

Adoption of Artificial Lighting Technology for Microgreen Cultivation as an Effort to Improve Community Economy

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Abstract. The adoption of artificial lighting technology in microgreen cultivation has great potential to be developed. The goal is to increase farmers' productivity to ensure the quality and quantity of production so that it does not depend on climatic conditions and other constraining conditions. Tunas Jaya Farmer Group (Poktan) and Niaga Jaya TNC Joint Business Group (KUB) are business units located in an extreme priority poor village, Purwojati Village, Purwojati District, Banyumas Regency. In order to improve the community's economy, both experience problems in optimizing available resources. This occurs due to environmental conditions in the form of dry land that dominates, which has an impact on the yields of the main commodities that are unable to achieve community welfare targets. In addition to these problems, there are organizational priority problems in several aspects such as production aspects, technical cultivation equipment, human resources, marketing, business networks, product design and packaging, as well as management and institutions. To overcome these problems, an approach was taken in the form of workshops and training as well as grants for artificial light-based cultivation equipment. With this method, there was an improvement in community business management through training, namely competitiveness and business sustainability by 22,2%, optimization of hydroponics and greenhouses with the concept of smart farming by 15,5%, marketing management by 22,9%, and organizational and institutional management by 10,8%.

Keywords: Microgreen; Hydroponics; Artificial Lighting; Economy.

INTRODUCTION

Banyumas Regency is an area in Central Java Province that has 63 poor villages and 43 extreme priority poor villages from 27 kecamatan (BPS, 2023). One of the sub-districts in Kabupaten Banyumas is Kecamatan Purwojati. This area has the largest dryland area of 2,237.2 ha, out of a total area of 3,786.2 ha (BPS, 2023). Purwojati Village is the village with the largest dry land area in Purwojati Sub-district that is categorized as poor and extreme priority in Purwojati Sub-district, Banyumas Regency. The main commodity of this village is rice, but the production in 2022 of 13,392 quintals has not been able to improve the welfare of the community (BPS, 2023). This is due to the characteristics of dry land that are less than ideal for rice crops, so it is not able to provide maximum results for community welfare. Based on these conditions, it is necessary to make empowerment efforts that involve the participation of the local community, especially in the economic field.

Tunas Jaya Farmer Group (Poktan) and Niaga Jaya TNC Joint Business Group (KUB) as an association of economic drivers in Purwojati Village are targets that can be used as activity partners. Poktan Tunas Jaya, which was formed on September 22, 2021 under the authorization of the Banyumas Regency Agriculture and Food Security Office, is led by Mr. Tarkim and focuses on the cultivation of horticulture and food crops such as rice, corn, cassava, as well as several fruit commodities such as mondong, avocado, and durian. However, the management of agricultural products in this group still tends to be traditional, namely sold in raw form in bulk or bought directly by middlemen from the land. This condition causes the added value received by farmers to be very limited. The low added value received by farmers occurs because of problems in several aspects that are considered crucial. A review of the priority problems faced by the Tunas Jaya Farmer Group (Poktan) is explained as follows:

- 1. Production or Cultivation Aspects:** (a) Business activities are limited to utilizing dry land for cultivation, (b) Fields are limited to low value-added products with long lead times, such as rice, kedondong, avocado, and durian, (c) No understanding of Good Agriculture Practices (GAP).
- 2. Technical aspects of cultivation equipment:** (a) The community does not have adequate modern technology, so it is still conventional, relying on weather and climate situations, (b) The community does not have the knowledge and operation of modern tools and appropriate technology.
- 3. Human Resources (HR) aspects:** (a) The majority of group members are farmers and casual laborers, (b) They do not pay attention to the continuous cycle of crop patterns, (c) They do not have the competence of processing potential products.
- 4. Marketing aspects:** (a) Marketing strategies have not been well managed, and (b) Digital marketing capabilities are limited.

