

Tilapia Fish and Vegetable Cultivation Using the Aquaponic System as an Economic Driver for the Mee Tanjong Usi Village Community in Pidie Regency

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Abstract: Gampong Mee Tanjong Usi is located in Mutiara Timur District, Pidie Regency, Aceh Province, and has residents whose main livelihood is as farmers. The dense population makes agricultural land scarce. Aquaponic cultivation system is an innovation offered as a solution. The Aquaponics system combines a hydroponic system and an aquaculture system. This PKM activity aims to increase the knowledge and skills of the "Mee Meuhase" group from Gampong Mee Tajong Usi in managing aquaponic systems, producing local food products and increasing income. The implementation method begins with observation and outreach, training and assistance in creating an Aquaponics system, application of technology as well as monitoring and evaluation of program sustainability. The fish seeds cultivated are tilapia (*Oreochromis niloticus*) and the vegetables grown are spinach (*Amaranthus sp*) and pokcoy (*Brassica rapa L.*). As a result of the implementation of the activity, the activity went well with high enthusiasm from the participants. Education and training that assembles, manages aquaponic systems, produces environmentally friendly products, increases environmental awareness and helps increase income.

Keywords: Cultivation, Tilapia, Organic Vegetables, Aquaponics.

Introduction

Gampong Mee Tanjong Usi is located in Mutiara Timur District, Pidie Regency, Aceh Province. This village is headed by a village head (Keusyik). This area has a population of 2,474 people consisting of 1125 men and 1,349 women. In terms of population, Gampong Mee Tanjong Usi is classified as a densely populated group. Most of the residents of the area have their main livelihoods as farmers and livestock breeders and a small number as traders and civil servants. The number of productive age people in the village is around 80% and the rest are elderly and children. Of the productive age group, around 30% are unemployed or do not have permanent jobs and live below the poverty line so that efforts are needed as a solution (Gampong Profile).

The high population has caused the community's need for supporting facilities for survival to increase

significantly, including: education and health facilities, and housing (Rosyid, 2021). To fulfill these needs, development is carried out, resulting in a change in land function, especially empty land and agriculture into built-up land. This makes empty land and agricultural land increasingly narrow (Putri et al., 2024).

The results of the situation analysis, there is a community group in Gampong Mee Tanjong Usi who is not economically productive, but has a high motivation to continue trying to utilize the remaining land for livestock (poultry, goats and cows). They continue to try to increase sales of their harvest, but have not been able to manage it well to become an economically productive business. The group is named "Mee Meuhase".

The Mee Meuhase group is engaged in agriculture (rice) and livestock (cows and goats). However, the business that the Mee Meuhase group tried to build did not develop because of the long harvest age for cows and

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goats (reaching 2-3 years), and the harvest age for rice reaches 3-4 months, as well as limited land and the lack of information about skills for farming and raising livestock on narrow land but still having big profits. The Mee Meuhase group only gets a profit of 35% for each sale after deducting capital costs and production costs so that it is unable to meet daily needs.

In addition, Gampong Mee Tanjong Usi is not far from the city center of Beureunuen which is the business center in Pidie Regency. This condition provides high access to market agricultural and livestock products. One of the innovations offered by the Jabal Ghafur University PkM Team is fish and vegetable cultivation using the aquaponic system as a solution for cultivation in narrow land (Handayani, 2018).

The aquaponic system is a combination of fish cultivation (aquaculture) and vegetables with a hydroponic system (Food, Agriculture and Fisheries Service, 2018). Fish and vegetables are cultivated simultaneously in the same place where both are connected and provide benefits (Jirifarm, 2022). The cultivated fish get food from the feed given by the cultivator. And, vegetables will get nutrients from the remaining fish metabolism and the remaining feed that has been perfectly decomposed to synthesize protein (Syarfrudin et al., 2019).

