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Socialization of aquaponics techniques for business efficiency at Aling Hydroponic Farm, Sandakan Sabah Malaysia

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ABSTRACT

Aquaponics is the application of integrated agricultural techniques between the cultivation of fish and vegetables that are environmentally friendly with efficient use of inputs and optimizing production. Aling Hydroponics Farm has long applied hydroponic techniques for cultivating vegetables, apart from also cultivating fish using fiber ponds. However, the application of these two techniques has not been integrated so that it is not efficient in using production inputs. This international collaborative community service activity aims to socialize aquaponic techniques to Aling Hidroponik Farm partners as an effort to increase the efficiency of resource use in farming. The method of implementing activities uses visits and discussions at hydroponic cultivation and fish cultivation locations. This activity was attended by lecturers from the Faculty of Agriculture, Muhammadiyah University of Makassar and lecturers from the Faculty of Sustainable Agriculture, Universiti Malaysia Sabah, students and the community. The results of the activity showed that the participants were very enthusiastic about taking part in the activity, the participants actively asked questions and expressed opinions regarding the opportunities and obstacles to implementing the aquaponic system from economic and social aspects.

Kata Kunci
Akuacultur
Hidroponik
Pertanian terintegrasi
Ramah lingkungan

Sosialisasi teknik akuaponik untuk efiesiensi usaha pada Aling Hidroponik Farm, Sandakan Sabah Malaysia. Akuaponik merupakan penerapan teknik pertanian terintegrasi antara budidaya ikan dan sayuran yang ramah lingkungan dengan tingkat efisiensi penggunaan input dan mengoptimalkan produksi. Aling Hidroponik Farm telah lama menerapkan teknik hidroponik untuk budidaya sayuran, selain itu juga membudidayakan ikan menggunakan kolam fiber. Namun penerapan kedua teknik ini belum terintegrasi sehingga belum efisien dalam penggunaan input produksi. Kegiatan pengabdian masyarakat kolaborasi internasional ini bertujuan untuk mensosialisasikan teknik akuaponik pada mitra Aling Hidroponik Farm sebagai salah satu upaya meningkatkan efisiensi penggunaan sumber daya dalam usaha tani. Metode pelaksanaan kegiatan menggunakan metode kunjungan dan diskusi di lokasi budidaya hidroponik dan budidaya ikan. Kegiatan ini diikuti oleh dosen dari Fakultas pertanian Universitas Muhammadiyah Makassar dan Dosen Fakulti Pertanian Lestari Universiti Malaysia Sabah selaku, mahasiswa dan masyarakat. Hasil kegiatan menunjukkan bahwa peserta sangat antusias mengikuti kegiatan, peserta aktif bertanya dan mengemukakan pendapat terkait peluang dan hambatan penerapan sistem akuaponik dari aspek ekonomi dan sosial.

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INTRODUCTION

Aquaponics is a production system that integrates hydroponics with a recirculating aquaculture system for the simultaneous production of plants and fish (Okomoda et al. 2023). Aquaponics is a combination of aquaculture and hydroponic techniques (Allen Pattillo et al. 2022). Aquaponics is a cultivation system designed for mutual benefit by combining vegetables and fish to produce more production at lower costs (Bich et al. 2020). The main principle of the aquaponics system is to save land and water use and increase business efficiency by utilizing food waste and fish metabolism as nutrients for plants (Zidni et al. 2013; (Zidni et al. 2019). Aquaponics can be used as an effort to overcome food scarcity and the environmental crisis facing the world today. A sustainable food system requires the support of resource-saving food production practices through aquaponic cultivation techniques that can minimize the use of water and fertilizer and reduce waste.

Aquaponics can be used as an effort to overcome food scarcity and the environmental crisis facing the world today. A sustainable food system requires the support of resource-saving food production practices through aquaponic cultivation techniques that can minimize the use of water and fertilizer and reduce waste.Aquaponics has not been widely applied, people mostly apply hydroponics for vegetables. Aling Farm Hidropnik is one of the hydropnic farmers who has successfully cultivated several types of vegetables. Aling Farm also breeds fish using fiber ponds. However, these two systems are managed separately, so they are less efficient in using resources. Through this activity, the implementing team will socialize aquaponic techniques to partners to provide an overview of the principles of aquaponics, the advantages and disadvantages of aquaponic systems.

