



# Empowering rural communities through Banana Pseudostem utilization as alternative food

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## ABSTRACT

This community service program was carried out in Rogo Village, Central Sulawesi, Indonesia, with the goal of empowering the local community by utilizing banana pseudostem as an alternative food source. A total of 30 participants, consisting of housewives, youth members, and micro-entrepreneurs, took part in a series of activities that included socialization, technical training on banana pseudostem chip production, basic business management, and digital marketing. The program adopted a participatory and hands-on approach, and its effectiveness was evaluated through pre-tests, post-tests, and product assessments. The findings showed a notable improvement in participants' knowledge and skills, as the average score increased from 60.67 before training to 85.40 after training. Participants were also able to produce banana pseudostem chips that met basic taste and hygiene standards, with several beginning to market their products online via WhatsApp Business and social media. Overall, the program strengthened entrepreneurial capacity, encouraged group collaboration, and introduced a sustainable food innovation that contributes to poverty reduction, food security, and responsible consumption in line with the SDGs.

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## 1. INTRODUCTION

Banana plants not only produce fruit as a primary commodity, but also generate agricultural waste in the form of banana stems (locally known as *gedebog*), which have not been optimally utilized (Muharni, 2023). This biomass actually contains fibers and nutrients that can be processed into food products such as flour and chips, providing opportunities for waste reduction and value creation (Nirmalasari et al., 2023; Sianturi et al., 2024). Prior studies demonstrate that simple, low-cost processing methods can convert banana pseudostems into marketable food items with economic potential (Badanayak et al., 2023).

Recent reviews further highlight that banana pseudostems have potential for eco friendly applications beyond food products for instance, as a biodegradable packaging material with promising

physical and thermal properties, and as a source of fiber with diverse processing possibilities (Badanayak et al., 2023).

In Central Sulawesi, banana production reached approximately 14,740.000 tons in late 2017 (CEIC, 2025), reflecting the abundance of raw materials in the province. Although village-level agricultural production data are limited, Rogo Village is recorded to have around 1,719 inhabitants, the majority of whom depend on small-scale banana cultivation. This situation implies that large quantities of pseudostem waste are generated annually, yet remain unutilized due to lack of knowledge and technology. The low added value of agricultural products contributes to household incomes that are generally modest and below regional averages.

Rogo Village in Sigi Regency, Central Sulawesi, is one of the banana-producing areas where pseudostem waste remains underutilized. In this village, most residents consume or sell bananas for their fruit, while the stems are discarded due to limited knowledge of their potential as alternative food resources (Gunawan et al., 2024). As a result, household income remains low, and entrepreneurship capacity is weak, while access to processing technologies and digital marketing is minimal. Preliminary engagement with community leaders and the Togisi youth group revealed high motivation to utilize banana pseudostems, coupled with clear gaps in technical knowledge, micro-business management, and market access. Abundant raw material availability and strong community enthusiasm highlight the potential for establishing sustainable, home-based enterprises if appropriate training and facilitation are provided.

This service program therefore aims to: (1) Build the technical skills of Rogo Village residents to hygienically process banana pseudostems into flour and chips; (2) Strengthen basic micro-business management, including bookkeeping and pricing; and (3) Expand market reach through introductory digital marketing practices suited for rural contexts.

## **2. METHODS**

The method used in this community service program was participatory, involving the active role of partners in every stage of the activity. The service program was directed at the Togisi Youth Group in Rogo Village, Dolo Selatan District, Sigi Regency, Central Sulawesi. The group consisted of approximately 30 Participant, mostly young villagers and housewives. This group was selected because they had strong motivation, availability of raw materials from banana cultivation, and support from the village government.

