

# Improving the Knowledge and Skills of Family Welfare Empowerment Members Through Aquaponics Training

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**Abstract** Members of Family Welfare Empowerment (FWE) in Jetis Hamlet, Malang, face challenges related to suboptimal family productivity and limited residential land. This community service initiative aimed to enhance family productivity by training 15 FWE members in aquaponic cultivation and harvest processing. Using intensive mentoring and a learning-by-doing approach, the program was conducted from July to December 2025 and included system installation, the maintenance of catfish (*Clarias* sp.) and vegetables, and product diversification. Evaluation using pretest and posttest instruments showed a substantial increase in participant capacity. Average knowledge scores increased from 37 to 82, whereas technical skills in system installation and product processing improved from 52 to 81. In addition to cultivation, participants successfully transformed harvested products into value-added products, namely Abon Aqual (catfish floss) and Keripik Viggieponik (vegetable chips). The results demonstrate that aquaponics is a viable urban farming approach for improving food security and economic independence among households with limited land.

## 1. INTRODUCTION

Community empowerment is a key component of efforts to achieve sustainable social and economic development (Yuzalmi et al., 2024). In Indonesia, the Family Welfare Empowerment (FWE) Program plays a central role in improving family and community welfare through various programs focused on women's empowerment (Emmywati et al., 2024). Empowering female FWE members as community actors and productive members of the workforce is essential for increasing awareness, independence, and business participation. These efforts aim to expand employment opportunities and increase family income (Rismawati et al., 2022). The results of a community service project by Putri & Widadi (2024) showed that empowering women by improving entrepreneurial skills can significantly increase family

income and reduce poverty in rural areas. Women play a crucial role in maintaining household economic stability. Through empowerment programs, women can acquire the knowledge, skills, and access needed to contribute actively to meeting their families' financial needs (Yuzalmi et al., 2024).

Jetis Hamlet, Mulyoagung Village, Dau District, Malang Regency, East Java, is one of the hamlets actively involved in FWE activities. FWE activities in this area generally include regular monthly social gatherings, Quran study groups, Dasa Wisma (neighborhood family group) activities, and savings and loan activities. FWE members in this area have not yet optimized FWE activities to make them more beneficial and sustainable. Interviews with FWE leaders revealed that families in this area have diverse social

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statuses, with some women working outside the home and others serving as homemakers. FWE representatives expressed the need for more productive FWE activities. The FWE team expects that more varied, productive, and sustainable activities will improve each family's finances and quality of life. A lack of innovation in work programs and the absence of serious efforts to develop productive activities, such as entrepreneurship, are among the main obstacles faced. The potential of FWE members, in terms of time, skills, and social networks, has not been optimized to promote family economic independence.

Based on the problem description presented above, aquaponic cultivation training was identified as a solution to increase family productivity. The selection of aquaponic cultivation as a solution was based on the environmental conditions and potential of the partner community. According to [Diskominfo \(2024\)](#), Dau District has an area of 141.96 km<sup>2</sup> and a population density of 66,278. Research by [Sutanto et al. \(2025\)](#) indicated that, by 2025, vacant land in the Malang region would become increasingly scarce. Currently, extensive development is occurring in Dau District, ranging from the establishment of new campuses to land clearing for housing. Indirectly, this condition has led to a decline in the availability of vacant land in the region and an increase in land prices. The substantial rise in land prices has severely affected each family's ability to purchase a house with sufficient space, leaving most households with limited land ([Andjani & Bagaskara, 2025](#)). Limited land conditions restrict community opportunities for innovation to improve the local economy [Hertika et al. \(2021\)](#). This finding was further supported by interviews and observations in Jetis Hamlet, Dau, Malang, which revealed that most residents in this area have limited yard space, thereby hindering their efforts to grow crops around their homes. Community representatives stated that, in addition to limited land, a lack of understanding of how to use limited space optimally is one factor that prevents residents from cultivating crops independently. The community therefore needs appropriate guidance to develop the knowledge and skills required to manage limited land more productively and sustainably. Accordingly, community service solutions through aquaponic cultivation are highly relevant.

Aquaponics is a combination of aquaculture and hydroponics. This system channels nutrient-rich wastewater from fish farming into a plant subsystem ([Hussain & Brown, 2025](#)). Aquaponic farming ensures adequate oxygen levels in the water and reduces toxic ammonia produced by fish waste. Combining hydroponics and aquaculture brings plants and fish closer to a natural system in which they complement each other effectively. Fish produce ammonia, which serves as a nutrient for plants, whereas plants reduce ammonia, which can be toxic to fish. Oxygen levels are maintained through the continuous water recycling process within the system ([Handayani, 2018](#)). Aquaponics is an innovative solution for developing fisheries and agriculture in areas with limited land ([Nugraha et al., 2024](#)). This system optimizes land use

by combining fish farming and hydroponics ([Nair et al., 2025](#); [Obirikorang et al., 2021](#)).

