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Introduction to aquaponics system in the bucket as an effort to meet household food needs in the Covid-19 pandemic era of the Dompyong Village community, Trenggalek Regency

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Abstrak Program Pemanfaatan Lahan (P2L) yang digagas pemerintah bertujuan untuk mengajak masyarakat memanfaatkan lahan pekarangan secara intensif dengan sumber daya local untuk ketahanan pangan keluarga. Permasalahan yang kerap muncul di Desa Dompyong, Kabupaten Trenggalek adalah rendahnya aktivitas masyarakat dalam pemanfaatan lahan pekarangan disebabkan oleh minimnya pengetahuan dan keahlian mereka. Lebih lanjut, sebagai wilayah pegunungan, masyarakat Desa Dompyong juga dihadapkan pada masalah ketersediaan air. Oleh karena itu, kegiatan pengabdian masyarakat diselenggarakan untuk memperkenalkan dan menyediakan pelatihan serta pendampingan kepada masyarakat mitra dalam sektor perikanan dan pertanian, yaitu sistem akuaponik di dalam ember. Sistem akuaponik sederhana ini membutuhkan sumber daya dan biaya yang minimal namun mampu menghasilkan produk perikanan sekaligus pertanian yang cukup untuk memenuhi kebutuhan konsumsi keluarga. Sistem akuaponik di dalam ember ini diharapkan mampu mendukung progam ketahanan pangan rumah tangga di Desa Dompyong, meningkatkan partisipasi masyarakat pada sektor perikanan, dan meningkatkan pemenuhan kebutuhan gizi keluarga.

Abstract The government Program Pemanfaatan Lahan (P2L) aims to appeal communities to utilize yards intensively with local resources ensuring household food security. The problem occurring in Dompyong Village, Trenggalek Regency is the lack of community activity in utilizing their yards due to the lack of knowledge and skills. Furthermore, as a highland area, the Dompyong Village community also experiences a problem with the availability of water sources. Therefore, this community service activity was held to introduce and provide training and assistance to the community in fishery and agricultural sectors, namely the aquaponics system in the buckets. This simple aquaponics system required minimal resources and costs but produces fishery as well as agriculture products for household consumption. This aquaponics system in the bucket was expected to support the household food security program in Dompyong Village, increase community participation in the fishery sector, and increase the fulfilment of household nutrition needs.

Keywords: aquaponics; community; fishery; food security; household

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INTRODUCTION

Dompyong Village, Bendungan District, Trenggalek Regency is a mountainous village at an altitude of 729 m above sea level. The total area of Dompyong Village is 1,782 ha. The utilization of which consists of 35 ha of rice fields, 127.5 ha of plantations, 95 ha of yards, 1,257 ha of forest, and other uses covering an area of 267.5 ha. The population of Dompyong Village in 2019 was 3,622 people, consisting of 1,823 male residents and 1,799 female residents. More than 26% of its population worked as dairy farmers. There were 512 male breeders and 430 female breeders in Dompyong Village (Badan Pusat Statistik Kabupaten Trenggalek, 2019).

Dompyong Village development policy is to improve the welfare and quality of life of its people. The village government's target programs include poverty alleviation through the fulfilment of basic needs, provision of facilities and infrastructure, developing local economic potential, and utilizing natural resources and the environment sustainably (Pemerintahan Desa Dompyong, 2017). To achieve these goals, the village government divided community group activities into several sectors, namely activities engaging in agriculture, animal husbandry, and fishery sectors.

However, the group that has been active in carrying out activities so far is only in the agriculture sector group. According to the statement of the Chief of the Village, the group's inactivity in the fishery sector is due to the difficulty of finding the right activity or program that can be carried out by the community without having to spend much capital considering that the majority of the population are farmers whose economy is certain to be limited. Another obstacle experienced by the fishery group is related to land availability. Although Dompyong Village has a large area of unoccupied land, they are forest and hilly fields. It is extremely difficult to carry out cultivation in those areas, especially for the provision of water sources. Based on this problem, the Community Service Team conducted training in the fishery and agriculture sectors, namely “the aquaponic systems in the bucket”. The “aquaponics system in the bucket” is cultivating fish and plants (vegetables) in one bucket, without the need for pumps, filters, and electricity. This simple aquaponic system does not require a large land size and affordable for the community.

