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Environmental Education Through Fish and Vegetable Farming (Aquaponics) at Menara Fitrah Islamic Elementary School

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Abstract

Instilling an attitude of environmental care can be done from an early age, namely in elementary school, through direct practice outside the classroom. One activity that can instill an attitude of environmental care is fish and vegetable farming (aquaponics). Menara Fitrah Islamic Elementary School is one of the schools that has adopted an attitude of environmental care, making it a partner in this community service activity. The purpose of this activity is to increase students' attitudes toward caring for the environment through fish and vegetable farming (aquaponics). This community service was carried out using Asset-Based Community Development (ABCD), which involves community service grounded in the community's strengths and potential. Community service activities are carried out through a preparation stage, namely coordination between the implementation team and the school, a socialization stage, and fish farming training for sixth-grade students and science teachers, a mentoring stage through fish and vegetable farming (aquaponics) involving sixth-grade students and students as field practice activities, and an evaluation stage. The results show that the activities carried out can increase students' awareness of the environment and, with direct student involvement in fish and vegetable farming (aquaponics), increase it by 100%.

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INTRODUCTION

The instilling of knowledge, skills, and attitudes in elementary education is the foundation for shaping children's personalities and shaping future societal identities. This instilling of these personalities can be realized through environmental awareness education. Environmental awareness is an attitude and action aimed at preventing damage to the surrounding natural environment and at repairing existing damage. A lack of concern for the environment can lead to environmental sustainability problems (environmental damage). In 2006, the Ministry of Environment developed an environmental education program at the elementary and secondary levels through the Adiwiyata program, which aims to create schools that have knowledge and awareness for school residents, thus fostering an environmentally conscious character in environmental

conservation efforts through good school governance to support sustainable development (Ministry of Environment, 2013).

Environmental education can be applied to students' attitudes and behaviors, helping them understand the importance of the environment and thus reflect it in their daily lives (Rahayu et al., 2020). Environmental awareness is fostered through character development, which begins at an early age, typically in elementary school (Ismail, 2014). According to Setyani (2013), environmental education is provided through formal education, both in elementary schools, to increase students' knowledge, skills, and awareness of environmental values.

Menara Fitrah Islamic Elementary School is one of the schools in Ogan Ilir that has implemented environmental awareness programs, including maintaining classroom and school cleanliness by avoiding littering, caring for plants (flowers), and conserving water and electricity. There are no environmental awareness activities related to school subjects conducted outside of the classroom.

Schools, as learning platforms, can effectively equip students with skills that can be practiced in everyday life outside of school hours and environments. Character building in elementary schools can be achieved through environmentally conscious learning. This is in accordance with the statement Rahayu et al., (2021) that schools must provide effective learning practices to develop environmentally responsible behavior and create a representative learning environment that is needed to provide ample space and opportunities for students to learn outside the classroom, observe nature, and practice and test theories they have learned in the classroom about the environment.

According to Winarni et al., (2015), the right learning method approach will increase students' understanding of the surrounding environment. Environmental education emphasizes the tradition of learning based on facts (fact-based education) (Gustafsson, 2008). The school environment, as part of nature, is a learning resource that can be explored, developed, and made into an engaging learning medium for students (Rahayu et al., 2020). Utilizing the school environment as a learning medium can increase environmental insight for students (Lismawati, 2018).

Menara Fitrah Islamic Elementary School has land that is not optimally utilized, resulting in it becoming easily overgrown and reducing the beauty and comfort of the school environment, which should provide students with a comfortable learning environment (Figure 1). Therefore, land optimization is necessary to utilize it for fish and vegetable farming (aquaponics) in support of the school's environmental awareness program. According to Bahrudin (2017), and Tikho & Gunandsyah (2017), vacant land around the school can be used for fish farming, increasing productivity (Sahribulan et al., 2022).

