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Zero-Waste Management of Cassava Waste: Compost, Fermented Feed, and Growing Media in Permata Baru Village, Ogan Ilir Regency

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Abstract

Permata Baru Village, North Indralaya District, Ogan Ilir Regency, generates cassava waste in the form of peels, stems, leaves, and processing pulp. These materials are commonly piled, discarded, or burned, creating odors and smoke while leaving their potential value unused. This community service program aimed to improve community knowledge and practical skills in managing cassava waste through a zero-waste approach and converting it into compost, fermented feed, and growing media. The main activity was conducted on 23 October 2025 using a participatory community-empowerment approach. Logistical records covered 25 people in total, including community participants and the implementation team; community participants represented cassava farmers, cassava-processing microbusinesses, women from local households, and village officials. Activities included needs identification, circular-economy education, technology demonstrations, hands-on practice, immediate evaluation, and follow-up planning. The program produced three initial outputs: compost starter, fermented feed stored anaerobically, and cassava-pulp growing media. More than 90% of end-of-session respondents stated that they could independently repeat the composting steps. Immediate impacts included stronger awareness of alternatives to piling and burning, improved procedural confidence, use of growing media for household vegetables, and a commitment to establish a village waste-management group. Because waste volume, income, product quality, and livestock performance were not measured over time, these outcomes are interpreted as short-term capacity and behavioral-intention changes. Continued monitoring, product-quality testing, feed-safety supervision, and organizational strengthening are required before larger-scale production and marketing.

Keywords: cassava waste; circular economy; compost; fermented feed; growing media

Introduction

Permata Baru Village in North Indralaya District, Ogan Ilir Regency, has substantial cassava (*Manihot esculenta*) cultivation and household-scale processing. These activities generate peels, stems, leaves, and processing pulp that are still commonly piled around yards, discarded, left to decompose, or burned. The problem affects both economically productive groups and nearby households. Farmer groups and cassava-processing microbusinesses have limited knowledge of composting, feed fermentation, and growing-media preparation and limited access to simple equipment, while households experience odors, smoke, and reduced environmental cleanliness. The absence of a community-based management system means that cassava waste is treated mainly as a disposal burden rather than a resource.

Cassava waste nevertheless has several feasible utilization pathways. The zero-waste and circular-economy approach redirects residues from disposal into new uses according to their characteristics. Cassava peels and stems can be composted, selected leaves and stems can be processed as fermented feed ingredients, and pulp can be combined with soil and compost as growing media. Previous studies report that cassava residues retain nutrients that may support ruminant feed after appropriate processing (Simanungkalit et al., 2020; Purba et al., 2019), while simple household-scale composting can support organic-waste management (Hastuti et al., 2022). Cassava pulp has also been reported as a potential component of horticultural growing media (Anugrah et al., 2021). Because cassava materials may contain cyanogenic compounds, feed-related use requires wilting, chopping, fermentation, controlled introduction, and continued safety supervision.

The community service program therefore combined education, appropriate technology, and participatory practice in one integrated cycle. Needs were identified with village partners, followed by education on environmental impacts and circular-economy principles. Participants then practiced material sorting, chopping, compost preparation, anaerobic feed fermentation, and growing-media preparation using composters, a manual chopper, and fermentation drums. The expected immediate impact was a change in how participants understood and handled cassava waste: instead of treating all residues as material to be piled or burned, participants were expected to separate residues into practical utilization streams. The longer-term impact sought was the establishment of routine community processing supported by shared equipment, simple records, and a village waste-management group.

Accordingly, the program aimed to increase knowledge of the environmental effects of cassava waste disposal, strengthen practical skills in producing compost, fermented feed, and growing media, introduce affordable technology that can be operated at household or farmer-group level, and build an initial institutional commitment for continued waste management. The expected benefits were cleaner handling of agricultural residues, substitution of selected farm and household inputs, productive use of household yards, and stronger community capacity to continue processing after the training. These outcomes were evaluated as immediate learning, procedural confidence, practical outputs, and organizational readiness rather than as proven long-term changes in waste volume or income.