Intensive fish farming (aquaculture) requires 50-60% feed costs (Abo-Taleb, H.A. et al, 2021; Mabrouk, M.M. et al, 2022; (Goda et al. 2024). The weakness of the aquaculture system is that it is wasteful of water and aquaculture waste causes environmental pollution (Rakocy, J.E., Losordo, T.M. & Masser, M.P, 2006; (Khater et al. 2024). The vegetable cultivation system with a hydroponic system is efficient in water use because it only uses 5% of water compared to conventional systems (Rackoy, 2012; Alshrouf A, 2017; (Folorunso et al. 2023). The results of the study (Folorunso et al. 2023), vegetable production with a small and medium-scale hydroponic system provides benefits.

Fish and plant cultivation by implementing plant and fish integration will produce products in the form of fish and vegetables and reduce the use of water and chemical fertilizers (Sewilam, Kimera, and Nasr 2023). Fish waste containing nutrients can fertilize plants and plants can purify fish farming water because they absorb these nutrients (Kyaw & Ng, 2017) (Khater et al. 2024). The results of the study (Knaus et al. 2024) showed that lettuce cultivation with an aquaponic system can increase production by 40% compared to conventional hydroponic systems.

The small-scale aquaponic system is one solution for sustainable household food production because it is able to produce fresh fish and vegetables and supports environmental sustainability by minimizing the use of water and chemical fertilizers (Zamnuri et al. 2024).

The Aquaponic System is an agricultural system that supports the sustainable development goals (SDGs), especially goals 1 and 2, namely no poverty and no hunger. This international collaborative community service activity aims to socialize aquaponic techniques to Aling Hidroponik Farm partners as an effort to increase the efficiency of resource use in farming businesses

METHOD

The partner of the international collaborative community service activity is Aling Hidroponik Farm, a farmer engaged in vegetable cultivation with a hydroponic system. The location of the activity is on the land of Aling Hidropnik Farm which is located at the design of the Manila River lot 245, Ranking 3, Batu 12 90000 Sandakan (Figure 1). The 10 participants of the activity are hydroponic farmers who are around the partner's location.

This community service activity will be carried out from November 2023 to May 2024 including socialization activities and implementation of the aquaponic system as well as assistance in recording the business. The socialization activity was carried out on November 26, 2023. The socialization was divided into 4 stages, namely: 1) Opening and Introduction of the implementing team; 2) Explanation of the hydroponic system; 3) Explanation of the aquaculture system; 4) Explanation of Aquaponics.

The implementing team for this international collaboration community service activity consists of lecturers and students from two universities, namely the Faculty of Agriculture, Muhammadiyah University of Makassar, and the Faculty of Sustainable Agriculture, Universiti Malaysia Sabah.

Figure 1. Location of Aling Hydroponic Farm Sandakan, Malaysia

RESULTS AND DISCUSSION

Community service activities begin with an opening by providing an explanation of the aims and objectives of community service activities to target partners. This activity aims to share experiences between the implementing team and partners in implementing hydroponic, aquaculture and aquaponic systems (Figure 2).

The team implementing community service activities consists of lecturers with multidisciplinary fields of expertise, namely plants, fisheries and agricultural social economics. The implementing team is lecturers from the Faculty of Sustainable Agriculture, University of Malaysia Sabah, the Faculty of Agriculture, Muhammadiyah University of Makassar and the Faculty of Agriculture, Animal Husbandry and Fisheries, Muhammadiyah University of Pare-pare.

Figure 2. Opening of activities

Hydroponic System

Hydroponics is a technology for cultivating plants without soil to produce high-quality, healthy, fresh and residue-free vegetables (Khan, Purohit, and Vadsaria 2020). Hydroponics is a farming technique without using soil by flowing nutrients to plant roots to support plant growth nutrients (Rockey, 2021; (Folorunso et al. 2023), this system is a plant production technology by controlling water supply, pH, temperature, pest and disease attacks, so as to reduce labor in producing vegetables in high volumes without using soil media (Ramos 2022). There are several types of hydroponic systems, including; 1) Nutrient Film Technique or NFT hydroponics (Hadidjah and Triyono 2017); 2) wick hydroponics (Santi and Nyayu 2022); 3) ebb and flow techniques (Hadidjah and Triyono 2017).