### **Location and Time**

This program was implemented in Rogo Village, Sigi Regency, Central Sulawesi. Activities took place from May 7 to 10, 2025, at the Rogo Village Hall. The method used in this activity was a combination of lectures and hands-on practice. The following activities were conducted each day: Day 1: Coordination and outreach with the village government and the Togisi Youth Group, introduction of the program's objectives, and sharing of initial knowledge about the potential use of banana pseudostems. Day 2: Technical training on hygienic processing of banana pseudostems into chips. Day 3: Micro-business management training, covering simple bookkeeping, cost calculations, and pricing strategies using real-life examples of chip production. Day 4: Digital marketing training (product photography, social media promotion, and label design) combined with program evaluation through pre-tests, post-tests, and participant feedback.

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### **Tools and Materials**

The main material used was banana pseudostems obtained from local plantations in Rogo Village. During the practical session, approximately 2 kg of banana pseudostem was used as the main raw material. The processing required supporting ingredients, namely about 2 liters of cooking oil for frying, 200 grams of flour as coating, and 20 grams of salt and seasonings. The 2 kg of pseudostem produced around 1.2–1.3 kg of banana pseudostem chips, equivalent to 12-13 packages of 100 g each. This trial production was used as the basis for participants to understand the yield and cost calculation in micro-business management training. Tools used were knives, chopping boards, basins, drying racks, frying pans, stoves, packaging plastics/standing pouches, and a grinding machine (disk mill) for flour processing.

### **Stages of Activities (Problem–Solving Approach)**

The program was carefully designed to directly address the main problems identified in the community. Each activity was structured to provide both knowledge and practical skills that could be immediately applied by the participants in their daily lives. The implementation was carried out over four days, with each day focusing on a specific aspect of capacity building.

On the first day, the focus was on coordination and socialization. The main problem identified was the community's lack of awareness regarding the potential of banana pseudostem utilization. To overcome this, coordination was established with village officials, followed by a socialization session aimed at explaining the objectives of the program as well as the economic potential of processing pseudostems. This step was essential to build understanding and motivation among participants before moving to more technical sessions.

The second day was dedicated to technical training in food processing. The problem addressed here was the community's limited skills in processing agricultural waste. As a solution, participants were guided through hands-on practice in processing banana pseudostems hygienically into flour and chips. They were trained to clean the pseudostems, slice them thinly, dry them under the sun, grind them into flour, fry them into chips, and finally package the products using standing pouches. This session provided participants with not only technical competence but also an appreciation of value-added agricultural products.

On the third day, the program emphasized micro-business management training. The main issue was the weakness in financial management practices among participants. Training was provided on simple bookkeeping using manual record books, cost calculation, and product pricing. To make the learning process more concrete, real examples were used by simulating the cost of producing 2 kilograms of pseudostem into 12–13 packs of chips. This simulation enabled participants to calculate the cost of raw materials, oil, flour, and packaging, and then compare these costs with potential selling prices to ensure business feasibility.

Finally, the fourth day focused on digital marketing training and evaluation. The challenge faced by participants was limited market access and low digital literacy. To address this, participants were introduced to the basic use of smartphones for marketing purposes. They practiced taking product photos, creating posts on social media platforms such as Facebook and WhatsApp, and designing simple product labels. At the end of the session, an evaluation was conducted through pre-test and post-test activities, along with feedback collection via short interviews and questionnaires. This final stage ensured that participants' learning progress was measured and their perspectives on the program were considered for future improvements.

## Data Collection Methods

Pre-test and post-test were administered to measure knowledge improvement in food processing, micro-business management, and digital marketing. Observation and documentation were conducted to record participants' practice in producing flour and chips (quantity, quality, and packaging). Short interviews and questionnaires captured participants' perceptions, challenges, and satisfaction with the training.

## Data Analysis

Quantitative data from pre-test and post-test scores, as well as production results, were analyzed descriptively using averages and percentages. Graphs were used to illustrate improvements in knowledge and skills. Qualitative data from observations, interviews, and documentation were analyzed narratively to describe participant responses and contextual factors.

