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Urban Farming: Hydroponic Alternative Solution to Utilize Narrow Land to Increase Food Security in the Islands

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Abstract

The island region, especially in urban areas, has geographical characteristics with limited land that is an obstacle to increasing food security and the community's economy. This condition requires a creative solution, namely the application of urban farming through hydroponic techniques to maximize the use of available resources. This service aims to develop urban farming through hydroponics to increase food security and the household economy in Jerambah Gantung Village, Pangkalpinang City. The methods used in this service are socialization, training, and mentoring for the Kenanga Women's Farmers Group (KWT), which consists of 12 women who are expected to be pioneers in the application of urban farming in Pangkapinang City. They are given knowledge and trained in urban farming practices, especially hydroponic techniques. The results of this service are an increase in the knowledge of KWT Kenanga members, as shown by an increase in the average pre-test and post-test results with an initial score of 70 to 95. Then, a skill increase was reflected in the harvest quantity, which increased by 37 percent, or originally 35 kg in the first harvest, to 48 kg in the second harvest. There is also an increase in community involvement and agricultural culture, which is marked by an increase in the implementation of independent hydroponics. Thus, this service not only provides direct benefits for KWT Kenanga members but is also expected to contribute to the development of broader urban farming in Pangkalpinang City.

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INTRODUCTION

Island regions have unique geographical and economic characteristics, where limited land is a major obstacle to improving food security and the community's economy. Limited land, particularly in urban areas, requires creative solutions to maximize the use of available resources. According to Sari *et al*. (2024), urban communities often face issues with local food availability and a high dependence on food supplies from outside their region. One promising solution is the implementation of hydroponic techniques as a form of urban farming. It is crucial for communities to understand the food security movement and urban farming, as urban farming programs can achieve food self-sufficiency in urban areas (Adetya, 2024).

Urban farming, with a focus on hydroponic methods, has emerged as an innovative solution to address the challenges of limited land use, where island regions typically face geographical constraints, dense infrastructure development, limited land, and high population density, making conventional farming traditions inadequate to meet local food needs. It has driven the emergence of urban farming, a concept that efficiently utilizes limited land within urban areas. In this context, hydroponics is an attractive alternative, as hydroponic systems for food crops—particularly vegetable cultivation—do not require extensive land and can be carried out in backyard gardens (Lukito *et al*., 2021). In line with Thoriq, Gumisiriza *et al*. (2023) and Nasrulloh *et al*. (2022) also noted that hydroponic farming is highly practical and efficient, as it does not require extensive areas and results in stronger plants that are more resistant to pests and diseases.

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Wibowo (2021) defines hydroponics as plant cultivation that does not use soil as a growing medium but instead uses water or other media (such as gravel, rockwool, and others). According to Karman *et al*. (2022), the hydroponic method can produce better vegetable quality, increasing sales revenue. Hydroponic cultivation can save 19 hectares of farmland per year (Waluyo *et al*., 2021). Continuous hydroponic vegetable cultivation on backyard plots has been proven to enhance food security and increase household income (Mustikarini *et al*., 2019). Furthermore, this method is an innovative approach that not only saves space but also reduces water and fertilizer use, making it more environmentally friendly (Purwasih, 2019).

The development of urban farming and hydroponics is highly relevant in improving the economy and food security, especially in island regions. Island communities generally face economic challenges and dependence on food supplies from outside sources. Transportation and distribution costs cause food prices to be higher, while food availability is often not consistently guaranteed. Additionally, the low availability of local food and dependence on imports makes communities vulnerable to global price and supply fluctuations. Therefore, integrating hydroponic systems into urban farming can be a strategic step to increase local food production, reduce dependence on external resources, and stimulate economic growth through new business opportunities.

Through training and mentoring, communities can be empowered to manage hydroponic systems effectively, sustainably, and in a way that is easily adoptable by communities in island regions. It enhances their skills and creates a sustainable agricultural model that surrounding communities can adopt. Increased local production can also open up business opportunities in agriculture and agribusiness. This also contributes to food security, as hydroponic systems can produce crops quickly and in controlled environments. Implementing urban farming itself can also serve as an additional income source for communities, as they can produce agricultural products independently and sell their harvest locally, thereby increasing family income.

