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Implementation of Bio-Integrated Farming System: Integration of Aquaponic System with Biofloc Technology as an Attempt to Increase Production in Fish Farmers in Cipadang Village, Pesawaran

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ABSTRACT

The Yang Faulinas II fish farming group from Cipadang Village, Gedong Tataan District, Pesawaran, specializes in catfish farming. However, they frequently face challenges related to water quality, waste management, and rising feed costs. A community service initiative was conducted to address these issues by sharing knowledge and implementing the Bio-Integrated Farming System, which combines aquaponic and biofloc technologies. This system aims to improve water quality and feed efficiency, offering farmers a solution to enhance production while also generating additional income from vegetable cultivation. The integration of aquaponics with the biofloc system allows fish farming and vegetable growing to work together, with plants placed above the biofloc tanks. The methods used in this initiative included lectures, discussions, and hands-on practice. As a result, the participants' knowledge increased by 40%, demonstrating that the adoption of appropriate technology provides a valuable solution and opportunity for fish farmers and communities to grow their businesses and boost production.

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PENDAHULUAN

One of the problems that often occurs in fish farmers is water quality problems, aquaculture waste management and increasing feed prices. This also happened to the fish farmer group Yang Faulinas II, located in Cipadang Village, Pesawaran Regency, which is chaired by Mr Dede Syaepudin. The fish farmed in this group is catfish. Catfish (Clarias sp.) farming is one of the fish farms that still has a lot of potential among fish farmers, because catfish is one of the fish that has a fast growth rate, so fish can be harvested immediately. According to KKP statistics (2023), the total catfish production in 2018-2021 reached 4,150,907.96 tonnes, but in 2020 the fish production decreased from the previous 2019 of 1,088,799.95 to 993,653.04. The increase in catfish production is accompanied by an increase in the amount of waste from feed residues and faeces, which then becomes sediment and is one of the causes of declining water quality in fish culture media (Yonarta et al., 2023). Declining water quality in aquaculture tanks causes fish growth to be inhibited (Pujiharsono & Kurnianto, 2020). Declining water quality causes fish to be stressed, resulting in inhibited growth and increased mortality (Maulana et al., 2018). As a result, the production value of catfish will continue to decline.

In fish farming activities, technological innovations are needed to increase the production of farmers, one of which is applying Bio-Integrated Farming System technology. This technology is an integrated fish farming with vegetable cultivation placed at the top of bioflocs called biofloc- aquaponic technology (Zulkarnain et al., 2022). Biofloc and aquaponic technologies are able to maximise water use, improve feed utilisation efficiency and fish production (Gaddard & Al-Abri, 2018). Biofloc systems work by utilising the role of heterotrophic bacteria that can break down organic N (NO2 and NH3) into flocs that will reduce ammonia in the water (Rarassari et al., 2021). Aquaponics is a combination of hydroponics and aquaculture that are integrated and benefit each other by utilising excrement or residual feed from fish as a source of nutrients for plants that will keep water quality in the maintenance medium (Love, et al., 2014) The application of the Bio-Integrated Farming System in biofloc and aquaponic systems is expected to increase production value and feed efficiency in catfish farming activities.

Yang Faulinas II fish farming group with 10 members is a freshwater fish farmer who cultivates catfish in Cipadang Village, Pesawaran Regency. Catfish is one of the consumption fish with high demand in the community because catfish has the advantage of relatively fast growth. However, currently there is often a decrease in production due to deteriorating water quality and increasing feed prices, so to overcome this, the pokdakan harvests catfish still in the form of 6-7 cm size seeds. The high need for feed with high feed prices also makes farmers sell catfish in seed size because if the cultivator raises catfish to consumption size, the cultivator needs quite a lot of feed, it can also cause more sediment residual feed in the cultivation pond which can reduce water quality in the cultivation pond decreases. The importance of this service activity is that the fostered partners are expected to develop, improve, and apply Bio-Integrated Farming System technology with a combination of biofloc and aquaponics to increase production in farmers in Cipadang Village, Pesawaran.

