2.5. Data Analysis Techniques

The data analysis technique used is a descriptive statistical analysis technique. Descriptive statistics is intended to analyze data by describing or describing the data that has been collected as it is, without intending to make generalized conclusions or generalize (Muslich & Iswati 2009). Furthermore, Arikunto (2019) that descriptive statistics provide a description of a data seen from the average value, standard deviation, minimum value, maximum value and or other data depictions. Descriptive analysis will provide an overview of the average water quality measured (temperature, salinity, pH, and dissolved oxygen levels-DO), as well as an overview of the success of modular system techniques obtained from the average fish size and fish harvest period.

3. Result and Discussion

3.1. Water Quality

Water quality analysis is intended to determine whether the condition of pond water is quite ideal or meets the quality standards of the aquatic environment for milkfish cultivation or not (bad conditions). Water quality analysis will obtain an overview of the condition of pond water, which is then compared with the quality standards of the aquatic environment (especially ponds) in fish farming activities (milkfish). According to Chang et al. (2018) that water conditions or water quality factors greatly affect the growth and production of milkfish (*Chanos chanos* Forsskal). In the activities of fish farming (pond) there are several key parameters, including; *dissolved oxygen (*DO), pH, temperature, salinity, BOD, Nitrate, Nitrite, and Ammonia (NH_4) (Saraswati & Sari 2017). In this research, pond water quality measurements were carried out in 3 (three) ponds, with 4 (four) main parameters, namely; temperature, salinity, pH, and dissolved oxygen (DO) levels. The measurement results are detailed as follows:

Table 1 Pond water quality measurement results

No	Parameters	Unit	Stunting Pond	Cultivate Pond I	Cultivate Pond II	Quality Standards
1	Temperature	oC	31.1	30.5	29.2	28-32
2	Salinity	ppt	27.4	29.5	28.0	15-35
3	pH	-	7.5	6.9	8.0	7-8.5
4	DO	ppm	7.5	10.0	12.5	>4

Source: Measurement results, 2023

3.2. Temperature

Temperature is one of the most important pond water quality parameters or one of the limiting factors for the growth of cultivated organisms) (Boyd 2019). Water temperature is measured in units (degrees) of high and low heat of water in a container (Choeronawati et al. 2019) including in ponds. The temperature of these waters greatly affects the growth and development and survival of milkfish (*Chanos chanos*) (Haser et al. 2018). It is further stated that in some types of organisms, temperature affects appetite and metabolism that occurs including respiration in these aquatic organisms. The following are the results of water temperature measurements in 3 cultivate ponds.

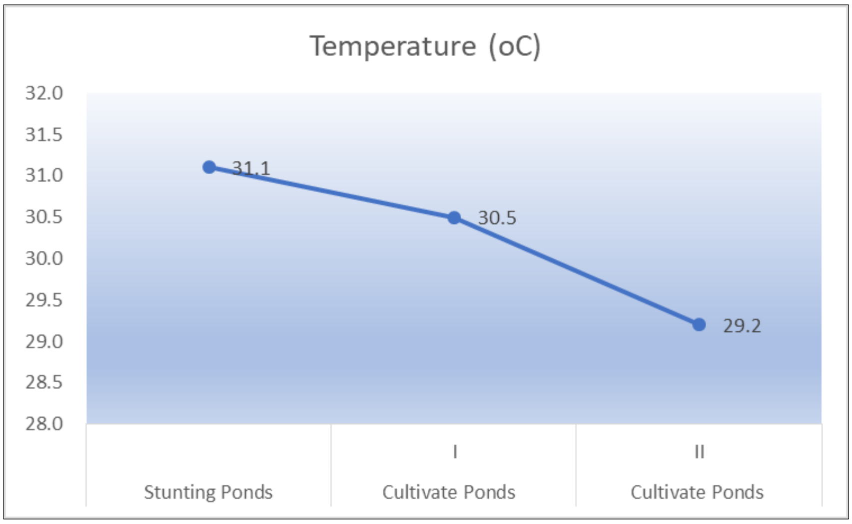

Figure 1 Water temperature measurement result (^0C)

