

Agricultural and Household Waste Utilization for Efficiency and Productivity of Maju Jaya Farmers

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Abstract

Fertilizer is an essential input for agricultural production, while agricultural and household activities generate large amounts of waste that are often underutilized. Agricultural and household waste can be processed into organic fertilizer, yet its adoption remains limited. Bandar District, Simalungun Regency, with 803 hectares of rice fields and annual production of 6,866 tons of rice, generates abundant straw waste. At the same time, farmers face increasing production costs due to limited access to subsidized fertilizers. This community service program aimed to empower the Tani Maju Jaya Farmer Group in Bandar Rakyat Village through the utilization of agricultural and household waste into organic fertilizer. Activities included socialization on the benefits of organic fertilizer and hands-on training in operating straw-chopping machines and producing organic fertilizer. The program improved participants' knowledge, enhanced their technical skills, and enabled sustainable organic fertilizer production, supported by periodic monitoring and evaluation to ensure long-term adoption and impact.

Keywords: Organic Fertilizer, Agricultural Waste, Household Waste, Agricultural Productivity

Abstrak

Pupuk merupakan kebutuhan utama dalam kegiatan pertanian, sementara aktivitas pertanian dan rumah tangga menghasilkan limbah yang belum dimanfaatkan secara optimal. Limbah tersebut berpotensi diolah menjadi pupuk organik untuk mengurangi ketergantungan terhadap pupuk anorganik. Kecamatan Bandar, Kabupaten Simalungun, memiliki luas sawah 803 hektare dengan produksi padi mencapai 6.866 ton per tahun sehingga menghasilkan limbah jerami dalam jumlah besar. Di sisi lain, petani menghadapi kendala terbatasnya pupuk bersubsidi yang meningkatkan biaya produksi. Kegiatan pengabdian kepada masyarakat ini bertujuan meningkatkan kemampuan Kelompok Tani Maju Jaya di Desa Bandar Rakyat dalam mengolah limbah pertanian dan rumah tangga menjadi pupuk organik. Metode yang digunakan meliputi sosialisasi mengenai manfaat pupuk organik serta pelatihan pengoperasian mesin pencacah jerami dan pembuatan pupuk organik. Hasil kegiatan menunjukkan peningkatan pengetahuan, keterampilan, dan kemampuan kelompok tani dalam memproduksi pupuk organik secara berkelanjutan melalui pendampingan, monitoring, dan evaluasi berkala.

Keywords: Pupuk Organik; Limbah Pertanian, Limbah Rumah Tangga; Produktivitas Pertanian



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INTRODUCTION

Fertilizer is an essential input in agricultural production. Without adequate fertilizer application, crop yields may decline, leading to reduced farmers' income. To lower production costs, the Indonesian government provides fertilizer subsidies. However, the allocated quota of subsidized fertilizer is often insufficient to meet farmers' needs and is not distributed evenly. The shortage of subsidized fertilizer places farmers in a difficult position. Without fertilizer

application, crop productivity is likely to decrease. On the other hand, purchasing non-subsidized fertilizer significantly increases production costs, thereby reducing farmers' profits.

Meanwhile, human production and consumption activities continuously generate waste that is commonly regarded as useless and discarded without proper management. Waste has become an important environmental issue because its accumulation may cause unpleasant odors, environmental pollution, and health problems within communities. Nearly every household produces organic waste on a daily basis, while post-harvest agricultural activities generate substantial quantities of rice straw. Agricultural and household wastes have considerable potential to be converted into organic fertilizer; however, proper waste management practices remain limited, resulting in the accumulation of organic waste (Pranata et al., 2021). In fact, these organic wastes can serve as valuable raw materials for organic fertilizer production.