Additionally, urban farming can contribute to environmental conservation by utilizing organic waste, which is abundant, while also helping to create a clean city through the implementation of the 3R principles (reuse, reduce, recycle), as urban farming can also serve as a source of organic compost fertilizer made from waste. Therefore, this urban farming program is highly suitable to be promoted as one form of sustainable city initiative, as it optimizes the use of available land (in this case, space) owned by each community member (Permana, 2012). Considering this background, community service focuses on developing urban farming and hydroponics as solutions for utilizing limited land, with the hope of improving household economy and food security in island regions. The location chosen for this community service is Jerambah Gantung Village, Gabek District, Pangkalpinang City, where the area is an urban area with limited land for conventional agriculture, as well as limited access, knowledge, and minimal community involvement still tied to traditional agricultural practices. Therefore, efforts are needed to enhance awareness, provide training, and encourage community participation in supporting sustainable agriculture based on technology.

The focus of this community service initiative is the Kenanga Women Farmers' Group (KWT), comprising 15 women, who are expected to become pioneers in the implementation of urban farming in Pangkalpinang City, particularly in Gabek District, as women farmers play a crucial role in household and community food security. The presence of farming groups in urban areas is expected to solve the food security and safety crisis in cities (Rahardjo & Sisnuhadi, 2021).

By empowering them in urban farming practices, local food production can be increased, and dependence on food supplies from outside the area can be reduced. Through education, training, and mentoring in urban farming practices, women farmers can improve their knowledge and skills in agriculture and environmental management. This type of community service model has been widely implemented in various regions and has proven effective. For example, research by Laily *et al*. (2022) shows that hydroponic-based urban farming training in urban areas can increase household production capacity and reduce the expenditure burden on vegetable consumption. Meanwhile, a study by Oktarina *et al*. (2023) emphasizes the importance of involving women farmers in urban farming activities because their role is very strategic in household food management and the environment. Empowerment models based on active participation and continuous training have proven to create self-reliant communities in local food management and foster innovation in using limited land in urban areas. Therefore, this approach is a strategic step toward creating sustainable community-based food security. It will enable them to become more efficient and productive in agricultural activities, thereby providing significant benefits for their well-being, families, and communities.

In addition to benefiting the community, implementing this service activity aims to enhance students' experiences outside the campus. Students have the opportunity to apply the knowledge they have gained in a real urban agricultural environment. By directly participating in community service

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practices, students can deepen their understanding of how urban farming impacts household economic improvement and apply theoretical concepts learned in a practical context. Through participation in the planning and implementing of urban farming community service activities, students can also acquire practical skills useful in activity management, time management, and teamwork.

MATERIALS AND METHODS

The community service activity was conducted at the Kenanga Women Farmers Group (KWT) in Jerambah Gantung Village, Gabek District, Pangkalpinang City. The community service method used was Participatory Rural Appraisal (PRA), a community-based approach involving the community throughout the entire process, from initial studies, planning, implementation, monitoring, and evaluation. The community service activities were carried out through socialization and practical training in hydroponics.

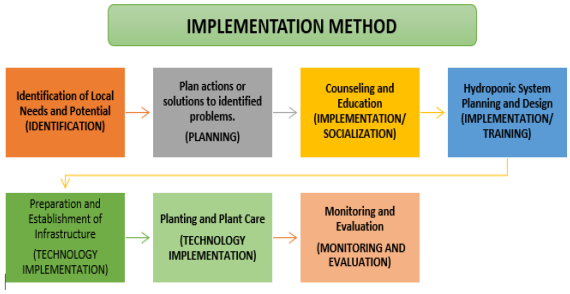

Fig. 1. Implementation of the community service program

The stages of the community activity program implementation method (Fig. 1) are as follows:

