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PROCESSING SAWDUST WASTE INTO INNOVATIVE ECO-SUBSTRATE THROUGH UPSKILLING BATULAPPA VILLAGE WOMEN'S GROUP

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Abstrak: Limbah serbuk gergaji dari hasil pengolahan kayu di Desa Batulappa menimbulkan dampak negatif bagi lingkungan, terutama pencemaran udara akibat pengelolaan yang tidak optimal. Program pengabdian masyarakat ini bertujuan untuk mengatasi permasalahan limbah serbuk gergaji tersebut dengan memberdayakan Kelompok Perempuan Desa Batulappa melalui berupa *Upskilling* mitra dalam pengolahan limbah serbuk gergaji menjadi *Eco-Substrate Innovative*. Mitra dalam program ini adalah 15 anggota Kelompok Perempuan Desa Batulappa yang tergabung dalam divisi SDM dan Pengelolaan Lingkungan Hidup. Metode yang digunakan meliputi penyuluhan, pelatihan, dan pendampingan berbasis partisipasi masyarakat (*society participatory*). Hasil evaluasi menunjukkan peningkatan signifikan, yaitu rata-rata 90% dari aspek pengetahuan dan keterampilan dalam mengolah limbah serbuk gergaji, dimana anggota mitra berhasil memahami dan menguasai teknik pengolahan serbuk gergaji menjadi produk bernilai ekonomis berupa *Eco-Substrate Innovative*. Selain itu, mitra juga memperoleh keterampilan tambahan, seperti pengemasan, pelabelan, pemasaran, dan pengelolaan keuangan sederhana. Melalui program pengabdian ini, mitra mampu mentransformasi limbah serbuk gergaji menjadi produk inovatif yang ramah lingkungan, sekaligus berpotensi untuk dapat meningkatkan kesejahteraan ekonomi bagi Kelompok Perempuan Desa Batulappa.

Kata Kunci: eco-substrate innovative, fermentasi, media tanam, serbuk gergaji, society participatory

Abstract: Sawdust waste from wood processing in Batulappa Village has a negative impact on the environment, especially air pollution due to suboptimal management. This community service program aims to overcome the problem of sawdust waste by empowering the Batulappa Village Women's Group by processing sawdust waste into Innovative Eco-Substrate. The partners in this program were 15 Batulappa Village Women's Group members of the Human Resources and Environmental Management division. The methods used include extension, training, and mentoring based on community participation (society-participatory). The evaluation results show a significant increase, namely an average of 90% in terms of knowledge and skills in processing sawdust waste, where partner members succeeded in understanding and mastering the technique of processing sawdust into economically valuable products in the form of Innovative Eco-Substrate. In addition, partners also gained additional skills, such as packaging, labeling, marketing, and simple financial management. Through this community service program, partners can transform sawdust waste into innovative, environmentally friendly products while also having the potential to improve economic welfare for the Batulappa Village Women's Group.

Keywords: eco-substrate innovative, fermentation, planting media, sawdust, society participatory

Introduction

Indonesia has abundant natural resources, including wood (Ridzeki *et al.,* 2024; Susanti *et al.,* 2022; Handayani & Sa'diyah, 2022). This wood potential has driven the growth of various wood processing businesses for building, decoration, furniture, and other purposes. However, the growth of the wood processing industry has also triggered an increase in the amount of waste produced, with an average percentage of 40.48% of the total volume of wood processing results per year. This waste consists of wood shavings (22.32%), wood chips (9.39%), and sawdust (8.77%) (Sitorus *et al.,* 2023; Lukman & Vegatama, 2023; Mirwan & Mufti, 2020).

Sawdust waste produced by wood processing plants harms local ecosystems and human health if not managed properly. This waste can pollute water and soil, produce dust that is harmful to the respiratory tract, and contribute to the accumulation of organic waste that is difficult to decompose (Sahrum *et al.,* 2021; Laksono *et al.,* 2021; Hertianti *et al.,* 2023). Therefore, effective waste management is urgently needed, especially considering the minimal utilization of this waste in Indonesia.