It is hoped that the aquaponics system in the bucket will be part of the community movement for the utilization of house yard for household food security, which has been proclaimed by the Ministry of Agriculture since 2011 through the Kawasan Rumah Pangan Lestari (KRPL, literally translated as Sustainable Food House Area) program. The program transformed into Program Pemanfaatan Lahan (P2L, literally translated as Land Utilization Program) in 2020. This movement aims to appeal community cultivating their yards intensively with various local resources that ensure the continuity of the supply of high quality and varied household food. The targets of the introduction and training of this simple aquaponics are the support for the household food security program in Dompyong Village, the increase of community participation in the agriculture and fishery sector, and the fulfilment of household nutrition needs. Furthermore, this activity has a direct impact on the development and application of science and technology in a higher education institution.

METHOD

This community service activity was carried out in several stages, consisting of the stages of preparation, implementation and evaluation. The preparatory stage begins with the socialization of activities carried out in the destination areas for the implementation of community service programs involving officials from Dompyong Village, Bendungan District, Trenggalek Regency. The target community that becomes partners was the fishery community group. The Community Service Team contacted village officials and received the hamlet head's contact number. Indirect communication was chosen with the consideration of the Covid-19 pandemic conditions which necessitated social distancing. Furthermore, the head of the hamlet created a group on the Whatsapp application which contained Community Service Team members and 20 participants who were willing to take aquaponics training. Then, the team formed these participants into 4 small groups of 5 members. In this preparation stage, the Community Service Team conducted online discussions with fishery groups and local village officials with the aim of:

1. Providing information about the objectives and intentions of the community service program;
2. Collecting data on problems faced by the community in the fishery sector;
3. Conducting discussions about the utilization of a house yard for fishery entrepreneurship; and
4. Discussing the location and schedule for the implementation of this community service program.

The team prepared training materials to be presented to the participants as follows:

1. Provide training information and the advantages of the aquaponics system in the bucket when compared to other cultivation systems.
2. Provide training on how to manufacture and control the aquaponics system in the bucket.
3. Providing sustainable aquaponics entrepreneurial management methods.

In the field practice of the aquaponics system in the bucket, several steps were carried out including:

1. The preparation stage of cultivation materials and tools,
2. The preparation stage of fish seeds,
3. The stage of making the aquaponics container,
4. Stage of control of the aquaponics system in the bucket,
5. Harvesting stage,
6. The sales stage.

The success of this community service was evaluated during the implementation. The initial evaluation was carried out in two ways, namely:

1. During the core activity, when participants receive training materials and the practice of aquaponics in the bucket.
2. Outside the core activity, namely reviewing the quality of fish aquaculture carried out in buckets as well as the quality of hydroponic vegetables produced for the participants to start independent aquaponics entrepreneurship.

Based on the results of surveys and online discussions with the participants and government officials in Dompyong Village, they were extremely interested in this aquaponics in bucket

training activities. The description of the activities that will be transferred to partners can be seen in Figure 1.