The growing public awareness of healthy and environmentally friendly lifestyles has increased consumer demand for organic agricultural products (Hasanah et al., 2020). Organic farming also offers greater economic opportunities for farmers because organic products generally command higher market prices than conventionally produced crops. These economic benefits can be further enhanced when farmers produce their own organic fertilizer, as this reduces production costs while simultaneously improving soil fertility (Ruwanto & Banowati, 2021) (Novira et al., 2022). Simalungun Regency is currently one of the leading rice-producing regions in North Sumatra Province. According to Statistics Indonesia (BPS) of North Sumatra, Simalungun has the third-largest rice cultivation area in the province, covering approximately 33,173 hectares, after Deli Serdang (49,658 hectares) and Serdang Bedagai (48,867 hectares) (BPS Sumatera Utara, n.d.). Within Simalungun Regency, Bandar District cultivates approximately 803 hectares of rice fields, producing around 6,866 tons of rice annually. Such production inevitably generates large quantities of rice straw. Despite its status as a major rice production center, rice farmers in the district continue to face shortages of subsidized fertilizer. This situation forces farmers to purchase more expensive non-subsidized fertilizer, substantially increasing production costs. Conversely, reducing fertilizer application would likely result in lower agricultural productivity. Consequently, farmers face a significant economic dilemma.

In addition, although chemical fertilizers have contributed to increasing rice production, their excessive use may negatively affect the environment. Fertilizer residues can be transported through rainfall runoff and irrigation systems, contaminating surrounding ecosystems. Excessive application may also increase soil compaction, reduce soil aeration, decrease beneficial soil microorganisms, and ultimately lower soil fertility. These environmental concerns have encouraged researchers and environmental practitioners to promote the use of organic fertilizers as a more sustainable alternative. At the same time, changing consumer preferences toward healthier lifestyles have increased the demand for organically produced food. Organic agricultural products also have higher market values than conventionally produced commodities. Furthermore, organic fertilizers can be produced independently by farmers using agricultural and household organic waste. Rice farming generates two major agricultural by-products, namely rice straw and rice husks, both of which can be processed into organic fertilizer. Rice straw contains high concentrations of potassium and lignin (Aprilia Ike Nurmalasari, Supriyono, Maria Theresia Sri Budiastuti, Sri Nyoto, 2021), while rice husks have been reported to adsorb harmful heavy metals and suppress pathogenic microorganisms in the soil (Wulandari & Gorda, 2022). Therefore, utilizing these agricultural residues as organic fertilizer provides an effective strategy for reducing farmers' production costs while simultaneously managing agricultural waste.

The Maju Jaya Farmer Group, located in Bandar Rakyat Village, is one of the farming communities affected by the shortage of subsidized fertilizer. The group normally receives subsidized NPK, urea, and NPK Formula fertilizers. However, the available allocation is insufficient to meet the needs of all members because fertilizer distribution is based on predetermined quotas. Some farmers receive no subsidized fertilizer due to discrepancies between proposed demand and available government allocations. Consequently, many farmers are compelled to purchase non-subsidized fertilizer at significantly higher prices. For example, subsidized urea costs approximately IDR 2,250 per kilogram, subsidized NPK costs IDR 2,300 per kilogram, and subsidized NPK Formula costs IDR 3,300 per kilogram. In contrast, non-subsidized urea costs around IDR 15,000 per kilogram, increasing fertilizer expenditures by nearly six times. Considering the abundance of rice straw and household organic waste, these materials should be managed and utilized as organic fertilizer. Such an approach would not only reduce dependence on subsidized fertilizer but also substantially lower fertilizer expenditures. Based on the situation analysis and the problems faced by the partner community, three priority issues were identified: (1) the shortage of subsidized fertilizer, (2) the high cost of non-subsidized fertilizer, and (3) inadequate management of agricultural and household waste. These priority issues are summarized in Table 1.