Community Service Methodology

Location, Time, and Target Participants

The program was implemented in Permata Baru Village, North Indralaya District, Ogan Ilir Regency. The main education and hands-on activity was conducted on 23 October 2025 after preparation, coordination, and initial information collection. The target community included cassava farmer groups, cassava-processing businesses, women from local households, community members, and village officials. Administrative logistics were prepared for 25 people in total, including community participants and the implementation team. The archived activity records available for this revision do not separate the final attendance count by role; therefore, the 25-person figure is reported as total activity involvement rather than as a participant-only count.

A participatory community-empowerment approach was used. Community members did not merely receive information; they were involved in problem identification, discussions to determine solutions, processing practice, evaluation, and the development of follow-up plans. The lecturer team served as coordinators and technical facilitators, while students assisted with documentation, group facilitation, and field implementation.

Needs Identification and Selection of Solutions

Needs identification was conducted by collecting initial data from the village profile and regional planning documents, carrying out a rapid survey, interviewing community leaders, holding focus-group discussions with farmer groups, and observing existing cassava waste management practices. The information was used to map problems related to production, business management, the environment, and household economics. The findings were then presented to village officials and community members to obtain feedback and agreement on the program focus.

Solutions were selected based on material availability, ease of application, cost, and the potential use of the outputs. The priority was education and training in waste processing. The second was the introduction of simple equipment and technical procedures. The third was the use of processed products for agriculture, livestock production, and home-garden vegetable cultivation. The fourth was group strengthening, simple record keeping, packaging, and marketing development once product quality and continuity could be maintained. In Table 1 Priority problems, solutions, and program indicators.

Table 1. Priority problems, solutions, and program indicators

Aspect	Problem	Solution	Indicator
Production	Cassava peels, stems, leaves, and pulp have not been processed; access to simple equipment is limited.	Training in composting, fermented feed, and growing-media preparation; introduction of composters, drums, and a manual chopper.	Participants are able to follow the basic procedures and produce samples of three types of products.
Business management	There are no systems for cost recording, packaging, branding, or allocation of management responsibilities.	Introduction to simple record keeping, packaging, branding, and group organization.	A commitment to collective management and a product-development plan are established.
Socio-environmental	Waste is piled or burned; no community-based management system is in place.	Education on environmental impacts and establishment of a waste-management group.	Improved understanding and the emergence of an institutional commitment at village level.

Aspect	Problem	Solution	Indicator
Household economy	Use of household yards and organic growing media remains limited.	Training in growing-media preparation and home-garden vegetable cultivation.	Participants are able to prepare growing media and use it for vegetable cultivation.

Implementation Stages

The program was divided into five interrelated stages, as presented in Table 2.

Table 2. Stages of community service implementation

No.	Stage	Main activities	Timing
1	Preparation and coordination	Team formation, communication with village officials, target-group selection, collection of initial information, and preparation of equipment and materials.	Before the main activity
2	Education and capacity building	Delivery of material on pollution, zero waste, the circular economy, material safety, and opportunities for waste utilization.	Main activity
3	Demonstration and hands-on practice	Material chopping, compost preparation, feed fermentation, growing-media preparation, and use of composters and drums.	Main activity
4	Evaluation and reflection	Immediate effectiveness assessment: facilitator observation of five documented performance indicators; one end-of-session self-assessment item on ability to repeat composting independently; and reflective discussion on usefulness, constraints, intended applications, and follow-up.	End of the main activity
5	Monitoring and follow-up	Assistance with product use, equipment maintenance, group formation, and plans for record keeping and business development.	After the main activity

Technology and Technical Procedures

The technologies were designed for operation at household and farmer-group levels. HDPE plastic composters with capacities of 50-200 liters were used as containers for decomposing peels, stems, leaves, pulp, and other organic waste. The composters were equipped with ventilation holes and leachate outlets. Processing capacity was estimated at 10-15 kg per week for households and 50-70 kg per week for group-scale use. A galvanized-iron manual chopper was used to reduce stems and leaves to approximately 1-3 cm so that decomposition and fermentation could proceed more evenly.

