



RESEARCH ARTICLE

## **Zero Waste Education Organic Waste Treatment For Students of SD N Petompon 3, Semarang, Indonesia**

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### **Abstract**

SDN Petompon 3 in Semarang faces challenges related to inadequate facilities and poor environmental sanitation due to improper waste management. To address these issues, a community service program has been initiated. The program aims to educate 5th and 6th-grade students about organic clean waste management using Black Soldier Fly larvae (maggots). Through this program, students are taught how to sort, recycle, and process organic waste. They are also directly involved in practical waste management activities at the school. The primary objectives of this program are to raise students' environmental awareness and encourage them to become agents of change. Additionally, the program aims to address the issue of organic waste management in the school by utilizing the effective waste decomposition capabilities of Black Soldier Fly larvae. The resulting products from the organic waste processing, such as pupae, can be used as animal feed or as raw materials for organic fertilizer. The program also includes an entrepreneurship development component. Students are taught packaging, branding, and marketing skills to run small businesses. It is hoped that students can develop entrepreneurial skills and create sustainable business opportunities. The program is carried out through several stages, including coordination with the school, preparation of tools and materials, and the implementation of socialization and practical activities. Through this program, it is expected that environmental problems at SDN Petompon 3 can be gradually resolved and increase students' awareness and active participation in maintaining environmental cleanliness.

**Keywords:** *Organic Waste, Maggot, BSF, Compost*

### **Introduction**

SDN Petompon 3 is an elementary school located at Jalan Kelud Raya No.5, Petompon, Gajah Mungkur District, Semarang City, Central Java. While situated in an urban area, the school's facilities are in a rather poor condition. Based on a survey conducted by a community service team, the school's buildings and supporting learning facilities are inadequate. Many of the buildings are quite old and have not been renovated, making it uncomfortable for students to learn. Additionally, the schoolyard is covered in moss, indicating a significant lack of maintenance and cleanliness. There is also a substantial amount of organic and inorganic waste scattered around the school premises, creating a less than optimal learning environment.



**Figure 1.** The atmosphere of SDN Petompon 3

The lack of implementation regarding environmental cleanliness and waste management at SDN Petompon 3 needs to be taken seriously. Litter scattered around the school can create an unclean and unhealthy environment for students, teachers, and the surrounding community. Kitchen and cafeteria organic waste, as well as daily activities that are not properly managed, can produce unpleasant odors and potentially contaminate the environment, even becoming a source of disease [1]. Based on a survey conducted, the implementation of environmental cleanliness at SDN Petompon 3 shows very poor results. This is based on a questionnaire given to 50 students, with results showing that 40 students still tend to litter, 43 students are unable to distinguish between organic and inorganic waste, and 38 students admit they do not know how to manage organic waste. This concrete problem indicates that awareness of environmental cleanliness and waste management at SDN Petompon 3 needs to be improved.



**Figure 2.** Organic Waste in SDN Petompon 3

Organic waste refers to leftover materials or garbage sourced from food and plants that can be recycled [2]. Additionally, at SDN Petompon 3, there is a student cafeteria and mobile food vendors that generate a significant amount of organic waste. The city of Semarang itself produces household waste reaching 800-900 tons per day, consisting of 62% organic waste and 38% non-organic waste [3]. Organic waste is generally easy to recycle, although it is classified as biodegradable waste; improper handling can result in environmental pollution and have negative impacts on health [4]. These impacts include unpleasant odors [5], infectious diseases [1], and more. Field surveys show that much of this waste is still being discarded indiscriminately, sometimes directly into rivers, ditches, and other water drainage systems [6] [7]. The nearest drainage system, often used for waste disposal, flows towards the Banjir Kanal Timur river, where some local residents use the water for washing clothes, bathing, and even washing food, which can have detrimental effects [8] [9].

Based on this analysis, the community service team, in collaboration with SDN Petompon 3, initiated a training program on processing food waste into more useful products using BSF (Black Soldier Fly) larvae-based maggots for students and educators. Maggots are a type of larva with small, white, or yellowish bodies [10]. Maggots are known to be effective in recycling organic waste, such as food scraps, animal manure, and other organic materials [11]. The digestive process of maggots significantly aids in waste processing and produces pupae, which can be utilized as animal feed or as raw material for organic fertilizers [10]. This innovation aims to educate

students and educators on how to process organic waste while supporting the implementation of environmental cleanliness [12].

