



Mapping the Potential and Challenges of Developing the Waru Brilliant Thematic Village in Bojong Renged

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ABSTRACT

The Waru Brilliant Thematic Village in Bojong Renged has been developed since 2021 in response to the limited natural resources in the Tangerang region and the impact of the COVID-19 pandemic. This program utilizes idle land for integrated agricultural and livestock activities, such as melon greenhouses, mushroom cultivation, chili gardens, and fish spawning. This service activity aims to map the available potential and identify the main challenges that hinder sustainability. Implementation methods include field observations, interviews with residents, and documentation of facilities. The results show that the physical potential is quite large but has not been supported by sustainable management. The main problems lie in low community participation, damage to facilities due to lack of ownership, and technical constraints related to weather and crop distribution. The findings emphasize the importance of collaboration and technology-based community empowerment strategies to support the sustainability of thematic villages.

Keywords: Service Activity; Agricultural; Greenhouses; Field Observation; Sustainable

ABSTRAK

Kampung Tematik Waru Brilliant di Bojong Renged dikembangkan sejak 2021 sebagai respons atas keterbatasan sumber daya alam di wilayah Tangerang dan dampak pandemi COVID-19. Program ini memanfaatkan lahan tidur untuk kegiatan pertanian dan peternakan terpadu, seperti greenhouse melon, budidaya jamur, kebun cabe, serta pemijahan ikan. Kegiatan pengabdian ini bertujuan untuk memetakan potensi yang tersedia serta mengidentifikasi tantangan utama yang menghambat keberlanjutan. Metode pelaksanaan meliputi observasi lapangan, wawancara dengan warga, dan dokumentasi fasilitas. Hasil menunjukkan bahwa potensi fisik cukup besar namun belum didukung oleh pengelolaan yang berkelanjutan. Permasalahan utama terletak pada rendahnya partisipasi masyarakat, kerusakan fasilitas akibat kurangnya rasa memiliki, serta kendala teknis terkait cuaca dan distribusi hasil panen. Temuan ini menegaskan pentingnya strategi pemberdayaan masyarakat berbasis kolaborasi dan teknologi untuk mendukung keberlangsungan kampung tematik.

Kata kunci: Aktivitas Pengabdian; Pertanian; Greenhouses; Observasi Lapangan; Keberlanjutan

INTRODUCTION

Waru Brilliant Thematic Village is an integrated agriculture-based area development initiative located in Bojong Renged, Tangerang Regency. This area has been developed since 2021 in response to the limitations of natural resources and the socio-economic impacts of the COVID-19 pandemic. The land used was previously idle



land owned by people from outside the area, which was later agreed upon to be utilized as a center for thematic village activities. In this context, the thematic village represents an approach as a form of community empowerment in the post-pandemic era through urban farming, livestock, and sustainable environmental management. However, in its implementation, the thematic village faces several serious challenges. Local community participation remains low, as indicated by the lack of a sense of ownership toward the facilities that have been built. This has led to many assets, such as goat pens and greenhouses, being poorly maintained or even becoming non-functional.

Agriculture contribute to ensuring food security, economic growth, and rural livelihoods (Pawlak & Kołodziejczak, 2020; Viana et al., 2022). However, challenges such as environmental degradation, resource depletion, and climate change continue to threaten agricultural sustainability (Huang & Wang, 2024). Water scarcity is a major global challenge, particularly in arid and densely populated areas, affecting two-thirds of the world's population annually. With agriculture consuming around 70% of global freshwater, inefficient irrigation practices worsen the problem. Traditional farming methods, which often lack modern technologies, further limit water efficiency and productivity. Integrating tools like the Internet of Things (IoT) can help optimize irrigation through real-time monitoring and automation, offering a promising solution to enhance resilience and resource efficiency in agriculture (Parra-López et al., 2025; Saputri et al., 2025). Thus, in response to these challenges, harnessing technological innovation in agriculture has become increasingly important to improve productivity, enhance resource efficiency, and support long-term sustainability (Karunathilake et al., 2023; Konfo et al., 2023; Saputri et al., 2024).