**Table 1.** Training sessions and objectives

Session	Activities	Objectives
Session 1	<ul style="list-style-type: none"> <li>- Program orientation and introduction of the implementation team</li> <li>- Introduction to the potential of banana pseudostem</li> <li>- Explanation of sample processed products to be developed</li> </ul>	<ul style="list-style-type: none"> <li>- To provide participants with an initial understanding of the program objectives and the potential of banana pseudostem waste as an alternative food product</li> <li>- To foster initial motivation and interest among participants</li> </ul>
Session 2	<ul style="list-style-type: none"> <li>- Identification and selection of raw materials (banana pseudostem)</li> <li>- Sorting, washing, and basic sanitation techniques</li> </ul>	<ul style="list-style-type: none"> <li>- To equip participants with basic skills in selecting appropriate raw materials for food production</li> <li>- To emphasize the importance of hygiene and sanitation in food processing</li> </ul>
Session 3	<ul style="list-style-type: none"> <li>- Hands-on practice in producing banana pseudostem flour and chips</li> <li>- Cutting, drying, and frying techniques</li> </ul>	<ul style="list-style-type: none"> <li>- To enhance participants' technical skills in processing banana pseudostem into products (chips)</li> <li>- To provide hands-on production experience</li> </ul>
Session 4	<ul style="list-style-type: none"> <li>- Product packaging training</li> <li>- Setting price and basic quality standards</li> </ul>	<ul style="list-style-type: none"> <li>- To raise awareness about the importance of product presentation in attracting consumers</li> <li>- To train participants to rationally determine the economic value of their products</li> </ul>
Session 5	<ul style="list-style-type: none"> <li>- Training in business management and financial recordkeeping</li> <li>- Group discussion on small business development</li> </ul>	<ul style="list-style-type: none"> <li>- To provide basic knowledge of microenterprise management</li> <li>- To prepare participants to manage home-based businesses</li> </ul>
Session 6	<ul style="list-style-type: none"> <li>- Digital marketing training: WhatsApp Business and social media</li> <li>- Product promotion simulation</li> </ul>	<ul style="list-style-type: none"> <li>- To improve participants' digital literacy for product marketing</li> <li>- To open online market opportunities for local products</li> </ul>
Session 7	<ul style="list-style-type: none"> <li>- Evaluation of training outcomes and participant product review</li> <li>- Closing session and collective reflection</li> <li>- Distribution of souvenirs from the partners</li> </ul>	<ul style="list-style-type: none"> <li>- To assess the effectiveness of the community engagement program</li> <li>- To provide space for participant appreciation and feedback</li> <li>- To encourage the sustainability of community initiatives post-program</li> </ul>

### **3. RESULTS AND DISCUSSION**

#### **Initial Presentation and Community Socialization**

The program began with a structured socialization meeting involving the village head, community leaders, and prospective participants. Conducted at the Rogo Village Hall, the session introduced the objectives of the program, the urgency of utilizing banana pseudostem waste, and the technical framework of the activities. Visual samples of potential products, such as pseudostem chips, were presented to encourage community interest. The session successfully attracted participation from 30 community members, including housewives, youth organization members, and local micro-entrepreneurs. This step served to build trust, ensure inclusivity, and establish clear communication channels. The training agenda was organized into seven sessions as outlined in Table 1.

#### **Raw Material Selection and Preparation**

Following the orientation, participants were directly involved in the selection and preparation of raw materials. This activity took place in home gardens where bananas are widely cultivated. Technical guidance was provided on selecting pseudostems that met the criteria: fresh, cut stems with a firm texture, not too young or rotten. Educational information was provided on important physical characteristics such as color, moisture content, and fiber density, which are known to affect the quality of processed products. The results of this practical session demonstrated that participants were able to select banana stems that met the criteria and cut the stems into manageable pieces for further processing (Figure 1).



**Figure 1.** Product processing technical training and practice

#### **Technical Training on Product Processing**

The training focused on thin and even slicing, soaking to reduce sap, controlled frying to achieve crispiness, and oil removal for better quality. The results showed that from 2 kg of pseudostem, participants produced 1.2–1.3 kg of chips, equivalent to 12–13 100 g packages. These products underwent organoleptic evaluation. Qualitative organoleptic testing was conducted with 10 participants acting as internal tasting panelists. Panelists evaluated the chips using descriptive criteria: color/appearance, aroma, texture/dryness, oil content, taste, and overall acceptability. The test results are presented in Table 2.