Aquaponics is a mutually beneficial combination of fish and vegetable farming systems. Aquaponics is a learning tool about environmental ecosystems that students can easily learn, understand, and practice (Rahayu et al., 2021). This material encompasses the mechanisms of growth and survival of organisms in nature, which are taught in natural science subjects at school. This facilitates easy understanding and practice, further enhancing student skills.

Fish and vegetable farming systems (aquaponics) utilize fish wastewater by converting it into nutrients beneficial for vegetable growth with the help of microorganisms. This eliminates the wastewater and feed waste, allowing it to be reused. The microbes in the media convert the wastewater into nitrites and nitrates, which are then absorbed by the vegetables as nutrients, promoting healthy growth. The water is also safer for the fish, as the vegetables and the media act as a water filter (Habiburrohman, 2012). Selecting commodities for an aquaponic system plays a crucial role in planning and achieving desired results. According to Suhubawa & Puspita (2021), freshwater fish suitable for aquaponic cultivation include tilapia, carp, koi, catfish, and giant prawns. Other vegetables suitable for aquaponics include red spinach, green spinach, kale, watercress,

and pak choi. Menara Fitrah Islamic Elementary School, Ogan Ilir, is a public school that follows the curriculum of the

Ministry of Education, Culture, Research, and Technology, as well as the Integrated Islamic School curriculum. The human resources (HR) of teachers are dominated by 31 Bachelor of Education, 2 Bachelor of Science, 1 Bachelor of Psychology, 1 Bachelor of Economics, and 1 Bachelor of Social Sciences. Only one graduate from the field of agriculture. This results in limited knowledge of fish and vegetable farming (aquaponics). Therefore, the selection of catfish and kale vegetables can be implemented as an environmental awareness program through fish and vegetable farming (aquaponics) at Menara Fitrah Islamic Elementary School, Ogan Ilir.

The objectives of this activity are to increase environmental awareness, improve the utilization of unused school land, improve environmental health, and introduce and enhance partners' knowledge in fish and vegetable farming (aquaponics).

METHODS

This community service was carried out using Asset-Based Community Development (ABCD), a method that leverages the community's strengths and potential. Data collection was conducted through discussions, interviews, outreach, and hands-on practice. This community service activity was conducted in June 2023 at the Menara Fitrah Islamic Elementary School in Ogan Ilir. The community service activities were conducted with sixth-grade students at the Menara Fitrah Islamic Elementary School in Ogan Ilir. The method used was active participation by partners in technology and knowledge transfer projects. The community service activities were conducted through several stages: preparation, outreach, training, and mentoring. The stages are as follows:

1) The preparation phase begins with coordination and a survey of the Community Service Team and partners.
2) The socialization and training phase begins with the presentation of material on independent feed production, catfish floss production, and financial management by the Sriwijaya University Community Service Lecturer Team. This is followed by discussions and training on independent feed production, catfish floss production, and financial management.
3) The mentoring phase. This phase is conducted using demonstration plots (demplots), providing partners with the opportunity to practice ornamental fish farming using the material presented in the socialization and training phase, with technical staff, namely students, present as part of the Field Practice activity.
4) The final stage in this implementation method is evaluation, which aims to measure the impact of this community service activity. Evaluation is conducted by observing and assessing participants' activities and by using tests or questionnaires to measure improvements in their knowledge and skills. Furthermore, during this evaluation stage, the community service team also identifies the strengths and weaknesses of the activity implementation. Input obtained from participants is crucial for improving and developing similar activities in the future. This evaluation focuses not only on the final results but also on the implementation process, thus providing a comprehensive picture of the effectiveness of this community service program.

RESULTS AND DISCUSSION

Community service activities are carried out in several stages: preparation, outreach and training, and mentoring. The preparation stage begins with coordination and a survey of the community service team and partners. Coordination with partners aims to inquire about the problems they face and solicit their willingness to cooperate.

