Contents lists available at openscie.com
E-ISSN: 2829-4521
Indonesian Journal of Community Services Cel
DOI: 10.70110/ijcsc.v5i1.131
Journal homepage: https://ijcomcel.org

Implementation of Banana Cultivation and Post-Harvest Technology in Wanasari Village, Purwakarta

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ARTICLE INFO

Article History:
Received 15 December 2025
Revised 10 February 2026
Accepted 12 February 2026
Published 14 February 2026

Keywords:
Banana,
Banana Chips,
Cultivation,
Purwakarta,
Postharvest.

ABSTRACT

Background: Bananas are among the most important horticultural commodities in Indonesia. In West Java, Purwakarta is a center of banana production. Farmers rely on traditional propagation and production methods, resulting in low yields and productivity. The main problem for banana farmers is the lack of seed availability, where almost no farmer used seed from tissue culture and only 10% of the respondent did not know about post-harvest processing technology.
Aims: The aim of this activity is to improve the skills of farmers in the propagation of banana plants by in vitro culture, banana production, and post-harvest technology. This activity took place in Wanasari, Purwakarta City.
Methods: The methodology for these activities was to deliver lectures and conduct practice sessions with farmers on banana propagation, production, and postharvest technology. Additionally, we provided them with a banana plant from in vitro culture.
Result: The community service activity showed that the farmers were highly interested and enthusiastic about the technology introduced to them with increasing the post-test score of those audiences. The participants' enthusiasm and confidence in implementing banana cultivation and post-harvest techniques demonstrate the effectiveness and practicality of the training methods in supporting banana cultivation. This work is expected to empower farmers to manage their gardens and post-harvest banana handling, thereby contributing to economic resilience and food security.

To cite this article: Mubarok, S., Budiarto, R., Rufaidah, F., Mutiara, P., Suminar, E., Yani, Y. M. (2026). Implementation of Banana Cultivation and Post-Harvest Technology in Wanasari Village, Purwakarta. *Indonesian Journal of Community Services Cel*, 5(1), 28–34.

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1. Introduction

Bananas (*Musa paradisiaca*) are a horticultural commodity native to tropical regions, including Indonesia (Sutanto *et al.,* 2024), and more than 200 varieties are cultivated throughout the country. Bananas are generally consumed fresh as a table fruit. Well-known table bananas include yellow Ambon, green Ambon, Cavendish, and white Ambon. Other banana varieties that have the potential to be popular with consumers include Raja (Raja Bulu), Barangan, Mas Banana, and Sere (Damarjati, 2000). In addition to being a table fruit, bananas can also be processed into other processed foods derived from unripe bananas, including chips such as Kepok banana, Horn banana, Cotton banana, Siem banana, and Jackfruit banana. In addition, various types of banana products can be developed, including various types of bread, sale, dodol, jam, fruit juice, syrup, sauce, and canned banana products. Bananas contain very high amounts of carbohydrates, contain beta-carotene, thiamine, riboflavin, niacin, vitamin B6, and serotonin (Elayabalan *et al.,* 2017). Serotonin is believed to play an active role as a neurotransmitter in smooth brain function. Vitamin B6 also plays a role in the metabolism of energy derived from carbohydrates. The role of vitamin B6 in supporting the brain's energy availability for daily activities is well established (Stach *et al.,* 2022).

The yield and quality of bananas are largely determined by cultivation techniques and post-harvest handling (Kavinda *et al.,* 2023). Yield reductions are generally caused by selecting superior seeds and poor cultivation methods, including fertilization, maintenance, and other activities (Liliane and Charles, 2020). While damage to the quality of bananas after harvest can be caused by several factors, including physical factors resulting from physiological processes in the plant (Belay, 2022), mechanical factors caused by impacts, friction, pressure, and punctures, and biological factors caused by pests and diseases (Pathare & Al-Dairi, 2022).

Wanasari Village is located in Wanayasa District, Purwakarta Regency, where the majority of the population is engaged in farming. Bananas are one of the village's leading crops. However, farmers in this village still face obstacles in producing bananas, resulting in poor-quality fruit. According to local residents, low production and quality are attributable to limited adoption of technology among farmers, who still use low-quality seeds and simple cultivation techniques. They still used the shoot-derived seed due to the farmer's limited knowledge of tissue culture technology for seed propagation. Only 10% of farmers know this technology. Furthermore, the post-harvest and processing technologies used by farmers remain inadequate. Among all farmers responding, only 10% knew the postharvest technologies for bananas. They only process unripe bananas into chips, and many ripe bananas are simply thrown away, ultimately becoming waste. Recognizing the obstacles and constraints faced by the community, we took the initiative to share our knowledge of propagation technologies, including tissue culture, cultivation, postharvest technology, and banana processing, to increase productivity and profitability for banana farmers in particular and the community in general. The objectives of this activity include increasing public and farmer knowledge of the importance of applying plant propagation and post-harvest banana technology, increasing banana production, reducing banana yield losses during the post-harvest process, developing banana processing technology into other processed materials (chocolate banana chips, cheese), increasing farmer and community income, increasing student activeness in community activities to help the community with the knowledge they have acquired, and increasing the entrepreneurial spirit.