Aquaponics offers efficient water use and reduces dependence on chemical fertilizers (Yulianyaha 2022). In the aquaponic system, water from the fish pond is not directly channeled to the plants, but is first channeled to the filtration system for the nitrification process. This is useful for settling fish waste and food waste, as well as converting nitrogen elements (urea and ammonia) in pond water into nitrate and nitrite ions (nitrification). Vegetable plants in the aquaponic system only absorb nitrate and nitrite ions as nutrients. Nitrification is also useful for preventing plants from being poisoned by nitrogen elements (Wongkiew et al., 2017). Aquaponics is included in the organic farming system because it does not use chemical fertilizers and pesticides that are harmful to human health (Syarfrudin et al., 2019). Aquaponic system cultivation can increase farmers' income (Ritonga et al., 2023). Aquaponics offers a sustainable and mutually beneficial ecosystem for plants and fish (Dwi Agustin et al., 2023) (Putra et al., 2023).

Therefore, through the collaboration through the PkM program with Geusyk Gampong Mee Tanjong Usi, Mutiara Timur District, the PKM team of Jabal Ghafur University will carry out educational activities, training and mentoring for fish and vegetable cultivation using the Aquaponics system, then monitor and evaluate post-training and mentoring activities to measure the achievement of the program activities, as well as the sustainability of the program in the long term.

It is hoped that this activity can empower the community of Gampong Mee Tanjong Usi in improving food security and creating new opportunities for economic development. Thus, this PkM not only contributes to the welfare of one farmer group, but can be an example for other groups or areas experiencing similar challenges.

Method

Observation and Socialization

Observation is conducted to identify problems and needs of partners. Partners participate by providing details of village conditions complete with problems. Furthermore, socialization of program implementation and activity coordination. Through socialization, it is hoped that this PkM activity will run smoothly. The expected achievement is to identify partner problems to obtain solutions and follow-up.

Education, Training and Mentoring

Education aims to provide a basic understanding of the aquaponic system, the tools and materials used and how the aquaponic system is run.

Training and mentoring aim to provide direct practice to partners with the aim of developing human resources in Gampong Mee Tanjong Usi. The resource person for this activity is the Head of the Experimental Garden of the Faculty of Agriculture, Jabal Ghafur University.

1. Application of technology

The application of technology for the community is expected to be the basis for managing the aquaponic technology package submitted by the Jabal Ghafur University PkM team. The steps in the application of aquaponic technology are: (1) making a tarpaulin pond base, (2) installing the tarpaulin, (3) preparing the planting media, (4) the process of sowing plants, (5) spreading fish, and (6) maintaining the aquaponic system cultivation.

2. Monitoring, Evaluation and Sustainability of the Program

Monitoring and evaluation are carried out to measure the success of the implementation of activities based on the targets that have been set. This activity will be carried out periodically by the Institute for Research and Community Service (LPPM) of Jabal Ghafur University by involving the Community Service Team, Keuchik (Village Head) and the Mee Meuhase group as the main partners.

For the sustainability of the program, the PkM Team of Jabal Ghafur University and Keusyk Gampong Mee Tanjong Usi have drawn up an agreement and are committed to continuing the cultivation of tilapia and organic vegetables using the aquaponic system.

This commitment and agreement are stated in the Cooperation Agreement.

Result and Discussion

Observation and Socialization

The Team Leader conducted observation and socialization of the activity program to the Geusyik of Mee Tanjong Usi village as a partner. Partners in this activity participated by providing a detailed description of the village's condition and its problems, as well as helping to provide input for the design of the activities to be implemented.



Figure 1. Socialization of Activity Program

The achievement of this stage is that the Team gets approval for the implementation of program activities, identifies partner problems and prepares activity designs to provide solutions to partner problems.

Knowledge and Skills Improvement

The PKM Team provided education on fish and vegetable cultivation using the aquaponic system to the Gampong Mee Tanjong Usi community group. The presentation of the material was delivered by the Resource Person (Head of the Laboratory of the Faculty of Agriculture, Jabal Ghafur University).

The material presented is an introduction to the cultivation of aquaponic systems, the tools and materials needed, how to make it and its benefits. This education is carried out to increase insight into sustainable cultivation techniques that are efficient and environmentally friendly.