The implementation of aquaponics is related not only to land-use efficiency but also to the potential to increase residents' income. Research indicates that the implementation of aquaponics in local communities can improve residents' economic well-being. [Awolumate et al. \(2024\)](#) found that the use of aquaponics in urban areas of Nigeria has the potential to strengthen the local economy. In addition to providing economic benefits, the use of aquaponics in household settings can also enhance food self-sufficiency. In their systematic literature review, [Debroy et al. \(2025\)](#) found that, in the long term, aquaponic technology could become an important solution for addressing food scarcity and promoting sustainable food production. [Dewi et al. \(2025\)](#) also found that the implementation of aquaponics has the potential to foster food self-sufficiency within individual households. Capacity building can be achieved through community empowerment training programs, which must be implemented effectively and precisely to improve economic conditions and ultimately achieve community food self-sufficiency. Efforts to strengthen community potential are aimed not only at improving economic conditions but also at enhancing overall quality of life ([Rohayati et al., 2024](#)). The results of a community service project by [Devi et al. \(2025\)](#) showed that an intensive training program effectively improved the knowledge and skills of the Jambangan community in developing aquaponic technology to support sustainable agriculture. Similarly, the results of community service programs by [Handayani et al. \(2025\)](#) and [Putra et al. \(2025\)](#) indicated that intensive training and mentoring activities in aquaponics are effective in enhancing the knowledge of farmer groups and the general public regarding sustainable food systems. However, most community service activities still focus on the training phase of aquaponic cultivation and have not been sufficiently developed to address the sustainability of harvest processing. In fact, harvest processing plays a crucial role in increasing product value, expanding business opportunities, and strengthening the economic sustainability of communities. Therefore, community service programs are needed that emphasize not only aquaponic cultivation training but also guidance on harvest processing and the sustainable development of aquaponics-based businesses.

Through this community service initiative, FWE members can use the harvest not only for family consumption but also for selling fresh vegetables and high-quality fish in local markets. In addition to selling the harvest in raw form, FWE members will receive training in business management and harvest processing to transform the harvest into value-added products. This processing is expected to enhance competitiveness and economic returns compared with direct sales. Examples of such processed products include vegetable chips and catfish jerky. Overall, the development of an aquaponics system in Jetis Hamlet can have a significant impact on the local economy.

By using existing resources and implementing innovative cultivation practices, this hamlet can not only meet local food needs but also increase community income and quality of life. Therefore, the objective of this community service activity is to enhance the capabilities and skills of FWE members in Jetis Hamlet, Mulyoagung Village, in practicing aquaponics to improve family productivity.

## 2. METHOD

### 2.1 Time and location of the community service program

The community service program, which included aquaponics training, aimed to improve FWE members' skills in aquaponic cultivation. This program was implemented from June to December 2025. The program partners were 15 FWE members from Jetis Hamlet, Mulyoagung Village, Dau Subdistrict, Malang Regency, East Java, Indonesia (Figure 1). The program was designed to empower FWE members by developing an aquaponics system using catfish (*Clarias sp.*). The vegetables used in the system included water spinach (*Ipomoea aquatica*), spinach (*Amaranthus sp.*), celery (*Apium graveolens*), and mustard greens (*Brassica rapa L.*).

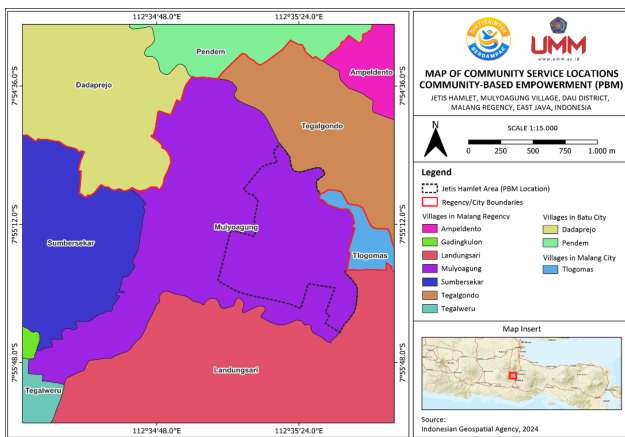


Figure 1 . Map of community service sita

### 2.2 Program implementation process

The community service activities for FWE members in Jetis Hamlet were carried out in four main stages: preparation, outreach, implementation, and program evaluation (Figure 2). The preparation stage consisted of a site survey, initial observations to assess the partners' conditions, community outreach, and the development of instruments to measure program success. The outreach phase generally consisted of engaging the target community, introducing the program, and establishing a mutual agreement with the community service partners. The program implementation phase included 1) delivering materials on aquaponics, 2) providing intensive mentoring on aquaponics setup, 3) delivering materials on business management, particularly the processing of aquaponics harvests, and 4) providing intensive mentoring on processing harvests into finished products, namely vegetable chips. Finally, the evaluation