2. Methods

The community service activity was conducted in Wanasari Village, Wanayasa District, Purwakarta Regency. To address existing problems in the farmer community, some activities to be carried out

include counseling and socialization on the use of tissue culture technology and post-harvest practices to improve banana quality and productivity and increase family income, as well as counseling on cultivation technology and post-harvest handling of bananas. The implementation steps of the activity through the following methods:

1. Assessments are conducted before the activity begins. The methods used are:
    a. Collecting data on the profile, potential, and problems of banana farmers
    b. Determining the location and time of extension activities.
2. Provide counseling and guidance related to tissue culture plant cultivation techniques and post-harvest handling by the lecturer from Universitas Padjadjaran, consisting of:
    a. Socialization regarding the propagation and cultivation of banana plants from tissue culture and post-harvest technology (accelerating and inhibiting banana ripening and banana processing).
    b. Explaining the benefits of propagation and cultivation of banana plants from tissue culture and post-harvest technology (accelerating and inhibiting banana ripening and banana processing).
    c. Identifying banana farmers and the extent of farmer groups' work in increasing banana production.
    d. Extension regarding the propagation and cultivation of banana plants from tissue culture and post-harvest technology (accelerating and inhibiting banana ripening and banana processing). This is done through:
        i. Lectures covering the basic needs of banana farmers.
        ii. Group discussions covering the problems faced by banana farmers.

Practices regarding acclimatization and cultivation of banana plants from tissue culture and post-harvest technology (accelerating and inhibiting the ripening of bananas and processing bananas)

3. Results and Discussion

3.1. Location condition

Based on pre-activity surveys, land in Wanasari Village was extensively used for banana cultivation, with yields remaining low. This was due to several factors, including suboptimal cultivation techniques and the use of seeds derived only from conventional propagation, i.e., from seedlings taken from several generations. The resulting bananas produced were of poor quality, and yields were also low. Post-harvest operations were conducted in a simple manner, resulting in high post-harvest losses and prompting banana chip entrepreneurs to import processed bananas from outside Wanayasa District.

Initially, the community planted only small quantities of bananas, and the cultivars were mostly Ambon bananas. Marketing these bananas was challenging, as they could be sold at very low prices, resulting in suboptimal care. Given these conditions, the Community Empowerment and Development (PKM) team sought to introduce the Kepok banana, a cultivar suitable for use as a raw material for banana chips. The use of superior quality banana seeds that are free from disease is one of the requirements for obtaining good results, so it is hoped that the local community will get information about the process of making tissue culture banana seeds, good cultivation techniques, and processing bananas into chips so that they have a high selling value and are long-lasting.

3.2. Technical Guidance

a. Propagation and Cultivation of Banana Plants from Tissue Culture

Community enthusiasm for our activities was very high, as evidenced by an attendance rate of approximately 75% (approximately 25 farmers) among the invited community members. Throughout the activities, the community and farmers paid close attention to the material presented. Indicators of the success of our activities are presented in Table 1.

The outreach activities consisted of lectures and practical exercises. Before the event began, each village head opened the event, emphasizing to the community the importance of our outreach to support the agricultural programs implemented by the farmer groups in both villages. This was followed by our lectures. Current activities include introducing banana propagation techniques using high-quality in vitro-cultured Kepok and Cavendish banana seedlings to address the community's challenge of obtaining high-quality seedlings for banana chips.

Table 1. Indicators of success of extension and practical activities for the propagation and cultivation of tissue-cultured banana plants.

No	**Indicator**	***Base Line***	Achievements After Activities
1	Farmers who know how to propagate banana plants using tissue culture (%) **)	10	80
2	The number of banana plant seedlings from tissue culture planted by the community	0	30

Note: **) percentage of the number of people involved in extension activities/present at extension activities

The results of the community services activity indicated that most farmers in Wanasari village were unaware of how to propagate and cultivate bananas through tissue culture. Prior to this extension, only about 10% of the total community/farmers present knew how to propagate and cultivate plants propagated through tissue culture. This data was obtained from direct questions to the extension participants. Knowledge of tissue culture was acquired through training provided by the Department of Agriculture and by reading magazines and books on tissue culture. Following this extension, approximately 80% of participants were able to propagate and cultivate bananas via tissue culture. The lecture was delivered in two sessions: the propagation of bananas via tissue culture and their acclimatization from tissue culture. The material was provided to the community in PowerPoint format, including images of banana tissue culture and several other plant species. In addition, they were given photocopies of the handouts of the material we provided so they could better understand and study it. However, among the total participants, only 80% had a limited understanding of the technology we introduced, due to limited absorption, limited knowledge, and age. Generally, those with the least understanding of the material were older than 55.