At this stage, the Community Service Team and partners develop a community service program plan, including a timeline for implementation. Partners will play an active role by providing facilities and props for the community service activities. One of the key

factors in the successful implementation of the community service program is the strong collaboration between the organizers, specifically the community service team, and the partners (Setyaningrum et al., 2020). For this activity, the partners prepared facilities such as a hall, sound system, and projector, and gathered teachers and sixth-grade students as participants. The proposing team prepared fish feed, fish, kale seeds, a fish pond, charcoal as a growing medium for kale, and an aquaponics system.

The second stage is outreach and training. The outreach and training activities begin with a welcoming speech and an opening by the Deputy Director of the Menara Fitrah Islamic School in Ogan Ilir. Presentations on independent feed production, catfish floss production, and financial management follow this. The material presented applies various farming technologies developed from research by the community service lecturer team at Sriwijaya University.

Community service activities are the diffusion of technology or knowledge from an institution, in this case, a team of lecturers, to partners. Technology diffusion is the process of technology transfer, either through the dissemination of messages through communication to the community (Annur, 2013). Technology diffusion can involve products or knowledge, both new and existing ideas. Technology diffusion in this community service program aims to enhance partners' understanding of the material presented. Technology and knowledge diffusion are facilitated by providing materials, including research results from the Sriwijaya University lecturer team, followed by training and mentoring activities for partners.

The material is delivered through a combination of lectures and hands-on practice to transfer knowledge and technology effectively. This aligns with the statement by Purnomo et al. (2015), who stated that face-to-face meetings and visits are one of the fastest ways to ensure technological innovation reaches network members, while the most effective extension methods are field schools, field meetings, and demonstration plots. The material delivery is presented in Figure 1.

Figure 1 Presentation of material

The transfer of knowledge about environmental care is carried out by teaching students about the importance of the environment, the negative impacts of environmental pollution, and the call to protect the environment (environmental care). This is expected to form an environmental care character in students. According to Asmani, the character value of environmental care is in the form of attitudes and actions that always strive to prevent damage to the surrounding natural environment, in addition to developing efforts to repair natural damage that has already occurred (Asmani, 2012). Zuchdi (2011) added that environmental care is an attitude and action that continually strives to prevent damage to the surrounding natural environment and to repair damage that has already occurred. Following the presentation of the material, training was conducted on examples of environmental pollution and solutions to protect the environment, which

were directly applied by the University Sriwijaya community service team.

The implementation of the Science and Technology environmental care program, specifically through the "Green Environment" program, is carried out by sixth-grade students, accompanied by teachers and students conducting field practice at partner locations. Students are divided into three groups based on the assistance units provided by the Community Service Team for fish and vegetable pond (aquaponics) activities. The program will include:

- Land clearing is carried out collectively.
- Aquaponic vegetable planting is carried out per group.
- Fish seed preparation and seed distribution are carried out per group.
- Fish feeding is scheduled daily by each group.
- Water quality checks are carried out per group.
- Fish sampling and aquaponic vegetable harvesting are carried out every 2 weeks by each group.
- Fish harvesting at the end of the farming period is carried out collectively.

The second topic discussed was fish farming. Catfish are omnivores but tend to be carnivores (Irfandi et al., 2020). Besides being carnivorous, catfish also eat decaying remains. Catfish are naturally nocturnal, meaning they are active at night and prefer darker areas. They will seek shelter and remain in dark areas during the day (Irfandi et al., 2019).

According to Ghufran et al. (2007), catfish nutritional requirements are 35-40% protein, 9.5-10% fat, and 10-20% carbohydrates. Fish farming is carried out for 2.5 months (one cycle). Fish are fed three times daily: at 8:00 am, 12:00 pm, and 5:00 pm, amounting to 3% of the fish biomass. The catfish used in this activity were 3-5 cm. During maintenance, temperature and pH were checked daily. Dissolved oxygen and ammonia levels were measured every two weeks. Following the presentation, a hands-on workshop on fish feed preparation was conducted by a team of Sriwijaya University Community Service students (Figure 2).