phase consisted of internal program evaluation by the Research and Community Service Institute, University of Muhammadiyah Malang, and external evaluation by the Ministry of Higher Education, Science, and Technology.

### 2.3 Program preparation phase

The community service activities began with surveys and observations at the service site. The site survey was conducted to assess the community's conditions and the location that would serve as the pilot site for aquaponics development. Outreach to the target community was conducted to gain a deeper understanding of the issues it faced. The approach involved unstructured interviews. The interviews were conducted with the Neighborhood Unit chairperson and representatives of FWE members from Margojoyo Street, Neighborhood Unit 01 and Community Unit 02, Jetis Hamlet, Mulyoagung Village. These interviews aimed to identify the activities carried out by FWE members and the challenges faced by the partners.

In addition to surveys and observations, the preparation phase involved developing assessment tools to measure the success of this community service program. The instruments used consisted of tests, in the form of essay questions, and non-test instruments, in the form of performance assessments. The test instrument was designed to measure FWE members' knowledge of aquaponics through 10 questions accompanied by a rubric for evaluating essay answers, with scores ranging from 0 to 3. Before being used in the community service activity, the test instrument underwent content validity assessment by experts. The experts involved in this assessment were one expert in aquaculture from the Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang (Expert 1), one expert in economics from the Faculty of Economics and Business, University of Muhammadiyah Malang (Expert 2), and one expert in assessment from the Department of Biology Education, University of Muhammadiyah Malang (Expert 3). The instrument validation sheet used a 1 to 5 Likert scale: 1) poor, 2) fair, 3) good, 4) very good, and 5) excellent. In general, each aspect of the instrument assessment produced good results (Table 1). However, there were minor suggestions for improvement, which the team addressed before the instrument was used in the community service activities.

Table 1 . Results of the validation of the aquaponics competency instrument

Aspects	Average experts rating (%)		
	Expert 1	Expert 2	Expert 3
Clarity	73%	80%	80%
Content accuracy	80%	80%	80%
Relevance	70%	80%	70%
Content validity	80%	80%	80%
No bias	80%	80%	80%
Language accuracy	80%	80%	73%
<b>Average</b>	<b>77%</b>	<b>80%</b>	<b>78%</b>
<b>Description</b>	<b>Good</b>	<b>Good</b>	<b>Good</b>

The non-test instrument used in this community service project was a performance assessment sheet designed to

measure FWE members' skills in practicing aquaponics and processing the harvest. The performance assessment instrument used a 0 to 4 Likert scale. Before being used in the community service activities, the instrument was validated by experts. The experts involved were one expert in aquaculture from the Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang (Expert 1), one expert in economics from the Faculty of Economics and Business, University of Muhammadiyah Malang (Expert 2), and one expert in assessment from the Department of Biology Education, University of Muhammadiyah Malang (Expert 3). The instrument validation sheet used a 1 to 5 Likert scale. In general, each aspect of the instrument assessment produced good results (Table 2). However, there were minor suggestions for improvement, which the team addressed before the instrument was used in the community service activities.

**Table 2 .** Results of the validation of the aquaponics competency instrument

Aspects	Average experts rating (%)		
	Expert 1	Expert 2	Expert 3
Clarity	80%	73%	73%
Content accuracy	80%	80%	80%
Relevance	80%	70%	80%
Content validity	80%	80%	80%
No bias	80%	80%	80%
Language accuracy	77%	77%	80%
<b>Average</b>	<b>79%</b>	<b>77%</b>	<b>78%</b>
<b>Description</b>	<b>Good</b>	<b>Good</b>	<b>Good</b>

### 2.4 Program outreach phase

The outreach phase involved introducing the program to FWE leaders on a broader scale. A total of 15 FWE members participated in this activity. The outreach activities included introducing the program to the partners.

### 2.5 Program implementation phase

The following is a detailed description of the implementation stages of the community service program.

