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Optimizing Organic Waste Management through Community Empowerment Using Black Soldier Fly Maggot Cultivation in Sonorejo Village, Magelang Regency, Central Java

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Abstract

Organic waste management remains a significant environmental issue in Sonorejo Village, Candimulyo District, Magelang Regency. Organic waste generated from household and agricultural activities is produced in large quantities and has considerable potential for utilization; however, its management has not yet been optimized. Limited community knowledge is a key factor hindering the optimal utilization of organic waste, which possesses economic potential. This community service activity aims to optimize organic waste management through community empowerment based on Black Soldier Fly (BSF) maggot cultivation. The implementation method involved several stages: problem identification, pre-test, socialization, and post-test. The results indicate a significant increase in community knowledge, marked by a rise in the understanding percentage from approximately 5.6% in the pre-test to 92% in the post-test. This improvement encompasses understanding of the BSF maggot cultivation concept as a solution for organic waste management, including its benefits, life cycle, and potential as alternative livestock feed. This enhanced understanding opens opportunities for implementing more environmentally friendly and sustainable organic waste management at the household level. The novelty of this activity lies in the application of socialization accompanied by measurable evaluation as an initial foundation for community empowerment in BSF maggot-based organic waste management at the village level.

Keywords: *Black Soldier Fly, Community Empowerment, Maggot, Organic Waste*

1. INTRODUCTION

Waste management issues remain a significant global challenge alongside population growth and expanding economic activities. A report by the United Nations Environment Programme (UNEP) in 2024 stated that global waste generation is projected to increase from 2.1 billion tons in 2023 to 3.8 billion tons by 2050 (UNEP, 2024). This condition is also reflected in Indonesia, which has experienced a substantial increase in waste generation. According to data from the Ministry of Environment and Forestry of the Republic of Indonesia (2025), total waste generation in 227 regencies and municipalities across Indonesia reached approximately 23 million tons per year, of which only 34.95% was properly managed, while the remaining 65.05% was not optimally managed.

Waste management problems also occur in various regions of Indonesia, including Magelang Regency. Based on data from the Environmental Agency of Magelang Regency, waste generation in the region is estimated to reach approximately 668.71 tons per day as a result of household and community activities, with an average per capita contribution of around 0.5 kg per

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day (Putra, 2025). Of this total, approximately 60% consists of organic waste. Organic waste refers to waste derived from the remains of living organisms that undergo decomposition processes (Wahyuningsih et al., 2023). Organic waste that is not effectively managed tends to accumulate at final disposal sites, potentially causing environmental pollution, reducing public health quality, and generating adverse socio-economic impacts (Nurrohman et al., 2023).

Sonorejo Village, located in Candimulyo District, Magelang Regency, is an agrarian village with a population of approximately 1,950 residents, most of whom rely on agriculture and livestock farming as their primary livelihoods. Activities in these sectors generate substantial amounts of organic waste. In addition, the relatively large population contributes to the generation of domestic waste that has not yet been managed optimally. Based on preliminary observations, organic waste handling practices in the village still rely on conventional methods, such as open burning and dumping in vacant land. This situation is further exacerbated by the non-functioning village waste bank program. Consequently, Sonorejo Village faces challenges in developing independent and sustainable waste management practices to prevent environmental and public health impacts.

One alternative approach to organic waste management that can be implemented in Sonorejo Village is the cultivation of Black Soldier Fly (BSF) maggots. Maggots represent the larval stage of the Black Soldier Fly life cycle and possess the ability to rapidly decompose organic waste (Febiola et al., 2024).The utilization of BSF maggots is considered effective, as it can reduce the volume of organic waste by up to 85% through relatively rapid decomposition processes (Qowasmi et al., 2023). In addition to serving as decomposer agents, BSF maggots have high nutritional value, containing approximately 40% protein and 24–30% fat, making them a potential alternative feed source for livestock (Andriani & Pratama, 2024). The availability of organic waste derived from agricultural and household activities in Sonorejo Village can be utilized as feed media for maggot cultivation. Furthermore, some community members are engaged in catfish and poultry farming, allowing maggot production to be used as a high-protein alternative feed. This utilization not only supports sustainable waste management and the application of zero-waste principles but also provides economic value for rural communities.