Figure 2 Fish feed making training

The third topic presented was vegetable farming (aquaponics). Aquaponic vegetable farming and harvesting were carried out over 14 days. Following the presentation on fish floss production, a team of Sriwijaya University Community Service students conducted hands-on training on vegetable seeding (aquaponics).

Aquaponics technology integrates hydroponic and other farming methods into a single system, optimizing water and space for maintenance. The basic principle of an aquaponics system, beneficial for aquaculture, is that leftover feed and fish waste, which can potentially degrade water quality, are used as fertilizer for aquatic plants (Nugroho et al., 2012). This nitrite-containing fish waste is converted into nitrate, which serves as a nutrient for plant growth (Hasan et al., 2017).

Aquaponic plants function as biofilters, reducing toxic substances into substances harmless to fish and supplying oxygen to the water used for fish farming (Maulana, 2016). The aquaponics system is a mutualistic symbiosis, or cycle of mutual benefit. The benefits of an aquaponics system include efficient water use and reduced waste pollution from discharge into public waters (Maulana, 2016). Catfish cultivated using an aquaponics system have advantages that can improve fish quality, unlike conventional systems (Novianti et al., 2022). This is supported by Palm et al., (2014), who found that aquaponically grown catfish meat is not mushy, has a savory taste, and is odorless. Wicaksana et al. (2015) added that cultivating catfish using an aquaponic system is easy, does not require a large area, and has a quick harvest period. Land spinach (Ipomoea reptans) is a plant in the Convolvulaceae family. It is a perennial plant that can live for more than a year (Iskandar, 2016). It is easily found and cultivated both on land and in water. One such growing medium is aquaponics. According to Setijaningsih & Umar (2015), the utilization of farming waste in the form of phosphorus and nitrogen in water by kale plants has a positive effect on fish growth. Another study showed that a reduction in ammonia concentration in an aquaponics system with 30 kale vegetables per clump can reduce ammonia levels (Dauhan et al., 2014).

The floating raft model of aquaponics is considered simple and easy to construct. Floating raft aquaponics can be constructed from Styrofoam or other floating materials. Holes are drilled into the rafts, and small pots are placed in them, supported by cotton, gravel, or rockwool to support the vegetables (Luta & Siregar, 2023). This socialization and training activity was closed with the handover of several tools and materials from the Community Service Team to Menara Fitrah Islamic Elementary School and continued with a group photo (Figure 3).

(a) (b)

Figure 3 (a) Handover of equipment and (b) Group photo

The final stage of the community service activity is mentoring. At this stage, the process is carried out in a demonstration plot (demplot), providing partners with opportunities to practice ornamental fish farming activities using materials delivered during the socialization and training stage. This is accompanied by technical staff, including students, as part of field practice activities. According to Setyaningrum et al., (2020), field practice is conducted to apply theoretical knowledge and provide a practical demonstration of the theory's results, enabling the expected technology transfer process to achieve its target. The mentoring activity carried out is fish maintenance, in which class VI student partners implement the Green Environment program, covering land preparation, fish preparation, vegetable preparation, fish feeding, water quality measurement, vegetable harvesting, and fish harvesting (Figure 4).

(a) (b) (c)

(d) (e) (f)

Figure 4 Assistance with (a) Land preparation, (b) Water filling, (c) Measuring fish weight and length, (d) Weighing feed, (e) Preparing aquaponic media, (f) Feeding fish

CONCLUSION

Based on the community service and environmental awareness activities, fish and vegetable farming (aquaponics) can be implemented at Menara Fitrah Islamic Elementary School. These activities helped participants understand environmental education and strive to consistently protect the environment, particularly through fish and vegetable farming (aquaponics) at school. Following this activity, it is hoped that participants will continue this program at their school.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTIONS STATEMENT

RCM provided the ideas. MF and ML provided direction for the program's activities and provided material on vegetable farming (aquaponics) and the environmental education program. MR and SZ, as field technicians, collected data and monitored the progress of the activities. All authors contributed to the preparation of the discussion of the results and contributed to the final manuscript.

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