Collectively, participants confirmed that the chips were ready to be introduced as a local market product with good consumer appeal.

## Business Management and Digital Marketing Training

Upon completing the technical phase, participants engaged in capacity-building sessions focused on basic business management and digital marketing. The sessions, delivered through workshops and simulations, addressed three essential aspects: (1) Basic Financial Recordkeeping; (2) Cost of Goods Sold (COGS) Calculation; and (3) Digital Marketing Strategies.

Participants were introduced to simplified manual bookkeeping formats to record expenses and revenues. Simulation exercises required participants to create financial reports based on estimated costs of raw materials, tools, labor, and projected sales, fostering early financial discipline.

**Table 2.** Qualitative Organoleptic Findings of Banana Pseudostem Chips (Final Product)

Attribute	Observation (Descriptive)
Color/Appearance	Chips exhibited a light golden-yellow color, with slices appearing uniform and visually appealing.
Aroma	A clean fried-snack aroma was noted, free from undesirable odors or excessive oil smell.
Texture/Crispness	Chips were consistently crisp and crunchy, breaking easily upon bite without any chewy centers.
Oiliness/Mouthfeel	The surface was dry to the touch, with minimal oil residue, giving a pleasant mouthfeel.
Taste/Seasoning	A balanced savory taste was perceived, with appropriate saltiness and no astringent aftertaste.
Overall Acceptability	The chips were considered acceptable to highly acceptable, and panelists stated they were suitable for market consumption.

COGS computation was taught using basic formulas that incorporated cost analysis and pricing strategies. Trainees were guided in determining profit margins and setting competitive yet realistic product prices. Market price comparisons with similar products in local stores and e-commerce platforms were also conducted.

In the digital marketing session, training included the creation of WhatsApp Business accounts, utilization of the product catalog feature, and basic photography techniques for product promotion. Participants also learned to develop simple social media accounts and promotional content. Several participants successfully uploaded their product content to personal platforms and received direct feedback from the facilitators.

The session enhanced participants' understanding of broader market access via digital channels, as opposed to relying solely on traditional outlets. Post-training monitoring indicated that 15 out of 30 participants became active in online product promotion, reflecting a significant behavioral shift.



**Figure 2.** Business management and digital marketing training

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### Enabling and Constraining Factors

Several enabling factors contributed to the smooth implementation and success of the program: (1) Institutional Support: The Rogo Village Government provided full logistical and administrative support, including access to the village hall, coordination of participants, and mobilization of local resources; (2) Participant Motivation: High levels of enthusiasm were observed throughout the training. No participants withdrew, and active engagement was evident in both discussion and practice sessions; (3) Strategic Coordination: Early coordination with village authorities and community leaders ensured program alignment with local schedules and minimized external disruptions. However, several constraints were encountered; (4) Equipment Limitations: Limited availability of processing tools, such as dryers and grinders, necessitated rotating usage among small groups, thereby extending the duration of training sessions; (5) Digital Literacy Gaps: Some participants struggled with operating mobile devices, creating WhatsApp Business accounts, or uploading content online. This suggests the need for follow-up training on digital competencies; (6) Weather Dependency: The sun-drying process was weather-dependent and experienced delays due to unfavorable conditions, which affected scheduling and material quality.

Despite these challenges, the program was successfully executed, owing to strong community support, team preparedness, and active participant involvement. The documented constraints offer critical insights for designing future interventions that incorporate adaptive strategies and appropriate technologies for resource-limited rural contexts.