Various community service programs have demonstrated that Black Soldier Fly (BSF) maggot cultivation is an effective organic waste management solution based on community empowerment. Sulaiman et al. (2023) reported that maggot cultivation training programs are capable of reducing organic waste volume while simultaneously increasing community participation in environmental management. Similarly, Sukmareni et al., (2023) showed that socialization programs combined with hands-on maggot cultivation practices at the village level can enhance community knowledge and open opportunities for utilizing maggots as alternative livestock feed.

Although various previous community service activities have addressed Black Soldier Fly (BSF) maggot cultivation as an alternative for organic waste management, this activity places particular emphasis on strengthening community understanding through structured and measurable socialization efforts. The socialization activities were conducted by combining material delivery with interactive discussions and were complemented by pre-tests and post-tests to quantitatively assess changes in community knowledge levels. Through this approach, the activity provides an initial overview of the effectiveness of socialization as an early stage in community empowerment–based organic waste management initiatives.

Based on the existing problems and potential of Sonorejo Village, as well as findings from empirical studies, this community service activity aims to optimize organic waste management through community empowerment based on Black Soldier Fly (BSF) maggot cultivation. The primary objective of this activity is to increase the knowledge and understanding of the Sonorejo Village community regarding maggot cultivation as an environmentally friendly solution for organic waste management. In addition, this activity seeks to enhance community capacity in utilizing maggots as an economically valuable commodity and as alternative livestock feed to improve the efficiency of farming activities. Through a community empowerment approach involving socialization activities, it is expected that the community will be able to manage organic

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waste independently and sustainably while also obtaining economic benefits that contribute to improving rural welfare.

2. METHOD

2.1 Activity Site

This community service activity was conducted in Sonorejo Village, Candimulyo District, Magelang Regency, and involved 39 participants from the Family Welfare Empowerment Group (PKK). The PKK group was selected as the primary target because of its strategic role in household management, and because some of its members had not yet engaged in productive activities, thereby requiring encouragement through empowerment programs that are practical and have economic value.

2.2 Methodological Approach

The method employed in this activity was a community empowerment approach implemented through socialization activities on Black Soldier Fly (BSF) maggot cultivation. The primary objective of the socialization was to equip individuals with the skills and knowledge necessary to meet their livelihood needs (Sekarjati et al., 2025; Sekarjati & Prasetiyo, 2021; Setyorini et al., 2023). The activity was systematically designed and carried out through several stages, as follows:

a) **Problem Identification**, conducted through field observations and initial discussions with the target community to identify baseline conditions and challenges related to organic waste management;
b) **Pre-Test,** administered to measure participants' initial level of knowledge regarding BSF maggot cultivation prior to the socialization activities;
c) **Socialization**, implemented interactively through material delivery, discussions, and technical explanations of the stages of BSF maggot cultivation provided by a maggot cultivation practitioner, Mrs. Zuni Salisa, with support from Community Service Program (KKN) students who acted as facilitators;
d) **Post-Test**, conducted to assess improvements in participants' knowledge and understanding after the socialization activities. According to (Sekarjati & Prasetiyo, 2024) the use of pre-test and post-test methods aims to measure the effectiveness of activities in enhancing community knowledge and understanding.