Compost preparation began with sorting and chopping the materials. Cassava peels, stems, leaves, and pulp were mixed with EM4 activator and locally available supporting materials and then placed in the composter. Moisture was maintained so that the mixture was neither too dry nor too wet, and the material was checked periodically. This process emphasized participants' ability to recognize the sequence of work, material conditions, and early signs of decomposition.

Fermented feed was prepared from selected cassava leaves and stems that were wilted and chopped. The materials were mixed with rice bran, molasses, and EM4, compacted in a 100-liter plastic drum, and tightly sealed to create anaerobic conditions. The program document specified a fermentation period of approximately 7-10 days. The training emphasized that processing should reduce risks associated with cyanogenic compounds and that the feed should be introduced carefully and gradually, with guidance from personnel familiar with feed formulation.

Growing media were prepared from decomposed or fermented cassava pulp, soil, and compost at a ratio of 2:1:1. The mixture was used to grow vegetables such as chili peppers, mustard greens, tomatoes, and water spinach. In addition to physical technologies, the program introduced product packaging for group and household markets, simple cost recording, local branding, and the use of social media once production could be maintained consistently.

Table 3. Specifications of the introduced technologies

Technology	**Specifications**	**Use**	**Capacity/application**
Composter	HDPE plastic, 50-200 liters; ventilation holes and leachate outlet.	Processes organic waste into compost.	10-15 kg/week for households; 50-70 kg/week for group use.
Manual chopper	Galvanized iron; approximately 80 x 40 cm; produces 1-3 cm pieces.	Reduces the size of stems and leaves so that processing is faster and more even.	Approximately 20 kg/hour under optimal conditions.
Fermentation drum	A tightly sealable 100-liter plastic drum.	Fermentation of leaves and stems using EM4, molasses, and rice bran.	Approximately 7-10 days of processing; planned group capacity up to 200 kg/cycle.
Growing media	Cassava pulp, soil, and compost at a 2:1:1 ratio.	Supports home-garden vegetable cultivation.	Adjusted to the number of pots and household needs.
Packaging and marketing	25-kg sacks and 5-kg bags; record-keeping and social media.	Supports product management once quality and continuity are achieved.	Implemented gradually through the group.

Figure 1. Resource-utilization concept in zero-waste agriculture

Source: Community service program document, 2025

Figure 1 summarizes the circular logic used in the program. Cassava residues generated during cultivation and processing are separated according to their characteristics and redirected into three main pathways: compost, fermented feed, and growing media. These outputs are then returned to crop production, livestock activities, and household gardening. The diagram therefore illustrates the intended shift from a linear pattern of use-discard-burn toward repeated resource utilization, while recognizing that each waste fraction requires a different processing and safety procedure.

Program Evaluation and Effectiveness Criteria

Immediate program effectiveness was assessed using three complementary sources. First, facilitator observation notes were organized for reporting into five performance indicators: active participation in discussion and practice, correct material sorting, correct order of the composting steps, ability to manage moisture and use the equipment, and ability to explain follow-up handling. These indicators were interpreted descriptively and were not combined into a numerical score. Second, the recorded participant self-assessment focused on one end-of-session question: "After this training, can you independently repeat the composting steps at home or on group farmland?" with the response options "Yes" and "Not yet." The proportion of affirmative responses is the basis for the reported result of more than 90%. Third, a reflective discussion documented perceived usefulness, implementation constraints, intended applications, and willingness to continue the activity. The available archive does not retain an item-level questionnaire beyond this self-assessment outcome; therefore, no additional scored questions are claimed in this article.

Sustainability was assessed from the community's readiness to share equipment, willingness to continue processing at home or on group farmland, and commitment to establishing a waste-management group. The monitoring plan included checking the use of composters and drums, recording the amount of material processed, observing product maturation and use, and providing organizational assistance. These indicators distinguish immediate training effectiveness from longer-term impact: the activity could demonstrate learning and readiness during the session, whereas actual reductions in waste disposal or burning require follow-up records after the program.