Figure 2. Aquaponic System Cultivation Education

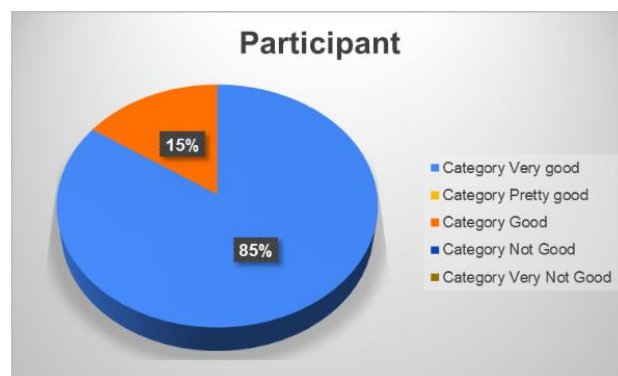


Figure 3. Analysis of Participant Knowledge and Skills Data.

Figure 3 shows that 85% (11 participants) have knowledge and skills in cultivating aquaponic systems in the very good category, and only 15% (2 participants) are in the Good category for all indicators assessed.

The achievements obtained are Participants gain a very good understanding of the basic concepts of aquaponics, the tools and materials needed, how to make it, including how to care for fish and plants simultaneously and the benefits of cultivating an aquaponic system for the knowledge aspect. As for the skills aspect, participants are skilled in designing an aquaponic system installation (preparing and assembling pipes for the planting system, preparing ponds and vegetable planting containers), skills in managing an aquaponic system (fish and plant maintenance skills, water quality control, and fertilization).

Product Quality Improvement

The products produced in this PKM activity are tilapia and organic vegetables with good quality, rich in nutrients, free from dangerous chemicals so they are very safe for consumption. To achieve this goal, the PKM Team made several efforts to improve product quality, namely:

- a. Improvement of cultivation techniques; by providing education, training and mentoring from resource persons who are experts in the field of aquaponics.
- b. Selection of Quality Seeds and Seedlings; Vegetable seeds and tilapia seeds are obtained from Trusted Sources and with good quality. Tilapia seeds are acclimatized first for a week before being released into the aquaponic pond. Likewise, vegetable seeds, seeds are planted on rockwool media to see the initial growth of the seeds.

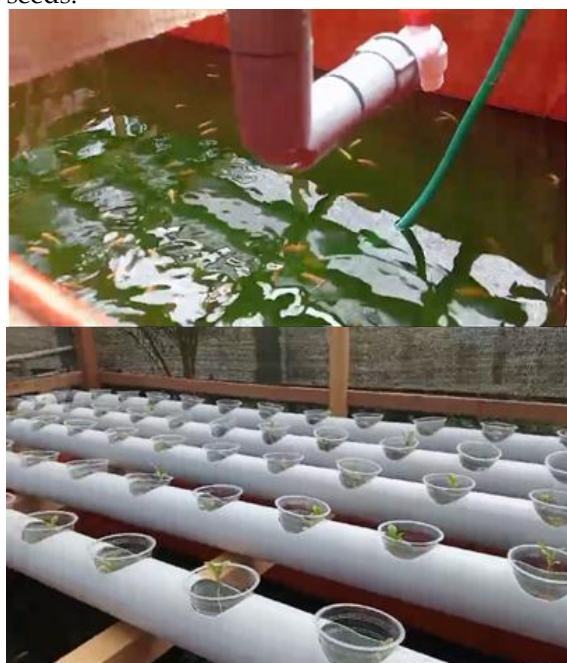


Figure 4. Tilapia Fish Seeds and Vegetables (1 week after fish distribution and vegetable seed planting).

- c. Nutrition Management; Quality feed is given 2 (two) times per day. Furthermore, ensure good water circulation so that plants get enough nutrients from fish waste and decomposition of fish food waste in the pond, by optimally managing the ratio between fish and plants. The aquaponic system requires maintenance of pond water quality standards that focus on dissolved oxygen levels, total dissolved solids, and pH (Okomoda et al., 2023).