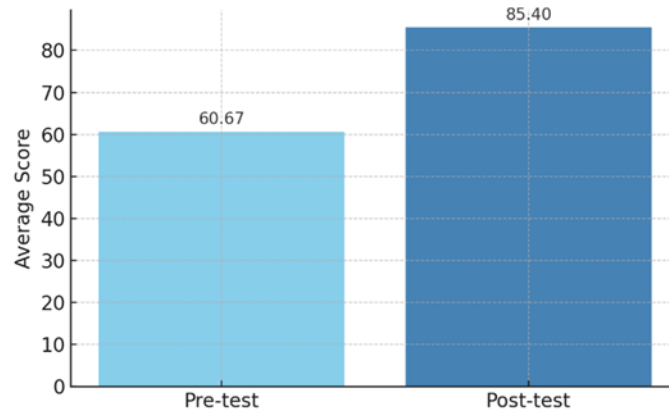


Figure 3. Product marketing

### Evaluation of Participants' Knowledge Development and Skill Achievement

Pre-test and post-test assessments revealed a marked improvement. The average pre-test score was 60.67, while the average post-test score reached 85.40, indicating an increase of 24.73 points (40.77 percent) (Figure 4). This confirms that the training was effective in strengthening participants' cognitive understanding of food processing and entrepreneurship. The evaluation also covered several key aspects of skill acquisition. The results are shown in Table 2.

Based on this evaluation, 90 percent of participants understood the concept of banana pseudostem processing, 85 percent were able to demonstrate product-making skills, 83 percent showed creativity and innovation, 80 percent successfully practiced product marketing, and 88 percent demonstrated teamwork ability. The post-test average score of 85.40 (Table 1) is consistent with these practical achievements (Table 2). This alignment confirms that the knowledge gained through the training was effectively translated into practical skills. Participants not only mastered the theoretical aspects but also successfully applied them in practice, which was evident in the high percentages of skill achievement across various aspects.



**Figure 4.** Comparison of pre-test and post-test scores

**Table 2.** Participants' skill achievement after training

Evaluated Aspect	Achievement (%)
Understanding of banana pseudostem processing	90
Skills in product making	85
Creativity and product innovation	83
Ability to market products	80
Ability to work in groups	88

## Discussion

The community service initiative in Rogo Village illustrates how participatory engagement, technical skill development, financial literacy, and digital marketing training can be integrated into a holistic empowerment model for rural communities. By focusing on banana pseudostems an underutilized agricultural by product the program successfully demonstrated that local innovations can simultaneously address waste management, create economic opportunities, and build community resilience. This finding reinforces the principles of the Community-Based Development (CBD) framework, which emphasizes that early and inclusive community involvement is essential to ensuring ownership and sustainability of initiatives (Widiyana et al., 2025). The high attendance and active discussion during the initial socialization phase reflected the effectiveness of this approach, showing that local trust and early participation form the foundation for long-term success.

Central to the program's effectiveness was the use of experiential learning through "learning by doing." Practical training sessions covering material selection, slicing, drying, frying, and packaging enabled participants to directly internalize essential processing skills, which were further reinforced by immediate feedback from facilitators and peers. Such experiential methods are known to accelerate knowledge transfer and enhance long-term retention (Raach & Bellemouche, 2024). The resulting banana pseudostem chips, evaluated through qualitative organoleptic testing, were consistently described as crisp, golden in color, and low in residual oil, suggesting that participants not only mastered technical skills but also achieved product quality suitable for market introduction. This finding aligns with studies emphasizing that community-based food processing initiatives are most successful when quality assurance is embedded from the outset (Dhivya et al., 2021).

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Building on technical mastery, the program introduced participants to microenterprise management, including financial record-keeping, cost of goods sold (COGS) calculations, and pricing strategies. These activities addressed a critical gap, as most participants had limited prior exposure to structured business practices. Financial literacy is widely recognized as a prerequisite for sustaining microenterprises and ensuring profitability over time (Zaniarti et al., 2022). By calculating costs based on actual raw material use (e.g., 2 kg pseudostem yielding 12–13 packs of chips), participants were able to make more informed decisions about pricing and profit margins. This grounding of financial concepts in lived production experiences demonstrates how technical and entrepreneurial skills can be meaningfully integrated within a single training framework.