Results and Discussion

Implementation and Community Participation

The main activity on 23 October 2025 proceeded as planned and received a positive response from the Permata Baru Village community. Farmer groups, cassava-processing business operators, women from local households, village officials, lecturers, and students participated in educational sessions, discussions, and hands-on practice. Enthusiasm was visible in sustained participation and in questions about suitable materials, fermentation duration, moisture management, feed safety, leachate utilization, and the use of growing media for home-garden vegetables. At the immediate-output level, effectiveness was judged from four documented outcomes: active participation, completion of the three processing demonstrations, more than 90% affirmative self-assessment on independent composting, and an initial commitment to continue the activity through collective waste management. These criteria indicate short-term learning and organizational readiness, not yet long-term environmental or income effects.

The following documentation illustrates the stages of coordination, partner involvement, material delivery, and participant interaction during the community service program. The photographs are included to strengthen the description of the implementation process and forms of community participation.

Figure 2. Initial coordination and needs identification with Permata Baru Village officials

Figure 2 documents the initial coordination between the community service team and village officials. The meeting was used to confirm existing cassava waste management conditions, identify target groups, adjust the materials to community needs, and agree on technical arrangements for implementation. The involvement of village officials from the initial stage strengthened the legitimacy of the activity and created opportunities for continued assistance after the main program ended.

At the beginning of the session, participants explained that cassava peels, stems, leaves, and pulp were commonly left to accumulate or burned because they were considered to have little use. Education on zero waste and the circular economy helped participants connect environmental problems with opportunities to reuse these materials. Waste was no longer understood merely as production residue, but as potential material for compost, processed feed, and growing media.

The involvement of village officials strengthened coordination and created space to discuss sustainability. Women from local households showed particular interest in growing-media preparation and home-garden cultivation, while farmer groups focused more on compost, fermented feed, equipment use, and the potential to reduce input costs. These different interests demonstrate that integrating three products enables the program to address the needs of different community groups.

Figure 3. Field visit by the community service team with village officials and students

Figure 3 shows the participation of lecturers, students, and village representatives during the field-visit stage. This activity formed part of the participatory approach because the team did not merely present the program; it also observed site conditions, communicated directly with partners, and confirmed readiness for implementation.

Figure 4. Opening session and group documentation with participants

Figure 4 illustrates community involvement at the opening of the activity. The presence of farmer groups, women from local households, village officials, lecturers, and students reflects collaboration between the university and the community. The documentation also shows that the program targeted both productive groups and households that could use compost and growing media for home-garden agriculture.

Improvement in Knowledge and Skills

The educational session improved participants' understanding of the impacts of waste disposal and burning and the importance of material sorting. Participants learned that product quality is influenced by particle size, material composition, moisture content, equipment cleanliness, processing time, and storage methods. The discussion also emphasized that zero waste does not mean that all materials must be processed in the same way; rather, each material should be directed to the most appropriate utilization pathway.

Figure 5. Delivery of material on zero waste and cassava waste processing technology

Figure 5 documents the presentation of material on zero-waste concepts, the circular economy, and alternative uses of cassava peels, stems, leaves, and pulp. Presentation media helped organize the processing stages systematically before participants moved to technical discussions on compost, fermented feed, and growing media.

Figure 6. Interactive discussion between the facilitator and program participants

Figure 6 shows the interactive discussion conducted during the educational session. Participants asked about material selection, activator use, fermentation duration, moisture management, feed safety, and possible household or farmer-group applications. The quantity and specificity of these questions, together with active participation during practice, provided qualitative evidence of strong audience interest. Effectiveness was not inferred from enthusiasm alone; it was considered together with the self-assessment result, completion of practical outputs, and willingness to continue processing after the session.

The composting practice provided direct experience in chopping materials, mixing activators, adjusting moisture, placing the mixture in the composter, and planning subsequent monitoring. Based on the final evaluation, more than 90% of participants stated that they were able to repeat the composting process independently at home or on group farmland. This response indicates greater confidence and procedural understanding, although the consistency of actual practice still needs to be assessed through follow-up monitoring.

A direct change in waste-handling practice was observed during the training. At the initial stage, cassava residues were described as materials that were commonly accumulated, discarded, or burned. During the practical session, participants instead sorted residues by intended use: peels and stems were directed to composting, selected leaves and stems to feed fermentation, and pulp to growing-media preparation. This represents an immediate procedural change from mixed disposal toward source separation and reuse. Whether the change was sustained at household and farm level after the program remains a follow-up question and should be measured through records of waste received, processed, reused, and still discarded or burned.