The achievements obtained are:

- a. Obtaining fresh food products, such as vegetables and fish, which can meet local needs

or be sold. Figure 4 shows that fish seeds placed in the pond begin to grow healthily as they get older, vegetable plants also grow more fertile. The vegetables planted are spinach (*Amaranthus sp*) and pokcoy (*Brassica rapa L.*). However, the tilapia and vegetables cultivated have not reached harvest age so they have not increased turnover.

- b. Increase environmental awareness: Educate about the sustainability and environmental benefits of aquaponics systems, such as reduced use of water and chemical fertilizers.
- c. Building networks and collaborations between farmers and educational institutions, to share knowledge and resources.
- d. Encouraging Innovation and Creativity of participants: participants are motivated to innovate in aquaponic system techniques and designs according to local needs. This can be seen from several participants explaining aquaponic installation designs other than existing designs.

Application of Technology

The technology applied in this PKM activity is the creation of an aquaponic system installation. Aquaponics is a combination of fish and vegetable cultivation with a hydroponic system (1). Fish and vegetables are cultivated simultaneously in the same place where both are connected and provide benefits (2). The cultivated fish get food directly from the feed given by the cultivator. And, vegetables will get nutrients from the remaining fish metabolism and the remaining feed that has been perfectly decomposed to synthesize protein (3). Aquaponics is included in the organic farming system because it does not use chemical fertilizers and pesticides that are harmful to human health (4). The aquaponic installation built in this PKM can be seen in the following picture.



Figure 5. Aquaponics installation handed over to Partner

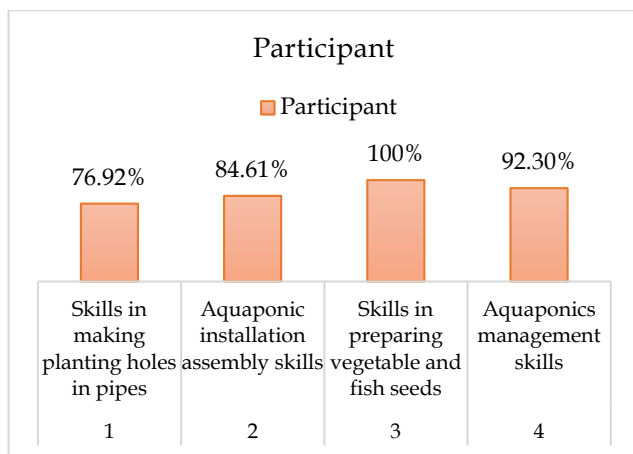


Figure 6. Questionnaire Analysis of Technology Implementation

Questionnaire analysis showed that participants were skilled in preparing planting holes in pipes (76.92%), assembling aquaponic installations (84.61%) and skilled in preparing vegetable and fish seeds (100%).

The achievement obtained is the availability of an aquaponic installation that can be used to cultivate fish and vegetables simultaneously. This aquaponic system is an alternative solution for cultivating organic fish and vegetables in narrow (limited) land. The aquaponic installation is the work of the Gampong Mee Tanjong Usi community.

Monitoring, Evaluation and Sustainability of the Program

Monitoring and evaluation were carried out by the Research and Community Service Institute of Jabal Ghafur University on the implementation of this PkM activity. Together with the PkM team, monitoring and evaluation were carried out on the effectiveness and efficiency of the aquaponic system that was built, feeding to ensure that fish can grow quickly, and replacing pond water periodically so as not to affect fish life. Monitoring and evaluation were also carried out on the use of pumps for water circulation to ensure the growth of fish and vegetables.



Figure 7. Monitoring and Evaluation Activities by LPPM Jabal Ghafur University

Conclusion

Aquaponic fish and vegetable farming activities offer sustainable solutions to food security and community empowerment challenges. The Mee Tanjong Usi village community has become very skilled in utilizing narrow land for fish and vegetable farming using the aquaponic system. In addition, the community can produce fresh, healthy and nutritious food, while protecting the environment with efficient use of resources.

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