Figure 1. Lecture in the community service activity

Due to limited knowledge of tissue culture, the Q&A session during the extension revealed that no farmers in either village had ever grown tissue-cultured bananas. In response, we provided 30 free kapok banana seedlings, which can be used as raw material for banana chips, to each village. These seedlings

were then distributed to 30 banana farmers for further development. During this extension, the community and farmers were very enthusiastic about the material and were very interested in the tissue culture technology we introduced. This was evident in the numerous questions we asked participants regarding the tissue culture techniques we outlined. These questions were generally posed by the heads or members of the farmer groups in both villages regarding the nursery issues they faced.

Based on this activity, the interest of the farmer group, particularly the group from Wanasari Village led by Mr. Dede, in this technology is very high. He seeks to collaborate further with us to establish a simple, household-scale tissue culture laboratory and to enhance banana farmers' proficiency in tissue culture techniques through participation in tissue culture training. The problem banana farmers currently face is the limited availability of seeds. The high market demand for bananas to be processed into chips, but the resulting production is very low due to the small number of plants planted, encouraging farmer groups from these two villages to want to build a simple tissue culture laboratory so that they can produce banana seeds quickly in large quantities.

b. Post-harvest technology extension and practice

Following the extension activities and practical training on the propagation and cultivation of banana plants from tissue culture, one month later, monitoring and extension activities were conducted on post-harvest banana technology and its practices. At the beginning of the extension activities, a question-and-answer session was conducted to assess participants' knowledge of post-harvest technology they had previously practiced. Questions were asked about how to accelerate and slow down the ripening of bananas. Overall, more than 80% of participants knew how to accelerate banana ripening; however, only about 10% knew how to slow it. Their knowledge of how to slow banana ripening and the factors that influence it remained limited due to the absence of information they had received (Table 2).

Table 2. Indicators of success of post-harvest technology extension activities and practices (accelerating and inhibiting banana ripening, and banana processing)

No	**Indicator**	***Base Line***	Achievements After Activities
1	Farmers who know how to speed up and slow down the ripening process of bananas (%) **)	10	90
2	The number of people who have implemented the technology of processing bananas into chips **)	25	50

Note: **) percentage of the number of people involved in extension activities/present at extension activities

Banana ripening retardation technology is crucial for increasing the shelf life of bananas (Ruiz et al., 2025), particularly for banana chips, and for preventing yield loss or spoilage during shipping, thereby minimizing spoilage-related losses (Kaushani *et al.,* 2022). Following a Q&A session with the participants, we continued with a presentation on banana post-harvest technology. The presentation was delivered in PowerPoint format, with illustrations that facilitated comprehension. Furthermore, we provided a module/handout to remind participants of the material. The presentation on banana post-harvest technology provides new knowledge for banana farmers and home banana chip producers on how to process and handle bananas post-harvest to prevent premature ripening or rotting. Following this presentation, nearly 90% of participants were able to follow and understand the material.

Following the presentation on post-harvest techniques and banana processing, monitoring was conducted among farmers to assess the extent to which the presentations were being applied in outreach activities. Among the approximately 10% of attendees who had already used bananas for chips, the share

increased by 25% following the outreach, bringing the total to approximately 50%. The insignificant increase in the number of people processing bananas into chips stems from their lack of motivation to do so, given the ease of obtaining them in the market. They prefer to buy them for family consumption rather than process them themselves due to the difficulty and hassle involved. They prefer ripe bananas to be consumed fresh or used in fried bananas. However, they generally process bananas into chips on important days such as Eid al-Fitr, weddings, and other large events.

4. Conclusions

Based on our results of community service activities, we concluded that the community generally grows bananas using conventionally propagated seedlings from shoots. The use of existing seedlings was justified because most people had not yet received information about tissue-cultured banana seedlings and were also unaware of where to obtain them. Public and student knowledge of banana propagation, including tissue culture, cultivation, and post-harvest processing, was limited. They still used methods passed down from their parents. The community and farmers were highly enthusiastic about our activities. With this activity, the number of farmers who know how to propagate banana plants using tissue culture increased by 70%, and almost 30% of banana seeds from tissue culture were cultivated by the farmers. 80% of farmers knew how to accelerate or slow the ripening process of bananas, and nearly 50% had implemented the technology for processing bananas into chips. Based on those results, it is hoped that the results of this activity will benefit the local community and encourage them to plant tissue-cultured banana seedlings on critical land.

5. Acknowledgment and Funding Information

We would like to thank the Wanasari village community for their assistance in implementing this activity. This community service project was independently funded

6. Conflict of Interest Declaration

The authors declare that there is no conflict of interest regarding the publication of this article. The Authors confirmed that the paper was free of plagiarism.

7. Author Contribution Statement

All authors contributed equally to the conduct community service project, data analysis, and writing and preparation of this article.

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