One area with large potential for sawdust waste is Batulappa Village, in Patimpeng District, Bone Regency, South Sulawesi Province. This potential is obtained from the existence of four medium-scale furniture craftsmen, namely Mebel ToBeLo, Mebel Anreka, Mebel Jaya Abadi, and Mebel Meyrika, which are spread across Uttibatue Hamlet, Rompegading Hamlet, Galung Lampe Hamlet, and Mangentang Hamlet. These four businesses process around ±30 logs of wood per day, with 30% of machine operations producing sawdust waste. In the production process that lasts for 3-4 months, furniture craftsmen process a total of 120 logs of wood per day into various products such as tables, chairs, frames, doors, cupboards, beds, and shelves, which produce around 240 sacks of sawdust waste (each sack weighs 10 kg) or equivalent to 2.4 tons.

To address the issue of sawdust waste in Batulappa Village, waste management innovation based on *Eco-Substrate Innovative* is a promising solution. This approach is still minimally applied in this area, although it has great potential to improve environmental quality and provide economic benefits. This solution integrates waste management into value-added products, such as organic planting media or lightweight construction materials, to support the principles of a circular economy.

Previous studies have shown that the utilization of sawdust waste can produce products such as bioenergy briquettes and planting media, but its application on a local scale, especially in Batulappa Village, is still limited. For example, several community service studies in other areas have shown the effectiveness of this waste processing in reducing environmental pollution (Sahrum *et al.,* 2021; Hertianti *et al.,* 2023), but there has been no systematic and sustainable effort to implement *Eco-Substrate Innovative* in this area. Therefore, this solution offers relevant novelty, with an approach that is not only environmentally friendly but also able to address the socio-economic problems of the surrounding community.

So far, sawdust waste in Batulappa Village has not been utilized or processed optimally; instead, it is left to pile up or often burned to reduce the amount. This burning practice causes

air and environmental pollution and risks triggering fires. In addition, the burning process takes a long time and produces smoke containing fine particles that the community can inhale. Sawdust contains hazardous chemical compounds such as formaldehyde, phenol, and aromatic hydrocarbons, which can cause health problems in the respiratory system and increase the risk of lung disease if exposed continuously (Rizal *et al.,* 2020). This risk shows the need for a safer and more sustainable approach to handling sawdust waste to protect the ecosystem and public health of Batulappa Village.

The views of the Batulappa Village community towards sawdust waste are still limited. In the past, this waste was often used as fuel for cooking, but now its use has shifted to gas. A few people try to use sawdust as a planting medium, but the results are not optimal because they have not applied fermentation techniques. Without the fermentation process, sawdust tends to bind nitrogen from the soil, which inhibits plant growth (Selan *et al.,* 2023). Fermentation is needed to decompose organic matter and increase the availability of nutrients in sawdust for plants. The lack of community knowledge and skills about fermentation technology is the main obstacle to utilizing the potential of this waste to the maximum. Therefore, appropriate education and training are needed to increase the effectiveness of sawdust use so that people can reduce waste while using it sustainably.

Based on the problems faced, a community service program was carried out that would empower one of the non-profit community organizations, namely the Batulappa Village Women's Group partners, to transform underutilized sawdust waste into products with commercial potential. Therefore, this community service program will focus on increasing the knowledge and skills (upskilling) of members of the Batulappa Village Women's Group by teaching sawdust processing techniques into planting media in the form of Innovative Eco-Substrate through a participatory by doing approach. Participatory by doing is an approach that empowers partners, where partners actively contribute through direct involvement in all community service activities (Asfar *et al.,* 2023). This approach aims to improve the community's skills, creativity, and economic welfare (Fajar *et al.,* 2023; Asfar *et al.,* 2022).

The processing of sawdust waste into *Innovative Eco-Substrate* can provide double benefits for Batulappa Village Women's Group partners. This program is designed to improve partners' knowledge and skills (*upskilling*) in utilizing sawdust waste effectively. Through training and mentoring, partners are expected to be able to process this waste so that it not only helps reduce waste problems in Batulappa Village but also increases agricultural productivity through the use of processed products as nutritious planting media. In addition, this waste processing contributes to improving environmental conditions by improving the physical properties and structure of the soil, thus supporting the creation of a healthier and more sustainable ecosystem.

Method

The community service program focused on processing sawdust waste into *Innovative Eco-Substrate* was implemented in Batulappa Village, Patimpeng District, Bone Regency, South Sulawesi Province, involving the Batulappa Village Women's Group consisting of 25 people. The location of the program implementation can be seen in Figure 1.