METHOD OF IMPLEMENTATION

This service activity was carried out from April - September involving partners from the fish farmer group Yang Faulinas II in Cipadang Village, Gedong Tataan District, Pesawaran Regency and Fisheries Extension Auxiliary of Pesawaran Regency. The assistance was carried out by the proposing team and students from the Department of Fisheries and Marine Affairs, Faculty of Agriculture, University of Lampung. The initial step taken to arrange the stages of the service programme was to conduct mapping. This activity is expected to increase community aquaculture production through the development and application of technology to improve the community's economy.

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The stages of implementation of activities carried out in this activity can be seen in Figure 1:

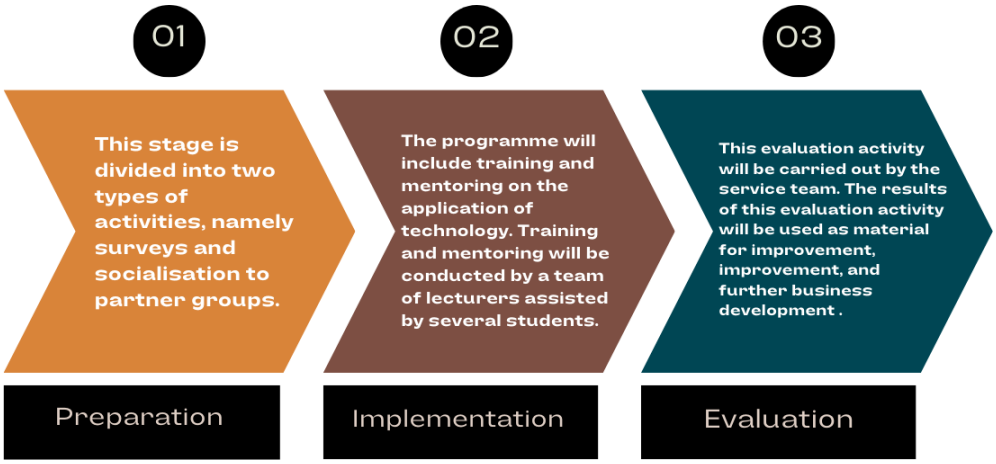

FIGURE 1. Flow chart of stages of community activities

RESULTS AND DISCUSSION

Preparation

The preparation was carried out in several stages. This stage began with a location survey of the Yang Faulinas II fish farmer group located in Cipadang Village on 30 April 2024 (Figure 2), the survey was conducted to determine the location of the aquaponic installation and biofloc ponds.

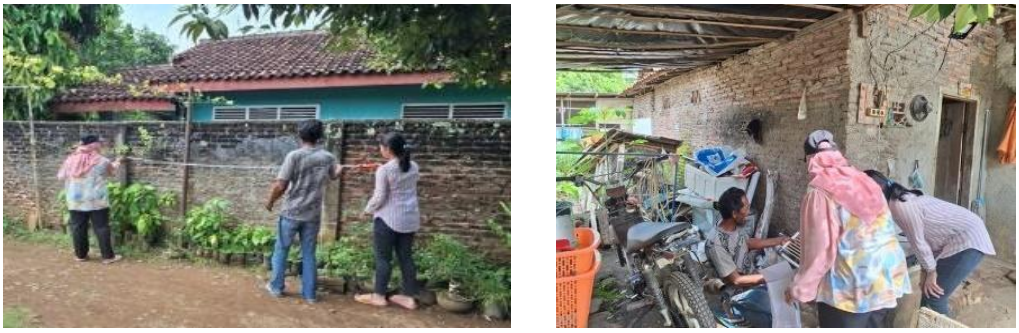

FIGURE 2. Determination of the location of aquaponics and biofloc ponds (30 April 2024)

After the team and the farms determined the location of the aquaponics and biofloc ponds, on 7 July 2024 (Figure 3) the distribution of complete tools and materials (seeds, rockwool, seedling trays) and biofloc materials (molasses, salt, probiotics) was carried out.

FIGURE 3. Handover of tools and materials (7 July 2024)

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At the next meeting on 12 July 2024 (Figure 4), the team together with the head of the Pokdakan started assembling the aquaponics, preparing the biofloc ponds, making bioflocs and sowing vegetable plants.

(A) (B)

(C) (D)

FIGURE 4. (A) Vegetable seedlings; (B) Biofloc production; (C) Aquaponic installation assembly; (D) Aquaponic installation and biofloc ponds.

On 19 July 2024 (figure 5) the team continued with the next activities of checking the biofloc ponds, planting the previous week's seedlings, stocking fish seeds and sowing vegetable seeds.