- The program implementation began with a pretest to assess the abilities and skills of FWE members.
- Module 1, which focused on aquaponics, was presented. This module covered fish species, vegetables, aquaponics equipment and materials, procedures for setting up an aquaponics system, and system maintenance.
- FWE members conducted a hands-on aquaponics setup activity with intensive guidance from the community service team.
- Module 2, which focused on managing the aquaponics harvest, was presented. This module covered processing the harvest into high-value products, particularly vegetable chips, as well as setting sales targets, packaging, and promotion.
- FWE members participated in hands-on harvest processing activities.

- A posttest was administered to assess the final competencies of FWE members after completion of the program and to evaluate program success.

### 2.6 Monitoring and evaluation phase

Activity monitoring was conducted by internal parties, namely the Research and Community Service Institute, University of Muhammadiyah Malang, and by external parties from the Ministry of Higher Education, Science, and Technology, as well as by the community service team. Monitoring was carried out flexibly on both a daily and weekly basis. Daily monitoring was conducted via WhatsApp to track progress, whereas weekly monitoring included on-site visits to partners to ensure that the program was proceeding as planned.

Evaluation was conducted by the community service team, which monitored the progress of activity implementation based on the monitoring results. In addition, the final evaluation of the community service activity was conducted through an analysis of data on FWE members' knowledge of aquaponics and their skills in cultivation and harvest processing. The data analyzed consisted of pretest and posttest data. Quantitative descriptive analysis was used to identify differences between the pretest and posttest results, thereby determining the level of improvement in FWE members' knowledge and skills after their participation in the community service activities.

## 3. RESULT AND DISCUSSION

In general, the community service activities included the preparation, outreach, and program implementation phases. The community service activities took place from July to December 2025 (Table 3). These activities were attended by 15 active FWE members from Margojoyo Street, Neighborhood Unit 01 and Community Unit 02, Jetis Hamlet, Mulyoagung Village, Dau Subdistrict, Malang Regency, East Java. The preparation phase began on Wednesday, July 23, 2025. This phase started with a site survey of the community service location to assess the conditions of the partner community, including the site for the construction of the aquaponics system. During this phase, the community service team conducted an assessment, including determining the number of FWE members to be involved and preparing the necessary facilities and infrastructure. These steps were taken to ensure that the outreach and training activities could proceed as planned and have a positive impact on the Jetis Hamlet community. The program outreach phase was conducted to ensure that all parties involved in the community service activities fully understood the objectives of the initiative. The outreach activities included meetings with local officials, namely the Neighborhood Unit and Community Unit, and FWE leaders. In this activity, the community service team presented a roadmap for future community service activities, provided a brief introduction to aquaponics, and administered a pretest to FWE members in Jetis Hamlet.

**Table 3 .** Schedule of community service activities

Date	Activities
July 23, 2025	Site survey and community partnership
August 30, 2025	Coordination with village officials (Neighborhood Unit and Community Unit of Jetis Hamlet)
September 7, 2025	Coordination and program introduction with the FWE
September 14, 2025	Presentation of the first session on aquaponics
September 21, 2025	Hands-on practice in setting up an aquaponics system (plant sowing)
September 28, 2025	Hands-on practice in setting up aquaponics technology
October 5, 2025	Hands-on practice in setting up aquaponics technology
October 5 – December 7, 2025	Independent maintenance of the aquaponics system, with alternating support from the team
November 8, 2025	Practical demonstration of harvesting vegetables grown via aquaponics (demonstration)
November 16, 2025	Presentation of material on business management of aquaponics harvests
December 7, 2025	Simultaneous harvest of catfish and vegetables, and practical demonstration of processing the aquaponics harvest

### 3.1 Aquaponics training program

The training session began with the presentation of basic material and foundational concepts related to aquaponic systems, which were delivered in a simple manner so that FWE members could understand them easily. The material covered efficient cultivation techniques, including the selection of plant and fish species, nutrient management, daily maintenance of the aquaponics system, and the benefits of using an aquaponics system for cultivation. The material was presented by community service team members from the Faculty of Agriculture and Animal Husbandry, University of Muhammadiyah Malang. The community service team invited the partners to participate actively in this meeting. In addition to presenting the material, the team brought a simple demonstration model of aquaponics system technology. The purpose of bringing this demonstration model to the meeting was to facilitate and clarify the presentation of the material to the partners.