The importance of adopting IoT-based smart farming has been highlighted in various studies. Rusli emphasized that implementing smart farming requires clear change management strategies, including vision building, goal setting, and step-by-step implementation to ensure the success of this multifaceted concept. The rapid development of Industry 4.0 demands that agriculture adapt through digital transformation, particularly by integrating cyber-physical systems such as IoT (Rusli, 2021). Similarly, Halawa noted that smart farming enables real-time monitoring and automatic control of agricultural processes, helping farmers make more accurate decisions based on weather and environmental data. The impact of this technology is not only technical but also socio-economic, as it can improve farmer income and attract younger generations to agriculture through innovations like agri-drones and automated irrigation systems (Nugrahani Halawa, 2024). Supporting these findings, a study on the design and implementation of an IoT-based smart agriculture system demonstrated that real-time data from sensors on soil moisture, temperature, and light intensity can guide irrigation and fertilization, leading to higher efficiency in resource use and reduced operational costs, while also boosting crop productivity (Dirayati et al., 2025). Collectively, these studies confirm that IoT adoption in agriculture is a crucial step toward sustainable and data-driven farming practices in Indonesia.

This initiative is part of the Community Service Program funded by a grant from the Ministry of Education, Culture, Research, and Technology, providing strong institutional legitimacy and support. Beyond the goal of introducing smart irrigation technology to support sustainable agriculture, this program specifically aims to map the potentials and challenges within the Waru Brilliant Thematic Village. The results of this mapping will serve as a foundational step in designing future community capacity-building programs that are relevant and impactful.

In line with the Sustainable Development Goals (SDGs), this initiative supports SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), and SDG 11 (Sustainable Cities and Communities), while also contributing to SDG 12 (Responsible Consumption and Production) through the promotion of efficient, environmentally friendly, and technology-based agricultural practices. Therefore, the main objective of this community service activity is to assess local readiness, identify development opportunities, and lay the groundwork for the implementation of an IoT-based smart irrigation system integrated with solar power technology in the Waru Brilliant Thematic Village.

METHODS

This community service activity was carried out on July 9, 2025 in Waru Brilliant Thematic Village, Bojong Renged, Tangerang Regency. This activity is part of the initial stage in the community service program which focuses on situation analysis, potential mapping, and formulating an implementation plan for a smart irrigation system based on the Internet of Things (IoT). This stage does not include the installation of devices or sensors, but is directed at understanding the actual conditions in the field and developing appropriate technical and social strategies. The approach used is Participatory Rural Appraisal (PRA), to ensure the active involvement of various interested parties (Hudayana et al., 2019; Sontakki et al., 2019). This community service activity was carried out in three main stages: preparation, implementation, and evaluation which is shown in Figure 1.



Figure 1. Service activity flow

1. Preparation Stage

The team conducted coordination meetings, prepared observation and survey instruments, and identified relevant stakeholders involved in the development of the Waru Brilliant Thematic Village in Bojong Renged.

2. Implementation Stage

The implementation began with field observations to identify existing agricultural facilities such as melon greenhouses, mushroom houses, and Women Farmers Group land. These observations aimed to map the village's agricultural potential and identify existing technical challenges. The team also conducted a technical survey focusing on potential locations for IoT-based irrigation systems and solar energy support, examining the availability of water sources, land conditions, and electricity access.

An open discussion forum was also held with stakeholders including the village head and thematic village manager, aiming to align development goals, explore collaboration opportunities, and understand the community's readiness for technology adoption. This dialogue is important in ensuring that the proposed interventions are contextually relevant and supported by local leadership. (Association et al., 2012; Rong et al., 2023)

3. Evaluation Stage

All findings were documented through field notes and informal interviews. The collected data served as the foundation for designing a smart irrigation system powered by solar energy, which will be implemented in the following phase of the community service program.

The approach used in this activity combined participatory observation, technical assessment, and collaborative dialogue, ensuring the resulting design aligns with local capacity and needs.

RESULTS

The results of the initial visit conducted on July 9, 2025, indicated that the Waru Brilliant Thematic Village has substantial potential to be developed into a technology-based integrated agricultural area. Field observations revealed that several agricultural units were already in operation, such as a drip irrigation system in the melon greenhouse, mushroom cultivation, and farmland managed by the Women Farmers Group (Kelompok Wanita Tani or KWT). However, some of these systems have been damaged and/or lost and are no longer functioning optimally.

For example, the $\pm 200 \text{ m}^2$ greenhouse, which was previously planted with melon, is covered with a paranet roof but continues to face challenges in maintaining optimal temperature and humidity due to extreme weather conditions. Moreover, the greenhouse has not yet been equipped with any automated monitoring or control systems to improve its performance and resilience. Observations also highlighted challenges in facility management and sustainability. Structures such as goat pens, which were previously developed, are no longer in use, pointing to community dependence on external support and a lack of ownership from local residents.

The absence of community participation in maintaining and managing agricultural facilities poses a serious barrier to the long-term success of development initiatives. Additionally, the lack of automated monitoring and control, both in irrigation systems and in broader agricultural management, has resulted in low operational efficiency and productivity.