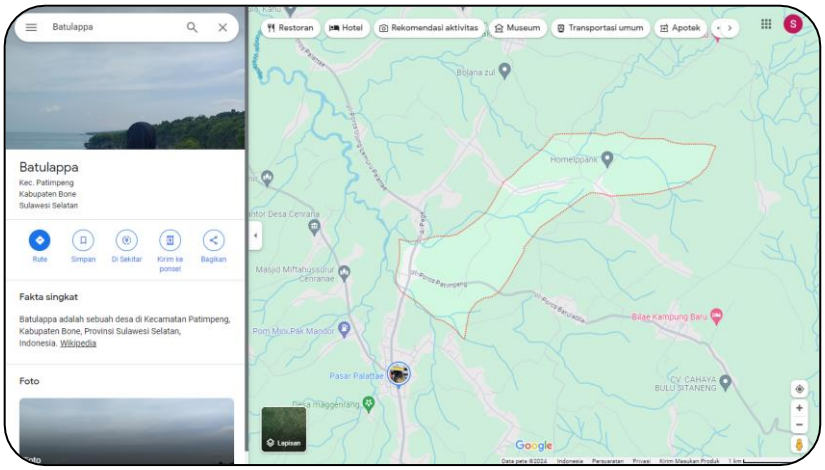

Figure 1. Location of Community Service Program Implementation

This community service activity aims to improve the knowledge and skills of partners (*upskilling*) in processing sawdust waste into economically valuable Innovative Eco-Substrate while supporting sustainable environmental management. The approach used is Participatory by Doing, which involves the participation of partners at every stage of the activity. This approach was chosen because it effectively increases community empowerment, especially through direct experience in implementing activities. Based on the theory of community empowerment (Chambers, 1994) in Mahendra, Asfar & Pratiwi (2024), active participation in direct practice can improve practical skills, sense of ownership, and program sustainability.

Table 1. Indicators of Success of Community Service Activities

No	Stage	Activity	Indicators of achievement
1	Extension	Short seminar on the utilization of sawdust waste	• Increasing partner knowledge about the benefits of sawdust waste • The willingness of partners to participate in all stages of community service activities.
2	Training	• *Innovative Eco-Substrate* Making Training • Packaging and labeling training on products • Marketing training • Simple financial management training	• Partners can process sawdust waste into *Innovative Eco-Substrate* • Partners know how to package and label the product marketing system through promotions. • Partners can do simple financial recording and management (*MS. Excel*)
3	Mentoring	Solving partner issues related to production constraints and evaluating partner abilities	Increasing community welfare and sustainability programs.

Community service activities refer to previous research results (Asfar *et al.,* 2022; Wulandari *et al.,* 2022; Wahyuni *et al.,* 2022) and use a three-stage approach: extension, training, and mentoring. These stages cover the entire process, from raising awareness to strengthening technical skills. Program success indicators involve partners' full participation and are measured by achieving targets at each activity stage, as shown in Table 1.

Based on Table 1, the program evaluation was conducted to measure the success of community service, especially in terms of increasing partner knowledge and skills. This evaluation was conducted using a quantitative approach, which involved filling out an online questionnaire using Google Forms (*Final Evaluation/Post-test*). The questionnaire was designed to assess several key aspects relevant to the program's objectives, as shown in Table 2.

Table 2. Evaluation of Partner Preferences Through Questionnaires

No	Aspects	Assessment Parameters
1	Knowledge Related to Sawdust Waste Processing and Utilization	• Understanding the characteristics of sawdust. • Knowledge of the importance of fermentation in waste processing.
2	Production Skills	• Accuracy in following manufacturing procedures. • Ability to use tools and materials according to standards.
3	Product Packaging and Labeling Skills	• Creativity and neatness of product packaging. • Clarity of information on the label, such as composition and instructions for use.
4	Marketing and Financial Management Skills	• Understanding of marketing strategies, both in person and *online*. • Ability to explain the added value of the product. • Ability to make simple financial records, such as costs and profits.

Data were collected using questionnaires and interviews to assess partner knowledge, skills, satisfaction, and technical evaluation tools to assess product quality. This evaluation approach supports quantitative and qualitative measurement of success indicators.

Evaluation was also carried out through Eco-Substrate Innovative product quality testing to ensure the program's success. Some indicators in the product quality test were the level of product water absorption, nutrient content, pH of the planting medium, stability of materials in the planting medium, and Cation Exchange Capacity (CTC). The following tests support evaluating the quality of *Eco-Substrate Innovative products* in Table 3.