Following the presentation, the next session consisted of hands-on practice and intensive guidance on building aquaponics systems. The hands-on training began on Sunday, September 14, 2025. The second training session began with training on sowing plant seeds for aquaponic cultivation. This sowing activity was conducted before the construction of the aquaponics system to improve time efficiency, so that the seedlings would be ready when the system was ready for use. The plants used in this aquaponic cultivation included leafy vegetables with fibrous roots that grow quickly (Sastro, 2019). Therefore, the vegetables used

in this community service activity were pak choi, water spinach, spinach, and celery. The plant propagation process began with sowing vegetable seeds and preparing seedlings for planting. The sowing process used charred rice husks as the growing medium for the vegetable seedlings. FWE members took turns receiving intensive guidance to carry out the sowing process. The seedlings resulting from this process were later transferred to the aquaponics system after the assembly was complete.

**Figure 2 .** Presentation on aquaponics

The third and fourth meetings were held to provide intensive guidance on constructing the aquaponics system. During the third meeting, FWE members were divided into two groups, and a faculty member and a student guided each group as they built two aquaponics systems. This activity focused on preparing the tools and materials for the aquaponics system, including PVC and metal frames and plastic tarps for the catfish ponds. During the practical phase, participants were introduced to various tools and materials used to construct the aquaponics system, including PVC pipes, metal frames, pipe fittings, water pumps, and plastic tarps for catfish breeding ponds. The service team explained the function of each component and the proper installation procedures to ensure that the aquaponics system operated optimally. Subsequently, FWE members actively participated in the aquaponics installation assembly process, from assembling the steel frames and installing PVC pipes as the water flow medium to installing the plastic tarps for the catfish ponds. Throughout the activity, the community service team directly assisted participants in measuring, cutting, and assembling the installation components so that they aligned with the planned design.

The process of constructing the aquaponics system frame during that session could not be completed in a single day because several assembly stages required precision and size adjustments to ensure that the system functioned properly. Therefore, the practical activity was continued in the next session to refine the assembly results and ensure that all components were installed optimally. Nevertheless, the community service team still provided FWE members with the opportunity to continue the installation process independently in their spare time before the next session. This activity was conducted as a skills-training exercise and to increase participants' confidence in building aquaponics systems through hands-on practice. The team also provided

simple technical guidance via WhatsApp as part of its monitoring efforts during the independent work process.

The aquaponic system was constructed using PVC pipes for the hydroponic racks, which supported the vegetable plants, and a tarpaulin-lined catfish pond. Specifically, the aquaponic system measured 2 m × 1.5 m, and the hydroponic racks consisted of six tiers. Each tier of the six-tier rack was planted with a different type of vegetable. For example, the first tier contained mustard greens, the second tier contained water spinach, the third tier contained spinach, the fourth tier contained celery, the fifth tier contained mustard greens, and the sixth tier contained water spinach. The vegetable growth process in this aquaponic cultivation system took approximately 4 weeks, or about 30 days. On the 30th day, all vegetables could be harvested in rotation by FWE members. This is in line with the view of Chia & Lim (2022) and Chowdhury et al. (2021), who stated that leafy plants generally grow quickly within 3 to 4 weeks. The fish tanks used in the aquaponic system measured 1.5 m × 1.5 m. Before the fish were placed in the tanks, the tanks were first filled with water for 24 hours to neutralize the water. The fish species used in racks 1 and 2 was catfish. The catfish used were 5 to 7 cm in size. Each aquaponics system contained 1,000 catfish. This number was set higher than the standard to account for initial mortality rates caused by adaptation stress, fluctuations in water pH, and population density (Rukmana et al., 2025). The catfish were released slowly into the tarpaulin pond to avoid temperature shock (Gea, Zai et al., 2025).

At the next meeting, the work completed by FWE members was reviewed and refined together with the community service team to ensure that the entire aquaponic system functioned properly, particularly the frame, PVC pipe connections, and water flow system. After the refinement process was complete, the activity continued with the release of catfish fry into the prepared tarpaulin pond and the planting of vegetable seedlings in the aquaponic growing medium. The community service team provided guidance and explanations on releasing fish fry, maintaining the pond, and planting and caring for vegetables to ensure optimal growth through the nutrient-circulation system from the fishpond. This guidance included 1) applying nutrient fertilizer, 2) feeding the fish twice daily, 3) draining sediment through the water tap, and 4) maintaining water cleanliness and pH levels in the system. The learning-by-doing approach allowed participants to directly understand the symbiotic relationship between fish and plants in an aquaponics system, in which fish waste serves as a natural nutrient for plants (Rukmana et al., 2025). Catfish can generally be harvested within 6 to 8 weeks, depending on the desired weight and size. In this community service project, the catfish were harvested simultaneously in the eighth week. This is consistent with findings showing that the success of an aquaponic system is strongly influenced by the stability of water quality, particularly the water circulation system, and the adaptation period of the organisms within it (Al-

Zahrani et al., 2024; Wang et al., 2023). According to Al-Zahrani et al. (2024), a decline in water quality in an aquaponic system affects plant performance, quality, and yield, as well as fish physiology, growth rates, and feed efficiency. This system requires synchronized growth between fish and plants, especially during the first week, which is a critical adaptation phase in the aquaponic cultivation process (Baganz et al., 2022; Zamnuri et al., 2024).