Aling Hydroponics Farm has been running a vegetable cultivation business using a hydroponic system using hydroponic Nutrient Film Technology or NFT (Figure 3) for the production of leaf vegetables such as lettuce, pak choy, mustard greens, kale and mint leaves (Figure 4).

Figure 3. Mitra's Hydroponic NFT System

Figure 4. Types of hydroponic vegetables at partner locations

The nutrients used in this hydroponic system are AB Mix which consists of nutrient A containing macro nutrients and Nutrient B containing micro nutrients which are chemical fertilizers. The use of AB mix nutrients in vegetable cultivation with a hydroponic system is needed in large quantities and its fairly expensive price will have an impact on the high input costs in the hydroponic system.

Alternative solutions to overcome the problem of high nutrient costs in hydroponic systems are to utilize agricultural waste such as; 1) tofu waste (Chiquito-Contreras et al. 2022); 2) biogas waste (Sakuma, Endo, and Shibuya 2023); 3) vinasse (Khan et al. 2020). The advantages of hydroponics compared to conventional agricultural systems are that it is easy to control, there is no soil contamination, faster plant growth, faster harvest time, high quality and is preferred by consumers. According to research results (Sapkota et al, 2019); (Solis and Magaret 2022) lettuce grown hydroponically can be harvested at 30 days, while with conventional techniques it takes 70 days.

Aquaculture System

Aquaculture is a system of fish maintenance and production under controlled conditions (Somerville C, et al., 2014). Aquaculture is classified into three groups, namely: 1) flow; 2) pond; 3) Recirculating aquaculture system (RAS); 4) open-net pe or net cage, floating and bottom (Chiquito-Contreras et al. 2022).Current activity partners are raising tilapia using fiber ponds (Figure 5).

Figure 5. Cultivating fish using fiber ponds

Aquaponics System

Aquaponics is an integrated cultivation system between fish cultivation with a recirculation system and hydroponics in one production system, where water from the fish pond is channeled through a filter to the plants as a source of nutrition and back to the fish pond (Somerville C, et al., 2014). Aquaponics can overcome poisoning in fish by using plants as biofilters to maintain water quality without disturbing fish growth (Bich et al. 2020). Aquaponics utilizes fish waste and nutrient-rich food waste to fertilize plants and prevent their release into the environment (Allen Pattillo et al. 2022).

Aquaponics is an alternative solution to increase the efficiency of farming efforts. The use of an aquaponics system in integrated fish and vegetable farming will increase the efficiency of cost and labor usage. According to (Somerville C, et al., 2014), aquaponics is an integrated cultivation system between fish farming with a recirculation and hydroponic system in one production system, where water from the fish pond is channeled through a filter to the plants as a source of nutrients and returned to the fish pond. An illustration of the aquaponic system that will be applied to partners can be seen in Figure 6.