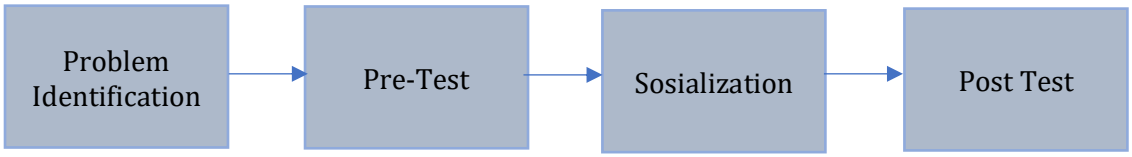

Figure 1. Flowchart of the community service activity

3. RESULTS AND DISCUSSION

3.1. Identification of Issues in Organic Waste Management in Sonorejo Village

Sonorejo Village has considerable potential for community-based organic waste management, given its characteristics as an agrarian village with household, agricultural, and livestock activities that generate a substantial amount of organic waste. However, under initial conditions prior to the implementation of the community service program, organic waste management in Sonorejo Village was still predominantly carried out using conventional methods, such as open burning and dumping on open land. These practices have the potential to cause environmental pollution, reduce the quality of public health, and fail to generate added economic value.

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Based on brief interviews with the Head of Sonorejo Village, it was found that, to date, organic waste management has not been carried out in a structured manner and still largely depends on individual community practices. The Head of Sonorejo Village stated that *"most household organic waste has not been utilized and is generally disposed of or burned due to the community's limited knowledge of more productive waste management practices*." This finding indicates that the low utilization of organic waste is primarily caused by limited community knowledge and understanding of environmentally friendly and economically valuable waste management alternatives. This condition highlights a gap between the abundant availability of organic waste and the community's capacity to manage it productively, thereby necessitating intervention through socialization activities as an initial stage of community empowerment.

Figure 2. Interview with the Head of Sonorejo Village on Initial Organic Waste Management Conditions

3.2. The Role of BSF Maggot Cultivation Socialization in Improving Community Knowledge

Based on the baseline problems indicating the low level of knowledge and understanding among the Sonorejo Village community regarding productive organic waste management, an intervention that is both educational and participatory was deemed necessary. Therefore, this community service activity was conducted in the form of a socialization program on Black Soldier Fly (BSF) maggot cultivation as an environmentally friendly and sustainable alternative for organic waste management.

The BSF maggot cultivation socialization activity was attended by 39 participants who were members of the PKK of Sonorejo Village. The socialization aimed to enhance participants' knowledge and understanding of organic waste management through Black Soldier Fly (BSF) maggot cultivation as a sustainable alternative solution. The activity was delivered interactively by combining material presentations with discussions, enabling participants not only to acquire theoretical information but also to ask questions and share experiences related to household waste management practices.

The active participation of attendees throughout the activity indicated a high level of enthusiasm and reflected the relevance of the presented materials to the needs and challenges faced by the local community. The community's enthusiasm in acquiring knowledge through the socialization method is illustrated in Figure 3.

Figure 3. Socialization Activity on BSF Maggot Cultivation

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The effectiveness of the *Black Soldier Fly* (BSF) maggot cultivation socialization activity was evaluated through the administration of pre-test and post-test assessments to the participants. The evaluation instrument consisted of six knowledge indicators designed to comprehensively assess participants' understanding of *Black Soldier Fly* (BSF) maggot cultivation. The first indicator assessed participants' understanding of the BSF maggot concept as an alternative solution for organic waste management within a circular economy framework. The second indicator measured knowledge of the BSF maggot life cycle as a technical foundation for cultivation, while the third indicator evaluated participants' understanding of the benefits of maggot cultivation from environmental and economic perspectives, as well as its utilization as a high-nutritional-value alternative animal feed.

Furthermore, the fourth indicator was used to measure participants' knowledge of the appropriate harvesting time to ensure product quality and production efficiency. The fifth indicator assessed understanding of marketing aspects and the economic value potential of BSF maggots, while the sixth indicator evaluated participants' knowledge of the facilities, infrastructure, and supporting materials required to ensure optimal BSF maggot cultivation. The measurement of respondents' level of understanding prior to the implementation of the BSF maggot cultivation socialization was conducted through a pre-test, as presented in Figure 4.