The results of measuring water temperature in the three ponds (stunting ponds, cultivate ponds I and II), found that the water temperature in the pond was relatively stable and met water quality standards for the cultivation of organisms in the pond, including for milkfish farming. Water temperature at the measurements of the three ponds ranged from 29.2 to 31.1 ^0C Where the water temperature shows water conditions that are still relatively safe for fish farming activities, because it is still within the required water quality standards, namely 28-32 ^{0}C. The relatively high water temperature in cultivate pond II is 31.1 ^{0}C. This can happen because of the difference in temperature measurement time, where measurements are carried out starting from the stunting pond and continuing to the cultivate pond along with the daylight hours, where the sun is getting hotter. The temperature range of pond water is also relatively high because at the time of measurement there is high heat or dry season which peaks in June to October. According to Georgiou et al. (2015) that water temperature is strongly influenced by solar irradiation factors. It is further stated that in summer, the water temperature is more risky (hotter) due to the higher intensity of solar irradiation, compared to the rainy season, where the water temperature is more stable (optimal), which ranges from 27-30.5^{0}C (Effendi 2003). While according to Beltran et al. (2020) that the optimum temperature range for milkfish rearing (*Chanos chanos*) is 22-35 ^{0}C. Although milkfish can withstand temperatures of up to 32-35 ^{0}C, the temperature of pond water needs to be maintained, especially when the fish is seed, on the other hand generally pond water only has a depth of 1-1.5 m which is the influence Sunlight is very dominant in generating heat in water. Hot pond water conditions can trigger death in fish, so it takes several efforts and techniques so that fish fry can be maintained and protected, such as; Efforts to enter or add water, as well as efforts to provide leaves (coconut leaves, taro leaves and the like) as protection for fish.

3.3. Salinity

Salinity is one of the limiting factors in the cultivation of organisms in ponds, including in milkfish farming. Milkfish is one species of fish that lives in brackish water, and is generally found in lion estuaries and seaside when the fry (seed) age up to a certain size. According to Novianto (2011) that milkfish live in coastal waters, estuaries, mangrove forest beds, lagoons, tidal puddle areas and rivers, while adult milkfish generally live in littoral waters. Salinity is closely related to the adjustment of osmotic pressure of aquatic organisms (Varsamos et al. 2005), including on whitefish. Salinity is measured in units of ppt (parts per thousand) which is interpreted as the weight in grams of all solids dissolved in 1 kilo gram of seawater (Zan et al. 2019) or interpreted as a representation of the ratio of salts dissolved in water (Juniarti & Jumarang 2017). In other words, salinity is a level of salt dissolved in water (Kale 2016). Salinity for pond cultivation should not exceed 35 ppt, if it exceeds, it can make shrimp die (Talley et al. 2002). While milkfish can live in the range of 60 ppt, but the optimal salinity for milkfish is in the range of 15-35 ppt. The results of salinity measurements are obtained as follows:

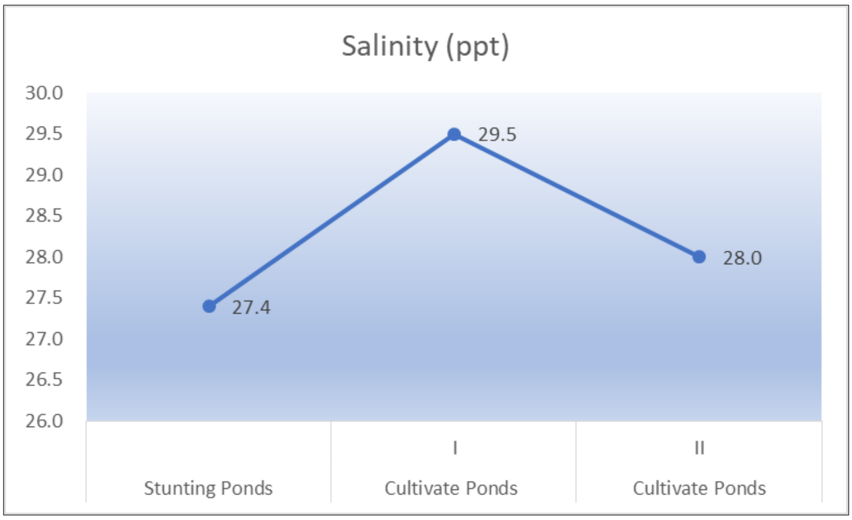

Figure 2 Salinity measurement results (ppt)

