

# The Making of an Organic Waste Shredding Machine to Improve Agricultural Yields in Pasir Impun Village

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## ABSTRACT

*Compost fertilizer is a type of fertilizer used by the Nur Alam community to enrich their agricultural land. This fertilizer is needed in large quantities every week. In this community service activity, a composting machine was created to assist Nur Alam Tani with their fertilizer needs. The function of this machine is to accelerate the compost production process by shredding waste into smaller sizes. The machine has dimensions of 490 x 455 x 950 mm. An electric motor with a power specification of 1Hp is used as its drive. This machine is capable of processing waste at a rate of 5 kg/hour, producing shredded material with an approximate size of 10 mm. The output from this machine has greatly benefited Nur Alam Tani, as prior to the use of this device, they were only able to produce about 10 kg of fertilizer per week.*

**Keywords:** fertilizer, compost, machine, composter

## 1. INTRODUCTION

Pasir Impun Village, located in the East Bandung region of Mandalajati District, Bandung City, is an area known for its hilly terrain, offering stunning views that make it an ideal location for agriculture and ecotourism activities. One agricultural initiative that supports the Pasir Impun area is the Nur Alam Tani community.

Nur Alam Tani is a community focused on food security that has been granted permission to manage approximately 4,000 m<sup>2</sup> of green space owned by the Bandung City government. This community has the potential in agricultural skills, such as soil preparation and other farming techniques. The plant maintenance process is conducted with limited resources, including the purchase of seeds, irrigation, fertilization, and pest management. Figure 1 shows the Nur Alam Tani community during their activity of planting chili peppers.



**Figure 1. Clearing the land of weeds and planting chili peppers**

One of the issues faced is the significant need for fertilizer, which becomes a major cost constraint due to limited resources. Another challenge is the accumulation of organic waste that has not been managed properly.

An effort to minimize waste accumulation and reduce fertilizer costs is to process organic waste into compost **(Maulana, 2024)(Mulyana, 2020)**. Compost is the result of the decomposition of a mixture of organic materials, accelerated by a variety of microbes or microorganisms in warm and humid environmental conditions **(Sulistyorini, 2011)**.

The compost produced from organic waste is rich in nutrients needed by plants, helping to improve soil structure, enhance water retention, and increase nutrient availability for crops **(Thesiwati, 2018)**. Manual processing of organic waste into compost takes a considerable amount of time, approximately four weeks. The size of the waste to be decomposed by microorganisms affects the decomposition time; the smaller the size, the easier it is to break down **(Suhastyo, 2017)**.

The process of reducing the dimensions of organic waste requires a shredding machine. An organic waste shredding machine is designed and constructed to facilitate the processing of organic waste into compost by shredding it into smaller, more easily decomposable sizes **(Sutrisna, Syawaldi, Dedikarni, & Raharjo, 2019)**. The procurement of this organic waste shredding machine addresses not only agricultural issues but also the environmental problems faced in this village **(Marwantika, 2019)**.

The goal of this community service activity is to design and create an organic waste shredding machine to be used in the composting process, providing a solution to operational fertilizer costs and the accumulation of organic waste in the agricultural land of Pasir Impun Village, Bandung. The expected benefits of procuring this organic waste shredding machine include:

1. **Accelerating the Composting Process**  
By shredding waste into smaller sizes, the surface area of contact between organic materials and microorganisms increases, allowing microorganisms to work more effectively. Using the shredding machine can shorten the compost production time from 2-4 weeks to a more efficient duration.
2. **Reducing Waste Volume**  
Organic waste that would otherwise be discarded can now be processed into a valuable product, thereby alleviating waste accumulation issues.
3. **Time and Labor Efficiency**  
Without a shredding machine, the process of cutting and decomposing organic waste is typically done manually, requiring significant labor. The introduction of the shredding

machine automates this process, reducing labor needs and saving operational costs in the long term.

4. Producing High-Quality Compost

Utilizing organic waste to produce compost supports environmental preservation efforts, reduces pollution, and promotes sustainable agriculture in the future (**Hamidah, Shintia, & Anshori, 2023**). The shredding machine not only cuts organic waste into small pieces but also aids in mixing diverse organic materials into high-quality compost, which is easier to dry and use as fertilizer.

5. Introducing Appropriate Technology to the Community

The procurement of the shredding machine introduces appropriate technology to the local community, offering practical recommendations for farmers and stakeholders in the village to adopt effective and environmentally friendly technologies to enhance agricultural productivity (**Siswati, Ariyanto, Setiawan, Wardi, & Yandra, 2021**).

The procurement of the organic waste shredding machine is anticipated to address the issues faced in Pasir Impun Village. This machine can process organic waste into compost more quickly and efficiently. The compost produced by this machine is of higher quality because the organic materials are finely shredded, making them easier to decompose by microorganisms in the soil.

Through the DIKTI development program, this shredding machine is expected to provide a solution to the existing challenges in Pasir Impun Village. The utilization of this machine is intended for the benefit of the Nur Alam Tani community in Pasir Impun Village.

## 2. METHOD

In general, the implementation of this community service is divided into several stages, as follows:

1. Field Survey

The first stage involves conducting a field survey aimed at identifying the partner's issues. The results indicate that unprocessed waste is leading to a decline in environmental quality in Pasir Impun Village.