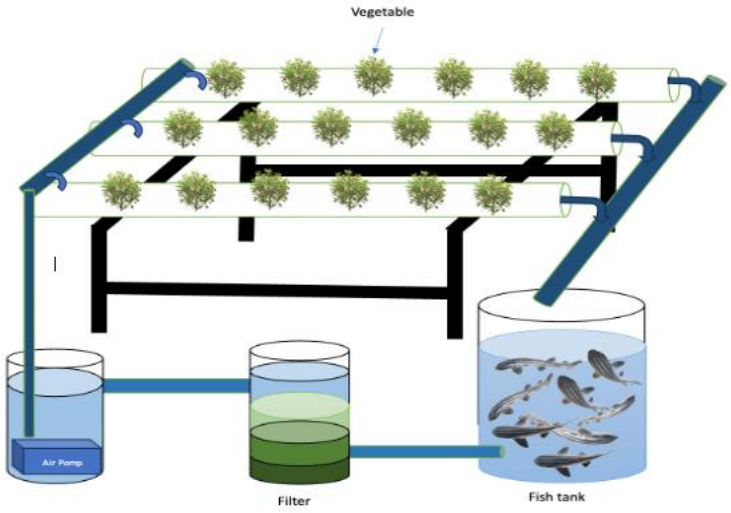

Figure 6. Illustration of the application of Aquaponics

Aquaponics has several advantages, including: 1) overcoming fish poisoning by utilizing plants as biofilters to maintain water quality without disrupting fish growth (Bich et al. 2020); 2) reducing environmental pollution due to pond water waste containing leftover feed and feces; 3) saving the cost of purchasing chemical fertilizers for plant nutrition in vegetable cultivation. Aquaponics utilizes fish waste and leftover feed (waste) which is rich in nutrients to fertilize plants and prevent its release into the environment (Allen Pattillo et al. 2022). Types of vegetables that can be combined with fish in an aquaponic system include mustard greens, spinach, kale, pak choy, lettuce. Research (Bich et al. 2020), using Talapia fish and spinach, while research (Hadidjah and Triyono 2017); (Zidni et al. 2019), using catfish and green mustard greens and kale.

The selection of types of fish and vegetables that will be used in aquaponic cultivation in this socialization activity places greater emphasis on community habits and the market potential of the fish and vegetables that will be cultivated so that the resulting fish and vegetable products can be sold on the market.

Based on the results of discussions with target partners, people generally like tilapia fish, so during socialization it is recommended to use this type of fish. Several types of fish that can be cultivated in aquaponic systems such as catfish, snakehead fish, tilapia. Fish that are commonly cultivated in Malaysia include: 1) Red tilapia (Hamid et al. 2023), 2) red tilapia (Anjur, Ali, and Shahadan 2024). Tilapia or Nile tilapia (Oreochromis niloticus) is widely cultivated because it tastes delicious and does not have many bones so it is liked by the community or consumers, and has good reproductive ability and can breed in natural habitats or in cultivation ponds (Susanto and Hermawan 2013).

Target partners use commercial feed in fish farming in fiber ponds. The cost of using fish feed in intensive fish farming in tarpaulin ponds is around 50-60% of the total cost (Goda et al. 2024). The high price of feed is a challenge for farmers in intensive fish farming (Anjur et al. 2024) The use of alternative feed is one solution to overcome the high cost of feed in fish farming. According to (Nurzanah, W., 2022), Duckweed (Lemna minor) can be used as an alternative feed for red tilapia. One species of Duckweed is Azolla (Moga, Craciun, and Matache 2017).

Pests that often attack lettuce plants in hydroponic systems are thrips and aphids (da Silva et al. 2024). Microorganisms that are harmful to humans found in aquaponic systems from the bacterial group include: 1). Actinetobacter vaumanii in hybrid catfish (Clarias macrocephalus x C.gariepinus) and lettuce plants (Lactuca sativa) (Dong, M, Feng, H.2022); (Dinev et al. 2023); 2) E. coli in Nile tilapia (Oreochromis niloticus) and lettuce (Lactuca sativa); (Dorick et al. 20210; (Dinev et al. 2023). Diseases caused by fungi such as: 1) Fusarium spp in lettuce and Clarias fish (Clarias gariepinus) and Carp (Cyprinus carpio) (Rakhashiya, P.M.; Patel, P.P.; Thaker, V.S, 2015; Sheema, K.K, Dorai, M., Paul D. 2017; Sprute et al., 2022; Dinev et al., 2023). 2) Phytium spp in lettuce plants (Lactuca sativa) (Alhussaen, K. 2006; (Dinev et al. 2023).

CONCLUSION

The research revealed the role of sharing knowledge on the principles of hydroponic cultivation and intensive fish farming using a recirculation system to the target partners. Meanwhile, this outreach activity has provided target partners with an understanding of the concept of an aquaponic system in integrated vegetable and fish cultivation as an effort to increase business efficiency by utilizing the availability of limited resources, namely natural resources, human resources and funds. In order to enhance more understanding of aquaponics concept to partners, it is necessary to carry out the implementation and assistance activities for cultivating vegetables and fish using an aquaponic system.

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