Furthermore, the community service team will conduct outreach on the utilization of BSF maggots resulting from waste processing into high-value products, enabling students at SDN Petompon 3 to engage in entrepreneurial activities from an early age.

### Metods



**Figure 3.** Flowchart of Socialization for Organic Waste Processing into Compost at SDN Petompon 3

The implementation method can be described as follows:

1. Team Coordination with Partners in Community Service Activities. The community service team communicates with SDN Petompon 3 Semarang to plan the socialization activities to be held at the school. Discussions are held with the partner (position) to discuss the details of the activities. Several agreed-upon points include the location for the socialization provided by SDN Petompon 3, the scheduling of class periods to be used for socialization, and the participants of the socialization, which will include 5th and 6th-grade students.
2. Preparation of Tools and Construction of a Modern Organic Composter for Organic Waste Processing. The community service team procures the tools and materials necessary for conducting various socialization activities involving 5th and 6th-grade students. The tools are purchased from convenience stores and construction stores, while materials such as maggot seeds are sourced from agricultural stores.
3. Socialization on Organic Waste Management Using Maggots. The community service team will conduct socialization for 5th and 6th-grade students at SDN Petompon 3. The necessary equipment and materials will be prepared by the team. Students and team members will wear protective clothing, such as long sleeves, masks, and gloves. The team will demonstrate the waste processing, and students will follow the same steps under the team's supervision. During the socialization, the team will also convey knowledge about the negative impacts of improperly managed organic waste.
4. Socialization on Processing By-products of Organic Waste Management Using Maggots. The community service team will conduct socialization on further processing of the by-products from organic waste management. Maggots that have reached the prepupa and pupa stages can be processed into animal feed and organic fertilizer. Organic fertilizer can be obtained by grinding the maggots into powder using a grinder.

5. Socialization on Entrepreneurship Development from By-products of Organic Waste Management Using Maggots. Socialization on entrepreneurship development from the by-products of organic waste management using maggots for 5th and 6th-grade students at SDN Petompon 3 will cover topics such as packaging, branding, and marketing strategies both online and offline. The community service team will educate students on attractive packaging techniques and how to brand soap products. Afterward, students will be introduced to online shop platforms and taught how to use these platforms to sell products online. Additionally, they will also be given knowledge about offline product marketing strategies.

**Result and Discussion**

**Analysis of Maggot Growth**

The organic waste processing using maggots has been implemented at SDN Petompon 3 Semarang, with an analysis of maggot weight growth and decomposed waste as shown in Table 1.

**Table 1. Analysis of Maggot Weight Growth and Decomposed Organic Waste**

Day	Maggot Weight (grams)	Decomposed Waste Weight (grams)	Remarks
5	141	493	Rapid initial growth.
10	567	1,134	Growth begins to slow.
15	1,272	1,986	Population reaches midpoint.
20	1,595	2,49	Growth nearly stops.
25	1,753	2,748	Stable population.
30	1,753	2,756	No significant change.

Maggot growth typically begins with a rapid exponential phase. This is due to their high metabolism to meet the substantial energy demands for growth. However, over time, this growth rate slows down [13]. Several factors contributing to this slowdown include nutrient limitations due to competition between individuals, the transition to the prepupal and pupal stages which reduces feeding activity, and restricted movement space [14]. The rapid growth of maggots during the early stages of their life cycle correlates with the rate of waste decomposition. The more maggots there are, the more efficiently organic waste is decomposed. However, when maggot growth starts to slow, the rate of waste decomposition also decreases. This is due to reduced maggot feeding activity [15].

Several external factors significantly influence maggot growth and the waste decomposition process. The type of maggot, the quality and quantity of feed, and environmental conditions such as temperature, humidity, and aeration are key factors. Additionally, excessively high population density can trigger competition and cannibalism, while the presence of pathogens can lead to maggot mortality and disrupt the decomposition process [16].