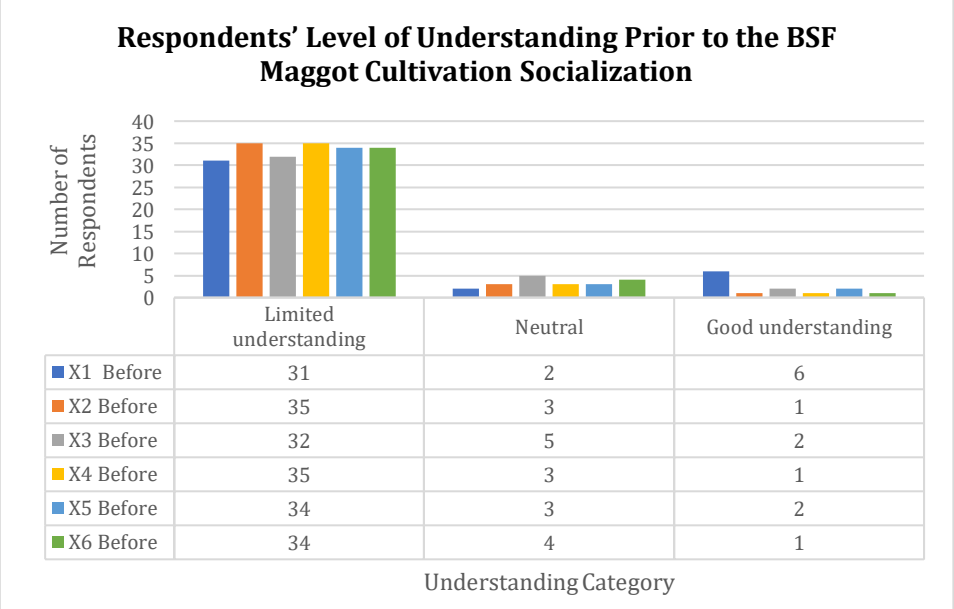

Figure 4. Graph of Respondents' Level of Understanding Prior to the BSF Maggot Cultivation Socialization

Based on the *pre-test* results, the initial level of community knowledge regarding BSF maggot cultivation was classified as low to moderate, with only 5.6% of respondents categorized as having good understanding prior to the BSF maggot cultivation socialization. Subsequently, educational materials were delivered covering the concept of BSF maggots as a solution for organic waste management, BSF maggot cultivation techniques, and the potential of maggot cultivation as an income-generating activity that provides added value and increases community income. The next step involved the redistribution of questionnaires to examine changes in the level of understanding among the community of Sonorejo Village, Candimulyo District, Magelang Regency, Central Java Province. The results showed a substantial increase in the level of understanding, reaching 92%, as illustrated in Figure 5.

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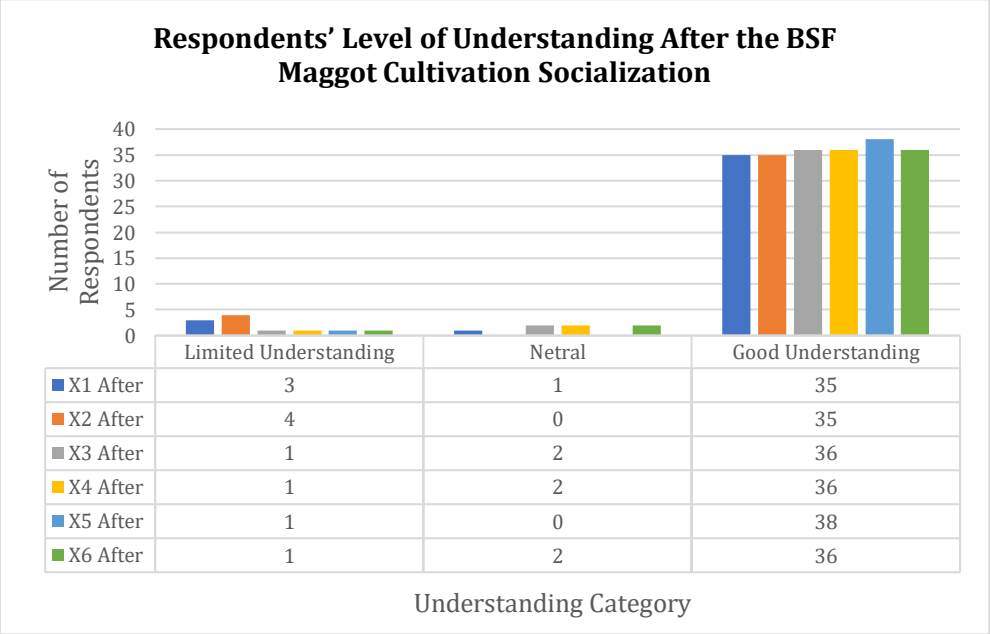