Table 3. Evaluation of *Innovative Eco-Substrate* Product Quality

No	Aspects	Parameters	Objectives
1	Water Absorption Capacity	The ability of the material to absorb and retain water	Assessing the effectiveness of *Eco-Substrate* in supporting water retention in planting media.
2	Nutrient Content (N, P, K)	Primary nutrient levels (Nitrogen, Phosphorus, Potassium)	Determining the potential of nutrients to support plant growth.
3	pH of Planting Media	Acidity or alkalinity of the planting medium	Determines the acidity or alkalinity level of the planting medium, which affects the availability of nutrients for plants.
4	Stability of Materials in Planting Media	Material resistance to degradation and physical changes	Assessing the suitability of materials as sustainable planting media.

No	Aspects	Parameters	Objectives
5	Cation Exchange Capacity (CTC)	Amount of exchangeable cations (cmol/kg)	Measuring the ability of the planting medium to absorb and exchange cation ions so that it can store important nutrients for plants and support optimal growth.

The product quality evaluation method in Table 3 above is designed to evaluate the suitability of the *Eco-Substrate Innovative product* as an organic planting medium. This method ensures that the product meets the quality standards required to support optimal plant growth in terms of water retention, balanced nutrition, and the stability of the ingredients in long-term use. Figure 2 shows the flow of implementing community service activities.

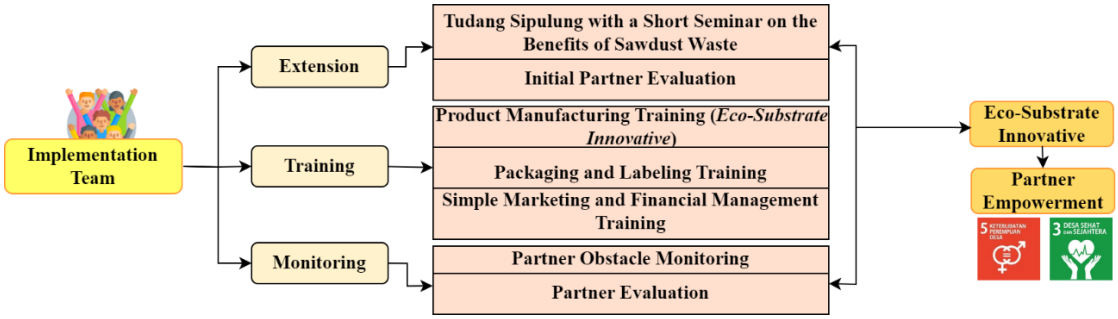

Figure 2. Method of Implementing Community Service Activities

With the methods and stages of implementation in Figure 2 above, this program is expected to empower partners to utilize sawdust waste and create value-added products that can sustainably improve the Batulappa Village community's economy.

Results and Discussion

Implementing this community service program focuses on improving the knowledge and skills (*upskilling*) of Batulappa Village Women's Group partners through transforming sawdust waste into *Innovative Eco-Substrate* (Organic Planting Media). The implementation of this activity has had a positive impact on partners. It has reduced the quantity of sawdust waste that has not received public attention and turned it into a product with high economic value. The description of the results of activities that have been carried out in this community service program consisting of socialization/extension, training, and mentoring are as follows.

Extension

Extension is an activity carried out as a persuasive effort to encourage partners to play an active role in every activity and provide the necessary knowledge. Thus, partners are expected to be able to understand and follow the activities to be carried out (Rasmiati *et al.,* 2023; Riska *et al.,* 2023). The extension is carried out in the form of *tudang sipulung* with the *Knowledge Transfer method* in the form of a short seminar between partners of the Batulappa Village Women's Group and the implementation team by providing information and some facts to partners of the Batulappa Village Women's Group related to the content and benefits of sawdust waste and its processing and utilization which can be used as *an Eco-Substrate Innovative* (Organic Planting Media) which is more environmentally friendly. This extension

activity was attended by 15 partner members and three implementation team members. The team conducted an initial evaluation (*pre-test*) to determine the partners' level of knowledge regarding the processing and utilization of sawdust waste. The Extension implementation process is shown in Figure 3.

Figure 3. Extension Process

The results of the implementation of Extension for partners (Figure 3) show that partners as a community group, namely the Batulappa Village Women's Group, are very enthusiastic about learning how to transform sawdust waste into planting media. It can be seen from the team's observations using *observational sheets*. Partners revealed that there has never been any Extension or socialization related to the utilization of sawdust waste, so it is only thrown away and often burned to reduce the quantity. The results of the initial evaluation also showed that there was no knowledge and skills from partners related to the utilization of sawdust waste. The conclusion from implementing extension activities illustrates that sawdust waste has never been processed or utilized by community groups and partners. Hence, the follow-up to this activity provides training to improve partner skills in transforming sawdust waste.