To answer this challenge, a group of local youths established KUB Niaga Jaya TNC on January 4, 2023, with Mizanto as chairman. KUB Niaga Jaya TNC comes with a mission to market and distribute crops and cultivation products of the Purwojati Village community with a more modern approach so that they have a higher selling value. Products that have been sold include vegetables, kedondong, various cakes and snacks, and fresh maggot. Similar to the Tunas Jaya Farmer Group (Poktan), in the process this group has obstacles in the business activities carried out. The challenges faced by the business unit in marketing the product of Purwojati Village occur due to various problems in several aspects:

- 1. Business Networking Aspects:** (a) Weak network and lack of public recognition, and (b) Unable to optimize social media.
- 2. Aspects of Product Design and Packaging:** (a) Products have not been well designed, (b) Sales are still limited to traditional markets, (c) Not familiar with product design, and (d) Not utilizing local wisdom-based and environmentally friendly packaging.
- 3. Management and Institutional Aspects:** (a) Management is not modern and professional, (b) Institutions are not organized, (c) Low knowledge of administration and business management.
- 4. Marketing Aspects:** (a) Not having reliable marketing personnel, (b) Limited digital marketing capabilities, and (c) Marketing strategies have not been well managed.

Based on this background, collaboration and capacity building through the adoption of modern technology and better supply chain management are very important in increasing the added value of agricultural products. The results of the activity are used to identify strategies that can strengthen the economic independence of the Purwojati Village community through empowerment based on farmer groups and joint businesses.

METHOD

In the Community Service program through the Kolaborasi Sosial Membangun Masyarakat (KOSABANGSA) scheme as an effort to improve the community's economy in Purwojati Village for the 2024 period, it is carried out by analyzing the priority problems faced and providing activities as a form of solution answers to the obstacles faced. The application of technology and innovation is also carried out in the form of vertigrow, which is artificial lighting technology for microgreen cultivation and horticultural cultivation. The adoption of this technology is done to ensure that the quality and quantity of products are maintained, without depending on certain conditions. The stages carried out in community empowerment to deal with the problems faced by partners are as follows:

1. Preparation

In the preparation stage, the Kosabangsa Universitas Peradaban implementation team coordinated with the Kosabangsa IT Telkom assistance team as well as the division of tasks between team members.

2. PDB Team Coordination and Focus Group Discussion with Partners

In coordination and discussion activities are carried out to identify and analyze the problems faced by partners, determine priority problems to be addressed by the Kosabangsa Team, and select appropriate activity participants.

3. Activity Planning

Activity planning focuses on selecting and procuring the necessary tools and materials, choosing the type of training that matches the priority problem, determining expert resource persons and supporting resources, and preparing a schedule of activities.

4. Activity Implementation

Socialization

The activity implementation phase began with socialization to potential participants, including the Tunas Jaya Farmer Group management and village government representatives such as the village head and village secretary. This socialization included information on the criteria for program participants, schedule of activities, training materials to be delivered, key resource persons, rights and obligations of participants, and indicators of program success.

Training

The training phase to improve the competence of human resources of Tunas Jaya Farmer Group partners involves training needs analysis, program planning, preparation of expert mentors, training scheduling, and implementation of training covering competitiveness and business sustainability, HR management, financial management, marketing management, regulation and licensing as well as organizational and institutional

management. It also provides training materials in the form of softcopy and hardcopy, assists the process of revamping and developing new entrepreneurs, and conducts evaluations to assess the success of the activities.

Application of Technology

The technology application program on technical and production aspects involves procurement, introduction, grants, and transfer of appropriate technology. The stages include calculation of average needs, inventory of existing equipment, procurement of tools, basic training in the use of technology and product design, and handover of equipment grants. The program also provides training materials, assists partners in the application of technology, necessary improvements, and the development of new entrepreneurs, ending with program evaluation.

RESULT AND DISCUSSION

The empowerment activities for TNC's Niaga Jaya KUB and Tunas Jaya Farmer Group (POKTAN) in Purwojati Village have had a positive impact on the community's business development potential. Several activities have been carried out not only to increase production capacity and quality, but also to ensure that the management of business units grows sustainably.



Figure 1: Kolaborasi Sosial Membangun Masyarakat (KOSABANGSA) Activities

1. Artificial Light-based Cultivation Tool Grant and Introduction

The application of new technology through the grant of artificial light-based cultivation tools has been an important step in increasing agricultural yields, especially on dry land in Purwojati Village. With this tool, farmers can cultivate vegetables and other horticultural crops more efficiently, without being affected by erratic weather conditions. This not only increases crop yields but also enables product diversification, allowing farmer group members to offer more types of agricultural produce in the market.



