HYDROPONIC INNOVATION: ADVANCING MODERN AGRICULTURAL TECHNOLOGY IN MERUYA SELATAN

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ABSTRACT

The community service program (PPM) was conducted with the target partners in Meruya Selatan Urban Village, West Jakarta. Based on the situational analysis, agriculture remains a key sector in supporting national food security. However, limited agricultural land and the declining quality of soil due to excessive use of chemical substances present major challenges that must be addressed. Hydroponics, as a modern soil-less farming technology, offers an innovative solution to enhance food production in an efficient, environmentally friendly, and sustainable manner. This technology enables communities, particularly in urban areas with limited land availability, to engage in independent farming. The objective of this activity is to provide training and assistance to the community on hydroponic systems, from fundamental concepts to practical implementation. With this knowledge, the community can utilize hydroponics as a modern farming alternative to improve productivity, strengthen food security, and create sustainable economic opportunities.
Keywords*:* Hidroponic, Agriculture, Modern Technology, Sustainable Economic.

1. INTRODUCTION

1.1. Background

The current environmental conditions have undergone significant changes. The expansion of residential areas has reduced the availability of open land suitable for farming. As the population continues to grow, so does the demand for agricultural land as the primary source of food production. In addition, changes in air quality and temperature—driven by population growth—have further impacted the environment. These conditions pose various challenges to conventional agriculture, making innovation in the agricultural sector an urgent necessity.

The limited land available to the community cannot be optimally utilized to meet food needs and improve the livelihoods of residents in Meruya Selatan Urban Village. Humans remain dependent on natural resources, particularly land, to sustain their lives. Land is utilized for housing, industry, livestock, and fisheries in efforts to boost economic development. However, while the demand for food continues to rise, agricultural land is increasingly unable to meet these needs. Therefore, the management of available resources must be carried out efficiently and optimally.

The net monthly income or wages received by residents of Meruya Selatan Urban Village who work in the industrial and service sectors remain below the 2022 Jakarta Provincial Minimum Wage (UMP) of IDR 4,641,854. The decline in income due to the COVID-19 pandemic also continues to be a challenge faced by the community in Meruya Selatan. Therefore, there is a pressing need to create opportunities to increase income and improve the local economy [4].

1.2. Focus on Community Service

The target partner in this empowerment program is the Meruya Selatan Urban Village. Meruya Selatan has five Child-Friendly Integrated Public Spaces (RPTRA), each with its own characteristic productive activities. However, RPTRA Meruya Selatan is one of the RPTRAs that has yet to develop productive activities capable of enhancing the local economy. This condition is influenced by several factors, including the high population density surrounding the RPTRA, the lack of available land for cultivation, the continued use of conventional farming methods that yield suboptimal results, and limited capital to adopt new agricultural technologies.

One of the steps that can be taken is to enhance the community's knowledge and skills in utilizing limited land not only to meet their own needs but also to improve their economic well-being through hydroponic farming methods.

1.3. Justification And Targets

Hydroponics is a method of cultivating plants without using soil as the growing medium. Instead, plants are grown in a nutrient-rich solution containing essential minerals required for their growth. This system is becoming increasingly popular due to its more efficient use of water, land, and fertilizers

compared to conventional farming methods [1]. In a hydroponic system, plant roots absorb nutrients directly from the water, enabling faster growth and more optimal yields.

The advantages of hydroponics include more efficient water usage, the absence of soil-borne pests and diseases, and the potential for vertical farming in limited urban spaces. However, this system requires more precise monitoring, relies heavily on electricity, and involves higher initial investment compared to traditional farming methods.

With technological advancements, hydroponics has emerged as a future-oriented solution for more efficient and sustainable agriculture, particularly in addressing the challenges of climate change and limited agricultural land [3].

1.4. Identification Of Problems

From the identification of these problems, several important points were obtained, including:

1. Underutilized vacant or idle land that has not been used productively by residents.
2. Lack of technical skills to support the application of hydroponic farming methods..
3. Limited knowledge regarding the maintenance of hydroponic plant.

1.5. Relevance

To enhance knowledge of hydroponic farming methods, improve skills in installing hydroponic systems and technologies, and develop the ability to maintain hydroponic plants, in order to increase community income and food potential for residents in Meruya Selatan Urban Village.

2. METHOD

The method of implementing the activity is divided into 4 parts, namely:

2.1. Pre-Activity

The initial stage includes the formation and consolidation of the implementation team, as well as outreach to the community members who will participate in the training. This stage aims to gather input for refining the program to ensure its smooth implementation and acceptance by the local residents.