Table 1. Priority Problems of the Partner Community

No	Priority Problem	Problem Description
1.	Shortage of subsidized fertilizer	The limited availability of subsidized fertilizer creates a dilemma for farmers. Without adequate fertilizer application, crop productivity is likely to decline.
2.	High cost of non-subsidized fertilizer	The only alternative available is non-subsidized fertilizer, which is considerably more expensive. Farmers face a difficult choice: reducing fertilizer use may decrease crop yields, whereas purchasing non-subsidized fertilizer substantially increases production costs.
3.	Underutilization of agricultural and household waste	Rice cultivation generates large quantities of rice straw. However, rice straw and household organic waste are generally discarded instead of being utilized, despite their potential to be processed into organic fertilizer.

Based on field surveys and interviews conducted with the partner community, namely the Maju Jaya Farmer Group in Bandar Rakyat Village, this community service program focused on addressing three priority problems identified during the needs assessment. The proposed solutions to these problems are presented in Table 2.

Tabel 2. Proposed Solutions

No	Priority Problems	Proposed Solution	Description
1.	Shortage of subsidized fertilizer	Utilization of agricultural and household waste for organic fertilizer production	Agricultural waste is processed into organic fertilizer using an appropriate technology, namely a straw-chopping machine, to reduce the size of the raw materials and accelerate the decomposition process.
2.	High cost of non-subsidized fertilizer		
3.	Underutilization of agricultural and household waste		

RESEARCH METHODS

This Community Service Program (PKM-DRTPM) was conducted in Bandar Rakyat Village, Bandar District, Simalungun Regency, Indonesia, by a team of lecturers and students from Universitas Negeri Medan. The community partner was the Maju Jaya Farmer Group, an established farmer organization operating in the village. The program employed two main approaches, namely educational outreach and technical training. The implementation stages are described as follows.

Socialization on the Utilization of Agricultural and Household Waste for Organic Fertilizer Production

This activity constituted the initial stage of the community service program and served as the primary medium for knowledge transfer to the partner community. The session introduced the basic concepts of utilizing agricultural and household waste as organic fertilizer and provided an overview of the subsequent activities before participants engaged in practical field implementation. The topics covered during the socialization included:

1. Introduction to the straw-chopping machine used to shred rice straw and household organic waste into smaller particles;
2. Benefits of organic fertilizer for crop growth, soil quality, and environmental sustainability; and
3. The potential of self-produced organic fertilizer to reduce production costs and improve agricultural productivity.

Technical Training on the Operation and Maintenance of the Straw-Chopping Machine

Following the socialization stage, participants received hands-on technical training on the operation and maintenance of the straw-chopping machine. The training was coordinated by the training and mentoring team, while the partner community provided agricultural and household organic waste as raw materials for the practical sessions on organic fertilizer production.

Demonstration of Organic Fertilizer Production

The demonstration was conducted directly by the PKM team, who explained the purpose and function of each step in the production process. Participants were trained to produce organic fertilizer using the following equipment: (1) a 150-L composting drum and a 60-L composting drum, (2) EM4 bioactivator solution, (3) a straw-chopping machine, and (4) water. The procedures for producing organic fertilizer were as follows:

1. Prepare agricultural waste and household organic waste, such as vegetable residues.
2. Prepare the composting drum.
3. Place the shredded agricultural and household organic waste into the composting drum.
4. Dilute the EM4 bioactivator with water, pour the solution into the composting drum, and mix thoroughly.
5. Stir the compost mixture once every week to ensure an effective fermentation process.
6. Solid organic fertilizer is ready after approximately 5–7 weeks, indicated by a dark color and the absence of foul odor. Liquid organic fertilizer is produced when a yellowish-brown liquid is formed without an unpleasant odor.

Program Monitoring and Evaluation

The community service program was implemented over an eight-month period, including approximately four months of intensive knowledge transfer and mentoring activities. Program evaluation consisted of both internal evaluation, conducted by the implementation team, and external evaluation, conducted by reviewers appointed by the Institute for Research and Community Service (LPPM) and the Directorate of Research, Technology, and Community Service (DRTPM).