The results of salinity measurements in the three ponds were obtained in the range of 27.4-29.5 ppt which shows that the salinity concentration in the three ponds is relatively safe, which is still within the required quality standards of 15-35 ppt. However, the ideal salinity is in the range of 25-28 ppt for farmed milkfish farming. This salinity level is the most preferred milkfish to grow well (Supono 2015). Further afield Budiasti et al. (2015) that milkfish (*Chanos chanos*) is a euryhaline fish that can adapt to wide salinity, can live in fresh, brackish and marine waters. Good salinity range for milkfish (*Chanos chanos*) is 10-25 ppt (Barman et al. 2012). On the other hand, sufficient salinity levels of hyperhaline are thought to adversely affect the rate of feed assimilation and osmoregulation systems of organisms (Su et al. 2010). According to Ferreira et al. (2011) that salinity levels determine the growth of organisms in waters, including in ponds. Water salinity needs to be considered in maintaining the growth of milkfish and shrimp. During the dry season, the salinity level of pond water will rise high, along with high evaporation, thus inhibiting the growth of fish in the pond. Similarly, in the rainy season, salinity will decrease due to relatively high freshwater supply. Water salinity can change at any time both morning and evening, dry season and rainy season, both due to evaporation and due to the addition of fresh water from rain or rivers that enter the pond.

3.4. pH

Water pH is a measure of the pH content contained in water substances and is one of the parameters measured to determine water quality, including pond water quality. According to Boyd et al. (2018) that pH is interpreted as the degree of acidity used to express the level of acidity or wetness of a solution. The degree of acidity or pH describes the potential activity of hydrogen ions in a solution expressed as the concentration of hydrogen ions (mol/l) at a given temperature, or pH = - log (H+) (Koparan et al. 2018). Brackish water generally has a neutral pH value, but in some areas, especially areas that have dominant *mangrove* plants, brackish water has a pH below 7 or is acidic, and vice versa in brackish areas that are dominant seawater, it is more alkaline (>7) (Qin et al. 2018). Normal brackish water has a pH range of 7-9 (Boyd & Tucker 1998; Chien 1992). The degree of acidity or pH is one of the chemical parameters that is quite important in monitoring the stability of waters (Kale 2016). The degree of acidity is a limiting factor that influences and determines the speed of metabolic reactions in consuming feed (Simanjuntak 2009; Chang et al. 2019). The following are the results of pH measurements in the three ponds.