The subsequent focus on digital marketing marked an important innovation in broadening market access. Although some participants initially struggled with low digital literacy, guided mentoring enabled many to establish WhatsApp Business accounts and begin experimenting with product promotion on social media. This aligns with previous findings that digital platforms are increasingly vital for small rural enterprises to improve competitiveness and extend market reach (Febrianty et al., 2024; Ratnadianti et al., 2020). Similar to recent studies, digital adoption in this program revealed uneven uptake, reflecting infrastructure limitations and varying levels of participant familiarity with online tools. These observations resonate with broader calls for hybrid marketing models that combine traditional trust-based community networks with digital tools to ensure inclusivity in rural entrepreneurship (Hakimi et al., 2023; Wiweko & Anggara, 2025).

Several enabling factors such as institutional support from the village government, high participant motivation, and strong facilitator coordination were key to the program's achievements. At the same time, constraints including limited equipment, weather-dependent sun-drying, and gaps in digital literacy underscored the challenges of implementing resource-intensive activities in rural contexts. These constraints are not unique; they have been documented in other rural innovation projects, where adaptive strategies such as introducing solar dryers or low-cost slicers, alongside scaffolded digital training, have been shown to mitigate structural barriers (Wiweko & Anggara, 2025; Zaniarti et al., 2022). Moreover, the findings of this program confirm what has been highlighted by Maghfuri (2023), namely that community-based initiatives not only generate economic benefits but also enhance public awareness regarding the sustainable use of agricultural waste. Such awareness strengthens collective responsibility and fosters long-term behavioral change.

Taken together, these findings suggest that empowering rural communities through simple, locally adapted innovations requires a dual track model: a technical track that standardizes production processes and quality control, and a business-digital track that builds financial discipline and market outreach capacity. This integrated approach not only strengthens household economic resilience but also positions community groups to act collectively in developing microenterprises (Dushkova & Ivlieva, 2024). In doing so, the program contributes directly to the Sustainable Development Goals, particularly SDG 1 (No Poverty), SDG 2 (Zero Hunger), and SDG 12 (Responsible Consumption and Production) (Lile et al., 2024). Moreover, it supports national higher education priorities by aligning with the Indonesian Higher Education Key Performance Indicators (IKU), especially those encouraging active university involvement in community empowerment.

Overall, the Rogo Village initiative demonstrates that simple technological and entrepreneurial interventions, when embedded within participatory and context-sensitive frameworks, can transform agricultural by-products into value-added products while fostering sustainable rural livelihoods. The lessons learned offer a practical model for replication in other villages and provide a foundation for future research into scalable innovations, including the integration of appropriate technologies and extended market trials.

#### 4. CONCLUSION AND RECOMMENDATIONS

This community service program in Rogo Village demonstrated that the innovation of processing banana pseudostems into flour and chips, supported by structured training in business management and digital marketing, significantly improved participants' knowledge, technical skills, and entrepreneurial capacity. The increase in post-test scores, independent product development, and active engagement in online marketing indicate that a participatory, hands-on approach can effectively transform agricultural waste into valuable products while fostering community-based microenterprises. The initiative not only enhanced household-level economic opportunities but also contributed to broader social cohesion and awareness of sustainable practices, thereby supporting national development priorities and aligning with the Sustainable Development Goals (SDGs).

Although the program achieved its objectives, several limitations were observed, such as the reliance on manual processing tools, weather-dependent drying, and participants' limited digital skills. Therefore, three practical recommendations are proposed. First, provide simple and affordable tools such as household-scale slicers and portable electric dryers that can be jointly owned by the community group to improve product quality and reduce dependence on weather. Second, organize short follow-up workshops on digital skills, focusing on WhatsApp Business, Facebook Marketplace, and simple product photography, which are easy to apply and directly useful for participants. Third, establish a small community group or cooperative to manage collective production, packaging, and marketing, so that participants can share resources, strengthen teamwork, and reach wider markets. These steps are feasible within the local context and can enhance both the sustainability and economic impact of the program.

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