FIGURE 5. Planting of seedlings, seed stocking and checking of biofloc ponds (19 July 2024)

Before the socialisation activity on 2 August 2024, the team checked the success of acuponics, fish and biofloc conditions (Figure 6).

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FIGURE 6. Aquaponic plant development and biofloc ponds

Implementation

After the preparation was completed, then on 4 August 2024, the socialisation activities were carried out, namely the delivery of material by the team (Figure 7) and seedling practices carried out by the farmer group and the surrounding community at the residence of the head of the Yang Faulinas II farmer group (Figure 8). The socialisation was attended by the head and members of the Yang Faulinas II farmer group, the surrounding community and one Pesawaran District Auxiliary Fisheries Extension Officer.

FIGURE 7. Submission of materials by the service team

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(A) (B

FIGURE 8. (A) Practice of vegetable seed sowing; (B) Photo with participants and PkM Team

Evaluation

This evaluation activity will be carried out by the service team and a team from the Institute for Research and Community Service (LP2M), University of Lampung. The evaluation carried out by the service team is by giving pretests and posttests to participants in the implementation of activities. The evaluation results can be seen in the diagram (Figure 9). Then on 6 September 2024, monitoring and evaluation was carried out by a team from LP2M, University of Lampung.

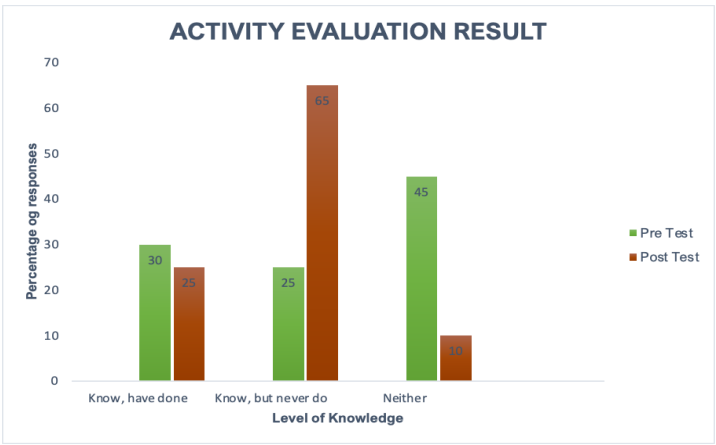

FIGURE 9. Results of Activity Evaluation

FIGURE 10. Monitoring and Evaluation Team of LP2M University of Lampung

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Discussion

Based on the results of initial discussions with the fish farmer group, it is known that the problem experienced is a decrease in production due to deteriorating water quality and increasing feed prices. One of the efforts to increase production and feed efficiency in catfish farming activities is to apply a combination of biofloc and aquaponic technology or also known as *Bio-Integrated Farming System.* This system works by using the flocs formed as food for catfish and nitrogenous substances from catfish excretion can be flowed into the aquaponic system as natural nutrients needed for vegetable growth (Sunaryono, et al., 2023). Aquaponics is a mutually beneficial combination of aquaculture and hydroponic systems, namely fish farming and vegetable growing (Fitriah *et al.,* 2020). Raising fish in one container can cause the existing water conditions to have concentrated ammonia levels, which have the potential to poison fish (Imaddudin *et al*., 2021). Biofloc technology is a solution to reduce the cost of catfish farming, namely by the availability of natural food in cultivation which comes from probiotics (Ma'ruf, 2016). Biofloc is an alternative method in solving waste water quality problems in fish farming which is a collection of various types of organisms such as fungi, bacteria, algae, protozoa, worms, and others, which are incorporated in clumps. (Fitriah *et al.,* 2020).

Therefore, Bio-Integrated Farming System technology with a combination of biofloc and aquaponics has several advantages, namely no need for additional fertilisers and pesticides in plant cultivation, efficient use of water (recirculation principle), suitable for limited land, and high productivity because the number of fish cultivated can reach 3-5 times that of fish farming without plant integration (Firdaus et al., 2018). In addition, this technology can produce two nutritious products at once, namely healthy vegetables and fish free of harmful ingredients (Zidni et al., 2019). This technology can also be modified according to consumer needs and the resulting products have global competitiveness, especially related to market demand trends for environmentally friendly agricultural products and free of hazardous materials (Assyafah & Primaditya, 2020).