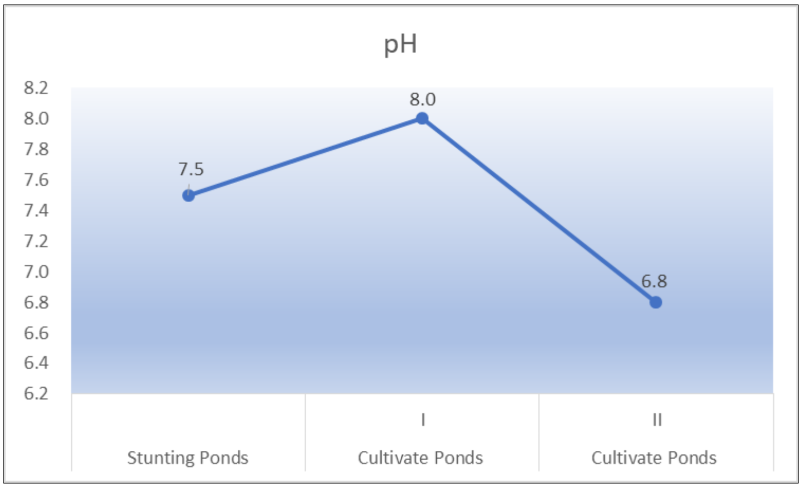

Figure 3 pH measurement results

The results of pH measurements obtained values ranging from 6.9-8.0 which indicate that the pH of pond water is in neutral conditions and is good for the growth of cultivated organisms, including for the cultivate of milkfish. The highest pH level was found in cultivate pond I which was 8.0, while the low pH level was found in cultivate pond II. This is due to the location of the pond, where the cultivate pond I is near the sea and directly adjacent to the sea, while the cultivate pond II is in the land area with a fresh water supply and former mangrove and mangrove land. According to Ching (2007) that one of the factors that affect the pH level of pond water is the location of the pond itself. The results of Schuler's (2008) research show that the pH value can be lower due to high organic matter content. Allegedly in cultivate pond II which is a pond located in the land area and is a former mangrove and mangrove land, is greatly influenced by the organic matter content found in the mangrove and mangroves. While the cultivate pond I which is located directly adjacent to the sea and river, so it undergoes continuous washing, and causes the organic matter content not to stay, so that decomposition that can cause a decrease in pH does not occur. The pH value of water may decrease due to the process of respiration and decay of organic substances. Low water pH levels can be due to high respiration factors and metabolic processes which produce high ammonia, and then the ammonia content causes a drastic decrease in the pH value of water However, the pH value of the water can still be tolerated, considering the pH level of water is still within tolerance limits for cultivated organisms. According to Beltran et al. (2020) that the optimal range of pH for milkfish (*Chanos chanos*) rearing is 6.8-8.7. Thus, the pH level of the pond is still relatively safe and good for milkfish cultivation activities in the pond.

3.5. Dissolved Oxygen (DO)

Is defined as the amount of oxygen dissolved in water derived from photosynthesis and absorption from the atmosphere/air (Xu & Xu 2016). Dissolved oxygen in water is one of the water quality parameters that affect the cultivation of organisms in ponds (Mwangamilo & Jiddawi 2003), including milkfish farming (*Chanos chanos*). Dissolved oxygen largely determines the life of organisms present in a water, especially in the biological function of growth

(Pörtner 2009; Kale 2016). According to Boyd et al. (2018) that the value of DO which is usually measured in the form of concentration shows the amount of oxygen (O_2) available in water. DO measurement also aims to see the extent to which water bodies are able to accommodate aquatic biota such as; fish or shrimp (Song 2019). In addition, the ability of water to clean pollution is also determined by the amount of oxygen in the water (Huang et al. 2019). The DO value, which is usually measured in terms of concentration, indicates the amount of oxygen (O_2) available in a body of water. The greater the DO value of the water, indicating that the water has good quality. Conversely, if DO value is low, it can be known that the water has been polluted. The results of the DO measurement are obtained as shown below:

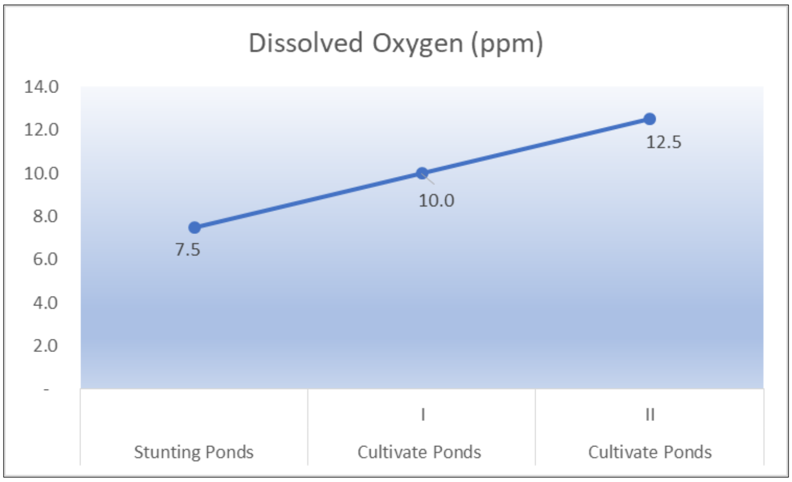

Figure 4 Dissolved Oxygen (ppm) measurement results

The results of DO measurements were obtained that the DO levels of the three ponds ranged from 7.5-12.5 ppm. The lowest DO level was found in the stunting pond at 7.5 ppm and the highest was found in the cultivate pond II at 12.5. The high level of DO in cultivate pond II is due to the factor of the pond area which reaches 5 Ha, so that the diffusion of free air into the water is very high. While the lowest DO levels are found in stunting ponds, which is 7.5 ppm. In addition to the factor of the area of the pond (the influence of the pond surface opening factor), the location of the pond is also protected from the wind by the presence of mangrove plants around the pond maturity (Salmin 2005). The openings of stunting ponds are also relatively small, measuring only 20 x 40 m^2, and when compared to cultivate ponds I and II which are relatively wide, namely 100 x 200 m^2 and 200 x 250 m^2, respectively. Wide pond openings will allow a stronger push of water against the surface of the water and cause free diffusion of air into the waters. This is as stated Allbab et al. (2016) that increased dissolved oxygen levels can be sourced from photosynthesis that produces O_2 as well as absorbs from free air. Meanwhile, low levels of dissolved oxygen in pond water can also be due to the high stocking density of fish, where the process of respiration and metabolism that occurs will reduce dissolved oxygen levels in water. The high density level carried out in milkfish stocking causes high respiration and metabolic processes as well as ammonia levels produced. High ammonia levels will cause a decrease in dissolved oxygen levels in water (Mmochi & Mwandya 2003). However, oxygen levels are still within the optimal range for aquaculture activities in ponds. This is as stated Beltran et al. (2020) that the optimal range of dissolved oxygen (DO) for milkfish rearing (*Chanos chanos*) is >3 mg/l.

3.6. Fish growth

The results of fish growth measurements were carried out with 6 (six times), namely, early stocking (G_0), end of stunting (G_1), beginning cultivate I (G_2), end of cultivate I (G_3), beginning cultivate II (G_4), end of cultivate II / harvest (G_5). The following are the results of measuring the average milkfish, starting from the initial phase (stocking) to the final phase (harvesting) in the three ponds.

The measurement results in the initial phase, namely the stunting phase, obtained a relatively small size change, namely from the early stocking size (G_0), which was an average size of 1.5 cm and at the end of the stunting phase the average was only 2.8 cm or had a growth delta of about 1.3 cm within 1 month or an average of 0.043 cm per day. The slow growth in the stunting phase, it is planned that the fish become hungry with a high appetite, so that when entering the rearing pond I, the high appetite of the fish becomes channeled, so that the growth of fish will be very fast. The stunting phase is carried out with a high stocking density. According to Faisyal et al. (2016) that the cultivation system with high stocking density greatly affects the growth of milkfish (*Chanos chanos*). Further afield Murnyak et al. (2015) and Lingam et al. (2019) states that high stocking density causes the growth of milkfish (*Chanos chanos*) is not uniform, even some of them experience stunting which is a condition where fish experience slow growth. This is reinforced Ofori-Mensah et al. (2018) and Adineh et al. (2019), that stocking density of fish also affects the degree of survival and growth of fish. The growth that occurs also affects changes in the cells that make up the tissue (Arisandi et al. 2011). These cell changes, can occur in gill organs, muscles, and intestines (Benjamin et al. 2019). The stunting technique is a technique of dwarfing fish with a high level of stocking density and no additional feeding so that fish experience slow growth (Murnyak et al. 2015; Lingam et al. 2019).