Training

Training activities are partner participation activities, namely joint learning, where all partners involved in program activities directly participate actively in carrying out practice in making products to be produced (Rosdaliani *et al.,* 2024). The training method applied in this stage is Participatory Learning and Action (PLA), a participatory learning and practice process, a new form of community empowerment previously known as " *learning by doing* " or learning while working. Participatory Learning and Action is the basis of various participatory approach models, where several types of participatory approaches are used to identify community needs. The training is carried out by providing training in making *Innovative Eco-Substrate* product packaging and labeling and simple marketing and financial management training. In this activity, partners are guided directly by the implementing team in making *Innovative Eco-Substrate*. In this activity, the implementing team explains the stages of training carried out by the proposing team as follows.

Product Manufacturing Training (*Eco-Substrate Innovative*)

This activity is the core training in this program. This training is conducted to provide partners with knowledge and skills in transforming or utilizing sawdust waste into planting media

that can be an alternative substitute for chemical mulch and chemical fertilizers. The training starts by preparing raw materials for sawdust waste that will be processed into environmentally friendly planting media, including fermentation tools. Procurement of equipment (facilities and infrastructure) ensures the sustainability of production by partners. The preparation of equipment and materials is complete, then the mixing of materials is carried out to support the fermentation process of sawdust waste such as EM4 (100 mL), Molasses (100 mL), and water (5 L). The mixed materials are then put into a barrel for fermentation. The fermentation process lasts for approximately 2 weeks to produce quality planting media. The planting media produced in this training process can be used for all types of plants, such as chilies, tomatoes, eggplants, corn, and others that require nutrients in their growth process.

Figure 4. Product Manufacturing Training Process

This training process involves demonstrating the process of making Eco-Substrate Innovative to partners. Then, participatory partners follow joint training by doing, where they make planting media together with the implementing team (see Figure 4). Learning by doing will help partners independently when they apply what they have learned in implementing this training. The training was attended by 14 partner members who enthusiastically received a product-making demonstration and actively practiced all steps in making *Eco-Substrate Innovative products*. Eco-Substrate Innovative products can be seen in Figure 5.

Figure 5. *Innovative Eco-Substrate* Products

Eco-Substrate Innovative product is an organic planting medium based on fermented sawdust waste. Tests show water absorption reaches 85%, neutral pH (6.8), sufficient nutrient

content (N 2.5%, P 1.2%, K 1.8%), and material stability for long-term use (3 months). Based on the results of the training activities, a quality test of the *Eco-Substrate Innovative planting media has been carried out*, with the test results being shown in Table 4.

Table 4. Results of *Innovative Eco-Substrate* Product Quality Tests and Testing Process

No	Aspects	Parameters	Methods	Results	Information
1	Water Absorption Capacity	Sawdust's ability to absorb water	Water Absorption Test (Gravimetric Method)	85% (optimal)	High absorption capacity indicates the ability of Eco-Substrate Innovative media to retain soil moisture, supporting the growth of plants that require stable moisture.
2	Nutrient Content (N, P, K)	Nitrogen (N), Phosphorus (P), Potassium (K) levels	Soil Chemistry Test using the Kjeldahl method (for N) and spectrophotometry (for P and K). Tested at the Soil, Plant, Fertilizer, and Water Laboratory of BPTP South Sulawesi (Makassar)	N: 2.5%, P: 1.2%, K: 1.8%	Sufficient nutrient content to support plant growth and increase soil fertility.
3	pH of Planting Media	Acidity or alkalinity of the planting medium	Soil pH Test (pH Meter)	pH 6.8	A pH in the neutral range is suitable for most plants that grow optimally at a neutral pH (6-7).
4	Stability of Materials in Planting Media	Resistance of materials to degradation by microorganisms and other physical factors	Biological and Physical Degradation Test (Rotting Test)	Stable within 3 months	The product does not degrade quickly in a short time, making it a durable material in the long term as a planting medium.
5	Cation Exchange Capacity (CTC)	The ability of the medium to absorb and exchange positive ions	CTC (Cation Exchange Capacity) test using the ammonium percolation method	20 cmol/kg	A fairly high CTC indicates that this media effectively absorbs the nutrients plants need.