2. Discussion and Solution Exploration with Partners

The second stage is a discussion with partners to explore solutions related to the organic waste shredding machine. The Nur Alam Tani community requires a machine for producing organic fertilizer. The proposed solution is the creation of an organic waste shredding machine to help reduce accumulated waste.

3. Designing the Shredding Machine

The third stage involves designing the shredding machine. Before the design process, a survey regarding the capacity of the waste to be processed by the machine is conducted. This is followed by determining the shredding mechanism and creating the machine design. The design of the shredding machine to be used is illustrated in Figure 2.



**Figure 2. Design of the Shredding Machine**

The principle of operation of the organic waste shredding machine is broadly as follows: organic waste is collected and then fed into the machine, where it is shredded inside a shredding chamber. This chamber contains rotating blades and stationary blades. Once the waste is shredded, it exits through the output hole of the shredding machine, ideally in smaller pieces to facilitate the composting process.

This shredding machine is designed with a shredder mechanism, where the input waste is drawn in, cut, and shredded into small fragments. The machine uses an electric motor as the primary power source, which rotates the drive shaft and blades connected through a pulley and belt transmission **(Nugraha, Pratama Septangga, Sopian, & Roberto, 2019)**. Additionally, the electric motor has lower pollution levels, both in terms of air and noise pollution, compared to a diesel motor.

The blades serve as the components that cut the waste into smaller pieces. In addition to the rotating blades attached to the shaft, there are also stationary blades fixed to a blade holder, which is mounted on a perforated plate, as shown in Figure 3.



**Figure 3. Blades of the Shredding Machine**

The next stage is the Manufacturing of the Shredding Machine. This organic waste shredding machine was constructed in the Mechanical Engineering Laboratory of the National Institute of Technology and at the home of one of the team members from the community service project. The manufacturing process includes material cutting, as shown in Figure 4.

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**Figure 4. (a) Material Cutting, (b) Welding and (c) Painting**

The components of the shredding machine that were manufactured include the drive shaft for the blades, blade holder, rotating blades, stationary blades, perforated plate, hopper, frame, and machine casing or cover. Additionally, several components were sourced from the market, such as the electric motor, belt transmission (v-belt), pulley, pillow block, and bearings. Figure 5 shows the completed shredding machine.



**Figure 5. The Completed Shredding Machine**

The next stage is the handover to the partner, as shown in Figure 6, followed by training on the operation of the machine for the partner. After the household organic waste shredding machine has been tested and handed over, the training on how to operate and maintain the machine will be conducted in the next phase, as this community service project is not yet complete.



**Figure 6. Handover to the Partner**

### 3. RESULTS AND DISCUSSION

The procurement of the organic waste shredding machine, carried out through collaboration between faculty members, students, and the Nur Alam Tani community in Pasir Impun Village, has provided a positive solution for compost production and organic waste management in the area. The contribution of the partner in this activity includes determining the specifications of the required machine and conducting the testing process. The final result is a shredding machine that can reduce organic waste to smaller sizes, thereby accelerating decomposition and improving compost quality. The specifications of the shredding machine are presented in Table 1.

**Table 1. Specifications of the Shredding Machine**

<b>Specifications of the Waste Shredding Machine</b>	
Capacity	5 kg/jam
Drive Motor Power	1 Hp
Dimensions	p x l x t (490 x 455 x 950 mm)
<b>Blades</b>	
Number of Blades	Total 15 pc Rotating Blades 12 pc Stationary Blades 3 pc
Blade Material	Karbida
<b>Shaft</b>	
Shaft Diameter	Drive Shaft 40mm
Shaft Material	S30C (48 kg/mm <sup>2</sup> )
<b>Casing</b>	
Casing Dimensions	Top Section $\varnothing$ 343x380 mm Bottom Section $\varnothing$ 343x380 mm
Casing Material	S30C (48 kg/mm <sup>2</sup> )
<b>Belt</b>	
Level 1	A-55 inch x 1pc
<b>Pulley</b>	
Level 1	2 inch <i>single groove</i> 8 inch <i>single groove</i>
<b>Frame</b>	
Total Dimensions	P x l x t (490mm x 455mm x 600mm)
Chassis Material	Siku L (5x5 mm)

The testing conducted to evaluate the shredding machine before it is handed over is as follows: The waste to be tested is prepared, and then the shredding machine is powered on. The waste is then fed into the input hopper for shredding. The shredded material will exit through the output hopper, as shown in Figure 7.

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**Figure 7. Testing the Device**

The shredded waste is then weighed. The results of the testing show that 90% of the waste was shredded, but there remains 30% of waste that did not exit from the output hopper. This means the output capacity of the shredded waste is 70%. The dimensions of the shredded material are approximately 10 mm. The results of the shredding can be seen in Figure 8.



**Figure 8. Shredded Material Results**

After testing the machine, another activity carried out with the partner was ensuring its sustainability. The machine requires a high electrical power supply, so the collaboration extended beyond the procurement of the machine itself to include the provision of the electrical power supply needed to operate the machine.

### **4. CONCLUSIONS**

The procurement of the organic waste shredding machine, carried out through collaboration between faculty, students, and the Nur Alam Tani community in Pasir Impun Village, has provided a positive solution for compost production and organic waste management in the area. The manufacturing process of the shredding machine has been completed. This machine is capable of reducing waste to a size of 10mm and has a processing rate of 5kg per hour, thereby accelerating the decomposition process and increasing the quantity of compost production.

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