RESEARCH RESULTS AND DISCUSSION

The community service program was conducted on 16 September 2024 in Bandar Rakyat Village, Bandar District, Simalungun Regency, with activities centered in the courtyard of the

Bandar Rakyat Village Office. The event was attended by the Village Head, members of the Maju Jaya Farmer Group, the PKM-DRTM implementation team, students, representatives from the Institute for Research and Community Service (LPPM), and local community members. During the opening ceremony, the Village Head expressed his support for the program, emphasizing that organic fertilizer production training would benefit local farmers by improving agricultural productivity while addressing the shortage of subsidized fertilizers. He also highlighted that the program could encourage farmers to become more self-reliant in managing agricultural and household organic waste.



Figure 1. Opening Remarks by the Head of Bandar Rakyat Village

The program consisted of four main activities: (1) socialization on the utilization of agricultural and household waste for organic fertilizer production, (2) technical training on the operation and maintenance of the straw-chopping machine, (3) demonstration of organic fertilizer production, and (4) monitoring, evaluation, and the handover of agricultural equipment.

Socialization on the Utilization of Agricultural and Household Waste for Organic Fertilizer Production

The socialization session served as the initial stage of knowledge transfer aimed at improving the partner community's understanding of organic fertilizer production. The session was delivered by Dra. Elfayetti, M.Pd., who introduced the straw-chopping machine, explained the benefits of organic fertilizer for crops, soil quality, and environmental sustainability, and discussed its potential to reduce production costs while increasing rice productivity. The straw-chopping machine was powered by a Honda GX-160 gasoline engine, enabling it to cut rice straw into pieces approximately 1–5 cm in length. Smaller particle sizes accelerate the decomposition process by increasing the surface area available for microbial activity. Organic fertilizer also contributes to improved soil fertility by supplying essential nutrients and enhancing soil physical properties, including water-holding capacity (Li, 2020) (Wang, 2018).



Figure 2. Community Outreach Session

The socialization activity was successfully implemented, with members of the Maju Jaya Farmer Group actively participating in discussions, asking questions, and sharing their experiences regarding current farming practices. Their enthusiasm indicated a strong interest in adopting organic fertilizer production as an alternative to conventional fertilizer use.



Figure 3. Participants in the Community Outreach Session

Technical Training on the Operation and Maintenance of the Straw-Chopping Machine

Following the socialization session, participants attended practical training on the operation and maintenance of the straw-chopping machine. The training was facilitated by the entire PKM team, who provided detailed explanations of the machine's operating procedures, safety precautions, and routine maintenance.



Figure 4. Technical Training on the Operation of the Straw-Chopping Machine

Participants were given opportunities to operate the machine directly under the supervision of the training team. Hands-on practice allowed farmers to become familiar with the equipment while receiving immediate feedback, thereby improving their confidence and technical competence in preparing raw materials for organic fertilizer production.

Demonstration of Organic Fertilizer Production

The demonstration was led by Nina Novira, Ph.D., with support from the entire PKM team. Rice straw was first processed using the straw-chopping machine to produce smaller fragments, which facilitate faster decomposition. Previous studies have shown that reducing the size of composting materials accelerates microbial activity and improves the composting process because microorganisms decompose smaller particles more efficiently than larger ones (Jalaluddin et al., 2017). The chopped straw was subsequently transferred into a composting drum, followed by the addition of water mixed with the EM4 bioactivator solution. The composting drum was then sealed and allowed to undergo fermentation for approximately two months to obtain mature organic fertilizer.

Following the demonstration, members of the Maju Jaya Farmer Group independently repeated the entire production process as a final evaluation of the training. The participants successfully completed all procedures according to the prescribed guidelines, demonstrating that the knowledge and practical skills had been effectively transferred. The positive impact of the program was reflected in participants' responses. Mr. Hemron, Head of the Maju Jaya Farmer Group, stated that the training had equipped the group with the knowledge and equipment required to produce organic fertilizer independently. He expressed optimism that fertilizer shortages would no longer pose a major challenge because farmers could now utilize locally available agricultural and household waste as alternative fertilizer resources.