Activities began with preparation, implementation and evaluation. In the preparation stage, the team held discussions with the farmer groups regarding the technology to be applied and agreed on the location of the aquaponic installation and the appropriate biofloc ponds (Figure 2). After agreeing, measurements were taken to adjust the size of the aquaponic installation to be made. The next meeting the team distributed the required tools and materials such as resun, vegetable seedling equipment (seeds, rockwool, seedling trays) and biofloc materials (molasses, salt, probiotics) (Figure 3). Before making bioflocs, the pond was repaired with the help of the head of the farmer group, and the following week the team conducted a trial of making bioflocs. The pond was 2 metres in diameter and 1 metre deep. Then the aquaponic installation was made using a 2.5 inch diameter pipe, 2 metres long and 4 levels. The flow is not carried out for 24 hours because the aquaponic installation model is DFT (Deep Flow Technique) so that the pond water that has previously been flowed will be left in the pipe so that the plant roots still get nutrients. Water from the aquaculture pond was piped in using a 13-watt submersible pump.

Before conducting socialisation activities to other members and the community, the team conducted a trial of making bioflocs and monitored its success and then evaluated it. The materials used in making biofloc are krosok salt, molasses, probiotics, and lime. After all the ingredients were included, the biofloc was left with a live aeration system for 24 hours as many as 6 points. In addition, vegetable seed sowing was also carried out. Seeding is done by planting vegetable seeds into rockwool media that has been moistened with water and placed in a seedling tray, then placed in an open space but not exposed to direct sunlight. The rockwool media was kept moist by spraying water onto the media using a hand sprey. The following week's activities included checking the bioflocs, transplanting the previous week's seedlings (Figure 5). In addition, the team moved the seeds from the previous week's seedlings that had grown into the aquaponic ponds. Then the water from the biofloc ponds began to be channelled into all the aquaponic pipes. On 2 August 2024, the team checked the success of aquaponics, the condition of the fish and bioflocs (Figure 6). The

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growth of vegetables in the aquaponic media was very good and lush. The fish in the biofloc pond also looked active and healthy. According to the head of the farming group, the challenges faced at that time were unstable temperatures due to unpredictable weather conditions and at that time there were high temperature conditions so that the installation needed to add paranet to make it moreshady.

The implementation was attended by 20 people consisting of members of the fish farmer group and the surrounding community. The participants were very enthusiastic from the beginning of the socialisation event until the end of the activity. As an evaluation of the activity, the team conducted a pretest and posttest. The socialisation activities were carried out using lecture, question and answer method and then practice. Before the service team provided socialisation, the activity began with a pretest conducted by the fish farmers and the community who attended, then continued with socialisation delivered by the service team in the form of a presentation. Material delivery was carried out by all members of the service team. The material presented is in accordance with the field of knowledge possessed by each member. Then the posttest, then at the end of the activity, the practice of sowing plants to making bioflocs was carried out. The results of the pretest and posttest (Figure 10) show that community knowledge has increased by 40%. Similar to the activities carried out (Dewi et al., 2022) the application of biofloc- aquaponic technology in Kalisidi Village based on the research results that the average community understanding increased by 10-40% which means that the application of appropriate technology is a solution and opportunity for fish farmer groups and communities to develop businesses so that production increases. In addition to the evaluation carried out by the service team, monitoring and evaluation was also carried out by the LP2M team of Lampung University. This was done to assess the implementation of the programme's suitability and achievements.

CONCLUSIONS AND RECOMENDATION

Conclusions

Based on the activities that have been carried out, it can be concluded that there is an increase in the skills and knowledge of fostered partners and the community, especially the Faulina II fish farmer group in utilising and applying technology that combines biofloc technology with aquaponics. Increased knowledge related to how to use the right feed in biofloc cultivation to be more efficient and economical. The additional activity of planting vegetable seeds with an aquaponic system can fulfil the nutritional adequacy of the household. It is also important to establish effective cooperation between universities and community groups.

Recomendation

In order to improve the skills and knowledge of farmers, it is necessary to conduct follow-up activities in terms of the latest technology, both fish rearing technology and aquaculture waste management technology, as well as simple aquaponic technology for households.

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