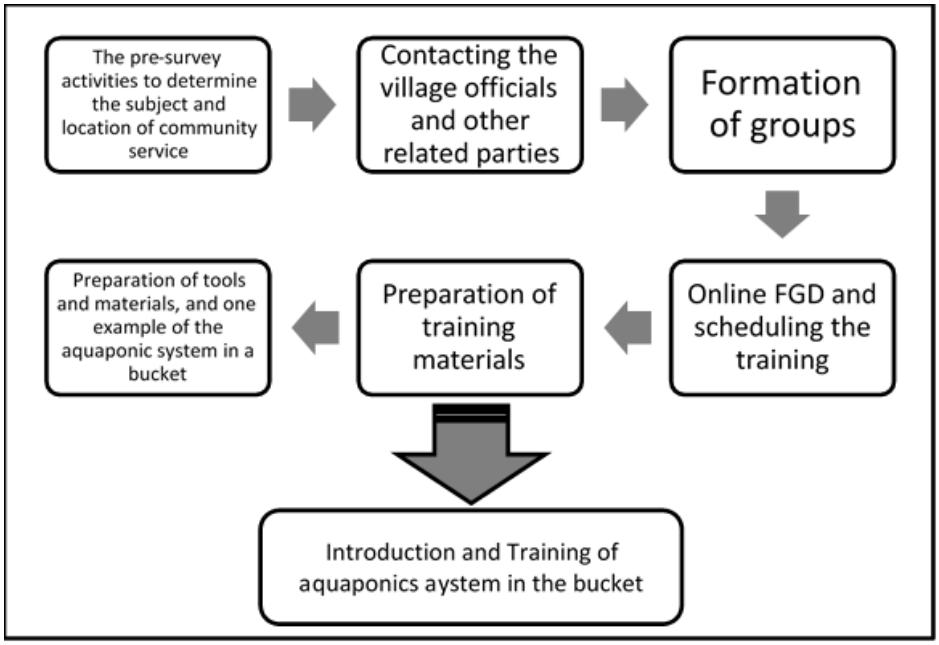

Figure 1. Diagram description of activities transferred to partners

RESULT

Community Service entitled "Introduction and Training of The Aquaponics System in The Bucket in Dompyong Village, Bendungan District, Trenggalek Regency" was held in August 2020. The stages of this activity were:

1. Preparation Stage

This preparation stage was preceded by pre-survey activities carried out by the Community Service Team. Dompyong Village has potential for aquaculture development. From the online FGD (Focus Group Discussion) conducted with fisheries groups and village officials, problems and obstacles were found, namely limited land and capital owned by the group. Therefore, the training of the aquaponics system in the bucket was the right solution for the problems of fishery groups in Dompyong Village. The Community Service Team then informed the purpose of this community service and determined the location and schedule for the implementation of the activities. The Community Service Team also prepared one example of an aquaponics system in the bucket to be presented for the participants on the scheduled days (Figure 2).

Figure 2. The preparation of one example of an aquaponics system in the bucket

2. Training of the aquaponics system in the bucket

This training of the aquaponics system in the bucket was carried out at the house of one of the members of each fishery group. Therefore, it can be said that the training was conducted door-to-door. Participants of each group live close to each other, so they gathered at one of the member's house and received training materials. Because activities were carried out during the Covid-19 pandemic, health protocols became a major concern besides the delivery of the training material itself. The training began with a lecture method using brochures and aquaponics introduction videos. The brochure provided information on the advantages of aquaponics when compared to other cultivation systems (Figure 3).

The team also conveyed directly to the participants that the aquaponics system in the bucket does not require electricity for oxygen supply and pool water recirculation, which made this technology is simple and inexpensive. Using a bucket instead of a pond will save space due to limited space available, so starting aquaponics is considered the best solution. The aquaponics system in the bucket can also save time than digging a pond. Another advantage is the ease of harvesting compared to harvesting in the pond. After the introduction of the aquaponics system in the bucket, participants seemed enthusiastic to practice as depicted in Figure 4.

After the lecture, the Community Service Team presented and practised the aquaponics system in the bucket. The tools and materials that have been prepared included a 60 litre-bucket, used plastic cups of mineral water (around 9 cups for one bucket circumference), planting media (in the form of charcoal, rockwool, soil, husk, or cocopeat), vegetable seeds (such as water spinach, spinach, mustard greens, lettuce, or other leafy vegetables) and about 40-50 fish seeds (such as catfish, gourami, tilapia, or cork), size 5-8 cm.