The Eco-Substrate Innovative product quality test in Table 4 shows that this product performs excellently as an organic planting medium. This product can effectively meet plant needs with high water absorption, sufficient nutrient content (N, P, K), ideal neutral pH, maintained material stability, and optimal cation exchange capacity (CTC). *Eco-Substrate Innovative* supports plant growth by providing a nutrient-rich environment and stable humidity. It shows potential for long-term application, making it a superior solution in sawdust waste management and increasing agricultural productivity.

Eco-Substrate Innovative product quality tests are supported by previous research findings. Several studies have shown that planting media with high water absorption capacity

contributes to optimal moisture retention for plant growth (Susilowati *et al.,* 2021). Nutrient content, especially N, P, and K, is essential in supporting vegetative and generative plant growth, as Padjung *et al.* (2024) explained. In addition, the neutral pH of the planting media (6.5–7.5) maximizes the availability of nutrients, as Yusuf *et al.* (2023) reported. The material's high stability in the planting media supports long-term use without reducing the physical or chemical quality of the media (Romadoni & Nursanti, 2024). The Cation Exchange Capacity (CTC) of 20 cmol/kg is also following research by Amalina *et al.* (2024), which shows that this CTC value is ideal for supporting the storage and release of cations such as calcium and magnesium, which are needed for soil nutrient balance. These results show that *Eco-Substrate Innovative products* serve as innovative solutions for waste management and benefit agricultural productivity, as supported by various previous studies.

Packaging and Labeling Training

The second training stage is the packaging and labeling stage. At this stage, the implementing team teaches partners how to properly package and label Eco-Substrate Innovative products (see Figure 6). This training aims to provide partners with skills in packaging and giving products identity. The packaging used to package planting media products is a *pouch ziplock* size 500 gr and 1 kg.

Figure 6. Product, Packaging and Label

This packaging and labeling training was attended by 15 members of the Batulappa Village Women's Group partners. The implementation of this training went smoothly, where partners were very active in carrying out the packaging and labeling process for *Eco-Substrate Innovative products* that had been produced in previous training.

Simple Marketing and Financial Management Training

The training conducted after the packaging and labeling stages is simple marketing and financial management training. At this stage, the implementing team provides knowledge and skills to partners on how to market products through *marketplaces* such as *Shopee* to partners. This training aims to enable partners to market products more widely through *online marketing*. The stages carried out start from the account registration stage to photo processing, product descriptions, product pricing, and the final stage of the process, product *launching*. This training was attended by 10 partner members who were very enthusiastic about its implementation.

This state is because previously, partners had understood the use of the *marketplace application* but only acted as *users* and had not made sales, so this training was an addition to new knowledge for partners in the form of skills in using *the marketplace* as a product provider. The results of this marketing and financial management training are creating a partner *Shopee account* for product commercialization and partners' skills in carrying out simple financial records using the *MS. Excel application* independently. The following is a display of the Eco-Substrate Innovative Product's online store (Shopee) and the sales brand (*Eco-Sawdust Innovation*).