**Analysis of Community Service Evaluation Results**

The evaluation of this community service activity covers all stages of the training and socialization process that have been carried out. This evaluation aims to assess the effectiveness and success of each step taken during the activities [17]. The evaluation stages include assessments of the training materials delivered, the socialization methods used, the level of participation and understanding of the participants, as well as the overall impact of the community service activities on the targeted students. This evaluation is conducted comprehensively to ensure that the objectives of the activities are achieved effectively and provide significant benefits to the participants.

**A. Team Coordination**

Before conducting the training process, the community service team first conducted surveys and analyses of the existing problems and coordinated with SD N 03 Petompon. The

results of the surveys and analyses provided a detailed overview of the needs and conditions in the field, allowing the steps taken to be more targeted and effective in addressing the issues faced by SD N 03 Petompon.

1. 70% of students have not yet adopted the habit of disposing of waste in the proper bins, as evidenced by trash bins that should contain organic waste but are instead filled with inorganic waste.
2. 90% of students admitted they do not yet understand the proper way to manage organic waste.
3. There has been no education regarding organic waste management using maggots and its potential for entrepreneurship.

#### B. Training Results

The training conducted at SD N Petompon 3 Semarang targeted 4th-grade students. This target was chosen because 4th-grade students are in the middle of elementary school and are assumed to be able to receive the theory delivered and have a strong potential to apply the training results.

1. Socialization of Organic Waste Management Using Maggots.

The socialization on organic waste management using maggots was carried out through a combination of theoretical presentation and practical waste management, as shown in Figure 4.



**Figure 4.** Socialization of Organic Waste Management Using

The strategy for delivering material on organic waste management using maggots was conducted through a classroom demonstration method, allowing students to observe each stage of the waste processing with maggots directly [18]. Additionally, students were given the opportunity to actively participate in every step, from collecting organic waste to managing and utilizing the maggots, enabling them to practice and understand the process in depth [19]. The method of material delivery was also adapted to the characteristics of the participants to ensure that the information was well-received and clearly understood by all attendees [20].

2. Socialization of By-product Processing from Organic Waste Management Using Maggots.

The method used for socializing the processing of by-products from organic waste management using maggots involved providing detailed explanations on how to process maggot by-products into various high-value products.



### **Figure 5. Socialization of By-product Processing from Organic Waste Management Using Maggots**

This explanation includes concrete steps for transforming maggots into nutrient-rich organic fertilizer, animal feed that can improve livestock health, and maggot oil with various benefits [21][22]. During this socialization session, illustrative images will also be presented to aid participants' understanding of the process and the final products that can be produced [23]. Additionally, interactive discussions and practical demonstrations will be conducted to ensure that participants comprehend each stage of the processing and can apply it in their daily practice [24]. The goal is for participants not only to master the theory but also to acquire practical skills in converting maggot by-products into useful and high-value products [25].

#### **3. Socialization of By-product Processing from Organic Waste Management Using Maggots.**

Early entrepreneurship education is a form of life skills training that should be cultivated from a young age [26][27]. The expected outcome of this socialization is that students will be able to utilize maggot by-products for early entrepreneurship. With the skills acquired through training, they are expected to identify various business opportunities based on the use of maggots as a solution for organic waste management. Students will be encouraged to develop innovative and creative ideas for using maggots, so they can not only reduce the environmental impact of organic waste but also create significant economic value through sustainable and eco-friendly entrepreneurship. Furthermore, with adequate knowledge and skills, students can become agents of change.

### **Conclusion**

The community service program conducted at SDN Petompon 3 Semarang has successfully addressed the issue of organic clean waste management at the school. Through intensive socialization and training, students have gained knowledge and skills in managing organic waste using maggot technology. The program not only focuses on waste processing but also encourages students to engage in entrepreneurship. By utilizing maggot by-products, students can produce economically valuable products such as organic fertilizer and animal feed, contributing to clean energy initiatives by promoting sustainable agricultural practices. This not only benefits the environment but also opens economic opportunities for students and the surrounding community. Overall, the program has achieved its goals of raising students' environmental awareness, improving school cleanliness, and empowering students through entrepreneurial activities. The success of this program demonstrates that with the right approach, waste management issues can be addressed and even turned into opportunities for value creation and clean energy development.

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