a. Identification of Local Needs and Potential
   Identify local food needs and available land potential in the archipelago. Review the geographical conditions, climate, and other factors that affect agriculture in the region.
b. Planning
   Partners and the service team collaborate to plan actions or solutions to address the identified issues.
c. Education and Training (Implementation through Socialization)
   Socialize the concept and benefits of urban farming and hydroponic techniques to the community. Provide training on how to set up a hydroponic system, plant management, and maintenance.
d. Planning and Implementation of Hydroponic System Design (Implementation in the form of Training)
   Hydroponic training and consulting with technical experts to design a hydroponic system suitable for local conditions and household needs. Additionally, a system that efficiently utilizes limited land should be designed.
e. Preparation and Establishment of Infrastructure (Implementation in the form of Technology Application)
   This stage involves several activities: Establishing infrastructure in the form of hydroponic modules; Selecting plant types and seeds, determining which plants are suitable for hydroponic cultivation in the area; Providing seeds or seedlings suitable for local conditions and community needs; Assisting in the preparation of hydroponic growing media such as Rockwool, cocopeat, or perlite; Providing the necessary nutrients for hydroponic plant growth; and assisting in the construction of basic infrastructure for urban farming, such as greenhouses or hydroponic systems.
f. Planting and Plant Care Practices (Implementation through Technology Application)
   Guiding the community through the process of planting plants using the hydroponic system. Guiding plant care, pest and disease control, and nutrient management
g. Monitoring and Evaluation (Mentoring and Evaluation)
   Conducting regular monitoring of plant growth and the condition of the hydroponic system. Evaluating harvest results and identifying problems and solutions encountered during the service process.

RESULTS AND DISCUSSION

Community service programs are a form of effort to empower communities and provide them with skills to face and solve problems independently. In addition, this program also encourages communities to become more independent, developed, and able to meet their own needs (Haris, 2014). The service is carried out through socialization and direct practice of urban farming through hydroponics. Urban agriculture and hydroponics development are highly relevant to improving the economy and food security, especially in island regions. Communities in island regions generally face economic challenges and dependence on food supplies from outside sources. Transportation and distribution costs cause food prices to be higher, while food availability is often inconsistent. Additionally, the low availability of local food and reliance on imports makes communities vulnerable to global price and supply fluctuations. Therefore, integrating hydroponic systems into urban farming can be a strategic step to increase local food production, reduce dependence on external resources, and stimulate economic growth through new business opportunities.

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The first activity was a socialization session for the Women Farmers Group (KWT) of Jerambah Gantung Village to help KWT members understand the concept and proper hydroponics methods (Fig. 2). This socialization was also attended directly by the Pangkalpinang City Agriculture Department, represented by Mr. Rosmin, and opened by the Jerambah Gantung Village Head, Mr. Suswoyo, S.IP. In this first activity, the speaker, Herry Marta Saputra, S.P., M.Si, a lecturer in agrotechnology with expertise in hydroponics, provided basic knowledge about hydroponics. The Kenanga Women Farmers Group (KWT), led by Mrs. Nurry Surasmini and all its members, was also given a pre-test questionnaire before the socialization and a post-test after the socialization to measure the extent of the KWT members' knowledge about the utilization of narrow land and hydroponics.

Fig. 2. Socialization of the concept and method of making hydroponics

In addition to socialization, PKM activities include practical training and guidance on hydroponics. According to Hardin & Rihaana (2021), training in hydroponics has a very positive impact on the community (Fig. 3). This is because hydroponic plant training provides the community with additional skills (hard skills) and knowledge (Khotmi *et al.*, 2022). Furthermore, the design and education about hydroponics positively impact the surrounding environment and can utilize limited land, as this is also related to environmental management (Khafidin et al., 2022). KWT members practised hydroponics, from sowing seeds to planting them in pre-made hydroponic pipes (Fig. 4).

Fig. 3. Assistance in making hydroponics

Fig. 4. KWT members practising hydroponic production

KWT members were enthusiastic about learning and practising seed sowing, making nutrients for plants, namely AB Mix, and planting seeds into hydroponic pipes. During this activity, the service team provided a number of tools and components as well as planting media (hydroponic modules) to KWT Kenanga, with the hope that the hydroponic equipment provided can be used optimally and support the implementation of urban farming at the Kenanga KWT in Jerambah Gantung Village.