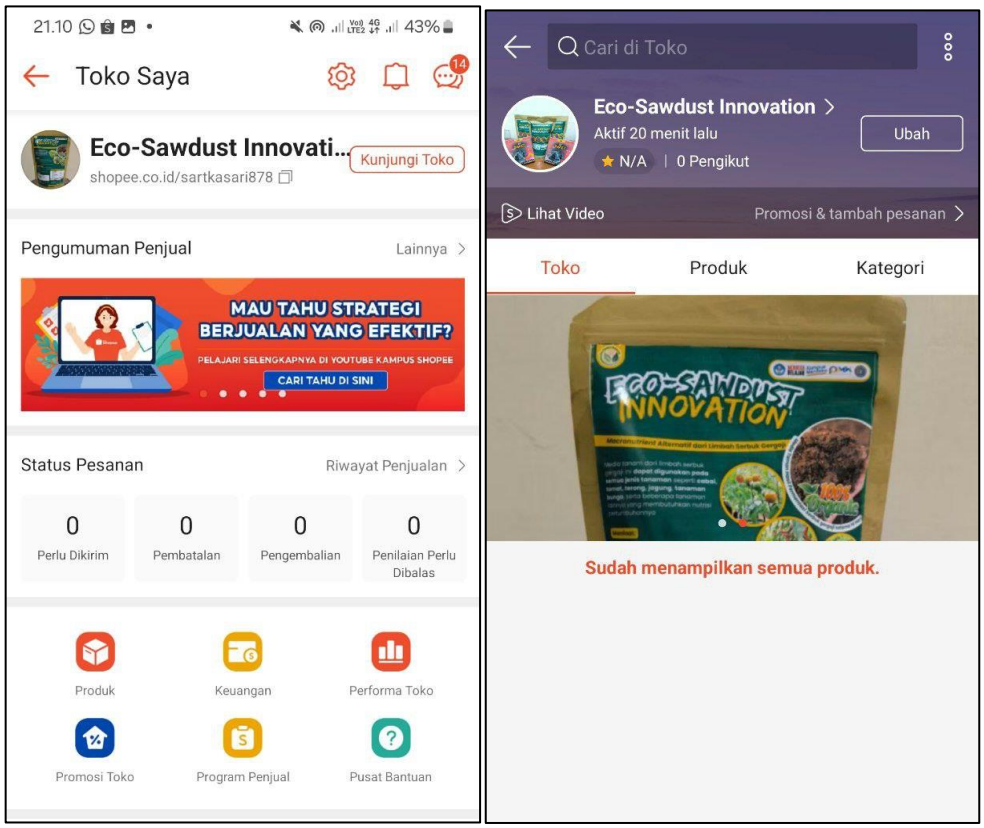

Figure 7. Product Marketing Account

Figure 7 above shows the appearance of the *marketplace account* used to market *Eco-Substrate Innovative products*. This account was created through online marketing training, where partners were taught how to register an account, upload product photos, write attractive descriptions, and set prices. The account display includes complete product information, including the *Eco-Sawdust Innovation brand name*, to attract potential buyers and expand market reach. This account is one of the strategic steps in strengthening the program's sustainability and increasing product competitiveness in the digital market.

Mentoring

The implementation of mentoring is carried out after conducting training for partners. The mentoring carried out uses the *Community Development method* in the form of cadre formation and restructuring of partner organizations. The mentoring process can be seen in Figure 8 below.

Figure 8. Mentoring Process

Mentoring is carried out in Figure 8 above, aimed at evaluating partners regarding the obstacles faced by partners in making products as well as the ability of partners to develop products produced independently. There were no significant obstacles experienced by partners during the training because the training process was carried out in detail and sequentially so that partners could follow *the steps* demonstrated by the implementing team. In this mentoring, an evaluation was given related to increasing partner knowledge and skills after training was carried out 3 (three) times.

Online questionnaires were distributed via *Google Forms* (Final Evaluation/*Post-test*). Figure 9 below shows the percentage of partner success indicators achieved in the form of increased knowledge and skills (Upskilling).

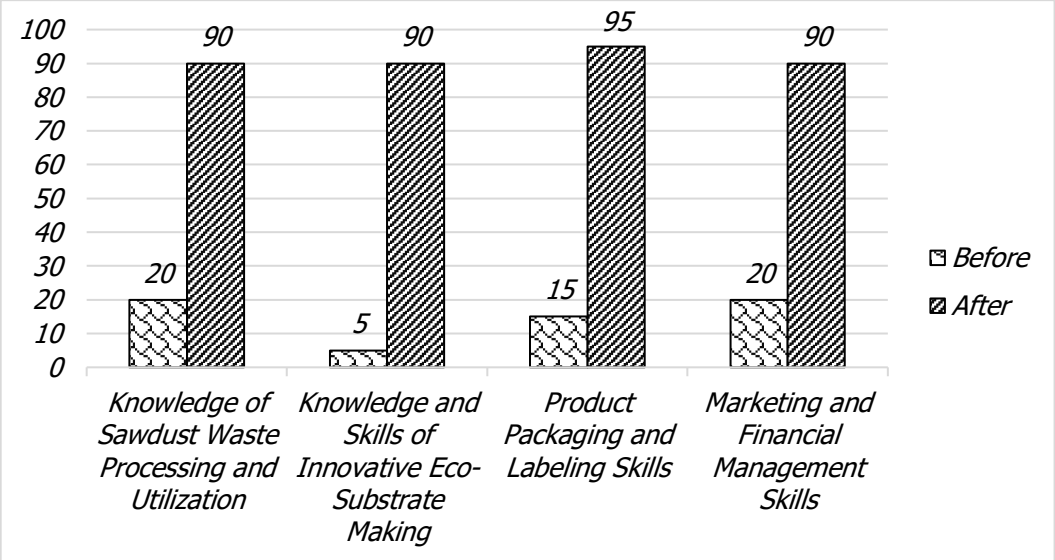

Figure 9. Percentage of Increase in Partner Knowledge and Skills

Figure 9 above shows the increase in knowledge and skills of partners after participating in the training program. The data illustrates a significant change from the condition before the program (average below 20%) to after the program (average 90%). It shows the effectiveness of the *Participatory by Doing approach* used in the training, where participants are actively involved in every activity stage. In particular, the highest increase occurred in packaging and labeling skills (95%), reflecting the high relevance and direct application of these skills in producing ready-to-sell products.