During the fermented-feed practice, participants learned how to select cassava leaves and stems, wilt and chop the materials, mix them with rice bran, molasses, and EM4, and store the mixture anaerobically in drums. Several livestock farmers introduced the fermented material to their ruminants and reported an initial response of increased interest in the feed. This finding is an early observation and cannot be used to conclude changes in growth or feed efficiency. Further use requires quality control and guidance because the safety of cassava-based feed materials must remain a priority.

Growing-media preparation received a strong response from women in local households. Participants mixed cassava pulp, soil, and compost and then used the mixture to grow vegetables in household yards. This practice demonstrates a direct link between waste reduction and household food security. The product can be used without waiting for a market to develop, allowing the initial benefits of the program to be realized through household use.

The available photographic documentation primarily records coordination, the opening session, material delivery, and participant discussions. Therefore, the descriptions of processing practices and product outputs in the following subsection are based on implementation records and program evaluation, rather than solely on visual evidence.

Outputs from Cassava Waste Processing

Photographs of the three processed outputs were not preserved in the archived documentation available for this revision. To avoid presenting unsupported visual evidence, the outputs below are reported from implementation records, facilitator observations, and the documented technical procedures. Future activities should photograph each product at the initial, maturation, and utilization stages so that visual evidence can complement process and quality records.

The first output was a sample of organic compost produced from cassava peels, stems, leaves, and pulp. Participants were able to carry out the initial stages of composting and recognize the functions of chopping, activators, and moisture control. The compost produced during the practical session was still in the early stage of the process, so full use required further maturation. The program provided starter material and maintenance guidance so that the process could continue after the activity.

The second output was fermented feed produced from cassava leaves and stems. The product was placed in sealed drums, and participants understood the importance of anaerobic conditions, fermentation time, odor, and container cleanliness. The expected benefit is the use of materials readily available around farms and a potential reduction in dependence on commercial feed. However, the program did not measure nutrient content, cyanide levels, or effects on livestock growth; therefore, the output should be understood as a technology demonstration rather than an effectiveness test of the feed.

The third output was organic growing media made from cassava pulp, soil, and compost. The media were used to cultivate mustard greens, chili peppers, and other home-garden vegetables. This option provides a relatively accessible pathway for households because the material can be used in pots or limited spaces. The activity also helped the community recognize that cassava-processing pulp can be returned to the food-production cycle.

Integrating the three outputs creates a more comprehensive utilization pattern. Coarse and fibrous materials can be directed to compost or feed after appropriate processing, while the pulp can be used in growing media. This approach reduces dependence on a single product and gives the community greater flexibility when the availability of specific materials changes.

Partner Participation, Institutional Development, and Economic Potential

Community partners participated from needs identification and preparation of local materials through hands-on practice and follow-up discussions. Farmer groups provided information on cassava-use patterns and the types of residues most commonly available. Women from local households participated in growing-media preparation and yard utilization, while village officials supported coordination and discussions on collective management. Such participation is important because technology sustainability depends not only on equipment but also on the allocation of responsibilities.

The activity encouraged an initial commitment to establish the Permata Baru Village Waste Management Group. The group is expected to organize the use of composters and drums, material collection, processing schedules, equipment maintenance, and distribution of outputs. The idea of establishing small processing units at the neighborhood (RT) level also emerged so that activities would not depend solely on community service meetings. Establishing the group is an important institutional outcome, but its effectiveness still needs to be assessed through routine activities, management arrangements, and record keeping after the program.

From an economic perspective, the most immediate benefit is the substitution of some production inputs. Compost can be used on farmland and in household yards, growing media can support vegetable cultivation, and fermented feed may serve as a supplementary feed material if its safety and quality are assured. Product sales represent a subsequent opportunity. The program document has outlined packaging, branding, cost recording, and digital marketing; however, the activity has not yet produced evidence of increased income. Therefore, claims of economic benefits should be based on records of production costs, product volumes, household use, sales, and changes in household expenditure during the assistance period.

Achievements, Implications, and Limitations

Program achievements and follow-up needs are summarized in Table 4.