Figure 5. Graph of Respondents' Level of Understanding After the BSF Maggot Cultivation Socialization

Quantitatively, the increase in the community's level of understanding indicates that most participants who previously had limited knowledge of BSF maggot cultivation have become able to comprehend the concepts, benefits, and utilization opportunities of BSF maggots as a solution for organic waste management and as an alternative animal feed. This finding is consistent with the studies of (Bagus Prasetiyo et al., 2023) and (Prasetiyo & Sekarjati, 2022) which reported that community empowerment approaches through socialization and hands-on practice effectively enhance community knowledge and participation in maggot-based waste management.

3.3. Implications of the Activity for Sustainable Organic Waste Management

The enhancement of community knowledge constitutes an important initial foundation and has the potential to promote behavioral change in organic waste management practices in Sonorejo Village. Through an improved understanding of Black Soldier Fly (BSF) maggot cultivation, the community has begun to recognize environmentally friendly alternatives to conventional organic waste management methods previously applied.

In addition to its environmental implications, the socialization activity also presents economic opportunities for the local community. The BSF maggots produced may be utilized as a high-protein alternative feed for fish and poultry, thereby potentially reducing production costs and improving the efficiency of livestock farming (Andriani & Pratama, 2024). Consequently, this community service activity contributes not only to the reduction of organic waste volume but also to the sustainable enhancement of community welfare. A summary of changes in community knowledge and understanding before and after the implementation of the socialization activity is presented in Table 1.

The changes in community knowledge and understanding as presented in Table 1 indicate that the socialization activity has the potential to promote sustainable organic waste management. From a community service perspective, this increase in knowledge represents an initial foundation that needs to be followed up to ensure consistent implementation in practice. The sustainability of community empowerment–based waste management programs can be strengthened through continued mentoring and the implementation of group-based activities (Sulaiman et al., 2023; Sukmareni et al., 2023)

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Table 1. Changes in Community Knowledge and Understanding

Aspect	Initial Condition (Before the Activity)	Condition After the Activity
Understanding of organic waste management	Organic waste management was still dominated by conventional methods such as open burning and disposal in open areas, which have the potential to cause environmental pollution and do not provide economic added value.	The community began to understand environmentally friendly alternatives for organic waste management through Black Soldier Fly (BSF) maggot cultivation as a sustainable management solution.
Knowledge of BSF maggot cultivation	The community's level of knowledge regarding BSF maggots was still limited, as indicated by the *pre-test* results, with only 5.6% of respondents categorized as having good understanding.	A significant increase in knowledge was observed, reaching approximately 92% in the post-test phase, including understanding of the BSF maggot concept, life cycle, benefits, harvesting time, marketing, and cultivation requirements.

Figure 6. Documentation of Black Soldier Fly Maggot Cultivation Socialization

4. CONCLUSION

Community service activities conducted through the socialization of Black Soldier Fly (BSF) maggot cultivation have proven effective in improving the knowledge and understanding of the Sonorejo Village community regarding organic waste management. This is evidenced by a significant increase in participants' levels of understanding from the initial condition prior to the activity to after the implementation of the socialization program, as indicated by the pre-test and post-test results. The activity contributes to promoting the adoption of more environmentally friendly organic waste management practices while also creating opportunities for the utilization of maggots as an economically valuable alternative feed. In the future, continued mentoring and the implementation of maggot cultivation are required to ensure the sustainability of the program's impact and to provide more optimal benefits for the community.

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