Figure 3 . Aquaponic farming practices

The catfish and vegetable cultivation process in the aquaponic system took place from October 5 to December 7, 2025. During this period, the community service team monitored the growth of the fish and vegetables via WhatsApp in collaboration with FWE representatives. In addition, faculty members and students conducted on-site monitoring once a week on weekends to more closely track the development of the catfish and vegetables. Throughout the monitoring process, several dead catfish and damaged vegetable plants were found. As a follow-up measure, the damaged vegetables were replaced with new seedlings to ensure optimal growth and maintain the effective and sustainable operation of the aquaponic cultivation system.

Subsequently, on November 8, 2025, the community service team conducted a demonstration harvest of catfish and vegetables that were ready for harvesting. This harvesting activity was demonstrative; therefore, not all catfish and vegetables were harvested, and only a portion was harvested as an example for FWE members. The size of the catfish harvested at that time ranged from approximately 8 to 10 cm. From Aquaponic System 1, 1 kg of catfish was obtained, and from Aquaponic System 2, another 1 kg of catfish was also obtained. In addition to the catfish harvesting practice, the community service team demonstrated vegetable harvesting. Vegetable harvesting was performed on only one or two plants as examples. The harvested vegetables were replaced with new seedlings to ensure that the growth cycle continued and that the aquaponic cultivation system operated sustainably.

On November 16, 2025, an economics lecturer from the University of Muhammadiyah Malang delivered a presentation on the management of aquaponic harvest-based businesses. The presentation aimed to provide

Table 4 . Total harvest of catfish and vegetables

Aquaponics	Catfish	Water spinach	Spinach	Celery	Mustard greens
Aquaponics 1	65 kg	1.5 kg	1 kg	1 kg	1 kg
Aquaponics 2	50 kg	1 kg	1 kg	0.5 kg	1 kg

participants with an understanding of the management and development of businesses based on aquaponic harvests, as preparation for the simultaneous harvest-processing practice activities held the following month. This session covered methods for processing catfish floss and vegetable chips, as well as packaging these products.

The next mentoring activity involved a joint harvest and the processing of aquaponic harvest products (Figure 4). During this activity, catfish were harvested from Aquaponic Systems 1 and 2. From a total of 1,000 fingerlings released at the start of the practical training, on December 7, 2025, a harvest of 65 kg was obtained from Aquaponic System 1, and 50 kg was obtained from Aquaponic System 2 (Table 4). During maintenance and monitoring, several dead catfish were also found. This condition is part of the dynamics of aquaculture, which are influenced by environmental conditions, water quality, and fish density within the systems. In addition to the catfish harvest, this activity included a simultaneous vegetable harvest from each aquaponic system. On average, each system yielded approximately 1 kg of vegetables at harvest (Table 4). This amount was smaller than the catfish harvest because the number of racks or growing media used in the aquaponic system was still limited.



Figure 4 . Processing of aquaponic harvests

The harvest from the aquaponic system was used not only to meet daily food needs but also to provide economic potential when processed into products with a higher market value than raw products. Therefore, the community service team guided FWE partners in processing the harvest into value-added products with market appeal and business opportunities. The products introduced to the FWE partners included vegetables processed into chips and catfish processed into abon (catfish floss) (Figure 5). The practical session began with the preparation of tools and materials provided by the community service team. Subsequently, the FWE partners were divided into two groups to ensure that the practical process ran more effectively. A faculty member and students guided each group. The first group was assigned to process vegetables

into chips, from washing and cutting to mixing seasonings and frying. The vegetables processed were water spinach and spinach. The postharvest processing results showed that 2.5 kg of freshwater spinach yielded approximately 1 kg of water spinach chips. In addition, 2 kg of fresh spinach yielded 1 kg of spinach chips. The vegetable chips were named Keripik Viggieponik, or Viggieponik Chips, meaning vegetable chips produced through aquaponics. The vegetable chip varieties included original, balado, and sweet corn.