Table 4. Program achievements and follow-up actions

Aspect	Achievement	Implication	Follow-up
Knowledge	Participants recognized the impacts of disposal/burning and identified separate utilization pathways for cassava waste.	Stronger environmental awareness and an immediate shift in intended handling from disposal to sorting and reuse.	Monitor changes in disposal and burning practices.
Compost	Participants practiced chopping, mixing, moisture adjustment, and composter use; >90% of end-of-session respondents stated that they could repeat the process independently.	Higher procedural confidence and an alternative source of organic material for farmland and household yards.	Monitor compost maturation and test compost quality.
Fermented feed	Participants practiced mixing and anaerobic storage in drums.	Utilization of leaves and stems and potential reduction of some feed costs.	Safety testing, formulation, and gradual use.
Growing media	A mixture of cassava pulp, soil, and compost was used for home-garden vegetables.	Supports the productive use of household yards and household food security.	Observe plant growth and repeated use.
Institutional development	A commitment emerged to establish a waste-management group and develop neighborhood-level processing units.	Provides a basis for assigning responsibilities and sustaining equipment and activities.	Appoint administrators, establish schedules and records, and secure village support.
Business	Ideas for packaging, branding, cost recording, and marketing were introduced.	Creates opportunities for future economic value, although increased income has not yet been demonstrated.	No evidence of increased income yet; market testing and record keeping are required.

The program results indicate that simple technologies are more readily accepted when they are directly related to everyday problems and use locally available materials. Composters, plastic drums, manual choppers, EM4, molasses, and rice bran do not require complex infrastructure. This finding is consistent with Hastuti et al. (2022) regarding the relevance of simple technologies for agricultural-waste management at the household level. Nevertheless, ease of use does not eliminate the need for consistent procedures and quality monitoring.

The integration of compost, fermented feed, and growing media also strengthens circular-economy principles. Each type of residue can be directed to a different function, so materials that are unsuitable for one product can still be utilized in another. The potential of cassava waste as a feed ingredient is supported by Simanungkalit et al. (2020) and Purba et al. (2019), while the use of cassava pulp as growing media is consistent with Anugrah et al. (2021). At the community level, this integration makes program benefits easier to recognize because the outputs can be used on farmland, for livestock, and in household yards.

The immediate positive impacts on the target audience were most evident in four areas. First, participants developed a clearer understanding that cassava waste could be separated and reused rather than routinely piled or burned. Second, participants gained procedural confidence, with more than 90% of end-of-session respondents stating that they could repeat the composting steps independently. Third, household participants used the growing-media concept for vegetable cultivation, creating an immediate link between waste reuse and productive yard use. Fourth, the activity generated an initial commitment to establish a village waste-management group and discuss neighborhood-level processing. However, the program has not yet demonstrated a measurable reduction in total waste volume, increased income, changes in feed costs, or improved crop and livestock productivity. No laboratory testing of compost or feed was conducted, so these impacts should be interpreted as short-term capacity, intended behavior, and institutional readiness rather than proven long-term outcomes.

Follow-up activities should focus on four priorities. First, the group should record the amount of waste received, the products generated, and how they are used. Second, compost quality and feed safety should be assessed before production is expanded. Third, group administrators should establish equipment-use schedules and allocate responsibilities. Fourth, marketing should be developed only after products are consistently available and meet basic quality standards. With these measures, environmental benefits can develop into economic benefits without compromising safety and quality.

Conclusion

The community service activity showed that cassava waste in Permata Baru Village can be redirected from piling and burning into three practical uses: compost, fermented feed, and growing media. The immediate positive impacts were stronger environmental awareness, improved procedural skills, practical use of growing media for household vegetables, and an initial commitment to collective waste management. More than 90% of end-of-session respondents stated that they could independently repeat the composting steps. The activity also changed the way cassava residues were handled during training, from mixed disposal to sorting according to their intended use. These results indicate short-term effectiveness in learning, practice, and community readiness. However, long-term reductions in waste volume, product quality, feed safety, income, and agricultural productivity were not measured. Follow-up monitoring, product testing, production records, and stronger group organization are therefore needed before larger-scale production and marketing are developed.

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