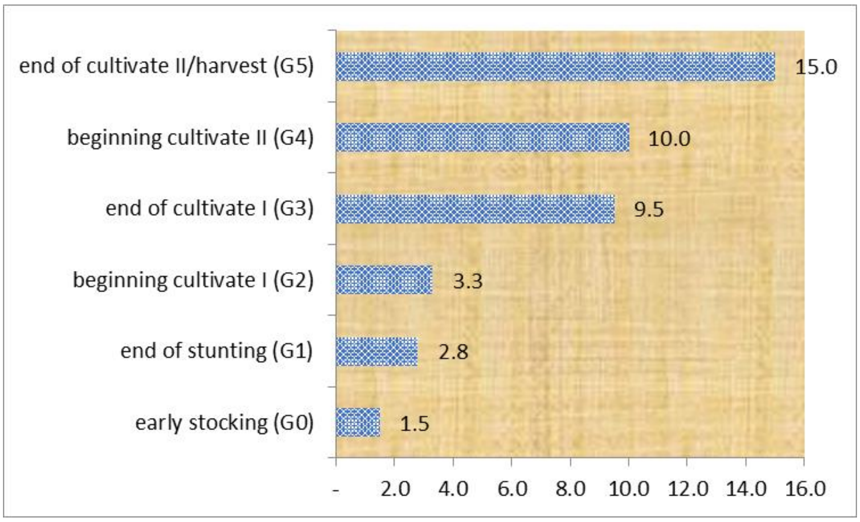

Figure 5 Milkfish measurement result (cm)

The impact of stunting caused fish in the rearing pond to become more greedy and strong to eat. This can be seen from the results of fish measurements at the end of the cultivate phase I, which is an average of 9.5 cm, which in the initial measurement of stocking in cultivate pond I, which is an average of 3.3 cm. Thus, the growth delta during cultivate pond I is 6.2 cm within 1 month (30 days) or the average growth rate per day is 0.21 cm. This happens considering that physiologically transferring fish from stunting ponds to cultivate pond I, is experiencing a condition of high appetite. This makes the fish strong to eat and eventually experience very fast growth. While the growth of fish in rearing pond II, slightly lower in growth rate, which is an average growth of 5.0 cm in 30 days or an average of 0.17 cm per day. The decrease is because the physiological condition of the fish has stabilized and returned to normal so that growth also becomes normal. However, the growth is still relatively high when compared to the average growth of milkfish with conventional cultivate techniques. Research results Jayadi et at. (2021) confirms that milkfish cultivation techniques with a modular system provide high profits, with a high harvest period and can be done with a relatively high level of density. It is further stated that intensive milkfish cultivate with modular methods is feasible to strive for and intensive milkfish technology innovation with modular methods can become new entrepreneurs in milkfish cultivation in ponds. Thus, to maintain the ideal fish growth rate, in the cultivate phase I and II, feeding is carried out to support fish growth and utilize the physiological conditions of fish that experience high hunger conditions.

4. Conclusion

The modular system technique can increase fish growth quickly, by the process of transferring fish periodically between ponds, making fish experience different conditions and physiological conditions that feel new. The modular system provides an average fish growth rate of 4.5 cm within 3 months or an average of 0.15 cm per day, with the highest rate occurring in rearing pond I, which is during the initial phase of post-stunting cultivate, which is an average growth rate of 6.2 cm per month, or 0.21 per day. Thus, this modular system technique can be used to increase the productivity of traditional ponds.

Compliance with ethical standards

Acknowledgement

Thank you to the Director General of DIKTI through the Matching Fund – Kedaireka program with contract number: 51/E1/HK.02.02/2023 with SP DIPA-023.17.1.677501/2023 Date 30 November 2022 for Fiscal Year 2023, and thank you to CV Lintas Samudra Mandiri who has become a partner in the implementation of the Matching Fund-Kedaireka program with Cooperation agreement number: 011/NGO/PKS/IV/2023, and thank you to all members of the research team and students who participated in the matching fund program. We also express our gratitude to the management unit at the university level, namely LPPM Cokroaminoto University of Makassar.

Disclosure of conflict of interest

I declare that I have no conflicts of interest, financial or otherwise.

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