Figure 2. Handover of Appropriate Technology

As a form of efforts to increase capacity and efficiency through grants of appropriate tools and technology, the Tunas Jaya Farmer Group (Poktan) now has more adequate equipment, namely: (a) microgreen cultivation technology devices in the form of RGB LED lights, microcontrollers, controller circuits, cables, power supply regulators, and panels with a size of 1 m x 1 m x 0.6 m per layer, (b) hydroponic technology devices in the form of paralon, microcontrollers, pumps, cables, power supply regulators, DC motors, and solenoid valves, and (c) greenhouses. The Niaga Jaya TNC KUB already has Eco Creative Packaging.

2. Competitiveness and Business Sustainability Training

The competitiveness and business sustainability training is an integral part of the empowerment program aimed at improving the competitiveness of TNC's Niaga Jaya KUB and Tunas Jaya Farmer Group in an increasingly competitive market. In this training, participants are provided with an understanding of the basic principles that support business sustainability, including efficient resource management, product innovation, and the application of sustainable agricultural practices. The training also covered innovation strategies in product development and business diversification. Participants were taught to conduct market research and identify new opportunities that could be leveraged to improve the competitiveness of their products. For example, farmer group members were introduced to new vegetable-based products that have high selling points and increasing market demand. This initiative not only opens up new sources of income but also provides opportunities for group members to innovate in cultivation and marketing techniques. The results of the training showed a 22,2% increase in knowledge and participants felt better prepared to face challenges in the market and were able to formulate more effective sustainability strategies for their businesses.

3. Training on Optimizing Hydroponics and Greenhouse with the Concept of Smart Farming

The greenhouse optimization and hydroponic farming concept training aims to increase agricultural productivity and sustainability among members of TNC's Niaga Jaya KUB and Tunas Jaya Farmer Group. In this training, participants were given an in-depth understanding of modern cultivation techniques that utilize greenhouse technology and hydroponic systems, which are alternatives in facing the challenges of dry land in Purwojati Village. One of the key achievements of the training was a 15,5% increase in participants' knowledge of efficient use of resources, such as water and nutrients. In hydroponic systems, participants learned how the implementation of technology in greenhouses and hydroponic systems has great potential in facing the challenges of climate change and the growing need for food.

4. Marketing Management Training

Marketing management training is one of the key components in the empowerment program aimed at improving the ability of members of TNC's Niaga Jaya KUB and Tunas Jaya Farmer Group to market their products effectively. In this training, participants were taught various relevant marketing strategies and techniques, including an understanding of market analysis, different marketing concepts, and digital marketing. One important aspect of the training was the introduction to digital marketing, which is becoming a key strategy in reaching a wider range of consumers. Participants were trained to utilize social media and other online platforms as a means to market their products. The training also included the development of skills in creating added value for products through more creative and innovative marketing. The results of the training showed that participants were able to understand the importance of their products' position in the market and how to target consumers more precisely. After the training, there was a 22,9% increase in participants' knowledge as measured by the pre-test and post-test.

5. Organizational Management and Institutional Training

In this training, participants were given insight into the basic principles of organizational management, including strategic planning, organizing, implementing, and controlling business activities. One of the most significant outcomes of the training was the participants' increased understanding of the importance of a structured organization and effective management in achieving business goals. By attending the training, farmer group members learned to develop more focused work plans, prioritize tasks, and allocate resources efficiently. This has a positive impact on organizational performance, where members can collaborate better in achieving common targets. Quantitatively, the increase in knowledge increased by 10,8%.

6. Increase in Community Productivity

The adoption of artificial lighting technology for microgreen cultivation in Purwojati Village, a dryland area, provides a solution for enhancing agricultural productivity and increasing community income. With artificial lighting, microgreens can grow optimally indoors, regardless of limited natural sunlight. Microgreens, which are nutrient-rich and have a high market value, can be harvested in a short period within 7 to 14 days. This allows farmers to harvest multiple times a month, significantly

increasing production levels. Because microgreens can be harvested quickly and there is a growing market demand, especially among health-conscious consumers, the income of Purwojati's community can steadily increase. Farmers gain higher profits compared to traditional crops that require longer growth periods and are vulnerable to weather conditions. The fast harvest cycle and high economic value of microgreens offer a sustainable new income source for communities in dryland areas.

CONCLUSIONS

Based on the results of the activities that have been carried out, it can be concluded that the impact of training and procurement of appropriate technology is able to increase community understanding of business management for microgreen cultivation development using the adoption of artificial light technology. The increase in community understanding is reflected in the pre-test and post-test results which show an increase. The direct impact arising from this series of activities is product diversification in the form of 2 units of hydroponic media cultivation and producing new types of commodities.

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