2.2. Implementation Stage

This stage includes the following activities:

- Presentation of techniques for plant cultivation, maintenance, and care. Participants are introduced to the basic techniques of planting, maintaining, and caring for hydroponic crops.
- Construction of necessary equipment
  This involves drilling holes in PVC pipes, spaced approximately 15–20 cm apart. The diameter of the holes is adjusted to fit the net pots. Both ends of the pipe are sealed to prevent water from leaking.
- Preparation of the nutrient reservoir
  One of the key success factors in hydroponic farming is the proper use and application of nutrients. Nutrient containers can be made using buckets or drums. A solution of water and AB mix is prepared according to recommended proportions and stirred evenly.
- Water circulation setup
  For the wick system, a fabric wick is used to connect the net pot to the nutrient solution below, allowing for passive water and nutrient absorption.
- Seed planting
  The selected crops are pak choi and water spinach (kangkung). The seedlings are placed in net pots and inserted into the prepared holes on the PVC pipes. The plant roots must be in contact with the nutrient solution to ensure proper absorption of water and nutrients.
- Plant maintenance
  Plant care in hydroponic systems is generally similar to conventional methods, including pruning, weeding, pest control, and regular fertilization. Pest, weed, and disease control is carried out manually by removing pests attached to the plants and discarding infected plants to prevent further spread.

2.3. Evaluation Stage

The evaluation stage is conducted after all phases of the program have been completed. This evaluation involves monitoring through periodic site visits with the partner community to ensure that the implemented systems remain functional and in good condition. The purpose of this evaluation is to improve future activities and ensure the sustainability of the program, enabling it to continue independently through community self-funding.

2.4. Post–Test dan Quesionnaire

In this stage, the community service team distributed questionnaires to participants to assess the benefits and their satisfaction with the materials delivered, as well as to gather suggestions for future community engagement activities. The majority of participants (over 95%) stated that the materials presented in this program were highly beneficial, as they supported community empowerment through knowledge of hydroponic methods, enhanced food security, and contributed to increased household income. Furthermore, more than 90% of participants expressed a desire for the community service team to provide ongoing guidance and to introduce new topics in future programs. Participants also proposed several suggestions for future training content, including skill development and activities that offer business opportunities for the community.

3. RESULTS AND DISCUSSIONS

3.1. Results

No	Types of Outputs	Achievement Indicators
1	Scientific publication in an ISSN-registered journal or proceedings 1)	
2	Publication in printed/online mass media or institutional repository 6)	
3	Improvement of competitiveness (increased quality, quantity, and added value of goods, services, product diversification, or other resources) 4)	
4	Enhancement of science and technology application in the community (mechanization, information technology, and management) 4)	
5	Improvement of community value systems (arts and culture, social, political, security, public order, education, health) 2)	Achieved
6	Publication in international journals 1)	Achieved
7	Services, social engineering, methods or systems, products/goods 5)	Achieved
8	New innovation or appropriate technology (TTG) 5)	
9	Intellectual property rights (patents, petty patents, copyrights, trademarks, trade secrets, industrial design, plant variety protection, protection of integrated circuit layout design) 3)	
10	ISBN-registered book 6)	

3.2. Discussions

The introduction of the hydroponic method was delivered through hands-on practice and direct installation of a hydroponic system for the residents of Meruya Selatan Urban Village. This practical approach focused on the cultivation of hydroponic vegetables, their maintenance, and the prevention of pests and diseases, as well as the installation of a hydroponic system using the Nutrient Film Technique (NFT) at the Meruya Selatan RPTRA. The success of this activity is measured by the participants' ability to understand and apply hydroponic farming methods that can be implemented in limited spaces. The harvested vegetables can be consumed for household needs or sold, thereby strengthening food security and increasing the income of Meruya Selatan residents.

This activity encountered minimal significant obstacles. This was largely due to the fact that it was conducted among residents of Meruya Selatan Urban Village, West Jakarta, who showed a strong interest in learning hydroponic methods as a means to utilize limited land and improve their income. Moreover, participants expressed a clear need for knowledge regarding the benefits of hydroponic farming, the NFT (Nutrient Film Technique) hydroponic system, as well as plant care and pest and disease prevention in hydroponic cultivation. The response from participants was highly positive; they arrived punctually and actively engaged throughout the sessions as scheduled. Additionally, the participants' motivation to gain knowledge and understanding of hydroponic methods contributed significantly to the smooth implementation of the activity. The relevance of this program lies in its potential to enhance the knowledge and insight of the local residents in Meruya Selatan, West Jakarta.

At the conclusion of the activity, the community service team distributed questionnaires to participants to assess the benefits and satisfaction regarding the materials delivered, as well as to gather suggestions for future community engagement programs. The majority of participants (over 95%) stated that the materials provided were highly beneficial, as they supported community empowerment through knowledge of hydroponic methods, enhanced food security, and increased household income. Furthermore, more than 90% of participants expressed the hope that the community service team would offer continued

guidance and introduce new topics in future programs. Participants also suggested that future activities include skill-building and initiatives that offer business opportunities for the local community.

4. CONCLUSIONS AND RECOMMENDATION

The community service activity, themed "The Application of Modern Agricultural Innovation as an Alternative for Sustainable and Productive Farming," was successfully implemented. This is evident from the high level of enthusiasm shown by residents during the training sessions, as most participants previously lacked the technical skills and knowledge related to hydroponic farming and plant maintenance. This activity has also provided valuable insight and practical skills for the community, enabling them to continue improving their hydroponic yields. The produce can be consumed for personal needs, thereby enhancing food security and creating sustainable economic opportunities for the residents.

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