Figure 5. Demonstration of Organic Fertilizer Production

During the closing session, participants expressed their appreciation for the training, noting that it had provided valuable knowledge and practical skills that could be directly applied to their farming activities. They also believed that producing organic fertilizer independently would significantly reduce expenditures previously allocated to purchasing conventional fertilizers.



Figure 6. Testimonial from the Partner Community

Monitoring and Evaluation

Following program implementation, monitoring and evaluation activities were conducted to assess both the effectiveness and sustainability of the community service program. During this stage, the PKM team observed the progress of the composting process inside the composting drums and evaluated the participants' ability to independently produce organic fertilizer. The monitoring activities were accompanied by an additional demonstration using household organic waste as the primary composting material. The results showed that members of the Maju Jaya Farmer Group were able to independently carry out the organic fertilizer production process according to the procedures introduced during the training. This finding demonstrates that the knowledge transfer and technical assistance successfully improved the community's capacity to manage locally available organic waste and produce organic fertilizer independently.



Figure 7. First Monitoring and Evaluation Session and Handover of the Hand Tractor

The monitoring session also included the formal handover of a hand tractor to the Maju Jaya Farmer Group. The provision of this agricultural equipment is expected to enhance farming efficiency, reduce labor requirements, and further improve agricultural productivity within the community.

Program Outputs

1. Community Service Activity Video

A video documenting the implementation of the community service program is available at: <https://youtu.be/CQ6igbCbCEw>

2. Media Coverage

The implementation of this community service program was featured in an online news article, which can be accessed at: <https://kaldera.id/news/medan/66569/tim-pkm-drtpm-unimed-gelar-pelatihan-pembuatan-pupuk-organik-komposter-di-desa-bandar-rakyat-simalungun/>



Figure 8. Media Coverage of the Community Service Program

3. Program Poster



increased significantly. Second, members of the Maju Jaya Farmer Group acquired the skills required to operate and maintain the straw-chopping machine properly. Third, the participants became capable of independently managing agricultural and household organic waste and converting it into organic fertilizer. The sustainability of the program is demonstrated by the partner community's commitment to continuing organic fertilizer production independently after the completion of the project. To ensure long-term impact, the PKM team will continue conducting periodic monitoring and evaluation of the program's outcomes and its benefits for the partner community. It is expected that the independent utilization of organic waste by the Maju Jaya Farmer Group will serve as a model of environmentally sustainable and economically beneficial farming practices for both the partner community and other farming groups.

The novelty of this community service program lies in its integrated approach to empowering farmers through the conversion of agricultural and household waste into organic fertilizer as a strategy to improve resource efficiency and support sustainable agricultural productivity. Rather than treating agricultural waste management solely as an environmental concern, this program connects waste utilization with farmers' practical needs to reduce dependence on external fertilizer inputs and address the economic challenges associated with limited access to subsidized fertilizers. Implemented with the Tani Maju Jaya Farmer Group in Bandar Rakyat Village, Simalungun Regency, the program combines educational socialization, hands-on training in straw-chopping machine operation, practical organic fertilizer production, and periodic monitoring and evaluation. This integration distinguishes the program's approach by linking knowledge transfer, technical capacity building, and continued implementation support within a community-based agricultural empowerment framework. Its contextual contribution lies in utilizing locally available rice straw and household waste as potential resources for developing a more circular agricultural system. Furthermore, the program emphasizes the importance of sustained farmer participation and follow-up monitoring to support the continued adoption of organic fertilizer production beyond the initial training activities. The program therefore offers a practical model for community-based waste valorization that can inform similar initiatives in agricultural communities facing fertilizer affordability and waste management challenges. However, claims regarding increased productivity, reduced production costs, or long-term environmental benefits require further validation through quantitative measurements of fertilizer output, input expenditure, crop yields, and sustained adoption.

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