The second group processed catfish into abon. This activity was carried out under the guidance of FWE members and followed the steps for making catfish abon: cleaning the fish, steaming, shredding the meat, mixing the spices, and frying the abon. All stages were carried out through hands-on practice so that FWE members could fully understand the processing procedure, from raw materials to finished catfish floss. A total of 5 kg of catfish was used in the catfish floss-making practice. This quantity was chosen to save time during the activity, particularly during the processing stage. The spices used were prepared in advance by the community service team to ensure that the practical session ran more efficiently.



Figure 5 . Processed fish and vegetable products from the aquaponic harvest

Nevertheless, the team provided detailed explanations of the spice measurements to FWE members as part of the mentoring process. Information regarding the spice composition was also included in the guidebook provided by the team to support program sustainability. From 5 kg of fresh catfish processed, 1.75 kg of catfish floss was produced. This result indicated weight loss during processing, but it still produced a value-added product that was ready to be developed as a community-based processed food. The catfish floss produced in this activity was named Abon Aquale, or Aquale Shredded Catfish, meaning catfish floss from aquaponics. The catfish floss was produced in three flavor variants: original, spicy, and sweet. In addition to processing, during this phase, FWE members were trained to package the product in accordance with food processing standards and to promote it on social media (Figure 5). Finally, to ensure program sustainability, the community service team provided a guidebook to FWE

members.

In general, the harvest from aquaponic farming can provide residents of Margojoyo Street, Neighborhood Unit 01 and Community Unit 02, with healthier food. The community has a clearer understanding of the origins of the vegetables and catfish consumed in daily life. The catfish and vegetables harvested from aquaponic farming are healthier and more environmentally friendly, thereby providing residents with a fresh, high-quality food source. In addition to providing health and environmental benefits, this aquaponic farming activity also enhances community food security.

Through a simple aquaponics system that can be implemented in a household setting, communities can produce their own food even with limited land availability in their area (Garnida, 2023). The availability of vegetables and catfish, which can be harvested regularly, helps ensure a steady food supply for families, particularly in meeting daily protein and vegetable needs. In addition, the implementation of aquaponics helps increase public awareness of the importance of food self-sufficiency and the productive use of backyard spaces (Awalina et al., 2025; Pratama et al., 2025). With skills in crop cultivation and postharvest processing, communities serve not only as consumers but also as producers of household food. This development represents a strategic step toward supporting community-based food security because it reduces dependence on market price fluctuations and enhances communities' preparedness to cope with potential food supply shortages in the future (Gea, Zandrato et al., 2025).

In addition to serving as a source of supplementary food, this initiative equipped residents with the knowledge and skills to process their harvests into products with higher economic value. Hidayanti et al. (2025) and Taufiq et al. (2025) found that community-based aquaponics can strengthen food security while promoting economic self-reliance. In the long term, implementing aquaponics has the potential to foster more sustainable farming practices, increase environmental awareness, and strengthen community collaboration. These impacts make aquaponics not only a technical solution but also a strategy for sustainable community empowerment (Wulandari et al., 2026). Through this community service initiative, catfish and vegetables that were previously sold only fresh or consumed for family needs can be processed into value-added products, such as catfish floss and vegetable chips, which are more appealing and command higher market prices. Processing these harvests not only improves the quality and variety of food products but also creates new business opportunities for FWE members. These products can be marketed through Micro, Small, and Medium Enterprise (MSME) bazaars, social media, and village cooperatives to support distribution and ensure the sustainability of community businesses. These marketing opportunities are expected to encourage the community to develop small businesses based on aquaponic farming, thereby increasing family income.

### 3.2 Improving aquaponic farming skills and competencies

The average pretest score for knowledge of the aquaponic farming system was 37, and the average score for each topic remained below the standard (Table 5). Furthermore, the average posttest score measured after the mentoring and practical training activities was 82 for aquaponic farming knowledge (Table 5). These pretest results aligned with findings from initial interviews conducted during the observation period, which indicated that FWE members in Jetis Hamlet had never engaged in aquaponics and that most were unfamiliar with the practice. The community believed that engaging in aquaculture or agriculture required a large tract of land.

**Table 5 .** Summary of pretest and posttest results on aquaponic farming system knowledge

Topics	Pretest Average	Posttest Average
Basic concepts of aquaponic	40	80
Tools and materials	30	80
Types of plants	40	85
Types of fish	40	80
Aquaponics system development process	30	85
Aquaponics system maintenance process	30	80
<b>Average</b>	<b>37</b>	<b>82</b>

The average pretest score for aquaponic system installation skills was 52, whereas the average for all other aspects was below 60. Subsequently, the average posttest score obtained after the mentoring and practical training activities was 81 (Table 6). These pretest scores were consistent with the average proficiency in aquaponic farming, which fell below the standard. A representative of the FWE members in Jetis Hamlet stated that they had never practiced or independently carried out aquaponic cultivation.