After conducting socialization and training, another assessment of knowledge about urban farming, specifically hydroponics, was carried out.

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The response from KWT members was very positive, as hydroponics can serve as an alternative solution for utilizing limited land, and urban farming is an activity that can be undertaken to meet family food needs, with the potential for economic and business opportunities if managed seriously and sustainably. During the training and mentoring sessions, the service team provided education on hydroponic techniques, agricultural business management, and sustainable plant management. After the educational and practical sessions, the team also regularly monitored the results of the hydroponic planting implementation (Fig. 5).

Fig. 5. Documentation of the hydroponic harvest results of the community service team and KWT members

The community service team also uses environmentally friendly methods to guide pest and disease control. In addition to providing training, we provide access to information and communication technology to facilitate information exchange. In summary, the measurable results of this community service program can be seen through several specific success indicators in each aspect implemented, namely: first, there has been an increase in community knowledge regarding urban farming based on hydroponics, as evidenced by a significant improvement in pre-test and post-test results of participants. The average score, initially at 70, increased to 95 after education and outreach activities were conducted. This indicates that the educational and training activities successfully enhanced participants' understanding and skills regarding hydroponics' techniques and basic principles. To support the implementation of this knowledge, the community service team also facilitated the provision of hydroponic modules that partners and the community can utilize. These modules serve as a means of continuous learning and a demonstration unit so the community can replicate and develop hydroponic systems independently in their home environments.

Second, there has been an increase in the quantity and diversification of locally produced food through urban farming based on hydroponics. The increase in quantity is evident from the steadily increasing harvest yields, with the first harvest yielding approximately 35 kg and increasing to 48 kg in the second harvest, representing a rise of around 37 percent. In addition to quantity, the diversity of plant types has also developed. Previously, the focus was on a single type of vegetable, but now the community has begun cultivating various types, such as pakcoy and pagoda. Some participants have even started experimenting with planting other types of plants, such as red onions, demonstrating initiative and a spirit of innovation in diversifying local food production.

Third, increased community involvement and the growth of agricultural culture in urban areas are also important indicators of success. This increase can be seen from the growing number of Women Farmers Group (KWT) members who can manage hydroponic systems independently. Out of 12 KWT members, 4 individuals, or approximately 10%, have successfully developed and maintained hydroponic installations in their respective homes within an 8-month. This signifies a shift in mindset and attitude toward modern agriculture, where communities, particularly women, are beginning to view agriculture as a productive activity that can be carried out on limited land using practical and efficient technological approaches. Overall, these results show that the community service program successfully enhances individual capacity and drives social and economic change at the community level, particularly in achieving community-based food security through sustainable urban agriculture approaches.

CONCLUSION

This community service program successfully increased community involvement, particularly among members of the Kenanga Women Farmers Group (KWT), in hydroponic farming practices. The main success can be seen in the significant increase in knowledge about hydroponics after participating in the training, as evidenced by better pre-test and post-test results. In addition to increased knowledge, there was also an improvement in participants' skills in managing limited land and producing local food, as evidenced by a 37% increase in harvest yields during the first and second harvests. The harvest results from the hydroponic system indicate that participants are able to efficiently utilize limited land while also enhancing food security and income potential through the sale of agricultural products. Additionally, there has been an increase in community involvement and agricultural culture, as evidenced by four out of 12 KWT members who have

begun experimenting with hydroponics independently at home.

Despite the many successes achieved, there are some limitations. One of them is the challenge of effectively marketing harvest results, as marketing is still done conventionally, leading to suboptimal sales of local agricultural products. For the sustainability and development of the program moving forward, several recommendations can be made, including conducting regular evaluations and monitoring to assess effectiveness and provide further guidance for participants. Building collaborations with various parties, providing marketing training, and promoting environmental sustainability should also be a focus in further development efforts. With these steps, it is hoped that the hydroponic program can contribute sustainably to improving the well-being of communities in the island region.

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