Figure 3. Example of the brochure for the aquaponics in the buckets for participants

Furthermore, the Community Service Team provided training in maintenance and business management of the aquaponics system in the bucket. Maintenance of this system can be performed by changing the water every 3 weeks. Meanwhile, the feed dose is given ad libitum or as much as possible depends on the type of fish. Harvesting of fish (in this training using catfish) can be done after 2 months of cultivation, while harvesting of vegetables (in this training using water spinach that has been previously sown) can be done 4 times in one period of the aquaponics system. The Community Service Team also provided socialization regarding the sale of fish and vegetable products. The market for these two commodities is very easy to find, starting from the surrounding traditional markets, as well as direct sales to fish and vegetable-based factories or home industries. Nevertheless, the Team appeal to the community to apply this aquaponics system in the bucket for household food security. It was discovered from the interview and online FGD that rarely do the community of Dompyong Village consume fish as the source of protein in their daily meals. Before ending the activity, the Team distributed each participant with 30 catfish seeds and vegetable seeds for free to motivate them starting the aquaponics system in the bucket.

Figure 4. The enthusiasm of participants in joining the training

3. Participants' implementation of the training

The Community Service Team maintained communication with the participants even after training to be able to monitor the progress of the implementation of the activities carried out by the participants. It was not uncommon for discussions conducted through the WhatsApp application to also be conducted with online meeting media such as zoom meetings facilitated by village officials. The participants admitted that for approximately 60 days (2 months) applying the aquaponics system in the bucket, they obtained fish yields of between 3,500-5,200 grams per bucket for their household consumption. Meanwhile, participants harvested water spinach once every week per bucket starting from the first week of the second month. Participants are continuing the activity to the present day and they are adding more buckets, modifying the size of the bucket and type of fish and crops for the aquaponics system, and inviting more households to do the same activity.

In simple terms, aquaponics can be described as a combination of aquaculture (fish farming) and hydroponics (cultivation of plants/vegetables without soil media). This system adopts an ecological system in the natural environment, where there is a mutual symbiotic relationship between fish and plants (Sastro, 2016). During the implementation of the aquaponics system in the bucket, the Community Service Team conceives that the aquaponics system in the bucket has several advantages in terms of its doer (the actor) and the environment. The actor benefits from this activity in the form of fish and crops to fulfil household needs (Perwitasari *et al*., 2019) and even on a large-scale, it can be used as a source of the household's economy (Johnson, 2016; Sulistyo *et al*., 2016). Besides, simple aquaponics systems are easy to maintain. In conventional fresh-water fishery systems, the time spent caring for fish is around 10 minutes per day, draining and cleaning the pond must also be performed regularly. With a simple aquaponics system application, maintenance does not require excessive energy and it is enough to do it once a week or twice a week depends on the size of the fish and bucket, on average, including cleaning and checking temperature, pH, and ammonia levels (Fathulloh & Budiana, 2015; Halim, 2018).

In terms of the environment, the aquaponics system, in general, is an environmental ecosystem between fish and plants that is incredibly water efficient (Nursandi, 2018). The decrease in water volume still occurs, but the amount is relatively small due to the process of water evaporation and is absorbed by plants. The addition of water is only done about once a

week to a predetermined water level, while the conventional fishery system must replace or fill the pond repeatedly so that the fish are not poisoned from the fish waste itself. Furthermore, in a fishery system, fish waste and feed residue must be cleaned, otherwise, ammonia buildup will occur which can poison the fish. In the aquaponics system, water containing waste is converted by microorganisms into nutrients that are beneficial for plant growth, so that no water and feed residue is wasted, all of which can be reused (Akter *et al*., 2018; Dauhan *et al*., 2014). Moreover, the research result of Hu *et al.*, (2015) showed that different plant species in an aquaponics system affect differently in nitrogen transformations primarily due to their root surface area. The higher the root surface area, the more abundance of nitrifying bacteria in such plant-based aquaponics. Plants in the aquaponics system do not use chemical fertilizers during their growth and fish in the aquaponics system do not need chemical elements during cultivation (Sagita *et al*., 2014). Aquaponics uses waste or fish waste as fertilizer for plants (Junge *et al*., 2017), plant growth becomes natural and aquaponic crops are guaranteed to be free from chemical elements (Susetya & Harahap, 2018).

CONCLUSION

Based on the results of community service activities that have been carried out, it can be concluded that:

1. There is an increase in the knowledge of the Dompyong Village community about the aquaponics system in the bucket, its advantages, and its application in their house yard.
2. The Dompyong Village community can directly practice the aquaponics system in the bucket, its cultivation and maintenance, and its business management.

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