**Table 6 .** Summary of pretest and posttest results on aquaponic system installation skills

Aspects	Pretest Average	Posttest Average
Preparation of tools and materials	50	80
Assembling the installation	55	80
Caring for fish and vegetables	50	85
Harvesting	50	80
Processing the harvest	55	80
<b>Average</b>	<b>52</b>	<b>81</b>

In general, this community service activity had a positive impact on the abilities and skills of FWE members in Margojoyo Street, Neighborhood Unit 01 and Community Unit 02, as evidenced by the increase in average scores before and after the training (Table 5 and Table 6). These findings are consistent with the results of community service activities by Saputro et al. (2026) and Winarno et al. (2026), which indicated that

mentoring activities had a positive impact on FWE cadres' productivity in optimizing the use of backyard land through aquaponic systems. This community service activity was divided into two phases: a theoretical component focused on building a conceptual foundation for FWE members and a practical component focused on developing members' skills in aquaponics. The activity began with a theoretical session using lectures and discussions led by the community service team, accompanied by a demonstration of a small-scale aquaponics system as a visual aid. This step was taken to establish a strong initial foundation for FWE members because the pretest results and interviews indicated that most participants were unfamiliar with both the concepts and practices of aquaponics. Through the presentation of basic material, FWE members gained a better understanding of the aquaponics system. In addition, the aquaponics model provided by the community service team allowed FWE members to observe the functional relationship among the fish tank, growing medium, pump, and filtration system, ensuring that their understanding was not merely abstract but also concrete and practical.

Following the presentation on aquaponics, the activity continued with a hands-on session on building an aquaponics system using a learning-by-doing approach. Through this approach, FWE members were actively involved in the process of preparing, assembling, operating, and maintaining the aquaponics system, as well as harvesting and processing the harvest. Through this direct involvement, FWE members understood aquaponics not only theoretically but also practically, thereby enhancing their aquaponic cultivation skills (Table 6). This finding aligns with Rasyid et al. (2025), who reported that the learning-by-doing approach can enhance FWE members' knowledge and skills in processing local agro-industrial products. Through the learning-by-doing approach, participants can gain a firsthand understanding of the principles of fish and vegetable cultivation in an aquaponics system, supported by hands-on activities, so that they do not rely solely on theory (Rukmana et al., 2025).

Overall, this community service activity was successfully carried out. This success was evidenced by the successful construction of the aquaponic system, the processing of vegetable chips and catfish floss, and the improvement in FWE members' capabilities and skills in building aquaponic systems and processing harvests into value-added products. This activity focused not only on the cultivation process and harvest processing but also on the product packaging stage and the delivery of material on simple social media marketing. For example, the community service team provided an introduction to and guidance on the use of social media, such as Instagram, through the account @pkkmargojoyo\_mlg to promote and sustain the program in the future. This activity is expected to continue and develop into a local MSME based on aquaponic cultivation. To ensure the program's sustainability, the community service team conducted regular monitoring through online guidance. In addition, to ensure the program's future sustainability,

the team compiled a guidebook, copyrighted under EC002025220058, to serve as a manual for FWE members on setting up aquaponic systems, processing vegetable chips and catfish floss, and following proper product packaging procedures.

## 4. CONCLUSION

The aquaponics training program for FWE members on Margojoyo Street, Neighborhood Unit 01 and Community Unit 02, Jetis Hamlet, Mulyoagung Village, Dau Subdistrict, Malang Regency, East Java, conducted from July to December 2025, had a positive impact on improving participants' knowledge and skills in constructing aquaponics systems and processing harvested produce into local food products. This improvement was demonstrated by the increase in participants' pre-test and post-test scores.

In addition, FWE members were able to maintain the fish and vegetables in the aquaponics system until harvest and process the harvested products into value-added food products, namely catfish floss and vegetable chips. From 2.5 kg of freshwater spinach, approximately 1 kg of water spinach chips was produced, while 2 kg of fresh spinach yielded 1 kg of spinach chips. Furthermore, 5 kg of fresh catfish produced 1.75 kg of catfish floss.

Overall, aquaponic cultivation can contribute to the provision of healthier food for the community. The local food products produced through this training may also serve as a potential strategy for improving household economic opportunities among families on Margojoyo Street, Neighborhood Unit 01 and Community Unit 02.

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## CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

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