This increase aligns with active learning theory, emphasizing that hands-on experience is one of the most effective learning methods. In addition, technical skills such as marketing and

financial management showed significant increases (90%), reinforcing the importance of integrating technical skills with product development for the program's sustainability. Table 5 describes the increase in partner knowledge and skills.

Table 5. Percentage of Partner Skill Improvement

No	Field	Before	After	Increase (%)
1	Knowledge	There is no training in sawdust waste processing (minimal knowledge)	Increased understanding regarding the benefits and content of sawdust waste, which can be used as an organic planting medium	90
2	Production Training	Handling sawdust waste is only done by burning it and throwing it into the river.	Independently produce *Innovative Eco-Substrate products from the training they have undertaken.*	90
3	Product Packaging and Labeling	There has never been any training related to improving packaging and labeling skills.	Increasing partner understanding in packaging and labeling products resulting from education on packaging and label design for *Innovative Eco-Substrate products with ziplock pouch* packaging.	95
4	Marketing and Financial Management Education	There is no training or Extension regarding product marketing education (partners know *the marketplace* but only as *users*)	Increasing partner knowledge about *online marketing Marketplace* Improving partner skills in using *the marketplace* Increased knowledge in carrying out simple financial management	90

Table 5 supports the results of Figure 9 by providing details on improvements in each area. Significant impacts are seen in the production area, where partners can efficiently process sawdust waste into Eco-Substrate Innovative products. Before the program, partners only disposed of or burned waste, whereas, after the training, partners could convert waste into products with economic value and are environmentally friendly.

These results are relevant in addressing waste issues and contribute to achieving Sustainable Development Goals (SDGs) point 12 on sustainable production and consumption. In addition, this program has the potential to be replicated in other areas with similar waste issues.

Impact of the Program

By processing sawdust waste into *Innovative Eco-Substrate* in an upskilling effort for the Batulappa Village Women's Group, the Community Service program has had tangible impacts in three main aspects: the environment, economy, and society.

Environmental Impact

This program has successfully reduced up to 90% of sawdust waste previously burned or dumped into rivers. Thus, air pollution due to carbon emissions from burning can be minimized. This waste processing supports the principle of environmental sustainability, in line with

research by Kurniawan *et al.* (2024), which states that fermentation-based organic waste management can reduce environmental impacts and improve soil quality.

Economic Impact

Waste processing into organic planting media with economic added value provides opportunities for partners to increase family income. The online marketing training also allows partners to reach a broader market through digital platforms such as Shopee. It aligns with research by Miradji *et al.* (2024), which highlights the importance of technology in supporting community economic empowerment through product innovation.

Social Impact

This program increases community capacity in managing waste sustainably and creates new job opportunities for women's groups in Batulappa Village. Partners' active participation in training and mentoring has strengthened the program's sense of ownership, supporting Chambers' (1994) findings in Maslihah, Ikhsan, & Kosasih's (2022) findings on community empowerment through the *Participatory by Doing method*. The success of this program not only provides a local solution to the waste problem but also has the potential to be a model that can be replicated in other areas with similar problems. It supports the agenda of Sustainable Development Goals (SDGs) point 12, namely responsible consumption and production while improving the economic welfare of local communities.

Conclusion

This community service program has succeeded in increasing the knowledge and skills of the Batulappa Village Women's Group in processing sawdust waste into *Innovative Eco-Substrate,* which was initially only piled up, thrown away, and even burned by the community. In addition to reducing waste, this program develops simple packaging, labeling, marketing, and financial management skills. Partners feel the impact and provide practical solutions for the broader community in waste management and utilization of planting media. This program makes a real contribution to supporting economic independence and community empowerment through high-value economic products. This community service activity uses a simple fermentation method to process sawdust waste into organic planting media. Further research is recommended to optimize the fermentation process, such as determining the type of microorganisms, temperature, humidity, and ideal fermentation duration. The author hopes that future research can explore innovative methods and new technologies to improve community skills in waste management, support empowerment, and community welfare.

Acknowledgment

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