To address these challenges, the team initiated a series of field activities, beginning with direct observations of agricultural infrastructure such as the melon greenhouse, mushroom houses, open fields, and other KWT-managed land. These observations aimed to map both the physical potential and technical constraints of the site. Issues identified included manual irrigation systems, non-operational equipment, and limited electricity access in remote field areas.

The activity began with field observations of the existing facilities available in the thematic village, such as melon greenhouses, mushroom cultivation houses, open agricultural areas, and Women Farmers Group land. This observation aims to map the potential of the location that can be further developed, as well as record technical challenges such as the condition of the greenhouse structure, the existence of a drip system that is still manual, and the limitations of the supporting network. Figure 2 documents the team's visit to the melon greenhouse, which is one of the development focuses.



Figure 2. Greenhouse visiting

Following the initial observation, the team conducted a technical survey to determine possible areas for future implementation of the IoT-based automated irrigation system. This included observations of water sources, active land area, accessibility of electricity networks, and feasibility of sensor and actuator installation locations. One of the key findings of the survey was the limited electricity supply at some points of the farmland that are away from the main building. Therefore, in the technical plan that is being developed, the automatic irrigation system will use renewable energy sources in the form of Solar Power Plants as a solution to provide independent electrical power. This Solar Power Plant technology is designed to support the operation of sensors, controllers, and actuators in a sustainable manner without relying on the PLN electricity network. The installation of this Solar Power Plant is planned to be part of UMN's community service grant, and will be given at the

next implementation stage. Figure 3 shows the process of measuring and mapping the land by the team, including recording strategic positions for the installation of mini solar panels and other IoT components.



Figure 3. The process of measuring and mapping the land

The visit also included a focus group discussion and collaboration forum with key stakeholders. The session was attended by the Bojong Renged Village Head, the thematic village manager Mr. Mahfud Eki and his team, and representatives from Universitas Multimedia Nusantara, including three lecturers and two students. The discussion explored issues such as long-term sustainability of village initiatives, low community involvement in facility maintenance, and appropriate strategies for introducing technology based on the community's readiness.

The stakeholders responded positively, particularly regarding the use of solar power as a sustainable solution for running the irrigation system. These conversations demonstrated openness to collaboration and willingness to participate in future training and system maintenance. However, the team noted that a gradual and participatory approach will be essential to foster community ownership and ensure that the solutions implemented are aligned with local capacity and needs. Figure 4 documents the collaborative dialog between the UMN team and the field partners.



Figure 4. Forum group discussion activity

The results of this activity provide an overview of the potentials and challenges, and offer a solid basis for developing the design and implementation strategy of the smart irrigation system and IoT-based solar power plant at a later stage. To conclude the activity, a group photo was taken at the session as shown in Figure 5. This session symbolized the commitment and enthusiasm of the village stakeholders and the implementation team in supporting the development of sustainable and technology-based agricultural systems in the future.



Figure 5. Group photo with village stakeholders and the implementation team during the mapping session in Bojong Renged

The success of the community service activities was measured through interviews conducted with the head of the Waru Brilliant thematic village and the village chief of Bojong Renged. These interviews aimed to assess community readiness, identify local challenges, and evaluate the alignment of program goals with village development plans. The feedback gathered provided qualitative insights into the effectiveness and relevance of the proposed interventions.

CONCLUSION AND RECOMMENDATION

Based on the results of observations, technical surveys, and collaborative discussions conducted during the initial visit on July 9, 2025, it can be concluded that the Waru Brilliant Thematic Village has great potential to be developed as a sustainable integrated agricultural area. The existence of facilities such as greenhouses, KWT farms, and mushroom cultivation houses shows that basic infrastructure is already available. However, this village also faces a number of obstacles, both in terms of management, technical limitations, and lack of community participation in the maintenance and development of existing facilities. This visit has successfully mapped the existing conditions and opened a space for dialogue and cooperation between the service team from Universitas Multimedia Nusantara and local partners.

As a follow-up, it is suggested that the next stage is focused on the design and implementation of a smart irrigation system based on the Internet of Things (IoT) designed in accordance with real field conditions, including the use of renewable energy in the form of Solar Power Plants as the main power source. In order for the implementation of this technology to be sustainable, it needs to be accompanied by education and training programs for local communities, especially management groups and farmers, to increase their capacity and sense of ownership of the system built. In addition, periodic documentation and evaluation are needed to monitor the effectiveness of the technology implemented,

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